



Rialtas na hÉireann
Government of Ireland

Ireland's 8th National Communication

to the United Nations Framework on Climate Change

2023

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Glossary

#

5YAR	Five Year Assessment of Research

A

AA	Appropriate Assessment
AAU	Assigned Amount Unit
ACA	Accelerated Capital Allowance
ACE	Action for Climate Empowerment
AD	Anaerobic Digestion
AEAs	Annual Emission Allocations
AECM	Agricultural Environmental Control Measure
AEOS	Agri-Environment Options Scheme
AER	Annual Emissions Report
AF	Adaptation Fund
AfDB	African Development Bank
AFHDV	Alternative Fuel Heavy Duty Vehicle
AIM	Animal Identification and Movement
AKIS	Agricultural Knowledge and Innovation Systems
AMOC	Atlantic Meridional Overturning Circulation
ANC	Areas of Natural Constraints Scheme
ANSP	Air Navigation Service Provider
ASAP+	Adaptation for Small-holder Agriculture Programme
ASBS	Atlantic Seaboard South Region
ASSAP	Agriculture Sustainability and Support Advisory Programme
ATS	Annual Transition Statement
AWS	Automatic Weather Station

B

BDGP	Beef Data and Genomics Programme
BEIS	UK Department for Business, Energy and Industrial Strategy
BEMU	Battery Electric Multiple Unit

BER	Building Energy Rating
BETTER	Business, Environment and Technology through Training Extension
BIM	An Bord Iascaigh Mhara (Seafood Development Agency)
BIM	Building Information Modelling
BMW	Biodegradable Municipal Waste
BR5	Fifth Biennial Report

C

CAROs	Climate Action Regional Offices
CAP	Common Agricultural Policy
CAP	Climate Action Plan
CBM-CFS3	Canadian Forest Service Carbon Budget Model
CCAC	Climate Change Advisory Council
CCAC Trust Fund	Climate and Clean Air Coalition Trust Fund
CCAP	Community Climate Action Programme
CCSAP	Climate Change Sectoral Adaptation Plan
CCMA	Customer Contact Management Association
CCP	Climate Change Programme
CEF	Connecting Europe Facility
CEG	Clean Export Guarantee
CEP	Clean Export Premium
CER	Certified Emission Reduction
CFE	Carbon Fund for Europe
CFRAM	National Catchment-based Flood Risk Assessment and Management
CGE	Computable General Equilibrium
CI	Climate Ireland
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMIP6	Coupled Model Intercomparison Project Phase 6
CNG	Compressed Natural Gas

COFORD	Programme of Competitive Forest Research for Development
CORINE	Co-Ordinated Information on the Environment
COSMO	COre Structural MOdel for Ireland
CPC	Continuing Professional Development
CRCG	Climate Research Coordination Group
CRF	Common Reporting Framework
CRS	Creditor Reporting System
CRU	Commission for Regulation of Utilities
CSA	Coordination Support Action
CSEUR	Consolidated System of EU Registries
CSP	Common Agricultural Policy Strategic Plan
CSPE	Civic, Social and Political Education
CSO	Central Statistics Office
CSOs	Civil Society Organisations
CVRT	Commercial Vehicles Roadworthiness Testing

D

DAC	Development Assistance Committee
DAFM	Department of Agriculture, Food and Marine
DAS	Disadvantaged Areas Compensatory Scheme
DCEDIY	Department of Children, Equality, Disability, Integration and Youth
DECC	Department of the Environment, Climate and Communications
DETE	Department of Enterprise, Trade and Employment
DFA	Department of Foreign Affairs
DHLGH	Department of Housing, Local Government and Heritage
DMAPs	Designated Maritime Area Plans
DPER	Department of Public Expenditure and Reform

E

EC	European Commission
ECAC	European Civil Aviation Conference
ECCA	European Climate Change Adaptation Conference
ECMWF	European Centre for Medium-Range Weather Forecasts
ECN	Electronic Communication Networks
ECS	Electronic Communication Services
ECV	Essential Climate Variables
EDRRS	Enhanced Decommissioning Rehabilitation and Restoration Scheme
EEA	European Economic Area
EI	Enterprise Ireland
EIP	European Innovation Partnerships Initiative
EMEP	European Monitoring and Evaluation Programme
EMU	Electric Multiple Unit
EO	Earth Observation
EOV	Ecological Outcome Verification
EP	European Parliament
EPA	Environmental Protection Agency
E-PRTR	European Pollutant Release and Transfer Register
ERU	Emission Reduction Unit
ERA-NET	European Research Area Networks
ESA	European Space Agency
ESB	Electricity Supply Board
ESD	Effort Sharing Decision
ESD	Education for Sustainable Development
eSPSV	Electric Small Public Service Vehicle
ESR	Effort Sharing Regulation
ESRI	Economic and Social Research Institute
ETB	Education and Training Board
ETS	Emissions Trading System
ETU	Emissions Trading Unit

EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUTL	European Union Trusted Lists
EVs	Electric Vehicles
EVPP	Electric Vehicle Policy Pathway
EXEED	Excellence in Energy Efficiency Design

F

FAPRI	Food and Agricultural Policy Research Institute
FET	Further Education and Training
FIPS	Forest Inventory and Planning System
FIRM	Food Institutional Research Measure
FOI	Forest Research Ireland
FRMPs	Flood Risk Management Plans

G

GAEC	Good Agricultural and Environmental Conditions
GAW	Global Atmospheric Watch
GCF	Green Climate Fund
GCP	Global Carbon Programme
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEMS	Global Environmental Monitoring Scheme
GEO	Group on Earth Observations
GHG	Greenhouse Gas Emissions
GLAS	Green, Low Carbon, Agri-Environment Scheme
GLOSS	Global Sea Level Observing System
GNI	Gross National Income
GNI	Gas Networks Ireland
GOLD	Grain, Oilseed, Livestock and Dairy
GPAS	Grants and Premiums Administration System

GPP	Green Public Procurement
GRA	Global Research Alliance
GSI	Geological Survey Ireland
GWP	Global Warming Potential

H

HABs	Harmful Algae Blooms
HCI	Human Capital Initiative
HE	Higher Education
HFC	Hydrofluorocarbon
HGV	Heavy Goods Vehicle
HIRLAM	High Resolution Limited Area Model
HVO	Hydrotreated Vegetable Oil

I

I3E	Ireland Environment, Energy and Economy Model
IAA	Irish Aviation Authority
IATiP	Irish Aquaculture Technology and Innovation Platform
ICAO	International Civil Aviation Organisation
ICE	International Combustion Engines
ICHEC	Irish Centres for High-End Computing
ICIP	Ireland's Climate Information Platform
ICOS	Integrated Carbon Observation System
IDA	International Development Association
IED	Industrial Emissions Directive
IIED	International Institute for Environment and Development
IEN	Irish Environmental Network
IFA	Irish Farmers' Association
IFIs	International Financial Institution
IMDBON	Irish Marine Data Buoy Observing Network
IMF	International Monetary Fund
IMO	International Maritime Organisation
IP	Intellectual Property

IPA	Institute of Public Administration
IPCC	Intergovernmental Panel on Climate Change
IPG	International Phenological Garden
IPPC	Integrated Pollution Prevention Control
IPPU	Industrial Processes and Product Use
IrBEA	Irish Bioenergy Association
IRC	Irish Research Council
ISGB	Irish Sovereign Green Bond
ITL	International Transaction Log

J

JPIs	Joint Programming Initiatives
JPI-FACCE	Joint Programming Initiatives on Agriculture, Food Security and Climate Change

K

KALRO	Kenyan Agriculture and Livestock Research Organisation
KP	Kyoto Protocol

L

LA	Local Authorities
ICER	Long-term Certified Emission Reductions
LDCs	Least Developed Countries
LDCF	Least Developed Countries Fund
LEAP	Low Emissions Analysis Platform
LEG	Least Developed Countries Expert Group
LEOs	Local Enterprise Offices
LESS	Low Emission Spreading Technologies
LIEN	Large Industry Energy Network
LIFE-AR	LDC Initiative for Effective Adaptation and Resilience (L'Instrument Financier pour l'Environnement)
LITA	Livestock Training Agency
LPG	Liquid Petroleum Gas
LPIS	Land Parcels Information System
LTS	Long-term Strategy

LULUCF	Land Use, Land Use Change and Forestry

M

MAC	Maritime Area Consent
MAP	Maritime Area Planning
MARA	Maritime Area Regulatory Authority
MCCF	Multilateral Carbon Credit Fund
MDBs	Multilateral Development Banks
MDD	Modified Domestic Demand
MDI	Metered Dose Inhalers
MEPC	Marine Environment Protection Committee
MNC	Multi-National Corporation
MOU	Memoranda of Understanding
MS	Member States
MSS	Micro-generation Support Scheme
MSW	Municipal Solid Waste

N

NC8	Eighth National Communication
NAF	National Adaptation Framework
NAP	National Adaptation Plan
NAPA	National Adaptation Programmes of Action
NASC	National Adaptation Steering Committee
NASCO	National Agricultural Soil Carbon Observatory
NCCAAP	National Climate Change Action and Awareness Programme
NCCLA	National Climate Conversation on Local Actions
NCSF	National Climate Stakeholder Forum
NCT	National Car Test
NDC	Nationally Determined Contribution
NDCA	National Dialogue on Climate Action
NDP	National Development Plan
NEEAP	National Energy Efficiency Action Plan

NERCG	National Environmental Research Coordination Group
NESC	National Economic and Social Council
NETs	Negative Emissions Technology
NEU	Northern Europe Region
NFFWS	National Flood Forecasting Warning Service
NFI	National Forest Inventory
NGOs	Non-Governmental Organisations
NIFTI	National Investment Framework for Transport in Ireland
NILU	Norwegian Institute for Air Research
NIR	National Inventory Report
NMPF	National Marine Planning Framework
NPF	National Planning Framework
NREAP	National Renewable Energy Action Plan
NRPP	National Recovery and Resilience Plan
NSOs	National Strategic Outcomes
NTA	National Transport Authority
NTMA	National Treasury Management Agency
NUIG	National University of Ireland, Galway
NWPP	National Waste Prevention Programme
NZEB	Nearly Zero Energy Buildings

O

ODA	Official Development Assistance
OECD	Organisation for Economic Co-Operation and Development
OES	Office of Environmental Sustainability
OHL	Overhead Transmission Lines
OOF	Other Official Flows
OPW	Office of Public Works
ORW	Offshore Renewable Energy
OREDPP	Offshore Renewable Energy Development Plan
ORESS	Offshore Renewable Electricity Support Scheme

P

PAMs	Policies and Measures
PCAS	Policy Coherence in Adaptation Studies
PEP	Pan European Phenology
PFC	Perfluorocarbons
PfG	Programme for Government
PM	Particulate Matter
PPI	Pasture Profit Index
PPNs	Public Participation Networks
PRSI	Pay Related Social Insurance
PSMR	Public Sector Monitoring and Reporting
PSO	Public Service Obligation
PUP	Pandemic Unemployment Payment
PV	Photovoltaic

Q

QA/QC	Quality Assurance/Quality Control
QELRC	Quantified Emission Limitation or Reduction Commitment
QQI	Quality and Qualifications Ireland

R

RCPs	Representative Concentration Pathways
RD&D	Research, Development and Demonstration
REDII	Renewable Energy Directive II
REFIT	Renewable Energy Feed in Tariff
REPS	Rural Environment Protection Scheme
RESS	Renewable Electricity Support Scheme
RMU	Removal Unit
RSEs	Regional Spatial and Economic Strategies
RSF	Research Stimulus Fund
R&D	Research and Development

S

SAF	Sustainable Aviation Fuel
SAPs	Sectoral Adaptation Plans

SBCI	Strategic Banking Corporation Ireland
SBSTA	Subsidiary Body on Scientific and Technical Advice
SCAR	Standing Committee on Agricultural Research
SCCAPs	Scheme Climate Change Adaptation Plans
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SEC	Sustainable Energy Communities
SED	Structured Expert Dialogue
SFI	Science Foundation Ireland
SFSI	Sustainable Food Systems Ireland
SHARP	Sustainable, Healthy Agri-food Research Plan
SIFLT	Strategic Investment Framework for Land Transport
SIDS	Small Island Developing States
SIM	Straw Incorporation Measure
SLR	Sea-Level Rise
SMD	Soil Moisture Deficit
SME	Small to Medium Enterprise
SMRs	Statutory Management Requirements
SOCAT	Surface Ocean Carbon Atlas
SOFF	Systematic Observations Financing Facility
SRF	Solid Recovered Fuel
SSG	Small-Scale Generation
SSPs	Shared Socioeconomic Pathways
SSRH	Support Scheme for Renewable Heat
STC	Smarter Travel Campus
STW	Smarter Travel Workplaces

T

TALIRI	Tanzania Livestock Research Institute
TAMS II	Targeted Agricultural Modernisation Schemes II
TCD	Trinity College Dublin

tCER	Temporary Certified Emissions Reduction
TCO	Total Cost of Ownership
TII	Transport Infrastructure Ireland
TPER	Total Primary Energy Requirements
TUPAR	True-up Period Assessment Report

U

UAA	Utilised Agricultural Area
UCC	University College Cork
UCD	University College Dublin
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
USC	Universal Social Charge

V

VOS	Voluntary Observing Ships
VRT	Vehicle Registration Tax

W

WAM	With Additional Measures
WAPCE	Waste Action Plan for a Circular Economy
WEDO	Women's Environmental Development Organisation
WEM	With Existing Measures
WFD	Water Framework Directive
WFP	World Food Programme
WFQA	Wood Fuel Quality Assurance
WLTP	Worldwide Harmonised Light Vehicle Test Procedure
WMO	World Meteorological Organisation

Y

YPCCC	Yale University's Programme on Climate Change Communications

Z

ZEVI

Zero Emission Vehicles Ireland

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Foreword by Ireland's Minister for the Environment, Climate and Communications



Image: Minister Ryan on a Beyond Oil and Gas Alliance panel discussion at COP27, Sharm-el-Sheikh November 2022

Climate change is an irreversible reality for every country on this planet, and communities around the world – including those close to home – are already facing severe and life-threatening impacts. 2022 was a year marked by severe droughts, devastating wildfires, and torrential flooding across continents.

The Sixth Assessment cycle reports of the Intergovernmental Panel on Climate Change have made it clear that without rapid, cross-sectoral action by governments and stakeholders, such climate extremes will become more frequent and more deadly.

Ireland is committed to taking the necessary steps both domestically and internationally to ensure a safer, greener future that leaves no one behind. Since the submission of Ireland's 7th National Communication and 4th Biennial Report to the UNFCCC, Ireland has made significant progress in both our climate ambition and implementation.

The NC8 outlines the various sectoral mitigation and adaptation plans underway in Ireland. The Climate Action and Low Carbon Development (Amendment) Act 2021 set legally binding emission reduction target of 51% by 2030, a commitment to achieve a climate neutral economy no later than 2050, established a strong statutory monitoring and reporting framework including annual updates in the form of Climate Action Plans, and measures such as the Carbon Budgets and Sectoral Emissions Ceilings, with Climate Action Plan 2023 published at the end of 2022.

Ireland's statutory National Adaptation Framework (2018) has been complemented by the introduction of Sectoral Adaptation Plans and Local Authority Adaptation Strategies requirements in 2019, ensuring a full society transformation.

Government Ministers are now required to provide an account of their progress each year in relation to their respective sectoral targets and actions. To assist a just transition, revenue gathered from the carbon tax increases introduced in the annual Budget are utilised to support lower income households through increases to social welfare, retrofitting programmes, and other schemes.

Ireland's international climate support explicitly focuses on the most vulnerable, who face the greatest impacts of climate change despite shouldering the least responsibility. To avoid exacerbating existing inequalities and vulnerabilities, Ireland's financial support is overwhelmingly grant-based, and emphasises sectors that are of most relevance to the poorest, such as agriculture and food security, energy and social protection. The published International Climate Finance Roadmap (2022) sets out our ambitious climate finance targets with clear, timebound deliverables.

Ireland recognises that international cooperation is essential to effectively manage climate change. Ireland will continue to proactively engage with the UNFCCC and Paris Agreement as strong multilateralism remains critical to effectively address the climate crisis.



Mr Eamon Ryan, T.D, Minister for the Environment, Climate and Communications

Chapter One:

Executive Summary

1. Executive Summary

Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are requested under Article 12 of the Convention to communicate information relating to their national climate mitigation and adaptation policies. These National Communications enable Parties to advise the Conference of Parties about progress in implementing climate change measures. Ireland's Eighth National Communication (NC8) is prepared in accordance with Decisions 9/CP.16 and 2/CP.17 and provides a comprehensive overview of Ireland's climate change policies and activities. The data on which Ireland's NC8 is based relates to the period 2018-2022, depending on availability.

The UNFCCC also requires under Decision 2/CP.17 that Annex 1 (developed country) Parties, including Ireland, provide Biennial Reports every two years, the first of which was due by 1 January 2014. This Report includes Ireland's fifth Biennial Report (BR5) which gives additional information on the provision by Ireland of financial, technology and capacity-building support to non-Annex 1 Parties. In order to avoid unnecessary duplication, Ireland has limited the overlapping of content between NC8 and BR5 as much as possible, and sections of BR5 make references to further information found in NC8.

1.1 National circumstances relevant to Greenhouse Gas emissions and removals

Ireland is situated off the north-west coast of the continent of Europe between longitude 5.5° and 10.5° West and latitude 51.5° and 55.5° North. Ireland has a mild temperate oceanic climate, due to the controlling influence of the Atlantic Ocean. Mean annual temperatures generally range between 9°C and 10°C with the higher values in coastal regions.

Ireland's national parliamentary democracy consists of the President and two houses – Dáil Éireann (the lower house) and Seanad Éireann (the upper house). The Government retains responsibility for ensuring the delivery of Ireland's responsibilities under the UNFCCC, the Kyoto Protocol and the Paris Agreement. A Cabinet Committee assists the Government in carrying out its responsibilities to implement a whole-of-Government approach given the cross-sectoral nature of climate. This Committee is supported by the Climate Action Delivery Board and a Senior Officials Group which provides whole-of-Government coordination, an essential function in the context of this cross-sectoral nature. The Minister for Environment,

Climate and Communications is responsible for Ireland's policy on climate change and has a lead role within Government in the delivery of this policy.

The current estimated population of Ireland from the 2022 Census is 5,123,536, an increase of 361,371 (7.6%) since 2016, continuing the steady growth since the 1990s. As of 2016 the average age was 37.4 years, while an increase over 2011 levels, continues to represent a young profile. While the population density of 70 persons per square kilometre increased since 2011, it remains low by European standards. Population density remains heavily concentrated in Dublin with 2022 Census estimates putting it at 28.5% of the population, and the Eastern region. A highly dispersed and low-density population can be found outside this region.

Ireland is a small, globalised economy which experienced an extended strong period of growth from 1995 to 2007, with gross domestic product (GDP) rising by an average of 6% per annum. However, this was followed by a sharp drop in economic activity during the global financial crisis and the subsequent collapse of Ireland's domestic property market and construction sector. Despite an uplift, the COVID-19 pandemic had a severe impact on the domestic economy from 2020 even though, at a headline level, GDP increasing by almost 6% in 2020. Modified Domestic Demand (MDD), which provides the best measure of domestic economic activity, fell by around 5% in 2020. The unemployment rate – including recipients of the Pandemic Unemployment Payment (PUP) – peaked at 30% in April 2020. Ireland saw some of the largest declines in private consumption and construction investment, as a result of the comparatively severe lockdowns throughout the year. Due to the success of our vaccination programme restrictions were eased over the course of 2021, with the domestic economy recovering strongly as a result. However, while Ireland's economy has recovered, considerable risks remain, including the geopolitical instability caused by the war in Ukraine, more persistent inflationary pressures and Brexit related disruptions to Irish exports.

1.2 Greenhouse Gas Inventory Information

The Environmental Protection Agency (EPA) has overall responsibility for Ireland's national GHG inventory, performing the role of inventory agency in Ireland and undertaking all aspects of inventory preparation and management as well as the reporting of Ireland's submissions annually.

Ireland has a quantified emission limitation or reduction commitment (2013–2020) (percentage of base year or period), QELRC, of 80% as set out in the Doha amendment of

Annex B to the Kyoto Protocol¹. The QELRCs for the European Union (EU) and its Member States for a second commitment period are based on the understanding that these will be fulfilled jointly with the EU and its Member States, in accordance with Article 4 of the Kyoto Protocol. The joint assigned amount for the EU, its Member States and Iceland is calculated pursuant to the QELRC listed in the third column of the table contained in Annex B to the Kyoto Protocol, while the assigned amount of each Member State is determined in accordance with the terms of the joint fulfilment agreement. The assigned amount for Ireland is fixed based on Annex II to European Commission Decision 2013/162/EU and as adjusted by Commission Implementing Decision 2013/634/EU.

Ireland's total GHG emissions in 2020, including indirect emissions from solvent use (without Land Use, Land Use Change and Forestry LULUCF) were 58,032.3 kt CO₂ equivalent, an increase of 5.9% on 1990 levels but 18.2% lower than the 2001 peak of 70,923.6 kt CO₂ equivalent.

The Energy sector accounted for 57.1% of total emissions in 2020, Agriculture contributed 36.3% while a further 5.0% emanated from Industrial Processes and Product Use and 1.6% was due to Waste. Emissions of CO₂ accounted for 60.6% of the national total in 2020, with CH₄ and N₂O contributing 26.2% and 11.8% respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ accounted for 1.5% of total emissions in 2020.

1.3 Policies and Measures

From the cross-sectoral Climate Action and Low Carbon Development (Amendment) Act 2021 (the Climate Act 2021) to the specific policies and measures in each Government sector, Chapter 4 sets out an overview of Ireland's increase in efforts to mitigate the impact of climate change and strive to ensure the achievement of Ireland's targets and commitments under the Paris Agreement and the Kyoto Protocol.

The Climate Act 2021 sees Ireland commit to reducing its GHG emissions by 51% by 2030 relative to 2018 levels and to achieving net zero emissions by 2050. The development of annual Climate Action Plans (CAP) – the most recent being Climate Action Plan 2021 (CAP21) which is referenced throughout the NC8 – and National Long Term Climate Action Strategy (LTS) every five years, supported by a system of carbon budgeting and sectoral emission ceilings clearly highlight delivery targets which are legally binding. Following a progress report

¹ Doha amendment to the Kyoto Protocol ([FCCC/KP/CMP/2012/13/Add.1](#))

by the Climate Change Advisory Council (CCAC), Government Ministers must report on their sectoral progress to the Oireachtas each year.

The CCAC prepares and submits carbon budgets to the Minister for their consideration. The Cabinet Committee on Environment and Climate Change oversees the Programme for Government climate and environment commitments. The Climate Action Delivery Board reports to Government every quarter on progress in implementing CAP actions, as well as monitoring the implementation of carbon budgets and sectoral emissions ceilings.

In Ireland, the EU Emissions Trading Scheme (ETS) is an important part of climate policy and it covers 108 stationary installations in addition to aircraft operators in relation to CO₂ emissions from electricity and heat generation, energy-intensive industries, and commercial aviation within the EEA. Outside of this, under the EU Effort Sharing Decision (ESD), the target set for Ireland is that emissions covered by the ESD should be 20% below 2005 levels from 2013 – 2020. Ireland may avail of purchasing additional international credits to bridge the gap where a shortfall occurs in relation to commitments. It has been succeeded by the EU Effort Sharing Regulation (ESR) which covers the period up to 2030. At a national level, agriculture emissions are central to the CAP21's ambition. Some of the other aims CAP21 proposes include to increase the proportion of renewable electricity to up to 80%, support the take up of electric vehicles to reduce transport emissions, make retrofitting more affordable and to encourage the uptake of carbon-neutral heating, increased electrification of high-temperature heating and the phase out F-gases in the enterprise sector. The Department of the Taoiseach leads the preparation of quarterly progress reports in relation to the CAP actions. The most recent quarterly progress report shows a delivery rate of 64%.

Project Ireland 2040 includes the National Planning Framework (NPF) towards the transition to a low-carbon and climate-resilient society and sets out a planned €21.8 billion investment over the 2018-2027 period taking into consideration the projected 1million increase in the country's population. The NPF plans to tackle quality of life issues and will implement a better distribution of regional growth. As Ireland's infrastructure is developed, so too are the vehicles availing of the infrastructure. The public transport sector is moving towards reducing emissions and with Electric Vehicle Incentives and residual electricity from micro-generation being sold back to the grid, we see individual contributions towards renewable, sustainable and alternative energy sources.

In industry, in addition to EU engagement and climate finance education, the National Sustainable Finance Roadmap sets goals for 2025. Irish Sovereign Green Bonds (ISGBs) are

available for green projects aimed at mitigating climate change. Also, CAP21 commits to the undertaking of a review of fossil fuel subsidies.

The carbon tax increases brought in through the Budget and the annual Finance Act apply to fossil fuels outside the scope of the EU ETS. Revenue from this tax is assigned towards social welfare fuel payments, the national residential retrofit programme and the Rural Environment Protection Scheme. The Accelerated Capital Allowances (ACA) promotes investment in energy efficient products and equipment (mostly not directly operated by fossil fuels).

In the Built Environment sector, the EU Energy Performance of Buildings Directive requires that all new buildings (public and private) are Nearly Zero Energy Buildings (NZEB) by 2020. For existing buildings, a wide range of supports are available to increase energy efficiency to a Building Energy Rating (BER) of B2.

The public Sector Energy Efficiency Programme supported retrofit works in over 370 buildings in the 2017 to 2021 period. An approach to cost effectively retrofit the public sector buildings stock is being developed and there is a commitment that (with certain exceptions) fossil fuel using heating systems will not be installed after 2023.

The Sustainable Energy Authority of Ireland (SEAI) Residential and Community grants schemes include the National Home Energy Upgrade Scheme, the Better Energy Warmer Homes Scheme, the Community Energy Grant Scheme and the National Retrofit Plan, which commits to the introduction of a new residential retrofit loan guarantee scheme. Ireland's ambitious National Retrofit Plan also includes a commitment to achieve 500,000 home energy upgrades, to B2 Building Energy Rating (BER) standard, by 2030.

Ireland is moving towards developing a sustainable, circular economy which will be guided by Ireland's first Whole-of-Government Circular Economy Strategy 2022-2023. These are just a few examples of the policy measures which are explored along with others across all sectors including advances in Agriculture, Transport, Industry, Renewable Energy, Waste, Forestry and Peatlands.

Information on further sector-specific policies and measures can be found in Chapter 4.

1.4 Projections and the Total Effects of Policies and Measures

The reporting of Ireland's projected emissions is carried out in compliance with the EU Governance of the Energy Union and Climate Action Regulation 2018/1999, and uses two scenarios, With Existing Measures (WEM) which forecasts Ireland's emissions including all national policies and measures implemented by the end of 2020, and With Additional

Measures (WAM) which assumes the implementation of the WEM scenario plus additional planned policy measures such as those in Ireland's CAP21.

The EPA produces GHG emission projections on an annual basis for all sectors of the economy in collaboration with relevant State and other bodies. Ireland's most recent projections for 2020 to 2040, finalised in March 2022, indicate that total emissions by 2030 will decrease by 5.4% or 24.1% on 1990 levels under the WEM and WAM scenarios respectively. By 2040 these decreases will be 11.6% and 36.2% under each scenario respectively.

The single largest source of emissions in 2020 projections was the agriculture sector which contributed to 37.4% of total national emissions (excluding LULUCF). By 2030 its share is projected to increase to 42.6%. The second largest source of emissions in 2020 is the Transport sector accounting for 17.7% of total national emissions. In 2030 it is projected to account for 20% of Irish emissions.

CO₂ emissions accounted for almost 60.6% of Ireland's emissions in 2020 and are projected to decrease to 57% by 2030.

1.5 Vulnerability Assessment, Climate Change Impact and Adaptation Measures

Projections for Ireland indicate that impacts will continue and intensify into the future, with Ireland's climate projected to become warmer, with an increase in both dry periods and heavy rainfall events, rates of sea level rise will increase, and the frequency of extreme weather events are expected to increase. Ireland's coastline and waterways may be particularly vulnerable to climate change impacts. The expected increased impacts of extreme weather events depend on accurate forecasts and climate modelling, which is a core activity of Met Éireann, the Irish Meteorological Service.

Discussed in Section 6.2, sectoral plans and local adaptation strategies have so far identified climate hazards including: heatwaves and droughts coinciding, cold spells, extreme precipitation, flooding, severe windstorms, storm surges, and coastal erosion.

Section 6.3 outlines the potential impacts on specific sectors, section 6.4 provides information on climate change impacts, and section 6.5 follows on with key domestic adaptation policies and strategies to address them.

The requirement for the development and approval of a National Adaptation Framework² (NAF) continues to be set out under section 5 of the Climate Act 2021. Ireland's first

² gov.ie - National Adaptation Framework (NAF) <https://www.gov.ie/en/publication/fbe331-national-adaptation-framework/>

statutory NAF was published in January 2018. This provided a structured basis for the development of nine statutory Sectoral Adaptation Plans (SAPs)³ covering 12 priority sectors in 2019 and the development of Local Authority (LA) Adaptation Strategies⁴ by all 31 Irish local authorities were also published in 2019. In addition, in 2019, all Local Authorities signed Climate Action Charters, committing the local authority sector to specific adaptation goals and objectives.

Ireland has a well-established monitoring and evaluation framework, which is discussed in Section 6.6. In addition to the new Climate Action Delivery Board, since 2014 the National Adaptation Steering Committee (NASC) review the NAF and SAPs at a minimum every 5 years, with a broad range of representatives.

Section 6.7 demonstrates the considerable progress Ireland has achieved since NC7 in the area of adaptation, including mainstreaming across national, sectoral and local levels. At a sectoral level significant developments have been made in: agriculture, forestry and seafood; flood risk management and flood relief schemes; nature-based solutions; electricity and communications networks; health; transport; water; and, built and archaeological heritage. The establishment of Climate Action Regional Offices (CAROs) has also contributed greatly to advancing work at local level.

1.6 Financial resources and transfer of technology

Ireland has a strong record of providing climate finance to developing countries, with significant progress achieved in the delivery of this climate finance in recent years. Ireland's International Climate Finance Roadmap⁵, published in July 2022, articulates the Government's vision for providing €225 million per year in climate finance to developing countries by 2025. Ireland will maintain its focus on supporting adaptation and resilience to climate change in some of the most climate vulnerable countries around the world.

Ireland's public funding for climate action includes on-going support for mitigation and adaptation action in developing countries, mainly through bilateral assistance to Ireland's key partner countries in Sub-Saharan Africa and through funding for Civil Society Organisations (CSOs). Ireland also provides contributions to multilateral funds established under the auspices of the UNFCCC, including the Least Developed Countries Fund, the Least

³ gov.ie - Sectoral Adaptation Planning <https://www.gov.ie/en/collection/51df3-sectoral-adaptation-planning/?msclkid=81a16bc7ab5b11ec923736ef67f74efa>

⁴ Climate Ireland <https://climateireland.ie/#/tools/adaptationStrategyExplorer> Adaptation Strategy Explorer

⁵ Irish Aid, 'Ireland's International Climate Finance Roadmap', 2022, <https://irishaid.ie/media/irishaid/publications/2022-Irelands-International-Climate-Finance-Roadmap-Digital.pdf>

Developed Countries Expert Group, the Global Environment Facility, the Adaptation Fund and the Green Climate Fund. The detail of these payments is provided in Section 7.2.

In 2019, Ireland provided €96,397,553.05 in overall climate finance, in 2020 this figure was €88,341,095.

The total amount of core multilateral climate finance, excluding Multilateral Development Banks (MDBs) and International Finance Institutions (IFIs), provided by Ireland in 2019 was €38,532,141. The climate specific multilateral total was €20,450,149. The total amount of core multilateral climate finance, also excluding MDBs and IFIs, provided by Ireland in 2020 was €56,717,360.87, representing a 47% increase on 2019. The climate specific total was €23,541,437. In 2020, a significant majority of bilateral climate spending went to cross-cutting activities, covering both mitigation and adaptation activities.

The total amount of core climate related funding provided through MDBs and IFIs in 2019 was € 41,427,883, climate specific was €10,885,380.03. The core climate related funding figure in 2020 was €54,429,654, climate specific was €16,574,227, with all of the funding marked as cross-cutting.

The total amount of climate specific bilateral and regional climate finance provided by Ireland in 2019 was €65,272,578.03. The total amount of bilateral climate finance provided by the Department of Foreign Affairs (DFA) in 2020 was €48,225,431. The 2020 figure represents a 26% decrease on 2019, which can mainly be attributed to the revised EU methodology for programming and projects.

The level of detail in Ireland's multilateral climate finance reporting has been improved in recent years due to changes in EU-level reporting requirements. Specifically, both climate-specific and core-funding amounts are calculated for all payments where feasible, and closer attention has been paid to the use of unearmarked funding in terms of categorisation eg. cross-cutting, adaptation, mitigation.

As discussed in section 7.3, Ireland does not have a long history of substantial investment in technology development, nor would it be regarded as a major climate technology developing nation when compared to many other countries. As such, large scale technology development or transfer is not usually a strong feature of Ireland's climate support. Notwithstanding this, Ireland supported a number of programmes in 2019 and 2020 that provided technology support to developing country partners. Section 7.4 highlights a number of capacity building activities.

1.7 Research and Systematic Observation

Research and systematic observations are essential to understanding and responding to climate change. Ireland has advanced a series of initiatives to support, develop and coordinate, climate change research as part of a national programme. It has developed a well-structured research programme which is primarily aimed at informing and supporting climate change policy implementation and development and informing actions by stakeholders. As part of this function, under EPA Research 2030: A Framework for EPA Research 2021-2030, two national Research Coordination Groups were established, one considering all environmental research (NERCG) and a second focusing specifically on climate research (Climate Research Coordination Group or CRCG)⁶. Further information on these coordination efforts is included in Section 8.6.

Public funding of climate research and systematic observation in Ireland is primarily given through national competitive research funding programmes, full details of which are outlined in Section 8.2 with some examples referenced below.

One of the primary Irish research funding organisations is Met Éireann. Met Éireann is Ireland's National Meteorological Service and is maintained by the State under the UN Convention of the World Meteorological Organisation (WMO), and works across State Departments and Agencies to support the whole-of-Government approach to delivering relevant actions under Ireland's Climate Action Plans.

A Global Climate Observing System (GCOS) National Committee for Ireland (GCOS-Ireland) was established early in 2018 following a joint initiative by the Director of Met Éireann, the Director General of the EPA, and the Chief Executive of the Marine Institute. The role of GCOS-Ireland is to coordinate and promote the GCOS observing principles relating to Essential Climate Variables (ECVs) of relevance to Ireland. The GCOS-Ireland report 'The Status of Ireland's Climate, 2020'⁷, co-funded by the EPA, the Marine Institute and Met Éireann, provides the status of climate monitoring in Ireland across land, ocean and the atmosphere. Alongside the competitive research call TRANSLATE, issued by Met Éireann in 2020 to standardise national climate projections, in March 2022 Met Éireann announced a 4-year project funding aimed at improving our understanding of the North Atlantic climate system and its impact on Ireland.

Section 8.3 discusses the new thematic approach that has been developed in climate change research for the 5YAR process, with the following four volumes:

⁶ <https://www.epa.ie/our-services/research/national-environmental-research-coordination/climate-research-coordination-group/>

⁷ <https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020.php>

- Theme 1: Science: Ireland in a changing world;
- Theme 2: Achieving climate neutrality by 2050;
- Theme 3: Being prepared for Ireland's future climate.
- Theme 4: Realising the benefits of transition and transformation is recognised as a cross-cutting theme to the other three.

Section 8.4 outlines the significant research outcomes since the submission of Ireland's NC7 and BR4.

Ireland recognises the international nature of climate change and the need to participate in global efforts, and participates in a number of groups discussed in Section 8.5 such as: JPI Climate, Water JPI, Biodiversa+ European Partnership, JPI Oceans, JPI FACCE, and the IPCC. Later sections of Chapter 8 further demonstrate the advancements made by Ireland in recent years in the areas of: modelling and prediction, impacts, and adaptation; socio-economic analysis and modelling; research and development on mitigation and adaptation technologies; and, systematic observation.

1.8 Education, Training and Public Awareness

Section 9.2 outlines efforts in relation to education, including primary, secondary and tertiary level. The Department of Education together with the Department of Further and Higher Education, Research, Innovation and Science are currently in the process of finalising the 2nd National Strategy on Education for Sustainable Development (ESD) to 2030, with the first launched in 2014. ESD to 2030 will be aligned with the UNESCO ESD framework⁸ and includes five key priority areas: advancing policy; transforming learning environments, building capacities of educators, empowering and mobilising youth; and accelerating local level actions. ESD to 2030 will build on the foundations laid under the first national strategy, further integrating ESD across the education system, strengthening educator capacity and giving an ever-stronger voice to young people.

A number of programmes and initiatives are run in conjunction with primary, secondary and tertiary educational providers in order to inform and empower their staff and students. These include: Green-Schools and Green-Campus programmes; Smarter Travel programmes; and green skills courses with a specific focus on the construction sector and net zero energy.

⁸ UNESCO, 'Education for sustainable development: a roadmap', 2020, <https://unesdoc.unesco.org/ark:/48223/pf0000374802>

Ireland's progress on climate change public awareness is outlined in Section 9.3. The National Dialogue on Climate Action (NDCA) is the primary vehicle through which Ireland's collaborative effort towards net zero by no later than 2050 will be realised, delivering a systematic means of actively engaging stakeholders and the public with climate action across Ireland enabling and empowering people at a local and national level.

In 2021, as part of the NDCA, a series of in-depth 'Climate Conversations' took place which captured the views of over 3,800 people, including inputs from over 200 individuals, 16 Public Participation Networks (PPNs), 100 young people from Comhairle na nÓg groups, and 70 other people from 12 years of age and upwards. It identified areas where people are already making changes and where individuals and communities feel they lack information, knowledge and resources, or the capacity to pursue these changes. The 2022 Climate Conversations series launched in July 2022.

The National Climate Stakeholder Forum (NCSF) was established, as a central pillar of the NDCA, by the Department of the Environment, Climate and Communications to function as a consultative forum on climate issues. The NCSF will meet three times each year in the form of a one-day workshop with the output of recommendations to inform the Climate Action Plans.

The first annual National Youth Assembly on Climate was also established and held on 2 March 2022 with 38 young people in attendance. The delegates were nominated by organisations, including Comhairle na nÓg, student bodies and community groups. Four workshops were held, each focusing on the areas of greatest concern to young people. The delegates presented their recommendations directly to the Minister for the Environment, Climate and Communications.

The public statements and Annual Review Reports of the CCAC also help to inform. Alongside numerous local-level actions, the EPA and SEAI also run a number of public awareness supporting initiatives, research programmes, and competitions.

The final Section 9.4 discusses the involvement of Public and Non-Governmental Organisations (NGOs) in Irish policymaking processes. The Department of the Environment, Climate and Communications (DECC) continues to engage with and provide funding to the environmental NGO sector in order to support them in the role they play in protecting the environment, raising awareness, promoting sustainability and participating in environmental policy development. DECC funds the Irish Environmental Network (IEN) an umbrella organisation of environmental NGOs in Ireland and this core funding is distributed to the IEN's 30 member organisations. Funding provided to the IEN has almost doubled since 2020.

ECO-UNESCO is one of the NGOs that Ireland regularly engages with, and it runs the Young Environmentalist Awards which is aimed at promoting environmental responsibility among young people aged 10 to 18. The programme culminates in an annual National showcase and awards ceremony which is partly funded by DECC.

In 2018, the DECC entered into a five-year financial commitment of €10 million to establish four CAROs. The CAROs coordinate actions between Local Authorities (LAs) and assist in the development and monitoring of implementation of 31 Local Climate Adaptation Strategies which are currently being delivered.

Since 2019, the DECC has also funded and engaged with the CAROs in relation to the implementation of an extensive LA climate action training programme. Over 13,000 LA staff received training in 2021 and further courses are in development.

As part of the NDCA, conversations are held at local level through Public Participation Networks (PPNs) and through targeted focus groups. The outputs of local engagement activities and the climate conversations will be analysed and inform the programme for a National Climate Conversation on Local Actions (NCCLA). The NCCLA will be a forum to allow communities and organisations to showcase projects, engage in practical discussions, share best practice, and explore the scalability of local activity or individual innovations. This event will be held annually.

Chapter Two:

National Circumstances Relevant to Greenhouse Gas Emissions and Removals

2. National Circumstances Relevant to Greenhouse Gas Emissions and Removals

2.1 Government Structure

Ireland is a parliamentary democracy. The national parliament is called the Oireachtas and consists of the President and two houses - the Dáil (the lower house), and the Seanad (the upper house). Bunreacht na hÉireann, the written Constitution of Ireland, sets out the administrative structure of the Government and defines the structure and principles of legal and social policy to guide the Oireachtas. The rights of every citizen are also enshrined in the Constitution. The power of the two houses of the Oireachtas derives from the Constitution and legislation. The Dáil is the primary House and the Government is answerable to the Dáil only. The Irish Government consists of not less than seven and not more than fifteen members. The Head of the Government is the Taoiseach, who is appointed by the President on the nomination of the Dáil. Departments of State are assigned to members of the Government, with a Minister occasionally being responsible for more than one Department.

The Irish Government, in exercising the executive powers of the State and delivery of its policy, retains overall responsibility for ensuring delivery of Ireland's obligations under the UNFCCC, the Kyoto Protocol, and the Paris Agreement. A Cabinet Committee assists the Government in carrying out its responsibilities to implement a whole-of-Government approach given the cross-sectoral nature of climate. This Committee is supported by a Senior Officials Group which assists in ensuring joined-up thinking, particularly for cross-sectoral issues such as climate change. The Minister for the Environment, Climate and Communications is responsible for Ireland's policy on climate change and has an overarching role in the delivery of this policy.

2.2 Population

The preliminary results of Ireland's most recent Census, in 2022, shows that Ireland's resident population stood at 4,761,865.⁹ Ireland's population has been steadily growing since the 1990s and increased by 35% between April 1990 and April 2016, although the increase from 2011 to 2016 has been the slowest inter census change over that period. The population

⁹ Central Statistics Office, Census of Population 2022 - Preliminary Results, <https://www.cso.ie/en/releasesandpublications/ep/p-cpr/censusofpopulation2022-preliminaryresults/>

growth measured by the 2016 Census was due to natural increase (births less deaths), as Ireland experienced a small amount of net outward migration between 2011-2016.¹⁰ The average age of Ireland's population had increased from 36.1 years to 37.4 years over the same period. The current estimated population from the 2022 Census is 5,123,536, an increase of 361,371 (7.6%) since 2016. This is also the first time that the population has exceeded 5 million since 1851.¹¹

Ireland's population density also increased to 70 persons per square kilometre by 2016, from 67 persons in 2011, although this remains relatively low compared to other European countries. However, the April 2021 population estimates show that 28.5% of the population is concentrated in the Dublin region, outside of which the State has a highly-dispersed, less-dense population.

2.3 Economic Profile

Ireland is a small, modern, trade-dependent economy. A strong period of economic growth over the period 1995 to 2007 saw GDP rise by an average of 6% per annum. However, this was followed by a sharp drop in economic activity during the global financial crisis and the subsequent collapse of Ireland's domestic property market and construction industry. GDP shrank by 10% between 2007 and 2011, with employment falling by 14%.

The economy experienced fitful growth over the next few years as it recovered from the financial crises and subsequent EU-IMF bailout programme. Growth began to increase again from 2014 onwards, with underlying growth of the domestic economy averaging around 4% per annum in the 5 years preceding the COVID-19 pandemic. This was accompanied by strong employment growth which resulted in the highest level of employment ever recorded in the State by the end of 2019. This placed the Irish economy in a strong position, with robust growth, balanced public finances, a current account surplus and a labour market close to full employment.

The COVID-19 pandemic however had a severe impact on the domestic economy. While at a headline level, GDP increased by almost 6% in 2020. This is very much a function of the 'dual-nature' of the Irish economy – characterised by highly productive and mainly foreign-owned Multinational Corporations (MNCs) on one side and domestic small to medium enterprises (SMEs) on the other – and masks an unprecedented contraction in the domestic

¹⁰ Central Statistics Office, Population and Migration Estimates, April 2021, <https://www.cso.ie/en/releasesandpublications/ep/p-pme/populationandmigrationestimatesapril2021/>

¹¹ Central Statistics Office, Census of Population 2022 - Preliminary Results, <https://www.cso.ie/en/releasesandpublications/ep/p-cpr/censusofpopulation2022-preliminaryresults/>

economy. Modified Domestic Demand (MDD), which provides the best measure of domestic economic activity, fell by around 5% in 2020. The unemployment rate – including recipients of the Pandemic Unemployment Payment (PUP) - peaked at 30% in April 2020. Ireland saw some of the largest declines in private consumption and construction investment, as a result of the comparatively severe lockdowns throughout that year.

Due to the success of our vaccination programme restrictions were eased over the course of 2021, with the domestic economy recovering strongly as a result. The strength of the recovery meant that by the third quarter of 2021, both output and employment had exceeded pre-pandemic levels, a remarkable outcome that speaks to the success of the Government's economic policies, which protected incomes, jobs and businesses. While Ireland's economy has recovered, considerable risks remain, including the geopolitical instability caused by the war in Ukraine, more persistent inflationary pressures and Brexit related disruptions to Irish exports.

2.4 Geographic Profile

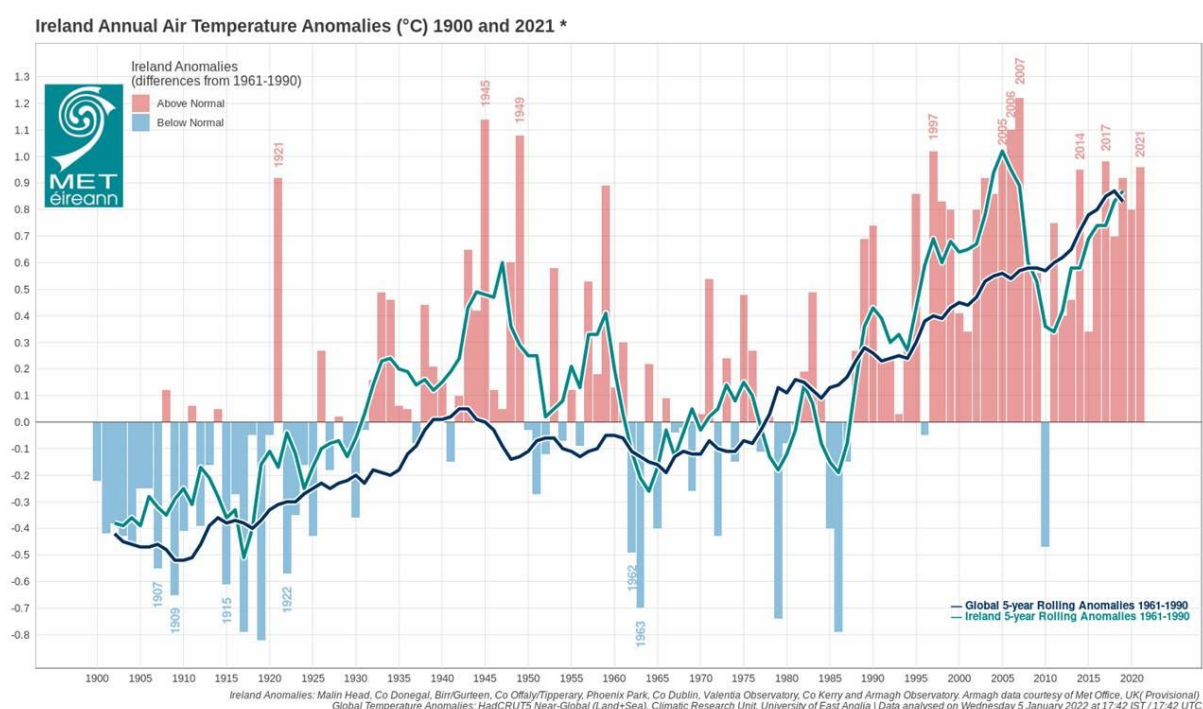
Ireland is situated off the north-west coast of the continent of Europe between longitude 5.5° and 10.5° West and latitude 51.5° and 55.5° North. The total area of the island of Ireland is 84,421 square kilometres. Within this, the Republic comprises 70,282 square kilometres. The greatest length of the island from the north to the south is 486 kilometres and the greatest width, from east to west, is 275 kilometres. There are 3,172 kilometres of coastline. The island consists of a large central lowland of limestone with a relief of hills and a number of coastal mountains, the highest of which, Carrantuohill, is 1,040m.

The Shannon, at 340km, is Ireland's longest river. Ireland's national parks are home to some of the most unique and spectacular scenery in the country, while wild bog lands occur in mountain and lowland areas and are among the most distinctive natural habitats in the country. The biodiversity of wildlife is comparatively low due to Ireland's isolation from mainland Europe with many species present on the continent being absent. Many common animals and plants have, in fact, been introduced by human settlers. However, as an island nation Ireland has its own distinct and unique biodiversity of plant and animal species. The marine habitats surrounding our island are home to whales, dolphins, vast colonies of seabirds, abundant fish and cold-water coral reefs, as well as rich algal and invertebrate communities. On land, there is a wealth of species in our mountains, peatlands, turloughs, woodlands, grasslands, lakes, rivers, and coastal habitats

2.5 Climate Profile

Ireland has a mild temperate oceanic climate, due to the controlling influence of the Atlantic Ocean. Mean annual temperatures generally range between 9°C and 10°C with the higher values in coastal regions. Summer is the warmest season, followed by Autumn, Spring and Winter. The highest temperatures occur inland during the Summer, with mean seasonal maxima between 18°C and 20°C while highest values occur in coastal regions during the Winter. July is the warmest month, followed by August and June; the coldest month is January followed closely by February and then December. A long-term average national temperature series for Ireland, derived using data from five centennial stations, shows that temperatures have varied considerably from year to year. National annual temperatures have largely been above normal (1961-1990) since the late 1980's and broadly consistent with global temperature trends. Fifteen of the top 20 warmest years on record have occurred since 1990. The annual average temperature in Ireland has increased by approximately 0.9°C over the last 120 years, with a rise in temperatures being observed in all seasons.

Figure 2.1: Annual Air Temperature Anomalies (1900-2021)



The highest rainfall occurs in the western half of the country and on high ground, while rainfall decreases to the northeast. The average annual rainfall is approximately 1230 mm, but totals in excess of 3000 mm may occur on high ground. The driest seasons are Spring and

Summer, with an average of approximately 260 mm, while Autumn and Winter have averages of approximately 350 mm. The driest months are April, May, June and July, with an average of approximately 80 mm each month. February, March, August and September have average rainfall totals of approximately 100 mm, while October, November, December and January have averages of approximately 130 mm.

Annual average amounts of precipitation are increasing. Annual precipitation was 6% higher in the period 1989 to 2018, compared to the 30-year period 1961 to 1990. The decade 2006 to 2015 was the wettest on record.

Climate observations also show that Ireland's oceans are also changing in line with global trends. Irish seas are becoming more acidic and warming and sea level is rising. Generally speaking, Ireland's climate is following global changing climate trends and national studies project these changes to continue.

2.6 Energy

Ireland is not endowed with significant indigenous fossil fuel resources and has only in recent years begun to harness significant quantities of renewable resources and more recently natural gas from the Corrib gas field off the west coast of Ireland. From circa 2000 – 2016, Ireland imported approximately 85% - 90% of its energy needs, this fell sharply following the opening of the Corrib gas field to a low of 66% in 2017. However, it has increased since and in 2020 Ireland's import dependency was 72%.

Data relating to national and sectoral statistics for energy production, transformation and end-use are collected by the SEAI in the year following the activity. Following collection these data are rigorously analysed with the data and analysis typically becoming available for public use in December of that year.

2.6.1 Key Trends in 2020

- In 2020, overall energy use decreased by 8.7%, against a backdrop of a 4.2% contraction in the economy.
- Practically all of the reduction in energy use occurred in the transport sector because of reduced mobility during the COVID-19 pandemic.
- Energy-related CO₂ emissions decreased by 6.3% in 2020 primarily due to reduced oil use for transport.
- Energy-related CO₂ emissions from the combustion of fossil fuels accounted for 57% of Ireland's total GHG emissions.

- Energy from renewable sources grew by 8.9% in 2020.
- Ireland succeeded against its EU 2020 renewable energy target for transport (10.2% vs. 10%), and just missed its renewable energy target for electricity (39.1% vs. 40%).
- There has been a strong reduction in the CO₂ intensity of electricity generation, especially after 2016, with intensity falling below 300 gCO₂ /kWh for the first time in 2020. It is now less than half of its 2005 value.

2.6.2 Energy Production 2005-2020

Domestic production accounted for 32% of Ireland's energy requirements in 1990. From the mid-1990s import dependency grew significantly due to the increase in energy use, together with the decline in indigenous natural gas production at Kinsale since 1995, and decreasing peat production. Ireland's overall import dependency reached 90% in 2006. It varied between 85% and 90% until 2016 when it fell sharply following the opening of the Corrib gas field. It fell to a low of 66% in 2017 but has increased since to 72% in 2020.

Domestic production of natural gas decreased by 95% from the previous peak in 1995 to a low of 113 ktoe in 2015. It increased dramatically in 2016 and rose again in 2017, to 2,854 ktoe. This was the highest natural gas production level ever recorded in Ireland. Production from the Corrib gas field has already begun to decline and in 2020 it was 1,654 ktoe, 42% below the 2017 peak. It is expected to continue this decline over the coming years.

Peat production was down 67% in 2020 on the previous year with Bord na Móna announcing a formal ending of peat harvesting on its lands in January 2021. Indigenous renewable energy production increased by 335% between 2005 and 2020, to 1,612 ktoe. Most of this is from wind energy. Total indigenous energy production in Ireland reached the highest level ever in 2018 of 5,044 ktoe, but declined to 3,541 ktoe in 2020 due to declining natural gas and peat production.

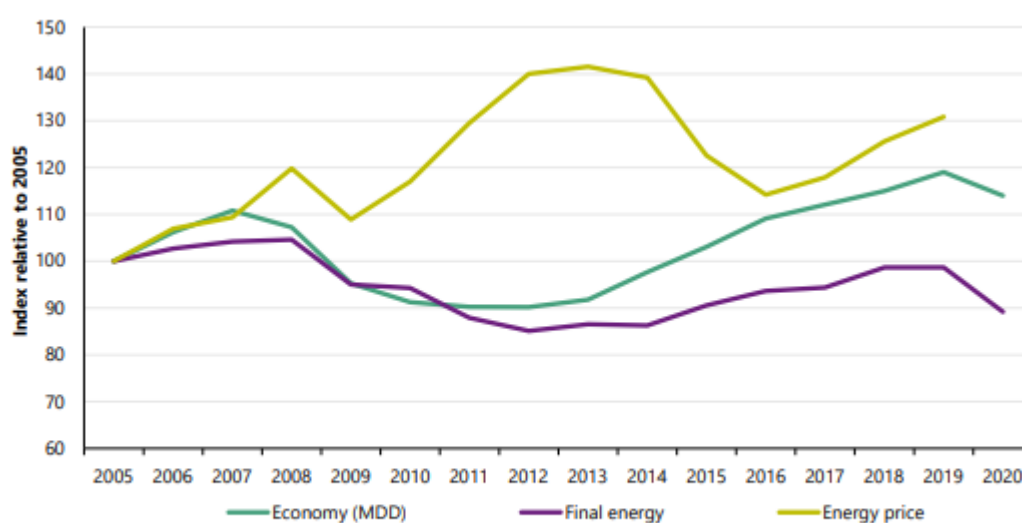
2.6.3 Energy Consumption – Trends 2005-2020

Energy supply responds to the level of demand for energy services (heating, transportation and electricity) and how end-users want that energy demand satisfied. Energy service demand is driven primarily by economic activity and by the energy end-use technologies employed in undertaking such activity. The relationship between economic activity and energy demand is less straightforward in Ireland than it is for most other countries.

GDP is the most widely accepted measure of economic activity internationally, but Ireland's GDP is strongly influenced by the revenue and profits reported by MNCs. Some economic activity of these companies results in large amounts of value added, but results in little energy consumption. This was illustrated clearly in 2015, when Irish GDP increased suddenly by 25% from 2014, due to the transfer of intellectual property from MNCs. Care must be taken when comparing macro-economic indicators, such as energy per unit GDP, across countries.

The Central Statistics Office (CSO) have developed alternative indicators to GDP, that more accurately reflect the level of economic activity in the domestic economy, and to remove the distorting effects of globalisation. MDD was first published in the Quarterly National Accounts results for Q1-2017 and excluded trade by aircraft leasing companies, exports and imports of research and development (R&D) services, and exports and imports of R&D-related intellectual property (IP) products. For comparison, Ireland's MDD grew by 5.3% from 2014 to 2015, compared to 25% for GDP. Figure 30 shows the historical trends for MDD, energy prices and final energy, each expressed as an index relative to 2005. This figure illustrates changes in economic growth between 2005 and 2020 and shows the effect of the economic downturn between 2008 and 2012 (and the subsequent return to growth after 2013). Table 14 gives the growth rates for the economy (GDP and MDD), primary energy, final energy and energy-related CO₂ emissions for the period 2005 to 2020. The starting year of 2005 is chosen to align to Ireland's 2020 GHG emissions target. Transport and industry have been responsive to economic activity, while energy use in the residential and services sectors are more driven by short-term annual variations in weather and energy prices.

Figure 2.2: Index of modified domestic demand, final energy demand and energy price



Source: Based on SEAI and CSO data

Table 2.1: GDP, MDD, final energy, primary energy, and energy-related CO₂ growth rate

	Overall change (%)			Annual average change (%)			
	2019-2020	2015-2020	2005-2020	2015-2020	2010-2015	2005-2010	2005-2020
Economy (GDP)	5.9%	34.6%	91.1%	6.1%	6.8%	0.4%	4.4%
Economy (MDD)	-4.2%	10.6%	14.0%	2.0%	2.5%	-1.8%	0.9%
Final energy	-9.6%	-1.5%	-10.8%	-0.3%	-0.8%	-1.2%	-0.8%
Primary energy	-8.7%	-4.1%	-15.8%	-0.8%	-1.1%	-1.5%	-1.1%
Energy related CO ₂	-11.4%	-14.5%	-30.3%	-3.1%	-1.5%	-2.5%	-2.4%

Source: CSO and SEAI

In 2009, tracking the decline in economic activity, all sectors experienced reductions in energy use and related emissions. This was somewhat balanced in 2010 by an exceptionally cold year that saw record high energy use for heat in the residential sector. Although MDD was relatively constant in 2012, energy demand continued to fall (mostly in the transport and residential sectors) largely due to record high energy prices, including a sustained period with oil prices of over \$100 per barrel. Strong growth of MDD returned 2014, with increases in energy demand and energy-related CO₂ emissions following after a one year lag, following the easing of energy prices. Final energy demand increased every year from 2014 to 2018, and fell slightly (-0.6%) in 2019, despite a 2019 growth in MDD of 3.2%. Most of the reduction in final energy demand in 2019 can be explained by reduced heat demand due to a warm year. When weather-corrected, final energy use in 2019 increased by 0.5%.

In 2020, final energy use fell by 9.6% and energy-related CO₂ emissions fell by 11.4%. MDD fell by 4.2%, due largely to the impact of COVID-19 on economic activity (while GDP increased by 5.9%).

2.6.4 Fuel Consumption Trends and Fossil Fuel Trends

Key fossil fuels trends for Ireland are as follows:

- Fossil fuels account for 73% of final energy use in 2020. This was down by 12.7% compared to 2019 levels, with the reductions coming from oil and natural gas use. While the use of coal and peat for final energy increased slightly in 2020, their combined share remains low at 4% of final energy use.
- In the last 15 years, from 2005 to 2020, the final consumption of oil, coal, and peat have all fallen in the range of 30-40%, while the final consumption of natural gas has increased by 43%.
- Since 2005, Ireland has reduced its overall final use of fossil fuels by 20%.
- A significant recent trend was the reduction in coal use for electricity generation, falling from 1,126 ktoe in 2015 to 148 ktoe in 2019. However, 2020 saw a slight reversal of this trend with coal for electricity generation rising to 195 ktoe, with a further rise in 2021 provisionally calculated as 673 ktoe. This significant increase was due to a combination of low wind availability and forced outages of alternative generation units that would normally be used in advance of coal. Similarly, the use of oil for electricity generation is increasing, rising from 35 ktoe in 2018 to a provisional figure of 359 ktoe in 2021.
- The use of peat for electricity generation fell sharply in 2020, from 434 ktoe to 214 ktoe, just over a 50% reduction due to the closure of two peat burning power plants.
- Oil continues to be the dominant energy source and maintained a 45% share of total primary energy requirement (TPER) in 2020. The share of oil in overall energy use peaked in 1999 at 60%. Consumption of oil, in absolute terms, decreased by 17% in 2020 to 5,825 ktoe from 7022 ktoe in 2019, due to the impact of the COVID-19 pandemic and related public health measures on the transport sector. However, there was an increase to 6,321 ktoe in 2021 primarily due to the emergence from pandemic restrictions.
- Natural gas use remained practically constant in 2020 (4,571 ktoe to 4,564 ktoe).

2.6.5 Renewable Energy Trends

Details of renewable growth rates, quantities and shares are outlined in **Table 2.2**, the key trends of 2015-2020 are highlighted below:

- Energy from renewable sources grew by 8.9% in 2020.
- Hydro and wind increased by 5% and 72.3% in this period
- Bioenergy use increased by 21.6%
- The overall share of renewables in total primary energy supply stood at 13% in 2020.

Table 2.2 Trends of renewable energy by type, quantities and shares

	2020		2005		2019-2020		2015-2020		2005-2020	
	Quantity (ktoe)	Share (%)	Quantity (ktoe)	Share (%)	Absolute change (ktoe)	Overall change (%)	Overall change (%)	Average annual change (%)	Overall change (%)	Average annual change (%)
Biomass & Renewable Wastes	288	19%	176	49%	5	1.8%	15.7%	3.0%	64%	3.3%
Liquid biofuels	174	11%	1	0%	-14	-7.2%	36.2%	6.4%	15789%	40.2%
Biogas and landfill gas	28	2%	17	5%	2	8.5%	7.2%	1.4%	63%	3.3%
Total bioenergy	491	32%	195	54%	-6	-1.3%	21.6%	4.0%	152%	6.4%
Wind	918	59%	95	26%	75	8.9%	72.3%	11.5%	870%	16.4%
Hydro	65	4%	65	18%	2	2.6%	5.0%	1.0%	0%	0.0%
Ambient	57	4%	4	1%	5	9.7%	111.5%	16.2%	1247%	18.9%
Solar	20	1%	0	0%	2	14.3%	66.9%	10.8%	4150%	28.4%
Total Renewable	1,551	100%	360	100%	78	5.3%	49.5%	8.4%	331%	10.2%

Source: SEAI

2.6.6 Electricity Imports

Ireland was a net exporter of electricity in 2020, switching from net imports of 55 ktoe in 2019 to net exports of 13 ktoe in 2016 – a difference of 68 ktoe.

Table 2.3 allocates Ireland's primary energy supply to each sector of the economy, according to its energy demand. The allocation is straightforward where fuels are used directly by a particular sector. Regarding electricity, the primary energy associated with each sector's electricity consumption is included to yield the total primary energy supply for each sector.

Primary energy supply gives a more complete measure than final energy demand (accounted for in the gas, oil, electricity and coal bills) of the impact of the individual sectors on national energy use and on energy-related CO₂ emissions. Energy use decreases across most sectors in 2020, which can be directly attributed to the pandemic. Energy use in the residential and services sectors relates mainly to space heating and due to the pandemic increased significantly.

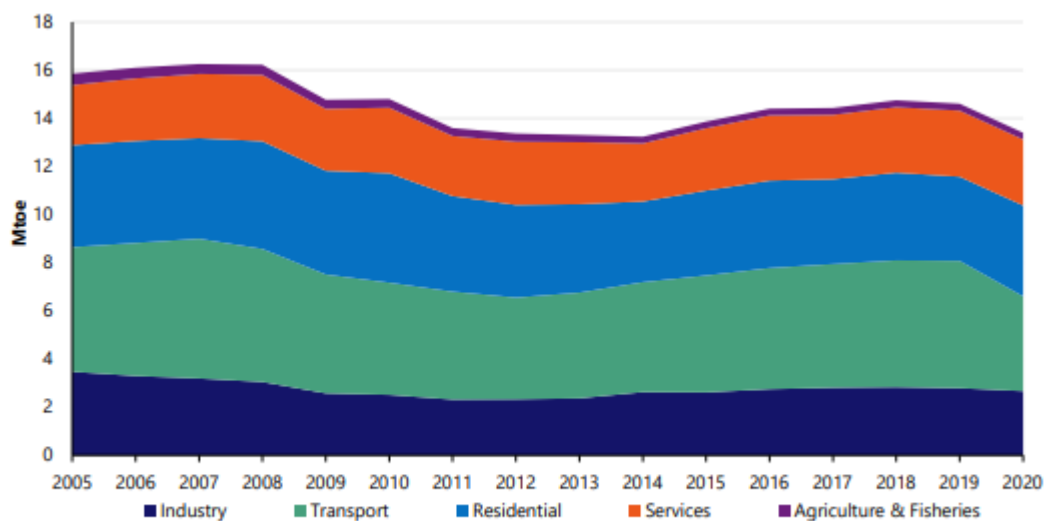
Table 2.3 Total primary energy sectoral requirements

	2020		2005		2019-2020		2015-2020		2005-2020	
	Quantity (ktoe)	Share (%)	Quantity (ktoe)	Share (%)	Absolute change (ktoe)	Overall change (%)	Overall change (%)	Average annual change (%)	Overall change (%)	Average annual change (%)
Industry	2,662	20%	3,470	22%	-121	-4.4%	1.9%	0.4%	-23.3%	-1.8%
Transport	3,941	30%	5,181	33%	-1,357	-25.6%	-19.0%	-4.1%	-23.9%	-1.8%
Residential	3,782	28%	4,234	27%	283	8.1%	7.2%	1.4%	-10.7%	-0.8%
Services	2,741	21%	2,503	16%	-2	-0.1%	5.8%	1.1%	9.5%	0.6%
Agriculture & Fisheries	282	2%	468	3%	-5	-1.8%	3.3%	0.7%	-39.9%	-3.3%
Total	13,350	100%	15,857	100%	-1,265	-8.7%	-4.1%	-0.8%	-15.8%	-1.1%

Table 2.3 illustrates total primary energy sectoral requirements and includes the following highlights:

- In 2020, transport had the largest share of primary energy, despite a 25.6% reduction against 2019 levels (5,298 ktoe to 3,941 ktoe)
- In 2020, primary energy use in households increased by 8.1% to 3,782 ktoe. This was influenced, of course, by the extra time spent in homes during the pandemic restrictions.
- Industry primary energy decreased by 4.4% in 2020 to 2,662 ktoe. Industry's share of primary energy was 20% in 2020.
- Services' share of primary energy was 21% in 2020.
- Agriculture/fisheries' primary energy use decreased by 1.8% in 2020 to 282 ktoe and accounted for 2% of primary energy.

Figure 2.3 Growth rates of the different sectors in terms of total primary energy requirement by sector since 2005



Source: SEAI

2.7 Transportation

Economic factors are the main drivers of transport demand and activity. Figure 2.4 'Economy and Transport Indicators, Ireland 1995 – 2020' shows the strong correlation between transport indicators and general economic activity, driven by commuters and goods moving around Ireland. The transport sector grows or reduces sharply in response to economic growth or contraction. Transport emissions peaked at 14.4 MtCO₂eq. in 2007, falling during the economic recession to 10.9 MtCO₂eq. in 2012. As the economic recovery took hold, the sector's emissions began to rise once more, illustrating a continued relationship between transport emissions and economic activity in Ireland that must be addressed¹. The emissions inventory reported a slight increase in transport emissions from 2018 to 2019². This was despite the introduction of increased biofuel use, improving vehicle efficiencies and a growing number of electric vehicles in the fleet.

The transport sector has been the fastest growing source of GHG emissions in Ireland, with a 112 % increase between 1990 and 2021³. In 2021 the transport sector was the second largest contributor to national GHG emissions, after agriculture, at 18% or 10.9 million tonnes CO₂ equivalent (compared to 17.5% or 10.3 million tonnes CO₂ equivalent in 2020, and 20% or 12.2 million tonnes CO₂ equivalent in 2019)⁴. Increases in transport emissions have been recorded for six out of the last eight years (2014-2021) as the economy has grown and transport movements have increased⁵. A significant decrease of almost 16% (or 1.9 Mt CO₂eq – excluding aviation)⁶ was seen between 2019 and 2020 but a partial rebound (of 6.1%) was seen between 2020 and 2021 as COVID -19 restrictions on car and public transport journeys were relaxed. Emissions from road transport make up 94% of transport emissions and were relatively stable between 2015 and 2019⁷.

¹ Climate Action Plan 2021 <https://assets.gov.ie/203558/f06a924b-4773-4829-ba59-b0feec978e40.pdf>

² Ireland's National Inventory Report 2021: Greenhouse Gas Emissions 1990-2019, Table 3.2 and p.75. [National Inventory Report](#)

³ EPA Greenhouse Gas Emissions By Sector, <https://www.epa.ie/resources/charts--data/climate/greenhouse-gas-emissions-by-sector.php#:~:text=The%20transport%20sector%20has%20been,increase%20between%201990%20and%202020.>

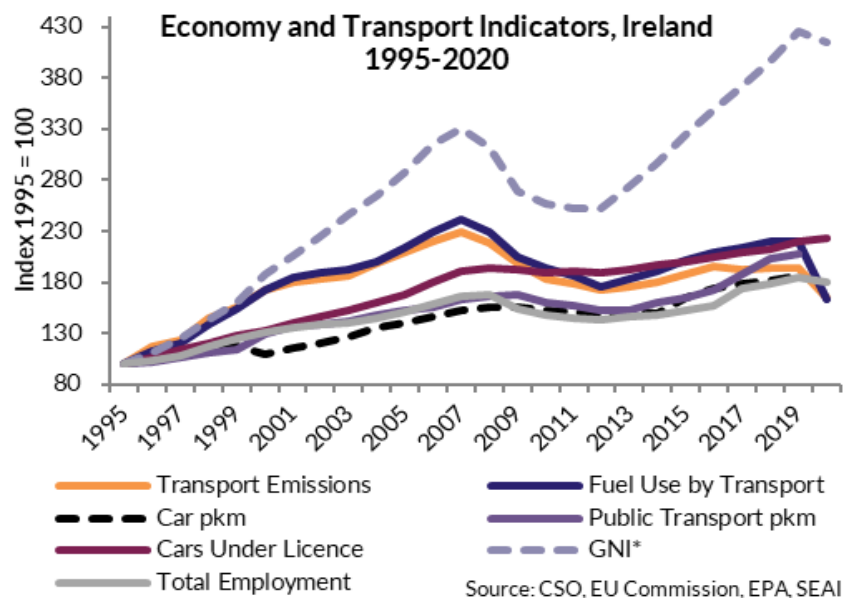
⁴ Environmental Protection Agency, 'Ireland's Provisional Greenhouse Gas Emissions 1990-2020', October 2021, <https://www.epa.ie/resources/charts--data/climate/greenhouse-gas-emissions-by-sector.php#:~:text=The%20transport%20sector%20has%20been,increase%20between%201990%20and%202020>

⁵ <https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/>

⁶ EPA Ireland's Provisional Greenhouse Gas Emissions 1990-2020, October 2021 https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Irelands-Provisional-Greenhouse-Gas-Emissions-report-1990-2020_finalv2.pdf

⁷ EPA Transport, <https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/transport/>

Figure 2.4 Economy and Transport Indicators, Ireland 1995 – 2020



In 2020 passenger cars were responsible for 54% of road transport emissions, with Heavy Goods Vehicles (HGV) responsible for 20%, Light Goods Vehicles for 18% and buses 7%. CO₂ emissions from private car use were down by 21%, or 1.3 million tonnes of CO₂ and emissions from HGV were down by 8.8%, or 0.2 million tonnes compared to 2019⁸. HGV activity was less impacted compared to private cars in terms of COVID-19 travel restrictions. Transport emissions in 2020 were 29% below, and in 2021 were 24.5% below peak levels in 2007 primarily due to the effect of COVID-19 restrictions, economic downturn and also due to improving vehicle fuel efficiency, the increased use of biofuels and a significant decrease in fuel tourism in recent years⁹.

Figure 2 'Transport Sector GHG emissions 1990 – 2020' shows the changes in transport emissions between 1990 and 2020; over this period, emissions increased by just over 137% from c. 5.1 million tonnes of CO₂ in 1990 to 12.2 million tonnes in 2019 with emissions peaking in 2007 at 14.4 million tonnes. However, as described above, the impact of COVID-19 led to a 16% decrease in transport emissions in 2020 compared to 2019. Early data for 2021 shows that energy use and related CO₂ emissions in most transport sectors had already rebounded back to pre-COVID-19 levels by the middle of 2021¹⁰.

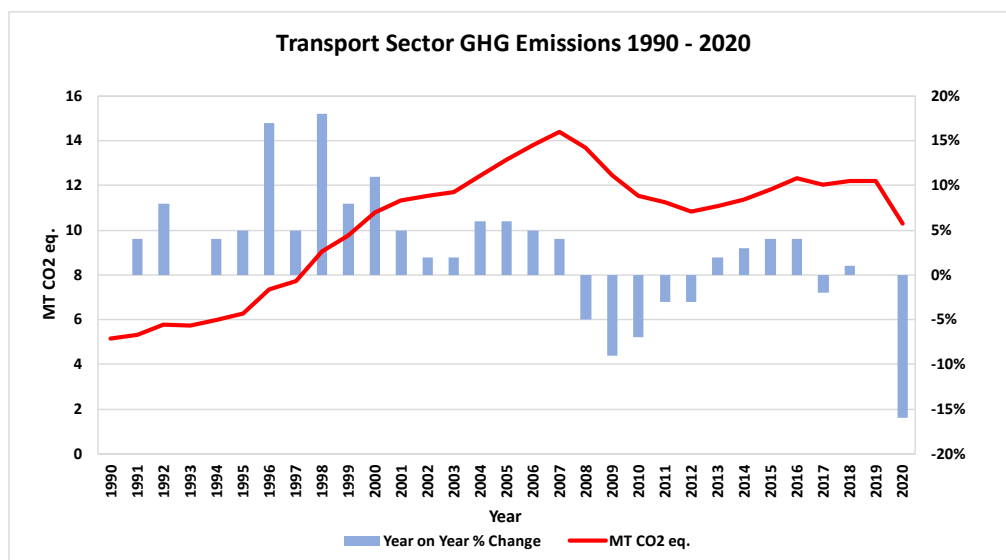
⁸ Environmental Protection Agency, 'Ireland's Provisional Greenhouse Gas Emissions 1990-2020', October 2021, https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Irelands-Provisional-Greenhouse-Gas-Emissions-report-1990-2020_finalv2.pdf

⁹ Environmental Protection Agency, 'Ireland's Provisional Greenhouse Gas Emissions 1990-2020', October 2021, https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Irelands-Provisional-Greenhouse-Gas-Emissions-report-1990-2020_finalv2.pdf p.10

¹⁰ Sustainable Energy Authority of Ireland, 'Energy in Ireland 2021 Report', <https://www.seai.ie/data-and-insights/seai-statistics/key-publications/energy-in-ireland/>

Since 1990 there has been a significant increase in both economic output and car ownership levels. Total vehicle kilometres for private cars rose by 17.5 % between 2011 and 2017 with a peak of 37,181 million kilometres in 2017. This had decreased to 35,453 million kilometres by 2019, and further to 26,102 million kilometres in 2020 (approx. 26%). Car ownership has increased from c. 800,000 vehicles on the road in 1990 to over 2.2 million in 2020.

Figure 1.5 Transport Sector GHG emissions 1990 – 2020 (Source: EPA, SEAI)



The road network in Ireland consists of approximately 99,000km of road. The National Roads Network, which caters for interurban travel, consists of some 5,332km (5.4%). Of this, less than 1,000km is motorway¹¹. The road network remains the dominant mode of internal transport.

Ireland has a higher road density compared to other EU Member States. European Commission data published in 2020 of the level of road density across EU Member States, measuring the number of road kilometres per 1,000 inhabitants in 2018, showed that Ireland's road density is high by European standards. With 20.5km per 1,000 inhabitants, this is likely a function of Ireland's low "lived density" and widely dispersed settlement pattern¹². In 2021 Ireland's road density remained high with 20.2km per 1,000 inhabitants.¹³

¹¹ Department of Transport, Project Ireland 2040, National Investment Framework for Transport in Ireland, 'Background Paper 11: Interurban Connectivity', <https://assets.gov.ie/129000/a70a2ea9-c50f-4d86-88c9-d916f3b45efc.pdf>

¹² Department of Transport, Transport Trends 2020, 'An Overview of Ireland's Transport Sector', February 2021, <https://igees.gov.ie/wp-content/uploads/2021/03/Transport-Trends-2020.pdf>

¹³ <https://www.gov.ie/en/publication/182bd-transport-trends-2021/>

The total number of licensed vehicles in Ireland has increased substantially, by 213% from 915,000 in 1985 to almost 2.9 million in 2020. Private cars accounted for most of this growth, with an increase of 1.5 million vehicles between 1985 and 2020¹⁴.

The number of new cars licensed for the first time in 2020 fell by 28,996 vehicles compared with 2019. The number of goods vehicles has increased by 305% from 93,400 in 1985 to 378,000 in 2020¹⁵.

In terms of fleet composition, 77% of total licenced vehicles in 2020 were private cars and 13.2% were goods vehicles, with the remainder including Small Public Service Vehicles, tractors, buses, motorcycles and vintage vehicles¹⁶. The latest Eurostat data (2019) suggests that the level of private car ownership in Ireland is lower than in many other European states. The estimated level of 458 private cars per 1000 inhabitants ranks Ireland below 22 other EU member states for which data is available. Ireland is the EU Member State with the highest share of passenger cars younger than 2 years old (% of total passenger cars) at close to 29%¹⁷.

Road traffic volumes have been impacted by COVID-19 restrictions. In 2020 total kilometres driven by Irish licensed vehicles fell to just over 36 billion kilometres compared with just over 47 billion kilometres in 2019. Irish licensed vehicles travelled, on average, 12,723 kilometres, a decrease of 25% compared with 2019¹⁸.

Private cars accounted for 72% of the total distance travelled in 2020 with goods vehicles accounting for 20%. On average, each private car travelled 11,803 kilometres in 2020, a decrease of 28% compared with 2019¹⁹.

Goods vehicle kilometre trends show growth from 4.7 billion kilometres in 2000 to a peak of 8 billion kilometres in 2008, followed by a decline to 7.8 billion kilometres in 2016. Goods vehicle demand was impacted strongly by Ireland's economic downturn. In 2019 goods vehicle kilometres reached the highest levels recorded over the last 15 years at 8.0 billion km, an increase of 1.7% compared to 2018, followed by a decline to 7.3 billion kilometres in 2020²⁰.

¹⁴ Central Statistics Office, 'Transport Omnibus 2020', <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/vehiclelicensingandregistrations/>

¹⁵ Central Statistics Office, 'Transport Omnibus 2020', <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/vehiclelicensingandregistrations/>

¹⁶ Central Statistics Office, 'Transport Omnibus 2020', <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/vehiclelicensingandregistrations/>

¹⁷ Central Statistics Office, Transport Omnibus 2020, 'Vehicle Licensing and Registration', <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/vehiclelicensingandregistrations/>
<https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210922-1>

¹⁸ Central Statistics Office, Transport Omnibus 2020, 'Road Traffic Volumes' <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/roadtrafficvolumes/>

¹⁹ Central Statistics Office, Transport Omnibus 2020, 'Road Traffic Volumes' <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/roadtrafficvolumes/>

²⁰ Transport Trends 2020, 'An Overview of Ireland's Transport Sector', <https://igees.gov.ie/wp-content/uploads/2021/03/Transport-Trends-2020.pdf>

In 2020 there were 137,617 goods vehicles (greater than 2 tonnes unladen weight) operating in Ireland and abroad in 2020; this represented an increase of 7.2% on 2019²¹.

Vehicles over 10 tonnes in weight accounted for 18% of the overall road freight fleet in 2020 but carried the majority of road freight activity, accounting for 56% of all laden journeys, 86% of tonnes carried and 89% of tonne-kilometres²².

Road freight activity (measured by total road freight tonne kilometres) increased from 12.3 billion tonne-km in 2000 to 18.7 billion in 2007 and then decreased to 9.7 billion in 2015, reaching 11.5 billion tonne-km by 2016 and 11.4 billion tonnes by 2020. However, the 2020 level was a decrease of just over 8% compared with the 2019 levels of 12.4 billion tonne-kilometres which was the highest seen since 2008. The 2020 level is close to the 2009 level of 12.0 billion tonne-kilometres but considerably below the 2007 peak.

Rail freight quantities are comparatively small and have declined significantly over recent decades from 3.4 million tonnes in 1985, to 516,000 tonnes in 2018, with a large drop of 33% compared to 2018 by 2019 to 346,000 tonnes (due to the movement of mineral ore declining significantly in 2019). However, this increased to 449,000 tonnes of freight in 2020, a 30% increase on 2019²³. Trends for total rail freight are reflected in this rise and fall of mineral ore freight traffic²⁴.

The total number of passengers travelling on public transport services grow each year between 2013 and 2019. In 2019, a total of 227.7 million passengers were carried on scheduled bus services, 48.3 million passengers travelled on the Luas and 50.1 million passengers travelled by rail. However, the pandemic had a dramatic impact on the number of people availing of public transport services. Following the onset of the pandemic, strict guidelines were put in place such as restrictions on the movement of people, capacity restrictions on all modes of public transport and the mandatory wearing of face masks.

Between the start and end of March 2020, total passenger journeys per week on Bus and Rail services reduced by 3.4 million or 88% (CSO, 2022), with rail passenger numbers falling to below 5% of pre-COVID levels during that period. Despite passenger numbers showing a slight recovery towards the end of 2020 as restrictions were eased, total fare revenue reduced by over 50% during the course of 2020 (National Transport Authority, 2021).

²¹ Central Statistics Office, Road Freight Transport Survey, Quarter 4 and Year 2020, October 2021, <https://www.cso.ie/en/releasesandpublications/er/rfts/roadfreighttransportsurveyquarter4andyear2020/>

²² Central Statistics Office, Road Freight Transport Survey, Quarter 4 and Year 2020, October 2021, <https://www.cso.ie/en/releasesandpublications/er/rfts/roadfreighttransportsurveyquarter4andyear2020/>

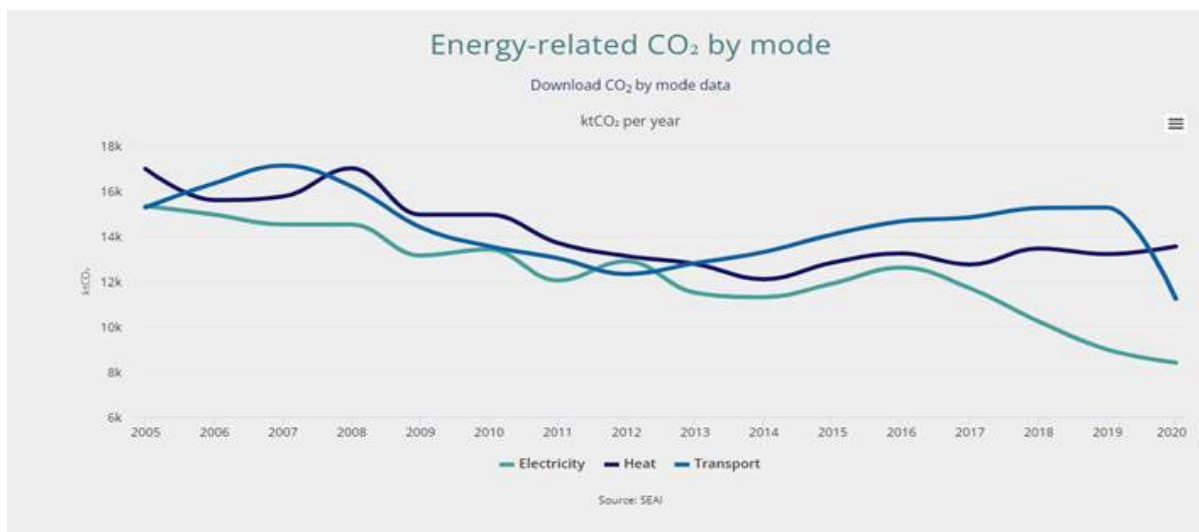
²³ Central Statistics Office, Transport Omnibus 2020, 'Public Transport', <https://www.cso.ie/en/releasesandpublications/ep/p-tranom/transportomnibus2020/publictransport/>

²⁴ Department of Transport, Transport Trends 2020, An Overview of Ireland's Transport Sector, <https://igees.gov.ie/wp-content/uploads/2021/03/Transport-Trends-2020.pdf>

According to the CSO's 2019 National Travel Survey, one in five (19.5%) of persons aged 18 years and over use bus services frequently, with one in sixteen (6.3%) taking the bus at least 5 times a week. Use of rail services (including mainline rail, DART and Luas) is less frequent, with just 7.2% using rail services a number of times a week. Just 2.2% of respondents travelled by rail at least 5 times a week.

GHG emissions from public passenger (bus, coach and taxi journeys) and the rail sector accounts for approximately 3% and 1% respectively of transport sector emissions²⁵.

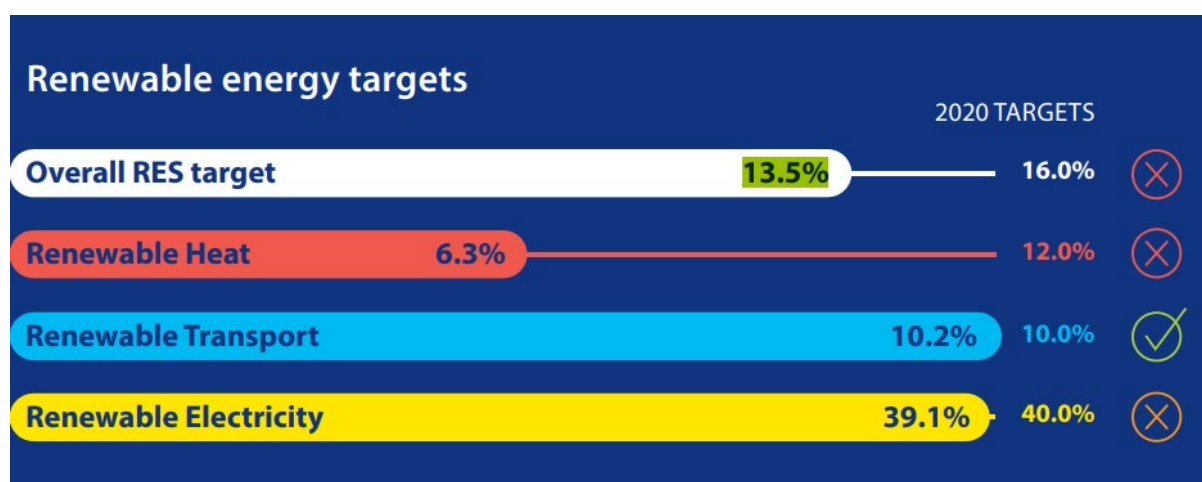
Figure 2.6 Energy by Transport Heat and Electricity since 2005



Energy used for heat increased by 3.2% in 2020 and CO₂ emissions from heating increased by 2.6% or 0.4 million tonnes. The overall share of renewable energy in 2020 was 13.5%, short of the 16% target. The lack of overall progress was primarily attributable to performance in renewable energy for heating. Ireland set a national target of 12% RES-H by 2020 to help deliver the overall mandatory target of 16% renewable energy but fell short of achieving this target, reaching just 6.3% RES-H (2020).

²⁵ Sustainable Energy Authority of Ireland, Energy in Ireland 2021 Report, https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

Figure 2.7 Progress on renewable energy targets



2.8 Industrial Profile

The industry sector in Ireland is a significant energy user, accounting for 19% or 2,171 ktoe of Ireland's primary energy demand in 2020. However, it should be noted that lower energy intensity industries, including the food, chemical, pharmaceutical, and electronic sectors account for over 80% of Ireland's industry output²⁶. Over the period 2005-2020, industrial energy consumption fell by 12.7%, while value added output from industry increased by 134%, resulting in a reduction in intensity of 63%. Fuel switching is among the drivers of these changes, with natural gas use increasing by 100% and the use of coal and oil decreasing by 64% over the period.²⁷

The 2021 report 'Energy in Ireland 2005-2020' outlines recent developments in energy use in the industrial and commercial sectors.

2.8.1 Key Trends

Final energy use in industry fell by 3.5% to 2.2 Mtoe while the economic activity of industry increased by 20% in terms of GDP. In 2020 consumption of natural gas decreased by 1.8% to 937 ktoe, and accounted for 43% of industry's final energy demand, and non-renewable wastes which fell by 5.2% to 42 ktoe. Electricity consumption in industry decreased by 6.5%, to 558 ktoe, and accounted for 26% of final energy consumption in industry. Renewable energy use in industry fell by 1.4% to 187 ktoe in 2020 and accounted for 26% of energy

²⁶ Central Statistics Office, Irish Industrial Production by Sector 2021, <https://www.cso.ie/en/releasesandpublications/ep/p-iips/irishindustrialproductionbysector2021/>

²⁷ Sustainable Energy Authority of Ireland, Energy in Ireland 2021 Report, https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf

consumption in industry. Oil use fell by 4.0% and accounted for 16.5% of industry's energy use at 359 ktoe. Coal use fell by 3.9% and accounted for just 3.5% of the energy share of industry. Non-renewable wastes decreased by 5.4% of industrial energy use in 2020 and accounts for 2.5% of energy use in industry.

2.8.2 Trends 2005 – 2020

Final energy use in industry was 12.7% lower in 2020 than in 2005. Between 2005 and 2012, there was an 30% fall in industrial final energy use. Between 2012 and 2020 energy use in industry increased by 25%. In 2020, it decreased by 3.5% and was 12.7% below 2005 levels. Over the period 2005 to 2020 natural gas, wastes and renewables have all increased their shares of industrial energy use, while the shares of oil and coal have decreased. Annual emissions from energy used for heating have been on an increasing trend since 2014, when Ireland emerged from the effects of the 2008 economic recession.

2.9 Waste

2.9.1 National Waste Management and Greenhouse Gas

In terms of waste management, one of the largest contributor to methane emissions in Ireland is the landfilling of Municipal Solid Waste (MSW). Municipal Solid Waste consists of three main elements - household, commercial (including non-process industrial waste), and street cleansing waste (e.g. street sweepings, street bins and municipal parks and cemeteries maintenance waste). The biodegradable element of MSW (Biodegradable Municipal Waste - BMW) primarily responsible for methane emissions consists of organic materials such as food and kitchen waste from households, caterers, restaurants and retail premises, as well as biodegradable garden and park waste.

Methane may, if not properly managed, be emitted from landfill sites as fugitive emissions, a process affected by the local weather conditions (humidity and climate). A simple model may divide the landfill process into three steps:

- a. During the initial active phase, the degradable portion of the landfilled waste undergoes both aerobic and anaerobic degradation; as the landfill is not sealed during this phase both methane and biogenic CO₂ are emitted;
- b. Once the landfill has been sealed, the 'methanogenic' phase takes place and the landfill gas contains greater quantities of methane than in the first phase;

- c. Finally, as different types of carbon degrade at different rates (sugars and fat degrade relatively quickly, while cellulose degrades more slowly) and there is very little degradation of lignin products (contained in wood) in landfill, these materials may not degrade appreciably even over much longer time periods.

National and regional waste policy are all predicated on the management of waste in line with the waste hierarchy, whereby the prevention, preparation for re-use, recycling and other recovery of waste are preferred (in that order) to the disposal of waste (in Ireland disposal means the landfilling of waste). In effect, national waste policy seeks to:

- i. Limit the overall amount of MSW going to landfill (which in turn reduces BMW to landfill); and,
- ii. Reduce the share of biodegradable material which is present in the MSW which does go to landfill (and divert BMW to more sustainable treatment such as anaerobic digestion and composting).

There are a number of reasons for seeking to reduce landfill as much as possible, including:

- i. Its impact on the environment from emissions of leachate (polluting water tables) and methane gas (GHG); and
- ii. The lost economic opportunity of burying material in the ground as opposed to reusing / recycling or recovering energy from it.

Methane emissions from Waste in Ireland reduced as a percentage share of total methane emissions over the period 2014-2019, largely as a result of the reduction in the volume of waste going to landfill. According to the EPA report- 'Ireland's Environment- An Integrated Assessment 2020' the waste sector in 2019 accounted for 1.5% of total national GHG Emissions, down from 2.1% in 2014.²⁸

2.9.2 Trends in Municipal Solid Waste to Landfill

The implementation of national and regional waste management policy has meant that the landfill of MSW has decreased from 92% in 1995 to 15% in 2019. This also reflects the increase in recycling and recovery of MSW from 8% in 1995 to 37% in 2019.²⁹

Diversion of municipal waste from landfill has been increasing for the following reasons:

- Increases in the landfill levy for disposal of waste to landfill.
- Requirements to divert BMW from disposal to landfill under the landfill Directive targets.

²⁸ EPA, Ireland's Environment - An Integrated Assessment 2020, pg.44

²⁹ EPA National Waste Statistics Summary Report 2019

- Capacity for incineration of municipal waste at Ireland's municipal waste incinerators.
- Increasing mechanical treatment of residual waste at waste facilities, leading to the production of refuse derived fuel/solid recovered fuel which is used as a fuel both in Ireland and abroad. Organic fines arising from the mechanical treatment of residual waste can be bio-stabilised and are generally recovered via backfill at landfill.

Since 2017, Ireland has two operational MSW Waste to Energy facilities with total licensed capacity of 835,000 tonnes of MSW per annum.

In addition to waste incinerated in these Waste to Energy facilities, Solid Recovered Fuel (SRF) derived from waste is co-incinerated in cement kilns in Ireland as part of the cement production process. The amount of SRF co-incinerated has remained relatively stable over recent years, in the range of 200,000 to 250,000 tonnes per year, although recent planning and licencing decisions may afford an increase in this figure. The 2021 estimate for SRF incinerated in cement plants in Ireland is 237,000 tonnes. This process not only recovers energy from MSW, but also decreases our reliance on importing fossil fuels.

The number of landfills accepting MSW has decreased from twenty-five in 2010 to three in 2022.

2.9.3 Trends in Biodegradable Municipal Waste to Landfill

The Landfill Directive, (1999/31/EC), sets limits on the quantity of BMW that can be disposed to landfill. The limits (tied to 1995 statistical base year) are phased, with each phase having a stricter diversion obligation. In the reference year of 1995, Ireland produced 1,220,840 tonnes of BWM. The landfill directive target for Ireland for 2020 was 35% of this, or 427,294 tonnes. In 2020, Ireland deposited 104,255 tonnes of BMW to landfill, significantly down on the 390,000 tonnes deposited in 2016 and reported in the 7th National Communication, and within not only the 2020 target but also within the 2035 target of 10% of the 1995 figure, or 122,084 tonnes.³⁰

2.10 Building Stock and Urban Structure

Preliminary data from the 2022 Census of Population indicates that there are approximately 1.8 million occupied dwellings in Ireland, an increase of 9% since the previous 2016 Census

³⁰ EPA, Biodegradable municipal waste to landfill, EPA waste data release, 31 March 2022

³¹. While more detailed information from the 2022 Census is not yet available, it is likely to indicate a minimum of 19% of Irish households living in private rented accommodation³².

The greatest challenge in the built environment in Ireland is the decarbonisation of buildings that were constructed prior to 2006. Improvements to the Building Regulations between 2005 and 2019 have resulted in a decrease in GHG emissions from the sector: the sector's share of GHG emissions has decreased in that period despite ongoing construction activity. New dwellings constructed after 2019 must have a Building Energy Rating (BER) of A2 or better. Buildings with this high level of performance are called Nearly Zero Energy Buildings (NZEB). The NZEB standard results in buildings that are 70% more energy efficient, and emit 70% less CO₂ than those built prior to 2006.

In 2020, the single largest energy source satisfying residential sector demand was oil (44% of weather corrected energy demand), followed by electricity (24%) and then natural gas (18%). Demand for all fossil fuel types has fallen in the residential sector over the last 15 years – coal (-23%), peat (-33%), oil (-9%) and natural gas (-6%). Direct consumption of renewable energy in the residential sector has more than tripled over the last 15 years, but still accounts for a small energy share (3%). Indirect consumption of renewable energy is more significant, and has increased more rapidly, through the decarbonisation of electricity supply, and the observed 16% increase in demand for this greener electricity supply by the residential sector over the last 15 years. The emissions of energy-related CO₂ emissions fell by 25.3% over the period 2005–2020.

There are an estimated 124,000 buildings in the commercial and public sector in Ireland, with the largest numbers being offices and retail outlets. The building stock in Ireland includes approximately 15,000 public sector buildings and approximately 109,000 commercial buildings. It is estimated that 29% of commercial buildings in Ireland also incorporate a level of residential use, with the remaining 71% being exclusively commercial.

In 2020, electricity remains the principal energy source for the commercial and public sector, currently accounting for 60% of energy demand, and increasing by 49% over the last 15 years. Approximately 40% of electricity is renewable, so this represents a very significant vector for indirect use of renewable energy by the sector. After electricity, natural gas (23%) and oil (15%) are significant energy sources for the commercial and public sector. No coal or peat was used in the sector in 2020. The renewables share of final energy used directly in

³¹ Central Statistics Office, Census of Population 2022 - Preliminary Results, <https://www.cso.ie/en/releasesandpublications/ep/p-cpr/censusofpopulation2022-preliminaryresults/>

³² A more up to date assessment of the residential housing stock should be available in 2023 following the compilation of data gathered through the 2022 Census which took place in April 2022.

commercial and public sector in 2020 was 2%. The emissions of energy-related CO₂ emissions fell by 23.8% over the period 2005–2020.

2.11 Land Use

2.11.1 Agriculture

i. Agriculture Profile

The agri-food sector is Ireland's oldest and largest indigenous exporting sector. In 2020, the sector accounted for 6.3% of Gross National Income (GNI) and 9% of exports in value terms. The sector accounts for 38% of total indigenous exports and over 60% of indigenous manufactured exports. It is estimated that the agri-food sector, which is classified as primary production (agriculture, fishing and forestry) along with food and beverages and the wood processing sector, accounted for almost 4% of Gross Value Added at factor cost in 2020, growing from €9.96 billion in 2010 to €13.03 billion in 2020.

The sector employed 170,400 people or 7.1% of total employment in 2021; it is of particular importance outside of Dublin and the mid-east region, where the sector provides between 10% to 14% of employment. Some 135,000 farms producing almost €9.5 billion in output in 2021; over 770,000 hectares of forest; and over 2,000 fishing vessels and aquaculture sites producing fish with a value of €700 million, underpin the sector. Beyond direct employment, the sector plays a key role in the wider rural and local economy, with estimates for output multipliers ranging from around 2.5 for beef, 2.0 for dairy and food processing and 1.75 for seafood. This compares with an average output multiplier of 1.4 for the rest of the economy and 1.2 for foreign owned firms. The food and drink sector accounted for 38% of all exports of Irish-owned firms in 2019.

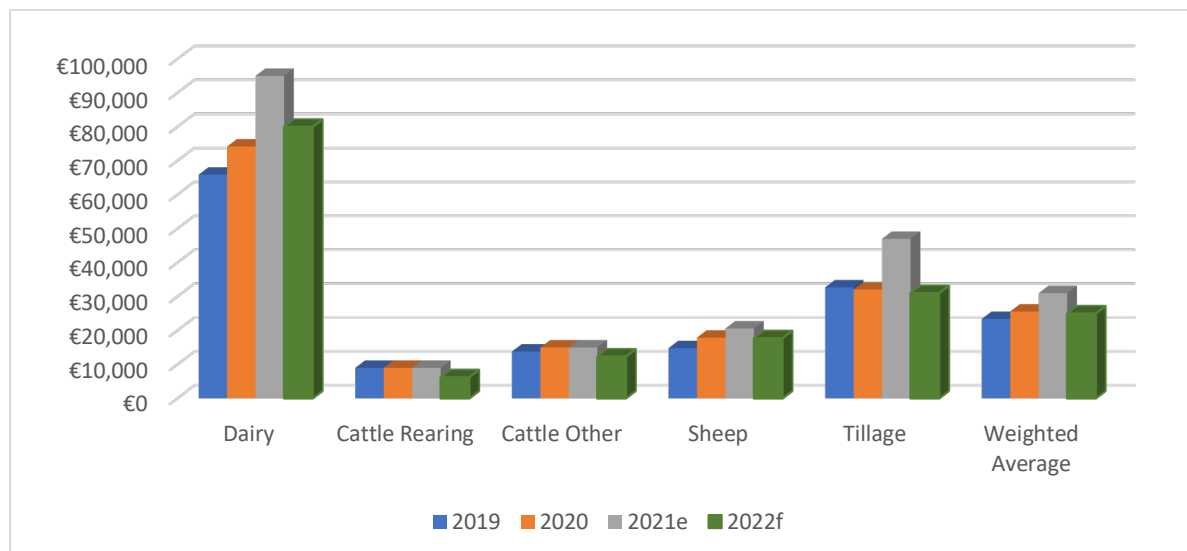
In 2018 there were 1,352 domestically owned food and drink corporations employing 32,070 people. 53 foreign owned corporations employed a further 20,521 and these, along with 2,488 self-employed people in the sector, give a total of 52,591 working in this sector. Irish-owned enterprises paid out €1.25 billion in total wages, compared to €1.07 billion by foreign-owned enterprises. While foreign-owned enterprises employ 39% of those working in the sector and pay 46% of the wages, they generate 76% of the gross value added in the sector. The impact of the food and drink sector is dispersed throughout the country and a strong driver of regional development accounting for 7.1% of total employment.

The agri-food sector is globally orientated, exporting almost 90% of the food produced. In 2021 Irish food and drink was exported to over 180 markets worldwide. Exports of agri-food products in 2021 were €15.4 billion, a 73% increase from €8.9 billion in 2010. In 2021 agri-food exports represented 9.3% of merchandising exports.

The sector produces food and ingredients with a global reputation for quality and safety, with a livestock sector built on an enviable grass-based production system. Global demand for high quality food is increasing with population, urbanisation and affluence, and the Irish agri-food sector is well placed to play a role in meeting this demand.

Average Family Farm Income increased during 2020 and again in 2021 for the third year in a row. In 2021 the performance of dairy farms had an average Family Farm Income estimated to have increased by 28% to around €95,000. Although Family Farm Income on cattle farms was unchanged, this is an improved performance as they were without the exceptional aid supports provided in previous years in light of market disturbance arising from Brexit uncertainty and COVID-19. Sheep farmers saw a very good rise in Family Farm Income, up by 15% to €20,600. Tillage farms also saw significant gains, up by 46% to €47,000. Average Family Farm Income is estimated to be up by 20% to €31,000, reflecting strong output prices currently and throughout 2021.

Figure 2.8: Family Farm Income 2019, 2020 with an estimate for 2021 and a forecast for 2022



Farm Type

According to the CSO preliminary results from the 2020 agricultural Census, Specialist Beef Production was the most common farm type and accounted for over half of all farms in 2020 (74,159 out of 135,037 farms). Specialist Sheep and Specialist Dairying were the next most common farm types with 17,435 and 15,319 farms respectively in 2020.

Table 2.4 Share of emissions by agricultural/land use activity type in 2020

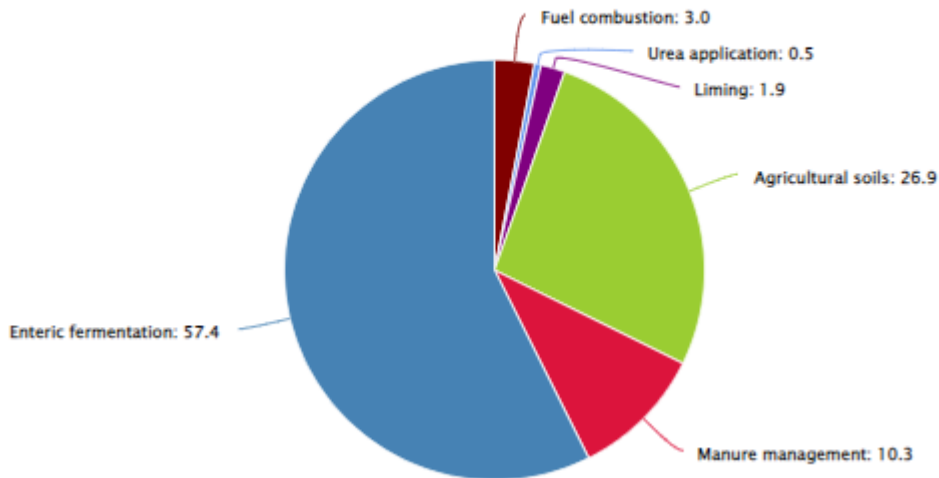
Type of Activity	Description and associated emissions	Share of Emissions (2020)
Enteric Fermentation	Fermentation that takes place in the digestive systems of ruminant animals such as cattle and sheep resulting in direct emissions of the GHG methane.	57.40%
Agricultural Soils	Activities that lead to the direct and indirect emissions of nitrous oxide related to agricultural production, including application of synthetic fertilisers, animal wastes and other organic fertilisers, biological nitrogen fixation by crops, cultivation of organic soils, and mineralisation of crop residues.	26.90%
Manure Management	Methane and nitrous oxide GHG are produced during the management, storage and spreading of animal manure. Emissions from manure management vary significantly between the types of management system used.	10.28%
Fuel combustion (Agriculture / Forestry / Fishing)	Emissions of CO ₂ from fuel combustion in agriculture and forestry sectors.	3.05%
Liming	Soil pH plays a key role in soil fertility. The application of limestone to correct soil acidity results in emissions of CO ₂	1.87%
Urea application	The addition of urea-containing fertilisers to soils results in emissions of CO ₂ that was fixed during the industrial production process.	0.51%

The most significant drivers for the increased emissions in 2020 were increased fertiliser use (+3.3%) and liming (+16.2%). The size of the dairy herd continued to increase, for the tenth consecutive year (+3.2% in 2020), with a 3.8% increase in total national milk production. From 2015 to 2020, dairy cow numbers increased by 19.2% and milk production increased by 29.7%. This reflects the national plans to expand milk production under Food Wise 2025 and the removal of the milk quota in 2015.

Other cattle numbers increased in 2020 by 0.6% and sheep numbers increased by 4.7%. Total fossil fuel combustion emissions from agriculture/forestry/fishing activities decreased by 2.6%. In the last six years (2015-2020) the numbers of other cattle have increased by 1.5%, while there have been increases in the numbers of sheep (+8.6%), pigs (+9.9%) and poultry (+13.3%).

Figure 2.9 Agriculture GHG emissions share by source 2020

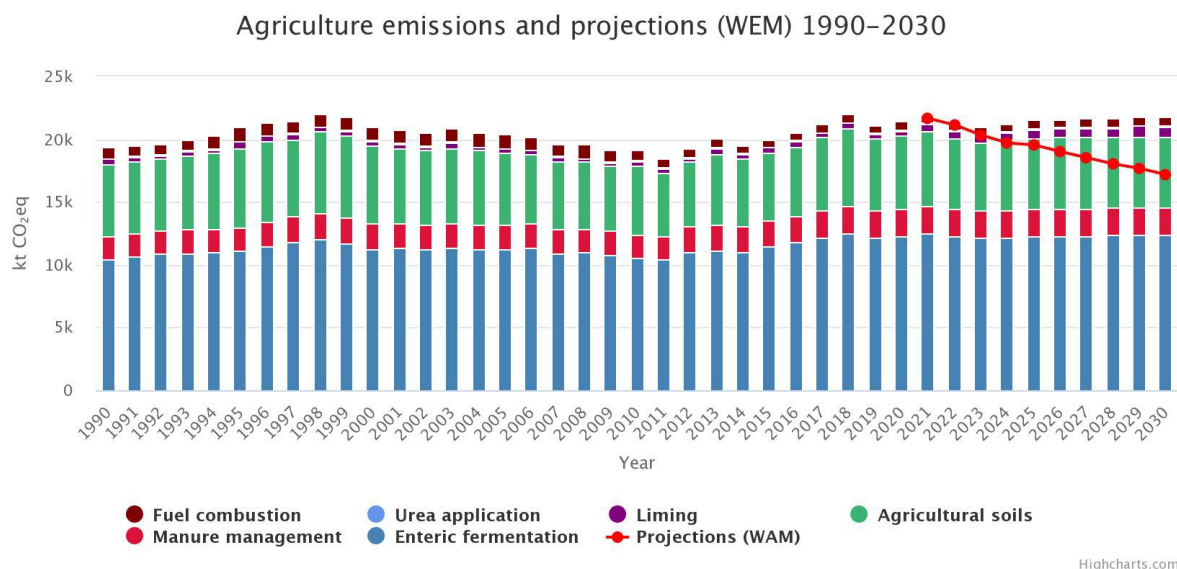
Agriculture GHG emissions share by source 2020



Total emissions from agriculture are projected to increase by 1.8% over the period 2020-2030 to 21.8 Mt CO₂ eq under the WEM scenario.

Under the WAM scenario emissions are projected to decrease to approximately 17.2 Mt CO₂ eq by 2030 which is a 19.8% reduction over the period of 2020 to 2030. This scenario assumes a total of 16.5 Mt CO₂ eq of mitigation over the period 2021-2030 with the implementation of Ireland's Climate Action Plan, including those measures in the Teagasc Marginal Abatement Cost Curve.

Figure 2.10: Agriculture emissions and projections (WEM) 1990-2030

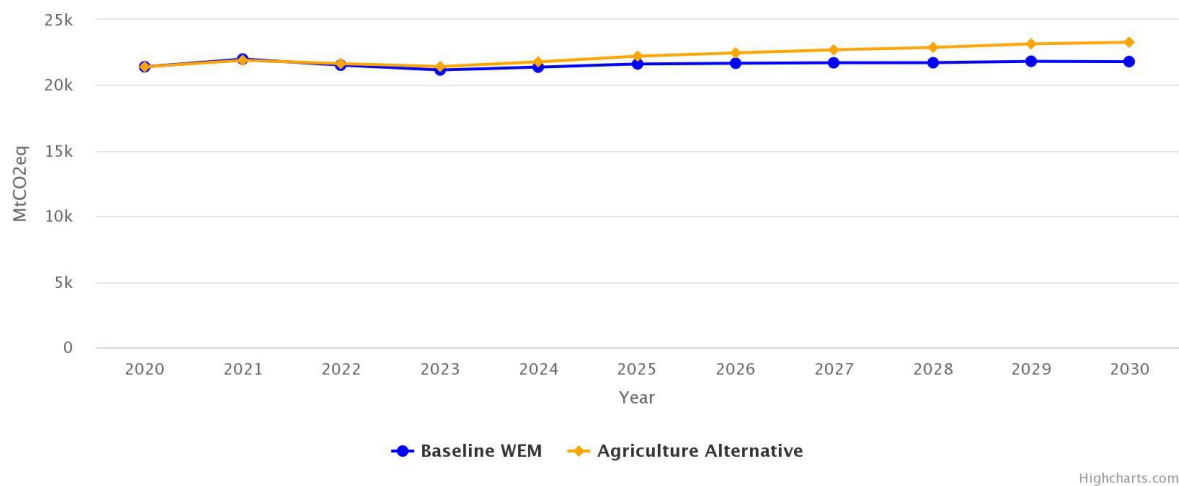


A sensitivity analysis of the WEM emissions scenario has been undertaken for the agriculture emissions projections based on alternative projected activity data scenarios provided by Teagasc. One alternative scenario is presented which looks at stronger growth in agricultural activity levels.

The resulting emissions are presented below alongside the WEM scenario, showing that stronger growth would likely lead to higher emissions over the projected period.

Figure 2.11: Sensitivity assessment of the agriculture sector under the WEM scenario to 2030

Sensitivity assessment of the Agriculture sector under the With Existing Measures (WEM) scenario to 2030



2.11.2 Forestry

Since the 1920s, when forest cover in Ireland had fallen to 1%, a series of national afforestation programmes resulted in an increase in forests to 11% of the land area of the country (or 770,020 hectares) by 2017, according to the latest available national forest inventory data. In particular, the period from 1990 to present has seen a significant expansion of forest cover through the introduction of annual payments to landowners, for a limited period, to compensate for lost agricultural income. Between 2016 and 2021, an average of 4,010 hectares has been planted per annum. Despite these efforts, forest cover is still quite low when compared with other EU Member States, where the average was 38% in 2020. Conifer species are the dominant species present, representing 71.2% of the stocked forest area while broadleaved species accounted for 28.7% of the area. The afforestation

programme has also resulted in a significant change to the ownership structure of Irish forests; approximately 50% of the national estate is now privately owned.

The acceleration of the afforestation programme over the last quarter of a century, coupled with high levels of reforestation, has resulted in just under three quarters of the national estate being less than 30 years old. Roundwood harvest has been steadily increasing over the past decade as the private estate has matured. In 2020 it reached 3.912 million cubic metres and was primarily used as feedstock for sawn wood and panel products, and fuelwood. The majority of the sawn wood and panel-board output is exported; Ireland is now a net exporter of both product categories. Usage of wood fuels is also increasing due to renewable energy policies and an increase in the supply of forest-based biomass, particularly from timber processing and forest harvesting residues. In 2018, 40% of wood fibre available for use in Ireland was used for energy generation, mainly within the forest products sector. The usage of forest-based biomass for the energy sector is estimated to have resulted in over 0.88 million tonnes of CO₂ emissions being abated in 2018.³³

The Roundwood Forecast 2021-2040 predicts that the annual potential roundwood supply, will increase from 4.9 million in 2021 to 7.9 million cubic metres by 2035, followed by a small decrease to remain constant at circa 7.6 million cubic metres up to 2040³⁴. Use of this expanded harvest in long-lived wood products and as a renewable fuel will extend the contribution of the forest sector to climate change mitigation. Sustaining harvest levels and climate change mitigation will require the continued expansion of forest cover to mid-century and possibly beyond.

There is a close liaison between the Forest Service and environmental and planning agencies in the regulation of afforestation and other forestry practices. Ireland operates a licencing system for wood harvesting. Afforestation must be approved by the Forest Service of DAFM. A forest report entitled 'Forests and wood products, and their importance in climate change mitigation' was published in 2022, which continues to emphasise the climate change mitigation benefits of the forest sector, through both afforestation and the sustainable use of harvested wood products.

i. Climate change mitigation and the forest sector

As part of the European Green Deal, the EU has set itself a binding target of achieving climate neutrality by 2050. In order to deliver this increased level of ambition, an

³³ Department of Agriculture, Food and the Marine, Forest Statistics - Ireland 2022, Forest Statistics and Mapping, <https://www.gov.ie/en/collection/15b56-forest-statistics-and-mapping/#annual-forest-sector-statistics>

³⁴ Coford, All Ireland Roundwood Production Forecast 2021-2040 <http://www.coford.ie/media/coford/content/CofordAllIrelandRoundwoodBookREVISED150721.pdf>

intermediate target of 55% net emission reduction by 2030 is planned. The European Commission has launched its 'Fit for 55%' measures which includes proposals for the Land Use, Land Use Change and Forestry (LULUCF) sector that sets targets for carbon removals by natural sinks.

Forests will play an important role in meeting these EU emissions reductions targets during the 2021 to 2030 period. In 2021, the European Commission proposed amendments to the LULUCF Regulation 2018/841. These EU Proposals will maintain the current accounting rules for the period 2021 to 2025. After 2025, the proposals envisage alterations to both the accounting rules and Member States obligations in terms of achieving net LULUCF removals. Compliance with EU targets will be verified based on reported GHG emissions and removals. For the period 2026-2030, binding annual targets of net GHG removals will be set for each Member State. A new target for Ireland is proposed that reported land use emissions reduce to 3.7 Mt CO₂ eq by 2030. Ensuring this figure is attained will require the sustainable management of existing forest lands and the protection of Irish forests, limiting deforestation and continued afforestation efforts. Based on the most recent National Inventory Report (NIR) to the UNFCCC, forests in Ireland sequestered over 4.4 Mt of CO₂ in 2019 with a further 0.6 Mt of CO₂ being added to the carbon pool of harvested wood products. The afforestation programme plays an important role in mitigating climate change by creating new land-based sinks for CO₂ and providing a source of renewable raw materials for use as fuel and wood products. However, the potential contribution of afforestation towards meeting short term targets (2021-2030) is quite small because of the initial slow growth of forests and initial emissions from organic and organo-mineral soils.

2.11.3 Peatlands

Peat soils (including grasslands on peat soils) cover around 21%, or 1.47 million hectares, of Ireland's land area and are either privately or publicly owned. Peatlands include bogs, wet heath and fens and are managed for various extents including forestry, agriculture, renewable energy and nature conservation. Research is ongoing to fully assess the potential for carbon storage and emissions reductions that may be achieved through management, restoration and rehabilitation of Ireland's peatlands.

GHG emissions and sinks associated with human intervention of peatlands are reported to the UNFCCC under three IPCC land use categories: Wetlands, Forest land and Grassland, and identified through analysis of land cover and the specific land declared by land managers.

Peatland under forest and grass are assumed to be subject to artificial drainage and carbon losses are estimated using IPCC default methodologies.

Peatlands within the Wetlands category are dominated by the area of degraded and pristine peatland ecosystems. These degraded peatlands have largely reverted to habitats which superficially resemble semi-intact peatland habitats but which are, in fact, significantly degraded in ecohydrological terms, a much reduced resilience and carbon sequestration potential. In recent decades traditional practices have been practically entirely replaced by mechanised methods of extraction.

Commercial industrial peat extraction occurred on approximately 80,000 kha of Irish land. The semi-state company, Bord na Móna dominated activity in this sector. Bord na Móna completed its acquisition of lands in the early 1980s, by which time it had largely concluded its operational drainage of lands intended for peat extraction. In early 2021 Bord na Móna announced the cessation of all commercial peat extraction on its lands and is currently developing a long-term strategy for environmentally sensitive management of its resources.

2.11.4 Land Use Review

Land, as natural capital, is an asset not just supporting nature and wildlife, but also underpins our economy through food and energy production and as a tourism and recreational resource. Our land is the vital platform to help us realise our many socioeconomic, climate and biodiversity ambitions. In our transition to a low-carbon and sustainable society, land and how we use it will play a key role.

The Climate Action Plan 2021 committed to a national land use review. The Land Use Review is to provide the framework and means to address these challenges, it is being carried out in two distinct phases. Phase 1 is an Evidential Review which aims to provide an evidence base to determine an appropriate land use indicator set for Ireland, as well as determining the environmental, ecological and socio-economic characteristics of land types across Ireland. It is currently in progress and being led by EPA. The EPA is due to submit its report in September 2022. Phase 2 will build on the evidence base of Phase 1 and will identify appropriate policies, measures and actions to be implemented in the context of the Government's wider economic, social and climate objectives.

It is anticipated that the land use review will allow knowledge transfer to policymakers, advisory services and landowners in making informed choices as to how best to use land now and into the future.

Chapter Three:

Greenhouse Gas Inventory

Information

3. Greenhouse Gas Inventory Information

3.1 Introduction

This Chapter outlines the process by which Ireland's emissions are measured and reported. It explains the rationale behind the methodologies used and gives detailed information on emissions and trends over the period 1990 to 2020.

The Environmental Protection Agency (EPA) has overall responsibility for the national greenhouse gas (GHG) inventory in Ireland's national system of recording emissions. This was established in 2007 under Article 5 of the Kyoto Protocol. The Office of Environmental Sustainability (OES) in the EPA performs the role of inventory agency in Ireland and undertakes all aspects of inventory preparation and management as well as the reporting of Ireland's submissions annually in accordance with the requirements of Regulation (EU) No. 525/2013⁴⁶ of the European Parliament and the Council, and the UNFCCC.

The national GHG inventory is compiled following the reporting guidelines⁴⁷ on annual inventories adopted by the UNFCCC which describes the scope and reporting of GHG emission inventories by Parties included in Annex I to the Convention. The inventory is compiled on an annual basis and submitted each January, to the European Commission in accordance with Regulation No.525/2013, and to the UNFCCC Secretariat by the 15th April deadline. The National Inventory Report 2022⁴⁸ (NIR) which contains the inventory data in the Common Reporting Format (CRF) along with full documentation of the assumptions underpinning the inventory has been submitted to the UNFCCC secretariat for the years 1990 to 2020.

The complete inventory currently comprises a time series from 1990 to 2020 for carbon dioxide (CO₂), methane (CH₄) nitrous oxide (N₂O) and for the fluorinated or F-gases (HFCs, PFCs, SF₆ and NF₃) – the year 1995 has been chosen as the base year for the fluorinated gases for obligations under the Kyoto Protocol. Summary tables showing emissions by gases and sector for the full time series are presented in **Annex 1.1 – 1.6**. The GHG inventory data outlined in this report was submitted to the UNFCCC on the 7th of September 2022.

⁴⁶ Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting GHG emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

⁴⁷ Decision 24/CP.19 Revision of UNFCCC reporting guidelines on annual inventories for Parties included in Annex I of the Convention (FCCC/CP/2013/10/Add.3) <http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2>

⁴⁸ EPA, Ireland's National Inventory Report 2022, <https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-national-inventory-submissions-2022.php>

3.1.1 Overview of National Emissions

In 2020, total emissions of GHG including indirect emissions from solvent use (without LULUCF) in Ireland were 58,032.3 kt CO₂ equivalent, which is 5.9% higher than emissions in 1990. The total for 2020 is 18.2% lower than the peak of 70,923.6 kt CO₂ equivalent in 2001 when emissions reached a maximum following a period of unprecedented economic growth. The Energy sector accounted for 57.1% of total emissions in 2020, Agriculture contributed 36.3%, a further 5.0% emanated from Industrial Processes and Product Use and 1.6% was due to Waste. Emissions of CO₂ accounted for 60.6% of the national total in 2020, with CH₄ and N₂O contributing 26.2% and 11.8%, respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ accounted for 1.4% of total emissions in 2020. Trends of GHG emissions by sector and gas are presented in Figures 3.1 and 3.2.

Total emissions of the seven GHG in Ireland (including indirect CO₂ emissions without land use, land use change and forestry) increased steadily from 54,823.2 kt CO₂ eq in 1990 to 70,923.6 kt CO₂ eq in 2001, which is the highest level of GHG emissions ever reported in Ireland. Emissions then plateaued until 2008 with estimates ranging from 68,791.7 kt CO₂ eq to 70,679.0 kt CO₂ eq. There was then a sharp decrease from 68,464.9 kt CO₂ eq in 2008 to 57,742.8 kt CO₂ eq in 2011. Emissions in 2020 at 58,032.3 kt CO₂ eq were 3.5% lower than 2019.

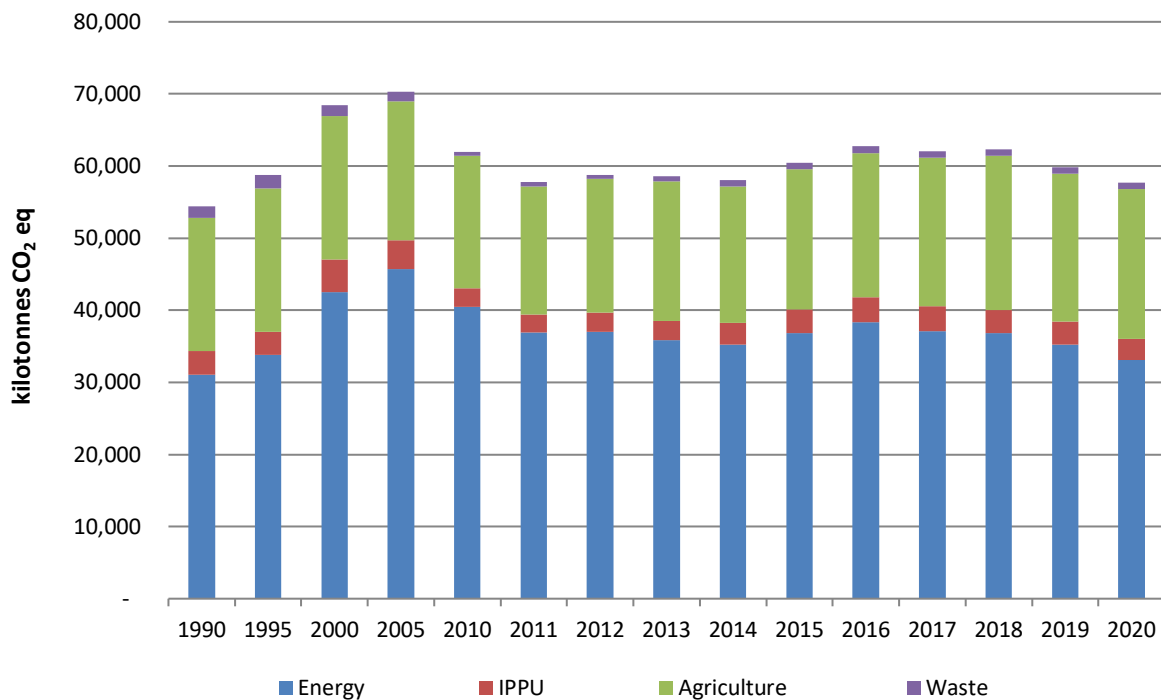
The largest annual change occurred from 2008 to 2009 when emissions decreased by 5,804.2 kt CO₂ eq from 68,464.9 kt CO₂ eq to 62,660.7 kt CO₂ eq, a reduction of 8.5%. Total emissions in 2020 were 5.9% higher than in 1990 and 18.2% lower than the peak level in 2001.

Ireland has a Quantified Emission Limitation or Reduction Commitment (2013–2020) (percentage of base year or period), or QELRC, of 80 as set out in the Doha amendment of Annex B to the Kyoto Protocol.⁴⁹ The QELRCs for the European Union and its Member States for a second commitment period are based on the understanding that these will be fulfilled jointly with the European Union and its Member States, in accordance with Article 4 of the Kyoto Protocol. The joint assigned amount for the European Union, its Member States and Iceland is calculated pursuant to the QELRC listed in the third column of the table contained in Annex B to the Kyoto Protocol, while the assigned amount of each Member State is determined in accordance with the terms of the joint fulfilment agreement. The assigned amount for Ireland is fixed based on Annex II to European Commission decision 2013/162/EU and as adjusted by Commission implementing decision 2013/634/EU.

⁴⁹ Doha amendment to the Kyoto Protocol (FCCC/KP/CMP/2012/13/Add.1) <http://unfccc.int/resource/docs/2012/cmp8/eng/13a01.pdf>

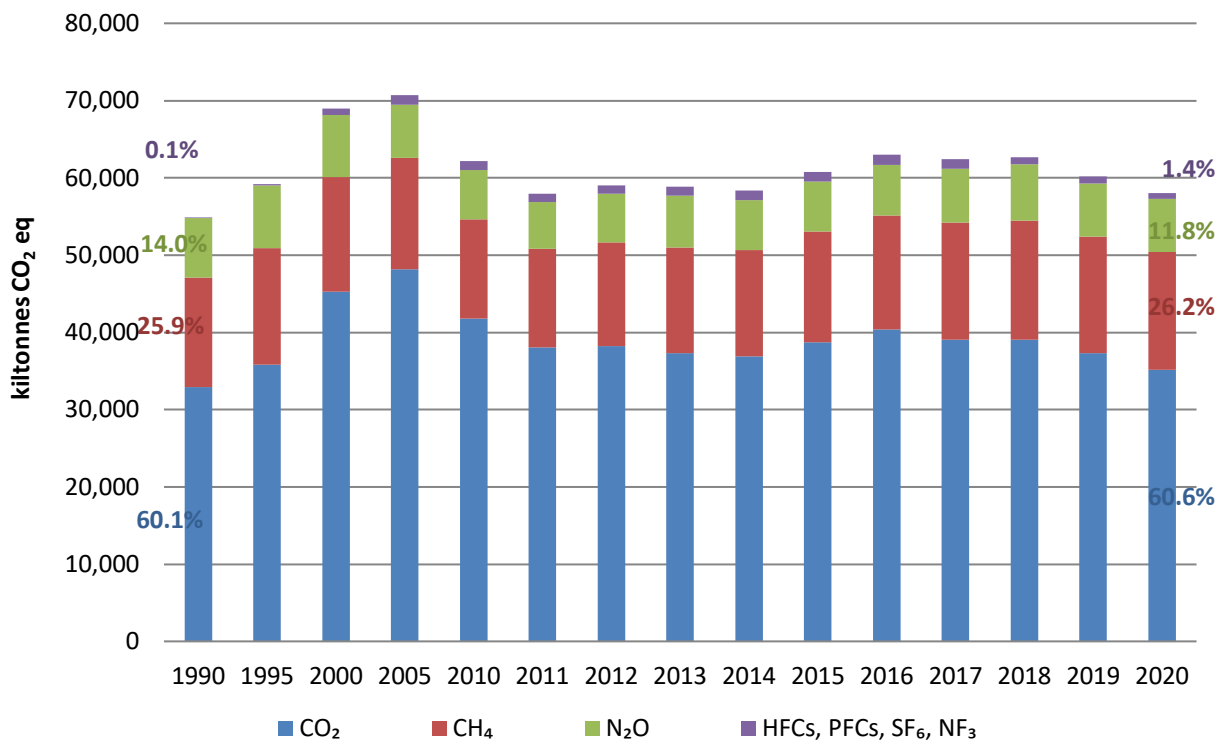
The assigned amount for Ireland for the 8-year second commitment period before including deforestation in the base year is 343,467,221 t CO₂ in accordance with the joint fulfilment agreement by the European Union, its Member States and Iceland. When the provisions of Article 3, paragraph 7 bis, are included, Ireland's assigned amount is 343,519,892 t CO₂; (Annual Emission Allocations 2013–2020, 343,467,221 kt CO₂ (as set under the EU agreement) + (8,229.962 kt CO₂ × 0.8 × 8)). These numbers were determined following the expert review of Ireland's report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol⁵⁰ based on Ireland's GHG inventory submission in 2016.

Figure 3.1 Trend in GHG emissions by Sector (excluding LULUCF) 1990-2020



⁵⁰ Report on the review of the report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol of Ireland (FCCC/IRR/2016/IRL) <http://unfccc.int/resource/docs/2017/irr/irl.pdf>

Figure 3.2 Trend in GHG emissions by Gas (excluding LULUCF) 1990-2020



3.2 National Inventory System

The EPA is required to establish and maintain databases of information on the environment and to disseminate such information to interested parties by the Environmental Protection Agency Act 1992. The Act states that the Agency must provide, of its own volition or upon request, information and advice to Ministers of the Government in the performance of their duties. This includes making available such data and materials as are necessary to comply with Ireland's reporting obligations and commitments within the framework of international agreements.

These requirements are the regulatory basis on which the EPA prepares annual inventories of GHG and other important emissions to air in Ireland. It is in this context that in 1995 the then Department of the Environment (now Department of Environment, Climate and Communications (DECC)) designated the EPA as the inventory agency with responsibility for the submission of emissions data to the UNFCCC Secretariat and to the Secretariat for the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

3.2.1 Inventory System – Institutional and Procedural arrangements

The establishment of Ireland's national inventory system was completed by Government Decision in early 2007, building on the framework that had been applied for many years. The EPA's OES is the designated inventory agency and the EPA is also designated as the single national entity with overall responsibility for the annual GHG inventory. Within the OES, the Climate Change Programme (CCP), compiles the national GHG emission inventories for submission on behalf of the DECC under the Framework Convention on Climate Change and Regulation (EU) 525/2013, the latter being the basis for EU Member States' reporting under the Convention and the Kyoto Protocol. All formal mechanisms together with the Quality Assurance/Quality Control procedures are fully operational since they were established in the 2007 reporting cycle.

Following the establishment of the national system, institutional arrangements directed towards national inventory reporting that involve the EPA, DECC and other stakeholders were reorganised, extended and legally consolidated across all participating institutions to strengthen inventory capacity within the EPA. This ensured that more formal and comprehensive mechanisms of data collection and processing were established and maintained for long term implementation. The system puts in place formal procedures for the planning, preparation and management of the national atmospheric inventory and identifies the roles and responsibilities of all the organisations involved in its compilation.

This was achieved through extensive discussions with all key data providers leading to the adoption of Memoranda of Understanding (MOU) between the key data providers and the inventory agency. These MOUs stipulate the scope, timing and quality of the inputs necessary for inventory compilation in accordance with the guidelines for national systems. Secondary MOUs are, in turn, used by some key data providers to formalise the receipt of data from their own particular sources. Table 3.1 lists the key data providers and indicates the range of data covered by MOUs in the national system. A QA/QC plan is an integral part of the national system and this plan is set out in **Annex A.2**.

Annex A.3 of this report provides a schematic overview of the institutions, procedures and information flows involved in the national system. In addition to the primary data received from the key data providers, the inventory team draws on various other data streams available within the EPA, such as the National Waste Database, reports on wastewater treatment, Annual Environmental Reports from companies subject to Integrated Pollution Prevention Control (IPPC), Industrial Emissions Directive 2010/75/EU (IED) and submissions prepared under the European Pollutant Release and Transfer Register (E-PRTR) as well as also obtaining information from other diverse sources to prepare the inventories for

fluorinated gases and solvent use. The inventory team also draws on national research related to GHG emissions and special studies undertaken from time to time to acquire the information needed to improve the estimates for particular categories and gases.

The Emissions Trading Unit (ETU), also within the EPA's OES, is a key component of the national system. The ETU are responsible for administering the European Union Emissions Trading System (ETS), under Directive 2003/87/EC, in Ireland and, as such, provide annual verified emissions data to the inventory team.

The estimates of emissions and removals for forest lands under the Convention, as well as those in respect of Article 3, paragraph 3, activities under the Kyoto Protocol, are prepared by consultants contracted to the Department of Agriculture, Food and the Marine (DAFM). These are delivered to the inventory agency under a Memorandum of Understanding between DAFM and OES.

The approval of the completed annual inventory involves sign off by the QA/QC manager and the inventory manager before it is brought to the Board of the EPA via the Programme Manager of the Climate Change Programme in OES. Any issues arising from the Board's examination of the estimates are communicated to the inventory experts for resolution before final adoption of the inventory. The results for the inventory year are normally released at national level in Autumn of the following year. This is in advance of their official submission to the European Commission in accordance with Regulation (EU) 525/2013 in January and March of the reporting year and subsequently to the UNFCCC secretariat in April⁵¹. The national system is also exploited for the purpose of parallel inventory preparation and reporting of air pollutants under the CLRTAP ensuring efficiency and consistency in the compilation of emission inventories for a wide range of substances using common datasets and inputs. The national system is also exploited for the purpose of parallel inventory preparation and reporting of air pollutants under the CLRTAP ensuring efficiency and consistency in the compilation of emission inventories for a wide range of substances using common datasets and inputs.

3.2.2 Inventory Planning

The inventory agency plans for preparation of the annual inventory as soon as possible after completion of the annual reporting cycle in April following submission to the UNFCCC Secretariat. Planning largely involves the identification of improvements to be undertaken by

⁵¹ Ireland's Final Greenhouse Gas Emissions 1990-2020, https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/Ireland-NIR-2022_Merge_v2..pdf

way of revised methodologies and updated activity data or emission factors as well as addressing the issues and recommendations in the review of the previous inventory submission.

Planning also considers the further development of inventory reporting for the LULUCF sector and for Kyoto Protocol activities under Article 3, paragraphs 3 and 4, as new data becomes available through national research and development of the national forest inventory.

In addition, any changes required by the outcome of review activities conducted among the Member States of the EU, or by the need to report in a manner consistent with other Member States for the purposes of Regulation (EU) 525/2013, are considered in inventory planning.

3.2.3 Overview of Inventory Preparation and Management

The first version of the latest annual inventory, produced in Autumn of the following year, and a short NIR are used to comply with the subsequent 15th January deadline prescribed by Regulation (EU) 525/2013, which governs the reporting of GHG and implementation of the Kyoto Protocol by the EU and its Member States.

The inventory preparation and management process thereafter involves making any revisions subsequent to the receipt of updated or outstanding information nationally. In addition, any observations or amendments following initial assessment at EU level of the 15th January submission by Member States to the European Commission are incorporated into the inventory between 15th January and 15th March.

The complete and final inventory submission, including the NIR, is submitted to the European Commission by 15th March as required under Regulation (EU) 525/2013. This version of the latest inventory is fixed and retained for submission to the UNFCCC secretariat by 15th April to complete the reporting cycle. Ireland's national system is operating very successfully and the timeliness of inventory preparation has benefitted from the implementation of more formal arrangements and enhanced engagement among the various institutions and contributors.

3.2.4 Inventory Preparation

An emissions inventory database normally contains information on measured emission quantities, activity statistics (populations, fuel consumption, vehicle/kilometers of travel, industrial production and land areas), emission factors and the associated emission estimates

for a specified list of source categories. In practice, very few measured data are available for GHG and, consequently, the emissions from most activities are estimated by applying emission factors for each source/gas combination to appropriate activity data for the activity concerned.

Virtually all emissions and removals estimates may be ultimately derived on the basis of such simple product of activity data and emission factors. However, a certain amount of data analysis and preparatory calculations are generally needed to make available suitable combinations of activity data and emission factors at the level of disaggregation that give the best estimates of emissions and removals. In the case of some source/gas combinations, such as methane emissions from enteric fermentation, manure management, municipal solid waste disposed at solid waste disposal sites and CO₂ sequestration by forest biomass, it may be necessary to apply sophisticated models to generate the activity data, the emission factors and or the emissions.

The methods recommended by the 2006 IPCC Guidelines for national GHG inventories use a tier system to take account of these issues and other factors, such as data availability, technical expertise, inventory capacity and other circumstances, which may vary considerably across sectors and Parties.

Table 3.1: Key Data Providers and Information covered by MOU

Key Data Provider	Data Supplied	Deadline	Sector in which data are used
Sustainable Energy Authority of Ireland (SEAI)	National Energy Balance; Detailed national energy consumption disaggregated by economic sector and fuel	30 September	Energy, Waste
Department of Agriculture, Food and Marine	Table 1.1-1.4 Statistical data for cattle compiled under the Animal Identification and Movement (AIM) scheme Fertiliser and lime statistics Poultry statistics Sheep statistics	30 September	Agriculture

Department of Agriculture, Food and Marine (Forest Sector Development Division)	Table 2.1 GHG emission/removal estimates from all pools for forest lands under the Convention Statistical data on Afforestation, Reforestation, Deforestation and harvesting for forest land lands under Article 3.3 of KP GHG emission/removal estimates from all biomass pools for KP Article 3.3 and elected activities under Article 3, paragraph 4, of the Kyoto Protocol (Cropland management and Grazing land management).	30 September	LULUCF and Article 3.3 and 3.4 of the Kyoto Protocol
Central Statistics Office	Annual population, livestock populations, crop statistics, housing survey data	30 September	Agriculture, Industrial Processes, Waste
Gas Networks Ireland	Analysis results for indigenous and imported natural gas	30 September	Energy
Marine Institute	Annual Report on Discharges, Spills and Emissions from Offshore Gas Production Installations	30 October	Energy
Environmental Protection Agency Emissions Trading Unit	Verified CO ₂ estimates and related fuel and production data for installations covered by the EU ETS	30 April	Energy, Industrial Processes
*Department of Environment Climate and Communications	National Oil Balance (as a component of the energy balance)	30 September	Energy

*Road Safety Authority	Road transport statistics from the National Car Test (NCT)	30 April	Energy
**Department of Agriculture, Food and the Marine (Forest Service)	(i) GIS data base on premiums and grants afforestation areas (iFORIS) with associated attributes (II) NFI database	30 September 2007, 2012, 2017	LULUCF and Article 3.3 & 3.4 activities
**Department of Agriculture, Food and the Marine (Coillte)	GIS data base of intersected of NFI permanent sample plot points (Coillte-NFI plots) with sub-compartment and management unit data.	30 September	LULUCF and Article 3.3 & 3.4 activities

*These bodies have MOUs with SEAI rather than with OES

** These bodies have MOUs with the Department of Agriculture, Food and the Marine rather than with OES

3.2.5 Data Collection and Storage

Preparation for the annual GHG inventory takes place in an Excel spreadsheet system where activity data stored in Source Data files are linked to calculation sheets in Data Processing files that produce the emissions estimates at the lowest possible level of disaggregation. These are combined and allocated according to IPCC requirements for direct transmission into the Common Reporting Format (CRF) Reporter online application for the generation of the CRF tables and Party submissions. These results are stored in Outputs files while supporting QA/QC sheets, extracted from Data Processing files, which are held in summary QA/QC record files.

The Data Processing files hold the emission factors and they are structured on a time-series basis, which facilitates efficient recalculation and output to the CRF Reporter. This procedure applies to all IPCC sectors of the GHG inventory for which the calculations are made by the inventory team and the full set of files applicable to each year under the four headings is stored using appropriate version control on the EPA servers.

Table 3.1 lists the principal data suppliers and the information that they are required to deliver to the inventory agency annually under MOU for the preparation of the GHG inventory. In some cases, e.g. the national energy balance, the input file received from the data supplier may be linked directly to the Data Processing files, but generally some degree

of preparation and pre-processing is needed before the activity data are used in inventory preparation. In collating and compiling the activity data, the inventory team collects data from the various data streams, e.g. Annual Emissions Reports (AERs) under the European Pollutant Release and Transfer Register.

A national model CBM-CFS3 (Canadian Forest Service Carbon Budget Model) is used to derive the estimates of emissions and removals for forest lands, which are incorporated in the overall scheme for LULUCF reporting under the Convention following the procedure outlined above. A variety of databases related to land cover, soil type and forest areas are applied for the LULUCF inventory under the Convention. These include the National Forest Inventory (NFI), the Forest Inventory and Planning System (FIPS), the Land Parcels Information System (LPIS), Coordinated Information on the Environment (CORINE) Land Cover Maps and the General Soil Map of Ireland. These are supported by statistical information from Bord na Móna, CSO and the National Roads Authority and the Department of Housing, Local Government and Heritage (DHLGH).

The static national model, CARBWARE has been extensively developed to a dynamic version to provide the necessary estimates for Article 3, paragraph 3 and paragraph 4, selected activities under the Kyoto Protocol. This work was undertaken by FERs Ltd, the consultants working to DAFM, who supply the estimates from these activities to OES under an agreed MOU (Table 3.1).

Secondary MOUs between DAFM and its data suppliers formalise annual data collection for this area of the inventory. The model contains a multitude of component modules needed to produce estimates of the carbon stock changes for the various carbon pools under afforestation and deforestation areas and for reporting any relevant emissions of CH₄ and N₂O. The model processes detailed spatially explicit data on forest species and soil type obtained from the NFI, FIPS, soils maps, supported by the Grants and Premiums Administration System (GPAS) of DAFM, and felling license records. The model uses complex pre-processing functions, growth models, allometric equations and pool allocation and transfers to produce the results required for Article 3, paragraph 3 and paragraph 4, selected activities.

The annual ETS compilation serves as an important source of activity-specific and company-specific data on CO₂ emissions, fuel use and emission factors for major combustion sources and industrial processes. The emissions trading scheme covers 105 stationary installations in Ireland with combined CO₂ emissions of 13,296.4 kt in 2020, accounting for 22.9% of total GHG emissions (58,032.3 kt CO₂ eq). Guidance provided under the associated Decision 2004/156/EC (EP and CEU, 2004) on methodologies for estimating and reporting

greenhouse gas emissions to support Directive 2003/87/EC, together with monitoring and verification mechanisms administered by the ETU, consolidates and improves the information in relation to a substantial proportion of CO₂ emissions for the purposes of reporting national GHG inventories under the Convention and the Protocol.

All the data used in the compilation of the national GHG inventory submission is stored on an EPA data server located in the Monaghan Regional Inspectorate of the EPA where key staff involved in the compilation of the national inventory are located. All background data for recent years are available in electronic format, with a transparent file structure. All data (emission estimates, activity data, inventory submissions, references, QA/QC) on the data server are backed up daily.

3.2.6 Methodologies and Emission Factors

Table 3.2 and Table 3.3 present summaries of the methodologies and emission factors used by Ireland to estimate GHG emissions reported for the years 1990-2020. More than 80% of the total emissions (excluding LULUCF) are covered by Tier 2 methods or higher in Ireland's GHG inventory under the Convention and a Tier 3 model is applied for carbon stock changes for Article 3, paragraph 3 and paragraph 4, activities under the Kyoto Protocol.

Table 3.2 Summary of Methods

IPCC SOURCE AND SINK	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆	NF ₃
1. Energy	CS, M, T1, T2,	CS, M, T1, T2,	CS, M, T1, T2,				
A. Fuel Combustion (Sectoral	M, T1, T2, T3	M, T1, T2, T3	M, T1, T2, T3				
1. Energy Industries	T1, T3	T1, T2	T1, T2				
2. Manufacturing Industries and Construction	T1, T2, T3	T1, T2	T1, T2				
3. Transport	M, T2, T3	M, T1, T3	M, T1, T3				
4. Other Sectors	T1, T2	T1	T1				
5. Other							
B. Fugitive Emissions from Fuels	CS, T3	CS, T1, T3	CS, T3				
1. Solid Fuels	NA	T1	NA				
2. Oil and Natural Gas	CS, T3	CS, T1, T3	CS, T3				
C. Carbon Dioxide Transport and	NA						
2. Industrial Processes and Product Use	T1, T3	NA	D	T1, T2, T3	T2	T1, T2	T2
A. Mineral Industry	T3	NA	NA	NA	NA	NA	NA
B. Chemical Industry	T1	NA	T1				
C. Metal Production	NA	NA	NA				

D. Non-Energy Products from Fuels and Solvent Use	T1, T2	NA	NA				
E. Electronic Industry	NA	NA	NA	T2	T2	T2	T2
F. Product Uses as Substitutes for ODS	NA	NA	NA	T1, T2, T3	NA	NA	NA
G. Other Product Manufacture and Use			T1			T1, T2	
H. Other							
3. Agriculture	T1	CS, T1, T2	T1, T2				
A. Enteric Fermentation		CS, T1, T2	NA				
B. Manure Management		T1, T2	T2				
C. Rice Cultivation		NA	NA				
D. Agricultural Soils		NA	T1				
E. Prescribed Burning of Savannas		NA	NA				
F. Field Burning of Agricultural Residues		NA	NA				
G. Liming	T1						
H. Urea Application	T1						
I. Other	NA						
4. Land-Use, Land-Use Change and Forestry	CS, D, T1, T2, T3	D, T1	T1				
A. Forest Land	CS, T1, T2, T3	D, T1	D, T1				
B. Cropland	CS, D	D, T1	D, T1				
C. Grassland	D, T1, T2, T3	D, T1	D, T1				
D. Wetlands	D, T1, T2, T3	D, T2	D, T2				
E. Settlements	D, T1, T3		T1				
F. Other Land	T1, T3						
G. Harvested wood products	T2						
H. Other							
5. Waste	T1	T1, T2	T1				
A. Solid Waste Disposal	NA	T2	NA				
B. Biological treatment of solid waste	NA	T1	T1				
C. Incineration and open burning of	T1	T1	T1				
D. Wastewater treatment and	NA	T1, T2	T1				
E. Other							
6. Other							
Article 3.3 Afforestation and Deforestation	T3	M, T1, T3	M, T1, T3				
International Bunkers							
Aviation	T1	M, T3	M, T3				
Navigation	T1	T1	T1				
Multilateral Operations	NA	NA	NA				
CO₂ Emissions from Biomass	T1	T1	T1				
CO₂ captured	NA	NA	NA				
Long-term storage of C in waste	NA	NA	NA				
Indirect N₂O	NA	NA	NA				

Indirect CO ₂	T1	NA	NA				

T1: IPCC Tier 1 or equivalent T2: IPCC Tier 2 or equivalent T3: IPCC Tier 3 or equivalent

Table 3.3 Summary of Emission Factors

IPCC SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆	NF ₃
1. Energy	CS, D, M, PS	CS, D, M, PS	CS, D, M, PS				
A. Fuel Combustion (Sectoral Approach)	CS, D, M, PS	D, M	D, M				
1. Energy Industries	CS, D, PS	D	D				
2. Manufacturing Industries and Construction	CS, D, PS	D	D				
3. Transport	CS, M	D, M	D, M				
4. Other Sectors	CS, D	D	D				
5. Other							
B. Fugitive Emissions from Fuels	CS, PS	CS, D, PS	CS, PS				
1. Solid Fuels		D					
2. Oil and Natural Gas	CS, PS	CS, D, PS	CS, PS				
C. Carbon Dioxide Transport and Storage							
2. Industrial Processes and Product Use	CR, D, PS		D	CS	CS	CS	CS
A. Mineral Industry	PS						
B. Chemical Industry	CS		PS				
C. Metal Production	D						
D. Non-Energy Products from Fuels and Solvent Use	D						
E. Electronic Industry				CS	CS	CS	CS
F. Product Uses as Substitutes for ODS				CS			
G. Other Product Manufacture and Use	CR		D			CS	
H. Other	CR						
3. Agriculture	D	CS, D	CS, D				
A. Enteric Fermentation		CS, D					
B. Manure Management		CS, D	CS, D				
C. Rice Cultivation							
D. Agricultural Soils			CS, D				
E. Prescribed Burning of Savannas							
F. Field Burning of Agricultural Residues							
G. Liming	D						
H. Urea Application	D						
I. Other							

4. Land-Use, Land-Use Change and Forestry	CS, D, OTH	CS, D	CS, D				
A. Forest Land	CS	CS, D	CS, D				
B. Cropland	D	D	D				
C. Grassland	CS, D	D	D				
D. Wetlands	CS, D	CS, D	CS, D				
E. Settlements	CS, D, OTH		D				
F. Other Land	CS		D				
G. Harvested wood products	D						
H. Other							
5. Waste	D	CS, D	D				
A. Solid Waste Disposal		CS, D					
B. Biological treatment of solid waste		D	D				
C. Incineration and open burning of waste	D	D	D				
D. Wastewater treatment and discharge		CS, D	D				
E. Other							
6. Other							
Article 3.3 Afforestation and Deforestation	CS	D	D				
International Bunkers							
Aviation	CS	M	M				
Marine	CS	D	D				
Multilateral Operations							
CO₂ Emissions from Biomass	CS, D	D, M, CR	D, M, CR				
CO₂ captured							
Long-term storage of C in waste disposal sites							
Indirect N₂O							
Indirect CO₂	CS, CR, D						

PS: Plant specific D: Default CS: Country specific M: Model CR: CORINAIR

i. Carbon Dioxide CO₂

Tier 2 or Tier 3 methods are used for most CO₂ combustion source categories and country-specific emission factors are used for all fuels. Even for those combustion categories where data limitations dictate the use of Tier 1 methods, such as 1.A.2 Manufacturing Industries and Construction and 1.A.4 Other Sectors, the CO₂ emissions obtained using the energy balance fuel data and country-specific emission factors are reliable. Tier 2 methods also apply to

important process sources of CO₂ emissions, such as cement and lime production, where country and plant specific circumstances are again taken fully into account.

The national model used to estimate carbon stock change in the various carbon pools for forest lands in respect of both Convention reporting and Article 3, paragraph 3 and paragraph 4, activities under the Kyoto Protocol is a Tier 3 methodology. The methods for CO₂ in other LULUCF categories and for relevant CH₄ and N₂O emissions in this sector are invariably Tier 1.

ii. Methane CH₄

Ireland's national circumstances are well captured in the Tier 2 methods applied for the major sources of CH₄ in the inventory, which are enteric fermentation and manure management associated with cattle and the CH₄ emissions from solid waste disposal sites.

Tier 2 and Tier 3 methods are used for CH₄ emissions from 1.A.1 Energy Industries and 1.A.3.b Road Transport, respectively, while Tier 1 methods and IPCC default emission factors are used for other CH₄ emissions.

iii. Nitrous Oxide N₂O

Ireland relies on the simplified IPCC Tier 1 methodologies and default emission factors to estimate all N₂O emissions in agriculture, which is the main source of N₂O in the inventory.

Tier 2 and Tier 3 methods are used for N₂O emissions from 1.A.1 Energy Industries and 1.A.3.b Road Transport, respectively, while Tier 1 methods and IPCC default emission factors are used for other N₂O emissions.

3.2.7 Overview of Key Categories

The 2006 IPCC guidelines defines a key category as one that is prioritised within the national inventory system because its estimate has a significant influence on the Party's total inventory of GHG in terms of the absolute level of emissions and removals, the trend in emissions and removals or uncertainty in emissions or removals. Information about key categories is crucial to the choice of methodology for individual sources and to the management and reduction of overall inventory uncertainty. The identification of such categories is recommended in order that inventory agencies can give them priority in the preparation of annual inventories, especially in cases where resources may be limited. Information on key categories is clearly also vital for the development of policies and measures for emissions reduction.

The 2006 IPCC guidelines provide two approaches for undertaking the analysis of key categories that can be applied at any appropriate level of source aggregation, depending on the information available. The simplest approach, approach 1, is again used for 2020 data to further highlight which sources of emissions are the most important in Ireland. This approach identifies key categories using a pre-determined cumulative emissions threshold. Key categories are those that, when summed together in descending order of magnitude, add up to 95% of the total level.

The 2006 IPCC guidelines encourage inventory agencies to use approach 2 for its key category analysis, and this has also been suggested in previous annual inventory review reports. In response to this, initial work on using approach 2 was carried out, which highlighted differences between the level of disaggregation found in the approach 1 key category analysis compared to the approach 1 uncertainty assessment. Some sub-categories are reported at a more detailed level in the key category analysis compared to the Uncertainty Analysis (such as transport). Due to resource constraints, it was not possible to complete this work for this year's GHG inventory submission so the finalisation of the approach 2 key category analysis and the further disaggregation of the approach 1 uncertainty assessment are planned improvements for the 2023 GHG inventory submission.

i. Key Categories at IPCC Level 2

As inventories of CO₂, CH₄ and N₂O were developed in Ireland during the 1990s, it was quickly established that CO₂ emissions from fuel combustion was by far the largest contributor to the combined national total for these three primary GHG. It was also evident that CH₄ emissions produced by Ireland's large cattle herd and the N₂O emissions from agricultural soils, associated with farming practices and large inputs of nitrogen to agricultural soils, were also major sources, even if the estimates were more uncertain than those for CO₂. A preliminary estimate of key categories is therefore provided by considering the emissions aggregated at the IPCC Level 2 source category classification, which clearly indicates the importance of CO₂ emissions from fuel combustion and CH₄ and N₂O emissions from agriculture.

The results at the IPCC Level 2 source category classification may be readily drawn from the CRF table Summary 2. Those for 1990 and 2020 are shown in Table 3.4 and Table 3.5, respectively. There are nine highly significant key categories of emissions in Ireland in the 1990-2020 trend including; CO₂ combustion sources in 1.A.1 Energy Industries, 1.A.2 Manufacturing Industries and Construction, 1.A.3 Transport and 1.A.4 Other Sectors, CO₂ process emissions from 2.A.1 Cement Production along with the CH₄ emissions from

categories 3.A Enteric Fermentation, 3.B Manure Management and 5.A Solid Waste Disposal and N₂O emissions from 3.D Agricultural Soils. These nine categories accounted for 91.8% and 94.7% of total emissions in 1990 and 2020, respectively. In the case of 2020 emissions, one additional Level 2 source categories is needed to reach the cumulative 95% threshold that defines key categories: N₂O emissions from 3.B Manure Management. 3.B is key in 2020 for N₂O level analysis and not in 1990, whereas categories 2.B.1 and 2.B.2 are key in 1990 level analysis and not in 2020.

The increase in the contribution of CO₂ emissions from category 1.A.3 Transport from 9.2% in 1990 to 17.5% in 2020 is notable, along with the reduction in the contribution from 1.A.1 in Energy Industries from 20.3% in 1990 to 14.7% in 2020. This simple analysis of key categories continues to prove useful to the formulation of mitigation strategies and for prioritising work on inventories in Ireland.

When LULUCF is accounted for in the Level 2 analysis, CO₂ emissions in LULUCF categories (4.A Forest land, 4.C. Grassland, 4.D Wetlands) become key categories in 1990, and the same three categories and associated gas, plus CO₂ emissions in LULUCF category 4.G Harvested wood products, become key categories in 2020.

Table 3.4 Key Categories at IPCC Level 2 in 1990

IPCC Category code	IPCC Category (level 2)	GHG	1990 Estimate (kt CO ₂ eq)	Level Assessment (%)	Cumulative Total of Level (%)
1.A.1.	Energy Industries	CO ₂	11,145.01	20.33	20.33
3.A	Enteric Fermentation	CH ₄	10,893.92	19.87	40.20
1.A.4	Other Sectors (Comm/Resid/Agric)	CO ₂	9,893.94	18.05	58.25
3.D.	Agricultural Soils	N ₂ O	5,816.68	10.61	68.86
1.A.3	Transport	CO ₂	5,029.63	9.17	78.03
1.A.2.	Manufacturing Industries and Construction	CO ₂	4,079.63	7.44	85.47
5.A	Solid Waste Disposal	CH ₄	1,318.08	2.40	87.88
3.B	Manure Management	CH ₄	1,288.15	2.35	90.23
2.B.2	Nitric Acid Production	N ₂ O	995.32	1.82	92.04
2.B.1	Ammonia Production	CO ₂	990.23	1.81	93.85
2.A.1	Cement Production	CO ₂	884.00	1.61	95.46

* Nitric acid and Ammonia plants ceased operation in 2002 and 2001, respectively

Table 3.5 Key Categories at IPCC Level 2 in 2020

IPCC Category code	IPCC Category (level 2)	GHG	2020 Estimate (kt CO ₂ eq)	Level Assessment (%)	Cumulative Total of Level (%)
3.A	Enteric Fermentation	CH ₄	12,605.24	21.72	21.72
1.A.3	Transport	CO ₂	10,169.20	17.52	39.24
1.A.4	Other Sectors (Comm/Resid/Agric)	CO ₂	9,365.05	16.14	55.38
1.A.1.	Energy Industries	CO ₂	8,513.14	14.67	70.05
3.D.	Agricultural Soils	N ₂ O	5,760.45	9.93	79.98
1.A.2.	Manufacturing Industries and Construction	CO ₂	4,500.43	7.76	87.73
2.A.1	Cement Production	CO ₂	1,769.64	3.05	90.78
3.B	Manure Management	CH ₄	1,597.33	2.75	93.53
5.A	Solid Waste Disposal	CH ₄	667.94	1.15	94.69
3.B	Manure Management	N ₂ O	602.67	1.04	95.72

ii. Disaggregated Key Categories

Ireland uses the approach 1 from the 2006 IPCC guidelines to extend the analysis above to identify key categories that may be treated separately at a more disaggregated level, level 3. This gives more information about the individual sources or combination of sources and gases that are of most importance within a Level 2 category. The disaggregation corresponds generally to that at which the emissions are calculated and to that used for estimating uncertainty. The results of the analysis for the approach 1 level 3 assessment in relation to emissions excluding LULUCF in both 1990 and 2020 are presented in **Annex tables A.4.1 and A.4.2 of Annex A.4**, respectively.

Annex tables A.4.3 and A.4.4 present the approach 1 level 3 assessment including LULUCF. Ranking in this way identifies those categories that should be prioritised in the inventory process itself and also the individual components of emissions that could be targeted by specific abatement measures. Results for approach 1 trend assessment for 1990-2020 excluding LULUCF are shown in **Annex table A.4.5** and the trend assessment including LULUCF is presented in **Annex table A.4.6**.

The complete tables of ranked sources for 2020 key category analysis are provided in Tables 1.A-D in Annex 1 of Ireland's NIR 2022.

The results of the level and trend assessments for 2020 excluding LULUCF categories may be summarised as follows:

- (i) The level assessment identifies 29 key categories, 24 of which are also key categories by trend assessment. CH₄ emissions in 3.B.1 Manure Management – Non-Dairy Cattle; CH₄ emissions in 3.B.1 Manure Management – Dairy Cattle; N₂O emissions in 3.D.2 Agricultural Soils – Indirect Soil Emissions; CO₂ emissions in 3.G.1 Liming and N₂O emissions in 3.B.2 Manure Management – Non-Dairy Cattle; are key categories by level assessment only.
- (ii) There are 19 key categories of CO₂ in level assessment, accounting for 59.1% of total emissions.
- (iii) There are 6 key categories of CH₄, 3 key categories of N₂O and one category of HFC in level assessment, which account for 24.7%, 10.4% and 1.0%, respectively, of total emissions.
- (iv) Energy accounts for 17 key categories, Agriculture for 9, while Industrial Processes and Product Use contributes two and Waste contributes one.
- (v) The trend assessment identifies 26 key categories, all of which but two (CO₂ emissions in 1.A.2 Manufacturing and Construction - Non-Renewable wastes and CH₄ emissions in 1.A.4.b Residential – Peat Fuels) are key categories for 2020 level assessment.
- (vi) There are 19 key categories of CO₂ in trend assessment, accounting for 84.0% of the total trend.
- (vii) There are 5 key categories of CH₄, one key category of N₂O and one key categories of HFC in trend assessment, which account for 8.7%, 1.0% and 1.5%, respectively, of the total trend.

The results of the level and trend assessment for 2020 including LULUCF categories may be summarised as follows:

- (i) The level assessment identifies 35 key categories, 24 of these are sources of CO₂ emissions, accounting for 65.0 % of total emissions.
- (ii) There are 8 additional categories that are not present in the assessment excluding LULUCF, 7 of which are LULUCF categories and 1 from Agriculture.
- (iii) The 8 additional categories are: CO₂ emissions from, 4.C. Grassland, 4.A.2 Land Converted to Forest Land, 4.A.1 Forest Land Remaining Forest Land, 4.D. Wetlands,

- 4.G Harvested Wood Products, 4.C Drained Organic soils and CH₄ emissions from, 4.C Drained organic soils and 3.B.1.3 Manure Management- Swine.
- (iv) There are 8 key categories from sources of CH₄ and 3 key categories of N₂O which account for 19.9% and 10.0%, respectively, of total emissions.
 - (v) Energy accounts for 16 key categories, Agriculture for 8, LULUCF for 6, while Industrial Processes contribute 4 and Waste contributes 1;
 - (vi) The trend assessment identifies 31 key categories, 6 of which were not present in the assessment excluding LULUCF: CO₂ emissions from LULUCF categories: 4.A.2 Land converted to Forest Land, 4.A.1 Forest land Remaining Forest Land, 4.C. Grassland, 4.D. Wetlands and 4.G Harvested Wood Products; CH₄ emissions from 1.A.4.b Residential-Solid fuels.
 - (vii) There are 24 key categories of CO₂ in the trend assessment, accounting for 85.7% of the total trend.
 - (viii) There are 5 key categories of CH₄, 1 key categories of N₂O and 1 key category of HFC in the trend assessment, which account for 7.0%, 1.0% and 1.3%, respectively, of the total trend.

The list of key categories given by level assessment in 2020 is very similar to that for 1990. However, the higher ranking of the main CO₂ emissions from road transport is notable in 2020. Six out of the top ten key categories in 1990 (excluding LULUCF) were in the top ten in 2020 but in a different order. The remaining four key categories in 2020 are: CO₂ emissions from 1.A.4.b Residential – Liquid Fuels, 1.A.2. Manufacturing Industries & Construction - Gaseous Fuels, 2.A.1 Cement Production and 1.A.4.b Residential – Gaseous Fuels. These sectors replaced 4 key sectors in 1990: CO₂ emissions from 1.A.1 Energy Industries – Solid Fuels, 1.A.1 Energy Industries – Peat Fuels, 1.A.4.b. Residential – Peat Fuel and 1.A.4.b. Residential - Solid Fuels.

Those six key categories contributed 42.6 and 56.6%, of total emissions in 1990 and 2020, respectively. The emissions of CO₂ from the use of liquid fuels by road traffic (1.A.3.b) and CH₄ emissions from 3.A.1. Enteric Fermentation - Non-Dairy Cattle were the largest source categories of GHG emissions in Ireland in 2020, accounting for 16.5 and 11.8% of the total, respectively.

The CO₂ emissions/removals in 6 categories (4.C. Grassland, 4.A.2 Forest Land Converted to Forest Land, 4.D. Wetlands, 4.A.1 Forest Land remaining Forest Land, 4.G Harvested Wood Products and 4.C Drained organic soils) and CH₄ emissions/removals in 1 key category (4.C

Drained organic soils) are key categories in level assessment when the LULUCF sector is included in the detailed analysis for 2020.

CO₂ emissions in KP B.3 Grazing Land Management and KP A.1 Afforestation/Reforestation and CH₄ emissions in KP B.3 Grazing Land Management are also key categories in 2020 when Article 3, paragraph 3 and paragraph 4, activities are included in the analysis.

3.2.8 Process for the Recalculation of Previously Submitted Inventory Data

Ongoing demands for more complete and more accurate estimates of GHG emissions means that the methodologies being used are subject to regular revision and refinement as inventory capacity is increased and better data become available. The general improvement in inventories over time may therefore introduce inconsistencies between the emissions estimates for recent years and those for years much earlier in the time-series. Recalculated estimates are often needed to eliminate these inconsistencies and to ensure that the inventories for all years in a time-series are directly comparable with respect to the sources and gases covered and that the methods, activity data and emission factors are applied in a transparent and consistent manner. In this way, the results can be used with greater confidence in identifying trends and in monitoring progress towards the commitments that have been defined with reference to emissions in the base year. The UNFCCC reporting guidelines provide for the reporting of recalculations as part of the annual submissions from Annex 1 Parties. Justification for the recalculations should be provided, as well as explanations of the changes that have been made and the numerical values of the original and revised estimates must be compared to show the impact of the changes.

Recalculations are systematically planned and undertaken annually by Ireland as part of the normal inventory reporting cycle. The recalculations reflect the inventory agency's own inventory development and improvement process and Ireland's response to the UNFCCC inventory review process. Each sectoral chapter of Ireland's NIR 2022 describes recalculations and improvements for the individual Level 1 source sectors of the inventory undertaken for the annual submission and they present the corresponding quantitative changes in emissions and removals within the individual sectors. Chapter 10 of the NIR 2022 records the major changes in regard to methodologies, activity data and emission factors and summarises the recalculations and assesses their effect in relation to total national emissions to record the updates and the most recent emissions estimates as they appear in the latest submission CRF tables. The original and revised numerical values of the emissions estimates for the years 1990-2020, along with the changes related to methods, activity data and

emission factors are detailed in the respective CRF Tables 8(a) and 8(b) in the 2022 GHG inventory submission.

3.2.9 Uncertainty Assessment

The approach 1, propagation of error, method provided by the 2006 IPCC guidelines has been used to make an assessment of uncertainty in the emissions inventory data for 2020 in the same way as for previous years. This method estimates uncertainties for the entire inventory in a year and the uncertainty in the trend over time by combining the uncertainties in activity data and emission factors for each source category. The analysis for 2020 data is presented in **Annex table A.5.1** (excluding LULUCF) and **Annex table A.5.2** (including LULUCF) in **Annex A.5**, using emissions on a Global Warming Potential (GWP) basis and a level of source category disaggregation that corresponds in general to the level used for emissions calculation and for key category analysis. This disaggregation level limits the likely dependency and correlation between source categories.

The input values of uncertainty for activity data and emission factors in the GHG inventory have been assigned largely on the basis of general information related to the methodological descriptions in the 2006 IPCC guidelines, supported by opinions elicited from the principal data suppliers, such as the CSO, SEAI, Government Departments and individual experts who contributed to certain parts of the inventory.

Where higher tier methods are used for combustion sources, such as those covered by ETS and road transport, the activity data uncertainty estimates are those indicated for the tier concerned. Accordingly, low estimates of uncertainty apply to the activity data for categories such as 1.A.1 Energy Industries and 1.A.3 Transport, as shown on Table A.5.1. Slightly higher uncertainty levels are used for energy activity data in sub-categories under 1.A.2

Manufacturing Industries and Construction and 1.A.4 Other Sectors, where the end use of fuels is not as well quantified in the top-down methods used. Low activity data uncertainties are justified in respect of CO₂ emissions sources in 2.A Industrial Processes, for which bottom-up data are applied in most cases and the major sources of emissions are covered by ETS. Country-specific CO₂ emission factors are used for all combustion sources, which gives a basis for assigning the uncertainties for emission factors while again considering the applicable tiers. Uncertainties in the emission factors for CH₄ and N₂O released from combustion sources are high and not well established quantitatively. For CH₄ and N₂O emission factors for combustion categories, the most up-to-date IPCC publications are used and an indicative uncertainty of 50% is used for both gases.

The Agriculture sector is the second most important sector in Ireland's GHG inventory and has a major influence on overall uncertainty due to its large contribution in terms of CH₄ and N₂O emissions. Ireland has long established and robust statistical data collection procedures in place for agriculture in general, which guides the selection of 1% as the activity data uncertainty for all agriculture sub-categories. The 2006 IPCC guidelines indicate that the emission factor estimates for the Tier 2 method to determine CH₄ emissions from enteric fermentation in cattle are likely to have an uncertainty of 20%. Following the opinion of national agriculture experts, a value of 15% has been adopted for these emissions to take into account Ireland's detailed Tier 2 method and use of reliable data.

In some of the other important emissions sources in Agriculture (such as manure management and agricultural soils) the activity data or emission factors ultimately used are determined by several specific component inputs, which are individually subject to varying degrees of uncertainty. Uncertainties in Agriculture have been estimated at the level of livestock for both enteric fermentation (3.A) and manure management (3.B), and according to the six direct nitrogen inputs for agricultural soils (3.D.1.1 - 3.D.1.6). This finer level of disaggregation is the principal reason for the overall level of the inventory uncertainty reducing in submission 2018 and continues in this submission in order to include the revised emission factors uncertainty associated with cattle dung and urine deposited by grazing cattle in category 3.D.1.3 to account for new country specific emission factors in this submission. The uncertainty estimates used for emission factors for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, using equations 3.1 and 3.2 in chapter 3 of the 2006 IPCC guidelines Volume 1 for each activity to obtain the input to the Tier 1 uncertainty assessment. The footnotes to Table A.5.1 show how some of these uncertainty inputs are obtained.

Category 5.A Solid Waste is the principal source of CH₄ emissions outside Agriculture. Under the methodology used, the component uncertainties for both activity data and emission factors for CH₄ generation are derived using equations 3.1 and 3.2 in chapter 3 of the 2006 IPCC guidelines Volume 1 as shown in the footnotes to Table A.5.1. These are combined with uncertainties of 30% and 10% for flaring and utilisation respectively to obtain the overall uncertainty using equation 3.2.

Equations 3.1 and 3.2 are both applied as appropriate in a hierarchical approach to derive uncertainty for LULUCF under the Convention and for activities under Article 3, paragraph 3 and paragraph 4, of the Kyoto Protocol. This is achieved by developing uncertainties for carbon pools, which are combined to give the values for the individual land-use categories,

which are then combined with uncertainties for other reported activities to give the totals for LULUCF and Article 3, paragraph 3 and paragraph 4, separately. Additional information on uncertainties for LULUCF is provided in chapters 6 and 11 of NIR 2022.

The F-gas inventory has been substantially revised following work by consultants in 2013, and new data sources were established. The uncertainties associated with the F-gas emission estimates were reviewed and are still considered to be appropriate for this GHG inventory submission.

The approach 1 uncertainty analysis (excluding LULUCF) for Ireland's 2020 inventory under the Convention gives an overall uncertainty of 4.02% in total emissions and a trend uncertainty of 2.32% for the period 1990 to 2020. This equates to an increase on level uncertainty as compared to the values reported in the 2021 GHG submission (for 1990 to 2019) of 3.85 and 2.33%, respectively.

The reason for the overall increase from 2019 to 2020 is primarily due to a higher emissions share of methane and nitrous oxide from Agriculture in the overall level of emissions in 2020 as these gases have higher associated level uncertainty.

Relatively low estimates are determined largely by the low uncertainties in the estimate of CO₂ emissions, which account for 60.6% of total national emissions in 2020 and which are estimated to contribute to 11.1% of the level uncertainty (excluding LULUCF). When CH₄ is included, bringing the proportion of total emissions up to 86.8%, the contribution to the level of uncertainty is 43.8% (excluding LULUCF), with 32.6% due to CH₄. However, it is the influence of N₂O that contributes 55.7% of the total level of uncertainty, whereas it accounts for only 11.8 per cent of national total emissions. The impact of HFCs, PFCs, SF₆ and NF₃ on inventory uncertainty remains negligible (0.6% contribution) because these gases account for only 1.4% of total emissions in Ireland.

The approach 1 uncertainty analysis (including LULUCF) for Ireland's 2020 inventory under the Convention (Table 1.13) gives an overall level uncertainty of 12.16% in total emissions and a trend uncertainty of 10.41% for the period 1990 to 2020.

3.2.10 Quality Assurance and Quality Control

In 2005, the inventory agency in Ireland commissioned a project with UK consultants NETCEN to establish formal QA/QC procedures that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual.

The manual provides a general overview of the QA/QC system. In addition, the manual provides guidance and templates for appropriate quality checking, documentation and traceability. The selection of source data, calculation methodologies, peer and expert review of inventory data and the annual requirements for continuous improvement for the inventory are also outlined in the manual.

The QA/QC plan (**Annex A.2**) identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting.

The inventory agency initiated a new approach to QA/QC in the 2006 reporting cycle. Its application was completed and consolidated in delivering the submissions up to this present 2020 GHG inventory submission. This involved the allocation of responsibilities linked to the national system mentioned in Chapter 3.2.1 and the use of a template spreadsheet system to record the establishment and maintenance of general inventory checking and management activities covering the overall compilation process, as well as the undertaking of specific annual activities and any necessary periodic activities in response to specific events or outcomes in inventory reporting and review. The system facilitates record keeping related to the chain of activities from data capture, through emissions calculations and checking, to archiving and the identification of improvements.

Ireland's calculation spreadsheets in all sectors are structured and organised to facilitate the QA/QC process and more efficient time-series analysis and to ensure ease of transfer of the outputs to the CRF Reporter Tool. This facilitates rapid year-on-year extension of the time-series, rapid inter-annual comparisons and efficient updating and recalculation, where appropriate, in the annual reporting cycle. Internal aggregation to various levels corresponding to the CRF tables provides immediate and complete checks on the results. External reviews of the Agriculture sector and of the entire ETS results for 2005 were conducted as important new components of quality assurance at the beginning of 2007. The review for the agriculture sector was performed by a Technical Inspector in the DAFM. This review used the new calculation files to assess the consistency of the time series which had been subject to considerable improvement and recalculation in the 2006 reporting cycle. These improvements and recalculations were part of a move to higher tier methods for enteric fermentation in cattle as well as advice from the Department on various aspects of input data and calculation parameters. A detailed bilateral review with UK agricultural experts took place in the offices of the EPA in July 2014 to review, in particular, the changes to the

agriculture inventory with respect to the use of the 2006 IPCC guidelines. The inventory agency also continues to work closely with the DAFM and seeks advice and guidance from experts in Teagasc, the Irish Agriculture and Food Development Authority on a regular basis. The inventory team has contracted an external service provider, Aether, to assist in aspects of inventory compilation from 2013 to 2020. The transparency, robustness and accessibility of the inventory data within the electronic filing structures were assessed by Aether, who concluded that the system is very well organised.

The ETS returns to the ETU provide for the complete coverage of CO₂ estimates in several sub-categories under 1.A.1 Energy Industries and 2.A. Mineral Products. When the allocation to these categories from the ETS raw data is completed, the output is returned to the ETS administrator for final checking against the source data. This ensures the efficient and consistent transfer of the verified ETS emissions estimates into the national inventory. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States. In 2014, experts from the inventory team attended 2 workshops, in March and June, organised by UBA Germany and the European Commission to facilitate the implementation of the 2006 IPCC guidelines for inventory reporting for the first submission for the second commitment period in 2015.

3.2.11 Procedures for Consideration and Approval of the Inventory

The approval of the completed annual inventory involves sign off by the QA/QC manager and the inventory manager before it is transmitted to the Board of the EPA via the Programme Manager of the CCP in OES (**Annex A.3**). Any issues arising from the Board's examination of the estimates are communicated to the inventory experts for resolution before final adoption of the inventory.

The results for the inventory year are normally released at national level in Autumn of the following year. This is in advance of their official submission to the European Commission in accordance with Regulation (EU) 525/2013 in January and March of the reporting year and subsequently to the UNFCCC secretariat in April. The national system is also exploited for the purpose of parallel inventory preparation and reporting of air pollutants under the CLRTAP ensuring efficiency and consistency in the compilation of emissions inventories for a wide range of substances using common datasets and inputs.

3.3 Emissions by Greenhouse Gas

The trends in emissions of the seven GHG in Ireland over the period 1990-2020 are shown in Table 3.6 and in further detail in **Annex A.1.1 to Annex A.1.6**.

The trends in the principal emission components, shown as CO₂ equivalents, within the five IPCC sectors are shown in Figures 3.1 and 3.2. Total emissions of the seven GHG in Ireland (including indirect CO₂ emissions without land use, land use change and forestry) increased steadily from 54,823.2 kt CO₂ eq in 1990 to 70,923.6 kt CO₂ eq in 2001, which is the highest level of GHG emissions ever reported in Ireland. Emissions then plateaued until 2008 with estimates ranging from 68,791.7 kt CO₂ eq to 70,679.0 kt CO₂ eq. There was then a sharp decrease from 68,464.9 kt CO₂ eq in 2008 to 57,978.0 kt CO₂ eq in 2011. Emissions in 2020 at 58,032.3 kt CO₂ eq are 3.5% lower than 2019.

The largest annual change occurred from 2008 to 2009 when emissions decreased by 5,804.2 kt CO₂ eq from 68,464.9 kt CO₂ eq to 62,660.7 kt CO₂ eq, a reduction of 8.5 per cent. Total emissions in 2020 were 5.9% higher than in 1990 and 18.2% lower than the peak level in 2001. Inter annual changes to national total emission estimates are shown in Figure 3.3.

Emissions of CO₂ accounted for 60.6% of the total (excluding LULUCF) of 58,032.3 kt CO₂ eq in 2020, with CH₄ and N₂O contributing 26.2% and 11.8%, respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ accounted for 1.4% of total emissions in 2020. In 1990, emissions of CO₂, CH₄, N₂O and the combined emissions of HFCs, PFCs, SF₆ and NF₃ accounted for 60.1, 25.9, 14.0 and less than 0.1%, respectively of total emissions of 54,823.2 kt CO₂ eq as presented in Figure 3.2.

Table 3.6 GHG Emissions 1990-2020 (kt CO₂ equivalent)

(a) Emissions by Gas

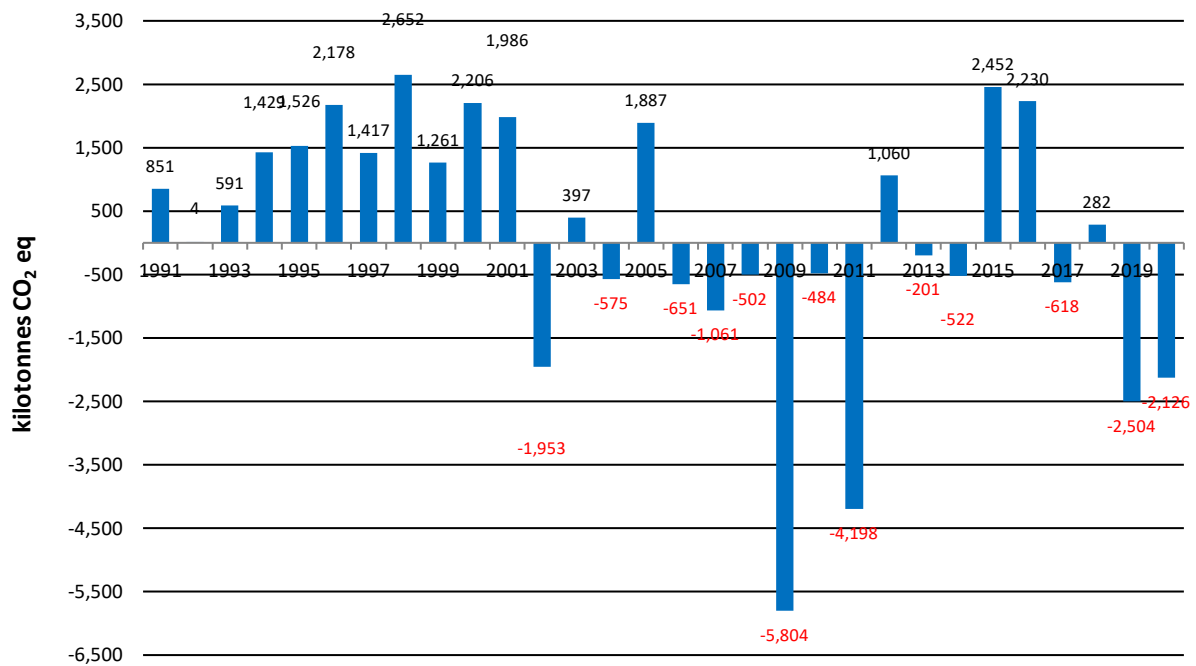
GHG Emissions	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Percentage change (1990-2020)
CO ₂ emissions without net CO ₂ from LULUCF	32,944.4	35,853.0	45,249.1	48,156.6	41,793.6	38,056.4	38,227.2	37,281.7	36,853.0	38,718.0	40,369.5	39,078.0	39,012.4	37,325.7	35,153.2	6.7%
CO ₂ emissions with net CO ₂ from LULUCF	38,464.8	42,204.8	52,128.8	55,142.7	48,324.0	44,018.6	43,526.8	43,121.3	42,398.8	44,961.0	45,945.4	46,027.2	44,825.1	43,199.8	41,049.1	6.7%
CH ₄ emissions without CH ₄ from LULUCF	14,180.7	15,035.4	14,864.8	14,420.4	12,804.3	12,751.9	13,424.6	13,717.9	13,828.3	14,346.4	14,735.2	15,149.0	15,456.9	15,048.0	15,226.6	7.4%
CH ₄ emissions with CH ₄ from LULUCF	14,637.1	15,493.9	15,307.8	14,905.8	13,561.0	13,319.0	13,874.7	14,262.9	14,395.2	14,865.0	15,224.3	15,895.6	16,010.0	15,587.6	15,794.7	7.9%
N ₂ O emissions without	7,663.4	8,108.9	8,054.8	6,903.3	6,450.5	6,023.9	6,263.9	6,678.7	6,408.8	6,473.5	6,579.7	6,915.0	7,262.9	6,867.2	6,868.2	-10.4%

N ₂ O from LULUCF																
N ₂ O emissions with N ₂ O from LULUCF	7,879.4	8,376.9	8,336.5	7,270.3	6,994.3	6,512.7	6,740.1	7,194.5	6,924.6	6,978.0	7,058.3	7,451.3	7,744.5	7,340.4	7,330.4	-7.0%
HFCs	0.6	45.2	270.0	857.1	1,048.3	1,084.4	1,075.0	1,106.4	1,183.7	1,164.2	1,236.0	1,150.2	837.8	819.1	694.2	117158.5%
PFCs	0.1	97.6	397.8	216.4	46.6	15.9	9.6	8.3	3.6	20.5	37.4	47.2	49.9	63.1	70.2	58526.2%
SF ₆	33.9	79.1	51.8	96.8	33.1	45.5	37.4	43.6	37.4	44.5	39.3	39.2	40.9	33.6	18.5	-45.4%
NF ₃	NO	4.4	49.2	28.4	NO	NO	0.8	0.9	1.0	1.0	1.0	1.3	1.3	1.4	1.5	-
Total (without LULUCF)	54,823.2	59,223.6	68,937.4	70,679.0	62,176.5	57,978.0	59,038.4	58,837.6	58,315.7	60,768.1	62,998.1	62,379.8	62,662.1	60,158.0	58,032.3	5.9%
Total (with LULUCF)	61,015.9	66,301.8	76,541.7	78,517.4	70,007.2	64,996.1	65,264.4	65,738.0	64,944.3	68,034.1	69,541.6	70,611.9	69,509.5	67,044.9	64,958.5	6.5%
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

(b) Emissions by IPCC Source Category (kt CO₂ equivalent)

GHG Source and Sink Categories	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Percentage change (1990-2020)
1. Energy	31,021.7	33,830.0	42,481.1	45,703.7	40,458.1	36,913.2	37,000.8	35,850.1	35,190.4	36,856.7	38,370.3	37,063.8	36,840.8	35,264.1	33,156.3	6.9%
2. Industrial Processes	3,310.2	3,218.4	4,559.3	3,965.4	2,595.9	2,483.1	2,688.0	2,640.4	3,051.1	3,242.2	3,468.9	3,481.2	3,229.6	3,189.0	2,895.7	-12.5%
3. Agriculture	18,939.3	20,346.0	20,404.3	19,685.2	18,588.4	17,963.5	18,810.7	19,653.4	19,195.2	19,711.0	20,192.4	20,890.0	21,676.9	20,790.6	21,074.6	11.3%
4. LULUCF	6,192.7	7,078.2	7,604.3	7,838.4	7,830.8	7,018.1	6,226.0	6,900.4	6,628.6	7,266.0	6,543.5	8,232.1	6,847.4	6,886.9	6,926.2	11.8%
5. Waste	1,552.1	1,829.2	1,492.8	1,324.7	534.1	618.2	538.9	693.7	878.9	958.2	966.4	944.9	914.8	914.3	905.7	-41.6%
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Total (including LULUCF)	61,015.9	66,301.8	76,541.7	78,517.4	70,007.2	64,996.1	65,264.4	65,738.0	64,944.3	68,034.1	69,541.6	70,611.9	69,509.5	67,044.9	64,958.5	6.5%

Figure 3.3 Interannual changes to national total GHG emissions 1990-2020



3.3.1 Carbon Dioxide

Carbon dioxide is the most significant contributor to GHG emissions with 1.A.1 Energy Industries and 1.A.3 Transport sectors responsible for 24.2% and 28.9% of total CO₂ emissions (excluding LULUCF) in 2020, respectively. 1.A.4 Other Sectors represents a share of 26.6%, 1.A.2 Manufacturing Industries and Construction has a 12.8% share and the remainder of CO₂ emissions (7.4% share) fall into other categories.

Emissions of CO₂ increased from 32,944.4 kt in 1990 to 35,153.2 kt in 2020, which equates to an increase of 6.7%. The main driver behind this increase in emissions is primarily fuel combustion in Transport followed by Energy Industries. Over the period 1990-2020, emissions of CO₂ from transport, predominantly road traffic in Ireland, increased by 102.2%. This trend is exaggerated somewhat in later years by so-called fuel-tourism. In 2020, it is estimated that 3.6% of diesel sold in Ireland was used in vehicles in the UK and other countries.

Over the time-series, emissions of CO₂ from 1.A.1 Energy Industries increased in the first decade by 54.7% until they peaked in 2001 and decreased by 50.6% to 2020, showing an overall decrease of 23.6% CO₂ over the 1990-2020 period. In addition, even though Ireland has only a small number of energy intensive industries, CO₂ emissions from combustion in the industrial sector 1.A.2 Manufacturing Industries and Construction increased by 10.3% between 1990 and 2020.

3.3.2 Methane

Methane is the second most significant contributor to GHG emissions in Ireland which is due to the large population of cattle. In 2020 emissions of CH₄ were 15,226.6 kt CO₂ eq, indicating a decrease of 7.4% on the 1990 level of 14,180.7 kt CO₂ eq. Emissions of CH₄ increased progressively from 1990, reaching a peak in 1998 of 15,790.3 kt CO₂ eq, which reflects an increase in livestock numbers and therefore increased emissions from source categories 3.A Enteric Fermentation and 3.B Manure Management.

Between 1998 and 2011, CH₄ emissions decreased because of falling livestock numbers due to reform of the Common Agricultural Policy (CAP). However, total CH₄ emissions in the period 2001-2014 fluctuated to some extent on a yearly basis. This trend is a direct result of fluctuating CH₄ emissions from 1.A.4 Other Sectors and 1.B Fugitive Emissions from Fuels. The main contributor to the CH₄ trend has been Agriculture and in 2020 the sector accounted for 93.3% of the total methane emissions (compared to 85.9% share in 1990 when emissions from Waste had a larger share in the methane trend). The sectoral methane emissions from Agriculture increased by 16.6% between 1990 (12,182.1 kt CO₂ eq) and 2020 (14,202.6 kt CO₂ eq).

Another significant source of methane emissions is the Waste sector, especially from landfill gas in category 5.A Solid Waste Disposal on Land. CH₄ emissions from Waste decreased from 9.3% share of total methane emissions (1,318.1 kt CO₂ eq) in 1990 to 4.4% share (667.9 kt CO₂ eq) in 2020. This decrease is a result of improved management of landfill facilities, including increased recovery of landfill gas utilised for electricity generation and flaring.

3.3.3 Nitrous Oxide

Nitrous oxide emissions decreased by 10.4% from their 1990 level of 7,663.4 kt CO₂ eq in 1990 to 6,868.2 kt CO₂ eq in 2020. Similar to CH₄, emissions of N₂O increased during the 1990s to reach peak level of 8,597.8 kt CO₂ eq in 1998 reflecting an increased use of synthetic fertilisers and increased amounts of animal manures associated with increasing animal numbers over that period. Emissions of N₂O subsequently showed a clear downward trend following reductions in synthetic fertiliser use and organic nitrogen applications on land as a result of the effect of the CAP reform on animal numbers as well the closure of Ireland's only nitric acid plant in 2002.

The largest contributor to the trend is the Agriculture sector with 92.6% share of the total N₂O emissions (6,363.1 kt CO₂eq) in 2020. This reflects an increase from 82.3% share

(6,305.5 kt CO₂eq) in 1990. Emissions from IPPU in the chemical industry used to be the second largest contributor to the trend contributing 13.4% to total N₂O emissions in 1990 and an average of 10.1 per cent share to the trend between 1990 and 2000, before falling to 3.9% share in 2002, the year of the nitric acid plant closure.

Energy and Waste sectors contributed 4.9% and 1.8%, respectively to total N₂O emissions in 2020.

3.3.4 HFCS, PFCs and SF₆

Emissions of F-gases (HFCs, PFCs, SF₆ and NF₃) were 784.3 kt CO₂ eq in 2020 compared to 34.6 kt CO₂ eq in 1990, a 23-fold increase over the time series. However, F-gas emissions only accounted for 1.4% of the national total in 2020. F-gases include a wide range of substances that are used in a diverse range of products and manufacturing processes.

Therefore, it can be difficult to identify the factors contributing to actual trends in emissions over time. However, it is possible to establish the main contributory sub-categories underlying these trends.

The main causative factor of the increase in F-gas emissions has been the growth in HFC emissions from 2.F.1 Refrigeration and Air Conditioning through their use as replacement refrigerants across virtually all refrigeration sub-categories since 1996. Increased use of HFCs in 2.F.4 categories: Metered Dose Inhalers (MDIs) and Aerosols is also an important component of the trend. On the other hand, following a 2013 study on F-gases, emissions from 2.F.2 Foams were proven to be not occurring in manufacturing process and consequently were removed from the whole time series. Similar was the finding in 2.F.3 Fire extinguishers between 1990-1996 (incl.) and significant emission reductions for the following years in the trend have been applied. Sector 2.E.1 Semiconductor Manufacture was the only source in 1990 until 2.F.4 Aerosols entered the market in 1990, followed by 2.F.1 MAC in 1993, 2.F.1 Refrigeration and Air Conditioning in 1995 and both 2.F.3 Fire extinguishers and 2.F.4 MDIs in 1996. Emissions from HFCs increased steadily from 0.6 kt CO₂ eq in 1990 to 694.2 kt CO₂ eq in 2020.

Emissions of PFCs increased from 0.12 kt CO₂ eq in 1990 up to their peak of 397.8 kt CO₂ eq in 2000 through their use in the semiconductor manufacturing process in 2.E.1 Semiconductor Manufacture. Semiconductor manufacturers continue to investigate various reduction initiatives through gas substitution and new process technologies which is reflected in the downward trend in PFC emissions between 2000 and 2020 (70.2 kt CO₂ eq in 2020).

SF₆ is used in a diverse number of products and processes and is therefore included in several IPCC source sub-categories including 2.E.1 Semiconductor Manufacture, 2.G.1 Electrical Equipment and four subcategories under 2.G.2 Other. Emissions of SF₆ were 33.9 kt CO₂ eq and 18.5 kt CO₂ eq in 1990 and 2020, respectively. However, total emissions of SF₆ across the time series vary considerably, primarily because the two largest sources (Semiconductor Manufacture and Electrical Equipment) vary from year to year. Emissions of SF₆ grew steadily from 1990, peaking at 126.1 kt CO₂ eq in 1997. The increase over the period 1990-1997 was largely due to increased use of SF₆ in Semiconductor Manufacture. Emissions from both Semiconductor Manufacture and Electrical Equipment then show a steady decline across the time series (although there are peaks in 2003 and 2005 due to elevated emissions from Semiconductor Manufacture). Similar to PFCs, semiconductor manufacturers have undertaken to reduce the use of SF₆ through gas substitution and new process technologies. In 2.E.1 Electrical Equipment, where SF₆ is used for electrical insulation, arc quenching and current interruption, a leak reduction programme has been in place since 1997, when peak emissions are observed.

NF₃ are solely released from 2.E.1 Semiconductor Manufacture. Emissions of NF₃ were reported since 1995 (4.4 kt CO₂ eq.) when use of this gas commenced in the industry and peaked in 2000 (49.2 kt CO₂ eq.), followed by fluctuations until 2008 when NF₃ was phased out from Semiconductor Manufacture for four consecutive years. Since 2012 small amounts of NF₃ were used again in Semiconductor Manufacture resulting in low emissions levels averaging 1.1 kt CO₂ eq per year.

3.4 National Registry

Directive 2009/29/EC adopted in 2009, provides for the centralisation of the EU ETS operations into a single EU registry operated by the European Commission (Directorate-General for Climate Action, BE-1049 Brussels, Belgium) as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries – in particular Decision 13/CMP.1 and Decision 24/CP.8. The consolidated platform which implements the national registries in a consolidated manner (including the registry of the EU) is called the Union Registry and was developed together with the new EU Registry, on the basis of the following modalities:

- Each Party retains its organisation designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;
- Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;
- Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;
- Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
- The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;
- The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making non-confidential information accessible to the public is fulfilled by each Party through a publicly available web page hosted by the Union Registry;

All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the consolidated national registries are uniquely identifiable, protected and distinguishable from each other.

3.4.1 Changes to the national registry

The following changes to the national registry have occurred since the last National Communication Report.

- a) The name and contact information of the registry administrator designated by the Party to maintain the national registry;

No changes during the reporting period. Ireland's EPA remains responsible for establishing and maintaining the National Registry in Ireland.

Party	Entity	
IRELAND	Environmental Protection Agency	PO Box 3000 Johnstown Castle Estate

		Co Wexford Y35 W821 IRELAND T: +353 53 91 60600 F: +353 53 91 60699
National Administrator	Primary Contact	Dr Maria MARTIN EPA Regional Inspectorate McCumiskey House Richview Clonskeagh Dublin 14 D14 YR62 IRELAND T: +353 1 2680100 F: +353 1 2680199
		E: etradmin@epa.ie E: m.martin@epa.ie
	Alternate Contact	Ms Jacinta PONZI Environmental Protection Agency PO Box 3000 Johnstown Castle Estate Co Wexford Y35 W821 IRELAND T: +353 53 91 60600 F: +353 53 91 60699 E: etradmin@epa.ie E: j.ponzi@epa.ie

- b) The names of the other Parties with which the Party cooperates by maintaining their national registries in a consolidated system;

There was a change in the cooperation arrangement during the reporting period as the United Kingdom of Great Britain and Northern Ireland no longer operate their registry in a consolidated manner within the Consolidated System of EU registries, CSEUR.

- c) A description of the database structure and capacity of the national registry;

The Union Registry is now updated to Version 13.5.2. No change was required to the database and application backup plan or to the disaster recovery plan. The database model is provided in electronic form as Appendix 1 - SIAR Supplementary Information to the NIR. No change to the capacity of the national registry occurred during the reporting period.

- d) A description of how the national registry conforms to the DES between registry systems for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development mechanism registry and the transaction log

(Decision 19/CP.7, para 1);

Both regression testing and tests on the new functionality are carried out prior to the release of the new versions in Production. These tests also include thorough testing against the DES and are carried out prior to the relevant major release of the version to Production. The site acceptance tests are carried out by quality assurance consultants on behalf of and assisted by the European Commission. No other change in the registry's conformance to the technical standards occurred for the reporting period.

- e) A description of the procedures employed in the national registry to minimize discrepancies in the issuance, transfer, acquisition, cancellation and retirement of emission reduction units (ERUs), certified emission reductions (CERs), temporary certified emissions reductions (tCERs), long-term certified emission reductions (lCERs), assigned amount units (AAUs) and/or removal units (RMUs), and replacement of tCERs and lCERs, and of the steps taken to terminate transactions where a discrepancy is notified and to correct problems in the event of a failure to terminate the transactions;

No change of discrepancies procedures occurred during the reporting period.

- f) An overview of security measures employed in the national registry to prevent unauthorized manipulations and to prevent operator error and of how these measures are kept up to date;

In 2020, the use of soft tokens for authentication and signature was introduced for the registry end users.

g) A list of the information publicly accessible by means of the user interface to the national registry;

Publicly available information is provided via the Union Registry homepage for each registry – for Ireland, this is found at the following links.⁵²:

In accordance with the requirements of Annex E to Decision 13/CMP.1, all required information for a Party with an active Kyoto registry is provided with the exceptions as outlined below.

In Paragraph 45 under account information, in line with the data protection requirements of Regulation (EC) No 45/2001 and the GDPR Regulation (EU) 2016/679 and in accordance with Article 110 and Annex XIV of Commission Regulation (EU) No 389/2013, the information on account representatives, account holdings, account numbers, all transactions made and carbon unit identifiers, held in the EUTL, the Union Registry and any other KP registry (required by paragraph 45) is considered confidential.

In paragraph 46, JI projects in Ireland, note that no Article 6 (Joint Implementation) projects are reported as conversion to an ERU under an Article 6 project, as this did not occur in the reporting period.

In paragraph 47, information on holding and transaction information of units is provided on a holding type level, due to more detailed information being declared confidential.

Detailed information on transactions is considered confidential according to Article 110 of Commission Regulation (EU) No 389/2013:

‘Information, including the holdings of all accounts, all transactions made, the unique unit identification code of the allowances and the unique numeric value of the unit serial number of the Kyoto units held or affected by a transaction, held in the EUTL, the Union Registry and any other KP registry shall be considered confidential except as otherwise required by Union law, or by provisions of national law that pursue a legitimate objective compatible with this Regulation and are proportionate’.

Further changes in this paragraph include:

- Ireland does not host JI projects (47c);
- Ireland does not perform LULUCF activities and therefore does not issue RMUs (47e)
- no ERUs, CERs, AAUs and RMUs have been cancelled on the basis of activities under Article 3, paragraphs 3 and 4 to date (47g);

⁵² <https://unionregistry.ec.europa.eu/euregistry/IE/public/reports/publicReports.xhtml>
<https://www.epa.ie/our-services/licensing/climate-change/eu-emissions-trading-system-/union-registry/public-reports-/>

- no ERUs, CERs, AAUs and RMUs have been cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 to date (47h);

For the second commitment period CP2, no ERUs, CERs, AAUs and RMUs have been retired to date (47j). Then in paragraph 47k:

- Ireland requests to carry over up to 7,816,073 AAUs; 5,255,000 CERs and 74,964 ERUs from the first to the second commitment period of the Kyoto Protocol.
- Ireland did complete a carryover of 5,255,000 CERs and 74,964 ERUs from the first to the second commitment period of the Kyoto Protocol in December 2016.

Reference should also be made to the final report on the individual review of the report upon expiration of the additional period for fulfilling commitments (true-up period) for the first commitment period of the Kyoto Protocol of Ireland.

The report is available on the UNFCCC webpage together with the true-up period assessment report (TUPAR) and the true-up period report submission by Ireland.⁵³

In paragraph 48, on entities authorised to hold Kyoto Units, in line with the data protection requirements of Regulation (EC) No 45/2001 and the GDPR Regulation (EU) 2016/679 and in accordance with Article 110 and Annex III of the Commission Regulation (EU) no 389/2013, the legal entity contact information (required by paragraph 48) is considered confidential.

h) The Internet address of the interface to its national registry;

No change of the registry internet address occurred during the reporting period.

i) A description of measures taken to safeguard, maintain and recover data to ensure the integrity of data storage and the recovery of registry services in the event of a disaster;

No change of data integrity measures occurred during the reporting period.

j) The results of any test procedures that might be available or developed with the aim of testing the performance, procedures and security measures of the national registry undertaken pursuant to the provisions of decision 19/CP.7 relating to the technical standards for data exchange between registry systems.

⁵³ http://unfccc.int/kyoto_protocol/reporting/trueup_period_reports_under_the_kyoto_protocol/items/9049.php

Both regression testing and tests on the new functionality are carried out prior to release of the new versions in Production. These tests also include thorough testing against the DES and are carried out prior to the relevant major release of the version to Production. The site acceptance tests are carried out by quality assurance consultants on behalf of and assisted by the European Commission.

No other change in the registry's conformance to the technical standards occurred for the reporting period.

Chapter Four:

Policies and Measures

4. Policies and Measures

4.1 Introduction

Ireland's policy-making process in the area of climate has undergone a significant evolution in recent years, recognising the need for increased ambition and concrete actions in order to achieve it. In acknowledgement of the need for a coordinated approach across the key sectors responsible for the emission reductions necessary to mitigate the impact of climate change, Ireland has pursued a whole-of-Government approach which this Chapter demonstrates. This Chapter opens with the legislative framework provided by the Climate Action and Low Carbon Development (Amendment) Act 2021, and gives a detailed breakdown of policies and measures at a cross-sectoral level, and in the areas of the built environment, transport, industry, renewable energy, agriculture, waste, forestry and peatlands. The Chapter gives an outline of the evolution of policy in each area and describes the measures in place at time of reporting in 2022.

4.2 Policy Making Process

4.2.1 Climate Action and Low Carbon Development (Amendment) Act 2021

In July 2021, the Climate Action and Low Carbon Development (Amendment) Act 2021 (hereafter, Climate Act 2021) was enacted and replaced its preceding Climate Action and Low Carbon Development Act 2015 (hereafter, Climate Act 2015) see 4.12, and significantly strengthened the statutory framework for governance of the climate challenge that had been set out in Climate Act 2015. The Climate Act 2021 binds Ireland to reducing its GHG emissions by 51% by 2030 relative to 2018 levels and to achieving net zero emissions by 2050.

The new framework set out in Climate Act 2021 requires the delivery of successive Climate Action Plans (CAPs) and National Long-term Climate Action Strategies, supported by a system of carbon budgeting and sectoral emission ceilings with appropriate oversight by Government, the Oireachtas and the Climate Change Advisory Council (CCAC), the latter having been established under Climate Act 2015.

Government Ministers will be required each year to give an account of their performance in relation to their sectoral targets and actions before an Oireachtas Committee. This framework replaces the previous Annual Transition Statement (ATS) process. The Climate Act 2021 builds upon Climate Act 2015 by placing on a statutory basis a 'National Climate

Objective', which commits Ireland to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy. The Climate Act 2021 establishes a legally binding framework with clear targets and commitments set in law, and embedded on a statutory basis, the necessary structures and processes are to ensure we achieve our national, EU and international climate goals and obligations in the near and long term.

Policy actions for each sector, detailed in annual interactions of the CAPs, are monitored by the Department of the Taoiseach and DECC to ensure that they are being implemented fully and on time. The CAPs will be bolstered by the National Long Term Climate Action Strategy which will be prepared every five years.

At a national level, the Climate Act 2021 states that Government Ministers are responsible for achieving the legally-binding targets for their own sectoral area with each Minister accounting for their performance towards sectoral targets and actions before an Oireachtas Committee each year.

At local government level, local authorities are required under the Climate Act 2021 to prepare their own CAPs, which will include both mitigation and adaptation measures and be updated every five years. Local Authority Development Plans will also align with the Local Authorities' CAPs. Public Bodies will be obliged to perform their functions in a manner consistent with national climate plans and strategies, and furthering the achievement of the national climate objective.

The Climate Act 2021 also strengthens the role of the CCAC, tasking it with preparing and submitting proposed carbon budgets to the Minister for their consideration. To support this role the CCAC has been expanded from eleven to fourteen members, and there are provisions that future appointments to the CCAC provide for improved gender balance and a greater range of relevant expertise.

The above arrangements detail how Ireland ensures compliance with commitments under the Kyoto Protocol. These administrative procedures (such as the annual revision to the CAP and Ministerial responsibility for sectors) act as review mechanisms and opportunities to re-adjust or refocus actions to ensure that targets and commitments under the Kyoto Protocol are achieved by the State.

4.2.2 Carbon Budgets and Sectoral Emission Ceilings

Under the Climate Act 2021, Ireland is obligated to establish a system of carbon budgeting with a 'carbon budget programme' comprising three five-year budgets that set a limit, on an

economy-wide basis, for the amount of GHGs that can be emitted in that period. The carbon budgets are supplemented by sectoral emissions ceilings, which apportion the economy-wide carbon budget across the relevant sectors, and determine what each sector may contribute in a given five-year period.

In line with the process set out in the Climate Act 2021, a carbon budget programme proposed by the CCAC was approved by Government on 21 February 2022, and subsequently adopted by both Houses of the Oireachtas, coming into effect on 6 April 2022. The programme comprises three successive carbon budgets for the periods 2021-2025, 2026-2030, and 2031-2035 (provisional). The average annual reduction proposed over the first five years is 4.8%; for the second period it is 8.3%; and for the final provisional period it is 3.5%.

Following on from the approval of the carbon budgets, the Minister of the Environment, Climate and Communications engaged with all relevant Government Departments and Agencies to prepare sectoral emissions ceilings for Government review and approval. This engagement was informed and supported by the procurement of additional external technical support, as well as modelling support from members of the Climate Action Modelling Group. The proposed sectoral emissions ceilings were approved by the Government on 28 July 2022. The next annual CAP, which is due to be published by the end of 2022, will reflect the legally binding carbon budgets and sectoral emissions ceilings, and provide a roadmap of actions to ensure compliance. Government Ministers will be responsible for achieving the targets for their own sectoral area, with each Minister accounting for their performance towards sectoral targets and actions before an Oireachtas Committee each year.

4.2.3 Monitoring and Evaluation of Policies and Measures

i. Climate Action Plan – Progress Reports

Ireland's CAPs provide a roadmap to reduce our GHG emissions and tackle the climate crisis. They provide specific actions that Government Departments, Agencies and public bodies will take across sectors, together with a timeline for the completion of each action. Quarterly reporting on the progress made for each of the actions and measures within the CAP is undertaken by the Department of the Taoiseach. These progress reports are provided to Government in advance of being published on the gov.ie website - Climate Action Plan Progress Reports (www.gov.ie). The latest Progress Report details progress made on 277 climate action measures due for delivery in Q2 2022.

ii. Climate Change Advisory Council

The CCAC is an independent advisory body tasked with assessing and advising on how Ireland can achieve the transition to a low-carbon, climate-resilient and environmentally sustainable economy. It works to provide contributions in critiquing, informing and shaping Ireland's response to climate change. As part of this work, the Council provides regular reports regarding Ireland's progress in achieving its national policy goals and greenhouse gas emissions targets agreed by the EU. The CCAC, which was established under Climate Act 2015, had its role strengthened by the Climate Act 2021.

Each year the CCAC reviews and reports on progress made during the immediately preceding year in achieving GHG emissions reductions. A report is then submitted to the Minister for the Environment, Climate and Communications, no later than 30 days after the completion of the review. Following the publication of this annual report, relevant Ministers are required to give account to an Oireachtas Committee on performance, both in implementing CAP actions and in adhering to their sector's emissions ceiling under the carbon budget period.

iii. Cabinet Committee on Environment and Climate Change

The Cabinet Committee on Environment and Climate Change oversees the implementation of Government commitments in relation to the environment and climate change. These include the implementation of the Climate Act 2021; just transition; agriculture and land-use considerations; access to finance for climate action; the development of a national retrofitting plan; and the progression to a higher rate of renewable energy. In addition, the Committee considers progress made on the implementation of the current CAP, and the planning which is now underway to develop the next iteration of that plan. The Committee, supported by the associated Climate Action Delivery Board and Senior Officials Group, is central to climate policy formulation and implementation on a whole-of-Government basis.

iv. Climate Action Delivery Board

The Climate Action Delivery Board is a group of Secretaries General of Government departments who are responsible for actions under the CAP. It monitors the extent to which these actions are being achieved and it reports on progress to Government each quarter. In addition, the Board will monitor implementation of the carbon budgets and sectoral emissions ceilings.

4.3 Policies and Measures at the National Level

4.3.1 Climate Action Plan 2021

With the enactment of the Climate Act 2021, there is now a vastly strengthened and much more detailed architecture – both statutory and administrative – of policy development, delivery and accountability for climate action than previously existed in Ireland. The CAP has been placed on a statutory footing, with required annual updates to focus on the near- and medium-term time horizon.

The Climate Action Plan 2021 (CAP21) was published in November 2021. It provides indicative ranges of emissions reductions for each sector of the economy out to 2030 and sets out the actions needed for Ireland to deliver on its climate targets. An accompanying Annex of Actions was published in December 2021 and this document provides detailed implementation maps for actions, including specific timelines and clear lines of responsibility for delivery by the relevant Department or Agency. This will ensure Ireland delivers on the statutory commitments laid out in the Climate Act 2021, including achieving our 2030 targets, preparing for climate neutrality by 2050 at the latest, and making Ireland a leader in responding to climate change.

CAP21 represents a significant step-up in terms of ambition and implementation. Some of the most significant measures include commitments to:

- Increase the proportion of renewable electricity to up to 80% by 2030, including an increased target of up to 5 Gigawatts of offshore wind energy
- Significantly reduce transport emissions by 2030 - Measures will include enabling 500,000 extra walking, cycling and public transport journeys per day by 2030, and supporting the take-up of electric vehicles to reach almost one million by 2030
- Implement a new National Retrofit Plan to increase supply capacity and make retrofitting more affordable
- Ensure a faster uptake of carbon-neutral heating, increased electrification of high-temperature heating and the phasing out of high global warming potential F-Gases in the Enterprise sector
- Reduce emissions associated with agriculture. This will be central to achieving Ireland's climate ambition: the Plan provides a pathway to reduce emissions while supporting world-class food production, through an innovation and science-based approach.

CAP21 also places just transition at its core. It commits Ireland to establishing a Just Transition Commission, which will make periodic recommendations to the Government,

building on research, engagement through the National Dialogue on Climate Action, and the annual review from the CCAC, on how Government policy can further the just transition. The Department of the Taoiseach monitors progress made against the actions and associated measures listed in the Annex of Actions and leads the preparation of delivery reports on the Plan. At the end of each quarter a delivery report is compiled and provided to Government, ahead of its publication. The most recently published quarterly progress report on the Interim Climate Actions, which has since been replaced by the CAP21, shows a delivery rate of 64%. Streamlining of the reporting process to distinguish between key actions that deliver significant emissions abatement and supporting actions is ongoing. This allows for greater transparency on progress towards decarbonisation.

In 2022 a new CAP will be developed to provide an update on the progress made in meeting Ireland's national climate objective and will seek to identify any challenges or obstacles in relation to this progress. The indicative ranges of emissions reductions for each sector, as set out in CAP21, will become specific ceilings in the next Plan, following the legal adoption of carbon budgets and sectoral emissions ceilings. As part of the process in 2022 to prepare and publish the next iteration of the CAP, the DECC will, in the coming months, engage proactively with the public, key stakeholders, and other Government Departments to ensure transparency and ownership.

4.3.2 National Long Term Climate Action Strategy

Under the Governance of the Energy Union and Climate Action Regulation, Ireland must submit a Long-Term Climate Action Strategy, identifying measures and pathways towards decarbonisation by 2050. Furthermore, the Climate Act 2021 establishes a significantly strengthened legally binding framework with clear targets and commitments set in law, including a national requirement to produce a Long-Term Climate Strategy, not less than once every five years, and consistent with Ireland's legally binding target of carbon neutrality by 2050.

Ireland's Long-Term Climate Action Strategy currently under preparation, will reflect Ireland's enhanced and statutory national climate ambition. Building on the decarbonisation pathways to 2030 set out by the carbon budgets and the CAP, and to be reflected in an updated National Energy and Climate Plan. Ireland's Long-Term Climate Action Strategy will identify additional measures and indicative pathways beyond 2030, towards achieving carbon neutrality in 2050, underpinned by analysis of transition options across key sectors of the

economy. It will inform future policy making, business investment decisions and household, community and citizen action.

Achieving net zero emissions by 2050 will require a transformational level of change across the economy and across society. While all of society must act together towards this objective, it is clear that the costs of climate action will be more acutely felt by some than by others. Ireland's Long-Term Climate Strategy is based firmly on just transition principles and will support the Programme for Government commitment to protect those most vulnerable and to ensuring a just transition to a low carbon economy.

4.3.3 National Planning Framework

In 2020 Ireland finalised the National Planning Framework: Ireland 2040, which provides a strategic planning and development framework for Ireland and all its regions for the period between now and 2040, setting a high-level strategy for the coordination of a range of national, regional and local policies and activities, planning and investment, for delivery through both the public and private sectors. Such a framework plays a key role in directing climate change mitigation and adaptation actions at national, regional and local levels.

The National Planning Framework seeks to support national targets for emissions reduction and objectives for climate change mitigation and adaptation by ensuring that climate change considerations are further integrated into the planning system, and that they continue to be taken into account as a matter of course in planning-related decision-making processes.

4.3.4 National Development Plan

The review of Ireland's National Development Plan (NDP) was brought forward from 2022 and completed in time for a revised plan running from 2021 – 2030, with an investment package of €165 billion. The revised NDP sets out the ten year capital ceilings to 2030 which will support economic, social, environmental and cultural development across all parts of the country under Project Ireland 2040, in parallel with the NPF which sets the overarching spatial strategy for the next twenty years. The alignment of the NDP and NPF under Project Ireland 2040 creates a unified and coherent plan for the country by ensuring our investment strategy supports spatial planning behind a shared set of strategic objectives for rural, regional and urban development.

The revised NDP measures underwent climate and environmental assessment for the first time, along with a further assessment of the NDP as a whole with the framing of a green recovery plan.

4.4 Cross-Sectoral Policies and Measures

4.4.1 Carbon Tax

In 2020 the Irish Government introduced legislation that set out a planned trajectory of carbon tax increases to 2030. The Finance Act 2020 provides for an annual schedule of carbon tax increases from €26/tonne in 2020 to €100/tonne in 2030. The rate of tax is currently €41/tonne. The carbon tax is applied to fossil fuels that are currently outside the scope of the EU Emission Trading Scheme (ETS). Installations operating within the EU ETS are exempt from the carbon tax as they already face a carbon price for their emissions. Carbon pricing will have a key role to play in Ireland's transition to a low carbon economy and has been recognised by the CCAC as an important tool for Ireland to achieve its decarbonisation objective in a cost-effective manner by 2050.

Revenue from the increases in the carbon tax is ring-fenced for climate action purposes and is a key part of funding a just transition through:

- Targeted social welfare payment increases that protect vulnerable households against fuel poverty;
- Funding a socially progressive national residential retrofit programme; and,
- Partial funding a Rural Environment Protection Scheme programme that encourages the uptake of greener and more sustainable farming practices.

The planned carbon tax increases may allow for an additional €9.5 billion in revenue up to 2030. €5 billion of the expected additional revenue will underpin an ambitious National Residential Retrofit Plan, that aims to retrofit 500,000 dwellings to BER B2/cost optimal or carbon equivalent by 2030. €1.5 billion of funding will be made available over the same period for new schemes that will incentivise farmers to farm in a green and more sustainable manner. The remaining €3 billion will be used to finance direct welfare payments to low-income households. The Government will continue to make decisions on specific measures each year as part of the annual budgetary cycle.

4.4.2 EU Emissions Trading Scheme

The EU ETS is a cornerstone of the EU's policy to combat climate change and for reducing GHG emissions in a cost-effective manner. The EU ETS was launched in 2005 and is now in its fourth phase covering the period 2021-2030. The EU ETS operates in all EU countries plus Iceland, Liechtenstein and Norway and covers approximately 40% of the EU's GHG

emissions. It covers CO₂ emissions from electricity and heat generation, energy-intensive industries, and commercial aviation within the EEA. Nitrous oxide emissions and perfluorocarbons are also included in the regulations, but Ireland does have installations associated with these emissions.

In Ireland the EU ETS covers 108 stationary installations in addition to aircraft operators. These installations are involved in activities including dairy, refining, power generation, and the production of cement, alumina, lime, and pharmaceutical goods.

In 2020 emissions in the stationary EU ETS sector decreased by 6.1%¹ to 13.3 Mt CO₂ equivalent. The EU ETS has proven to be an effective tool in driving emissions reductions cost-effectively. Although the EU ETS covers around 40% of EU emissions, only 20% of total emissions in Ireland fall under the regime, reflecting our smaller heavy industrial base. The EU ETS is currently designed to deliver a reduction of 43% of emissions EU-wide by 2030.

4.4.3 Effort Sharing Decision

Emissions outside the EU ETS are legislated for under the EU Effort Sharing Decision (ESD), Decision 406/2009/EC. The ESD sets binding annual greenhouse gas emissions targets for EU Member States covering the period 2013 to 2020. Of the sectors covered by the ESD, Agriculture and Transport make up the bulk of Ireland's emissions, accounting for a combined total of 71.3% of total ESD emissions in 2020.

Under the ESD, binding annual GHG emissions targets are set for EU Member States covering the period 2013 to 2020 for the year 2020, the target set for Ireland is that emissions covered by the ESD should be 20% below 2005 levels. Following a review of Ireland's 2020 emissions inventory by the European Commission in June 2022, it was calculated that Ireland's cumulative shortfall to meeting its ESD obligations over the period 2013 to 2020 is 12.36MtCO₂eq. This shortfall is reflective of both the country's constrained investment capacity over the past decade and the extremely challenging nature of the target itself, which was one of the most demanding 2020 reduction targets allocated to EU Member States under this Decision.

Notwithstanding the gap to Ireland's 2020 target, the legislative framework of the ESD provides for a number of compliance options beyond direct emissions reductions to enable Member States to comply with their annual emissions targets. These include using banked

¹ EPA Provisional 1990-2021 Inventory Data, <https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions-data/#:~:text=In%202020%2C%20Ireland's%20GHG%20emissions,for%202019%20compared%20to%202018>

excess allowances from earlier years, purchasing international carbon credits, and trading surplus allowances between Member States.

As a result of the option to bank allowances, Ireland was fully compliant with annual emissions targets from 2013 to 2018. For 2019, Ireland was compliant through use of 5.3 million international credits, and for 2020, Ireland will purchase additional credits/ allowances to comply as the projected shortfall to the target is 7.1 MtCO₂eq.

4.4.4 Flexible Mechanisms of the Kyoto Protocol

In order to meet Ireland's obligations under the first commitment period of the Kyoto Protocol (2008-2012), Ireland established a carbon fund, under the Carbon Fund Act 2007, for the purchase of carbon units on behalf of the State and designated the National Treasury Management Agency (NTMA) as the Irish Government's purchasing agent. Any units purchased were intended to supplement domestic climate mitigation action.

Ireland's strategy for achieving its Kyoto target for reducing greenhouse gas emissions was set out in the National Climate Change Strategy 2007-2012, published in April 2007. An assessment of the cross-sectoral measures in place at that time under the National Climate Change Strategy suggested that Ireland would require the use of flexible mechanisms including the purchase of Kyoto Protocol units – now generally referred to as 'carbon credits' – in order to comply with its targets. Accordingly, Ireland invested in three funds created by the World Bank and the European Bank for Reconstruction and Development and, via the NTMA, purchased 5,255,000 carbon credits directly from the market during 2008 and 2009. The subsequent economic downturn reduced the requirement for these units significantly. A number of carbon credits received from the investments in multilateral funds were surrendered in 2015 in order to comply with our targets under the first commitment period of the Kyoto Protocol (2008-2012). The remaining carbon credits not surrendered (5.3 million) were carried forward to the second commitment period (2013-2020) with further purchases were made between 2019-2021.

As of 1 January 2022, the State held 8.2 million ESD-eligible international credits in its national registry for use in complying with its targets under the ESD. To comply with the 2019 ESD target, 5.3 million units were utilised in early 2022. This means that at present, the State holds 2.9 million ESD-eligible credits. These will be used to assist in compliance with the 2020 ESD annual target.

4.4.5 Accelerated Capital Allowances

The Accelerated Capital Allowance (ACA) is an Irish tax incentive scheme that promotes investment in energy efficient products and equipment. The ACA is based on Ireland's long-standing 'Wear and Tear Allowance' for investment in capital plant and machinery, whereby capital depreciation can be compensated through a reduction in an organisation's tax liability. The ACA scheme allows a sole trader, farmer or company that pays corporation tax in Ireland to deduct the full cost of the equipment from their profits in the year of purchase. As a result, the reduction in tax paid by the organisation in that year is currently 12.5% of the value of capital expenditure. By contrast, the Wear and Tear Allowance provides the same tax reduction, but this is spread evenly over an eight-year period.

The Minister for the Environment, Climate and Communications, with the consent of the Minister for Finance, designates equipment as allowable under this scheme. The Triple E Product Register as administered by the SEAI is a database of approved energy efficient products for ACA. Another driver for energy efficient products is the European Union Energy Efficient Public Procurement Regulations 2011. These require public bodies to only procure equipment or vehicles that are listed on the Triple E Product Register. Products procured from 1st January 2022, for equipment directly operated by fossil fuels are no longer eligible for the ACA tax incentive for energy efficient equipment.

4.4.6 Spatial Policy Measures

Good spatial planning has the potential to deliver emission reductions through developing integrated and efficient transport systems that reduce dependence on the private car. Ireland's National Spatial Strategy, published in 2002 and covering the period to 2020, aimed to improve the balance of social, economic and physical development across Ireland by providing a framework for planning at national, regional and local level.

The National Spatial Strategy was superseded in February 2018 by the launch of Project Ireland 2040. This overarching policy initiative consists of a National Planning Framework (NPF) which sets out a spatial strategy for the country, and a national infrastructure investment programme, the NDP. Project Ireland 2040 includes a national strategic outcome of the transition to a low-carbon and climate-resilient society, in line with Ireland's national policy position, and sets out a planned €21.8 billion investment over the 2018-2027 period. This will seek to reduce Ireland's carbon emissions over the period to 2030 and to ensure that Ireland is on a sustainable trajectory towards securing our climate targets. The initiative adopts a cross-sectoral approach encompassing taxation measures, expenditure, regulation

and behavioural change, targeting emissions from the transport, energy and agriculture sectors while also recognising the need to invest in climate resilience including substantial investment in flood relief schemes to minimise the impact of river and coastal flooding. The NPF is based on a set of values that will ensure Ireland's long term economic, environmental and social progress for all parts of our country. In framing a new way forward, the NPF draws upon lessons learned from the National Spatial Strategy and highlights a vision of success based on better choices compared to a 'business as usual' approach. The ultimate objective of the NPF is to guide the future development of Ireland, taking into account a projected 1 million increase in the country's population, the need to create 660,000 additional jobs to achieve full employment and a need for 550,000 more homes by 2040;

- Of the 1 million extra people,
 - 25% of the population increase is planned for Dublin, recognised as the country's key international and global city of scale and principal economic driver,
 - 25% is planned across Ireland's other four cities combined (Cork, Limerick, Galway and Waterford), enabling all four to grow their population and jobs by 50-60%, and become cities of greater scale, i.e. growing by twice as much as they did over the previous 25 years to 2016, and
 - The remaining 50% of growth will occur in key regional centres, towns, villages and rural areas, to be determined in the forthcoming regional plans – Regional Spatial and Economic Strategies (RSESs).
- The NPF aims to enable people to live closer to where they work, moving away from the current unsustainable trends of increased commuting;
- The NPF will regenerate rural Ireland by promoting environmentally sustainable growth patterns;
- The NPF plans for and will implement a better distribution of regional growth, in terms of jobs and prosperity;
- The NPF aims to transform settlements of all sizes through imaginative urban regeneration and bring life / jobs back into cities, towns and villages;
- The NPF will coordinate delivery of infrastructure and services in tandem with growth, through a joined-up NPF/National Investment Plan and consistent sectoral plans, which will help to manage this growth and tackle congestion and quality of life issues in Dublin and elsewhere.

The location of schools, jobs, shops, local services and other land uses relative to the location of residential developments are critical determinants of the need to travel, the distances to be travelled and the modes of transport chosen. The provision of sustainable transport alternatives can only be effective if matched with complementary development patterns which support and facilitate their use. Public transport use and modal shift can be encouraged through efficient planning.

4.4.7 Carbon Pricing

Carbon pricing is a key pillar of Ireland's overall decarbonisation strategy, and in that regard CAP21 reiterates the Government's commitment to carbon pricing playing a key role in supporting the transition to a low-carbon economy.

Finance Act 2020 set a statutory trajectory to increase the carbon tax in steps to reach €100 per tonne by 2030. This provides a clear signal as well as price certainty to consumers, businesses and investors alike. In line with this trajectory, Budget 2022 included an increase of €7.50, from €33.50 to €41.00 per tonne.

The planned carbon tax increases are expected to raise an additional €9.5 billion in revenue over the period to 2030. This revenue is being allocated to programmes such as energy efficient retrofits (€5 billion), addressing fuel poverty and providing for a just transition (€3 billion) as well as the promotion of sustainable agriculture practices (€1.5 billion).

Carbon tax revenue of €412 million has been allocated to the programmes below for 2022:

- €174 million on targeted social welfare and other initiatives to prevent fuel poverty and ensure a just transition;
- €202 million to part fund a national retrofitting programme targeting all homes, but with a particular emphasis on households in or at risk of energy poverty; and
- €36 million to other sectors to support programmes such as peatlands rehabilitation and the Midlands Just Transition Fund.

4.4.8 Electric Vehicle Incentives

Through Budgets 2021 and 2022, a suite of taxation measures have been introduced to promote electric and low emission vehicles and to dis-incentivise fossil fuel vehicles. These include:

- The strengthening of the environmental rationale of the vehicle registration tax (VRT) and motor tax regime through the introduction of a modified new structure of rates

and bands which have been adjusted to take account of the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) emission testing system. Budget 2022 introduced further increases in the rates of VRT, which are to be applicable from January 2022.

- The €5,000 VRT relief for Battery Electric vehicles is being extended to 31 December 2023².
- Extension of ACA for gas vehicles and refuelling equipment to 2024 and to include hydrogen powered vehicles/equipment.
- Further adjustments introduced to the Nitrogen Oxide (also known as NOx) surcharge bands so that higher NOx emitting vehicles will pay more.

4.4.9 Electricity Generation Sector

Finance Act 2021 introduced a tax disregard with respect to household income from selling residual electricity from micro-generation back to the grid. More specifically, section 20 of Finance Act 2021 inserted a new section 216D into the Taxes Consolidation Act 1997 to provide for an exemption of up to €200 from income tax, universal social charge (USC) and pay-related social insurance (PRSI) for certain profits arising to a qualifying individual who generates energy from renewable, sustainable or alternative energy sources for their own consumption. The profits which are exempted are those profits from the generation of residual electricity at an individual's qualifying residence, with an estimated cost of €1 million.

4.4.10 Enterprise Sector

Budget 2021 saw the extension of the ACA scheme for Energy Efficient Equipment. The ACA scheme is designed to improve energy efficiency among Irish companies and unincorporated businesses. The ACA scheme allows taxpayers to deduct the full cost of expenditure on eligible energy efficient equipment from taxable profits in the year of purchase. The scheme was reviewed in accordance with guidelines for best practice for the evaluation of tax expenditures. Following this review, the Minister has agreed that the scheme will be extended until 31 December 2023.

In Budget 2022 the ACA scheme was amended to prohibit equipment directly operated by fossil fuels from qualifying for the scheme.

² Revenue, Calculating Vehicle Registration Tax (VRT), <https://www.revenue.ie/en/importing-vehicles-duty-free-allowances/guide-to-vrt/calculating-vrt/electric-hybrid-vehicles.aspx>

4.4.11 Sustainable Finance

i. Green Bonds

In 2018, the NTMA issued Ireland's first Sovereign Green Bond (ISGB) of €3 billion to provide a new funding channel for green projects aimed at mitigating climate change. These were issued using the Green Bond Principles (2018 version) developed by the International Capital Market Association and underpinned by the ISGB Framework³. An amount equal to the net proceeds of any ISGB are allocated to finance new projects, or to refinance existing projects, where the relevant project qualifies as an Eligible Green Project on the basis set out in the ISGB Framework. The NTMA reports strong demand for the ISGB, with additional issuances bringing the total raised to over €6 billion. The pipeline for eligible green expenditure also remains strong. The NTMA will continue to support the Government's climate agenda through engagement with the sovereign green bond market.

Building on the inaugural issue of €3 billion in 2018 and a syndicated tap of €2 billion in 2019, in September 2020, the NTMA held its first auction of the ISGB as part of its regular benchmark bond issuance program. There was €1 billion nominal sold in the competitive phase of the auction with bids of €1.82 billion in total. There was an additional €100.6 million nominal sold in the non-competitive phase of the auction. A further tap in November 2021 of €750 million nominal increased the total amount outstanding to €6.85 billion nominal. Under the CAP21, the NTMA has committed to monitor market developments and consider opportunities for issuance of new ISGB to complement the State's eligible green projects.

ii. Ireland for Finance

Sustainable finance is one of the five themes of the Government's strategy for the further development of the international financial services sector, 'Ireland for Finance', which was launched in April 2019 and which strives to make Ireland a true leader in this field. The aim is to further enhance and deepen the base of expertise and activity in sustainable finance that we already have in Ireland. Actions delivered include:

- A national sustainable finance roadmap setting out where we aim to be in 2025 and how to get there;
- Engaging at the EU level on sustainable finance proposals, and internationally on the sustainability agenda;

³ National Treasury Management Area Ireland, Irish Sovereign Green Bond Framework <https://www.ntma.ie/wp-content/uploads/2018/09/Irish-Sovereign-Green-Bond-Framework.pdf>

- Delivering and developing training and educational programmes in sustainable finance; and
- Hosting Climate Finance Week and Sustainable Finance Development Day events annually.

iii. Fossil Fuel Subsidies

CAP21 commits us to undertake a review of fossil fuel subsidies, specifically actions 66 and 259 outlined below.

Action 66 seeks to continue to reform budgetary processes and procedures to provide transparency on the Government's financial commitments to the climate change agenda. The steps to achieving this are;

- Developing and publishing a methodology to identify expenditures that are having a negative impact on emissions and identifying these expenditures through the budgetary process on an ongoing basis, to be completed by Q4 2021,
- Refining and applying methodologies to assess impact of Government spending on climate and environmental outcomes in line with international best practice and emerging evidence, to be completed by Q4 2022,
- Developing a new Performance Budgeting Framework encompassing climate as one of the criteria to be assessed, to be completed by Q3 2023.

Action 259 seeks to develop a road map for review and transition away from fossil fuel tax subsidies in transport sector. The steps to achieving this are;

- A review of existing fossil fuel subsidies, to be completed by Q3 2023, and
- Adoption of a road map at Government level to transition away from fossil fuel subsidies, to be completed by Q1 2024

4.5 Built Environment

4.5.1 New Buildings

i. More Energy Efficient Building Regulations

Part L – Conservation of Fuel and Energy in Buildings, one of twelve parts comprising the Second Schedule to the Building Regulations, is in place to limit the energy use and carbon dioxide emissions from a building as far as is practicable and requires an energy performance and carbon dioxide emissions performance to meet the cost optimal level of energy

performance as required by the Energy Performance of Buildings Directive 2010/31/EU. This is recognised as an advanced energy performance requirement for buildings.

The Energy Performance of Buildings Directive requires that all new buildings (public and private) are Nearly Zero Energy Buildings (NZEB) by 2020.

Part L of the Building Regulations for Dwellings and for Buildings other than Dwellings set the NZEB performance requirements for all new buildings. For dwellings, this represents a 70% improvement in energy performance when compared with the 2005 Part L requirements. These measures are bringing about significant reductions in carbon emissions from all new dwellings completed after the 1st November 2019. For buildings other than dwellings, this represents in the order of 60% improvement in energy performance compared with the 2008 Part L requirements. These measures will bring about significant reductions in carbon emissions from all new buildings other than dwellings completed after the 1st January 2019.

4.5.2 Existing Buildings

DECC provides a wide range of supports, including capital grants to help the residential and non-residential sectors improve the energy efficiency of their buildings. These various supports are administered by the SEAI, Ireland's national sustainable energy authority.

i. Public Sector Buildings

The CAP21 sets specific energy and emissions reduction targets and requirements for the public sector to achieve by 2030:

- 50% energy efficiency improvement (target increased from 33% by 2020).
- 51% CO₂eq. emissions reduction target.
- Action to develop an approach to cost effectively retrofit the public sector buildings stock with a focus on emissions reduction.
- Commitment that the public sector will not install heating systems that use fossil fuels after 2023 (certain exceptions apply).

Ireland achieved a 34.1% improvement in energy efficiency performance by end 2020, exceeding the 2020 target of 33%.

ii. Public Sector Energy Efficiency Programme

This energy management and advisory programme offers comprehensive support and engagement to the public sector, focussing on embedding energy management and capacity building and supporting over 350 public bodies and 4,000 schools in achieving these targets.

The Public Sector Pathfinder Programme (an element of the Public Sector Energy Efficiency Programme) is a capital support fund for public sector energy efficiency and the decarbonisation of the sector's building stock. The Programme is targeted at those large public bodies, or sectors of public bodies, where retrofit activity can be coordinated centrally, and is aimed at developing building retrofit approaches and models that can be replicated across the wider public sector.

The Programme is co-funded by the DECC and a number of partners and is administered by the SEAI. Current partners include the Department of Education, the Higher Education Authority, the Office of Public Works (OPW), Local Authorities and the Health Service Executive. In the period 2017 to 2021, the programme supported retrofit works in over 370 buildings.

iii. Residential and Community Retrofit

The Climate Act 2021 commits Ireland to reach a legally binding target of net zero emissions no later than 2050, and a cut of 51% by 2030 (compared to 2018 levels). CAP21 set a goal to reduce greenhouse gas emissions from the residential sector from 7 Mt CO₂eq. in 2018 to between 3.5-4.5 Mt CO₂eq. in 2030.

As part of the achievement of this goal, the Programme for Government and CAP set ambitious targets to retrofit the equivalent of 500,000 homes to a BER of B2/cost optimal or carbon equivalent and the installation of 400,000 heat pumps in existing homes to replace older, less efficient heating systems by end-2030. This represents approximately 30% of the housing stock and is among the most ambitious retrofit programmes worldwide.

iv. National Retrofit Plan

The National Retrofit Plan, which was published as part of CAP21, sets out how the government will deliver on our retrofit targets. The Plan is designed to address barriers to retrofit across four key pillars: driving demand and activity; financing and funding; supply chain, skills and standards; and governance. For each pillar, barriers were identified and time-bound policies, measures and actions were put in place to address them. The initiatives in the Plan were guided by a number of key principles:

- Fairness: ensuring fairness to all and supporting a just transition
- Universality: covering all housing types and consumer segments/income deciles
- Customer-centric: designing customer centric solutions to reduce the costs and hassle, making the process easier for those investing in retrofit
- Cost-optimal: encouraging retrofits to cost-optimal level and maximising emissions abatement

- Industry-led: stimulating and supporting industry confidence to invest, grow and take on more workers

The NDP committed to an unprecedented level of investment in residential retrofit and provided clarity on the annual funding allocations for the coming years, giving the industry a major confidence boost to plan and expand. The overall NDP allocation to the DECCs for residential retrofit will be approximately €8 billion to 2030, of which €5 billion will be allocated from carbon tax receipts.

The annual allocations will primarily be used to fund the expansion and enhancement of SEAI residential and community retrofit schemes, including energy poverty schemes as well as other initiatives to support retrofit. The investment committed to 2030 will enable the supply chain to scale up, creating thousands of high-quality jobs and delivering on this critical national objective

v. SEAI Residential and Community Grant Schemes

National Home Energy Upgrade Scheme

In February 2022, Government announced a package of supports to make it easier and more affordable for homeowners to undertake home energy upgrades, for warmer, healthier and more comfortable homes, with lower energy bills. The measures address barriers to undertaking energy upgrades (retrofits) reported by homeowners and those working in the industry. They also reflect the step-change needed – in pace and scale of delivery – to build toward achieving our ambitious target of 500,000 home energy upgrades, to B2 BER standard, in this decade. The changes represent an important step in delivery of the National Retrofit Plan, which identifies a range of measures aimed at driving demand for retrofit, expanding the size and capacity of the supply chain, as well as making retrofits more affordable.

One such measure is the new National Home Energy Upgrade Scheme which offers increased grant levels of up to 50% of the cost of a typical B2 home energy upgrade with a heat pump (up from the current level of 30-35%). The scheme introduces a new way to undertake home energy upgrades with One-Stop-Shops providing an end-to-end service for homeowners. This includes surveying the home; designing the upgrades; managing the grant process; helping with access to finance; engaging contractors to deliver the work; and quality assuring the work.

Homes and apartments, built and occupied before 2011, and owned by private homeowners, non-corporate landlords and Approved Housing Bodies are eligible for the scheme. This provides an unprecedented opportunity for people all over Ireland to upgrade to a warmer, healthier and more comfortable home, with lower energy bills.

Grants for homeowners that want to take a step-by-step approach to upgrading their homes have also been significantly increased in line with the National Home Energy Upgrade Scheme.

Free Energy Upgrades

The Better Energy Warmer Homes Scheme delivers a range of energy efficiency measures free of charge to low-income households vulnerable to energy poverty. The primary aim of the scheme is to provide upgrades to those living in, or at risk of, energy poverty. Eligible homes are allocated on a first-come, first-served basis. This approach ensures consistency and fairness in the management of a demand-led scheme, which offers upgrades to often very vulnerable homeowners.

A budget allocation €118 million has been allocated to the energy poverty schemes this year. Additional funding has also been sought through the European Regional Development Fund. This funding will support an increase in the number of free home upgrades, from an average of 177 per month in 2021 to 400 per month in 2022.

In addition, €85 million funding has been provided by the Minister for Housing, Local Government and Heritage for the Local Authority Energy Efficiency Retrofit Programme. This investment is targeted to deliver 2,400 B2 (or equivalent cost optimal) upgrades this year.

Community Energy Grant Scheme

The Communities Energy Grant Scheme funds community-based partnerships to improve the energy efficiency of the building stock in their area. Funding is available for public, commercial, community buildings including Public Sector Organisations, Housing Associations & Local Authorities, private energy poor households, private non-energy poor households and rental properties.

The Sustainable Energy Communities (SEC) Programme supports the low carbon energy transition by developing skills and capacity, at a community level, in determining how to use less energy, adopting lower carbon options for transport and heating, shifting energy use to off-peak times or investing in smart technologies.

Based on feedback from the network of communities, and in order to facilitate more local sustainable energy activation, a targeted and more streamlined strand of the Communities Grant Scheme focused on smaller projects for retrofitting homes will also be introduced in Q2, 2022.

Retrofit Loan Guarantee

The National Retrofit Plan commits to the introduction of a new residential retrofit loan guarantee scheme. The Department is working with the Strategic Banking Corporation of Ireland (SBCI), Department of Finance, SEAI, the NTMA, the European Investment Bank and

financial institutions to develop the scheme. The loan guarantee will provide risk protection to retail credit institutions participating in the scheme. This will enable credit institutions to offer loans with reduced interest rates to private homeowners and non-corporate landlords and make comprehensive home energy efficiency upgrades more affordable to consumers. A Pre-qualification call to potential lenders to participate in the Retrofit Loan Guarantee Scheme has now concluded and the invitation stage will soon begin. This represents a major milestone in the development of the retrofit loan guarantee scheme. The Scheme will be made available by end 2022.

Measures to address skill constraints

The Expert Group on Future Skills Needs report 'Skills for Zero Carbon – the Demand for Renewable Energy, residential Retrofit and Electric Vehicle Deployment Skills to 2030' published in November 2021 indicated that the number of Full Time Equivalent workers engaged in carrying out retrofits will need to increase rapidly to approximately 17,000 by the middle of the decade to deliver on the Government targets. The report also makes recommendations to ensure that the future skills needs of activities supporting the transition to a low carbon economy, including home energy retrofit, are fully addressed by stakeholders through the education and training system and any other relevant sources of skills supply. A further report now in preparation for SOLAS will also focus on approaches to green skills provision.

The Government is confident that the provision of €8 billion in funding for retrofitting under the NDP up to 2030, with clarity on the annual allocations for the coming years, should give companies the confidence they need to hire extra staff, plan for the long-term and expand into what is now being transformed into an always on key sector of our economy. The growth and higher profile of this sector should also help to encourage school leavers and those looking at changing jobs to consider a career in retrofitting as they can be assured there will be well-paid work in this sector for the next decade and beyond.

The new SEAI grant scheme processes and expansion of the Local Authority Retrofit Programme are transforming what was previously a stop start sector into an always on key sector of the economy. This will also greatly increase the capacity of the sector to deliver increased numbers of retrofits.

The range of measures in the National Retrofit Plan will encourage new entrants to the retrofit market as well as incentivising existing market players to grow. SEAI will also work with these businesses to encourage them to avail of the range of supports available through the Local Enterprise Offices (LEOs), which include financial supports, training programmes and mentoring.

4.6 Transport

4.6.1 Changes in Transport Journeys and Future Investment in Infrastructure

Project Ireland 2040 sets out both the planned spatial development and investment framework for the coming years, through the NPF and the NDP. To underpin transport-led development and a stronger focus on transport decisions through a climate lens and to support achieving the National Strategic Outcomes (NSOs) of the NPF, the Department of Transport published a new investment framework for land transport, the National Investment Framework for Transport in Ireland (NIFTI), in December 2021. In recognition of the importance of achieving our Climate goals, Decarbonisation is one of the four Investment Priorities set out in NIFTI. All new investments planned for the transport sector will have to demonstrate their alignment with these priorities in order to be considered for funding. NIFTI also requires new investments to be considered in the framework of a Modal Hierarchy, which promotes the consideration of active travel solutions first, followed by public transport and ahead of solutions reliant on private transport. Within the NPF / NDP framework, Government has committed to major investments in improving the efficiency, effectiveness, and sustainability of the transport network. The investment committed to within the NDP will result in the delivery of a number of significant projects and programmes, such as heavy rail maintenance and renewal; BusConnects programme of improved bus services and infrastructure in all major cities, including significantly enhanced cycling facilities; MetroLink; and DART+ (formerly DART Expansion) programme. The following sets out progress on key public transport projects and programmes; enhanced supports for active travel; progress on the implementation of an overarching Sustainable Mobility Policy (published April 2022), and the work to develop a better understanding of the most appropriate demand management options for towns and cities across Ireland.

The Department of Transport is focused on the promotion of walking and cycling through the provision of funding for infrastructure as well as behavioural change programmes to encourage the use of more sustainable transport modes. The Programme for Government committed that €360 million in cross-Government funding will be spent on walking and cycling per annum over the lifetime of the Government, equivalent to 20% of the entire transport budget. This investment will help support the planned delivery of almost 1,000 kilometres of improved walking and cycling infrastructure by 2025 as well as additional investment in Greenways.

The move away from private car use and towards active travel has numerous benefits, from contributing to the decarbonisation of the transport sector to improving mental and physical health. In order to encourage this modal shift towards walking and cycling, a certain amount of innovation is needed. In 2021 the Department of Transport in partnership with the Department of Education launched the Safe Routes to School programme which looked to provide funding to accelerate the delivery of walking and cycling infrastructure on key access routes to schools.

In addition to the increased funding for walking and cycling infrastructure, multiple behavioural change programmes are being progressed by the Department to support and promote efforts to increase active travel. The Department of Transport funds the delivery of CycleRight training through Cycling Ireland, which delivers cycling training to school-children around the country in addition to funding the travel theme of the Green-Schools Programme, which has the ultimate aim of increasing the number of pupils walking, cycling, scooting, carpooling, using public transport or using 'park 'n' stride' instead of the private car on the school run.

There has been a rise in the popularity of e-Bikes and the benefits they provide to those using them for commuting or recreational purposes. To this end, the Bike-to-Work scheme, a tax incentive scheme which encourages employees to cycle to work, was broadened in 2020 to allow for the purchase of an e-Bike.

In 2021 the Department of Transport launched a joint initiative with the Department of Rural and Community Development which is providing high-quality up-cycled bicycles and e-bikes for those on low incomes and those who are most marginalised and disadvantaged. This scheme will have the triple benefit of recycling old or disused bicycles, making them available to those on low incomes, and the creation of jobs in communities around the country.

In December 2019, in line with Action 81 of the CAP19, the Department of Transport, Tourism and Sport commissioned a Transport Demand Management Study. The purpose of the Study was to identify transport demand drivers in Dublin, Cork, Waterford, Limerick and Galway, and to assess the impact and suitability of an array of different demand management measures for each city.

The Study focused on addressing four main challenges facing our cities: decarbonisation, air quality, congestion, and improving the overall urban environment. The Study is evidence-based using insight from an extensive international best practice review, national and local stakeholder engagement and supported by detailed qualitative (Phase 1) and quantitative (Phase 2) appraisal.

The three priority measures that were recommended for implementation across the five cities are:

- Develop and embed the concept of 15-minute neighbourhoods through national and local plans and strategies, providing resources to incentivise their implementation through national funding/grants schemes.
- Enhance delivery of the NPF.
- Public Parking Controls.

Importantly, the Study has also made clear that there is no single solution to tackling the challenges facing our urban environments. Utilising an integrated Travel Demand Management approach to policy development, land use planning and delivery of transport infrastructure and services will be fundamental to addressing these challenges in the coming years.

In line with CAP21 commitments to advance demand management measures, the Department of Transport has developed associated actions in its Sustainable Mobility Policy including a commitment to develop an approach to demand management taking account of the aforementioned Study and to develop a demand management scheme for the Greater Dublin Area in 2023. The new National Sustainable Mobility Policy sets out a strategic framework to 2030 for active travel and public transport to support the requirement to achieve a 51% reduction in carbon emissions by the end of this decade. It builds on and replaces existing active travel and public transport policy as set out in the 2009 policy documents, *Smarter Travel: A Sustainable Transport Future* and the *National Cycle Policy Framework*.

The targets of the policy were aligned with the transport target metrics in CAP 2021 of 500,000 additional daily active travel and public transport journeys and a 10% reduction in kilometres driven by fossil fuelled cars by 2030. It is noted that the policy acknowledges that these targets would be subject to review pending further updates to the Climate Action Plan to account for the carbon budget programme and sectoral emissions ceilings, which were expected to increase the level of ambition required. The policy is primarily focused on measures to promote and facilitate active travel and public transport for all and, in doing so, encourage less private car usage nationally and particularly to, from, and within our towns and cities. It includes a comprehensive set of actions to be completed by 2025 to increase walking and cycling infrastructure provision and improve public transport capacity and services across the country. A Leadership Group oversees the delivery of the policy's actions and targets; supported by an SMP Delivery Team which will identify a series of 'pathfinder' projects to demonstrate the opportunities from sustainable mobility interventions and build

capacity for accelerated replication and scaling-up. The SMP Pathfinder Programme will have a strong emphasis on experimental and innovative approaches, and to be delivered at pace (by 2025). Many of the projects will incorporate aspects of road space reallocation, shared mobility, rural community-based transport solutions, behavioural change, and communications. They will also meet key criteria on issues such as health, well-being, place-making, permeability, and universal design.

These will be supported by behavioural change and demand management measures to make sustainable modes the preferred choice for as many people as possible. A further action plan will then be developed to cover the remaining period of the policy out to 2030.

The CAP21 sets out additional measures to promote other complementary transport mitigation measures such as the switch over to electric car usage and greater use of renewable fuels for transport including freight.

The new Sustainable Mobility Policy will be underpinned by funding under the NDP which provides €35 billion for transport over the next decade. This will support the commencement of the major public transport projects of BusConnects in the five cities (Cork, Dublin, Galway, Limerick and Waterford), DART+ and Metrolink in Dublin along with increased investment in the inter-urban and regional rail network. This will be complemented by expanded public transport services including in rural and regional areas under Connecting Ireland, which is the NTA's programme to provide better bus connections between villages and towns and enhanced connectivity to regional centres and cities.

The freight sector, which is critical to economic activity in an island economy, is heavily dependent on imported oil. Switching to alternative fuels and technologies will be essential to decarbonise the sector but progress in the development of such technologies has been slower than in other sectors. The Government has developed a 10-year strategy for the haulage sector that will focus on generating efficiencies and improving standards, and helping the sector move to a low-carbon future.

Alternative fuels and biofuels will be an important transitional measure in the decarbonising of transport and current focus in the freight sector is on transitioning to low emission fuels, such as compressed natural gas (CNG) and Hydrotreated Vegetable Oil (HVO). In order to support the transition to low emission vehicles, Gas Networks Ireland (GNI) has begun rolling out CNG refuelling infrastructure throughout the country as part of its Causeway and its Green Connect Projects.

The high initial cost of investing in low or zero emission trucks is also a deterrent. However, the Government is providing incentives to the sector to make the transition. The Alternative Fuel Heavy Duty Vehicle (AFHDV) Purchase Grant Scheme is administered by Transport

Infrastructure Ireland (TII) and is intended to help bridge some of the difference in purchase price between conventional HDVs and those powered by alternatively fuelled powertrains. A reduced toll regime for alternatively fuelled HGVs, as well as a wear-and-tear capital allowance scheme, is also in place to help support the uptake of more environmentally friendly trucks. The Government has also agreed to maintain a low excise rate for natural gas and biogas for a period of eight years (starting from 2017) to facilitate the uptake of CNG and natural gas technologies and the acceleration of indigenous renewable biogas production. The Renewable Fuels for Transport Policy Statement sets out a future increase in the use of biofuels in road transport to 20% biodiesel (B20) and 10% bioethanol (E10) by 2030, as well as a range of measures and incentives for future supply of renewable fuels such as biomethane and green hydrogen.

The provision of Eco-Driver training is also an important step towards the decarbonisation of the haulage sector as it helps teach hauliers to drive their vehicles in a safer and more eco-friendly manner. This training, which has been proven to lead to a significant reduction in fuel consumption and related carbon emissions, not only benefits the environment, but also generates cost savings and improved efficiencies for haulage companies. The 10-year Haulage Strategy will consider further how to support and advance eco-driving schemes across the road freight sector.

The Department has also commissioned a number of studies to identify actions that haulage operators and companies can take to reduce carbon and other emissions. Collectively, these projects will form a substantial evidence base on which a longer-term decarbonisation strategy can be developed.

4.6.2 Improving Energy Efficiencies in the Public Transport System

Within public transport a number of energy saving initiatives have been undertaken by service providers/operators through adopting various technological solutions and instigating driver behaviour change programmes.

Bus Eireann's fleet upgrade programme advanced significantly in 2021, with over 200 new, more energy efficient, and cleaner emission vehicles joining the fleet, across both public service obligations (NTA funded) and inter-urban Expressway. This included for the first time 59 hybrid double-deck buses, using regenerative braking with on-board batteries. These vehicles have delivered fuel savings of approximately 20% on routes where they operate, with corresponding CO₂ emission reductions. 63% of the Bus Eireann service fleet is now at

the Euro VI cleaner emission standard. The transition to alternative fuel sources is actively being planned as part of the transport decarbonisation strategy to meet Ireland's CAP targets. A shift to more sustainable travel modes is a significant part of the strategy. The first battery electric town bus service will be introduced in early 2023 in Athlone and three hydrogen fuel-cell electric double deck vehicles have entered service on a Dublin commuter route as part of a significant trial of this technology. A new buildings energy improvement programme has been developed as part of Bus Éireann's new Sustainability Strategy, adopted in 2021. Improvements to facilities and bus stations such as LED lighting upgrades, solar PV and better building insulation are key parts of that strategy. The innovative Eco Drive fleet telematics initiative continues to make progress and is now fitted to all of Bus Éireann's service fleet, emphasising energy efficiency in driving techniques amongst our 2,000 drivers. Through the measures outlined above, Bus Éireann continued to consistently improve its energy efficiency over the period, as reported through the public sector monitoring and reporting (PSMR) performance reporting system.

For Dublin Bus, modal shift was on track with continued passenger growth in 2019 and then the pandemic saw passenger numbers drop off significantly due to public health measures & restrictions. As we emerge from the pandemic, modal shift is key to improving reduced traffic levels, emissions and journey times. Regained confidence is needed to encourage people out of private cars and onto public transport. Fleet renewal & investment are still prominent. Procurement of low & zero emission fleet is high priority but with more emphasis on the zero emission as this allows for future proofing and attributes to CAP21 targets. Further development of infrastructure & long term planning will help deliver goals and by showing commitment and delivering projects, this will inform and open the market to new technologies and different vehicle manufactures. Dublin Bus objectives include:

- Deliver on NTA's plans to have the urban bus fleet fully electrified by 2035, this is a large scale project which required long term planning and forecasting
- Introduction of full battery electric buses will overall improve efficiency drastically but also in terms of fleet renewal
- ECO driving is addressed through ongoing Certificate of Professional Competence (CPC) driver training
- The new plug-in hybrid double decks produce 30% less greenhouse gas emissions with improved fuel efficiency

With respect to rail, with assistance of Climate Action Funding, Iarnród Éireann have completed the implementation of an improved "lock-up" dual clutch automatic transmission

for the ICR 22000 fleet on a single prototype vehicle. The transmission has demonstrated savings of +10% in tests and the 22000 fleet represents +40% of the energy consumption for the company.

This trial also facilitates conversion to a hybrid vehicle where the hybrid pack will collect regenerative energy and store electric energy to permit electric-only running within urban areas. This will have the added benefit of reducing emissions (both noise and exhaust gases). Engine components are under manufacture to facilitate trials and the initial hybrid drive trial is scheduled for 2023. As part of the increased electrification of our rail network, a framework order has been placed for 750 new electric vehicles (EMU) and battery electric vehicles (BEMU). The first order for 65 x BEMU vehicles and 30 x EMU vehicles was placed in 2021. The 10-year supply framework also permits the order of trains powered by traction battery to permit up to 50km operation in areas without overhead electrification thus facilitating an earlier move to carbon free public transport. Other energy saving initiatives include the continued application of Envirox fuel additive, the introduction of B7 biofuel into the CIE Group mix, the increased roll-out of EV rapid chargers, and the replacement diesel generators on the Enterprise train with improved emissions friendly generator sets. It is estimated that collectively through modal shift to sustainable travel means, improved behaviour and infrastructure, Iarnród Éireann can achieve a savings figure of 30 kt CO₂eq by 2030.

4.6.3 Implementation of EU Regulations and Rebalancing VRT and Motor Tax

EU legislation sets mandatory emission reduction targets for new cars and vans sold in Europe. Since 2008, to achieve the maximum impact of the EU drive to reduce vehicle emissions, Irish vehicles registration and annual motor taxation systems have been based on CO₂ emissions. The tax changes had an immediate and substantial positive effect in changing buyer behaviour encouraging the take up of low CO₂ emission vehicles, with those choosing to purchase lower-emission vehicles paying less in VRT and motor tax. The original banding structure was based on 7 tax bands (A-G). In 2013 further revisions to the banding structure for motor tax were implemented, splitting the lowest CO₂ Band 'A' (1 - 120g/km) into four new bands and Band 'B' (121 - 140g/km) into two new bands. A zero emissions band for electric vehicles was also introduced for motor tax purposes.

Motor tax rates for vehicles registered on or after 1 January 2021 are based on the CO₂ levels established using the more stringent emissions test, the Worldwide Light Vehicle Test Procedure (WLTP). A new tax table was opened for these vehicles, breaking the banding

structure down into 16 separate bands. The revised banding recognises that ever more fuel-efficient cars are becoming available and allows for the differentiation of the environmental incentive in favour of the most environmentally friendly vehicles now and into the future.

There has been a marked change in the proportion of new cars purchased within the lower emission bands. New private cars sold in the lowest emitting A bands rose from just 7.65% in 2008 to 72% in 2020. However, for 2021, CO₂ based on WLTP has brought about a reduction in the proportion of new vehicles falling into the A bands (electric and vehicles with CO₂ emissions of 120g/km or less) to 38%, and an increase in vehicles falling into the B bands (44% in 2021 versus 22.5% in 2020). For 2022, corresponding percentages to the end of August were 46% new passenger vehicles purchased in the A bands for the year to that point, and 43% in the B bands.

4.6.4 Steps Taken to reduce emissions of GHGs in Marine bunker fuels

Ireland is an active participant in multilateral efforts to limit and reduce GHG emissions in the maritime sector through the negotiation and securing of worldwide agreements at the International Maritime Organisation (IMO) and through regional measures as the European Union.

Through active engagement at the EU and the IMO, Ireland has sought maximum ambition in the reduction of emissions from shipping, including maritime fuels. This has been Ireland's negotiation position in relation to the 'Fit for 55' package of environmental measures currently being negotiated at the EU.

Ireland is a member of the "Shipping High Ambition Coalition", which is made up of a number of EU and third country states promoting ambitious targets for Maritime GHG emission reductions within the IMO's Marine Environment Protection Committee (MEPC). Ireland also attends and contributes to the European Sustainable Shipping Forum, the IMO Intersessional Working Group on Greenhouse Gases and the MEPC.

Ireland is a co-sponsor of an EU proposal on introducing a global GHG fuel standard for maritime fuels (ISWG-GHG 12-3-3). This paper will be discussed further at MEPC 79 which takes place in December 2022. Ireland enforces the IMO 2020 exhaust emissions regulations, a cap on the sulphur content of fuel leading to reduction of the resultant Nitrogen and Sulphur Oxide emissions.

There is a need to develop net zero operational GHG non-fossil fuels via a combination of bioenergy and renewable fuels, hydrogen and its derivatives. To this end Ireland has also

endorsed the Getting to Zero Coalition, an industry-led and private sector driven initiative to stimulate decarbonisation.

Finally, Ireland is one of the signatories of the Clydebank Declaration which aims to establish green shipping corridors.

4.6.5 Steps Taken to Reduce emissions of GHG's in Aviation

Ireland, along with all EU and European Civil Aviation Conference (ECAC) Member States, has committed to participate in CORSIA from the pilot phase onwards. Ireland continues to honour its commitments in this respect by reporting emissions data to the International Civil Aviation Organisation (ICAO through the CORSIA Central Registry. Ireland's Department of Transport and the EPA share responsibility for CORSIA, overseeing policy and implementation, respectively.

Ireland continues to participate in the EU ETS for Aviation and continues to advocate for its strengthening in EU discussions on the Revision of the ETS Directive. A General Approach was agreed by the Council of the European Union on 28th June 2022 and the trilogue process is due to commence in September 2022. Ireland has also been supportive of the EU's proposed ReFuel Initiative which aims to mandate the use of Sustainable Aviation Fuel (SAF) across the EU with increasing levels of blended drop in fuel from 2025 onwards. The Council of the European Union reached a General Approach on this file on 2nd June 2022 and the trilogue process is due to commence in September 2022.

Ireland's Air Navigation Service Provider (ANSP), the Irish Aviation Authority (IAA), continues to be among the most efficient ANSPs in Europe and has placed sustainability at the heart of its corporate strategy. Ireland continues to advocate for reform of the Single European Sky Initiative at EU level. This could generate fuel savings (and corresponding environmental benefits) of up to 10%. Ireland's State Action Plan on Aviation Emissions Reduction outlines actions at the national and supra-national level to mitigate impacts of aviation emissions.

4.6.6 Incentives to Encourage Alternative Fuel and Technologies

Providing a sustainable, low-carbon transport system is a key priority of the Department of Transport. The recently agreed sectoral emissions ceilings commits the Transport sector to reduce their emissions by 50% in 2030; ultimately, the goal is for a zero-emission mobility system by 2050. Electrification and the use of biofuels as a transitional measure will be key to achieving this objective in the transport sector. The development of the electric charging and renewable refuelling network is expected to be progressed in coordination with

mandatory targets that will be set under the forthcoming EU's Alternative Fuels Infrastructure Regulation, which also contains provisions for the long-term promotion of alternative fuels in the aviation and maritime sectors.

Electric vehicles (EVs) are the most prominent transport mitigation measure in CAP21 and Ireland has set an ambitious target of 945,000 EVs on our roads by 2030. This target is challenging but indicates the scale of the transformation that is needed across all sectors if Ireland is to achieve its climate targets in the coming years.

Considerable progress has been made, as a result of the work of the Low Emission Vehicle Taskforce, to ensure that conditions and policies are in place to support citizens in making greener vehicle choices. A comprehensive suite of measures is available to EV drivers, including purchase grants for private car owners and taxi drivers, VRT relief, reduced tolls, home charger grants, favourable motor and BIK tax rates, as well as a comprehensive charging network. These measures have collectively contributed to an increased take up of EVs in Ireland in recent years, albeit from a low base of 3,799 in 2017, to approx. 61,000 at end-May 2022.

In addition, the Department convened the Electric Vehicle Policy Pathway (EVPP) Working Group to produce a roadmap to achieving the 2030 EV target. The EVPP Working Group comprises senior officials and has considered regulatory, financial, and taxation policies to help drive a significant ramp-up in passenger EVs and electric van sales. The recommendations of the EVPP Working Group were approved by Government and the full report is available online.

The Working Group examined the issue of price parity between EVs and internal combustion engine (ICE) vehicles. The Report finds that there is divergence within the research community as to when total cost of ownership (TCO) in economic terms cost parity will be achieved with some studies estimating that it is likely to occur in the middle of this decade, driven by falling battery prices and savings due to economies of scale, while others argue that the crossover point may not occur until towards the end of the decade.

In the meantime, in order to support the transition to EVs, the Group recommended that:

- The generous suite of EV supports already in place in Ireland should be retained until at least end-2022. Additional measures to further incentivise EVs and/or disincentivise fossil fuelled vehicles will also be necessary. Cost-effective, targeted policy supports should continue to be developed and strengthened over the coming years; and
- An Office for Low Emission Vehicles should be established, as a matter of priority, to co-ordinate the implementation of existing and future EV measures and

infrastructure. The new Office should also take charge of developing and launching an extensive communication and engagement campaign, whole-of-Government in coverage, to drive the availability and understanding of key information regarding EVs, tailored to household, business and public sector consumers.

As per the EVPP recommendation, the Office for Low Emission Vehicles was established in July 2022, named Zero Emission Vehicles Ireland (ZEVI) to reflect the ultimate ambition, to oversee Ireland's transition to zero emission vehicles. The Office will lead on matters relating to the delivery of the Government's climate action goals relating to electric vehicles, namely that Ireland will have c. 945,000 electric vehicles in the fleet by 2030, the majority being passenger cars. ZEVI has been established within the Department of Transport for the first number of years, bringing in expertise from a number of government agencies to assist in the delivery of EV policy and infrastructure objectives, including TII, NTA and SEAI. ZEVI will work across government, industry, and society to support the transition to zero emission vehicles. Its operations will include:

- supports for the uptake of zero emission vehicles
- infrastructure delivery through funding and policy guidance
- strategy and policy lead, including taxation and regulation
- research and innovation
- communications and public and stakeholder engagement

The Government is fully committed to supporting a significant expansion and modernisation of the electric vehicle charging network over the coming years. A draft national charging infrastructure strategy was published for public consultation in early 2022, with a final strategy expected to be published in early 2023 and which will set out the pathway to stay ahead of demand over the critical period out to 2030.

A report was published by the consumer contact management association (CCMA) on the provision of guidance to local authorities on the provision of charging infrastructure.⁴

In terms of existing supports for public charging, the Public Charge Point Scheme has been implemented and continues to be available during 2021 to provide local authorities with a grant of up to €5,000 to support the development of on-street public chargers. The primary focus of the scheme is to provide support for the installation of infrastructure which will facilitate owners of electric vehicles, who do not have access to a private parking space, but

⁴Local Authority Electrification of Fleet and EV Charging Guidance Document, August 2021, <https://www.lgma.ie/en/publications/general-publications/local-authority-electrification-of-fleet-and-ev-charging-guidance.pdf>

instead rely on parking their vehicles in public places near their homes to charge their EVs. The Department is reviewing the Scheme at present to ensure that it is as effective as possible in driving the decarbonisation effort.

Having an effective and reliable recharging network is essential to enabling drivers to choose electric. Charging at home is the most convenient and cheapest way to recharge. Targeting the installation of smart home chargers is a priority as we look to moving towards more energy efficient and sustainable ways to charge. A grant is available from the SEAI for those individuals seeking to install a home charger.

Since July 2022, a new scheme has been implemented to provide for the installation of EV charging infrastructure at shared parking in apartment blocks and similar developments.⁵

There is also a need for a seamless public charging network that will provide for situations or instances where home charging is not possible such as on-street and residential charging, destination charging, and workplace charging.

€10 million was committed from the Climate Action Fund to support ESB investment in the charging network and this has leveraged a further €10 million investment from ESB, with the infrastructure to be in place by the end of 2022. This intervention alone will result in:

- 90 additional high-power chargers, each capable of charging two vehicles. 17 high-power chargers distributed across 14 multi-vehicle hubs have been delivered as part of the programme to date.
- 52 additional fast chargers, which may replace existing standard chargers. This work is completed at 36 locations.
- 264 replacement standard chargers with more modern technology and with each consisting of two charge points. This work is substantially complete. 258 of the chargers have now been successfully replaced.

Further details on the progression of this project can be found online.⁶

ZEVI is also planning a new scheme which will support the installation of destination charge points in locations such as hotels, visitor centres and parks. This new initiative will help provide another critical link in the overall network for public charging.

To promote the decarbonisation of the heavy-duty sector, and to assist road transport companies to transition from fossil fuels, the Department launched a new Alternatively-Fuelled Heavy-Duty Vehicle (AFHDV) Purchase Grant Scheme on 15

⁵ SEAI Electric Vehicle Home Charger Grant, <https://www.seai.ie/grants/electric-vehicle-grants/electric-vehicle-home-charger-grant/>, SEAI Apartment Charging Grant, <https://www.seai.ie/grants/electric-vehicle-grants/apartment-charging-grant/>

⁶ <https://esb.ie/ecars/our-network/network-upgrades>.

March 2021. The Scheme supports the purchase of new large vans, trucks, buses and coaches.

The Scheme, which is administered by TII, is intended to help bridge some of the difference in purchase price between conventional HDVs and those powered by alternatively-fuelled power-trains that offer environmental benefits over standard diesel vehicle technologies, and that would not otherwise have been bought.

To accord with EU State Aid rules, grant levels under the Scheme are calculated as a percentage of the difference in price between a conventionally-fuelled diesel HDV and its alternatively-fuelled equivalent. Maximum grant levels for eligible vehicles depend on the size of the company or enterprise applying for the grant, and on the fuel-type of the vehicle that the applicant wishes to buy.

€2m was allocated to this scheme in 2021 and given the excellent response to the initiative, the Department allocated an additional €1m in funds to assist the heavy-duty vehicle sector in its transition to zero-mobility. Funds for 2021 were fully allocated and the scheme will continue in 2022.

In parallel, a network of 14 CNG refuelling stations and a renewable gas injection facility is being progressed. The roll-out of CNG refuelling infrastructure is being progressed by GNI through the Connecting Europe Facility (CEF) funded Causeway and Green Connect projects. The implementation of this infrastructure is ongoing, with first deployment phase of 14 stations (Causeway project) underway, with an injection point at Cush, Co. Kildare. A further 21 stations and 3 gas injection points to follow (under Green Connect).

Significantly, in 2019, Ireland committed to no longer procuring diesel-only buses for our urban public fleet. Since then, an array of alternatively-fuelled technologies have been assessed as part of the department's Low-Emission Bus Trials to determine their suitability for providing a reliable and low-carbon bus service. To better inform future bus purchasing decisions, between December 2018 and August 2021, the Department's Green Public Transport Fund was deployed to carry out a comprehensive series of bus trials in Dublin and Cork.

The trials evaluated the emissions and operational performance of a range of low-emission fuels and technologies (electric, hydrogen fuel-cell, diesel-hybrid, compressed natural gas/biogas and retrofitted diesel models) against a Euro VI diesel baseline. The initial findings of the trials were published in Q3 2019 in line with reporting commitments under the CAP.

The final report, including the results for the tests of hydrogen fuel-cell buses and an updated cost-benefit analysis, is due to be published in 2022.

The Department of Transport has also developed a scheme to incentivise the adoption of EVs within the taxi fleet. The aim of the Electric Small Public Service Vehicle (eSPSV) Grant Scheme is to increase the uptake of fully electric SPSVs and zero-emission capable wheelchair accessible SPSVs. It is aimed at improving air quality in urban areas, reducing the CO₂ emissions of a sector which typically has very high mileage. The scheme is also important in normalising the uptake of zero emission passenger cars by improving general perception and awareness of the benefits of electric vehicles.

In this context, the Electric Small Public Service Vehicle (eSPSV) Grant Scheme continued in 2022. The Scheme, which is administered by the NTA, provides enhanced supports up to €20,000 for eligible taxi and hackney drivers switching to EVs. €15 million was provided in 2022 year to support up to 750 taxi and hackney drivers in scrapping their older vehicles and replacing them with zero-emission capable electric alternatives. The scrappage scheme is open to taxis and hackneys reaching their maximum permissible age limit in 2020/21. Up to €20,000 is available for eligible drivers switching to a new all-electric vehicle and up to €32,500 for those moving to a wheelchair accessible full electric vehicle. The eSPSV infrastructure scheme was designed to encourage more taxi drivers to convert to electric vehicles. The project involves installing taxi dedicated electric vehicle chargers at major transport hubs nationwide. Funding was allocated in 2020 which saw chargers installed in Dublin (Heuston), Cork and Limerick (Colbert) train stations as well as Dublin and Cork airports. Additional funding was allocated in 2021 towards the installation of more SPSV dedicated fast EV recharging points at critical transport hubs. These charge points will be installed in 2022.

4.6.7 Biofuels Obligation Scheme and Renewable Fuels for Transport Policy

The Biofuels Obligation Scheme commenced on 1 July 2010 and is administered by the National Oil Reserves Agency. The Scheme was launched to ensure that a proportion of the transport fuel used in the State consists of environmentally sustainable biofuels by placing an obligation on suppliers of road transport fuels to ensure that a proportion of the fuels they place on the market here are produced from renewable sources. The initial rate of the obligation has increased over time from a share of 4.166% in 2010 to 13% by volume in 2022. In order to meet the overall decarbonisation in transport by 6-7MT CO₂eq by 2030,

16-18% of this carbon emission reduction (c1.1MTCO₂eq) will be achieved through an increase in biofuels in diesel and petrol.

The CAP21 target is to increase the proportion of biofuels in diesel to 20% (from the current B7 to a B20 blend) and the proportion of ethanol in petrol to 10% (from the current E5 to an E10 blend) by 2030. The biofuels currently in use in the transport sector in Ireland, and included in the scheme, are biodiesel (blended with diesel), bioethanol (blended with gasoline in petrol), and bioLPG and biomethane. The Department published 'A Review of Requirements and Constraints on Biofuels in Ireland' in October 2022 along with a summary report on the public consultation on the policy in 2022. The future approach for the next iteration of the policy on renewable transport fuel will be the focus of further consultation in early 2023.

In 2021, over 246 million litres of biofuels were placed on the Irish road transport fuel market, mainly biodiesel and ethanol and to a lesser extent bio-liquid petroleum gas (LPG). Small quantities of biomethane were also placed on the market. In 2021, biofuels in transport replaced c. 209 million litres of fossil fuels and avoided approximately 623ktCO₂eq of greenhouse gas emissions. By 2030, under the targets set out in the CAP21, biofuels will have delivered approximately 18% of the GHG reductions projected in the transport sector. The Minister for Transport published the Renewable Fuels for Transport Policy Statement in November 2021, (addressing CAP21 Action 280). The Policy Statement sets out the pathway for increasing the supply and use of renewable fuels in transport, including extending the biofuel obligation currently applied to road transport fuels to rail by 2024.

The Policy Statement also addresses Ireland's obligation under European directives to require increased supply of renewable fuels used in transport, such as hydrogen and biomethane. SI 350 of 2022, European Union (Renewable Energy) Regulations (2) 2022, transposed the recast Renewable Energy Directive (RED II) in July this year, which seeks to incentivise the development of advanced biofuels (i.e. from a broader suite of non-crop based feedstocks) and renewable fuels of non-biological origin, such as green hydrogen; with sub-targets for increasing the share of these fuels in land transport as well as aviation and maritime transport in the future. From January 2023 regulations will be established to include an advanced biofuel sub-target of 0.3% within the renewable transport fuel obligation on fuel suppliers in Ireland. Further regulations to further incentivise development fuels through multiple credits for their supply will be established in 2023 subject to enabling legislation.

The Policy Statement includes the following key elements:

- In support of the CAP target for 2030, the indicative trajectory of annual increase in the biofuel blending obligation rate to 2025, as well as the proposed increase in the buy-out charge applied if the biofuel obligation is not met through blending.
- Incentivising the transition to E10 (bioethanol blend in petrol) by 2023 (recognising that the UK applies an E10 mandate since 2021 and extended it to Northern Ireland in 2022).
- Further incentives from 2023 to develop the supply of advanced renewable fuels such as biomethane and green hydrogen.
- The commitment to ensure maintenance of the highest standards of sustainability of biofuel supply from source, including a review of the sustainability of biofuels and work being undertaken at European level to implement the Renewable Energy Directive II (REDII) database to enable the tracing of liquid and gaseous transport fuels.
- A more robust enforcement regime for non-compliance with the Fuel Quality Directive requirement to achieve 6% carbon intensity reduction in fuel supply for transport use.

4.6.8 The National Car Test (NCT)

The NCT is conducted every 2 years for vehicles 4 years and older, and annually for vehicles 10 years and older. This regular roadworthiness testing of cars is aimed at improving vehicle safety standards and includes a 'Tail Pipe Opacity Test' for diesel engines and an 'Exhaust Gas Analyser Test' for petrol vehicles. These tests determine, in as far as possible, if the engines are operating normally and are in compliance with Directive 2014/45/EU. Newer vehicles (of emission classes Euro 6 and Euro VI) are subject to an On-Board Diagnostics check, which further examines vehicle exhaust gases.

These checks help to reduce fuel consumption and the environmental impact of private vehicles used on Ireland's roads. HGV roadworthiness testing, which also include such 'Tail Pipe Opacity Tests' and 'Exhaust Gas Analyser Tests', are conducted through the Commercial Vehicles Roadworthiness Testing (CVRT) regime. 'Eco-driving' of HGVs has been encouraged by way of targeted projects within commercial fleets through Sustainable Energy Authority of Ireland projects.

4.7 Industry

4.7.1 EU Emissions Trading System

Participation in the EU ETS has played a significant role in curbing GHG emissions across Europe. The EU ETS is the main mechanism by which the EU aims to reduce industrial emissions. Its application in an Irish context, including to Irish industry, is outlined in Chapter 4.4.2.

4.7.2 Energy Efficiency in Industry

Ireland provides several state-funded supports for businesses to improve energy efficiency and decarbonise their activities. Some of these supports, such as the Accelerated Capital Allowance Scheme, are cross-sectoral and are outlined in Chapters 4.4.5. The SEAI is Ireland's national sustainable energy authority and works with industry to improve energy efficiency. The SEAI support energy audits, provide free training, and financial supports to businesses for adopting energy efficient practices. Ireland promotes energy efficiency in Industry through the following initiatives.

i. Large Industry Energy Network

The Large Industry Energy Network (LIEN) is a network of 196 of Ireland's largest energy users which are supported by the SEAI. The membership consists of companies with an annual energy spend of €1 million or more. The SEAI work with these companies to improve their energy performance. Special working groups within the Network have developed best practice guides on how to manage energy performance. LIEN members report annually on energy consumption and projects undertaken to help increase efficiency.

Members also have access to a range of best practice initiatives including networking events, case studies, training and awareness supports, guides and tools. Members are also encouraged to take a structured approach to energy management through support for the ISO50001 Standard.

All sectors reported an improvement in energy efficiency for 2020, compared to 2019. Based on the energy saving project data provided by the LIEN members, organisations reported 492 GWh of energy savings for 2020 which corresponds with approximately 142,000 tonnes of CO₂ reduction and a reduction of €17.6 million on their energy bills.

In 2020, the total primary energy requirement (TPER) from 170 reported companies was 25,455 GWh and the estimated TPER for all the active members was 30,270 GWh⁴. Energy spend was €953m for reported companies, with a total estimated energy spend of €1,127m

for all the active members. The TPER of the LIEN organisations accounted for approximately 18% of the national TPER.

ii. Excellence in Energy Efficiency Design

Excellence in Energy Efficiency Design (EXEED) is a program for companies planning a major investment and planning in an energy efficient design project. The EXEED Certified program aims to influence and deliver new best practices in energy efficient design management. EXEED designs, verifies, and manages optimum energy performance and management at the earliest stages of the lifecycle. The EXEED grant scheme supports organisations with the costs of embedding energy efficient design in their assets to reduce lifecycle impact, through lower energy use and carbon emissions. EXEED is supporting the replacement of fossil fuels with renewables in industrial processes and the development of standards for businesses to report on their environmental impact.

Under CAP21, there is a commitment to developing an approach to retrofit the existing commercial building stock, with the ultimate aim of achieving net zero emissions by 2050. Following the publication of the National Heat Study, work commenced on this action, using the information and outcomes from the SEAI National Heat Study, and the learnings and programme data from existing SEAI Schemes and Programmes, such as the Support Scheme for Energy Audits, to inform this approach.

4.7.3 Green Public Procurement

i. Green Public Procurement

Green Tenders – An Action Plan on Green Public Procurement⁷, published in 2012, is the first action plan on GPP in Ireland. Actions on GPP have featured prominently in more recent national Government policies and documents including:

- Climate Action Plan 2021
- Waste Action Plan for a Circular Economy
- Whole-of-Government Circular Economy Strategy
- Circular 20/2019: Promoting the use of Environmental and Social Considerations in Public Procurement⁸

The Programme for Government commits to progressing GPP objectives such as mandating the inclusion of green criteria in all procurements using public funds, to be completed within

⁷ <https://www.gov.ie/en/publication/74075-green-tenders-an-action-plan-on-green-public-procurement/#:~:text=Its%20overall%20objective%20is%20to,to%20boost%20green%20public%20procurement>

⁸ <https://www.gov.ie/en/publication/4221c-waste-action-plan-for-a-circular-economy/>

three years. In December 2021, Government approved the review of the 2012 'Green Tenders' and its implementation to be led by the Minister for the Environment, Climate and Communications. DECC has commenced the process of reviewing and updating Green Tenders – An Action Plan on Public Procurement.

The EPA has produced GPP guidance, Green Public Procurement: Guidance for the Public Sector⁹, which was published in September 2021. This follows a comprehensive review and update of the original guidance that was published in 2014. The guidance includes detailed criteria covering ten priority product and service groups¹⁰. The EPA has funded GPP training to over 200 public sector procurers from 100 different organisations between June 2020 and December 2021. Training supports on GPP to suppliers have also been developed by the EPA. CAP21 assigns lead responsibility to the EPA to report on GPP activity.

4.7.4 Bioeconomy

Ireland's vision for the bioeconomy was first set out in the National Policy Statement on the Bioeconomy in 2018. It stated that Ireland would aim to be a global leader for the bioeconomy through a coordinated approach, which would harness Ireland's natural resources and competitive advantage, while fully exploiting the opportunities available and while closely monitoring activities to avoid unintended consequences.

In the National Policy Statement Ireland set out the principles of the bioeconomy, which are of paramount importance to developing appropriate supporting policies. These principles aim to ensure that the bioeconomy operates as intended; sustainably, conscious of cascading values, with a precaution for our people and environment and with a 'food-first' objective.

- **Sustainability:** Environmental sustainability is an integral, core principle of the bioeconomy. Products developed must be sustainable. The volume and type of biomaterial extracted for use within the bioeconomy should not have a negative impact on our biological resources. It should not exceed the capacity of the environment to replenish itself and should cause no lasting damage to our environment. These should be regarded from a holistic view, taking account of all biomasses, including those in our soil. Activity in the bioeconomy should not degrade the resilience or biodiversity in the ecosystem.

⁹ <https://www.epa.ie/publications/circular-economy/resources/GPP-Guidance-for-the-Irish-Public-Sector.pdf>

¹⁰ Road Transport Vehicles and Services. ICT Product and Services. Food and Catering Services, Cleaning Products and Services, Office Buildings, Lighting, Heating Equipment, Energy related products, Paper Products and Printing Services, Textiles

- **Cascading Principle:** The principle of prioritising use through cascading the processes value, is essential for these activities. Higher value applications must be preferential to ensure that the maximum value is derived from biobased materials.
- **Precautionary Principle:** This principle ensures a risk management approach, to prevent policies or actions causing harm to the public or the environment. Innovation in the bioeconomy will depend on the sensible application of this principle and it should be informed by the latest scientific information and consensus.
- **Food First:** This principle gives priority to food and nutrition security by improving the availability of, and access to, a safe and healthy food supply for citizens.

These guiding principles reflect the broad array of activities within the bioeconomy which cuts across and interlinks with many sectors in our broader economy.

Since the publication of the National Policy Statement in 2018, policy development has continued across Government Departments and in our domestic bio-based industries. A High-Level Bioeconomy Implementation Group was established by the DECC and the Department of Agriculture, Food and the Marine (DAFM). The membership of this group includes Government Departments including the Department of Taoiseach, the Department of Transport, the Department of Enterprise, Trade and Employment (DETE), the Department of Public Expenditure and Reform (DPER), the Department of Rural and Community Development, the Department of Further and Higher Education, Research, Innovation and Science, the Department of Finance, the Department of Housing, Local Government and Heritage, the Department of Education, and also state agencies including Teagasc, Marine Institute, An Bord Iascaigh Mhara (BIMSEAI), the National Economic and Social Council (NESC), Science Foundation Ireland, the EPA, and Enterprise Ireland. The cross-cutting membership of this group reflects the broadness of our bioeconomy. This broad array of activities requires a consistent approach in policymaking. The High-Level Bioeconomy Implementation Group have centrally managed bioeconomy policy for the last number of years and will be instrumental in the delivery of supportive policies over the coming years. A number of other actions have been achieved since 2018, including the setting up of a National Bioeconomy Forum which consists of industry representatives, academics and experts in the bioeconomy. The Forum was established in July 2021 and has completed a significant body of work in the year since, producing a report with a list of recommendations for Government to consider.

CAP21 built on the progress made since 2018 by setting out various actions to support the bioeconomy in Ireland. These actions include developing a detailed Bioeconomy Action Plan,

which will include an update on the implementation of the 'National Bioeconomy Policy Statement'.

4.7.5 Circular Economy

i. Whole-of-Government Circular Economy Strategy 2022-2023

The Programme for Government, Our Shared Future, and the Waste Action Plan for a Circular Economy (WAPCE) committed to a range of actions to support the transition to a circular economy. 'The Whole-of-Government Circular Economy Strategy'¹¹ is Ireland's first national circular economy strategy. The purpose of this strategy is to set a course for Ireland to transition across all sectors and at all levels of Government toward circularity. The WAPCE shifted focus away from waste disposal and towards how we can preserve resources by creating a circular economy. This strategy further explores the opportunity for circularity across government and beyond, establishing a policy framework that can help turn a vision of circularity into tangible actions and results. The strategy is a key addition to the Government's drive to achieve a 51% reduction in overall GHG emissions by 2030 and to get on a path to reach net zero emissions by no later than 2050, as per commitments in the 'Programme for Government' and the Climate Act 2021.

The objectives of the strategy are as follows:

- To provide a national policy framework for Ireland's transition to a circular economy and to promote public sector leadership in adopting circular policies and practices
- To support and implement measures that significantly reduce Ireland's circularity gap, in both absolute terms and in comparison, with other EU Member States, so that Ireland's rate is above the EU average by 2030, such measures to address facets of sustainable production and consumption most impactful in an Irish context
- To raise awareness amongst households, business and individuals about the circular economy and how it can improve their lives
- To support and promote increased investment in the circular economy in Ireland with a view to delivering sustainable, regionally balanced economic growth and employment

- To identify and address the economic, regulatory, and social barriers to Ireland's transition to a more circular economy

ii. Circular Economy Programme 2021-2027

In December 2021, a new 'Circular Economy Programme'¹² was launched by the EPA. The 'Circular Economy Programme' incorporates and builds upon the previous National Waste Prevention Programme to support national-level, strategic programmes to prevent waste and drive the Circular Economy in Ireland.

Over the course of its six-year duration, the EPA's Circular Economy Programme will:

- Provide leadership on the circular economy to improve coherence and alignment of national, regional and local circular economy activities and ensure maximum impact;
- Maintain a competitive programme of supports to drive the circular economy through providing innovation grants and seed-funding to nationally relevant initiatives;
- Implement actions that build knowledge and an evidence base to inform circular economy development in Ireland, and to report on progress towards greater circularity;
- Realise the enterprise opportunity of a circular economy by supporting new business models; promoting resource efficiency; and retaining material value through enhanced use of secondary/recycled materials, applying the appropriate regulatory framework.

4.8 Renewable Energy – Electricity Generation and Heat Sector

i. National Heat Study

The Sustainable Energy Authority of Ireland (SEAI) published the [National Heat Study](#) on 22 February 2022. The Study contains detailed analysis which will now facilitate the development of options, policies and measures to decarbonise the heating and cooling sectors in Ireland to 2050 and will be a key input into the delivery of a number of actions contained in the Climate Action Plan 2022.

ii. Renewable Heat Obligation

The Department completed a public consultation in Q4 2021 on the potential introduction of a new Renewable Heat Obligation, which would, if introduced, require the suppliers of energy used in the heat sector in Ireland to ensure that a certain proportion of the energy

¹² The Circular Economy Programme 2021-2027, <https://www.epa.ie/publications/circular-economy/resources/the-circular-economy-programme-2021-2027.php>

supplied is renewable.¹³ All 50 of the submissions received in response to the consultation process are available to view on the Department's website.

Following the decision on the Sectoral Emissions Ceilings, Government has agreed to the introduction of an obligation on the heat sector to include renewable heat by 2024. The obligation will further incentivise suppliers of all fuels in the heat sector to ensure that a certain proportion of the energy supplied is renewable. The Department has commenced a scoping exercise to develop Scheme options which will form the basis of the next phase of stakeholder engagement, due to launch in Q1 2023.

4.8.1 Support Schemes for Renewable Electricity

Through the Climate Act 2021 and the NDP, the Government has committed to a binding target to reduce GHG emissions by 51% over the decade (2021 – 2030), to achieving net zero emissions by 2050 and increasing the share of electricity generated from renewable sources by up to 80% by 2030. An accelerated transition to renewable electricity will be key to successfully meeting the ambitious renewable energy and GHG emission reduction targets outlined in the European Green Deal and Ireland's CAP21. There are a range of support schemes for renewable electricity in place and in development in Ireland to enable us to achieve these targets, which will provide a comprehensive framework of supports for installations at micro-, small- and utility scale.

i. Solar PV Scheme

The SEAI launched a pilot micro-generation grant scheme in July 2018 to help domestic customers who install rooftop solar photovoltaic (PV) equipment on their homes. Grant supports for domestic solar PV installations will continue to be administered by the SEAI as part of the transition to the Micro-generation Support Scheme

ii. Micro-generation Support Scheme (MSS)

The Micro-generation Support Scheme (MSS) domestic solar PV grant scheme commenced on the 16th of February 2022. Domestic applicants can apply to the SEAI for a grant towards the cost of installing solar PV equipment, up to a maximum of €2,400 in 2022, with no minimum post-works Building Energy Rating (BER) requirement. SEAI will assess extending scheme to other (non solar) technologies in Q2 2022.

¹³ <https://www.gov.ie/en/press-release/83757-government-agrees-to-the-introduction-of-an-obligation-on-the-heat-sector-by-2024/>

As of end April 2022 there were 10,361 applications who received grant support over the lifetime of the scheme's with some €24.82 million spent to date, saving approx. 10,930 T of CO₂emission per annum.

The SEAI will extend the MSS grant scheme to non-domestic applicants in July 2022 for installations up to 6.0kW.

Non-domestic projects between 6kW and 50kW will receive a Clean Export Premium (CEP) tariff per kWh exported, for a period of 15 years, from their electricity supplier. The CEP will be €0.135/kWh in 2022. Any shortfall between the CEP tariff and wholesale electricity prices will be supported by the Public Service Obligation (PSO) levy. Exported volumes of electricity eligible for the CEP tariff will be capped at 80% of generation capacity to incentivise self-consumption

It is expected that the CEP will commence further to a public consultation on an implementation plan by the Commission for Regulation of Utilities (CRU) in Q3 2022.

All applicants under the MSS will also be eligible to receive the Clean Export Guarantee (CEG) tariff, for any exported electricity, at a competitive market rate from their electricity supplier

iii. Small-Scale Generation (SSG)

The CAP21 commits to the development of a support scheme for small-scale non-domestic renewable electricity generators (above 50kW, but smaller than those supported under the Renewable Electricity Support Scheme (RESS)).

This scheme will enable farmers, auto producers and communities to maximise their participation in the energy transition. The design of the scheme is being progressed in 2022 and it is expected to become available in 2023.

iv. Renewable Electricity Support Scheme (RESS)

CAP21 includes a suite of actions to realise the full potential of Ireland's onshore and offshore renewable energy resources including a commitment to the achievement of up to 8GW of installed onshore wind, up to 2.5GW of solar, and 5GW of installed offshore wind capacity by 2030. Additionally, there is a further commitment to develop a longer-term plan to harness the estimated potential of at least 30GW of offshore floating wind power in our Atlantic waters.

The RESS is one of the major Government policies to help deliver on the ambition in the CAP21 of up to 80% renewable electricity by 2030. The RESS is an auction-based support scheme which invites grid-scale renewable electricity generation projects to compete to receive a guaranteed price for the electricity they generate. Renewable energy delivered

under RESS will pay back to consumers when wholesale electricity prices are high through the PSO Levy.

The first projects from the first RESS auction (RESS 1), held in 2020, achieved commercial operation at the end of 2021, with Ireland's first large solar farm achieving commercial operation in April 2022. Over 1GW of new wind and solar generation was secured in the first RESS auction, and projects are expected to reach commercial operation before the end of 2023.

The second RESS auction (RESS 2) which took place recently, is expected to deliver an increase of nearly 20% in Ireland's renewable energy generation. Renewable energy delivered under the RESS 2 auction will shield consumers from high prices, reduce dependency on imported fossil fuels in the context of the phasing out of Russian energy imports across the EU and contribute to communities across the country.

Design of the RESS 3 onshore auction is also currently under development and terms and conditions on the first of three planned auctions this decade for the offshore Renewable Electricity Support Scheme (ORESS) are being finalised. A roadmap of future RESS auctions which sets out the indicative timelines and volumes for onshore and offshore auctions over the coming decade was published in December 2021.

Through the measures set out in the National Energy Security Framework and the CAP21, work is underway across Government to rapidly boost the supply of renewable energy generation to reduce our dependency on imported fossil fuels and delivering on our climate targets.

v. REFIT

Three REFIT schemes, namely REFIT 1, REFIT 2 and REFIT 3, have been in place in Ireland for a number of years. The REFIT schemes effectively provide a floor price for renewable electricity, guaranteeing a minimum return to investors in the various technologies. Different rates are set for different technologies and successful applicants must complete the development of their projects within a specified time period. REFIT 1, REFIT 2 and REFIT 3 will remain in place until 2027, 2032 and 2030 respectively, and are estimated to result in combined cumulative GHG emissions reductions of 59.09 MtCO₂eq over the period 2016 to 2030. The last REFIT scheme closed in December 2015 and was replaced in 2020 by the RESS.

4.8.2 Offshore Renewable Energy

CAP21 includes a suite of actions to realise the potential of Ireland's offshore renewable energy (ORE) potential, while the Programme for Government commits to the achievement of 5GW of installed offshore wind capacity as part of Ireland's commitment of up to 80% of our electricity generation from renewable sources by 2030 and a long-term plan to take advantage of a potential of at least 30GW of floating wind thereafter.

The Maritime Area Planning (MAP) Act was enacted and signed into law at end-2021 to provide for the licencing of the development of offshore renewable energy (ORE) projects in Ireland's maritime areas, previously limited to the 12 nautical mile foreshore area under the Foreshore Act (1933). The MAP Act provides a modern, efficient and Aarhus compliant regulatory and marine planning framework for ORE development. It replaces existing State and development consent regimes with a single consent principle to authorise usage of the maritime area, and one development consent (planning permission), with a single, robust environmental assessment. As one of the key features of the MAP Act, the Maritime Area Consent (MAC) is a first step in the new planning process. Under the first phase of the MAC, a pathway was provided to enable a select number of projects, which had advanced under the existing Foreshore regime and satisfy the definition of "relevant maritime usage" as set out under legislation, to transition to the new MAP regime once established. Under the special transition provisions in the MAP Act, the Minister for the Environment, Climate and Communications will have the responsibility for assessing and granting MACs for a first batch of offshore projects. An 8-week window opened on 25 April 2022 for MAC applications from projects satisfying the definition of "relevant maritime usage". The MAC represents a key milestone for projects, enabling them to progress their application for other requisite consents as well as development permission subject to the full assessment procedures by An Bord Pleanála. The first MACs are expected to be granted in the second half of 2022.

The first phase of offshore wind in Ireland will be necessary but not sufficient to reach our 2030 5GW ambition. An additional phase is required comprised of projects which can deliver by 2030 and before completing the transition to a plan-led Enduring regime. A consultation was closed in March 2022 which gathered views on the scale, make-up and sequencing of Phase Two of offshore wind deployment. Submissions are currently being reviewed and potential inclusion of an innovation category in the Phase 2 criteria is also being examined. The MAP Act also provides the establishment of a new agency Maritime Area Regulatory Authority (MARA) to regulate development. MARA will have four key roles: granting of all Maritime Area Consents (MACs) for the maritime area; granting Maritime licences for specific scheduled activities including environmental surveys; ensuring robust compliance and

enforcement measures; and managing the existing State Foreshore portfolio of leases and licences. The MAP Act provides that public participation is an absolute priority in plan and policy-making and in the assessment of all development proposals. The MAC procedures laid out in it are Aarhus-compliant in the context of the overall sequence of consents envisaged by the new regime.

Work has also commenced on an update of the Offshore Renewable Energy Development Plan (ORED P) first published in 2014, which will include a comprehensive review of available data on Ireland's maritime area and any potential gaps. Together with the National Marine Planning Framework (NMPF), Ireland's first marine spatial plan, ORED P II will provide a framework for the sustainable development of Ireland's offshore renewable energy resources and an evidence base for the assessment of zones or areas suitable for deployment of wind, wave, and tidal technologies in Ireland's Exclusive Economic Zone. This will include an assessment of other maritime activities and marine biodiversity. The ORED P II will also facilitate the future designation of Designated Maritime Area Plans (DMAPs) under the MAP Act 2021. The development of the ORED P II will involve a number of environmental assessments, including a Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA), to evaluate potential impacts and inform the direction of the ORED P II, and these will be the subject of public consultation. The ORED P II engages stakeholders from the public service, academia, industry, communities and civil society, and an Advisory Group is facilitating participation in the ORED P II process across economic, environmental, and social pillars.

Terms and conditions for offshore wind-specific auctions under the RESS are being drafted. Owing to the specific scale and nature of typical offshore wind farms, dedicated auctions are initially required to support the longer-term potential of this technology in Ireland. This approach, along with the RESS scheme itself, received state aid clearance in July 2020. At least three offshore auctions are currently planned for this decade. Following public consultation of the Draft ORESS 1 Terms and Conditions, published by the DECC, the Department issued a formal response to feedback received in May 2022, with final Terms and Conditions to be approved by Government in Q4 2022, ahead of launching the auction by year-end.

A new framework for Ireland's future offshore electricity transmission system was also approved by Government in April 2021, and provides for offshore grid development, operation and ownership. The framework provides for a phased transition from the current decentralised offshore transmission system model to a centralised model over the course of this decade, as part of the wider transition towards a Plan-Led regime, to take place in line

with three scheduled offshore RESS auctions. The enduring centralised model, with transmission system assets to be planned, developed, owned and operated by EirGrid, will be established by the third offshore RESS auction, and has been identified as delivering maximum societal benefits.

4.8.3 Support Scheme for Renewable Heat

The Support Scheme for Renewable Heat (SSRH) is a government funded initiative designed to increase the energy generated from renewable sources in the heat sector whilst also reducing GHG emissions. The scheme is open to commercial, industrial, agricultural, district heating, public sector and other non-domestic heat users and is administered by the SEAI

The SSRH consists of two types of support mechanism: -

- An on-going operational support (paid for a period up to 15 years) for new installations or installations that currently use a fossil fuel heating system and convert to using biomass or anaerobic digestion heating systems.
- A grant (of up to 30%) to support investment in renewable heating systems using heat pumps.

The CAP21 outlines that the SSRH will be developed, subject to the availability of exchequer funding, with an increased focus on large energy users. The annual review for 2022 is underway and is due for completion in Q3 2022. This review will also take into consideration the outputs of the [National Heat Study](#).

4.8.4 District Heating

Further to CAP21, a Steering Group for district heating has been established. The Steering Group draws together a wide range of expertise from relevant stakeholder bodies and is chaired by the DECC. The Steering Group meets regularly and will report to Government in early 2023. It will report on the work it has undertaken, informed by relevant research, and it will make recommendations as to policy measures to facilitate rapid deployment of district heating.

4.9 Agriculture

4.9.1 Food Vision 2030 - a World Leader in Sustainable Food Systems

For some twenty years, the Irish agri-food sector has benefited from having a coherent, stakeholder-led vision and plan to underpin the sector's continued development. This multi-stakeholder approach to policy formulation has proven successful and the new Food Vision 2030 Strategy was launched by the Government in August 2021. Food Vision is a landmark for the Irish agri-food sector and has the potential to transform the agriculture, food, forestry and marine sectors in the period to 2030, with sustainability at its core. The Strategy is honest and upfront about the challenges ahead. Crucially, it proposes solutions and charts a pathway to sustainability in all its dimensions – environmental, economic and social. One of the stand-out aspects of the Strategy is its adoption of a food systems approach, taking a more holistic view of agri-food by ensuring an interconnectedness between it and the areas of health and nutrition and the environment.

Food Vision aims for Ireland to be a world leader in Sustainable Food Systems, which would deliver food security and nutrition for all in such a way that the economic, environmental and social basis to generate food and nutrition for future generations are not compromised. This will deliver significant benefits for the Irish agri-food sector itself, for Irish society and the environment. In demonstrating the Irish agri-food sector meets the highest standards of sustainability, this will also provide the basis for the future competitive advantage of the sector. Food Vision 2030 sets out 22 goals under four high-level missions that the sector must achieve if it is to fulfil this ambition¹⁴:

- A Climate Smart, Environmentally Sustainable Agri-Food Sector
- Viable and Resilient Primary Producers, with Enhanced Wellbeing
- Food that is Safe, Nutritious and Appealing, Trusted and Valued at Home and Abroad
- An Innovative, Competitive and Resilient Sector, Driven by Technology and Talent.

¹⁴ The Strategy and more information on Food Vision 2030 is published at : [gov.ie - Food Vision 2030 - A World Leader in Sustainable Food Systems \(www.gov.ie\)](https://www.gov.ie/en/food-vision-2030-a-world-leader-in-sustainable-food-systems/)

4.9.2 European Common Agricultural Policy

The development of the Irish agriculture sector is supported by the EU's Common Agriculture Policy (CAP) through a combination of direct payments to farmers, financial assistance towards investments in rural development and environmental protection and market support measures. The CAP has already made a significant contribution to the environmental sustainability of the European agri-food sector in recent years through the two-pillar structure. The previous programming period covered from 2014 to 2020. Transitional arrangements are in place for the period 2021-2022, with a new CAP programme for the period 2023-2027 due to commence from 1 January 2023. A revised structure is being implemented under a CAP Strategic Plan (CSP) which brings closer alignment of the traditional two pillars approach, to increase complementarity, and placing an increased emphasis on promoting and supporting environmental sustainability in our agriculture production systems. Enhanced environmental ambition is achieved through a strong focus on climate and environmental issues, with three of the CAP's nine specific objectives relating to these issues, namely:

- To contribute to climate change mitigation and adaptation;
- To foster sustainable development and efficient management of natural resources such as water, soil and air; and,
- To contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes.

Ireland's CSP contains a range of new measures for more climate friendly farming, including:

- Strengthened conditionality requirements for the receipt of direct payments, which integrate existing Greening measures and introduce new requirements to, for example, enhanced protection of wetlands (incl. peatlands);
- A new Eco-scheme, comprised of a number of climate and environment-focused farming practices, which will allow farmers an opportunity to participate in order to maximise the value of their Pillar 1 direct payments. These include practices aimed at reducing and maximising efficiency of chemical nitrogen usage, increasing tree planting, increasing space for nature and biodiversity rich land areas and encouraging extensive livestock production;
- An ambitious new Pillar 2 environmental scheme, targeted at 50,000 participants, that will be underpinned by a greater focus on results-based actions and on cooperative actions aimed at achieving landscape-scale benefits;

- An enhanced and expanding Organic Farming Scheme aimed at more than tripling the area of agricultural land that is farmed organically to 7.5% of total utilised agricultural area (UAA);
- A Suckler Carbon Efficiency Programme, and a Sheep Improvement Scheme that will improve the environmental efficiency of livestock production systems; and,
- A new Straw Incorporation Measure and an expanded Protein Aid Scheme that will improve soil quality and lead to a reduction in chemical nitrogen usage.

The Plan will be underpinned by extensive training of farmers and advisors, as well as, a targeted Knowledge Transfer programme, all of which will strengthen the capacity to deliver optimal climate and environment outcomes from the various interventions.

It is recognised that the CSP alone will not be able to address all the climate and other environmental challenges. Where possible, technological innovations and industry support will also be leveraged to effect appropriate change at farm level. In some cases, increased regulation will be required to address specific issues. Other EU, national and private funds will also be required to facilitate achievement of the full ambition.

4.9.3 Methane and Nitrous Oxide Emissions

Several measures have been taken to reduce stocking densities on land, encouraging less intensive farming methods and lower CH₄ and N₂O emissions.

i. Targeted Agricultural Modernisation Schemes (TAMS II)

This scheme supports capital investment in a number of target areas which will promote, inter alia, sustainability and assist in lowering CH₄ and N₂O emissions (e.g., low emissions slurry spreading equipment, farm nutrient storage, and renewable energy and energy efficiency).

ii. The Green Direct Payment Scheme and Cross-Compliance

Since 1st January 2005 direct payments to farmers under the CAP have been fully decoupled from production, i.e. the level of CAP direct payments to farmers is now independent of the level of production of agricultural products. Applicants under the various Direct Payments Schemes are required to comply with the requirements of cross compliance as detailed in EU governing regulations. Cross compliance involves two elements:

- A requirement for farmers to comply with 13 statutory management requirements (SMRs) set down in EU legislation on the environment, (including the Nitrates Directive) food safety, animal health, welfare, and plant health, and

- A requirement to maintain the farm in good agricultural and environmental condition.

If an applicant is found to be non-compliant with any element of these requirements, sanctions as provided for in the governing EU regulations, will be applied to all of an applicant's area-based payments under the Direct Payments regime.

From 1 January 2023, Cross-Compliance will become 'Conditionality' with new enhanced base line requirements as one of three core elements of the "Green Architecture" of CAP 2023-2027 consisting of 11 statutory management requirements (SMRs) and a further 9 Good Agricultural and Environmental Conditions (GAEC) which farmers must comply with.

iii. Agri-environment Options Scheme (AEOS)

AEOS replaced Rural Environment Protection Scheme (REPS) in 2010. The Scheme builds on the principle of respect for and protection of the environment which started with the first REPS scheme in 1994. Under the Scheme 20,000 farmers are paid to undertake actions which specifically target three environmental challenges namely those of:

- Halting the loss of Biodiversity
- Contributing to the improvement of Water Quality
- Combating Climate Change.

Unlike REPS, AEOS is not based on a whole farm approach with farmers having the option of choosing to implement those measures which are best suited to their individual circumstances. Primary actions addressing Climate Change promote the reduced and most efficient use of fertilisers, thus reducing the nitrous oxide emissions and also supporting measures to protect and enhance soil carbon levels. These actions include the following:

- Arable margins
- Green Cover Establishment from a Sown Crop
- Minimum Tillage
- Use of new technologies for slurry spreading

Other actions such as tree and hedgerow planting contribute to the overall objective of climate change through carbon sequestration, and in general actions within the Scheme involve less fertiliser use. The scheme closed in December 2018 with participants given the option, before the completion of their AEOS contract to move into the 'Green Low Carbon Agri-Environment Scheme'.

iv. Green, Low Carbon, Agri-Environment Scheme (GLAS)

GLAS is an agri-environmental scheme that incentivises agricultural production methods to address issues of climate change, water quality and biodiversity loss. The scheme supports

low carbon agriculture through a range of cross cutting measures and promotes the delivery of targeted environmental advice and best practice at farm level.

v. Organic Farming

Organic agriculture, in general, requires less fossil fuel per hectare due to the avoidance of synthetic fertilisers and aims at improving soil fertility and nitrogen supply by using leguminous crops, crop residues and cover crops. The enhanced soil fertility leads to a stabilisation of soil organic matter and in many cases to a sequestration of carbon dioxide into the soils. This in turn increases the soil's water retention capacity, therefore contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels. Organic production methods emphasising soil carbon retention are most likely to withstand climatic challenges particularly in those countries most vulnerable to increased climate change.

Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers' knowledge, soil fertility-building techniques and a high degree of diversity. At present, there are 2,963 organic operators in Ireland with c.90,000 hectares of land under organic production methods. The market value of the organic sector in Ireland grew by 16.2% in 2020 to €189 million. The budget allocation for the 'Organic Farming Scheme' in 2022 increased from €16 million to €21million. The Scheme, which is open to all sectors is currently open to new applications with a closing date of 8 April 2022.

To build further momentum and growth in the Organic sector, a training programme will be undertaken in early 2022 by farm advisors to ensure nationwide advisory support is available for those farmers who are interested in joining the 'Organic Farming Scheme'.

vi. BETTER Farms Programme

'The Business, Environment and Technology through Training Extension and Research (BETTER) Farms Programme' includes a number of working farms as a means of demonstration, channelling research knowledge and outputs to practising farmers via discussion group networks and farming media. The programme focuses in particular on areas of animal breeding, grassland management and herd wealth, all of which promote resource efficiency.

vii. The Signpost Programme

The 'Signpost Programme' is a new, Teagasc-led, collaborative, multi-actor initiative to lead and support Irish farmers in climate action. Building on the success of many industry collaborations over almost 30 years and recognising the need for a collaborative approach to respond to the major challenge of climate change, Teagasc launched the 'Signpost

Programme' in May 2021. Many of the features of previous successful industry collaborations have been adopted, including:

- A multi-actor approach involving farmers, advisers, researchers, government and state agencies, agri-food industry organisations (including all our milk and beef processors) and media
- A focus on farmer-to-farmer learning through demonstration farms. There are approximately 120 demonstration farmers participating in the programme across all enterprises – dairy, beef, sheep, tillage, pigs, poultry, forestry, and including five organic farmers
- Each demonstration farm is supported by both their local Teagasc adviser, a dedicated programme adviser, and in many cases an adviser working with one of the Signpost partner organisations resulting in a multi-actor approach at farm level
- A broader reaching advisory campaign – including facilitating opportunities for farmer-to-farmer learning through demonstration events and discussion groups, and specific farmer training events
- Clear objectives agreed by all partners at the outset; in this case, to reduce agricultural GHG emissions, in line with both national policy objectives and market/consumer requirements.

This is a unique initiative led by Teagasc. In fact, it is the first time that we have brought all of the partners together under one programme. We also believe that this multi-actor, climate action by farmers' initiative is unique across Europe.

Finally, Teagasc, represented by the 'Signpost Programme', is part of two Horizon Europe projects aiming to ensure the achievement of the EU's climate objectives, through the engagement of farmers, the strengthening of Member States' Agricultural Knowledge and Innovation Systems (AKIS), and the development of targeted advice to farmers on climate issues. These projects are:

1. HORIZON-CL6-2021-CLIMATE-01-04: Demonstration network on climate-smart farming – linking pilot farms (approved February 2021).
2. HORIZON-CL6-2022-CLIMATE-01-03: Demonstration network on climate-smart farming – boosting the role of advisory services (proposal submitted February 2021).

Both projects meet the recommendations of the 2019 Standing Committee on Agricultural Research (SCAR) AKIS report calling for a “more specific and explicit focus on on-farm demonstrations in the various project calls, guidelines, criteria and requirements”.¹⁵

viii. Areas of Natural Constraints Scheme (ANC)

The ‘Areas of Natural Constraints Scheme’ (ANC) replaced the ‘Disadvantaged Areas Compensatory Scheme’ (DAS). The ANC manages areas of land situated on the mainland which are designated as disadvantaged. The ‘Areas of Specific Constraints scheme’ (Island Farming Scheme) deals with areas of land situated on offshore islands. These designations are pending the delineation of the ANC in accordance with the provisions of Regulation (EU) No 1305/2013. The lands situated on offshore islands are designated as Areas of Specific Constraints in accordance with the provisions of Article 32 of Regulation 1305/2013.

The scheme was designed due to the fact that farmers in particular areas were confronted with challenges relating to lower productivity and higher production costs than farmers in other areas where levels of disadvantage were not as prevalent. This financial support aids farmers by ensuring continued agricultural land use, while also contributing to the maintenance of a viable rural society; management of the countryside; and maintaining and promoting sustainable farming systems which include environmental protection.

ANCs are divided into three main areas

- mountain areas
- severely handicapped
- less severely handicapped

ix. The Sheep Welfare Scheme

The ‘Sheep Welfare Scheme’ was introduced to contribute to the sustained development in animal and health welfare in the sheep sector. It entails farmers going beyond the relevant compulsory standards to improve the principles of animal welfare in the Irish sheep flock. This scheme is designed in keeping with Article 33 of Regulation (EC) No 1305/2013 in particular with the range of European Regulations underpinning the provision of support for Rural Development. This scheme offers targeted support to those areas of animal welfare recognised in making a significant positive contribution to sheep welfare, having regard to the systems of production in Ireland and the environment in which Irish sheep production is practiced.

¹⁵ EU SCAR AKIS, *Preparing for Future AKIS in Europe*. Brussels, European Commission, 2019, Available here: https://scar-europe.org/images/AKIS/Documents/report-preparing-for-future-akis-in-europe_en.pdf

x. Straw Incorporation Measure

The Straw Incorporation Measure (SIM) is a support measure for tillage farmers under Article 28 of Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 (Agri-environment-climate). SIM was introduced in 2021 to encourage tillage farmers to increase soil organic carbon levels by chopping and incorporating straw from cereal crops. This will sequester carbon in tillage soils, thereby reducing GHG emissions. The incorporation of straw will also have positive impact on soil biology and soil workability. This will further improve the environmental sustainability of the tillage sector.

xi. Pasture Profit Index (PPI)

This grassland selection index has been progressed further in 2021 to include a grazing utilisation value, which illustrates the grazing differences between varieties. Grazing utilisation is a key driver of farm profitability and sustainability. Using PPI when choosing grass varieties will deliver improved climate mitigation benefits. Research is underway to produce a carbon profit index (based on white clover) for the industry.

xii. Origin Green

The 'Origin Green sustainability development programme' unites government, the private sector and food producers in a common vision to improve the environmental performance of individual farms and food producers.¹⁶

4.9.4 Animal Husbandry

One of the factors that influence methane emissions from the dairy herd is longevity of the cows, which is influenced by the health and fertility of the cows. As yields per cow increase there is a tendency for fertility to reduce, thereby leading to an increase in the number of replacements kept on farms. Teagasc has an ongoing research programme aimed at improving fertility levels in the dairy herd. Part of the animal breeding programme focuses on other important genetic parameters – increasing yield by cow, improving milk composition as well as increasing the fertility status of the dairy herd, with a significant focus on fertility traits within the beef and dairy indices. They are also focused on improving grazing techniques and pasture management (including increasing the use of clover) and manure management in both dairying and beef systems with a view to identifying the best and most environmentally sustainable management systems that facilitate increased productivity, improving output per unit of input, while at the same time developing strategies to reduce

¹⁶ Origin Green Ireland, www.origingreen.ie

surplus nitrogen. Teagasc has developed an enteric methane research programme in sheep, beef and dairy to determine country specific emission factors, to evaluate the impact of management as well as determining the impact of additives on enteric methane emissions. A further part of the research programme aims to reduce nitrous oxide emissions by using nitrification inhibitors. In addition, an important part of the Teagasc advisory programme focuses on improving the uptake of various technologies at farm level that will have the effect of increasing outputs and reducing inputs including transfer of information through for example the 'Signpost' and 'Grass' programmes. Improvements in efficiencies, which flow from this work, are leading to reductions in GHG emissions per unit of output for both milk and meat production.

i. Beef Data and Genomics Programme (BDGP)

This livestock improvement scheme aims to improve animal husbandry with breeding efficiencies. This scheme provides suckler farmers with an incentive to take samples from stock bulls and a selection of suckler cows (4/5 cows with best genetic linkages) for genotyping. This helps to accelerate the kind of genetic improvement that will drive efficiency and increase profitability at farm level. The Irish Cattle Breeding Federation is a world leader in the area of Genomics, and Ireland was the second country to introduce Genomic selection in dairy animals. Genetic gain in the beef herd lags that in the dairy herd, mainly due to poor use of genomic selection. This needs to be addressed by collecting Genomic data on stock & AI bulls, and the genetically best connected females in herds around the country. Improving beef efficiency at farm level will help to reduce dependence on direct payments and increase the contribution of the beef sector to job creation and the wider economy.

Subject to Commission approval the follow on to BDGP will be the 'Suckler Carbon Efficiency Programme' which is expected to commence during 2023.

ii. The Carbon Navigator

The Carbon Navigator has been used with Irish farms to provide feedback and advice on practices that effectively reduce the carbon footprint of farm produce and improve the economic performance of the farm. Work is ongoing to replace the Carbon Navigator with the Teagasc Farm Sustainability Planner which broadens the range of climate mitigation actions being considered and broadens the scope of the plan to provide options to deal with water quality actions and biodiversity loss mitigation actions in a coordinated plan. The system prototype is currently in use with the 'Agriculture Sustainability and Support Advisory Programme' (ASSAP) and 'Signpost' Programmes.

4.9.5 Research

i. Animal Diet Research

Research is ongoing in Teagasc to evaluate a range of measures with the potential to reduce methane emissions from ruminant livestock. Dietary strategies to mitigate enteric methane emissions under evaluation comprise a range of feed additives/supplements including seaweeds and their extracts, plant lipids and essential oils and halides in the form of both bespoke and proprietary products. In addition to this we are also examining the role of novel grass/non-grass (forbs) species and their management, in both fresh and ensiled format, as methane abatement strategies for grazing animals. Research studies employ state of the art in vitro and in vivo methane measurement equipment. Animal based experiments are being performed across all stages of physiological development including both lactating and non-lactating states. Studies will also establish the impact of effective dietary regimens of interest on rumen microfloral composition to ascertain the underlying biological mechanisms of action. All studies will involve a circular systems-based approach encompassing the entire trajectory of the production cycle. This is important work in the context of developing the most appropriate, holistic and robust animal feeding strategies to consistently reduce emissions. The aforementioned dietary intervention studies will complement on-going ruminant animal genetic studies. Indeed, sizeable genetic variation in methane emissions has already been established for the main ruminant livestock species and we envisage a synergistic approach to effective methane mitigation matching genetics with appropriate dietary intervention. We are acutely conscious of the challenge of effective delivery of dietary based mitigation interventions to the grazing animal. To this end, we are also examining the potential of slow-release bolus technology to deliver the most effective nutraceuticals established from our dietary intervention-based studies. We are conscious of the necessity to deliver both cost effective and ultimately carbon neutral solutions. Therefore, our research program is underpinned by detailed bio-economic and life cycle analytical approaches to establish the impact of any putative mitigation strategies on both economic and environmental sustainability metrics.

ii. Soil Research

Soils research on soil carbon sequestration and GHG emissions was further expanded through a range of national and internationally funded projects. The National Agricultural Soil Carbon Observatory (NASCO) was funded to establish carbon sequestration and emissions associated with a range of uses on mineral and peat soils. This new infrastructure has begun

to be established across 30 sites and is associated with the soil carbon monitoring of the 105 Signpost farms to create a baseline of soil carbon stocks and identify where additional carbon sequestration can be targeted. The Science Foundation Ireland (SFI) funded VISTA milk research centre started projects on soil carbon sequestration and enteric methane emissions. New research was carried out to improve the quantification of carbon sequestration associated with hedgerows to improve the national GHG inventory and identify management practices to enhance carbon capture in hedgerows. Enhancing carbon sequestration on mineral soils through deep ploughing has begun to be investigated in Ireland and New Zealand. The role of soil pH and soil phosphorus on nitrous oxide emissions from soils was investigated and the results have shown that the agronomic optimum for pH and phosphorus reduces emissions by approximately 40%. A new research project was funded to investigate the role of low nitrate compound nitrogen fertilisers on nitrous oxide and ammonia emissions and initial results have indicated that switching to low nitrate fertilisers reduces nitrous oxide emissions by over 30%. Systems research on low nitrogen fertiliser dairy systems commenced on multispecies swards. Initial results have indicated that nitrogen fertiliser rates can be reduced from 250 to 65 kg N ha⁻¹ with no loss in milk production. This research is being expanded to investigate even lower nitrogen fertiliser rates to reduce nitrous oxide emissions even more and to better quantify the effect on enteric methane emissions and carbon sequestration.

4.9.6 Manure Management and Agricultural Soils

i. Anaerobic Digestion

The CAP21^[1] has set a target of 1.6 TWh per annum of indigenous sustainably produced biomethane for injection into the gas grid by 2030 including the use of agricultural feedstocks (organic manures, grass/grass silage).

Ireland has supported the development of on-farm anaerobic digestion facilities through the 'Scheme of Investment Aid for Demonstration On-Farm Waste Processing Facilities', since 2007. In recognition of the potential role of farmers in this area as providers of agricultural feedstocks such as grass/grass silage and animal manures, the DAFM is also supporting research, development and demonstration in this particular area. In October 2018, two projects were approved for funding from the European Innovation Partnerships Initiative (EIP) under the Rural Development Programme 2014- 2020.

^[1] Climate Action Plan 2021, Department of the Environment, Climate and Communications; Department of the Taoiseach, [gov.ie - Climate Action Plan 2021 \(www.gov.ie\)](https://www.gov.ie/en/publications-and-resources/publications/climate-action-plan-2021/)

In addition, the recently published SEAI National Heat Study^[2] identifies significant potential for the role of the agriculture sector in this regard and will inform future policy development in this area.

4.10 Waste – Waste Measures

4.10.1 Policy and Measures to Reduce Municipal Solid Waste and Biodegradable Municipal Waste to Landfill

i. Circular Economy Act

The Circular Economy and Miscellaneous Provisions Act 2022 is a key step in Ireland's transition to a Circular Economy and will provide a robust statutory framework for moving from a focus on managing waste, to a much greater focus on adapting patterns of production and consumption. The Act was enacted by the Oireachtas in July 2022.

ii. Landfill and Waste Recovery Levies

A landfill levy (currently at €75 a tonne for liable waste disposed at landfill) is accredited with diverting large amounts of MSW (including BMW) from landfill to recovery options. The level of the levy is kept under regular review.

In addition, the Waste Action Plan for a Circular Economy, Ireland's 5 year strategic waste policy, published in September 2020, commits to the introduction of a waste recovery levy payable on certain waste streams that are sent to recovery, including energy recovery, with a view to further incentivising reuse and recycling.

iii. Collection of Municipal Solid Waste, including Biodegradable Municipal Waste

Collectors of waste must conduct their activities in accordance with the relevant legislation and the conditions of their waste collection permits which require that waste is managed in line with the waste hierarchy.

In line with the commitment set out in A Resource Opportunity - Waste Management Policy in Ireland and in the interest of encouraging further waste prevention and better segregation, 'flat-rate fees' for kerbside household waste collection were phased out over the period Autumn 2017 to Autumn 2018. Operators are required to offer an incentivised usage pricing plan to new or renewing customers over that period, i.e., a plan which contains a per lift or weight related fee for the collection of residual waste. This charging regime is being extended to cover commercial MSW collections, under provisions in the Circular Economy and

^[2] SEAI National Heat Study, [National Heat Study | SEAI](#)

Miscellaneous Provisions Act 2022. Information and awareness campaigns have been, and will continue to be, rolled out by the DECC and the Regional Waste Management Planning Offices to take account of the new approach to waste reduction, increased recycling and charging. In particular, the Regional Waste Management Planning Offices will continue to roll out waste awareness and education initiatives re-focussing on the use of the brown bin (for food and bio-waste), but also concentrating on improving and increasing recycling, waste prevention and the correct use of the kerbside collection system.

iv. Food Waste

The EU (Household Food Waste and Bio-waste) Regulations 2015¹⁷ sets out the requirements in relation to segregation of household food waste and separate collection of household food waste for households in population agglomerations greater than 500 persons. They aim to contribute to the achievement of the targets set out in the Landfill Directive (Directive 99/31/EC) for the diversion of biodegradable municipal waste from landfill sites by directing source-segregated household food waste to composting and to other forms of treatment.

The Waste Management (Food Waste) Regulations 2009¹⁸, as amended, are designed to promote segregation and recovery of food waste arising in the commercial sector and reduce disposal to landfill.

The Waste Action Plan for a Circular Economy, published in September 2020, which is being delivered on a phased basis over the 5-year lifetime of the Plan, includes a number of measures to tackle food waste in Ireland, with a key focus on food waste prevention, redistribution and infrastructure, and food waste management. Food waste prevention measures include, for example:

- Developing a Food Waste Prevention Roadmap that will set out a series of actions to deliver the reductions necessary to halve Ireland's food waste by 2030, meet any other related targets, and promote our transition to a circular economy
- Continuing to commit resources nationally to the prevention of food waste and to the regulation of optimal food waste collection and treatment practices
- Through our agencies and public sector partners, supporting innovative pilot projects to trial solutions to some of the challenges of preventing food waste

¹⁷ Statutory Instrument 430 of 2015

¹⁸ Statutory Instrument 508 of 2009

- Working with key business sectors to ensure they play their part in not only reducing the waste that arises at the point of sale, but also collateral waste that occurs lower down and higher up the food chain on farms, in food production and in our homes.

Measures to improve food waste management include:

- Making the provision of an organic waste bin mandatory as part of a waste collection service for all households
- Through changes to waste collection permits, and working with the Local Authority sector, ensuring that every householder and business has access to a reliable, clean and sustainable way of managing food waste
- Working with the Department of Housing, Local Government and Heritage to make regulatory changes in planning and tenancy laws required to ensure apartment dwellers are provided with infrastructure to support food waste segregation
- Using the National Waste Collection Permit Office and other 'brown bin' data to develop strategies and investigate how new technology can support greater usage
- Working to reduce contamination levels in recycling bins

Measures relating to redistribution and infrastructure include:

- Using the EPA's Food Waste Charter, supporting a voluntary target with retailers and the processing industry for a percentage of edible food to be donated
- Supporting food donation and investigating ways to simplify food donation for businesses
- Investigating the potential impact of a prohibition on the destruction of edible food in advance of its 'use by' date
- Investigating the regulatory and legal barriers to 'Good Samaritan' acts of donation and whether mandatory donation of edible food from retail outlets would reduce food waste
- We want to realise the Anaerobic Digestion (AD) and composting potential of the food waste resource. AD and composting provide opportunities for regional development with benefits for communities through sales of locally generated energy and compost.

Ireland is focused on reducing its food waste by 50% by 2030 in line with the United Nations Sustainable Development Goal 12.3. As mentioned above, the WAPCE includes a commitment to develop a Food Waste Prevention Roadmap that sets out a series of actions to deliver the reductions necessary to halve our food waste by 2030, meet any other related

targets, and promote our transition to a circular economy. Following the preparation of a draft National Food Waste Prevention Roadmap, a public consultation on the draft roadmap was launched in late January 2022¹⁹. The National Food Waste Prevention Roadmap will be finalised and published later this year.

4.11 Forestry & Peatlands

4.11.1 Restoring Forest Cover and the Afforestation Programme

One of the aims of Ireland's forestry policy is to encourage planting by private landowners in order to achieve a forest cover of 18% over the long term. This aim is supported by a set of measures in the current 'Forestry Programme 2014-2020' which covers the cost of afforestation, and an annual forest premium to landowners to compensate for income foregone as a result of converting farm land to forest. The 'Forestry Programme 2014-2020' will be in place until the end of 2022, with a new forestry programme beginning in 2023. Ireland has had, on a per capita basis and as a proportion of land area, one of the most intensive afforestation programmes in the developed world since 1990, funded by the Government, and in the past jointly with the EU. Since 1990, over 336,000 ha have been afforested, with much of this increase being undertaken by farmers. Despite this rate of planting, however, Ireland remains one of the least forested countries in the EU. In 2017, the national forest estate stood at 770,020 ha, which represents about 11% of the area of the country, compared to an average of 38% for the EU 27 in 2020.

New forestry legislation came into force in 2017 - Forestry Regulations 2017 (SI No 191 of 2017), which replaced earlier legislation. Under the Forestry Regulations all applications for licences for afforestation, forest road construction projects, whether grant-aided or not, and for aerial fertilisation and tree felling operations, require the prior written approval of the Minister for Agriculture, Food and the Marine. Landowners are obliged to replant their forests after clear-felling unless an exemption is provided by the Minister. This helps to ensure that deforestation is very limited. It is estimated to have averaged 734 ha per year over the period 2010-2019, based on latest estimates from data submitted to the UNFCCC for the inventory year 2021.

¹⁹ Public Consultation on the Draft National Food Waste Prevention Roadmap, 27 January 2022, <https://www.gov.ie/en/consultation/96a04-public-consultation-on-the-draft-national-food-waste-prevention-roadmap/>

4.11.2 Forest Management Initiatives

Forest owners are required to draw up a forest management plan in collaboration with a professional forester to continue to receive annual premium payments. This helps to make forest owners aware of the benefits of managing their forests, including thinning at the appropriate time. Thinning can increase the cumulative carbon sequestered by a forest and associated forest products. Tending and thinning of broadleaf plantations also qualifies for grant aid. This measure has resulted in substantial mobilisation of additional firewood, principally for domestic use.

4.11.3 Forest Infrastructure

Forest roads provide access to forests for management and harvesting activities such as inspections, thinning and clear-felling, which can increase total cumulative carbon sequestration in the long term including through the use of long-lived wood products. This measure also aids in the mobilisation of timber and forest-based biomass and creates amenity opportunities. The construction of forest roads is supported through grant-aid available under the 'Forest Roads Scheme' of the Forest Service. This scheme provides grants to cover 100% of costs, up to a forest road length threshold, incurred in building such roads to ensure that the requisite access and infrastructure are put in place. Between 2006 and 2020 an average of 90 km of private grant-aided forest roads were built annually.

4.11.4 Bioenergy and Use of Forest-Based Biomass and Related Measures

A dedicated web site, www.woodenergy.ie is run by the Department of Agriculture, Food and the Marine (DAFM) and provides advice on wood fuel specification and use, as well as on supply chain technologies and costs. Initiatives such as The Wood Fuel Quality Assurance (WFQA) scheme for Ireland administered by the Irish Bioenergy Association (IrBEA) increases consumer confidence in wood fuel products sold in Ireland. The WFQA independently certifies and verifies suppliers of firewood, wood pellets, woodchip and wood briquettes. All certification is carried out against EN ISO 17225 standards for biomass fuels. By 1st January 2022, all wood burning stoves must comply with the Ecodesign European directive in a bid to tackle air pollution and particulate emissions. By 1st January 2020 the directive applies to all biomass boilers. Firewood at 20% moisture content produces less than 33% of the emissions of wood fuel at 30% moisture content when burned in older stoves. However, if firewood is burned in modern Eco-Design stoves the emission levels are reduced by almost 90%.

Firewood will continue to provide an important market for forest owners in the thinning of forests.

Additional bioenergy options have been included in the afforestation measure of the Forestry Programme to cover agro-forestry and short rotation forestry, forestry for fibre, which aims to broaden the appeal of afforestation to landowners. These measures will continue until the end of 2022.

In 2018, the use of forest-based biomass for energy reduced by 11% (Table 4.1). Some 243,000 m³ of firewood was used in the Republic of Ireland, to a value of €35 million, showing that it is providing a steady and a growing market for first thinnings from forest plantations. In 2018, 40% of the round wood harvested was used for energy generation, mainly within the forest products sector.

Table 4.1: The use of forest-based biomass for energy

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Wood-biomass use by the energy ³⁰ and forest products industry	554	572	611	660	760	796	1,049	1,296	1,080
Roundwood chipped for primary energy use	39	41	30	100	100	114	117	49	67
Domestic firewood use	199	214	225	230	235	237	237	239	243
Short rotation coppice	1	5	5	5	5	5	20	20	18
Wood pellets and briquettes	121	129	144	161	150	154	160	175	172
Charcoal	2	5	2	1	1	1	1	1	2
Total	916	966	1,017	1,157	1,251	1,307	1,584	1,780	1,582
Roundwood harvest									
Roundwood available for processing	2,708	2,740	2,594	2,852	2,975	3,016	3,108	3,242	3,248
Firewood harvest	199	214	225	230	235	237	237	235	243
Total	2,907	2,954	2,819	3,082	3,210	3,253	3,345	3,477	3,491
Forest-based biomass as a % of total roundwood harvest	31.5	32.6	36.0	33.5	36.3	34.8	34.1	42.1	40.0

4.11.5 Peatlands

Ireland's National Peatlands Strategy (2016) sets out the long-term framework within which all of the peatlands within the State can be managed responsibly in order to optimise their social, environmental and economic contribution to the well-being of this and future generations. It sets out a cross-governmental approach to managing issues that relate to peatlands, including: compliance with relevant national and international environmental legislation, agreements, plans and policies; climate change; forestry; water quality; flood control; energy; nature conservation and restoration; land use planning; and agriculture. It is underlined by 25 key principles and commits to the undertaking of 32 actions across various sectors and themes, including, among others, Research, Tourism, Agriculture, Forestry,

Conservation, Restoration, Peat Extraction, Energy, Water Quality and Climate Change. The Strategy was established to cover the period 2015 through 2025 and is currently undergoing a mid-term review.

As set out as an action in Ireland's CAP21, its protected²⁰ raised bogs (c. 22,000 hectares) are currently undergoing an intense programme of peatlands habitat restoration and rehabilitation. It is estimated that this will result in estimated emissions reductions equivalent to approximately 47,000 tonnes CO₂ per year. Since 2018 circa 3,800 hectares of these raised bogs in State and private ownership have had measures undertaken to rewet the lands with the aim of reversing the effects of peat oxidation and CO₂ release. Several other blanket bog conservation projects and initiatives are underway including the EU LIFE Integrated project Wild Atlantic Nature and the Collaborative Action for the Natura Network and Co-operation across Borders for Biodiversity projects funded under the INTERREG VA programme.

Under Ireland's Enhanced Decommissioning Rehabilitation and Restoration Scheme (EDRRS), 33,000 ha of post-production peatlands will be rehabilitated to improve ecological and hydrological conditions in order to reduce GHG emissions and reinstate carbon sequestration conditions over time. This rehabilitation will take place on 82 bogs over a 5 year period. The EU's Recovery and Resilience Facility through the National Recovery and Resilience Plan (NRRP) is investing up to €108 million in the EDRRS which, in conjunction with the restoration of third party peatlands, will sustain up to 350 jobs. The Recovery and Resilience Facility is the key instrument at the heart of NextGenerationEU to help the EU emerge stronger and more resilient from the effects of the pandemic. In 2021, the first year of this project, 19 rehabilitation plans were approved with works commenced on 18 bogs. Plans for the 2022 campaign on a further 20 bogs in the Midlands region are well advanced. To monitor the impacts of rehabilitation on the carbon emissions from the production peatlands, a GHG monitoring programme is being developed by the operators of the scheme, Bord na Móna, a commercial semi-state company.

A number of peatland sites are being established as EU and global monitoring sites as part of a network of climate change related indicators. There is a network of eight Eddy Covariance towers currently operating or planned for on bogs by various bodies in Ireland including the National Parks and Wildlife Service of the Department of Housing, Local Government and Heritage, Bord Na Móna, the Environment Protection Agency and academic institutions. In addition, there are seven Eddy Covariance Towers planned for agriculturally managed sites with peat soils as part of the establishment of the National Agricultural Soil Carbon

²⁰ Those raised bogs designated as special areas of conservation and natural heritage areas

Observatory which is funded by the Department of Agriculture Food and the Marine (DAFM) and managed by Teagasc. Collectively, these towers, which directly observe the exchanges of gas, energy, and momentum between the ecosystem and the atmosphere, will establish an impressive peatland-GHG monitoring network across Ireland.

i. Organic Soils under Agricultural Management

The Programme for Government and consequently the All-of-Government CAP21 has clearly identified the need for urgent climate action across all sectors of our economy. As a reflection of the role that artificially drained organic soils under agricultural management contribute to the overall net emissions of Land Use, the Land Use Change and Forestry (LULUCF) sector, a commitment has been given under the All-of-Government CAP21 to reduce the management intensity of up to 80,000ha of organic soils currently under agricultural management. This is a key action for the land use sector and represents a pathway for farmers and landowners to not only contribute to the overall national efforts towards the achievement of carbon neutrality but will also aid the agricultural and land-use sectors to achieve sectoral carbon neutrality. The reduced management of these organic soils represents a land-use and income diversification opportunity for farmers and landowners with a number of mechanisms, currently being considered by the DAFM, in particular to financially reward farmers and landowners for their efforts in this area.

The increased need to address emissions from the LULUCF sector while also maximizing carbon sequestration and removal activities is reflected in CAP21 which outlines the changes that need to be implemented throughout the LULUCF sector to maximise the climate gains for this area.

ii. Area of Natural Constraints (ANC)

The Areas of Natural Constraints (ANC), along with the Areas of Specific Constraints (Island) scheme form part of the proposed future Rural Development Plan, 2022-2027 which directly affects the management of mountain areas and other less favoured areas which contain a large proportion of peat soil area. This scheme encourages farmers to implement appropriate stocking levels and scrub encroachment management to ensure that damage to peat soils is minimised or eliminated.

iii. Good Agricultural and Environmental Condition (GAEC) 2: Protection of Wetland and Peatland

Conditionality sets the base line requirements for farmers in receipt of payments under CAP. This system is made up of Statutory Management Requirements (SMRs) and also standards for the maintenance of land in Good Agricultural and Environmental Condition (GAECs).

Within this framework GAEC 2 will aim to protect peatlands (and wetlands), determined as agricultural areas and eligible hectares. Such areas are submitted by applicants as part of area-based schemes. Large quantities of carbon are stored in peatlands (and wetlands) and certain agricultural practices (e.g. ploughing) may have a negative impact on such soils with regard to carbon storage. The minimum standards established for management under this GAEC will be aimed at minimising carbon loss from such soils. Ireland proposes this GAEC will be applicable from 2024 onwards as a lead time is required to define and map these areas.

iv. Agricultural Environmental Control Measure (AECM)

Ireland has proposed an innovative approach to the delivery of our AECM which will incorporate two different approaches, AECM General and AECM Co-operation, based on a geographic location identified by a defined mapping system. Within these approaches the management of peatsoils will be influenced by

- **Low input peat grassland:** To reduce losses of GHG emissions from drained peat soils under agricultural management through reduced management intensity at farm level. This measure, although targeted at GHG emissions in the first instance, will have important additional benefits for biodiversity and water quality.
- **AECM Co-operation measure:** The AECM Co-operation measure will only be available to farmers in defined high priority geographical areas and as such will be appropriate for projects on peat soils which cover a large geographic area. In addition to undertaking general AECM measures, participating farmers will also be offered bespoke farm, landscape and catchment measures and a Local Project Team to assist with the implementation of the scheme at local level.

v. EIP-AGRI projects

The European innovation partnership for agricultural productivity and sustainability or [EIP-AGRI](#) is a European initiative that promotes innovation to make the agriculture and forestry sectors fit for today's global challenges. Initiated in 2012, it coordinates the funding of projects, networking and knowledge exchange activities through the CAP and the 'European Research and Innovation Programme' ([Horizon 2020](#), [Horizon Europe](#) from 2021).

EIP-AGRI projects apply interactive innovation or the 'multi-actor approach'. This means that farmers, farm advisors, scientists and other stakeholders collaborate throughout the project to develop innovative solutions to practical problems. These solutions have a greater chance of being relevant and used as they are elaborated with and for farmers or practitioners.

In recognition of the usefulness of European Innovation Partnerships (EIPs) as a research and demonstration tool, Ireland has included an indicative allocation of €36.1m under its current

draft CSP to support 6 non-environmental EIPs and 30 environment EIPs of various sizes. The indicative themes include generational renewal, gender balance, environmental challenges including a targeted call on water quality and breeding waders, the uptake of digital tools and technologies at farm level. The protection of organic agricultural soils and peatlands is included under this framework.

vi. Research and Data Refinement

Ireland currently has an estimated 330,000ha of artificially drained organic peat soils under agricultural management. These organic soils represent a significant source of GHGs and as such significant national research and investment is currently being undertaken to not only fully assess the level of GHGs that these areas are responsible for, but also, to explore pathways to incentivise our farmers and land managers to rewet these areas thereby reducing or eliminating this source of GHGs. An overview of some of the relevant activities in this area includes:

- **RePeat:** The RePeat project will acquire a high-quality digital version of the complete series of the Bog Commissioner's Maps and other available peat maps and carry out extensive field visit verification of map boundaries. Currently available soil maps are not at a scale to accurately identify, at field level, the location of peat soils. This project will revisit the work survey commissioned by Britain of over one million acres of bogs in Ireland, between 1810 and 1814. The Commissioner's Report on the Nature and Extent of Bogs in Ireland represents the first inventory of a natural ecosystem in Ireland and is likely to be one of the most detailed assessments of an ecosystem at this scale in the world at the time.
- **FarmPEAT EIP:** The FarmPEAT (Farm Payments for Ecological and Agricultural Transitions) Project is developing a locally-led, innovative, results-based farm scheme for farmers who manage lands that surround some of Ireland's finest remaining raised bogs. The programme will reward farmers for improved management of habitats on peat soils along with other important landscape features such as eskers, field boundaries and watercourses. The programme will be results-based in that farmers will get paid depending on the scores they achieve, with higher scores, indicating higher environmental quality, getting higher payments.
- **Farm:Carbon Carbon Farming for Nature, Communities and Climate EIP:** The aim of this EIP is to deliver a results-based agri-environmental scheme that increases income for farmers for improving the environmental services provided by their lands, in particular their agricultural peatlands. These measures will diversify and improve their

incomes by means of a collaborative approach that is supported by a wide range of project partners. The EIP will help farmers deliver a range of mitigation measures on their farms to assure farm sustainability by improving the quality of their farm habitats or whole farm score.

- National Agricultural Soil Carbon Observatory (NASCO):** Currently Ireland's emissions are reported to the NIR through the EPA using a mixture of Tier 1 emissions factors and nationally measured and accepted emissions factors called Tier 2. Reported emissions factors under the Tier 1 system are based on international average figures and do not accurately reflect national variations. The inclusion of organic soils for the siting of flux towers as part of the NASCO programme will further refine the true emissions derived from this source under the National Inventory Reporting framework while also influencing appropriate policy decisions for this sector.
- Pilot Soil Sampling Programme:** The pilot 'Soil Sampling Programme' is a farm level soil sampling and analysis initiative which will provide farmers and their advisors with comprehensive details about the soil health and soil condition on their farms. These results can be used to target soil management and farming practices to achieve economic and environmental sustainability on their farms. Each sample will be taken over a maximum of 4 hectares and limited to a maximum of 64 hectares on each farm. This Programme will provide much needed information, for both mineral and organic type soils, at both farm and policy making level to as to the location and nutrient status of on-farm soils thereby allowing farmers and land managers to make better informed and appropriate farm specific management decisions.
- National Soil Moisture Monitoring Network:** DAFM committed to fund a proposal by the National Soil Moisture Monitoring Network, a working group on agro-meteorology which comprises researchers from Teagasc and University College Dublin (UCD), to purchase soil moisture monitoring equipment to enable Ireland to develop a national soil moisture measurement network. This infrastructure will allow for the real-time reporting of a number of different climatic variables and will be of benefit to a range of stakeholders, such as those involved in peatland conservation and restoration.
- SEPLA:** Ireland is one of four countries participating in the EU Commission's Joint Research Centre SEPLA (Satellite based mapping and monitoring of European Peatland and wetland for LULUCF and Agriculture) project. This project involves

developing a methodology to identify and map 'candidate' peatland/wetland areas. Furthermore, it will assess methods and tools to support the creation of a carbon theme for conditionality and eco-schemes. Finally, it will define a prototype for Earth Observation (EO) based monitoring of peatland/wetlands. The timeline for completion of this project is April 2023.

4.12 Policies and Measures No Longer in Place

4.12.1 Time Limited Schemes

The Government is strongly committed to helping combat the rising cost-of-living being experienced throughout the country. In this context, a suite of new measures is being introduced by Government to help with this issue, including a 20% average fare reduction on PSO services until the end of 2022. These discounted fares will benefit the hundreds of thousands of people across the country who use public transport every day. A further €54m in Exchequer funding has been secured to allow for the introduction of these discounted fares, this is in addition to the REV22 allocations. The NTA will work with the PSO public transport operators in the coming weeks to commence rolling out these fare reductions across the public transport network in late April/ early May.

With regard to agricultural policy, the following time limited schemes have come to an end:

- Knowledge Transfer Programme (2019) – a three-year programme set out in Ireland's Rural Development Programme to up-skill Irish farmers to encourage efficiency and effectiveness at work and ensure they engage to develop their enterprise and contribute to the overall development of the agri-food sector.
- Agri-environment Options Scheme (2018) - scheme to provide financial support to help farmers conserve and promote biodiversity, encourage water quality management, and combat climate change.

4.12.2 Superseded Policies and Measures

Ireland's National Policy Position on Climate Action and Low Carbon Development (2014) set out the fundamental national objective of transitioning to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. It set out the context for the objective, clarified the level of greenhouse gas mitigation ambition envisaged and established

the process to pursue and achieve the overall objective. It has been replaced by the Climate Act 2015 and the Climate Act 2021.

Ireland's Climate Act 2015 provided the statutory basis for the national transition objective – the goal of progressively pursuing a low carbon, climate resilient and environmentally sustainable economy by 2050. To enable the achievement of this objective, Climate Act 2015 provided the legislative framework for the development, and submission to Government for approval, of national mitigation plans and national adaptation frameworks.

Ireland's policies in relation to adaptation and mitigation were given legislative underpinning by the Climate Act 2015, to be driven in the main through the National Mitigation Plan and the National Adaptation Framework structures. Management of the majority of policies and measures implemented through these structures took place at a national level, reflecting the limited role of regional and local government in Ireland.

Section 14(1) of Climate Act 2015 required that an Annual Transition Statement (ATS) must be presented annually to both Houses of the Oireachtas by the Minister for the Environment, Climate and Communications. The ATS served an important function in providing an overview of climate change mitigation and adaptation policy measures adopted to reduce greenhouse gas emissions and to adapt to the effects of climate change in order to enable the achievement of Ireland's National Transition Objective.

In July 2020, the Irish Supreme Court quashed the 2017 National Mitigation Plan on the basis that the Mitigation Plan did not comply with Climate Act 2015, as it did not set out how the national transition objective of decarbonising Irish society was to be achieved. This decision was welcomed by the Minister for Communications, Climate Action and Environment, Eamon Ryan, who noted that his Department would consider the implications of the ruling and use it to raise ambition and empower action. The Minister also highlighted the work being undertaken to further strengthen the legal framework for Ireland's climate action objectives and emissions reduction targets.

The new Sustainable Mobility Policy builds on and replaces existing active travel and public transport policy as set out in the 2009 policy documents - Smarter Travel: A Sustainable Transport Future and the National Cycle Policy Framework.

The publishing of the National Investment Framework for Transport in Ireland (NFTI) will result in the replacement of the 2015 Strategic Investment Framework for Land Transport. This framework translates the ten National Strategic Outcomes to a transport-specific context. This will require future transport investment projects to show their fit with the NFTI

and the National Planning Framework (NPF) as a whole. Four investment priorities have been identified in the NFTI that replace the three established by SIFLT in 2015.

4.12.3 Other Policies and Measures no Longer in Place

There was no further information to add.

Table 1. Summary of policies and measures by sector

*See tabs "Sector" and
"Objectives" for keys to
these categories

Summary of policies and measures by sector									Estimate of mitigation impact (not cumulative in ktCO ₂ eq)			
Name of policy or measure [a]	Sector(s) affected* [b]	GHG(s) affected	Objective and/or activity affected*	Type of instrument [c]	Status of implementation [d]	Brief description [e]	Start year of implementation	Implementing entity or entities	2020	2025	2030	2035
Sustainable Energy Authority of Ireland Large Industry Programme (With Existing Measures)	Energy consumption	Carbon dioxide (CO ₂)	13	Regulatory	Implemented	Voluntary network of companies working to maintain strong energy management and environmental protection practices.	2000	Sustainable Energy Authority of Ireland	1,041.6	1,001.9	896.5	822.8
Accelerated Capital Allowance for energy efficient equipment (With Existing Measures)	Energy consumption	Carbon dioxide (CO ₂)	11; 12; 13	Fiscal	Implemented	The Accelerated Capital Allowance for Energy Efficiency Equipment (ACA), introduced in 2008, aims to improve the energy efficiency of Irish companies by encouraging them to purchase energy saving technologies. The ACA is a tax incentive for companies paying corporation tax and aims to encourage investment in energy efficient equipment. The ACA offers an attractive incentive whereby it allows companies to write off 100% of the purchase value of qualifying energy efficient equipment against their profit in the year of purchase.	2008	Department Of Finance	211.2	162.5	121.4	92.9

CHP Deployment - Public and Business sectors (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Expired	The CHP Deployment programme provided grants for selected renewable and alternative heat sources and was designed to prime the market and to establish a supply chain. The CHP Deployment programme provided grant aid towards the installation of small scale CHP, up to 1 MWe at sites with a suitable heat load.	2006	Sustainable Energy Authority of Ireland	108.0	115.5	115.5	115.5
Renewable Heat (ReHeat) Programme	Energy supply	Carbon dioxide (CO2)	1	Economic	Expired	The ReHeat programme provided grants for selected renewable and alternative heat sources and was designed to prime the market and to establish a supply chain.	2008	Sustainable Energy Authority of Ireland	68.2	68.2	68.2	68.2
Carbon Tax (With Existing Measures)	Cross-sectoral	Carbon dioxide (CO2)	18	Fiscal	Implemented	Incorporate a price signal for carbon on the non-ETS sector, specifically fuels used for heating and transport. The tax applies to petrol, diesel, kerosene, marked gas oil (for agricultural use), Liquid Petroleum Gas (LPG), fuel oil, natural gas, coal and commercial peat.	2008	Sustainable Energy Authority of Ireland	395.7	1,037.0	1,418.0	1,395.0

Public Sector Programme (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	12; 10	Economic; Informa tion; Education	Implemented	The programme aims to increase energy efficiency by providing a range of funded services including advice, mentoring and training to participating Public Sector bodies. Implementation of measures to enable the public sector contribute to its requirements under the national target of increasing energy efficiency nationally by 20% by 2020.	2011	Revenue Commissioners	520.1	501.5	494.7	497.3
Supports for Exemplar Energy Efficiency Projects (SEEEP) and Energy Efficiency Retrofit Fund (EERF) & Better Energy Workplaces	Energy consumption	Carbon dioxide (CO2)	12; 10	Economic	Expired	The Supports for Exemplar Energy Efficiency Projects (SEEEP) programme aimed to achieve significant energy efficiency gains through increasing the capability of the supply chain and stimulating direct employment focusing on energy efficiency projects. The Energy Efficiency Retrofit Fund (EERF) provided for funding towards the implementation of a limited number of qualifying energy efficiency projects. Better Energy Workplaces relates to stimulating energy-saving actions in the business and public sectors.	2009	Department of the Environment, Climate and Communications	87.6	77.3	70.3	65.6

Small and Medium Enterprises (SME) Programme (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	12; 10	Education; Information	Implemented	The programme aims to increase energy efficiency in SMEs through providing advice, mentoring, training and grant-funding to participating SMEs	2008	Sustainable Energy Authority of Ireland	48.3	43.3	40.0	37.7
2005/2008 Building Regulations Part L Conservation of Fuel and Energy - Buildings other than dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Expired	The measure imposes minimum efficiency standards for new Buildings other than Dwellings	2005	Department of the Environment, Climate and Communications	193.5	170.1	154.2	143.6
2002 Building Regulations - Part L Conservation of Fuel and Energy in Dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Expired	The measure imposes minimum efficiency standards for new dwellings from 2002 onwards. The 2002 Part L Building Regulations was the first in a series of incrementally improved efficiency standards which is now moving towards low to zero carbon housing.	2003	Sustainable Energy Authority of Ireland	227.7	227.7	227.7	227.7
2008 Building Regulations Part L Conservation of Fuel and Energy in Dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Expired	The 2008 Part L Building Regulations for Dwellings were one of a series of incrementally improved efficiency standards which is now moving towards low to zero carbon housing.	2008	Sustainable Energy Authority of Ireland	212.1	212.1	212.1	212.1
2011 Part L Conservation of Fuel and Energy in Dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	The 2011 Part L Building Regulations for dwellings are one of a series of incrementally improved efficiency standards which is moving towards low to zero carbon housing. The measure imposes minimum efficiency standards for new dwellings.	2012	Department of Housing, Planning, Community and Local Government	92.2	92.2	92.2	92.2

Energy Efficient Boiler Regulation	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	The measure set a minimum seasonal efficiency of 86% for boilers installed in existing or new dwellings from 2008 and 90% from 2011. The 2008 Part L Building Regulations imposed a minimum boiler efficiency of 86% for all boilers installed in new or existing buildings. This was further improved to a minimum boiler efficiency of 90% in 2011 Building Regulations.	2008	Department of Housing, Planning, Community and Local Government	279.1	314.2	314.2	314.2
Domestic Lighting (Eco-Design Directive)	Energy consumption	Carbon dioxide (CO2)	14	Regulatory	Implemented	The measure is a phasing out of incandescent lights through the Energy related Products Directive (2009/125/EC) and Commission Regulation (EC) No 244/2009. Commission Regulation (EC) No 244/2009 of 18 March 2009 implements Directive 2005/32/EC (superseded by Directive 2009/125/EC) with regard to eco-design requirements for non-directional household lamps. The regulation provides for the phased introduction of minimum efficiency standards for lamps and effectively phases out incandescent lamps.	2008	Department of Housing, Planning, Community and Local Government	295.5	207.3	122.9	50.6

Greener Homes Scheme	Energy consumption	Carbon dioxide (CO2)	10	Economic; Voluntary/negotiated agreements; Information; Education	Expired	The measure provided grant aid for the installation of renewable domestic heating systems.	2006	Department of Housing, Planning, Community and Local Government	34.5	31.6	28.8	26.5
Warmer Homes Scheme (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic; Voluntary/negotiated agreements; Information; Education	Implemented	The measure targets vulnerable and fuel poor homes and provides funding for the installation of domestic energy efficiency upgrades via regional not-for-profit organisations and private contractors.	2000	Department of the Environment, Climate and Communications	96.7	113.3	113.8	105.0
Better Energy Homes (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic; Information; Education	Implemented	Stimulating energy-efficiency actions to reduce energy usage by homeowners and the general public. Sustainable Energy Authority of Ireland grant-aids householders who want to make their homes more energy-efficient by providing incentives towards the implementation of energy efficiency measures including attic and wall insulation and heating controls with efficient boilers and/or solar thermal.	2011	Department of Jobs, Enterprise & Innovation	409.0	485.8	490.0	452.4
Electric vehicle deployment (With Existing Measures)	Transport	Carbon dioxide (CO2)	18	Economic; Fiscal	Implemented	Grant support for new electric vehicles. Electric vehicles were identified as an important element in efforts to achieve both energy efficiency and renewable energy targets as part of the EU Climate Change-Energy Package.	2011	Sustainable Energy Authority of Ireland	24.3	158.4	821.6	1,996.2

Vehicle Registration Tax and Motor Tax Rebalancing	Transport	Carbon dioxide (CO2)	16; 20	Regulatory; Education; Fiscal	Implemented	The measure was a fundamental shift in the Vehicle Registration Tax and Annual Motor Tax regime whereby vehicles have been taxed on the basis of their CO2 emission levels since 1st July 2008.	2008	Sustainable Energy Authority of Ireland	405.3	401.7	401.8	402.0
Improved fuel economy of the private car fleet (EU Regulation)	Transport	Carbon dioxide (CO2)	16	Regulatory	Implemented	The EU, through Regulation 443/2009 has mandated an improvement in average new car efficiency to 130 g CO2/km by 2015 with a target of 95 g CO2/km by 2021.	2012	Department of the Environment, Climate and Communications	0.0	0.0	0.0	0.0
Aviation Efficiency	Transport	Carbon dioxide (CO2)	20	Voluntary/negotiated agreements	Implemented	The aim is to increase operational efficiency in aviation through international co-operation in air space control. The Irish and UK National Supervisory Authorities (NSAs) created the UK-Ireland Functional Airspace Block in 2008 to create a seamless and cost efficient operation across joint airspace. This has included efficiency in savings of fuel and CO2 emissions.	2008	Sustainable Energy Authority of Ireland	63.6	63.0	63.0	63.0
Replacement of coal fired electricity generation with natural gas (With Existing Measures)	Energy supply	Carbon dioxide (CO2)	3	Research; Planning	Implemented	This measure is aimed at examining the effect of replacing coal fired electricity generation with natural gas fired electricity generation.	2019	Department of the Environment, Climate and Communications	1,516.6	1,545.6	1,263.7	1,179.9

Mobile Air Conditioning Directive (Directive 2006/40/EC)	Transport	Hydrofluorocarbons (HFCs)	28	Regulatory	Implemented	The Directive lays down the requirements for the EC type-approval or national type-approval of vehicles as regards emissions from, and the safe functioning of, air conditioning systems fitted to vehicles. It also lays down provisions on retrofitting and refilling of such systems.	2011	Sustainable Energy Authority of Ireland	41.8	72.3	146.9	172.0
Landfill Directive (1999/31/EC)	Waste management/waste	Carbon dioxide (CO ₂); Methane (CH ₄)	34; 37; 32	Regulatory;Planning	Implemented	This Directive by way of strict operational and technical requirements aims as far as is possible to reduce the negative effects of landfills on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment.	1999	Department of Finance	624.7	730.1	801.2	1,649.7
Other Agriculture Measures Announced in the 2019/21 Climate Action Plan (With Additional Measures)	Agriculture	Methane (CH ₄)	39	Voluntary/negotiated agreements;Education	Planned	A basket of Agriculture measures announced in the 2019 and 2021 Climate Action Plans including: animal related measures and feed change measures to reduce methane emissions.	2021	European Commission	0.0	1,666.5	3,675.9	3,825.6
Renewables - With Measures scenario (Electricity Generation)	Energy supply	Carbon dioxide (CO ₂)	1	Regulatory;Economic	Implemented	This measure encompasses the development of renewable energy in electricity generation under the With Measures scenario. Under this measure RES-E is 38.5% in 2020.	2005	National Standards Authority of Ireland	2,557.4	3,984.4	7,188.7	8,879.1

Renewables - With Measures scenario (Transport)	Transport	Carbon dioxide (CO2)	18	Regulatory;Economic	Implemented	This measure encompasses the development of renewable energy in transport under the With Measures scenario. Under this measure RES-T is 7.7% in 2020.	2005	Irish Aviation Authority	509.6	693.0	577.5	512.7
Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC- Heat component	Energy supply	Carbon dioxide (CO2)	1	Regulatory	Planned	The Irish Government has set a target of 12% renewable heat by 2020. This renewable heat target in conjunction with renewable fuel penetration in the transport sector (RES-T) and renewable electricity targets (RES-E) forms part of Irelands overall renewable energy target of 16% by 2020 under Directive 2009/28/EC. By 2020 this PaM under the With Additional Measures scenario assumes Ireland will have achieved 9.8% renewable heat (RES-H) share in 2020.	2021	UK National Air Traffic Services	967.0	2,238.1	4,068.3	6,164.8

Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC - Electricity component	Energy supply	Carbon dioxide (CO2)	1	Regulatory	Planned	The Irish Government has set a target of 40% electricity consumption from renewables sources by 2020. This renewable electricity target in conjunction with renewable fuel penetration in the transport sector (RES-T) and renewable fuels for heat (RES-H) forms part of Irelands overall renewable energy target of 16% by 2020 under Directive 2009/28/EC. By 2020 this PaM under the With Additional Measures scenario assumes Ireland will have achieved 38.9% renewable (RES-E) share in 2020.	2021	Department of the Environment, Climate and Communications	2,604.4	4,116.6	8,339.7	11,082.2
Directive 2009/28/EC - on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC- Transport component	Transport	Carbon dioxide (CO2)	18	Regulatory	Planned	The Irish Government has set a target of 10% renewable fuels in transport by 2020. This renewable fuels in transport target in conjunction with renewable electricity targets (RES-E) and renewable fuels for heat (RES-H) forms part of Irelands overall renewable energy target of 16% by 2020 under Directive 2009/28/EC. By 2020 this PaM under the With Additional Measures scenario assumes Ireland will have achieved 10.8% renewable (RES-T) share in 2020.	2021	Commission for Energy Regulation	509.6	1,319.8	1,318.0	1,300.6

Better Energy Communities (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Implemented	The Better Energy Communities scheme, introduced in 2012, supports sustainable energy upgrades to existing buildings, services, facilities and processes in the community sector. It promotes projects with an aggregation of upgrades across sectors within a single project and favours projects where deeper retrofit can be demonstrated.	2012	Department of Transport, Tourism and Sport	123.7	180.7	192.0	180.4
Supplier Obligation Scheme (With Existing Measures)_cross-sectoral	Energy consumption	Carbon dioxide (CO2)	10; 12; 13; 14	Regulatory	Implemented	The Energy Efficiency Obligation Scheme (EEOS) is being implemented pursuant to the Energy Efficiency Directive 2012, Article 7. The Directive imposes a legal obligation on Member States to achieve new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors and all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013.	2014	Department of the Environment, Climate and Communications	791.5	1,266.7	1,736.8	1,640.5

Deep Retrofit Pilot	Energy consumption	Carbon dioxide (CO2)	10	Economic	Implemented	Deep retrofit is the significant upgrade of a building toward nearly zero energy requirements where the whole home is viewed as a system with respect to its energy performance.	2017	Environmental Protection Agency	3.1	3.0	2.7	2.5
EXEED Certified Grant (EXEED Grant Scheme) (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10; 12; 13	Economic	Implemented	EXEED Certified (Excellence in Energy Efficiency Design) is an energy efficiency design management process. The process sets out steps for designing in energy efficiency and energy management into design projects, for both new investments and upgrades to existing assets. The EXEED Grant Scheme was launched in 2016 with an incentive of up to €500,000 for industrial and commercial businesses to use the EXEED process to design in energy efficiency and energy management into their new or existing assets. One of the purposes of the EXEED process is to move away from looking at energy efficiency measures in isolation. Instead EXEED's scope treats an asset as an energy system and converges on a solution that ranks the priority of different energy efficiency investments relative to that system.	2016	Department of Agriculture, Food and the Marine	53.7	61.6	50.9	43.5

Heat Pumps Non-Domestic (With Existing Measures)	Energy supply	Carbon dioxide (CO2)	1	Economic	Implemented	Through the Support Scheme for Renewable Heat consumers in industrial, services and public sectors can avail of a grant towards the cost of an electric heat pump. The grant, administered by SEAI, can cover up to 30% of eligible costs.	2018	Department of the Environment, Climate and Communications	10.0	46.9	36.6	20.8
Public Sector Capital Exemplars (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Implemented	The programme is intended to create scalable investment in energy efficiency across key segments of the public sector. This includes the demonstration of best practice retrofit approaches, project procurement and delivery approaches, and testing pilot measures. The overall intent of this programme is to create and stimulate a long term renovation strategy in these key segments, grow capacity, and delivery savings. To date work has been focused on Department of Education (schools), OPW, HSE the Local Authority sector and the Higher Education Authority sector.	2017	Sustainable Energy Authority of Ireland	16.3	26.6	24.5	23.1

Warmth and Wellbeing Pilot (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Implemented	The Warmth & Wellbeing scheme is an initiative led by the Department of Communications, Climate Action and Environment (DCCAE) in conjunction with the Department of Health (DoH), the Health Service Executive (HSE) and Sustainable Energy Authority of Ireland (SEAI). It aims to make homes warmer and healthier to live in by providing extensive, deeper energy efficiency upgrades to those in energy poverty that are living with chronic respiratory conditions.	2016	Department of Transport, Tourism and Sport	2.1	2.2	2.0	1.9

EXEED Certified Grant (EXEED Grant Scheme) (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10; 12; 13	Economic	Planned	EXEED Certified (Excellence in Energy Efficiency Design) is an energy efficiency design management process. The process sets out steps for designing in energy efficiency and energy management into design projects, for both new investments and upgrades to existing assets. The EXEED Grant Scheme was launched in 2016 with an incentive of up to €500,000 for industrial and commercial businesses to use the EXEED process to design in energy efficiency and energy management into their new or existing assets. One of the purposes of the EXEED process is to move away from looking at energy efficiency measures in isolation. Instead EXEED's scope treats an asset as an energy system and converges on a solution that ranks the priority of different energy efficiency investments relative to that system.	2021	Department of the Environment, Climate and Communications	53.7	151.7	228.1	282.8
Heat Pumps Non-Domestic (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Planned	Through the Support Scheme for Renewable Heat consumers in industrial, services and public sectors can avail of a grant towards the cost of an electric heat pump. The grant, administered by SEAI, can cover up to 30% of eligible costs.	2021	Sustainable Energy Authority of Ireland	9.0	80.4	74.4	42.2

Heat Pumps - Domestic (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Planned	A grant of up to €3,500 towards the capital cost of an electric heat pump is available to homeowners through an SEAI scheme. Homes must achieve a minimum heat loss requirement in order to be eligible.	2021	Department of the Environment, Climate and Communications	0.0	144.2	785.6	341.6
Public Sector Capital Exemplars (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Planned	The programme is intended to create scalable investment in energy efficiency across key segments of the public sector. This includes the demonstration of best practice retrofit approaches, project procurement and delivery approaches, and testing pilot measures. The overall intent of this programme is to create and stimulate a long term renovation strategy in these key segments, grow capacity, and delivery savings. To date this programme has been focussed on schools, and central government buildings but is growing to other areas such as health, third level education, and water.	2021	Commission for Regulation of Utilities	16.3	66.0	113.1	156.2

Warmth and Wellbeing Pilot (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Planned	The Warmth & Wellbeing scheme is an initiative led by the Department of Communications, Climate Action and Environment (DCCAE) in conjunction with the Department of Health (DoH), the Health Service Executive (HSE) and Sustainable Energy Authority of Ireland (SEAI). It aims to make homes warmer and healthier to live in by providing extensive, deeper energy efficiency upgrades to those in energy poverty that are living with chronic respiratory conditions.	2021	Department of Transport, Tourism and Sport	2.1	2.2	2.0	1.9

Accelerated Capital Allowance for energy efficient equipment (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	11; 12; 13	Fiscal	Planned	The Accelerated Capital Allowance for Energy Efficiency Equipment (ACA), introduced in 2008, aims to improve the energy efficiency of Irish companies by encouraging them to purchase energy saving technologies. The ACA is a tax incentive for companies paying corporation tax and aims to encourage investment in energy efficient equipment. The ACA offers an attractive incentive whereby it allows companies to write off 100% of the purchase value of qualifying energy efficient equipment against their profit in the year of purchase.	2021	Sustainable Energy Authority of Ireland	211.2	175.2	146.5	124.1
Sustainable Energy Authority of Ireland Large Industry Programme (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	13	Voluntary/negotiated agreements	Planned	The Large Industry Energy Network (LIEN) is a voluntary network, facilitated by the Sustainable Energy Authority of Ireland, of companies working to maintain strong energy management and environmental protection practices.	2021	Department of the Environment, Climate and Communications	1,041.6	1,132.2	1,214.1	1,298.6

CHP Deployment - Public and Business sectors (With Additional Measures)	Energy supply	Carbon dioxide (CO2)	3; 1	Economic	Planned	The CHP Deployment programme provided grants for selected renewable and alternative heat sources and was designed to prime the market and to establish a supply chain. The CHP Deployment programme provided grant aid towards the installation of small scale CHP, up to 1 MWe at sites with a suitable heat load.	2021	Sustainable Energy Authority of Ireland	108.0	126.8	145.5	164.2
Carbon Tax (With Additional Measures)	Cross-sectoral	Carbon dioxide (CO2)	10; 14	Fiscal	Planned	Incorporate a price signal for carbon on the non-ETS sector, specifically fuels used for heating and transport. The tax applies to petrol, diesel, kerosene, marked gas oil (for agricultural use), Liquid Petroleum Gas (LPG), fuel oil, natural gas, coal and commercial peat.	2021	Sustainable Energy Authority of Ireland	401.5	1,030.8	1,278.1	1,284.4
Public Sector Programme (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	12; 10	Economic; Information; Education	Planned	The programme aims to increase energy efficiency by providing a range of funded services including advice, mentoring and training to participating Public Sector bodies. Implementation of measures to enable the public sector contribute to its requirements under the national target of increasing energy efficiency nationally by 20% by 2020.	2021	Sustainable Energy Authority of Ireland	520.1	505.9	501.2	503.5

Small and Medium Enterprises (SME) Programme (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	12; 10; 14	Education;Information	Planned	The programme aims to increase energy efficiency in SMEs through providing advice, mentoring and training to participating SMEs	2021	Sustainable Energy Authority of Ireland	48.3	43.3	40.0	37.7
Warmer Homes Scheme (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic;Voluntarily/negotiated agreements;Information;Education	Planned	The measure targets vulnerable and fuel poor homes and provides funding for the installation of domestic energy efficiency upgrades via regional not-for-profit organisations and private contractors.	2021	Sustainable Energy Authority of Ireland	96.7	111.3	129.3	135.0
Better Energy Homes (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic;Information;Education	Planned	Stimulating energy-efficiency actions to reduce energy usage by homeowners and the general public. Sustainable Energy Authority of Ireland grant-aids householders who want to make their homes more energy-efficient by providing incentives towards the implementation of energy efficiency measures including attic and wall insulation and heating controls with efficient boilers and/or solar thermal.	2021	Department of the Environment, Climate and Communications	409.0	438.3	449.4	508.6
Electric vehicle deployment (With Additional Measures)	Transport	Carbon dioxide (CO2)	18	Economic;Fiscal	Planned	Grant support for new electric vehicles. Electric vehicles were identified as an important element in efforts to achieve both energy efficiency and renewable energy targets as part of the EU Climate Change-Energy Package.	2021	Sustainable Energy Authority of Ireland	24.3	263.7	1,370.7	1,998.2

Better Energy Communities (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic	Planned	The Better Energy Communities scheme, introduced in 2012, supports sustainable energy upgrades to existing buildings, services, facilities and processes in the community sector. It promotes projects with an aggregation of upgrades across sectors within a single project and favours projects where deeper retrofit can be demonstrated.	2021	Department of Health	123.7	260.7	386.5	424.9
2018 Building Regulations - Buildings other than dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	NZEB (Nearly Zero Energy Buildings) has been introduced for all new non domestic buildings, it sees a reduction in the energy performance of approximately 60% compared to the previous regulations. Also required is a Renewable Energy Ratio of 20%, meaning that 20% of the primary energy use must be from renewables onsite or nearby.	2017	Health Service Executive	67.7	208.4	323.9	427.3

2019 (proposed) Building Regulations - Dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	NZEB (Nearly Zero Energy Buildings) will be introduced to all new domestic buildings, it sees a reduction in the energy performance of approximately 25% compared to the previous 2011 regulations. Also required is a Renewable Energy Ratio of 20%, meaning that 20% of the primary energy use must be from renewables onsite or nearby.	2019	Sustainable Energy Authority of Ireland	4.9	154.2	244.9	299.3
Heat Pumps - Domestic (With Existing Measures)	Energy supply	Carbon dioxide (CO2)	1	Economic	Implemented	A grant of up to €3,500 towards the capital cost of an electric heat pump is available to homeowners through an SEAI scheme. Homes must achieve a minimum heat loss requirement in order to be eligible.	2018	Sustainable Energy Authority of Ireland	0.0	187.0	310.0	134.8
Better Energy Finance (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Economic;Fiscal	Implemented	The Better Energy Financing (BEF) project is a Government initiative working to identify market based solutions that could be developed as an alternative to direct Exchequer funding and overcome the reluctance of consumers to take on debt for energy efficiency improvements.	2019	Sustainable Energy Authority of Ireland	0.8	0.7	0.7	0.6

Solar Pilot Scheme (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10; 12	Regulatory	Implemented	Support to homeowners for the installation of Solar PV panels and battery energy storage systems.	2019	Sustainable Energy Authority of Ireland	6.2	14.6	8.6	3.6
Major Renovations - Dwellings	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	Major Renovation is defined within the building regulations and applies to any building where 25% of the external envelope undergoes renovation and it is technically, functionally and economically feasible to apply. For Domestic projects this has been defined in the regulations as applying where external or internal wall insulation is used and requires the heating system and ceiling insulation to achieve minimum standards, or alternatively the building achieves a B2 Building Energy Rating.	2020	Department of the Environment, Climate and Communications	3.7	11.8	18.5	24.1
Other Domestic Retrofit (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Planned	This is a catch-all category for the remaining residential savings as required to meet the energy efficiency improvement required by 2030	2021	Sustainable Energy Authority of Ireland	0.0	0.0	521.3	481.3

Better Energy Finance (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10; 12	Economic;Fiscal	Planned	The Better Energy Financing (BEF) project is a Government initiative working to identify market based solutions that could be developed as an alternative to direct Exchequer funding and overcome the reluctance of consumers to take on debt for energy efficiency improvements.	2021	Department of Health	0.8	2.3	4.6	5.5
Solar Pilot Scheme (With Additional Measures)	Energy supply	Carbon dioxide (CO2)	1; 3	Regulatory	Planned	Support to homeowners for the installation of Solar PV panels and battery energy storage systems.	2021	Health Service Executive	6.2	25.5	27.5	13.9
National Home Retrofit Scheme OSS (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	Stimulating energy-efficiency actions to reduce energy usage by homeowners	2021	Department Of Finance	0.0	18.7	24.5	22.6
National Home Retrofit Scheme OSS (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10	Regulatory	Implemented	Stimulating energy-efficiency actions to reduce energy usage by homeowners	2021	The Office of the Revenue Commissioners	0.0	65.2	59.8	66.8
Smart Meter Roll-Out - Household (With Existing Measures)	Energy consumption	Carbon dioxide (CO2)	10; 14	Regulatory	Implemented	Supplier to homeowners to monitor and reduce energy consumption	2021	Sustainable Energy Authority of Ireland	0.0	228.4	124.1	54.8
Smart Meter Roll-Out - Household (With Additional Measures)	Energy consumption	Carbon dioxide (CO2)	10; 14	Regulatory	Implemented	Supplier to homeowners to monitor and reduce energy consumption	2021	Sustainable Energy Authority of Ireland	0.0	225.9	118.0	53.0

Supplier Obligation Scheme (With Additional Measures)_cross-sectoral	Energy consumption	Carbon dioxide (CO2)	10; 12; 13; 14	Regulatory	Implemented	The Energy Efficiency Obligation Scheme (EEOS) is being implemented pursuant to the Energy Efficiency Directive 2012, Article 7. The Directive imposes a legal obligation on Member States to achieve new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors and all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013.	2014	Revenue Commissioners	791.5	1,330.3	1,791.2	1,924.8
Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC- Heat component	Energy supply	Carbon dioxide (CO2)	1	Regulatory	Implemented	The Irish Government has set a target of 12% renewable heat by 2020. This renewable heat target in conjunction with renewable fuel penetration in the transport sector (RES-T) and renewable electricity targets (RES-E) forms part of Irelands overall renewable energy target of 16% by 2020 under Directive 2009/28/EC. By 2020 this PaM under the With Additional Measures scenario assumes Ireland will have achieved 9.8% renewable heat (RES-H) share in 2020.	2005	Department of the Environment, Climate and Communications	963.8	1,964.2	2,990.5	4,037.8

Nitrous oxide savings from Ammonia abatement measures	Agriculture	Nitrous oxide (NO ₂)	39; 42	Regulatory	Implemented	Ammonia abatement measures to minimise nitrous oxide and ammonia loss.	2020	Sustainable Energy Authority of Ireland	8.0	30.9	39.3	39.5
Crude protein reduction in dairy cows	Agriculture	Nitrous oxide (NO ₂)	41	Regulatory	Implemented	Reduction of crude protein content of livestock feeding stuffs to minimise nitrous oxide and ammonia loss	2020	Sustainable Energy Authority of Ireland	0.0	11.8	12.5	12.7
Reduced pig crude protein (with Additional Measures)	Agriculture	Nitrous oxide (NO ₂)	41	Regulatory	Planned	Reduction in the crude protein content of pig feed resulting in reduced nitrous oxide and ammonia emissions	2021	Sustainable Energy Authority of Ireland	0.0	1.5	1.6	1.6
Fertiliser use measures (with Additional Measures)	Agriculture	Nitrous oxide (NO ₂)	39	Regulatory	Planned	Replacement of calcium ammonium nitrate fertiliser applied to grassland with inhibited urea products	2021	Department of the Environment, Climate and Communications	0.0	363.4	957.6	1,043.8
Peatlands rehabilitation	Land use, land-use change and forestry	Carbon dioxide (CO ₂)	54	Regulatory	Implemented	Programme for rehabilitation of peatlands.	2020	DECC, DHLGH	0.0	1,157.2	1,084.8	1,084.8
New afforestation (with Additional Measures)	Land use, land-use change and forestry	Carbon dioxide (CO ₂)	46	Regulatory	Planned	New afforestation to 2030	2021	DAFM	0.0	24.3	267.0	692.9
Water table management on drained organic soils (with Additional Measures)	Land use, land-use change and forestry	Carbon dioxide (CO ₂)	54	Regulatory	Planned	Reduced management intensity (water table management) of 80,000 hectares on drained organic soils by 2030	2021	DAFM	0.0	1,460.2	2,509.2	2,510.1
Replacement of coal fired electricity generation with natural gas (With Additional Measures)	Energy supply	Carbon dioxide (CO ₂)	3	Research;Planning	Planned	This measure is aimed at examining the effect of replacing coal fired electricity generation with natural gas fired electricity generation.	2021	Sustainable Energy Authority of Ireland	1,516.6	1,521.0	1,021.3	1,059.6

*See tabs "Sector" and "Objectives" for keys to these categories

Sector Id	Sector Description	Note
1	Energy supply	power generation includes manufacturing and construction, commercial/public services & residential
2	Energy consumption	
3	Transport	
4	Industrial processes	
5	Waste management/waste	
6	Agriculture	
7	Land use, land-use change and forestry	
8	Other sectors	

Objective Id	Objective Description	Sector Id
1	Increase in renewable energy sources in the electricity sector	1
2	Increase in renewable energy in the heating and cooling sector	1
3	Switch to less carbon-intensive fuels	1
4	Enhanced non-renewable low carbon generation (nuclear)	1
5	Reduction of losses	1
6	Efficiency improvement in the energy and transformation sector	1
7	Carbon capture and storage or carbon capture and utilization	1
8	Control of fugitive emissions from energy production	1
9	Other energy supply	1
10	Efficiency improvements of buildings	2
11	Efficiency improvement of appliances	2
12	Efficiency improvement in services/tertiary sector	2
13	Efficiency improvement in industrial end-use sectors	2
14	Demand management/reduction	2
15	Other energy consumption	2
16	Efficiency improvements of vehicles	3
17	Modal shift to public transport or non-motorized transport	3
18	Low carbon fuels	3
19	Electric road transport	3
20	Demand management/reduction	3
21	Improved behavior	3
22	Improved transport infrastructure	3
23	Reduce emissions from international air or maritime transport	3
24	Other transport	3
25	Installation of abatement technologies	4
26	Improved control of fugitive emissions from industrial processes	4
27	Improved control of manufacturing, fugitive and disposal emissions of fluorinated gases	4
28	Replacement of fluorinated gases by gases with a lower GWP value	4
29	Other industrial processes	4
48	Enhancing production in existing forests	7
49	Increasing the harvested wood products pool	7
50	Enhanced forest management	7
51	Prevention of deforestation	7
52	Strengthening protection against natural disturbances	7
53	Substitution of GHG intensive feedstocks and materials with harvested wood products	7
54	Prevention of drainage or rewetting of wetlands	7
55	Restoration of degraded lands	7
56	Other land use, land-use change and forestry	7
35	Waste incineration with energy use	5
36	Improved wastewater management systems	5
30	Demand management/reduction	5
31	Enhanced recycling	5
32	Enhanced CH ₄ collection and use	5
33	Improved treatment technologies	5
34	Improved landfill management	5
39	Reduction of fertilizer/manure use on cropland	6
41	Improved livestock management	6
40	Other activities improving cropland management	6
42	Improved animal waste management systems	6
43	Activities improving grazing land or grassland management	6
44	Improved management of organic soils	6
45	Other agriculture	6
46	Afforestation and reforestation	7

47	Conservation of carbon in existing forests	7
37	Reduced landfilling	5
38	Other waste	5
57	Other objective(s)	8

Chapter Five:

Projections and Total Effects of Policies and Measures

5. Projections and Total Effects of Policies and Measures

5.1 Introduction

The National Climate Change Strategy (2007)¹ designated the responsible for developing annual national emission projections for GHG for all key sectors of the economy, in collaboration with relevant State and other bodies. Projections are compiled to inform national policy development and to meet EU reporting obligations (Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action)².

Since Ireland's 7th National Communication, a number of changes have been made to the approach used to produce these emissions projections. These changes include both updates to reflect newer source data, and methodological changes made to improve the accuracy and repeatability of the results. In this report the starting point is the latest inventory available (1990-2020³). The key methodological change is a new model for producing energy demand projections, a key input dataset that is used to produce the final energy demand projections. This new model, called the "Ireland Environment, Energy and Economy" model (I3E) reproduces the structure of the economy in its entirety. The model is described in detail in Section 5.8. As before, the output from this model is adjusted to consider the projected impact of energy related policies and measures.

In relation to the input assumptions the latest projections for 2021-2040 (published by the EPA in June 2022⁴) uses two scenarios: With Existing Measures (WEM) and With Additional Measures (WAM):

- The first scenario, WEM, forecasts Ireland's emissions including all national policies and measures implemented by the end of 2020. This is the cut off point for which the latest national greenhouse gas emission inventory data is available, known as the 'base year' for projections. Implemented measures in the National Development Plan (NDP)⁵ and CAP19 are included in this scenario.
- The second scenario WAM has a higher level of ambition and includes government policies and measures to reduce emissions such as those in Ireland's CAP21. This was published in November 2021 and the included measures have

¹ Department of Environment, Heritage and Local Government, National Climate Change Strategy 2007-2012, 2007

² Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action

³ EPA, Ireland's Provisional Greenhouse Gas emissions 1990-2020, <https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-provisional-greenhouse-gas-emissions-1990-2020.php>

⁴ Ireland's Greenhouse Gas Emissions Projections 2021-2040, <https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/irelands-greenhouse-gas-emissions-projections-2021-2040.php>

⁵ National Development Plan 2021-2030, <https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/>

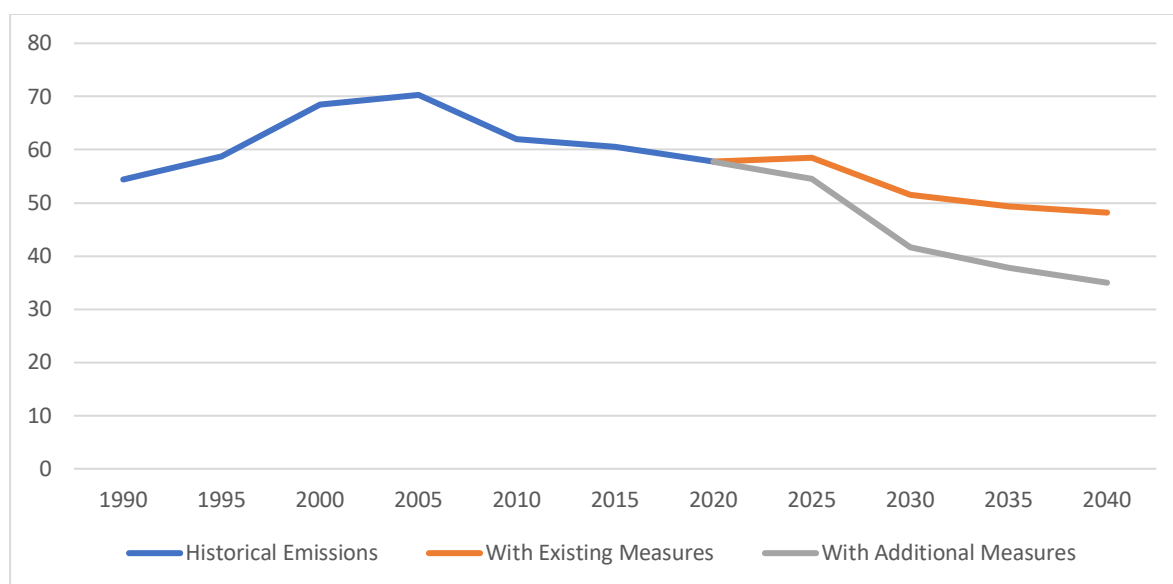
not yet moved into implementation phase. As implementation happens the measures will be migrated into the WEM scenario.

In terms of agriculture, similar to the 7th National Communication, this report considers the proposed activity for meeting the overarching objectives of Ireland's Food Wise 2025⁶ plan (further details described in Section 5.5.8 below).

For the projections Ireland has not developed a 'without measures' scenario or estimated indirect GHG projections for carbon monoxide, nitrogen oxides, non-methane volatile organic compounds, and sulphur oxides. The preparation of a 'without measures' scenario and projections for indirect GHG projections for carbon monoxide, nitrogen oxides, non-methane volatile organic compounds, and sulphur oxides is being kept under consideration.

5.2 Projections of Greenhouse Gas Emissions

Figure 5.1 - Historical and projected greenhouse gas emissions for the 'With Measures' and 'With Additional Measures' scenarios⁷



By 2030 total emissions are set to decrease by 5.4% and 24.1% on 1990 levels under the WEM and WAM scenarios respectively. By 2040 total emissions are set to decrease by 11.6% and 36.2% respectively, relative to 1990 levels. In contrast, Ireland's 7th National Communication reported that by 2030 total emissions were set to increase by 19% and 12% respectively, relative to 1990 levels.

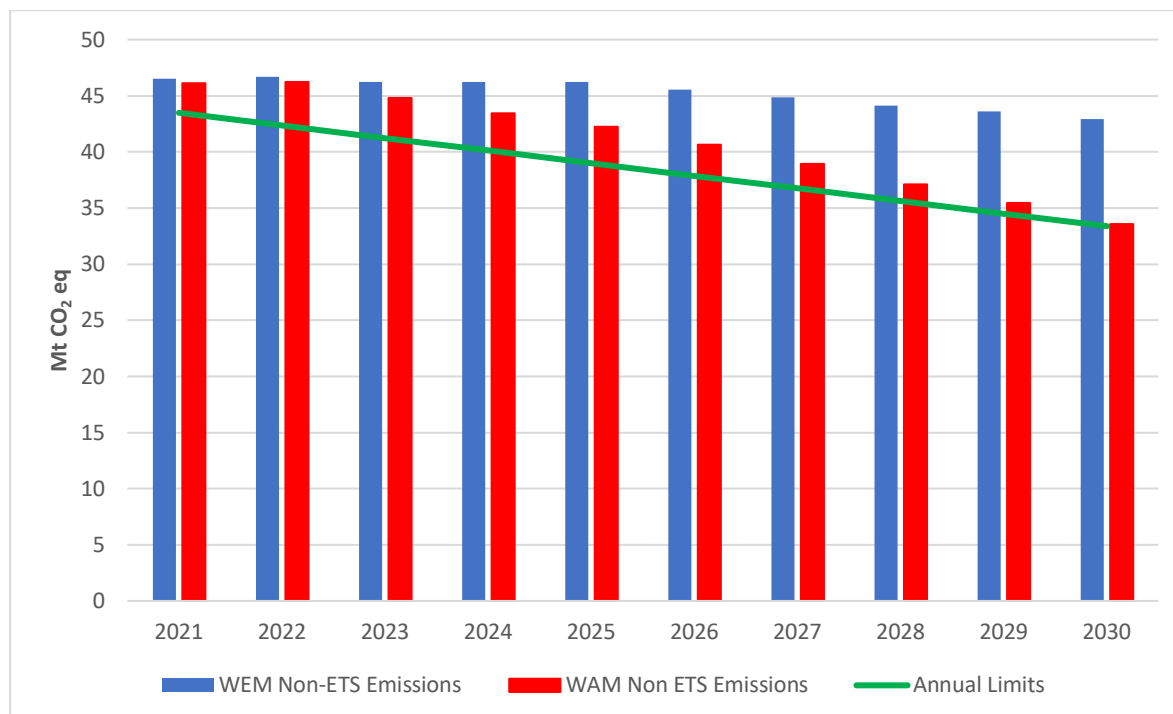
⁶ DAFM, Food Wise 2025, <https://www.gov.ie/en/publication/a6b0d-food-wise-2025>

⁷ Total without LULUCF

Ireland's 2030 target under the EU's Effort Sharing Regulation⁸ (ESR) on greenhouse gas reduction is a 30% reduction of emissions compared to 2005 levels by 2030. The ESR includes the sectors outside the scope of the EU ETS (agriculture, transport, built environment, waste and non-energy intensive industry). The latest EPA projections show that currently implemented measures (WEM) will achieve a reduction of 10% on 2005 levels by 2030. This should be considered a conservative outlook which understates the likely progress by 2030, as these projections imply that no additional policies or measures will be implemented after 2021. If measures in the higher ambition (WAM) scenario are implemented, the 30% reduction target by 2030 can be achieved.

In addition, the ESR sets out annual binding emissions reduction targets⁹ for Member States for the period 2021-2030 for the non ETS sector to ensure a gradual move towards the 2030 target. The 2021-2030 targets under the ESR include Annual Emissions Allocations (AEAs) for each year from 2021-2030 calculated using Global Warming Potentials (GWPs) specified in the 5th IPPC assessment report (AR5). Any overachievement of the binding emissions limit in a particular year can be banked and used towards compliance in a future year.

Figure 5.2 - WEM and WAM GHG emissions projections and comparison with the reduction pathway required between 2021 and 2030 (GWPs as per AR5)



⁸ Regulation (EU) 2018/842

⁹ Specified in Commission Implementing Decision (2020/2126)

Under the WEM scenario, Ireland is projected to cumulatively exceed its obligations by 68.6 Mt of CO₂ eq over the period 2021-2030. Under the WAM scenario, Ireland is projected to cumulatively exceed its obligations by 24.3 Mt of CO₂ eq over the period 2021-2030 (Fig5.2).

5.3 Projections by Sector

5.3.1 Projections by Sector (WEM)

Sectoral emissions in this Chapter are presented in line with the sectoral breakdown as published in the most recent national EPA GHG emission projections report published in June 2022¹⁰. See the Appendix in this national publication for further explanation of the categories.

Sectoral shares for the 'WEM' scenario are presented in Table 5.1 and Figure 5.3 for historical and projected years. The single largest source of emissions in 2020 was the agriculture sector which contributed to 37.4% of total national emissions (excluding LULUCF)¹¹. By 2030 its share is projected to increase to 42.6%. The second largest source of emissions in 2020 is the Transport sector accounting for 17.7% of total national emissions. In 2030 it is projected to account for 20%.

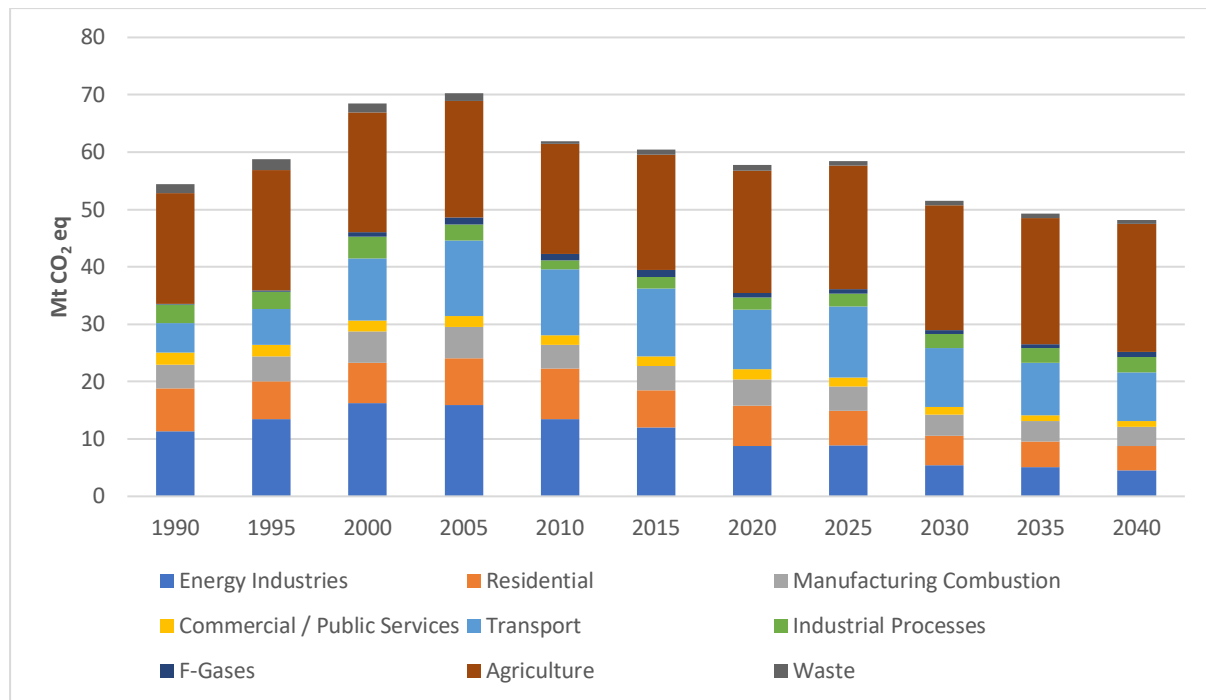
Table 5.1 Sectoral share (WEM)

Sector	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy											
Industries	20.7%	22.8%	23.5%	22.5%	21.7%	19.7%	15.1%	15.2%	10.5%	10.3%	9.3%
Residential	13.7%	11.1%	10.2%	11.6%	14.1%	10.7%	12.3%	10.2%	10.0%	9.0%	8.8%
Manufacturing											
Combustion	7.5%	7.3%	8.0%	7.7%	6.7%	7.0%	7.8%	7.3%	7.0%	7.0%	7.0%
Commercial / Public Services											
	3.8%	3.4%	2.8%	2.7%	2.7%	2.8%	3.2%	2.7%	2.5%	2.0%	1.9%
Transport	9.4%	10.6%	15.7%	18.6%	18.5%	19.5%	17.7%	21.0%	20.0%	18.5%	17.6%
Industrial Processes	6.0%	5.1%	5.5%	3.9%	2.4%	3.3%	3.6%	3.8%	4.6%	5.1%	5.6%
F-Gases	0.1%	0.4%	1.1%	1.7%	1.8%	2.0%	1.4%	1.3%	1.3%	1.5%	1.9%
Agriculture	36.0%	36.3%	31.1%	29.4%	31.2%	33.4%	37.4%	37.2%	42.6%	44.9%	46.6%
Waste	2.8%	3.1%	2.2%	1.9%	0.9%	1.6%	1.6%	1.4%	1.5%	1.5%	1.4%

¹⁰ EPA, Ireland's Greenhouse Gas Emissions Projections 2021-2040, [Monitoring & Assessment: Climate Change: Air emissions Publications | Environmental Protection Agency \(epa.ie\)](#)

¹¹ Note that the projections total for Agriculture includes fuel combustion in Agriculture and Forestry, whereas inventory data does not, hence the small difference in percentage figures between Chapter 3 and Chapter 5.

Figure 5.3 Sectoral Share (WEM)



The Energy Industries sector is the third largest source of emissions in 2020 accounting for 15.1% of emissions. By 2030 its sectoral share is projected to decrease to 10.5%. Emissions from Manufacturing Combustion accounted for 7.8% of total emissions in 2020 and are projected to reduce slightly to 7% of total emissions in 2030. Emissions from Industrial Processes accounted for 3.6% of total emissions in 2020 and the projected share is to be 4.6% in 2030.

Emissions from Commercial and Public Services accounted for 3.2% of total emissions in 2020 and are projected to reduce to 2.5% in 2030. Emissions from the Residential Sector accounted for 12.3% of total emissions in 2020 and are projected to reduce to 10% in 2030. In 2020 the waste sector accounted for 1.6% of national total emissions, and is projected to reduce slightly in 2030 at 1.5%.

Ireland's 7th National Communication also reported that Energy Industries, Transport and Agriculture were the three largest sources of emissions out to 2030, however the proportion of emissions in 2030 from Agriculture has increased from 30.6% in the 7th National Communication to 42.6% in this report. This is a consequence of other sectors of the economy being projected to decarbonise more quickly. The assumptions underpinning the WEM scenario in the latest projections are outlined in the Sectoral Analysis section below.

5.3.2 Projections by Sector (WAM)

Sectoral shares for the 'WAM' scenario are presented in Table 5.2 for historical and projected years.

Under the WAM scenario the share of emissions from the proportionally largest sector, agriculture, is projected to increase to 41.3% in 2030. The second largest source of emissions, the transport sector, is projected to account for 17.8% of emissions in 2030.

Table 5.2 Sectoral Share (WAM)

Sector	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy Industries	20.8%	22.9%	23.7%	22.6%	21.7%	19.8%	15.1%	16.0%	10.7%	12.2%	11.2%
Residential	13.8%	11.2%	10.3%	11.7%	14.2%	10.8%	12.3%	10.3%	9.6%	5.3%	2.9%
Manufacturing Combustion	7.5%	7.4%	8.0%	7.8%	6.7%	7.1%	7.8%	7.9%	8.9%	9.2%	8.5%
Commercial / Public Services	3.9%	3.4%	2.8%	2.7%	2.8%	2.8%	3.2%	2.8%	2.4%	1.3%	1.0%
Transport	9.5%	10.7%	15.8%	18.7%	18.6%	19.5%	17.8%	20.2%	17.8%	15.8%	14.6%
Industrial Processes	6.0%	5.1%	5.5%	3.9%	2.4%	3.3%	3.7%	4.1%	5.7%	6.7%	7.7%
F-Gases	0.1%	0.4%	1.1%	1.7%	1.8%	2.0%	1.4%	1.4%	1.7%	2.1%	2.9%
Agriculture	35.5%	35.8%	30.6%	29.0%	31.0%	33.1%	37.4%	35.8%	41.3%	45.3%	49.2%
Waste	2.9%	3.1%	2.2%	1.9%	0.9%	1.6%	1.6%	1.5%	1.9%	2.0%	2.0%

The Energy industries sector is the third largest source of emissions, by 2030 its sectoral share is projected to decrease to 10.7%. Emissions from Manufacturing Combustion are projected to increase to 8.9% of total emissions in 2030. The projected share from Industrial Processes is projected to be 5.7% in 2030. Emissions from Commercial and Public Services are projected to reduce to 2.4% in 2030. Emissions from the Residential Sector are projected to reduce to 9.6% in 2030. The waste sector is to increase slightly to 1.9% of total emissions in 2030 under the WAM Scenario.

Ireland's 7th National Communication also reported that Energy Industries, Transport and Agriculture were the three largest sources of emissions out to 2030, however the proportion of emissions in 2030 from Agriculture has increased from 32.1% in the 7th National Communication to 41.3 % in this report. This is a consequence of other sectors of the

economy being projected to decarbonise more quickly. The assumptions underpinning the WAM scenario in the latest projections are outlined in the Sectoral Analysis section below.

Table 5.3 Breakdown of GHG emissions by ETS and non ETS sector for the period 2021 to 2040 (GWPs as per AR5)

	Year				
With Existing Measures	2021	2025	2030	2035	2040
ETS Total (kt CO ₂ eq)	15,841	13,252	9,612	9,490	8,953
Non-ETS Total (kt CO ₂ eq)	46,516	46,213	42,941	40,826	40,245
With Additional Measures					
ETS Total (kt CO ₂ eq)	15,772	13,064	8,714	8,995	8,106
Non-ETS Total (kt CO ₂ eq)	46,134	42,252	33,553	29,402	27,536

Table 5.3 presents the breakdown of greenhouse gas emissions by ETS and non ETS sector for the period 2021 to 2040 for both the WEM and WAM scenarios. In the WEM scenario it is projected that the ETS sector will account for 18% of total emissions in 2030 and 2040. In the WAM scenario it is projected that the ETS sector will account for 20.6% and 22.7% of total emissions in 2030 and 2040 respectively.

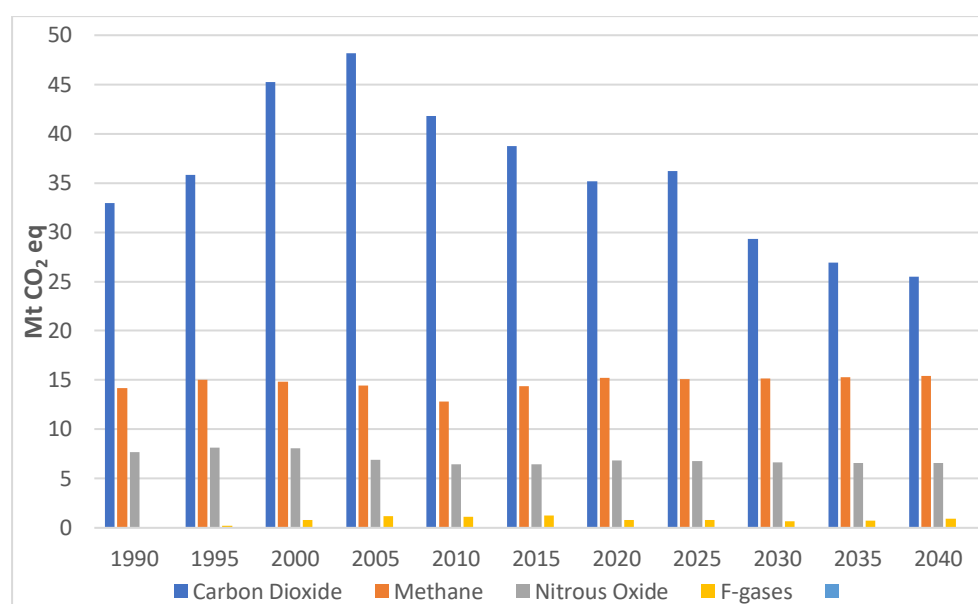
5.4 Projections by Gas

5.4.1 Projections by Gas (WEM scenario)

CO₂ emissions accounted for 61% of national total (excluding LULUCF) emissions in 2020, with CH₄ and N₂O contributing 26% and 12%, respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ accounted for 1.4 % of total emissions in 2020. By 2030 emissions of CO₂ are projected to decrease to 57% of national total emissions, with CH₄ and N₂O accounting for 29% and 13% respectively. By 2040 emissions of CO₂ are projected to decrease further to 53% of national total emissions, with CH₄ and N₂O accounting for 32% and 14% respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ are projected to increase to 2% by 2040. Table 5.4 and Figure 5.4 provide historical and projected emissions by gas for the 'WEM' scenario.

Table 5.4: Historical emissions and projections by gas for the WEM scenario (Mt CO₂ eq)

Gas	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Carbon Dioxide	32.94	35.85	45.25	48.16	41.79	38.72	35.15	36.18	29.34	26.92	25.51
Methane	14.18	15.04	14.86	14.42	12.80	14.35	15.23	15.07	15.16	15.30	15.44
Nitrous Oxide	7.66	8.11	8.05	6.90	6.45	6.47	6.87	6.77	6.65	6.61	6.61
F-gases	0.03	0.23	0.77	1.20	1.13	1.23	0.7843	0.77	0.696	0.76	0.901
Total	54.8	59.2	68.9	70.7	62.2	60.8	58.0	58.8	51.8	49.6	48.5

Figure 5.4 Historical emissions and projections by gas for the WEM scenario (Mt CO₂ eq)

In 2020 the largest source of CO₂ emissions was Transport accounting for almost 30%. By 2030, Transport remains the largest contributor to CO₂ emissions at 35% and remains the largest in 2040 at 33%. The second most significant contributor to greenhouse gas emissions in Ireland is CH₄ accounting for 26% of emissions in 2020 and 29% in 2030. It is projected that by 2040 CH₄ will account for 32% of emissions. The main driver behind CH₄ emissions in Ireland is from cattle (enteric fermentation and manure management). Emissions from the agriculture sector are projected to increase as a result of expansion plans in the sector. Similar to emissions of CH₄, the agriculture sector is the largest source of N₂O emissions in Ireland reflecting the significant quantities of nitrogen from animal manures and synthetic fertilizers applied to agricultural soils. Nitrous oxide emissions accounted for 12% of national total emissions in 2020 and are projected to account for 13% in 2030 and increase to 14% in 2040.

Emissions of the F-gases (HFCs, PFCs, SF₆ and NF₃) were 784 kt CO₂ equivalent in 2020 (1.4% of the national total). F-gas emissions are projected to decrease to 696 Kt CO₂ equivalent in 2030 but increase in 2040 to 901 Kt CO₂ (1.9% of the national total). Table 5.5 provides historical and projected emissions of F-gas in the WEM scenario.

Table 5.5 Historical emissions and projections by F-gas for the WEM scenario (kt CO₂eq)

F-Gas	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
HFCs	0.6	45.2	270.0	857.1	1048.3	1164.2	694.2	670.0	575.9	620.5	736.4
PFCs	0.1	97.6	397.8	216.4	46.6	20.5	70.2	82.7	97.3	114.5	134.7
SF ₆	33.9	79.1	51.8	96.8	33.1	44.5	18.5	19.4	21.1	24.1	27.5
NF ₃	NO	4.4	49.2	28.4	NO	1.0	1.5	1.7	2.0	2.4	2.8
Total	34.6	226.3	768.7	1198.6	1128.0	1230.1	784.3	773.7	696.3	761.4	901.5

5.4.2 Projections by Gas (WAM scenario)

By 2030 in the WAM scenario emissions of CO₂ are projected to make up 58% of national total emissions, with CH₄ and N₂O accounting for 27% and 14% respectively. By 2040 emissions of CO₂ are projected to decrease to 50% of national total emissions, with CH₄ and N₂O accounting for 32% and 16% respectively. The combined emissions of HFC, PFC, SF₆ and NF₃ are projected to increase to from 2% in 2030 to 3% by 2040.

Table 5.6: Historical emissions and projections by gas for the With Additional Measures scenario (Mt CO₂ eq)

Gas	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Carbon Dioxide	32.94	35.85	45.25	48.16	41.79	38.72	35.15	34.23	24.05	20.25	17.36
Methane	14.18	15.04	14.86	14.42	12.80	14.35	14.91	13.09	11.16	11.12	11.08
Nitrous Oxide	7.66	8.11	8.05	6.90	6.45	6.47	6.87	6.40	5.67	5.55	5.54
F-gases	0.03	0.23	0.77	1.20	1.13	1.23	0.78	0.78	0.72	0.81	1.00
Total	54.8	59.2	68.9	70.7	62.2	60.8	57.7	54.5	41.6	37.7	35.0

By 2030 in the WAM scenario, Transport remains the largest contributor to CO₂ emissions at 30% and also remains the largest in 2040 at 29%. In the WAM scenario the second most significant sectoral contributor to CO₂ emissions in Ireland is the energy industries sector and is projected to account for 17.9% of CO₂ emissions in 2030 increasing to 21.9% in 2040. Nitrous oxide emissions are projected to account for 14% of national total emissions in 2030 and increase to 16% in 2040.

5.5 Sectoral Analysis

5.5.1 Energy Industries

The majority of emissions within Energy industries come from power generation and are largely regulated under the EU ETS. In addition, emissions from the manufacture of solid fuels, petroleum refining (also largely included within ETS) and fugitive emissions are included. Energy industries accounted for 15.1% of Ireland's total emissions in 2020. Power generation covers all electricity generation including electricity generated from renewable sources. The Plexos_Ireland model was used to model electricity generation for

each year to 2040. As an electrical systems model, the core input data comprises technical details of generators, transmission lines and loads as well as fuel costs, operational costs and emission reduction rates and costs.

Under the WEM scenario, emissions from the energy industries sector are projected to decrease to 5.4 Mt CO₂ eq by 2030 and to 4.5 Mt CO₂ eq by 2040.

In the WAM scenario, emissions from the energy industries sector are projected to decrease to 4.5 Mt CO₂ eq by 2030 and to 3.9 Mt CO₂ eq by 2040.

Projections for oil refining and solid fuel manufacture are based on data provided by the relevant operators as energy demand from these sectors is not covered in SEAI's energy forecasts. The oil refining sector (1.A.1.b) in Ireland consists of a single installation. Carbon dioxide emission projections, provided by the operator, are based on assumptions about future product specifications, crude oil qualities and market demand.

With respect to solid fuel manufacture (1.A.1.c), one large operator produces a range of peat-based fuels for domestic and industrial customers including the electricity generation sector. Carbon dioxide emissions projections for solid fuel manufacture are provided to the EPA by the operator.

The main source of emissions from the energy industries sector (1.A.1) is power generation, accounting for 94.5% of emissions from this sector in 2020. Projected emissions from oil refining are projected to remain relatively static with emissions projected to be 305 kt CO₂ eq out to 2040. Projected emissions from solid fuel manufacture reduce to 22 kt CO₂ eq in 2025 and remain static to 2040.

Under the WEM scenario, emissions from power generation are projected to decrease by 39.1% between 2020 and 2030. Total fossil fuel used in the same period is expected to decrease by 31%. In this forecast the WEM assumptions are based on Ireland reaching 70% of electricity consumption from renewable energy by 2030. Renewable electricity generation capacity is dominated by wind energy, with an offshore wind capacity target of 3.5 GW by 2030. Solar (1.5 GW by 2030) and hydro sources also contribute to the renewable energy mix. In the assumptions underpinning the WEM scenario, one power station generating electricity from peat (cofiring with 30% biomass) continues to operate until planning permission expires in 2023. Ireland's non-renewable energy generation is from a mix of fuels such as natural gas, coal and peat. The WEM scenario assumptions have a coal fired power station operating in the market up to the end of 2025, at which point this power station no longer generates electricity from coal. In terms of inter-connection, the WEM scenario has the Greenlink 500MW interconnector to the UK coming on stream in 2025 and the Celtic 700MW interconnector to France coming on stream in 2027. The WEM scenario also

assumes a roll out of approximately 2.25 million smart meters by 2024, on a phased basis. Allowing greater control of energy usage in homes and businesses will support reduced energy usage leading to reduced emissions.

Under the WAM, emissions from power generation are projected to decrease by 50.8% between 2020 and 2030 while fossil fuel used in electricity generation is projected to reduce by 44% over the same period. In the WAM scenario it is assumed that by 2030 renewable energy generation increases to approximately 80% of electricity consumption (as set out in the Climate Action Plan 2021). This is mainly a result of further expansion in wind energy (comprising 5.0 GW offshore). Expansion of other renewables (e.g. solar photovoltaics increasing to 2.2 GW by 2030) also occurs under this scenario. Under the WAM the same assumptions are in place as for the WEM scenario for peat electricity generation, coal-fired electricity generation and inter-connection. 2 GW storage is to be in place by 2030 in the WAM scenario.

Expected progress by 2030 for the RES-E share is 71.5% in the WEM scenario and 78.3% in the WAM scenario. This is in contrast to the 7th National Communication, where the RES-E share was 25% in the WEM scenario and 40% in the WAM scenario reflecting the increased ambition in renewable energy generation targets in both the WEM and WAM scenarios.

Fugitive emissions of GHG cover those associated with natural gas distribution and production (1.B.2) and historical coal mining (1.B.1). In relation to natural gas distribution, ERVIA (formerly Bord Gáis Éireann (BGE)), Ireland's gas company, assessed methane losses in the pipeline network in the context of the needs of annual greenhouse gas inventory reporting. Methane emissions from natural gas production relate largely to gas extraction. In determining future emissions from domestic gas production, it is assumed that 36% of gas demand in 2020 comes from domestic sources decreasing to 14% in 2030 as the gas field on the west coast of Ireland decreases productivity. Emissions associated with this level of gas production are calculated. Coal mining ceased in Ireland in 1995, however emissions can still occur. Emissions from this sector are estimated using the default methodology as presented in the 2006 IPCC Guidelines and follows the approach undertaken in the national greenhouse gas emission inventory.

5.5.2 Manufacturing Industries and Construction

This sector accounted for 7.8% of Ireland's total emissions in 2020. Under the WEM emission projection, emissions from industrial combustion in this sector are projected to decrease by

19.3% between 2020 and 2030 while final energy demand is projected to increase by 6.3% over the same period. Emissions in 2040 are projected to be 25.2% lower than in 2020 with approximately 26.5% increase in final energy demand in the sector over the same period. This scenario assumes implementation of existing energy efficiency programmes such as SEAI's Large Industry Programme (to maintain strong energy management and environmental protection practices in industry), ACA programme (aims to improve the energy efficiency of Irish companies by encouraging them to purchase energy saving technologies) and the Excellence in Energy Efficiency Design programme (EXEED), a process for energy efficiency design management in businesses.

Under the WAM emission projection, emissions from industrial combustion are projected to decrease by 18.3% from 2020 to 2030 whilst final energy demand increases by 6.5% in the same period. Emissions in 2040 are projected to be 34.2% lower than in 2020 with approximately a 25.5% increase in final energy demand in the sector over the same period. This scenario assumes further roll out of energy efficiency programmes included in the WEM scenario.

5.5.3 Transport

Transport emissions cover road transportation; rail; domestic and international aviation; navigation and other transportation (pipeline compressors). The WEM and WAM emissions projections for road transportation and gas transmission are based on the Baseline and Current Trajectory energy forecasts, respectively, published by SEAI. Energy forecasts for the aviation sector were developed separately in consultation with the relevant bodies, i.e. individual Airport Authorities.

i. Road Transportation

The main source of emissions from the transport sector is road transport, accounting for approximately 94% of transport emissions in 2020. Freight transport energy demand is strongly influenced by the level of commercial activity in the economy. Personal transport energy demand is significantly influenced by both the level of employment as well as the oil price.

Under the WEM scenario, road transport emissions are projected to increase by 0.3% over the period 2020-2030 and to reduce by 19% over the period 2020-2040. When using 2020 as a base year it must be taken into account that COVID-19 restrictions were in place and these restrictions impacted transport emissions in particular. The main policy instruments

impacting transport emissions in this scenario are the move from diesel and petrol to electric vehicles and a mix of renewable fuels in petrol and diesel at the pumps. The Biofuel Obligation Scheme places an obligation on fuel suppliers to blend an increasing percentage of biofuel with their fuel. For road transport in the WEM scenario a statutory target of approximately 12% biofuel applies from 1 January 2020. In terms of the uptake of Electric Vehicles, the WEM scenario assumes approximately 556,000 electric vehicles on the road by 2030. This includes approximately 363,000 passenger battery electric vehicles and 178,000 passenger plug in hybrid electric vehicles. The WEM scenario includes the impact of transport infrastructure projects such as the DART Expansion and BusConnects programmes, which aim to reduce car passenger journeys in the Dublin area.

Under the WAM scenario, road transport emissions are projected to decrease by 30.2% over the period 2020 to 2030 and by 53.7% over the period 2020 to 2040. For the WAM scenario, it is assumed that incremental increases will occur in the Biofuel Obligations Scheme with 10% blend for petrol and a 20% blend for diesel at the pumps by 2030. This scenario assumes 944,600 electric vehicles on the road by 2030, as a result of the implementation of the CAP21. This includes approximately 661,000 battery electric vehicles, 183,000 plug-in hybrid electric vehicles and 95,000 electric delivery vans. This scenario also includes the impact of transport infrastructure projects such as the DART Expansion and BusConnects programmes and extension of Smarter Travel measures to promote greater sustainable mobility with particular emphasis on schools, colleges and workplaces.

ii. Rail (IPCC Sector 1.A.3.c)

For Ireland's emissions projections, emissions from rail will increase by 43.9% from 2020 to 2030 in the WEM scenario (109 to 157 Kt CO₂ eq) and by 62.3% in the WAM scenario (109 to 177 Kt CO₂ eq).

iii. Navigation (IPCC Sector 1.A.3.d)

Emissions from navigation have remained relatively static over the last number of years. Projected emissions from navigation are assumed to be equal to that combusted in the sector in 2020 for each projected year to 2040 in both scenarios.

iv. Total Projected GHG emissions from the Transport sector

As mentioned above the main source of emissions from the transport sector is road transportation. Under the WEM emission projection, total emissions from transport are projected to increase by 0.6% between 2020 and 2030. Emissions are projected to reduce by

17.3% between 2020 and 2040. Petrol consumption is projected to reduce by 44.3% from 2020 to 2040.

Under the WAM emissions projections, total emissions from transport are projected to reduce by 28% between 2020 and 2030 and by 50.4% between 2020 and 2040. The higher level of reduction in emissions relative to the WEM emission projections is primarily attributable to increased biofuel penetration and higher numbers of electric vehicle deployment.

The expected progress by 2030 for the RES-T share is 15.3% in the WEM scenario and 31.7% on the WAM scenario. This is in contrast to the 7th National Communication, where the RES-T share was 8% in both the WEM and WAM scenarios.

v. Other transport (IPCC sector 1.A.3.e)

Emissions in this sub-sector refer to the use of natural gas in pipeline compressor stations. Future gas demand for “own use and transformation” is inferred based on forecast gas demand in the residential, commercial and industrial sectors in both the Baseline and Current Trajectory energy forecasts. Subtracting the amount of gas estimated to be lost from the distribution network allows “own use” gas demand and associated emissions to be estimated for the WEM and WAM scenarios.

5.5.4 Residential

Emissions from the Residential Sector arise from fuel combustion for domestic space and hot water heating such as natural gas, oil, coal and peat. This sector contributed 12.3% of Ireland's total emissions in 2020. Residential energy demand is influenced by the weather, fuel prices and more recently the move to home working.

i. Projected GHG emissions from the Residential sector (IPCC sector 1.A.4.b)

Under the WEM scenario, emissions from the residential sector are projected to decrease by 27.2% between 2020 and 2030 while final energy demand is projected to decrease by 4.5% over the same period. Final energy demand in 2040 is projected to be equal to that of 2020. The WEM scenario assumes heat pump uptakes based on grant rates funded by NDP allocation (annual delivery in line with estimated funding allocation) and a ban on oil boilers (from 2022) and gas boilers (from 2025) in new dwellings. WEM scenario also assumes implementation of a range of residential energy efficiency programmes including, for example, Greener Homes, Better Energy Homes and Warmer Homes Schemes, Better Energy Communities Programme and the impact of building regulations. These programmes provide

funding for renewable heating systems, attic and wall insulation and other energy efficiency upgrades for private households and communities.

Under the WAM scenario, emissions are projected to decrease by 43.8% between 2020 and 2030. This scenario assumes full implementation of the relevant measures in the CAP21.

Measures in the CAP21 include:

- A ban on oil boilers (from 2022) and gas boilers (from 2025) in new dwellings.
- The installation of 680,000 heat pumps by 2030
- A total of 1,600GWh of biomethane use across the heat and transport sectors by 2030
- Energy Efficiency programmes involving upgrades to homes, and retrofits to achieve BER 'B2' rating
- District heating growth to 2.7 TWh in 2030, as outlined in the CAP21

The expected progress by 2030 for the RES-H¹² share is 21.6% in the WEM scenario and 30.4% on the WAM scenario. This is in contrast to the 7th National Communication, where the RES-H share was 9% in the WAM scenario.

5.5.5 Commercial / Institutional Services

Emissions from the Commercial and Public Services Sector arise from fuel combustion for space and hot water heating. This sector contributed 3.2% of Ireland's total emissions in 2020 and is projected to reduce to 2.5% in 2030

Under the WEM scenario, emissions from the commercial and public services sector are projected to decrease by 30.3% between 2020 and 2030. This scenario assumes implementation of a range of energy efficiency programmes including the retrofit of public building stock, with a focus on decarbonisation through schemes such as the Support Scheme for Renewable Heat and Public Sector Capital Exemplars.

Under the WAM scenario, emissions from the commercial and public services sector are projected to decrease by 45.5% between 2020 and 2030 from 1.8 to 1 Mt CO₂ eq (Figure 15). This scenario also assumes the implementation of a range of energy efficiency programmes including the retrofit of public building stock with a focus on decarbonisation and the Energy Performance Contract Scheme (introduced from 2024 to 2030) as outlined in the CAP21.

¹² RES-H is the projected rate of thermal energy sourced from renewable sources across the residential, commercial services and industrial sectors based on current forecasts.

5.5.6 Industrial Process

Industrial Processes and Product use includes cement and lime production, other product use of carbonates, non-energy products from fuels and the use of fluorinated gases. Major industrial processes within the chemical sector and metal production are no longer undertaken in Ireland.

The Industrial Processes sector contributed 3.6% of Ireland's total emissions in 2020. There is only one scenario (WEM) for greenhouse gas emissions projections from this sector based on available data. Emissions are projected to increase by 13% between 2020 and 2030 from 2.1 Mt CO₂eq to 2.4 Mt CO₂eq as the majority of emissions come from cement and lime industries and the projections are based on growth forecasts from the cement industry.

i. Mineral Industries (IPCC sector 2.A)

Process emission projections were developed for the cement and lime industries (2.A.1 and 2.A.2) and other process use of carbonates (2.A.4) only. The other industrial process emission source, glass production (2.A.3), is no longer undertaken in Ireland therefore projected emissions are not estimated. Projected emissions from the cement industries are estimated using growth forecasts from the cement industry. Projected emissions from lime production are assumed to remain at 2020 levels.

Process emissions from mineral industries are projected to increase by 13.8% from 2020 to 2030 and by 29.7% from 2020 to 2040 under both the WEM scenario, and WAM scenarios.

5.5.7 Solvents and Other Product Use

Emissions projections of CO₂ eq from solvent use for the following activities were developed:

- Paraffin wax use (candles and other uses)
- Lubricant use
- Solvent use

Projected emissions from Paraffin wax use (candles and other uses) and Lubricant use are assumed to remain at 2020 levels.

Only one scenario was developed for solvent use which uses the rate of population growth in determining projected emissions. Emissions of CO₂ eq from solvent use are projected to increase by 8.3% between 2020 and 2030 to 107 Kt CO₂ eq and to increase to 116 Kt CO₂ eq in 2040.

Fluorinated gases accounted for approximately 1.4% of Ireland's total national greenhouse gas emissions in 2020. The key sources of fluorinated gas emissions in Ireland are production, use and disposal of equipment containing these fluids (e.g. refrigerators, mobile air conditioning systems, metered dose inhalers and electrical switch-gear).

The Fluorinated-gas emission projection outlook is developed in both scenarios: WEM and WAM.

Projections were developed for four fluorinated gases: HFC, PFC, SF₆ and NF₃. In 2020, HFCs accounted for 88.5% of total fluorinated gas emissions with the majority of HFC emissions estimated to come from stationary refrigeration and air conditioning systems in vehicles. Perfluorinated compounds, used in semi-conductor manufacturing, accounted for 9% of total fluorinated gas emissions in 2020 while SF₆ accounted for 2.4% and NF₃ accounted for 0.2%.

Projections were developed for all four fluorinated gases. Table 5.7 summarises the basis for developing projections for each F-gas from the relevant sector.

Fluorinated-Gas (F-Gas) emissions are projected to decrease by 11.2% from 0.78 to 0.70 Mt CO₂eq between 2020 and 2030 under the WEM scenario. This is largely due to the move away from mobile air-conditioning systems in vehicles that contain F-Gases with a high global warming potential.

Emissions are projected to reduce by 8.6% between 2020 and 2030 from 0.78 to 0.72 Mt CO₂eq under the WAM scenario. The results show that in the more ambitious WAM scenario fluorinated-gas emissions are slightly higher than in the WEM scenario by 2030. The reason for this is the different projected uptake rates in heat pumps in each scenario. In the WAM scenario the number of heat pumps being deployed annually is over double the number in the WEM scenario by 2030. The switch to lower Global Warming Potential gas (R32) in and heat pumps and air conditioning units over the projected period in the WAM scenario means that despite this large increase in heat pump numbers, the increase in GHG emissions is small.

Table 5.7: Key assumptions underlying the F-gas projections

Sector	F-gases	Basis for projection
Refrigeration and air conditioning	HFC	Phasedown requirements of F-Gas Regulation EU No. 517/2014 and heat pump trajectory data from SEAI (based on CAP rollout)

Mobile Air Conditioning (MAC)	HFC	Projected new car registrations and introduction of low (< 150) GWP gases based on the MAC Directive 2006/40/EC.
Fire-extinguishers	HFC	Current disposal factor maintained with no net growth in the number of units installed as older units are replaced
Aerosols	HFC	Pro-rata basis using UK emission projections and UK and Irish population projections
Metered dose inhalers	HFC	Population projections and prevalence of asthma in the Irish population
Semi-conductor manufacture	HFC, PFC, SF ₆ and NF ₃	GDP
Electrical equipment	SF ₆	Projected use and stock of SF ₆ used in switchgear in the electricity transmission network provided by electricity distribution operator
Window sound-proofing	SF ₆	Projections are based on the known current stock of SF ₆ in installed windows, annual leakage and disposal factors
Medical Applications	SF ₆	The use of SF ₆ in Irish hospitals is assumed to remain constant at 2020 levels

5.5.8 Agriculture

Emissions projections for CH₄ and N₂O were developed for the agricultural sector.

The key sources of CH₄ emissions in the agricultural sector are enteric fermentation and manure management. The key sources of N₂O emissions are manure management and agricultural soils. The same methodology as that used in developing the national inventory estimates is used in developing emission projections for the sector.

This sector contributed 37.4% of Ireland's total emissions in 2020. The key sources of CH₄ emissions in the agricultural sector are enteric fermentation and manure management. The key sources of N₂O emissions are manure management and agricultural soils. Estimates of historical N₂O emissions from these sources are determined using a Tier 1 or default approach in the inventory. The same methodology is used in developing emission projections.

Two distinct scenarios have been developed for agriculture sector emissions. The WEM scenario assumes that those measures for which there are legislative levers in place prior to the end of 2020 are included in the scenario. The Nitrates Action Programme includes actions on these measures such that:

- all slurries on derogation farms are spread with Low Emission Spreading technologies (LESS). Current evidence shows that the use of LESS has penetrated to non-derogation farms. Therefore, the target of 90% of slurries spread by LESS by 2027 as per AgClimatise is applied
- reduction in crude protein of dairy cow concentrates of 1%
- The target lime application of 2 Mt per annum by 2030 is reached (AgClimatise).
- The use of inhibited urea fertiliser remains at current levels.

In Ireland's 7th National Communication there were no identified policies and measures in the With Existing Measures scenario.

The WAM scenario assumes that the remaining measures outlined in the CAP21, the Teagasc GHG MACC, AgClimatise and Teagasc NH₃ MACC are in place. For the WAM scenario, total emissions from the sector reduce to 18 Mt CO₂ eq by 2030. This equates to a 22% reduction in 2018 emission levels. Measures included in this scenario include:

- Reduction in crude protein in pig diets
- Use of slurry amendments for cattle and pigs
- All slurry stores (cattle and pig) to be covered by 2027
- Drying of poultry manure
- Ban on straight urea fertiliser by end of 2023, replaced with inhibited urea products
- Replace 65% of CAN and NPK fertiliser products with inhibited urea fertiliser by 2030
- Target fertiliser sales at 350 kt N by 2025 and 325 kt N by 2030.
- Reductions in methane emissions are assumed based on the residual between the sum of the above nitrogen (and thus N₂O) measures and the required (22% reduction) target path for the sector. This results in a 30% reduction in methane emissions by 2030 compared to the 2018 level.

In Ireland's 7th National Communication there was one Agriculture policy in the WAM scenario (Nitrogen Use Efficiency).

The WAM scenario assumes a total of 16.5 Mt CO₂ eq of mitigation over the period 2021-2030 attributable to measures in Ireland's CAPs (largely implementation of those measures

included in the Teagasc Marginal Abatement Cost Curve¹³) and DAFM Ag Climatise. These savings are subtracted from the latest Teagasc (FAPRI Ireland Partial Equilibrium Commodity Model¹⁴) projections in the WAM scenario. Some of the key measures include nitrogen use efficiency, use of protected urea products, improved animal health, extended grazing, reducing crude protein in pigs, low emission slurry spreading and inclusion of clover in pasture swards.

The FAPRI-Ireland modelling system captures the dynamic interrelationships among the variables affecting supply and demand in the main agricultural sectors of Ireland. The model consists of a system of equations covering the dairy, beef, sheep, pigs, poultry, wheat, barley, oats, rapeseed and biofuel sectors. The Irish model (created and maintained by Teagasc) is fully incorporated within the EU Grain, Oilseed, Livestock and Dairy (GOLD) run by FAPRI at the University of Missouri. The combined modelling system provides a systematic framework that takes account of interactions among the agricultural sectors in regional, EU and World markets. The models generate annually determined, 10-year Baseline projections of all the major agricultural commodity prices, production levels and greenhouse gas emissions, against which policy scenarios can be compared. Baseline projections provide a benchmark against which projections derived from policy scenarios can be compared and interpreted. The modelling system is then further simulated with changes to policy variables and the results are compared against the Baseline to isolate the policy effects across the ten-year projection period. The model incorporates variables representing the major policy instruments associated with the EU CAP, as well as external trade commitments made by the EU. These policy variables can be altered to run scenarios for the purposes of policy analysis as agreed by the project management board. The model has a detailed representation of Irish agricultural GHG emission sources and is therefore capable of projected emissions of GHGs under different scenarios.

i. Projected GHG Emissions from the Agriculture Sector (IPCC sector 3)

The WEM scenario forecasts total emissions from agriculture to increase by 1.9% over the period 2020-2030 from 21.7 to 22.1 Mt CO₂ eq. The data that underpins the WEM Scenario comes from Teagasc's Base Case Scenario.

Under the WEM scenario:

¹³ Teagasc Greenhouse Gas Working Group, An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030, March 2019, <https://www.teagasc.ie/media/website/publications/2018/An-Analysis-of-Abatement-Potential-of-Greenhouse-Gas-Emissions-in-Irish-Agriculture-2021-2030.pdf>

¹⁴ <http://fapriireland.org/downloads/pubs2001/goldmodelmanual.pdf>

- Dairy cow numbers are projected to increase by 13.3% (202k cows) in 2030 relative to 2020. In contrast, beef cow numbers are projected to decrease by 30.1% by 2030. Total cattle in 2030 are projected to be 6.8 million, a 6% (428k cattle) decrease relative to 2020. As dairy cows produce more methane per animal than other cattle, this overall decline in animal numbers does not reduce methane emissions.
- Dairy production systems operate at a higher stocking rate than beef production systems and this higher stocking rate is reflected in higher projected use of nitrogen fertiliser per hectare and in total aggregate nitrogen fertiliser use by the Irish agricultural sector. Total nitrogen fertiliser use in 2030 is projected to be 407,169 tonnes. This represents a 7.3% increase relative to 2020.
- Irish ewe and total sheep numbers are projected to increase over the period to 2030. By 2030 total Irish sheep numbers are projected to increase to 5.3 million. This represents a 1% increase relative to 2020. This increase reflects the increased profitability of sheep production in the period to 2030.
- The total crop land area is projected to continue to decline due to the higher level of profits per hectare in dairy farming as compared to tillage farming. By 2030 total cereal area harvested in Ireland is projected to decline from 265,600 to 224,350 hectares. This represents a 16% decrease relative to 2020.

Under the WAM scenario emissions are projected to decrease to approximately 17.2 Mt CO₂ eq by 2030 which is a 20.3% reduction over the period 2020-2030.

Under the WAM scenario:

- Implementation of additional measures committed to in the CAP21 in order to achieve the minimum level of emissions reductions in the plan are assumed.
- Some of the key measures include nitrogen use efficiency, use of protected urea products, improved animal health, extended grazing, reducing crude protein in pigs, low emission slurry spreading and inclusion of clover in pasture swards.

Ireland's 7th National Communication projected an increase in Agriculture emissions as a result of the proposed national herd, crop areas and fertiliser use to meet overarching objectives of Food Wise 2025 Agricultural emissions. This prediction has proved reliable as the most recent inventory indicates methane emissions from agriculture are steadily increasing due to increased production¹⁵.

¹⁵ Ireland's Provisional Greenhouse Gas Emissions 1990-2021, 2022, [Ireland's Provisional Greenhouse Gas Emissions 1990-2021](#)

5.5.9 Land Use, Land Use Change and Forestry (LULUCF)

The LULUCF sector includes GHG emissions and removals due to land use and land use change. It consists of six subcategories: Forest Land (4.A), Cropland (4.B), Grassland (4.C), Wetlands (4.D), Settlements (4.E) and Other Land (4.F). The approach taken in estimating GHG emission and removals from the sector utilises the approach used for the national GHG inventory in conjunction with a projected land use and land use change matrix.

In Ireland, projected forest land areas are the most developed, followed by wetland areas and areas under settlement. Projected cropland and grassland areas are supplied by Teagasc (The Irish Agriculture and Food Development Authority) in conjunction with the activity data supplied for the agriculture sector. The area converted to Settlements is assumed to grow in line with GDP forecasts. Other land accounts for the remainder in each year.

i. Forest Land (IPCC sector 4.A)

Projected emission and removal estimates are undertaken for the following activities: Forest Land remaining Forest Land (4.A.1) and Land converted to Forest Land (4.A.2), as well as for activities Forest Land converted to Grassland (4.C.2.1), Forest Land converted to Wetlands (4.D.2.1), Forest Land converted to Settlements (4.E.2.1) and Forest Land converted to Other Land (4.F.2.1). Information on projected afforestation and deforestation is provided by the DAFM. Projected estimates for Harvested Wood Products are also provided.

ii. Cropland and Grassland (IPCC sectors 4.B and 4.C)

This section covers both Cropland (CL) and Grassland (GL) land uses as these land uses are closely linked. Projected emission and removal estimates are undertaken for the following activities: Cropland remaining Cropland (4.B.1), Grassland remaining Grassland (4.C.1) and Land converted to Grassland (4.C.2). In addition, information in relation to, Cropland converted to Settlements (4.E.2.2), Grassland converted to Forest Land (4.A.2.2), and Grassland converted to Settlements (4.E.2.3) is also used. Other conversions are assumed not to occur, as is the case in national emission inventory estimates. Projected crop and grassland areas are provided by Teagasc in conjunction with project animal numbers and fertiliser use as discussed for the agriculture sector. A Monte Carlo analysis is used to project future crop/temporary grassland rotations in a similar fashion to the back casting approach used in the national inventory estimates.

iii. Wetlands (IPCC sector 4.D)

Projected emission and removal estimates are undertaken for the following activities 4.D.1 (Wetland remaining Wetland) and 4.D.2 (Land converted to Wetland), as well as for activities

4.A.2.3 (Wetlands converted to Forest Land). Other conversions are assumed not to occur in line with national emission inventory estimates. The recent departure (and its effect on future emission levels) of a state-owned company from the commercial harvesting of peat is taken into account in projected emission estimates.

iv. Settlements (IPCC sector 4.E)

The future area of Settlements is estimated based on a number of national strategic plans which detail future population, housing stock and commercial/industrial installation growth¹⁶. Projected emission and removal estimates have been undertaken for the following: 4.E.1 (Settlements remaining Settlements) and 4.E.2 (Land converted to Settlements). In addition, it is assumed that as there is no land use change from Settlements to other lands in the historic national inventory estimates, that it will not occur into the future. The area under activity 4.E.1 is considered fixed, as in the historical series. Therefore, the increase in areas is disaggregated between the different land uses in 4.E.2 (Land converted to Settlements) with the main land use changes from cropland and grassland.

V. Other Land (IPCC sector 4.F)

Projected emission and removal estimates are undertaken for the following activities: 4.F.1 (Other Lands remaining Other Lands) and 4.D.2 (Land converted to Other Lands), as well as for activities 4.A.2.5 (Other Lands converted to Forest Land) and 4.E.2.5 (Other Lands converted to Settlements). The only source of new Other Lands in the historical series is Forest Land. Similar to national inventory estimates this category accounts for the remaining land area of the country for which a particular land use has not been previously assigned.

5.5.10 Waste

The Waste sector contributed 1.6% of Ireland's total emissions in 2020. There is only one scenario (WEM) for GHG emissions projections from this sector based on available data. Ireland's landfill rate for municipal waste dropped to 15% in 2019, reflecting a steep decline from 62% in 2008 and is on track to comply with the Landfill Directive (1999/31/EC) target of less than 10% of Municipal waste landfilled by 2035.

Waste sector emissions are projected to decrease by 15.7% between 2020 and 2030 from 1.0 to 0.8 Mt CO₂ eq. The waste sector includes landfill, incineration and open burning of waste, mechanical and biological treatment and wastewater treatment. Emissions are primarily attributable to methane emissions from landfill which reduce over the projected

¹⁶ Project Ireland 2040, <https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/>

period in line with the projected reduction in waste going to landfill and the age of the waste already there. It is assumed that the amount of landfill gas flared and utilised for energy production is 57% in 2020 and is projected to decrease to 46% in 2030 in line with more recent trends in the latest inventory.

5.6 Assessment of the Aggregate Effect of Policies and Measures

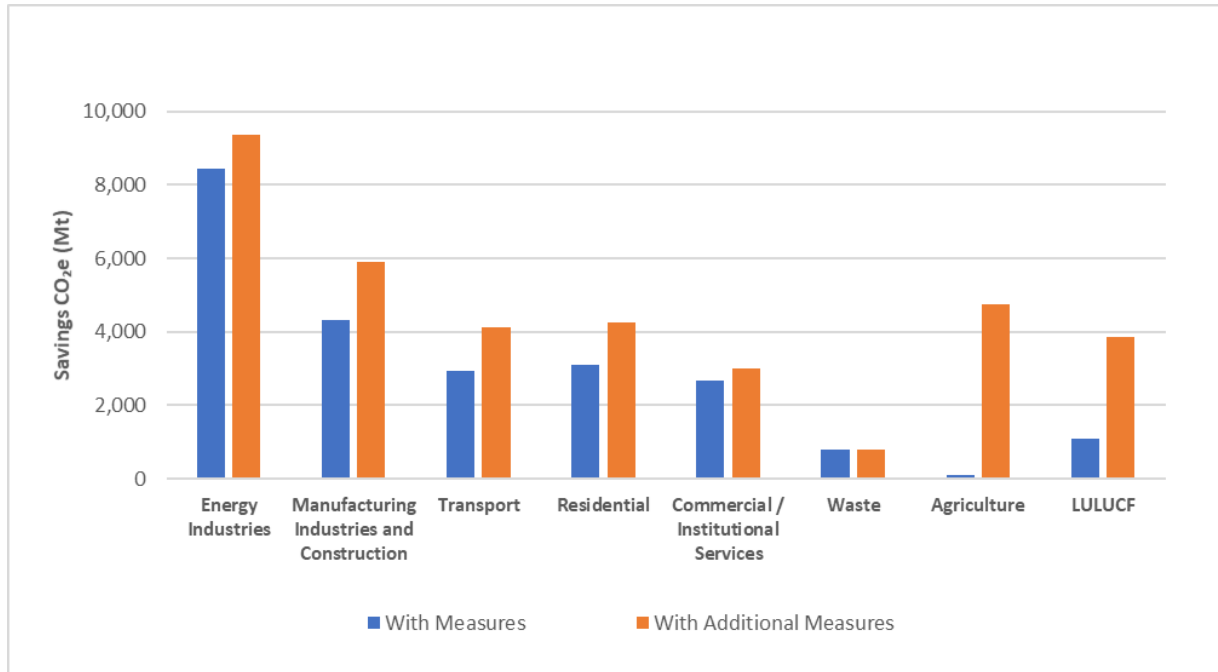
The aggregate effect of policies and measures by sector for the WEM and WAM scenarios is presented in Table 5.8. The impact of savings is further illustrated in Figure 5.5, highlighting the additional savings projected to be associated with planned measures. In calculating the aggregate effect of policies and measures a bottom-up approach was used, aggregating the effect of individual measures described in detail in chapter 4. Existing measures have various implementation dates with the earliest of those included being implemented in 1995.

Table 5.8 Emissions savings due to policies and measures included in the WEM and WAM scenarios from 2020 to 2035

Sector	CO ₂ e (kt)			
	2020	2025	2030	2035
<i>With Existing Measures</i>				
Energy Industries	4,074	5,530	8,452	10,059
Manufacturing Industries and Construction	2,386	3,388	4,321	5,273
Transport	1,258	2,041	2,925	4,084
Residential	2,067	2,911	3,102	2,753
Commercial / Institutional Services	1,689	2,245	2,673	2,601
Waste	625	730	801	848
Agriculture	22	84	113	123
LULUCF	0	1,157	1,085	1,085
Total savings	12,120	18,086	23,473	26,827
<i>With Additional Measures</i>				
Energy Industries	4,074	5,638	9,361	12,142
Manufacturing Industries and Construction	2,386	3,881	5,903	8,154
Transport	1,258	2,763	4,127	4,873
Residential	2,067	2,896	4,247	3,773
Commercial / Institutional Services	1,689	2,461	3,017	3,097
Waste	625	730	801	848
Agriculture	22	2,128	4,767	5,032
LULUCF	0	2,642	3,861	4,288
Total savings	12,120	23,138	36,084	42,207

While the GHG being reduced by the implemented measures in the WEM scenario is primarily carbon dioxide, there are also savings projected for other gases. The planned measures in the WAM scenario are anticipated to also result in substantial reductions of methane and nitrous oxide, particularly as a result of measures in the Agriculture sector. Table 5.9 presents the estimated savings broken down by greenhouse gas for both scenarios. Looking more closely at the individual sectors we can see that for Energy Industries the main measures are the removal of coal fired electricity generation and an increase in renewable electricity generation. In the WAM scenario 80% of electricity consumption is to be from renewable sources by 2030.

Figure 5.5 – PAMs savings by sector for WEM and WAM for 2030



In Manufacturing Industries and Construction, the main measures include the implementation of energy efficiency programmes such as SEAI's Large Industry Programme and an increase in the use of energy from renewables for heat generation.

Table 5.9 Estimated CO₂ eq savings by gas where savings for Policies and Measures have been estimated in the WEM and WAM scenarios

Gas Type	CO ₂ e (kt)			
	2020	2025	2030	2035
<i>With Existing Measures</i>				
CO ₂	11,363	17,009	22,159	25,375
CH ₄	643	840	914	966
N ₂ O	71	165	253	314
HFC	42	72	147	172
Total savings	12,120	18,086	23,473	26,827
<i>With Additional Measures</i>				
CO ₂	11,363	19,902	29,920	35,674
CH ₄	643	2,593	4,738	4,944
N ₂ O	71	571	1,279	1,417
HFC	42	72	147	172
Total savings	12,120	23,138	36,084	42,207

In Transport the main energy savings come from the move to electric vehicles and an increase in renewable energy used to fuel these vehicles as well as an increase in biofuel in petrol and diesel as part of the Biofuel Obligations Scheme.

The Residential sector savings are mainly due to measures to encourage a move from oil and gas boilers to heat our homes to the use of heat pumps, in addition to home upgrades and retrofits.

Savings from the Commercial and Institutional Services Sector assume implementation of a range of energy efficiency programmes including the retrofit of public building stock with a focus on decarbonisation and the Energy Performance Contract Scheme (introduced from 2024 to 2030) as outlined in the CAP21.

Emissions savings from the Waste sector are due to a reduction in methane emissions as a result of implementation of the Landfill Directive (1999/31/EC).

There is a sharp increase in savings from the Agriculture sector in the With Additional Savings measures scenario. Implementation of additional measures committed to in the CAP21 in order to achieve the minimum level of emission reductions in the plan are assumed.

The LULUCF sector includes greenhouse gas emissions and removals due to land use and land use change. Measures to achieve the savings projected for the WAM scenario include continued peatlands rehabilitation, new afforestation and water table management of grassland on drained organic soils.

5.7 Memo Items

Projected emissions from international maritime transport and international aviation are estimated (see estimated emissions associated with Memo Items in the tables in the ANNEX - Projected emissions by sector and by gas of this report). Emissions from international aviation are estimated based on forecasted landing and take-off forecasts supplied to the inventory agency. Emissions from international maritime transport are assumed to equal 2020 levels for each projected year.

5.8 Methodology

National energy projections showing future energy trends are provided by the SEAI¹⁷. Energy projections underpinning the 2021 emissions projections were prepared by SEAI in conjunction with the Economic and Social Research Institute (ESRI) and University College Cork. The ESRI produce energy demand projections using the I3E model (Ireland Environment, Energy and Economy model)¹⁸.

SEAI compile two energy projections scenarios, which are used in national emission projections out to 2040:

- The Baseline or WEM, forecasts Ireland's emissions including all national policies and measures implemented by the end of 2020. This is the cut off point for which the latest national greenhouse gas emission inventory data is available, known as the 'base year' for projections. Implemented measures in the NDP¹⁹ and CAP19²⁰ are included in this scenario.
- The Advanced or WAM has a higher level of ambition and includes government policies and measures to reduce emissions such as those in Ireland's CAP21²¹. This was published in November 2021 and the included measures have not yet moved into the implementation phase. As implementation happens the measures will be migrated into the WEM scenario.

The Baseline energy projection underpins the WEM emissions projection for the energy sector and the Advanced energy projection underpins the WAM projection for the Energy sector.

¹⁷ SEAI Publications, <https://www.seai.ie/resources/publications/>

¹⁸ ESRI, The I3E Model - Energy, Environment and Infrastructure, <https://www.esri.ie/current-research/the-i3e-model>

¹⁹ DPER, National Development Plan 2021-2030, <https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/>

²⁰ DECC, Climate Action Plan 2019, <https://www.gov.ie/en/publication/ccb2e0-the-climate-action-plan-2019/>

²¹ DECC, Climate Action Plan 2021, <https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/>

The Baseline energy projections compiled by SEAI provides future energy demand to 2040 for the following sectors: 1.A.1.a, 1.A.2, 1.A.3.b, 1.A.3.e, 1.A.4.a, 1.A.4.b and 1.A.4.c and include progress in the implementation of policies and measures set out in the Ireland National Renewable Energy Action Plan (NREAP), National Energy Efficiency Action Plan (NEEAP), NDP and CAP19. The Advanced energy projections provides future energy demand for the above sectors to 2040 whilst accounting for further implementation of government policies and measures in addition to Ireland's CAP21.

Article 4 of Directive 2009/28/EC on renewable energy requires each Member State to adopt an NREAP and submit it to the European Commission. The NREAP sets out the Member State's national targets for the share of energy from renewable sources consumed in transport, electricity and heating and cooling in 2020, demonstrating how the Member State will meet their overall national target established under the Directive.

Ireland submitted its NREAP to the European Commission in July 2010. Progress reports have subsequently been submitted, one in January 2012, the second in February 2014, the third in April 2016 and the fourth in February 2018. The fifth and most recent report was submitted in February 2020.

The NEEAP sets a clear vision for each of the sectors covered by the Action Plan, around which public and private sector actors can mobilise. Ireland's first NEEAP was published in May 2009, which built on the Energy Efficiency Action Plan submitted to the Commission in 2007 and was required as part of Ireland's obligations under the Energy Services Directive. Subsequently three further iterations have been published, Ireland's NEEAP 2 in 2012 and NEEAP 3 in 2014 in addition to NEEAP 4 which was published in 2017.

For the energy demand projections, the ESRI used the I3E model.

The I3E model is an intertemporal Computable General Equilibrium (CGE) model, which reproduces the structure of the economy in its entirety, including productive sectors, households, and the government, among others. In the model the nature of all existing economic transactions among diverse economic agents is quantified. According to micro economic behaviour, producers and consumers maximise their profits/utility given their budget constraints. In other words, a CGE model examines how inputs and outputs flow between production sectors of the economy and finally result in final goods consumed by households. The model combines theory and data to examine energy use changes due to developments in the economy, labour market, policies and international prices. Where the detailed representation of various fuel inputs into production and as consumption goods can fully capture the various mechanisms behind changed in fuel demand.

The explicit modelling of sectorial inter-linkages makes it possible to investigate the wider economic impacts of a specific shock or policy through the different transmission channels in the economy. Therefore, CGE models have become a standard tool of empirical analysis and are widely used to analyse the welfare and distributional impacts of policies whose effects may be transmitted through multiple markets. Because of its nature, CGE modelling is significantly useful for policy design and evaluation specifically when policy measures are expected to lead to indirect as well as direct effects, as in the case of energy-related policies. For example, the economic implications of an energy tax in the transport sector can be evaluated both for the transport sector and other sectors through inter-sectoral spill-overs. The I3E model includes energy flows and emissions in addition to the standard monetary flows. Each production sector produces an economic commodity using labour, capital, material inputs, and energy inputs. The I3E model explicitly comprises a set of carbon commodities including peat, coal, natural gas, crude oil, fuel oil, LPG, gasoline, diesel, kerosene, and other petroleum products. Production activities produce in the cheapest way possible by using the optimal set of capital, labour, energy and other intermediate inputs based on both relative prices and substitution possibilities. When an energy policy is implemented (e.g. an increase in carbon tax) or in case of an external shock (e.g. an increase in international energy prices or ETS price), production sectors will, where possible, substitute energy inputs for other inputs and/or decrease the carbon content of their energy inputs by demanding cleaner energy. From the consumers' perspective, higher prices of goods with higher carbon content will encourage them to consume less carbon-intensive products. I3E is a dynamic model, which incorporates economic growth over the modelling horizon. Economic growth originates from three sources; the growth of employment driven by population growth, the growth in capital stock driven by investment, and the growth in total factor productivity or productivity of factors of production. It is assumed that the total population grows at a constant rate and the technology, i.e. the productivity of labour force grows at a constant rate. In the current version, the values of population growth and economic growth are retrieved from the medium-run estimates of the macro econometric forecast model of the ESRI, namely COSMO (COre Structural MOdel for Ireland).

i. Baseline Assumptions

In CGE modelling, a change in a policy variable/parameter or a set of policy variables/parameters is defined as a shock process or experiment. The effects of the experiment are given as the paths of variables that are solved within the model and are reported in terms of a percentage change with respect to the Baseline. The Baseline is a path

such that there is no change in any policy variables/parameters, but an economy evolves according to its internal dynamics. For instance, since the internal dynamics of the I3E model are driven by the population and labour productivity growths, the Irish economy would grow at 3.3% per annum without any policy intervention. Since there are no external interventions in the economy, the base path is also called the business-as-usual path. The base path now includes a varying carbon tax that increases to €100 per tonne by 2030.

ii. Fossil Fuel Prices

Future international fossil fuel prices are given as input to the I3E model. For the central fossil fuel price scenario (i.e. in the case of the energy related projections described in this document), the UK Department for Business, Energy and Industrial Strategy (BEIS) central price scenario is applied (oil, gas and coal price projections). Furthermore, how other fuel prices (gasoline, diesel, kerosene, LPG, fuel oil and other petroleum products) fluctuate with the oil price are econometrically estimated. These estimated relationships are used to project future international prices of all fuel types.

iii. Carbon prices

The I3E model implements two carbon prices, namely the Irish carbon tax and the EU ETS price. The Irish carbon tax was €33.50 a tonne in 2020 and will rise to €100 a tonne in 2030. Both WEM and WAM scenarios include a varying Irish carbon tax that reaches €100 per tonne by 2030 and is maintained at this price until 2040.

Historically, the recommended EU Reference Scenario Emissions Trading Scheme (ETS) carbon prices have been included in our projections. This is a linear increase in the price from €25 per tonne in 2020 to €30 per tonne by 2030. However, due to the recent growth in the ETS price, the most recent EU Reference scenario has been surpassed so our projections increase the ETS price from its current level of approx. €45 per tonne in 2021 to €100 per tonne by 2030 and €150 per tonne by 2050.

The software used to model the Irish Electricity Market is PLEXOS which is a power systems modelling tool used for electricity market modelling and planning.

To produce the finalised Baseline energy projections, SEAI amends the output of the energy demand produced by ESRI to take account of the expected impact of energy efficiency measures put in place before the end of 2020 but which are considered too recent to be detectable in any time-series analysis. The WAM energy projections builds on the WEM projections with adjustments made to account for implementation of additional policies and measures outlined in Ireland's CAP21.

Table 5.10 Key assumptions underpinning Ireland's 2021 energy forecasts

	2020	2025	2030	2035	2040
Average Annual % Growth Rate					
GDP	-6.6	3.2	3.1	3.2	3.2
GNP	-10.4	3.2	3.1	3.1	3.2
	2020	2025	2030	2035	2040
Housing Stock ('000)	2,083	2,208	2,377	2,566	2,772
Population ('000)	4,612	4,800	4,995	5,198	5,409
EUETS: Carbon €₂₀₁₆/tCO₂	25	69	100	113	125
Carbon tax €₂₀₁₆/tCO₂ (WEM Scenario)	33.5	63.5	100	100	100
Coal €₂₀₁₆/boe	11.3	11.3	12.0	12.9	12.9
Oil €₂₀₁₆/boe	48.3	54.0	63.0	72.0	72.0
Gas €₂₀₁₆/boe	30.6	34.0	39.4	44.5	44.5
Peat €/MWh	25.0	25.0	25.0	25.0	25.0

Further details on the models used for preparing the energy projections (i.e. I3E, Plexos Integrated Energy Model, SEAI National Energy Modelling Framework, SEAI BioHeat Model) are included in the 2022 submission made under Article 18 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action. This is available in relevant 2022 submission folders at the following link: <https://reportnet.europa.eu/public/dataflows>

The energy projections completed in 2022, which follow the 2020 national energy balance²², form the basis for the majority of fuel combustion activities (1.A) emissions projections namely:

- Energy Industries (1.A.1.a)
- Manufacturing Industries and Construction (1.A.2)
- Road transportation (1.A.3.b)
- Other transport (1.A.3.e)
- Commercial /Institutional (1.A.4.a)
- Residential (1.A.4.b)
- Agriculture/Forestry/Fishing (1.A.4.c).

Emission projections for the remaining fuel combustion activities (i.e. oil refining (1.A.1.b), peat briquetting (1.A.1.c), rail transport (1.A.3.c), domestic aviation (1.A.3.a), and navigation (1.A.3.d)) are calculated separately and are based on data provided by individual operators to

²² SEAI, National Energy Balance, <https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance/>

the EPA and from EPA databases. Emissions from 1.A.5 (Non-Specified) combustion is reported as “IE” (Included Elsewhere) as emissions from combustion are accounted for in the other sectors as listed above.

Non-energy related emissions cover the following sectors:

- Agriculture (3.A, 3.B, 3.D, 3.G and 3.H)
- Waste (5.A, 5.B, 5.C & 5.D)
- Industrial processes (2.A.)
- 2D Non-Energy Products from Fuels and Non-Energy Products from Fuels and Solvent Use
- Fluorinated gases (2.E, 2.F and 2.G) and
- Land Use, Land Use Change and Forestry (4.A – 4.D)

The LULUCF sector includes GHG emissions and removals due to land use and land use change. It consists of six subcategories: Forest Land (4.A), Cropland (4.B), Grassland (4.C), Wetlands (4.D), Settlements (4.E) and Other Land (4.F). The approach taken in estimating GHG emission and removals from the sector utilises the latest national inventory estimates (1990-2020) in conjunction with a projected land use and land use change matrix.

Emissions and removals from the sector follow a hierarchical approach in line with national inventory estimates. In Ireland projected forest land areas are those submitted as part of Ireland's National Forestry Accounting Plan and Forest Reference Level under Regulation (EU) 2018/841. Projected grassland and cropland areas are provided by Teagasc in conjunction with activity data supplied for the agriculture sector which in the case of cropland undergo a monte carlo type analysis to forecast forward rotation patterns based on known rotation patterns for the period 2000 to 2018 (further details of this modelling approach are included in Chapter 6 of Ireland's NIR. Projected Settlement areas take into account future road and housebuilding as outlined in national infrastructure plans²³. For Wetlands recent national developments with respect to the halt in harvesting of peat for electricity generation and future afforestation and restoration plans are taken into account.

5.9 Sensitivity Analysis

A sensitivity analysis involves modelling how much projection results change when key parameters are varied. Different sensitivity analyses can be performed to examine the effects that various economic and policy impacts could have on the projected emissions. Performing

²³ Project Ireland 2040, National Planning Framework, <http://npf.ie/>

sensitivity analyses is also a part of producing projections in compliance with Article 39 of the Governance of the Energy Union and Climate Action Regulation.

A sensitivity analysis of the WEM forecast was undertaken for two sectors: Agriculture and Transport.

The sensitivity analysis undertaken for the agriculture emissions projections is based on alternative projected activity data that assumes stronger growth in agricultural activity levels (Figure 5.6). The resulting alternative scenario is described in more detail below, it shows that stronger growth would likely lead to higher emissions over the projected period.

For the agriculture projections the sensitivity scenario is based on stronger growth in agriculture activity levels in comparison to the Baseline agriculture (WEM) projection. This scenario assumes continued growth in the dairy herd accompanied by a stable, rather than contracting beef cow herd. Under this scenario the allocation of Ireland's Common Agricultural Policy (CAP) budget is assumed to change from 2020 onwards to provide additional coupled support to beef cow numbers. Irish farm gate milk prices are also assumed to be higher than under the WEM scenario by approximately 10%. These two assumptions are used to generate a larger dairy and beef cow inventory.

Under this scenario, dairy cow numbers in 2030 are projected to reach 1.8 million. This represents a 19% increase relative to 2020.

Under this scenario the provision of coupled direct payments from 2020 slows the projected decline in the Irish beef cow inventory. By 2030, Irish beef cow numbers reach 0.808 million. This represents a 15.2% decrease relative to 2020. By 2030 projected total cattle inventories are 7.26 million. This represents a 0.58% increase relative to 2020. Under this scenario, the modest projected contraction in beef cow numbers is more than offset by a strong increase in dairy cow numbers. The dairy share of the total cattle population increases, and the higher stocking rate is reflected in a higher level of nitrogen use per hectare and in total nitrogen use in aggregate over the period to 2030. In 2030 the total use of nitrogen is projected to be 437,553 tonnes.

Under this scenario Irish ewe and total sheep numbers are also projected to increase over the period to 2030. By 2030 Irish total sheep numbers are projected to increase to 5.18 million. This represents a 2% decrease relative to 2020. This slower rate of expansion reflects the assumed decline in the relative profitability of sheep systems as compared to beef systems, which receive coupled direct payments in the sensitivity scenario.

Total crop land area is projected to decline over the period to 2030. The higher profitability of land use in dairy production systems leads to a shift of land from tillage to grassland use.

By 2030 total cereal area harvested in Ireland declines to 216,988 hectares. This represents a 18% decrease relative to 2020.

A sensitivity analysis of the WEM emissions scenario has been undertaken for the transport emissions projections based on alternative projected activity data. The sensitivity analysis undertaken for the transport emissions projections is based on lower fuel prices. Low fuel prices from the UK Department of Business, Energy and Industrial Strategy (BEIS) were used. The alternative scenario is presented in Figure 5.7 alongside the WEM scenario. It shows that lower fuel prices would likely lead to higher emissions over the projected period.

Figure 5.6 Sensitivity assessment of the Agriculture Sector under the WEM scenario out to 2030

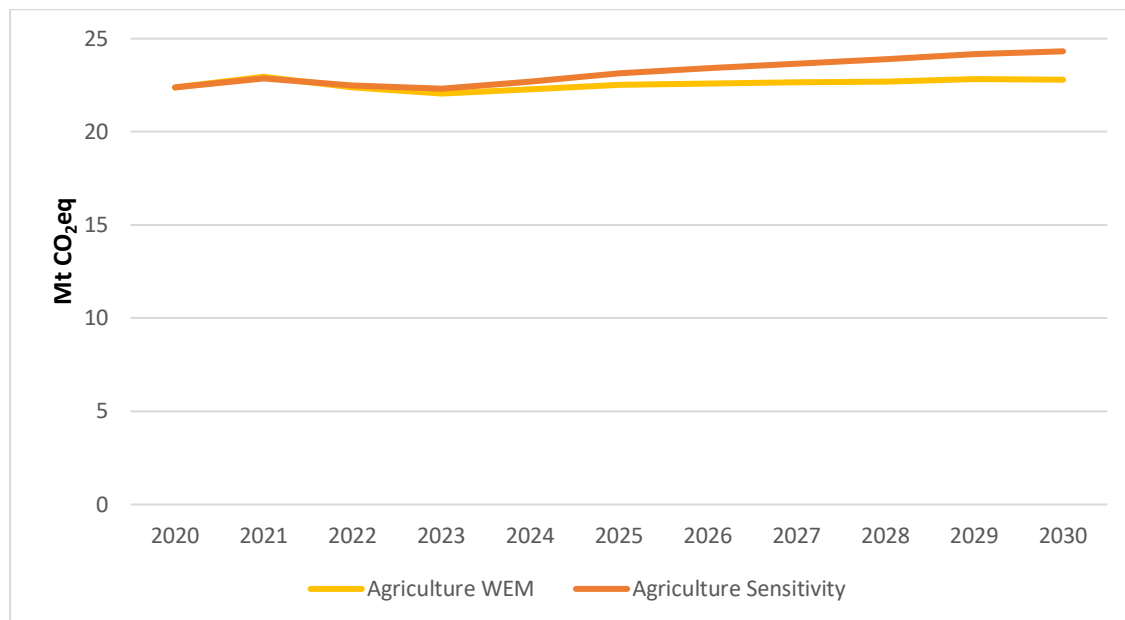
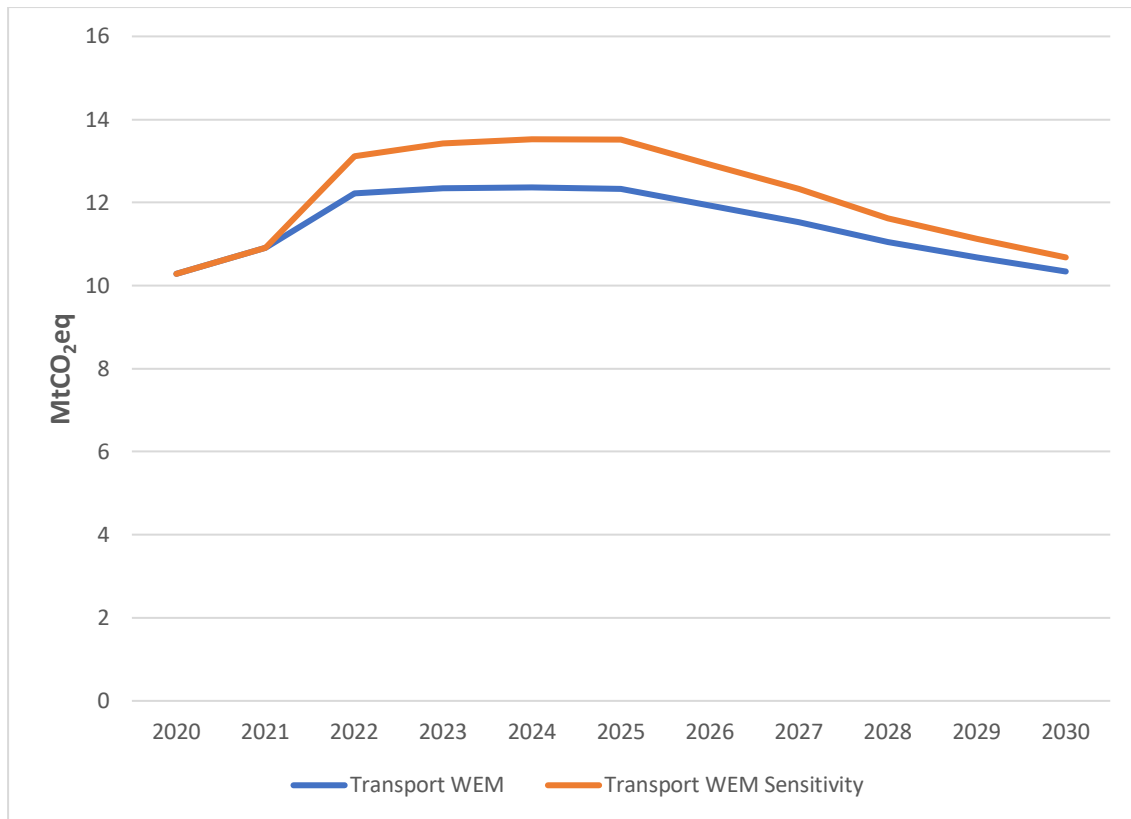


Figure 5.7: Sensitivity assessment of the Transport Sector under the WEM scenario out to 2030



Projected emissions by sector and by gas

Table 2 (a) Summary of Greenhouse Gas Emissions by sector for the With Existing Measures Scenario 1990-2040 (Kt CO₂ equivalent)

Sector	GHG emissions and removals (Kt CO ₂ equivalent)							GHG emission projections (Kt CO ₂ equivalent)			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy Industries	11329.0	13478.3	16199.5	15902.2	13465.8	11954.9	8739.1	8911.2	5431.4	5096.3	4494.2
Residential	7521.3	6563.8	7044.1	8198.6	8771.3	6506.4	7114.5	5987.6	5178.1	4487.3	4276.8
Manufacturing Combustion	4099.2	4333.1	5481.5	5473.5	4150.4	4271.9	4521.1	4275.6	3648.8	3495.4	3381.2
Commercial / Public Services	2108.7	2004.7	1943.8	1898.9	1709.6	1721.6	1833.5	1561.8	1275.8	1006.4	933.8
Transport	5145.0	6283.5	10789.2	13132.0	11531.4	11821.9	10295.6	12350.0	10359.1	9188.7	8510.7
Industrial Processes	3275.6	2992.1	3790.6	2766.7	1467.9	2012.1	2111.4	2242.6	2384.6	2537.2	2700.6
F-Gases	34.6	226.3	768.7	1198.6	1128.0	1230.1	784.3	773.7	696.3	761.4	901.5
Agriculture	19757.8	21512.6	21427.3	20783.8	19418.1	20291.1	21727.0	21869.4	22094.9	22265.9	22565.4
Waste	1552.1	1829.2	1492.8	1324.7	534.1	958.2	905.7	815.3	769.9	748.3	694.2
LULUCF	6192.7	7078.2	7604.3	7838.4	7830.8	7266.0	6926.2	9654.0	11062.8	12568.5	11447.4
Total (excluding LULUCF)	54823.2	59223.6	68937.4	70679.0	62176.5	60768.1	58032.3	58787.2	51838.9	49586.9	48458.3
Total (including LULUCF)	61015.9	66301.8	76541.7	78517.4	70007.2	68034.1	64958.5	68441.2	62901.8	62155.4	59905.7
Memo items											
International Aviation	1081.7	1163.5	1830.1	2507.7	2325.6	2538.1	1187.5	3074.0	2667.8	2570.2	2788.7
International Maritime Transport	57.4	373.2	482.8	333.7	434.7	496.5	481.8	481.8	481.8	481.8	481.8

Table 4(a) Summary of Greenhouse Gas Emissions by sector for the With Additional Measures Scenario 1990-2040 (Kt CO₂ equivalent)

Sector	GHG emissions and removals (Kt CO ₂ equivalent)							GHG emission projections (Kt CO ₂ equivalent)			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Energy Industries	11329.0	13478.3	16199.5	15902.2	13465.8	11954.9	8739.1	8710.3	4460.2	4609.5	3932.9
Residential	7521.3	6563.8	7044.1	8198.6	8771.3	6506.4	7114.5	5598.9	3995.9	2010.6	1004.1
Manufacturing Combustion	4099.2	4333.1	5481.5	5473.5	4150.4	4271.9	4521.1	4288.0	3693.0	3461.9	2973.7
Commercial / Public Services	2108.7	2004.7	1943.8	1898.9	1709.6	1721.6	1833.5	1533.9	998.1	496.2	356.0
Transport	5145.0	6283.5	10789.2	13132.0	11531.4	11821.9	10295.6	10991.4	7411.1	5946.4	5107.1
Industrial Processes	3275.6	2992.1	3790.6	2766.7	1467.9	2012.1	2111.4	2242.6	2384.6	2537.2	2700.6
F-Gases	34.6	226.3	768.7	1198.6	1128.0	1230.1	784.3	780.3	716.5	810.0	997.0
Agriculture	19757.8	21512.6	21427.3	20783.8	19418.1	20291.1	21727.0	19537.6	17169.6	17105.1	17216.3
Waste	1552.1	1829.2	1492.8	1324.7	534.1	958.2	905.7	815.3	769.9	748.3	694.2
LULUCF	6192.7	7078.2	7604.3	7838.4	7830.8	7266.0	6926.2	8169.5	8286.7	9365.5	7838.0
Total (excluding LULUCF)	54823.2	59223.6	68937.4	70679.0	62176.5	60768.1	58032.3	54498.3	41598.8	37725.1	34981.9
Total (including LULUCF)	61015.9	66301.8	76541.7	78517.4	70007.2	68034.1	64958.5	62667.8	49885.5	47090.7	42819.9
Memo items											
International Aviation	1081.7	1163.5	1830.1	2507.7	2325.6	2538.1	1187.5	3074.0	2667.8	2570.2	2788.7
International Maritime Transport	57.4	373.2	482.8	333.7	434.7	496.5	481.8	481.8	481.8	481.8	481.8

Table 2(b) Summary of Greenhouse Gas Emissions by gas for the With Existing Measures Scenario 1990-2040 (Kt CO₂ equivalent)

Gas	GHG emissions and removals (Kt CO ₂ equivalent)							GHG emission projections (Kt CO ₂ equivalent)			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
CO ₂ (excluding LULUCF)	32944.4	35853.0	45249.1	48156.6	41793.6	38718.0	35153.2	36182.3	29336.9	26915.3	25507.0
CO ₂ (including LULUCF)	38464.8	42204.8	52128.8	55142.7	48324.0	44961.0	41049.1	45051.8	39622.8	38729.2	36188.0
CH ₄ (excluding LULUCF)	14180.7	15035.4	14864.8	14420.4	12804.3	14346.4	15226.6	15065.8	15156.6	15298.0	15442.2
CH ₄ (including LULUCF)	14637.1	15493.9	15307.8	14905.8	13561.0	14865.0	15794.7	15616.5	15708.9	15850.7	15994.8
N ₂ O (excluding LULUCF)	7663.4	8108.9	8054.8	6903.3	6450.5	6473.5	6868.2	6765.4	6649.1	6612.2	6607.7
N ₂ O (including LULUCF)	7879.4	8376.9	8336.5	7270.3	6994.3	6978.0	7330.4	6999.2	6873.8	6814.0	6821.4
F-gases (excluding LULUCF)	34.6	226.3	768.7	1198.6	1128.0	1230.1	784.3	773.7	696.3	761.4	901.5
F-gases (including LULUCF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (excluding LULUCF)	54823.2	59223.6	68937.4	70679.0	62176.5	60768.1	58032.3	58787.2	51838.9	49586.9	48458.3
Total (including LULUCF)	61015.9	66301.8	76541.7	78517.4	70007.2	68034.1	64958.5	68441.2	62901.8	62155.4	59905.7

Table 4(b) Summary of Greenhouse Gas Emissions by gas for the With Additional Measures Scenario 1990-2040 (Kt CO₂ equivalent)

Gas	GHG emissions and removals (Kt CO ₂ equivalent)							GHG emission projections (Kt CO ₂ equivalent)			
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
CO ₂ (excluding LULUCF)	32944.4	35853.0	45249.1	48156.6	41793.6	38718.0	35153.2	34225.0	24055.0	20251.2	17364.6
CO ₂ (including LULUCF)	38464.8	42204.8	52128.8	55142.7	48324.0	44961.0	41049.1	41610.0	31564.7	28862.1	24436.2
CH ₄ (excluding LULUCF)	14180.7	15035.4	14864.8	14420.4	12804.3	14346.4	14910.3	13091.9	11157.8	11118.5	11077.2
CH ₄ (including LULUCF)	14637.1	15493.9	15307.8	14905.8	13561.0	14865.0	15478.4	13642.6	11710.1	11671.3	11629.8
N ₂ O (excluding LULUCF)	7663.4	8108.9	8054.8	6903.3	6450.5	6473.5	6868.2	6401.1	5669.5	5545.5	5543.1
N ₂ O (including LULUCF)	7879.4	8376.9	8336.5	7270.3	6994.3	6978.0	7330.4	6634.9	5894.2	5747.3	5756.8
F-gases (excluding LULUCF)	34.6	226.3	768.7	1198.6	1128.0	1230.1	784.3	780.3	716.5	810.0	997.0
F-gases (including LULUCF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (excluding LULUCF)	54823.2	59223.6	68937.4	70679.0	62176.5	60768.1	57716.1	54498.3	41598.8	37725.1	34981.9
Total (including LULUCF)	61015.9	66301.8	76541.7	78517.4	70007.2	68034.1	64642.3	62667.8	49885.5	47090.7	42819.9

Table 5: Summary of key variables and assumptions used in the projections analysis

Key underlying assumptions	Unit	Historical											Projected	
		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2025	2030
GDP growth rate	%											-6.58	3.23	3.09
Population	thousands											4,612.35	4,799.82	4,994.91
Population growth	%											-3.77	3.91	3.91
Number of households	thousands											2,083.00	2,203.81	2,372.17
International oil price	USD / boe											50.05	57.30	60.30
International coal price	USD / boe											11.70	12.00	11.50
International gas price	USD / boe											31.70	36.00	37.80

Chapter Six:

Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

6. Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

6.1 Introduction

The IPCC Working Group I report, published in August 2021, states that the scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years. It further states that it is unequivocal that human influence has warmed the atmosphere, ocean and land; widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

The report shows that emissions of GHG from human activities are responsible for approximately 1.1°C of warming since 1850-1900, and finds that averaged over the next 20 years, global temperature is expected to reach or exceed 1.5°C of warming. This assessment is based on improved observational datasets to assess historical warming, as well as progress in scientific understanding of the response of the climate system to human-caused GHG emissions. It projects that global surface temperature will continue to increase until at least mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO₂ and other GHG emissions occur in the coming decades.

The IPCC Working Group I Contribution to the 6th Assessment Report makes a number of high level projections for Europe as a whole and of more specific relevance in the Irish context; a number of further projections are made for the Northern Europe (NEU) region. The report states:

- there has been an observed increase in pluvial flooding attributed to human influence and pluvial flooding is indeed projected to further increase at global warming of 1.5°C (medium confidence) and 2°C and above (high confidence)
- a projected decrease in river flood at global warming of 2°C and above (medium confidence)
- a projected increase in severe windstorms at global warming of 2°C and above (medium confidence)

The IPCC Working Group II report published in March 2022, 'Climate Change 2022: Impacts, Adaptation and Vulnerability', details the impacts of climate change. It warns how the climate crisis will influence our ecosystems and biodiversity, and how it will affect people's lives

overseas and here in Ireland. Human-induced climate change, including more frequent extreme events, has already caused widespread impacts. It has exposed millions to acute food insecurity and reduced water security. The report confirms that climate impacts are now an irreversible reality for every country. While adaptation efforts to date have reduced some climate vulnerabilities, limits are already beginning to be reached. The most extreme impacts can still be avoided through enhanced adaptation and mitigation efforts. This report makes clear that enhanced adaptation, together with improved ecosystem protection and management, can reduce risks from climate change to biodiversity and people everywhere. However, it is also clear that transformative measures are needed to meet the challenges. Observations recorded in Ireland are in line with IPCC data and show that Ireland's climate is changing in terms of sea level rise, increases in average temperature, changes in precipitation patterns and weather extremes. Temperatures have increased by 0.968°C during the period 1900 to 2021 – a linear average of 0.072°C per decade. The overall trend is upwards and consistent with global patterns of change. The availability of robust information has considerably increased nationally, through national research and international reports, which will facilitate the process of implementing adaptation actions and increasing social, economic and environmental resilience to climate change in Ireland.

This climate change is expected to have diverse and wide-ranging impacts on Ireland's environment, society and economic development, including on managed and natural ecosystems, water resources, agriculture and food security, human health, and coastal zones. The most immediate risks to Ireland which can be influenced by climate change are predominantly those associated with changes in extremes, including floods, droughts and storms. For Ireland, climate change impacts are projected to increase in the coming decades and could include the following:

- sea level rise
- more intense storms and rainfall events
- increased likelihood and magnitude of river and coastal flooding
- water shortages in Summer
- increased risk of new pests and diseases
- adverse impacts on water quality
- changes in distribution and phenology (the timing of lifecycle events) of plant and animal species on land and in the oceans

To address these challenges, Ireland has made considerable progress in putting in place a robust institutional framework for adaptation and also in developing climate resilience measures since the submission of our 7th National Communication. There have been

developments in capacity building measures, improvements in the research and knowledge base and mainstreaming of adaptation relevant measures into a many national policies (flood risk management and spatial planning). These developments are discussed in Chapter 9.

Ireland's first statutory National Adaptation Framework (NAF)¹ was published in January 2018. This provided a structured basis for the development of nine statutory Sectoral Adaptation Plans (SAPs)² covering 12 priority sectors in 2019 and the development of Local Authority (LA) Adaptation Strategies³ by all 31 Irish local authorities also published in 2019. In addition, in 2019, all Local Authorities signed Climate Action Charters, committing the local authority sector to specific adaptation goals and objectives.⁴

CAP21 details Adaptation measures across key sectors, including actions addressing flooding, built environment, transport and energy and communications networks. These actions are mainstreamed into the appropriate sectoral chapters of the Plan. In addition, chapter 21 of CAP21 is dedicated to ongoing implementation of the NAF and appropriate national adaptation actions.

6.2 Climate modelling, projections and scenarios

Met Éireann is Ireland's National Meteorological Service and is maintained by the State under the UN Convention of the World Meteorological Organisation (WMO). It is the public service scientific organisation responsible to the Irish State for:

- the production and communication of authoritative weather and climate services to protect life and property, and to promote wider societal and economic well-being
- conducting research into weather and climate, to inform decision-making
- the collection and production of high-quality meteorological data

A regional climate modelling facility was established in Met Éireann in 2003 to produce future climate projections and to examine the impacts of climate change at a regional scale. A comprehensive [report](#) was released in 2008, describing the expected changes in a variety of climate parameters and the likely key impacts, including those on water resources, flooding potential, and wind energy. Climate modelling is a now core activity in Met Éireann.

Met Éireann is a core partner of the Europe-wide EC-Earth consortium⁵ which develops an IPCC-class Earth system model. Two additional Irish partners are the Irish Centre for High-

¹ National Adaptation Framework, 2018, <https://www.gov.ie/en/publication/fbe331-national-adaptation-framework/>

² Sectoral Adaptation Planning, <https://www.gov.ie/en/collection/51df3-sectoral-adaptation-planning/?msckid=81a16bc7ab5b11ec923736ef67f74efa>

³ Adaptation Strategy Explorer, <https://climateireland.ie/#!/tools/adaptationStrategyExplorer>

⁴ A copy of the Charter is available at [https://www.caro.ie/local-authority-climate-action-\(2\)/local-authority-climate-action-charter](https://www.caro.ie/local-authority-climate-action-(2)/local-authority-climate-action-charter).

⁵ <https://ec-earth.org/>

End Computing (ICHEC) and University College Dublin (UCD). In research funded by the EPA, Met Éireann and the Marine Institute, and conducted by the ICHEC and Met Éireann, global EC-Earth simulations over the 21st Century were performed which contributed to Phase 6 of the Coupled Model Intercomparison Project (CMIP6), which was used to inform the IPCC's recent AR6 WG I report. This is discussed in Chapter 8.

Work is currently underway to downscale the output from an ensemble CMIP6 GCMs for Ireland. This work focuses on downscaling the Shared Socioeconomic Pathways (SSPs) and will extend the future period considered to include the full 21st-century.

The EC-Earth consortium has recently begun development of the next version of the model, EC-Earth4. As part of Ireland's contribution to the development of EC-Earth4, Met Éireann is partnering with ICHEC on a 4-year research programme to improve EC-Earth's representation of the North Atlantic climate system and to study the impact of changes in this system on Ireland's climate. The project will produce high-resolution simulations of Ireland's future climate using EC-Earth4 combined with a range of regional climate models. This will enable researchers to study the climate impacts at a local level.

Met Éireann has shared the development of its weather forecasting system with the international consortium HIRLAM (High Resolution Limited Area Model) since 1989. In 2019 a consortium was formed comprising Sweden, Denmark, Finland, Norway and Spain to develop a climate version of the Harmonie-AROME model system known as Harmonie-Climate or HCLIM. Met Éireann has recently joined the HCLIM consortium as a full member and will contribute to its further development. Joining the consortium enables Ireland to develop and strengthen its capacity to produce high quality regional climate change information.

With a wide range of Earth system and regional climate models now available, there is the need for an official standardised set of national climate projections that capture the range of change in future climate projections to inform policymaking and planning. To deliver such a set of projections for Ireland, Met Éireann issued a competitive research call in 2020 for a 2-year project entitled TRANSLATE. TRANSLATE began in early 2021 and will be delivered by researchers from ICHEC and the SFI Research Centre for Energy, Climate and Marine (MaREI).

Ireland's coastline and waterways may be particularly vulnerable to climate change impacts. The expected increased coastal impacts of extreme weather events and offshore resource assessment studies depend on accurate coastal weather forecasts and climate modelling. To address this need, Met Éireann co-funded a 4-year project with SEAI and the Marine Institute

to develop a fully coupled atmosphere-wave-ocean model system for Ireland. Work on fully operationalising this system is ongoing at Met Éireann.

The observed changes in Ireland's climate are in line with changing global climate.⁶

Downscaled projections for Ireland indicate that this trend will continue and intensify into the future, with Ireland's climate projected to become warmer⁷, with an increase in both dry periods and heavy rainfall events, rates of sea level rise will increase, and the frequency of extreme weather events are expected to increase. Table 6.1 summarises Ireland's key climate observations and projections, with further information on climate observations and projections available via Climate Ireland.

Table 6.1: Summary of climate observations and projections for Ireland. Observation and projection data from Cámara García and Dwyer (2021)*, Nolan and Flanagan (2020)†, Feser et al. (2015)^{‡8}, IPCC (2021)⁹ and Olbert et al. (2012)¹⁰.

Parameter	Observations	Projections
Temperature	- The annual average surface air temperature has increased by approximately 0.9°C over the last 120 years, with a rise in temperatures being observed in all seasons* - The number of warm spell days has slightly increased over the last 60 years*	- Mid-century mean annual temperatures are projected to increase by 1–1.2°C and 1.3–1.6°C for the intermediate (RCP4.5) and high (RCP8.5) emission scenario† - Heatwave events are expected to increase by mid-century; over the 20-year period (2041-2060), increases in the number of events range from 1 to 8 for the intermediate emission scenario (RCP4.5) and from 3 to 15 for the high emission scenario (RCP8.5)†

⁶ Status of Ireland's Climate Report 2020 Climate Change | Environmental Protection Agency (epa.ie). Cámara García, W. and Dwyer, N. 2021. Climate Status Report for Ireland 2020 [Online]. EPA Research. Available from: https://www.epa.ie/publications/research/climate-change/Research_Report_386.pdf

⁷ Research 339: High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach Climate Change | Environmental Protection Agency (epa.ie). Nolan, A.P. and Flanagan, J. 2020. High-resolution Climate Projections for Ireland – A Multi- model Ensemble Approach [Online]. EPA Research. Available from: https://www.epa.ie/pubs/reports/research/climate/researchreport339/Research_Report_339_Part1.pdf

⁸ <https://rmets.onlinelibrary.wiley.com/doi/epdf/10.1002/qj.2364>

⁹ <https://www.ipcc.ch/report/ar6/wg1/>.

¹⁰ <https://www.sciencedirect.com/science/article/abs/pii/S027843431200091X>

Precipitation	• Annual precipitation was 6% higher in the period 1989 to 2018, compared to the 30-year period 1961 to 1990* • The decade 2006 to 2015 has been shown to have been the wettest on record (1711-2016)*	• There is an indication of a slight reduction in the annual precipitation of $\approx 0-6\%$ for the RCP4.5 scenario. However, projected reductions are small ($\approx 0\%$) over most of the country for both RCP4.5 and RCP8.5 scenarios. • Substantial decreases in precipitation are projected for the Summer months, with reductions ranging from $\sim 0\%$ to 11% for the RCP4.5 scenario and from 2% to 17% for the RCP8.5 scenario. • The frequencies of heavy precipitation events show notable increases over the year, and in the Winter and Autumn months “likely” projected increase in the number of very wet days of 5-19%†
Wind Speed and Storms	• No long-term trend in wind speed can be determined with confidence based on the limited analysis carried out to date* • Storm tracks over the North Atlantic-European sector shifted northward as indicated by multi-proxy indicators over the North Atlantic § • Most long-term studies show decadal variability for the last 100–150 years, and that there is no evidence of a sustained long-term trend in the number of storm events‡	• Projections indicate a slight reduction in wind speed (10 m) of 1-2.7% for the intermediate (RCP 4.5) and 1.6-3.3% for the high (RCP 8.5) emission scenarios † • The results show an overall reduction of $\sim 10\%$ in the number of storms and suggest an eastward extension of the more severe windstorms over Ireland from mid-century. There is considerable uncertainty in projected changes regarding the number and intensity of storms impacting Ireland. Further research is needed in this area. • Average and maximum rainfall rates associated with storms are expected to increase.
Sea-level and Sea Surface Temperature	• Satellite observations show sea level has risen by ca. 2-3mm/year since the early 1990s*	• Relative to 1995-2014, the likely global mean sea level rise by 2100 is 0.44-0.76 m under the intermediate emissions scenario (SSP2-4.5), and 0.63-1.01 m under the very high emissions scenario (SSP5-8.5)§

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• Average sea surface temperature at Malin Head has been 0.47°C higher over the last ten years compared to the period 1981-2010*	• Sea surface temperatures are projected to continue warming for the coming decade. For the Irish Sea, projections indicate a warming of 1.9°C by the end of the century[#]
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6.3 Assessment of risks and vulnerability to climate change

Progress has been made in identifying some of the key impacts and vulnerabilities for Ireland. In the development of SAPs, vulnerability and risk analysis are required as part of the plan development process set out in Sectoral Guidelines for Climate Change Adaptation. These assessments will be revised and updated in the next cycle of SAPs to reflect updated climate projection information.

The assessment of climate risks and vulnerability in Ireland has been undertaken by sectors and local authorities as they have developed their statutory adaptation plans, as required under the 2018 NAF. In 2019, 12 SAPs and 31 LA Adaptation Strategies were published. To support the development of both sectoral and local authority plans guidelines were published in 2018 and 2019. The core methodology for the development of plans is based on climate observations and projections, vulnerability analyses, expert opinion and stakeholder inputs. The sectoral plans and adaptation strategies highlighted a number of climate hazards that have been observed in Ireland.

Table 6.2: An overview of observed hazards in Ireland.

Type	Hazards
Heat and Cold	Heatwave
	Heatwave and drought
	Cold spell
Wet and Dry	Extreme Precipitation
	River Flood
	Pluvial Flood
	Groundwater Flood
	Landslide
	Hydrological Drought
Wind	Agricultural and Ecological Drought
	Severe Windstorm
Snow and Ice	Heavy Snowfall

	Increase in Relative Sea Level
Coastal	Storm Surge
	Coastal flood
	Coastal erosion

These hazards and vulnerabilities contribute to the risks each sector faces. A summary of the risks for each sector are detailed below plus key factors that will contribute to vulnerability. The NDP and the NPF collectively provide a strategic planning and development framework for Ireland and all its regions for the period to 2040. The framework plays a key role in directing climate change mitigation and adaptation actions at national, regional and local levels by ensuring that climate change considerations are further integrated into the planning system, and that they continue to be taken into account as a matter of course in planning-related decision-making processes.

6.3.1 Agriculture

With fertile soils and a temperate climate, Ireland has many advantages for farming the land to produce food. Agriculture is dominated by a grass based (dairy and beef) system with ambitious plans to increase production (e.g. the Foodwise 2025 strategy) over the coming years. Ireland's climate is also particularly suited to forestry with sustainable forest management identified as making a key contribution to delivering abatement of carbon dioxide over the period 2021-2030. Ireland's ocean economy contributed to 1.16% GDP in 2018 and Ireland's vision for the ocean economy is provided through Harnessing Our Ocean Wealth– an Integrated Marine Plan for Ireland¹¹ and aims to double the value of Ireland's ocean wealth to 2.4% of GDP by 2030 (relative to 2007).

The impact and vulnerability assessment conducted by DAFM during the development of the 2019 Sectoral Adaptation Plan identified a series of priority impacts and consequences. Impacts associated with Ireland's changing climate include slurry storage and issues relating to land spreading may lead to potential water quality issues and increased ammonia emissions. Where wet and dry conditions impact on soil quality, compaction and trafficability can become concerns and can lead to the secondary pressures of poor grass growth and plant health being affected. Where irrigation interventions are required for example, food safety issues could potentially arise. Further risks identified were damage to infrastructure and heat stress, both of which could impact on the health and safety of animals and farmers.

¹¹ Harnessing Our Ocean Wealth: An Integrated Marine Plan for Ireland, <https://oar.marine.ie/handle/10793/810>

Animal and plant health could also be affected by an increase in survivability of vector borne diseases and changes in pest and disease behaviour in response to changes in the Irish climate.

6.3.2 Forestry

For the Forestry sector in Ireland, projected increases in temperature may result in faster growth rates which may lead to some reduction in wood quality in some species (e.g. Sitka Spruce). Projected increases in temperature may result in the introduction of new pests or diseases and the impacts of these may be compounded by projected climatic stress, such as drought and increased temperature.

The risks associated with predicted climate change also include alterations to local forest site conditions, the frequency and degree of disturbances (e.g. fire, drought, extreme storms), phenology (seasonal timing of biological activity), and the distribution and abundance of invasive species and pests. These risks leave Irish forests vulnerable to increased tree maladaptation and mortality, and changes in competitive interrelationships leading to reduced forest health and economic loss. Conversely, predicted climate change could also see an increase in the suitability of some tree species and, relatedly, higher productivity levels.

The main impacts of climate change on forestry in Ireland will not affect the sector in isolation but will combine, resulting in likely resilience challenges across the country. Changes to temperatures and CO₂ concentrations may promote increased growth rates. However, it is uncertain to what extent this growth will be limited by water and nutrient availability, and greater difficulties in forest establishment. Such impacts are likely to vary spatially and according to species. Anticipated decreases in Summer precipitation, particularly in the eastern part of Ireland, may limit water availability for some species and consequently reduce their productivity. The impact of a large increase in the length of the growing season over Ireland by the middle of this century could result in some species not fulfilling their Winter chilling requirements (necessary for dormancy release of buds) or lengthen the time needed to satisfy the chilling requirement of plants. This is likely to result in delayed budburst for certain conifers and oceanic species, significantly affecting their growth patterns.

Extreme weather events, such as drought and storms, pose the greatest climatic threat to forest productivity. A combination of increased wind and Winter rain events is likely to result in a substantial increase of windthrow risk for vulnerable species. The consequences of this include damage to forest stands and reductions in forest rotations and timber quality. The increased risk of uncontrolled fire is another potential impact of climate change on Irish

forests. The conditions for increases in fires are associated with increased temperature, soil moisture deficits and the levels of potential fuel load. The consequence of such disturbance is the risk of serious damage to forest stands with accompanying economic and environmental losses. Climate change resulting in warmer Winter and Summer temperatures will negatively impact forests by presenting conditions for more successful establishment of pests and pathogens.

Projected increase in the occurrence and magnitude of storm events will increase the occurrence of windthrow, this is particularly the case for forest plantations located on exposed, windy sites with poor drainage. Large disturbance events may also influence forest age class structure and overall productivity. Higher temperatures and moisture deficits are also likely to increase the risk of forest fires.

Climate change will result in more favourable climatic conditions for forest pests and diseases to thrive, leading to some forest species being susceptible to harm.

6.3.3 Seafood

For the Seafood sector, an iterative process was undertaken by the Department with significant input from experts from the Marine Institute and Bord Iascaigh Mhara in identifying and assessing the scale of risks facing the sector. The process was guided by templates provided by Climate Ireland and with guidance from MaREI/UCC, on behalf of Climate Ireland, on process and prioritisation. In particular, the significant challenge for the Seafood Sector, identified by the process is to quantify the scale of risks posed by climate change impacts. The areas of particular vulnerability identified provided the basis upon which to prepare a series of case studies to examine the challenges faced in greater detail. Research contained within EPA Report No. 159 supported this work.

Areas of immediate concern for the aquaculture industry are the potential for increased pathogenic waterborne bacterial infections and increased range and potential toxicity of harmful algal blooms (HABs) associated with warming water temperatures. Warming of the ocean and the consequent reduction of dissolved oxygen will result in stress and increased metabolic demand, causing increased sensitivity to other stressors such as reduced oxygen and acidification, and will accelerate vulnerability to infectious diseases.

Additionally, ocean acidification is critical for the early life stages of crustaceans and molluscs, changing pH alters biomineralisation pathways in calcifying organisms including commercially important molluscs, thereby compromising the structural integrity of the shell. While changing rainfall patterns have the potential to negatively impact aquaculture through

decreased water availability for freshwater aquaculture particularly over the Summer months and inducing freshwater pulses in estuarine systems in the Autumn/Winter.

Sea level rise is identified as a key risk in many of the adaptation plans developed by various Government departments. This risk has the potential to increase the frequency of inundation of coastal population centres and infrastructure, including fishing ports and seafood processing facilities. Sea level rise may also compromise key habitats for seabirds and other species.

For the Seafood sector, projected increase in ocean acidity may have impacts on commercially sensitive shellfish (e.g. oysters and mussels) resulting in decreased seafood production. Projected changes in sea surface temperature may result in changes in the distribution of traditional fisheries as the distribution of fish stocks move north with the loss of native species and an increased threat of non-native species. Changes in the timing of fish spawning is expected with subsequent changes in the timing of harvesting. Increases in the occurrence of harmful algal blooms is expected resulting in restrictions on shellfish harvesting.

Projected increases in extreme precipitation events may increase the potential for flooding of inland aquaculture facilities. In contrast, projected increases in the occurrence of dry spells may result in low river flows and reduced availability of water for inland aquaculture farms. Reduced water availability may also result in an increased requirement for recirculation and oxygenation of the waters in aquaculture farms.

Projected sea level rise in combination with increases in the intensity of storms and surge events may result in increased damage to fishing vessels and infrastructure, increased tie-up time in ports, and health and safety impacts.

Changing ocean temperatures and the incidence of marine heatwave events represents a risk to many living resources in the ocean. Particular life stages of fish development are profoundly impacted by warmer ocean temperatures. Protracted marine heatwaves, some of which have already been observed in Ireland, have the potential to impact on the distribution and abundance of fish and on productivity in finfish and shellfish aquaculture.

Observed shifting phytoplankton and zooplankton distributions provide the basis for more harmful algal blooms impacting aquaculture and predator-prey mismatches for juvenile fish at key life stages impacting commercially fished species.

To address the impacts of climate change on aquaculture, the seafood sector has incorporated mitigation policies as well as developing adaptive capacities. These include:

- Developing the knowledge base on the issues to be addressed.
- The provision of policy and an implementation forum.

- Technological and capacity building.
- Enabling financial mechanisms to resource the industry for change.
- Reducing carbon footprints.

A study of the national sites collecting in-situ essential ocean variables was produced in 2021. This will be expanded to other data providers in the coming years. Marine Institute continue to maintain observing systems to monitor essential ocean variables including the national marine data buoy observing network (IMDBON), tide gauge network, wave buoy network and catchment monitoring of the land ocean continuum in Newport, Co. Mayo. Vessel-based CO₂ monitoring is underway on both national research vessels.

Environmental conditions determine the distributions of each fish species. Climate change will result in a change of these conditions and some species may be more severely impacted by these changes than others. Existing harbour infrastructure may be vulnerable to the impacts of sea level rise.

6.3.4 Flood Risk Management

For the Flood Risk Management sector, projections indicate an increase in intensity of storms, increases in the frequency of extreme precipitation events and increases in sea level which will result in the increased frequency and extent of fluvial, pluvial and coastal flooding. These changes will have impacts for the flood risk management sector.

Existing guidelines on zoning adopt a precautionary approach to climate change and the robust implementation of the guidelines should reduce the potential impacts of climate change on properties developed in the future. The design of flood relief schemes in the current programme of flood relief works includes adaptation to potential climate change impacts as part of scheme identification, development, design and implementation. However, for older flood relief schemes, the standard of protection over time may reduce the inclusion of climate change design.

Projected increases in the frequency of extreme precipitation events may result in saturation and waterlogging of agricultural land, with impacts on arterial drainage schemes. However, projected decreases in precipitation over the Summer months, which would reduce water tables, may mitigate the increased waterlogging from increased rainfall. Projected changes in average temperature may result in increased vegetation growth affecting performance of drainage schemes. Water bearing infrastructure that is fed artificially will also be affected by changes in precipitation variability and changes in demand.

Projected sea level rise and increases in the frequency of extreme precipitation may have adverse impacts for arterial drainage schemes in estuarine areas (i.e. embankments) resulting in increased damage and loss.

Projected changes in flooding and sea level rise may affect hydrometric stations and make accessing the gauge more difficult. There will be an increased need for more finely resolved hydrometric data to assess the effects of climate change on flooding. Moreover, a change in focus of hydrometric schemes toward drought and flooding may be required with implications for network design and operation. Further analysis may be required beyond the National Catchment-based Flood Risk Assessment and Management (CFRAM) programme to reflect new climate change projections placing a demand on resources to review and update the hazard and risk assessments.

The inclusion of climate change adaptation measures in the design and construction of flood relief schemes is relatively new. Therefore, the standard of protection offered by some flood relief schemes completed to date may reduce over time as sea levels continue to rise, and if river flood flows and levels rise as a result of the impacts of climate change. Existing urban water drainage systems have design standards that may not be adequate for projected climate conditions with potential impacts for operational management.

6.3.5 Health

For the Health sector, flood risk due to projected increase in the frequency of heavy rainfall events along with projected increases in sea level may result in the increased disruption of health services due to inundation, impact health through the increased frequency of drownings or injury and indirect impacts including increased mental health impacts.

Projected increases in the frequency of extreme precipitation events may result in more water-borne disease (e.g. E. coli) from contamination of drinking water as a result of overland flows of pollutants. Projected increases in annual average temperature combined with wetter conditions may result in enhanced environmental conditions for bacterial growth and viral survival with potential increase in food-borne disease.

Projected increases in the frequency of heatwaves may result in an increase in heat-related mortality and morbidity. Moreover, increases in average temperatures and in the frequency of heatwaves may result in:

- increased exposure to ultraviolet radiation from higher levels of ambient UV radiation and also from people spending more time outdoors in warm weather

- weather-driven increases in air pollutants such as ozone, particulate matter (PM) and aeroallergens, aggravating existing health risks from air quality, particularly for vulnerable populations such as older adults, individuals with chronic illness, children and those living in deprived communities
- increased aeroallergen levels due to a prolongation of the pollen season and an increase in indoor growth of mould and fungus secondary to increased precipitation and flooding
- the potential to support the emergence or re-emergence of vector borne diseases

In contrast, projected changes in climate indicate the occurrence of warmer Winters, reducing the risk of cold-related illness. However, there may be significant health impacts associated with extreme cold snaps and more frequent heavy precipitation events during Winter, including snow, sleet or hail.

Population projections indicate an increase in the proportion of persons aged 65 years and over relative to the overall population, consequently there is expected to be a rise in the number of people living with chronic diseases. These people will more severely impacted during a heat wave, leading to harm to individuals and increased pressure on health services. Climate change will cause increased temperatures, which may lead to people spending more time outdoors. Irish people with fair skin are considered to particularly vulnerable to UV damage, are at higher risk of skin cancer and could be more vulnerable to the impacts of climate change as a result.

Climate change has the potential to reduce air quality, therefore, people that live in affected areas are more vulnerable to climate change.

Climate change increases the likelihood of water contamination, e.g. via increased flood occurrence, therefore, people who derive their water from private wells are more vulnerable to the impacts of climate change.

6.3.6 Transport

For the Transport sector, projected increases in the frequency of extreme precipitation are expected to result in the increased frequency of pluvial and fluvial flooding with a range of impacts on the sector including disruption and suspension of transport services, hazardous driving conditions, increases in the occurrence of bridge scour as a result in increased flows and increased landslide risk due to saturation of soils.

Projected increase in the intensity of windstorms is expected to result in disruption of transport hubs and networks. Air and seaports may be subject to increased levels of delay

and cancellation while increased disruption of transport networks as a result of fallen trees and debris is expected.

Projected sea level rise (SLR) and increases in the intensity of high winds, storms and storm surges have the potential to significantly impact on the transport infrastructure, particularly transport networks and hubs located in low-lying coastal areas, on eroding coastlines and on estuaries; for instance, the Dublin to Rosslare rail line, which is already particularly susceptible to coastal erosion and flooding.

Projected increases in the frequency of heatwaves and drought may result in the degradation of transport infrastructure, e.g. deformation of road surface and rail buckling. Over-heating of trains, trams and buses could affect passenger comfort and temperature control measures may also be required in transport hubs, particularly airports and public transport depots. Higher average temperatures may also lead to a rise in active travel, with positive co-benefits for carbon mitigation.

Projected decreases in the number of frost and ice days may result in benefits to the transport sector with decreases in the occurrence of service disruption and minor accidents due to frost and ice.

Transport hubs, trains, trams and buses with poor ventilation or no active cooling will be particularly vulnerable to the impact of heatwaves. The transport infrastructure (e.g. road surfaces) currently in place may not have the design or material specifications that are able to cope with future climatic conditions such as heat waves.

6.3.7 Built and Archaeological Heritage

For the Built and Archaeological Heritage sector, projected increases in the frequency of flooding as a result of increases in the frequency of extreme precipitation events may result in the partial or complete loss or damage to built and archaeological heritage, potential closure of heritage sites, and health and safety risks.

Projected changes in storm activity are expected to result in increased impacts to built and archaeological heritage sites. In addition to increased levels of direct impacts, such as structural damage and partial or complete loss, indirect impacts as a result of falling trees will increase, potentially altering landscape character and damaging nearby structures and archaeological features. In addition, increases in storm activity will result in increased pressure to respond to an escalating number of exposures of archaeological finds.

Many built and archaeological sites are located in coastal areas in Ireland, consequently projected increases in sea level rise, storms and storm surge have the potential for a wide

range of adverse impacts. For example, Ireland's major cities, home to a wide range of built and archaeological sites (e.g. protected structures, libraries and galleries, archives, and museums) are situated on estuaries and will become increasingly exposed to coastal flooding. Projected sea level rise may also result in increased erosion and will have detrimental impacts for sites situated in coastal areas and underwater cultural heritage, while saline intrusion will compromise historic structures and archaeological deposits through physical and chemical reactions. The preservation in situ of underwater archaeology will be compromised as both water temperature and acidity increase.

Projected changes in temperature and relative changes in humidity will create favourable conditions for mould growth. Projected increases in the frequency of heatwaves and drought conditions may result in the increased frequency of wildfires with implications for built and archaeological sites and landscapes. Bog bursts are also expected to be more frequent as a result of the increased dry periods followed by heavy rainfall events resulting in loss or damage to archaeological deposits.

Cultural landscapes may consist of native vegetation species that may not be able to respond to new climatic conditions in some climate scenarios. Levels of preservation of any built and archaeological heritage sites is considered particularly sensitive to changes in climatic conditions.

6.3.8 Biodiversity

For the Biodiversity sector, climate change may alter the timing of phenological changes and geographical distribution. Phenological changes in plant and animal phenologies will likely be reflected in Ireland's biodiversity disruption to previously synchronised ecosystem functioning. This could lead to a change in species composition and ecosystem functioning. Increasing Winter temperatures suggests the continued north-east shifts of the ranges of many of Ireland's waterbirds. Increases in birds, currently considered to be rare in Ireland are projected e.g. the Mediterranean Gull. Many species and habits are expected to experience significant changes in geographical range.

Projected changes in temperature and precipitation will result in a significant loss of suitable climatic areas for peatlands; particularly for low-lying areas of the south and west. Projected increases in temperature and precipitation will result in the increased occurrence of invasive species and competitive pressures for native species. Projected increases in sea surface temperature may have detrimental implications for cold-water fish stocks, e.g. cod and herring; while warmer water species (e.g. hake) may benefit.

Projected increases in the frequency of extreme weather events (e.g. heatwaves, droughts, and storms) may have devastating impacts for Ireland's coastal habitats. Sea level rise, storm surge and flooding will result in intertidal areas being unavailable for foraging birds. These events may affect the shape of estuaries with effects on the distribution and abundance of invertebrates.

Projected increases in the frequency of extreme precipitation events are expected to result in increased levels of runoff affecting water quality and fish survival. Projected increases in temperature and in the frequency of extreme precipitation events may result in the increased frequency of bog bursts and landslides indirectly impacting on other habitats such as lakes. Habitats that are already degraded, fragmented, and isolated are likely to be the most vulnerable to the impacts of climate change as their ability to cope and adapt to new climatic conditions is reduced.

Sea level rise and coastal erosion is projected to result in the loss of coastal habitats, however, particularly vulnerable are those areas subject to 'coastal squeeze'. These are habitats that are prevented from extending/migrating landward due to the presence of some fixed or artificial boundary.

Climate change in Ireland is expected to impact on freshwater river systems, ponds, mesotrophic lakes, native woodlands, lowland heaths, coastal floodplains, coastal salt marshes, and coastal sand dunes are all particularly vulnerable to colonisation by invasive species.

6.3.9 Communication Networks

For the Communication Networks sector, projected increases in extreme precipitation will result in the increased frequency of flooding, with new areas at flood risk which will result in the increased exposure of communications infrastructure to flooding impacts. Projected increases in sea level and in the intensity of storms and storm surge may result in the increased exposure of communications infrastructure situated in coastal areas to flooding with potential for infrastructure damage or loss.

Projected increases in the intensity of windstorms will result in increased levels of impact on communications infrastructure. Projected increases in the frequency of extreme weather events will result in increased accessibility issues to key communications infrastructure resulting in increased levels of service disruption.

Street cabinets that house communications infrastructure may be more vulnerable to increases in the intensity and frequency of heat wave events. To date, active cooling has not

been required for these cabinets with passive cooling being adequate to offset adverse heat-related impacts.

The overhead line network is a key component of the communications network. These lines are more vulnerable to the effects of windstorm events. Conversely, the underground parts of the network are not impacted by windstorm events but may be more severely impacted by flooding.

Parts of the communication network infrastructure, such as base and transmission stations, are in remote areas. During extreme weather events these sites may be difficult or impossible to reach if required.

6.3.10 Electricity and Gas Networks

For the Electricity and Gas Networks sector, water shortages and drought will have implications for water usage at conventional electricity generation plants which use significant amounts of water (primarily cooling water). Projected increases in the frequency of Summer drought may result in soil compaction and damage to underground cables and pipelines.

Seasonal changes in rainfall distribution may result in reduced hydro power generation at certain times of the year. Notably, hydro stations play a role in flood alleviation and projected increases in extreme precipitation events may result in this role becoming more significant. Projected increases in the frequency and extent of flooding may result in increased damage to the electricity and gas transmission and distribution systems. Projected change in extreme precipitation events and in the occurrence of drought conditions may have impacts for foundations of wind farms.

Projected sea level rise in combination with projected increases in the intensity of wind storms and storm surge may impact on electricity and gas infrastructure including generation plants, transmission and distribution systems. Salt fog is also considered a risk to transmission assets. Projected increases in coastal erosion may also have adverse impacts on infrastructure and underground utilities.

Projected increases in the growing season in combination with projected changes in intensity of wind storms may result in increased windthrow and damage to transmission and distribution systems.

Projected increases in wind variability may lead to turbine shut down either due to low or high winds or to structural damage. This will increase the need for generation backup and or storage.

The electricity transmission system and gas infrastructure are designed and operated to meet the requirements of the relevant Irish and European Standards. There may be instances where these standards would not be suitable for the projected future climatic conditions in Ireland. Consequently, any infrastructure that is in place that is not of sufficient standard for the future climate may be vulnerable to the adverse impacts of climate change.

6.3.11 Water Quality and Water Services

For the Water Quality and Water Services sector, projected increases in average temperature and the increased occurrence of invasive species could have adverse effects on the environmental and ecological status of habitats, reducing water quality.

Projected decreases in average annual precipitation, particularly over consecutive seasons and with corresponding increases in annual average evapotranspiration, could result in reduced river flow, reservoir refill capability and groundwater recharge. Lower water tables could modify hydrological conditions leading to increased nutrient and sediment transport to rivers and lakes resulting in significant water quality issues. Lower water levels combined with depletion of Dissolved Oxygen (DO) due to eutrophication and algal blooms and the toxic effects of cyanobacteria may result in increased fish kills and significant damage to pollutant sensitive species.

Projected increases in the frequency of drought could result in decreased water supply while changes in consumption patterns due to higher temperatures and heat-wave events could result in water supply shortages.

High precipitation could result in high pollutant concentrations and loads as a result of overland flows resulting in an increase in nutrient concentrations in rivers, lakes and reservoirs and coastal waters leading to eutrophication and the increased occurrence of algal/cyanobacterial blooms.

Ireland's water supply may be vulnerable to climate change impacts as infrastructure may come under pressure to meet the long-term balance of water supply and demand under some climate scenarios.

Some natural water bodies and catchments are already considered as being of poor status according to the criteria of the Water Framework Directive and may be further impacted as their ability to cope with future environmental impacts is reduced. This has potential to further reduce Ireland's water supply if ongoing remediation efforts are not successful.

6.3.12 Social Vulnerability to Climate Change

In terms of social vulnerability, according to the Central Statistics Office (CSO) Survey of Income and Living Conditions¹², in 2019, 12.8% of the Irish population were at risk of poverty. Those considered most at risk of poverty were individuals who were not at work due to illness or disability and those who were unemployed. The Trinity National Deprivation Index 2016 identified that the areas (electoral districts) with the highest levels of deprivation are found in cities or in other urban areas within otherwise predominantly rural counties. Ireland's most recent Census, in 2016¹³ (the 2021 census was delayed until 2022 due to the Covid crisis), shows that Ireland's population stood at 4,761,865 in April 2016, an increase of 173,613 (3.8%) since April 2011. Ireland's population has been steadily growing since the 1990s, and has increased by 36% since 1990, although the increase from 2011 to 2016 has been the slowest over that period. The population growth recorded by the 2016 Census was brought about by natural population increases, offset by a small net migration. The average age of Ireland's population had increased from 36.1 years to 37.4 years over the same period. In 2016, 63% of Ireland's population resided in urban areas while 37% resided in rural areas. Between 2011 and 2016, urban areas saw an increase of 4.9% while rural areas showed a 2% increase in population. By 2040 the population of Ireland could grow to 5.7 million people with a continued increase in urban populations. As part of Project Ireland 2040 and the NDP there is a strategic objective to support and enable the sustainable growth of more compact urban and rural settlements rather than continued sprawl and unplanned, uneconomic growth.

Ireland's population density also increased to 70 persons per square kilometre, although this remains relatively low compared to other European countries. However, 40% of the population is concentrated in the Greater Dublin Area, outside of which the State has a highly dispersed and low-density population. All of Ireland's major cities (Dublin, Cork, Galway, Limerick and Waterford) are situated on coastal estuaries. Likewise, much of Ireland's industry and general infrastructure is coastal, notably power stations, communications and transport hubs. Since the 1980s, the population of Ireland's coastal areas has been increasing as a result of urban expansion. In 2016, there were 1.9 million persons within 5km of the coast, representing 40% of the total population. Of these, 40,468 were living less than 100 metres from the nearest coastline.

Projections indicate that Ireland's population is expected to reach at least 5.58 million in 2051 with substantial increased in persons aged 65 years and over by 2051. This represents

¹² <https://www.cso.ie/en/aboutus/takingpartinasurvey/surveysofhouseholdsindividuals/surveyonincomelivingconditions/>

¹³ <https://www.cso.ie/en/census/census2016reports/>

an increase of 13% of the population aged 65 years and older in 2016 to between 23.9% and 27.4% in 2051. The number of persons aged 80 years and over is projected to rise from 147,800 in 2016 to between 535,900 (+262.6%) and 549,000 (+271.4%) in 2051.

6.4 Climate Change Impacts

Climate Impact information for Ireland, which relates to key impacts, is provided by a number of official sources including Met Éireann, the Office of Public Works, the EPA, Climate Ireland, and Local Authorities.

6.4.1 Met Éireann

Climate modelling is a core activity of Met Éireann. Met Éireann has collaborated with University College Dublin and the Irish Centre for High-End Computing to contribute to the development of a new global climate model (EC-Earth) which can provide analysis of the impacts of global climate change on Ireland to inform policy making. The Global Climate Observing System National Committee for Ireland (GCOS-Ireland), involving Met Éireann, the EPA and the Marine Institute, coordinates and promotes the GCOS observing principles relating to essential climate variables of relevance to Ireland. The GCOS-Ireland report 'Climate Status Report for Ireland 2020' provides high quality evidence to support the development of appropriate climate mitigation and adaptation solutions.

6.4.2 Office of Public Works

The Office of Public Works' (OPW) national flood information portal¹⁴ provides access to historical and projected maps of flood extents for Ireland for potential future scenarios as well as for current conditions. This map and plan viewer website is an important resource, to support adaptive measures in other sectors and at the local level, as well as for spatial planning, emergency response planning, and to empower people and communities to respond to flood risk.

¹⁴ Office of Public Works' national flood information portal, <https://www.floodinfo.ie>

6.4.3 The Environmental Protection Agency

The EPA is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. Along with protecting people and the environment from the harmful effects of radiation and pollution, the EPA plays a key role in provision of environmental data, assessments and evidence to inform decision making.

A Summary of the State of Knowledge on Climate Change Impacts for Ireland¹⁵ presents a summary of the state of knowledge on ongoing climate change and projected impacts for Ireland. It updates and enhances the information provided in the 2009 Summary of the State of Knowledge Report.

The EPA Research Report, 'High-Resolution Climate Projections for Ireland – A Multi-model Ensemble Approach'¹⁶ downscales multiple global climate models to provide a higher resolution update of climate projections for Ireland used to develop the first cycle of SAPs. These climate projections, which will be made available via www.climateireland.ie will need to be analysed to identify potential impacts for different sectors in different parts of the country. This work will then feed into revisions of national policies, including the next iteration of SAPs.

To further support decision-making for adaptation, the EPA is leading the development of Ireland's first '5-Year Assessment Report' (5-YAR) on Climate Research. The '5-YAR' will provide an authoritative assessment of our understanding of climate change based on; scientific research and systematic observations in Ireland, linked EU and global analysis and to provide summary information which can inform decision making on climate actions.

The ongoing EPA Research project 'Policy Coherence in Adaptation Studies: Selecting and Using Indicators of Climate Resilience' (PCAS) project combines an analysis of international best practice and approaches to the development of climate change indicators co-designed by key stakeholder representatives to identify a tailored suite of Ireland-relevant climate adaptation indicators. The results of this project along with proposals on indicators announced in the recent EU Adaptation Strategy will inform Ireland's approach to indicators at national level.

¹⁵ Summary of the State of Knowledge on Climate Change Impacts for Ireland, [Climate Change | Environmental Protection Agency \(epa.ie\)](http://Climate Change | Environmental Protection Agency (epa.ie))

¹⁶ Nolan P, Flanagan J (2020) [Climate Change | Environmental Protection Agency \(epa.ie\)](http://Climate Change | Environmental Protection Agency (epa.ie))

6.4.4 Climate Ireland

'Climate Ireland' is a national web-based resource of up-to-date and fit-for-purpose climate and adaptation information and tools. It provides this service for local, regional and sectoral decisionmakers in line with the published adaptation strategy development guidelines.

Climate Ireland also plays a key role in increasing awareness of and building capacity for adaptation planning through one-to-one support, and the provision of tailored adaptation planning workshops and seminars.

6.4.5 Key Climate Change Impacts

Some of the impacts of climate change that could potentially impact priority sectors in Ireland include:

- Precipitation extremes and flooding, resulting in disruption of transport services, unsafe driving conditions and gradual deterioration of infrastructure
- Increased water demand as a result of the increased frequency of heatwaves, leading to further strain on water transmission and distribution networks, as well as on supply (abstraction and storage)
- Projected increases in the frequency of extreme precipitation events may result in more waterborne disease (e.g. E. coli) from contamination of drinking water as a result of overland flows of pollutants. Projected increases in annual average temperature, combined with wetter conditions, may result in enhanced environmental conditions for bacterial growth and viral survival with a potential increase in food-borne disease
- Projected increases in sea levels and storm surge will result in increased frequency of coastal flooding and erosion, with significant impacts for coastal and heritage sites situated in proximity to the coast and on estuaries
- Projected increases in the intensity of windstorms, and in the duration of the growing season, may result in increased wind-throw leading to damage to overhead power lines with potential cascading risks, including to Water Supply and Telecoms
- Projected increases in the frequency of heatwaves will result in degradation of communications infrastructure (e.g. street cabinets), potentially leading to an increased requirement for active cooling
- Projected changes in temperature and precipitation will result in the arrival of invasive species more suited to changed climate conditions, some of which may have negative impacts on the economy (e.g. via impacts on farming and fisheries)

- Projected increases in the frequency of extreme precipitation events will result in increased levels of run-off and potential water quality issues, with implications for slurry storage and land spreading
- Projected increases in the frequency of heatwaves and drought, resulting in the increased frequency of wildfires damaging forests stands

The list above is a subset of some of the impacts identified within each sectoral plans. It is not possible to provide a full list of all impacts identified across all priority sectors within the context of this report however further details of other impacts are available on the aforementioned gov.ie website.

6.5 Domestic adaptation policies and strategies

Planned adaptation in Ireland aims to take measures to counter current or expected climatic impacts, as described in previous sections, within the context of ongoing and expected societal change. SAPs and LA Adaptation Strategies fall under the NAF, and were developed in line with national guidance issued by the Department of Environment, Climate and Communications to ensure a consistent approach to the development of plans at national and local level.

6.5.1 Climate Act 2021

Ireland's climate adaptation policy is given legal effect by the Act and requires the development of a NAF which must be reviewed every five years. It also requires that Sectors Impacted by Climate Change impacts can be required to develop SAPs. Significant amendments to the Act make provision for the Government to request two or more Ministers of the Government to jointly make and submit a sectoral adaptation plan in relation to a matter for which such Ministers of the Government share responsibility. Local Authorities now have a requirement to develop Local Authority Climate Action Plans which must include adaptation measures and nationally.

6.5.2 National Adaptation Framework

The requirement for the development and approval of a NAF is set out under Section 5 of the Act. Ireland's first statutory NAF was published in January 2018. The NAF sets out Ireland's strategy for the application of adaptation measures in different Government sectors,

including the local authority sector to reduce the vulnerability of the State to the negative effects of climate change but also to avail of any positive effects that may occur. The strategic vision for the NAF was to develop a 'climate resilient Ireland'. It sets out a high-level vision of the capacity of Ireland's social, economic and environmental systems to cope with climate change by responding or reorganising in ways that maintain their function, identity and structure, while also developing capacity to adapt, learn and transform. A primary objective of the NAF is to bring a clear and strong focus to both the challenges and the opportunities of transitioning to a climate resilient future, and the importance of a positively focussed and cost-effective national transition agenda.

The key objectives of the NAF are implemented through activities at sectoral, regional and local level aimed at:

- enhancing adaptive capacity at the sectoral, regional and local level
- strengthening the resilience of social, economic and environmental systems to current and future climate change, including identifying how resilient these systems are to current and future climate variability, and the steps which should be taken to achieve resilience
- reducing vulnerability to climate change: How vulnerable are systems to current and future climate change
- taking advantage of any opportunities that might arise from climate change

The NAF considered how best to ensure that relevant sectors coordinate on their respective Plans given the fragmented responsibilities that occur across sectors, e.g. emergency planning, water, marine, and biodiversity sectors. The NAF made recommendations and suggested action to strengthen existing governance bodies (e.g. national adaptation steering group).

Progress under NAF has been dependent on research funded by funding organisations (including SFI, EPA, DAFM, Marine Institute, GSI, IRC, CCAC, Met Éireann, SEAI, and OPW) and performed by national higher education institutions. In addition, sustainable climatological observations from Met Éireann stations are critical to the assessment and research of climate change in Ireland

The development of the 2018 NAF took account of a range of policies, plans and programmes. The NAF considered existing and future international obligations for Ireland in relation to adaptation including:

- obligations under the UNFCCC and the Paris Agreement
- the 2013 EU Climate Adaptation Strategy and assessments made by the European

Commission under the EU Adaptation Scoreboard

- nationally relevant policy and legislation including the Sustainable Development Goals, WFD, Habitats Directive, SEA, Spatial Planning
- overall approach accounts for findings from existing non-statutory SAPs published at the time it was made e.g. OPW and CFRAMS

A review of the NAF commenced in December 2021. The review included a public consultation which took place in mid 2022. A report on the outcome will be made to the Minister for Environment, Climate and Communications following completion of the review process.

6.5.3 Sectoral Adaptation Plans

The current NAF identifies 12 key sectors requiring SAPs. These SAPs were approved by Government and published in October 2019. The SAPs under the current Government Department configuration are grouped under four themes in Table 6.3 below. The completed SAPs describe and assess the extent of the risks presented by climate change to the sector, and present contingency plans to address these risks and ensure climate resilience of the sector. They include actions to mainstream adaptation into policy and administration at the sectoral level. In addition, they include actions to improve cooperation and coherence across other sectors and with the Local Government sector.

Table 6.3 : List of national adaptation sectors

Theme	Sector Level	Lead Department for Sectoral Adaptation Plans
Natural and Cultural Capital	Seafood	Department of Agriculture, Food and the Marine
	Agriculture	
	Forestry	
	Biodiversity	Department of Housing, Local Government and Heritage
	Built and Archaeological Heritage	

Critical Infrastructure	Transport infrastructure	Department of Transport, Tourism and Sport
	Electricity and Gas Networks	Department of Environment, Climate and Communications
	Communications networks	
Water Resource and Flood Risk Management	Flood Risk Management	Office of Public Works
	Water Quality	Department of Housing, Local Government and Heritage
	Water Services Infrastructure	
Public Health	Health	Department of Health

Sectors prepared their SAPs according to a risk-based adaptation management approach in Ministerial Guidelines which were published by DECC in May 2018. The five key steps in this approach are:

1. Building the adaptation team – defining the scope of work
2. Assessing the adaptation baseline
3. Assessing future climate risk
4. Identifying, assessing and prioritising adaptation options
5. Monitoring and Review

Sections 6 and 7 of the Climate Act 2021 set out the requirements for the preparation of SAPs by Ministers of the Government and, depending on the outcome of the NAF review, there may be impacts for existing SAPs. The Climate Act 2021 makes provision for the Government to request 2 or more Ministers of the Government to jointly make and submit a sectoral adaptation plan under (referred to as a ‘joint sectoral adaptation plan’), in relation to a matter for which such Ministers of the Government share responsibility. The CCAC and other stakeholders have suggested that there may be a need to consider developing SAPs for Sectors not previously working under a SAP. Suggestions for additional and/or cross-cutting SAPs have already been made by key Stakeholders regarding the Finance, Tourism, and Coastal policy areas and for the Built Environment.

The Agriculture, Forest and Seafood Climate Change Sectoral Adaptation Plan was published in 2019 and it aims to reduce climate risk and build resilience through awareness raising and by embedding adaptation planning in sectoral policies. Buy-in and behavioural change are key to making progress. The 2020 Programme for Government Our Shared Future, emphasises the need to implement the SAP for the agri-food and seafood sector and commits to assisting in efforts to adapt with the changed environment. It also recognised “that farmers are the primary custodians of the rural environment and have a vital role to play in addressing the climate and biodiversity crisis.”

The Climate Change Adaptation Plan for the Health Sector 2019-2024 identifies the main climate change impacts and risks which will be faced by the health sector and sets out a range of measures to build resilience and reduce vulnerabilities. The Plan envisages six climate change impacts with health implications, namely temperature change, drought and flooding, storms, mental health impacts and impacts to the provision of health services, both in terms of usage patterns and of infrastructure threats.

The actions proposed by the Plan are set out across a range of themes, namely Leadership/Oversight; Severe Weather Events; UV / skin cancer; Air Pollution; and the monitoring, research and evaluation of progress.

6.5.4 Climate Action Plans & Mainstreaming

The integration of climate change adaptation policies into other national, sectoral and local level policies, plans and programmes is recognised in the NAF as a key policy approach to implementing adaptation. The 2018 NAF commenced the process of identifying opportunities to integrate climate change adaptation across all relevant policy areas. The publication of CAP21 significantly progressed this process.

CAP21 provides a detailed plan for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and setting Ireland on a path to reach net zero emissions by no later than 2050, as committed to in the Programme for Government and set out in the Climate Act 2021. The Plan lists the actions needed to deliver on our climate targets and sets indicative ranges of emissions reductions for each sector of the economy. It will be updated annually, including in 2022, to ensure alignment with our legally binding, economy-wide carbon budgets and sectoral ceilings. In addition to actions related to Ireland's international commitments on Adaptation, over 60 key actions (and additional sub actions) are directly related to improve resilience in Ireland. These actions are mainstreamed into appropriate sectoral chapters including flooding, built environment, transport and energy

and communications networks.

6.5.5 Local Authority Adaptation

The Climate Act 2021 now gives legal underpinning to climate action by the public sector. It requires all public bodies to perform their functions in a manner consistent with Ireland's climate ambition. Local Authorities (LAs), in particular, have a pivotal role to play in the decarbonisation transition. LA Adaptation Strategies were published in 2019 and, under the Act, LAs are now required to develop Climate Action Plans. Guidelines are being developed to assist LAs in this process.

In January 2018, the government established four Climate Action Regional Offices (CAROs) in recognition of the commitment by local government to develop and implement its own climate action measures, as well as the need to build capacity within the sector to respond and adapt to climate change.

The CAROs are operated by a lead local authority in each region (Mayo County Council, Cork County Council, Dublin City Council, and Kildare County Council, respectively), and focus on the predominant risks in each geographical area. The CAROs play an important role in ensuring that cross-sectoral issues are identified and addressed, and in community engagement. They also played a key role in coordinating the development of the LA Adaptation Strategies and ensuring their alignment with SAPs. CAROs will have a role in supporting Local Authorities to develop Local Authority Climate Action Plans required under the Climate Act 2021.

6.6 Monitoring and evaluation framework

The monitoring and evaluation of climate adaptation policy and action in Ireland takes place on a number of levels. Key to the framework are the Climate Action Delivery Board, the National Adaptation Steering Committee (NASC), the Climate Change Advisory Council (CCAC) and the Climate Action Regional Offices (CAROs).

6.6.1 Climate Action Delivery Board

The Climate Action Delivery Board is composed of a group of Secretaries General of government departments who are responsible for implementing their Departments' sectoral actions under the CAP21, including those that are adaptation related, must be reported to

the Department of the Taoiseach on a quarterly basis. In CAP21, over 60 adaptation related actions are set out which cover:

- Provision of data, information and decision supports on climate impacts and adaptation
- Building local and regional resilience to the impacts of climate change through delivery of LA Adaptation Strategies
- Revision of the NAF
- Pilot project to identify a suitable approach for the use of Climate Change Adaptation Indicators at national level
- Develop Ireland's national climate change risk assessment capacity to identify the priority physical risks of climate change to Ireland
- Flood risk management
- Improve the understanding of, and the communication around, Ireland's changing climate and the co-creation and delivery of climate services
- River basement management
- Climate change and health
- Adaptation and the electricity and gas networks sector

The Climate Action Delivery Board monitors how well these actions are being achieved and it reports on progress to Government. These progress reports can be found online.¹⁷

6.6.2 National Adaptation Steering Committee

DECC leads and coordinates national adaptation policy and supports the implementation of the NAF at national, sectoral and local government levels working through the National Adaptation Steering Committee (NASC) under the Climate Act. The NASC, established in 2014, is chaired by DECC and includes representatives of CAROs, Local Authorities, the EPA, Sectors and Met Eireann. Implementation of SAPs falls under the remit of relevant Ministers. The NAF and the SAPs form part of an iterative process to be reviewed, at a minimum, every 5 years to reflect developments in science and to facilitate the modification and escalation of adaptation actions as necessary in line with National priorities, CCAC recommendations and Ireland's EU and International obligations. This review process for the current NAF will be completed in 2022.

¹⁷ Climate Action Delivery Progress Reports, www.gov.ie/en/publication/55fde-climate-action-important-publications/

6.6.3 Climate Change Advisory Council

The Climate Change Advisory Council (CCAC) provides independent and science-based advice to Government and policy makers on what Ireland needs to do to achieve a climate-resilient, biodiversity-rich, environmentally sustainable and climate-neutral economy by 2050. It is also tasked with assessing the progress made towards this goal; consequently, it has a number of reporting obligations, including annual and period reviews of progress.

The first periodic report was published in July 2017, and the most recent at the end of 2021. The CCAC in its Annual Review provides an update on implementation progress across sectors and local authorities in Ireland.

In 2016, the CCAC established an Adaptation Committee to consider matters relating to climate change adaptation. This includes:

- national policy related to climate change adaptation, in particular the NAF, SAPs and LA Adaptation Strategies and Plans
- contributions on climate change adaptation for council reports
- council statements related to climate impacts, risks and vulnerabilities
- any other issues delegated to the Committee by the Council

CCAC Annual reviews and responses by CCAC to all sectors in relation to the development of the sectoral plans are published on the CCAC website.

6.6.4 Agriculture, Forest & Seafood

The Department of Agriculture, Food and the Marine (DAFM) established an internal governance mechanism for monitoring and reporting on climate action including adaptation. The DAFM Climate Action Management Board, chaired by the Secretary General oversees implementation and delivery of climate commitments. As part of this process, the Department has streamlined its approach to mitigation and adaptation governance. This approach is reflected in the CAP21 which has seen a greater integration of adaptation actions into sectoral chapters.

6.6.5 CAROs and Local Authority

Four Climate Action Regional Offices (CAROs) were established to drive climate action and link the local and national levels. The regional structure of the CAROs was designed around the geographical and topographical characteristics, vulnerabilities and shared climate risks experienced across local authority areas. Work programmes are overseen by a National

Adaptation Steering Committee, including DECC. CAROs are represented on the NASC. Local adaptation strategy implementation progress is reported to DECC by CAROs annually and monitored on an ongoing basis via CARO oversight structures.

A local authority progress reporting template has been developed by the CAROs to enable that sector to report on the progress of the implementation of its climate change adaptation strategies / climate action plans annually to the DECC. The most recent report can be found online.¹⁸

Most actions completed to date can be classified as soft. In total, Local Authorities adopted 2,451 actions across all 31 adaptation strategies covering areas including adaptation, mitigation, awareness building, and community engagement. Actions completed across all 31 strategies to date include:

- 12 actions relate to establishing an adaptation steering group, with another 4 putting a Climate Action Officer in place
- 14 actions lead to the mainstreaming of climate change / action considerations into plans and policies of local authorities as well as 7 actions also mainstreaming biodiversity considerations into relevant plans / policies
- 5 actions put climate action as a standing item on the agenda for senior management team meetings
- 5 actions relate to mainstreaming within business continuity plans
- 8 actions focused on increasing the capacity of emergency response around and clean-up after extreme events
- 4 actions related to monitoring & review systems of impacts during extreme events including resources used
- 5 actions relating to flooding management and flood alleviation schemes.

Other common actions within strategies include actions relating to:

- Waste management & single-use plastic policies
- Building energy efficiency and retrofit plans
- Improving teleconferencing facilities / working hubs
- Incorporating climate considerations into the design, planning and construction of infrastructure

All adaptation strategies are accessible via the Climate Ireland website or on the website of the local authority that developed it.

¹⁸ [https://www.caro.ie/local-authority-climate-action-\(2\)/a-profile-of-local-government-climate-action-in-ir](https://www.caro.ie/local-authority-climate-action-(2)/a-profile-of-local-government-climate-action-in-ir)

6.7 Progress and outcomes of adaptation action

The considerable progress that Ireland has made since the last communication is detailed throughout this communication. National, Sectoral and Local Adaptation Policies, Strategies and Plans have been put in place. Mainstreaming of Climate Adaptation action has significantly progressed at National, Sectoral, and Local level.

The integration of climate change adaptation policies into other national, sectoral and local level policies, plans and programmes is recognised in the NAF as a key policy approach to implementing adaptation. The 2018 NAF commenced the process of identifying opportunities to integrate climate change adaptation across all relevant policy areas. The publication of CAP21 significantly progressed this process.

6.7.1 National Progress & Outcomes

Important national mainstreaming actions include the process, incorporated into Cabinet procedures, of ensuring that all government memoranda and major investment decisions are subject to a climate mitigation and adaptation evaluation.

i. Project Ireland 2040 Funds

Four Project Ireland 2040 funds, comprising the Climate Action Fund; Disruptive Technologies Innovation Fund; the Urban Regeneration and Development Fund; and the Rural Regeneration and Development Fund, will have a collective budget amounting to an estimated €4 billion to 2027. Each of the four funds will continue to promote investments for climate action within the scope of their mandates. The Climate Action Fund will continue to fund initiatives that contribute to the achievement of Ireland's climate and energy targets in a cost-effective manner. It offers the potential for innovative interventions in these sectors which, in the absence of support from the fund, would not otherwise be developed. Seven projects spanning the electricity, heat, transport, and agriculture sectors, with both an urban and rural focus, have been approved for funding of up to €77 million under the first call from this fund. By requiring a minimum contribution from each project, the fund's commitment will leverage a total investment of over €300 million.

6.7.2 Sectoral Level

i. Agriculture, Forest & Seafood

The Agriculture, Forest and Seafood, Climate Change Sectoral Adaptation Plan was published by the DAFM in 2019. The Plan aims to reduce climate risk and build resilience through awareness raising and by embedding adaptation planning in sectoral policies.

Since the Plan was published work has been ongoing to embed adaptation planning in a range of sectoral policies including as part of the development of Ireland's CAP Strategic Plan, the agri-food strategy Food Vision 2030. The new forest strategy will also consider the important role forests play in climate change mitigation and adaptation.

Steps which are identified relating to the seafood sector in the adaptation plan prepare the seafood sector for the adaptation required as our climate changes. Studies are underway in many key areas to inform adaptation strategies including fish distribution, ocean carbon, ocean circulation and sea level rise.

Progress on implementation has been made both within DAFM and externally. Internal progress includes raising awareness through an Internal Adaptation Steering Group, a staff newsletter and through in-house climate training. A Seafood Climate Action Group was also established to drive implementation of seafood adaptation actions.

In seeking to build adaptive capacity in the farming community DAFM and Teagasc have endeavoured to ensure outcomes of relevant research programmes are incorporated into knowledge transfer and advisory programmes. Weekly Signpost Webinars for Agri Professionals have been run by Teagasc through the ConnectED programme since April 2020. The series featured two specific sessions on climate adaptation. More recently the SignPost Farm Programme launched in May 2021 includes a strong focus on Advisory activities within the programme, as well as the inclusion of Agricultural Colleges as SignPost Demonstration Farms within the programme. Advisory programmes and initiatives around fodder assessment, grass growth predictions and the Agricultural Sustainability Support and Advisory Programme (ASSAP) all continue. There was a strong emphasis in local advisory activity around silage production and quality in Spring 2021 as part of helping farmers improve their planning and budgeting for quality feed supply.

Work is ongoing on measures to support action on agricultural carbon rich soils falling under three streams;

- Rewetting
- Mapping
- Verification of CO₂ emissions /removals

The new CAP Strategic Plan includes support for the up skilling of both agricultural advisors and farmers in relation to climate change challenges and adaptation practices. A number of other interventions have benefits for adaptation such as a new flagship Agri-Environment And Climate Scheme (AECM). A range of other locally led environmental schemes will contribute significantly to the achievement of improved biodiversity and water quality outcomes including;

- Increased support for organic farming, in line with the Programme for Government Commitment and EU Farm to Fork ambitions.
- A proposed new Suckler Carbon Efficiency Programme designed to reduce absolute emissions by improving the environmental sustainability and genetic merit of the suckler herd.
- A new On-Farm Investment Scheme to address key environmental objectives through the provision of grant aid for new capital investments that contribute to environmental, farm safety or animal health and welfare objectives.
- Participation in tailored specific training as a core requirement for farmers participating in a number of the above schemes.
- A focus on both Knowledge Transfer as well as Continuous Professional Development for Agricultural Advisors.

The DAFM competitive research funding programme launched in December 2020 included five themes with climate change adaptation and mitigation embedded as cross-cutting themes. The Call included a theme dedicated to climate smart agriculture connected to adaptation and mitigation. Researchers were also encouraged to cut across the themes and the objectives, including the climate theme.

A number of research awards were made in 2021 including;

- ContinuFOR – Transformation to Continuous Cover Forestry
- ForES – Accounting for forest ecosystem services in Ireland
- ADAPTForRes – Adaptation, mitigation and protection strategies to increase resilience of Irish forests to address the impacts of climate change
- CRRIsP - Climate Resilient and Responsible Innovations in Potatoes
- CircAgric-GHG - Strategies for Circular Agriculture to reduce GHG emissions within and between farming systems across an agro-ecological gradient
- DairyMix - Multi-criteria assessment, decision support and management tools for sustainable circular mixed farming systems for dairy production

- BeyondPeat - Utilising organic bio-resources and novel technologies to develop specifically designed and sustainable peat replacements for professional horticultural crop production
- CropGas - The effect of conservation agriculture interventions on greenhouse gas emissions

Aquaculture offers opportunities to avail of renewable energy as a crucial mitigating action and can promote the sequestration of carbon in particular sectors. For instance, there are two main pathways through which commercial seaweed aquaculture can positively impact greenhouse gas emissions: natural sequestration and end-use products. One study considers that the European seaweed industry could mitigate 198,000 tonnes and 5,335,000 tonnes of CO₂ by 2030 through these two streams respectively. The industry's adoption of new technologies (e.g., recirculating systems, IMTA) provides the prospect of minimising carbon emissions. The establishment of IATiP and collaborative links with equivalent EU platforms has laid the foundation for the sector's research-driven development. Improved monitoring and reporting will provide farmers with better information to base their management plans and assess their GHG emissions.

Potential mechanisms for adaptation include adoption of new culture systems both in traditional and new offshore locations, selective breeding, changing feeding practices, and application of new control technologies. This must be aligned to the continued development of preventive measures – e.g., vaccines, genomics, and functional feeds. Increased reliance on digital systems to optimise production processes is already evident in the sector but there is a clear need for improved sensor technologies and intelligent systems for disease detection and husbandry management.

It is also clear that aquaculture needs to become increasingly aligned with the carbon reduction agenda. For instance, there is the potential to decrease emissions from service vessels and feeding barges by the pro-active adoption of offshore renewable energy (ORE) systems.

There are opportunities for training and developing awareness of climate change and sustainable development through the national seafood colleges, direct interactions with industry and collaborative links with researchers around Ireland which can be utilised to address specialist issues.

The promotion of sustainability programmes like Origin Green provides an opportunity to improve resource use by the sector, while at the same time, also increases awareness of impacts of climate change. These links also offer options for increasing our understanding of climate change impacts on aquaculture and the sector's development.

A number of studies related to the impact of climate change on aquaculture have been undertaken; including the BlueFish project to develop an understanding of the vulnerability of fish and shellfish to climate change and the Oasis Project: Integrated Multi Trophic Aquaculture in underutilised peatlands.

Ocean literacy is a key component of our climate adaptation response. An Irish Ocean Literacy network has been established and will contribute to the CAP21. This enables engagement with stakeholders in government, local authorities, and the public on climate matters.

ii. Flood Risk Management

The Office of Public Works' (OPW) Flood Risk Management Climate Change Sectoral Adaptation Plan outlines the existing flood risk, flood risk-management practice in Ireland, and summarises existing science on climate change and the current state of knowledge for impacts on flooding and flood risk. It defines the policy for adaptation in the flood risk-management sector and sets out a series of actions to enhance the understanding of the potential impacts of climate change on flooding and flood risk and to embed adaptation into flood risk-management practice. The plan also identifies how changing flood risk should be taken into account in spatial planning and other sectors and sets out what is required for the monitoring, review and evaluation of the plan.

Substantial progress has been made in implementing the Plan, and an independent review carried out by the CCAC in 2021 found that overall good progress is being made with advanced progress being made in both risk, prioritisation & adaptive capacity and resourcing & mainstreaming.

iii. CFRAM Programme and the Floods Directive

In May 2018, the OPW completed the National Catchment Flood Risk Assessment (CFRAM) Programme that is the principal mechanism for the assessment of the potential impacts of climate change on flood risk, and for planning for the sustainable management of flood risk over the long-term in Ireland, through the Flood Risk Management Plans (FRMPs). The FRMPs embed the consideration of climate change in the development of flood relief schemes. The future scenario flood maps produced under the CFRAM Programme will facilitate this approach, inform other sectors, and provide a valuable resource for local adaptation planning and sustainable land use management and planning.

A review of the FRMPs was carried out in 2021 that considered progress to date against the FRMPs and the requirement for additional measures to supplement those already included in the FRMPs. The review of the FRMPs acknowledges the cross-reference between the

Climate Change Sectoral Adaptation Plan (CCSAP) for Flood Risk Management and the FRMPs and notes and details the actions contained within the CCSAP.

The OPW has commenced a review of the Preliminary Flood Risk Assessment that was carried out for the first cycle of the Floods Directive. The review will be informed by the most up-to-date research and projections of climate change to assess the potential impacts on flooding and flood risk across the country. To inform the review, the OPW has completed key national level coastal and fluvial assessments to provide updated flood levels and mapping for both current and future scenarios in areas not covered in detail by the CFRAM Programme; the Irish Coastal Wave and Water Level Modelling Study for the coast and the National Indicative Fluvial Flood Mapping project.

iv. Flood Relief Schemes

The OPW deliver flood protection works to communities through flood relief schemes. The FRMPs developed under the CFRAM Programme identified 118 flood relief schemes that are being progressed. The progression of these schemes is supported by the Government's NDP 2018 – 2030, which includes a total funding allocation of €1.3bn over the lifetime of the Plan to underpin the delivery of the existing flood relief capital works programme and the additional prioritised flood relief schemes recommended in the Flood Risk Management Plans.

As part of the design of all flood relief schemes, the OPW has made it a requirement to prepare Scheme Climate Change Adaptation Plans (SCCAPs). The SCCAPs will set out how climate change has been taken into account during the design and construction, and what adaptation or alternate measures might be needed and when into the future. This approach is currently being piloted as part of the Midleton Flood Relief Scheme and the lessons from this pilot will be translated into a guidance note for application across the flood relief capital works programme.

Furthermore, there are 50 existing flood relief schemes providing a level of protection to communities from flooding. The OPW has commenced a pilot SCCAP for existing flood relief schemes and have committed to developing SCCAPs for all existing flood relief schemes by 2027.

v. Nature-based Solutions

The OPW, in coordination with other relevant stakeholders, are continuing to enhance their knowledge and capacity concerning nature-based solutions for catchment management. The OPW has made it a requirement, as part of the design process, for all flood relief schemes being progressed to assess the feasibility for nature-based solution to contribute to flood

protection including climate adaptation. To support this, research is ongoing into the application of nature-based solutions, including the use of demonstration sites in agricultural catchments in Ireland.

vi. Awareness and Capacity Building

In 2021, the Climate Action Regional Offices, supported by the OPW, delivered training to all local government bodies in Ireland to further build awareness and capacity in relation to the impacts of climate change on flood risk and possible adaptation opportunities.

vii. Electricity and Gas Networks

Infrastructure such as electricity and gas networks play an essential role in ensuring social and economic wellbeing. Risks to this infrastructure from extreme weather events (such as flooding) and gradual climate change could have significant economic and social consequences and therefore it is important to future proof Ireland's energy system against future climate impacts.

Electricity and gas networks have linked and mutual dependencies on each other and disruption to one network may have severe knock on effects on the functioning of the other as well as on other sectors of the Economy. The publication in 2019 of the Electricity and Gas Networks Sectoral Adaptation Plan, and future iterations of the plan will help identify these interdependencies and ensure that suitable adaptation measures are put in place.

Eirgrid, which operated and develops the electricity grid in Ireland, has identified a number of weather related risks to the electricity transmission system in Ireland such as:

- Flooding from rivers, sea level rise, storm surges, extreme precipitation patterns
- Risks associated with temperature relating to asset life and equipment ratings
- Wind, wintry showers, ice and snow related risks related to mechanical loading
- Corrosion issues related to salt fog / spray
- Lightning associated risk to grid operation

Adaptation strategies and actions include identifying climate risks, prioritising affected infrastructure, undertaking desk-based flood risk assessments and also using detailed flood risk models to inform recommended actions. Eirgrid is also currently investigating flood risk to Overhead Transmission Lines (OHL).

ESB Networks is responsible for managing almost 160,000 km of high, medium and low voltage overhead, operating in all environments and conditions, across Ireland. Information gathered on asset condition, duty, exposure and location, will be used to inform and prioritise maintenance, repair and replacement decisions, so that the investments delivered are

targeted to maximise impact on operational and safety risk, and provide assurance that the asset management objectives are met.

ESB Networks is responsible for managing 646 high voltage substations across Ireland. ESB Networks is moving to a higher level of condition assessments and placing an increased emphasis on the role of inspections for both asset condition and station security.

ESB Networks' proposed investment in protection relay replacement over the 2021-25 period acknowledges that the impact of climate change is growing and becoming more pervasive, and that our protection systems need to adapt to these changes by introducing more intelligent relays and adaptive setting changes.

Climate change and high wind conditions are having an increasingly negative impact on network performance, ESB Networks is proposing a progressive investment programme of €45.9m in a programme of automation and related activities. ESB also plans on delivering targeted service improvement to the most disadvantaged rural customers. The impact of climate change is driving annual increases in the number of these worst served customers.

viii. Communications Networks

The Climate Change Adaptation Plan for the Communications Sector (published in 2019) was devised as a requirement under the NAF (first published in 2017 and to be reviewed by the end of 2022), which necessitated several sectors to produce plans for improving adaptation measures within their industries to combat climate change.

This Adaptation Plan represents a high-level approach to climate change adaptation planning for the communications networks (telecommunications and broadcasting) sector. It is a first step to set the communications sector on a path to robust climate change adaptation planning. It will lead to improved understanding of how best to adapt the sector to climate variability, which is essential given the communications sector's importance to the social and economic fabric of the country. This is more apparent than ever since the impact of the COVID-19 pandemic and the need for workers to work and enterprises to conduct business from home.

The project being led by ComReg, the Irish Commission for Communications Regulation: 'Climate change impact and adaptation of telecom networks in Ireland'. This study seeks to:

- Understand current and future, changes to climatic variables and subsequent weather-related events in Ireland that could impact the resilience of Electronic Communication Networks and Services ("ECN" and "ECS");
- Identify vulnerabilities within the communications sector, which have occurred or may occur in the future due to Climate Change;

- Understand what steps or actions have been already taken and/or are planned on being taken by the industry, to adapt to, and/or mitigate the impact of Climate Change, for example, this could include any actions to reduce the operational power consumption of fixed and mobile networks; and
- Identify and set out a series of potential adaptation actions that could be taken by operators of ECS and ECN, in line with existing government policy and proposed and current legislation in this area.

ix. Health

While the onset of the global COVID-19 pandemic impacted severely on the capacity of Ireland's health sector to progress the actions identified in the 2019 Plan, a number of significant developments have taken forward the climate agenda within Ireland's health sector. Ireland has carried out a significant body of research into incidence of UV-related cancers. National policy as set out in the National Skin Cancer Prevention Plan 2019-22 which was launched in May 2019, projects significantly increased rates of skin cancer over the period to 2045, consistent with projected climate change impacts.

The Healthy Ireland Framework, which coordinates national policy targeting health and wellbeing, includes a number of initiatives with climate co-benefits, including active travel, diet, warmth & wellbeing and outdoor recreation. Further information can be found in the National Physical Activity Plan.¹⁹

While national policies aimed at reducing the carbon footprint of the public sector are outlined elsewhere in this National Communication, it is worth noting that the health sector has achieved a 26% reduction in energy use in 2019, compared with 2009 levels. Although outside the scope of the Eighth National Communication, since 2021 a range of actions have been taken across the health sector to develop leadership, coordination and oversight of climate action. These actions and their impacts will be outlined in future reports to the UNFCCC.

x. Transport

Given its vital role in daily life, and the potential for loss of income by operators, the transport sector was an early mover in climate change adaptation. The first Adaptation Plan for Transport, Developing Resilience to Climate Change in the Transport Sector, was published in November 2017. Adaptation planning is an iterative process, and this sectoral Plan was as an important step towards the preparation of future statutory SAPs.

¹⁹ <https://www.gov.ie/en/policy-information/b60202-national-physical-activity/>

Following on from this, the Department established a team of key Transport stakeholders from key operators in Road, Rail, Aviation; Ports; and Bus Services. Together this group collaboratively developed the first statutory Transport Sectoral Adaptation Plan which was published in November 2019. This team identified current and potential climate change-related impacts, the consequences of these impacts for transport services and infrastructure and the capacity of stakeholders to respond. The Transport SAP has been developed with input from both these key stakeholders and from the EPA in line with EU guidelines for adaptation planning. It outlines initial research and analysis on the likely effects of climate change on the Irish Transport Sector and proposes preparatory actions to develop climate resilience within the sector.

The Department of Transport has continued to work with stakeholders nationally and internationally to address the knowledge gaps identified in the Transport SAP in 2019. An important aspect of this has been working cross-sectoral with stakeholders including the EPA and Met Éireann.

Other examples of the work the Department is progressing on adaptation is its ongoing work with local authorities across Ireland.

Following on from the publication of the statutory plan, the Department established the Road Allocations for Climate Adaptation and Resilience Works which provided €17.3m in grant funding in 2021. Additionally, the Department worked with CAROs to develop guidance material for Local Authorities on Climate Adaptation of Regional & Local Roads.

xi. Water Quality and Water Services Infrastructure

Water is at the heart of adaptation to climate change, serving as the crucial link between the climate system, human society and the environment, it is a finite and irreplaceable resource. Managed efficiently, water can play a key role in strengthening the resilience of social, economic and environmental systems. In this regard, Ireland's Sectoral Adaptation Plan for the Water Quality and Water Services Infrastructure Sectors presents an assessment of key future climate risks to the sectors and outlines the adaptive measures available to build resilience to the effects of climate change and weather related events, and other Socio-Economic developments in both sectors. Published in October 2019, this adaptation plan is the beginning of an iterative process that will see adaptation planning continuing into the future.

As outlined in the sectoral plan, protecting and improving water quality and improving water services infrastructure are major challenges in Ireland, with climate change-induced threats exacerbating already existing negative impacts in both sectors. In the prioritisation exercise

conducted to identify priority changes and impacts, a number of acute climate-related pressures for both sectors were identified.

Table 6.4: Climate-related pressures on water quality and water services infrastructure

Water Quality Impacts	• High rainfall and flooding leading to mobilisation of pollutants. • Reduced dilution of contaminants in water bodies at low flow • Drying of peatland resulting in the reduction of natural filtration of pollutants • Increased spread and viability of pathogens, such as livestock waste and slurry • Changes in the distribution and viability of native, non-native and invasive flora & fauna
Water services infrastructure Impacts	• Increased surface and sewer flooding leading to pollution, water and wastewater service interruptions. • Reduced availability of water resources. • Hot weather increasing the demand for water. • Increased drawdown from reservoirs in the Autumn/Winter for flood capacity, leading to resource issues. • Business continuity impacts or interruptions for water services providers.

By containing overall objectives and “high level goals” for consideration rather than specific actions, the adaptation plan will inform the design, resourcing and review of policies and measures, and provide strategic direction across the water quality and water services infrastructure sectors. These high-level goals include;

- Fully adopting the ‘integrated catchment management’ approach
- Improving treatment capacity and network functions for water services infrastructure
- Water resource planning and conservation – on both supply and demand sides
- Including climate measures in monitoring programmes and research

Many of these goals are already incorporated into existing and scheduled water sector plans and programmes. For example, the River Basin Management Plan for Ireland 2018 – 2021, sets out the actions that Ireland will take in order to improve the quality of our aquatic environment and meet the objectives of the EU Water Framework Directive. Irish Water’s National Water Resource Framework and Regional Water Resources Plans, the establishment

of the Local Authority Waters Programme and the Agricultural Sustainability Support and Advice Programme will also seek to enhance the resilience of the sector.

Other measures have also evolved since the publication of the plan that will address the negative impacts of climate change, such as the development of an implementation strategy for a Nature Based Sustainable Urban Drainage systems including the development of interim guidance on best practice for Nature-based Solutions to Manage Rainwater and Surface Water Runoff in Urban Areas.

Ireland is also currently finalising the next River Basin Management Plan, to cover the period 2022 – 2027. This plan, which provides a coordinated framework for improving the quality of our waters, will be influenced by the risks and potential measures outlined in the SAP.

The Plan is to be viewed as a 'live' document and will be evaluated and reviewed to account for changing science and socio-economic conditions via the existing monitoring mechanisms (such as the water policy advisory committee, Irish Water governance arrangements).

Quarterly updates on the objectives of the plan are also provided National Adaptation Committee, which allows for the tracking and revision of the sectoral priorities as adaptation and mitigation efforts are made across the sectors.

xii. Built and Archaeological Heritage

The Climate Change Sectoral Adaptation Plan for Built and Archaeological Heritage, published in October 2019, aims to build adaptive capacity within the sector, reduce the vulnerability of built and archaeological heritage to climate change and identify and capitalise on the various potential opportunities for the sector. The plan identified five key goals:

1. Improve understanding of each heritage resource and its vulnerability to climate change impacts;
2. Develop and mainstream sustainable policies and plans for climate change adaptation of built and archaeological heritage;
3. Conserve Ireland's heritage for future generations;
4. Communicate and transfer knowledge, and
5. Exploit the opportunities for built and archaeological heritage to demonstrate value and secure resources.

In order to achieve these goals, specific actions are included which include carrying out risk and vulnerability assessments, undertaking the monitoring of climate change impacts on heritage assets and integrating heritage issues into national and local policies. Capacity building, disaster-risk management and increasing heritage resilience and preventing maladaptation are key objectives.

Cross-sectoral impacts are identified, including in the areas of flood relief, agriculture and energy efficiency measures, which will be critical to manage in terms of protecting Ireland's heritage assets.

A monitoring strategy has been developed to track the implementation of planned actions. Progress is being measured against selected indicators, which will help to identify problems and inform improvements to the adaptation plan as part of an iterative process.

Climate change issues have been integrated into the policies of the Department including the national heritage plan – Heritage Ireland 2030 – launched in March 2022 and the national policy on architecture – Places for People and the vernacular heritage strategy – A Living Tradition – launched in December 2021. The Department has developed Memoranda of Understanding on Climate Action and Cultural Heritage with both Historic Environment Scotland and the Department of Communities, Northern Ireland.

In order to increase the resilience of historic structures to both catastrophic and cumulative impacts of climate change, the Department has revised the criteria for its Built Heritage Investment Scheme grant scheme – to allow for the funding of works of maintenance and minor repair. Building resilience to climate change has been incorporated as a core aim of the Historic Structure Fund grant scheme. The Department published guidance in December 2020 for the custodians of historic buildings on disaster-risk management including climate-related disasters such as flooding, weather damage, decay and rot, and catastrophic collapse. In 2020, a new grant scheme was launched by the National Monuments Service – Community Monuments Fund – a key objective of which is to build resilience into archaeological monuments to enable them to withstand the effects of climate change. With €5 million of funding to be awarded this year to over 170 projects, the scheme is having a significant impact in protecting monuments from the impacts of severe weather.

Substantial progress has been made in implementing the Plan. An independent review carried out by the CCAC in 2021 found that moderate progress is being made overall, with good progress being made in efforts to integrate with the CAP and developing cross-sectoral links and capacity. The review also acknowledged that linking of climate change and grant schemes, most recently the Community Monuments Fund, is potentially powerful.

The Department continues to work with stakeholders nationally and internationally to address the knowledge gaps identified in the SAP. An important aspect of this has been working cross-sectorally with stakeholders. The Climate Change Implementation Group meets regularly and Working Groups have been established. The Department maintains regular communication with a larger climate-change stakeholder group via email circulation

and social media. External support is being procured to develop a number of key actions and to carry out the required mid-term review of the Adaptation Plan.

6.7.3 Local Authority Level

The establishment of the CAROs has led to significant progress in the LA sector. Adaptation strategies have been developed and LA Climate Action Plans will be developed shortly. LAs have all signed up to a Local Authority Climate Charter. A key CAP21 action is that each local authority will develop a decarbonisation zone within its administrative area that will become the focus for a range of climate mitigation, adaptation and biodiversity measures. This process will include the identification of projects and their associated outcomes that will contribute to achieving our national climate targets

Another important CAP19 LA action dealt with the need to assess adaptation requirements for the roads network. LAs have worked on the impacts of projected future climate on the road network's climate resilience in terms of new and existing infrastructure. The CARO in the Atlantic Seaboard South Region (ASBS) has undertaken an investigation into the requirements of the Local Authority Roads Sector in meeting the challenge of climate change. Phase 1 of the project involved the establishment of a Project Working Group, a review of international and national literature and guidelines and an online survey of senior local authority roads personnel. The findings of the investigations have identified that there are four key requirements in integrating climate adaptation into the management of the Regional and Local Road network. The requirement for Roads Adaptation Guidance documents and the broad areas to be covered is clear from the investigation. For the remaining three (methodology for identification and recording of vulnerable locations, mapping of vulnerable locations and prioritisation methodology for adaptation interventions), the alignment with MapRoad PMS and the connection between their themes indicate that they should be progressed together in a single MapRoad PMS enhancement project. Under a CAP21 action, LAs are now working on the delivery of Phase 2 of the project to deliver Guidance and Systems Development. Details of further local climate adaption action undertaken by the sector can be found online.²⁰

²⁰ Local climate adaptation action information, [https://www.caro.ie/local-authority-climate-action-\(2\)/a-profile-of-local-government-climate-action-in-ir](https://www.caro.ie/local-authority-climate-action-(2)/a-profile-of-local-government-climate-action-in-ir)

Chapter Seven:

Financial Resources, Technology Transfer, and Capacity Building

7. Financial Resources, Technology Transfer, and Capacity Building

7.1 Introduction

The term “climate finance” is generally used to describe financial flows from developed countries to developing countries to help the latter respond to climate change through mitigation and/or adaptation. For the purpose of this report, climate finance is defined as the provision of financial support to developing countries, drawn from public sources, including those that seek to mobilise private finance, that seeks to support mitigation and adaptation actions in the context of sustainable development²¹.

Climate finance can be from a variety of sources, both public and private, and can include publicly funded (in whole or in part) grants, loans or other financial instruments, and the provision of programmes for capacity building/skills transfers for climate change response. Ireland's actions to address climate change through financial resources and technology transfer is situated within our overall international development policy.

The principle of reaching the furthest behind underpins Ireland's strategy for international development, A Better World. In recognition of the disproportionate vulnerabilities they face, this informs Ireland's focus on Least Developed Countries (LDCs), particularly in Africa, and Small Island Developing States (SIDS) in our global climate action and finance. In response to the particular needs of this target group, Ireland also strives to prioritise funding for climate adaptation.

Ireland's public funding for climate action includes ongoing support for mitigation and adaptation action in developing countries, mainly through Ireland's international development programme, particularly in Sub-Saharan Africa and Southeast Asia and through Irish Civil Society Organisations (CSOs) operating across developing countries.

Ireland also provides contributions to multilateral funds established under the auspices of the UNFCCC, including the Least Developed Countries Fund (LDCF), the Least Developed Countries Expert Group, the Global Environment Facility (GEF), the Adaptation Fund and the Green Climate Fund (GCF). These funds, in line with their respective mandates, provide support for mitigation and adaptation action in developing countries. Funding through these mechanisms is provided through the DECC and through the Official Development Assistance (ODA) budget managed by the Department of Foreign Affairs (DFA).

Developed country Parties to the UNFCCC committed in 2009 to a goal of mobilizing jointly USD \$100 billion a year by 2020 from public and private sources to support climate action in

²¹ Irish Aid, 'Ireland's International Climate Finance Roadmap', 2022, <https://irishaid.ie/media/irishaid/publications/2022-Irelands-International-Climate-Finance-Roadmap-Digital.pdf>

developing countries. This was reiterated at COP21 in 2015 when Parties agreed that developed countries should continue their existing collective mobilisation goal, and that prior to 2025 the UNFCCC would set a new collective quantified goal from a floor of USD \$100 billion per annum, taking into account the needs and priorities of developing countries. This goal was not met by COP26, where Parties agreed in the Glasgow Climate Pact to renew the commitment to increase climate finance to achieve the €100 billion goal per annum, and to double adaptation finance in support of developing countries by 2025 from 2019 levels.

7.1.1 Methodology

i. Rio Markers (Bilateral channels and vis CSOs)

Ireland applies the OECD Rio policy markers in the calculation of the climate finance it provides through bilateral channels and via CSOs. Rio markers were developed by the OECD to enable the consistent measuring and monitoring of climate and environment finance provided by donor countries and multilateral institutions to developing countries. Donors are provided with broad-based definitions and guidance on the application of the Rio markers both through development cooperation and Other Official Flows (OOF) which are regarded by the OECD as additional to ODA but which don't fulfil ODA requirements. The definitions as applied by Ireland are provided in Table 7.1 and Table 7.2.

The Rio markers on biodiversity, climate change mitigation, and desertification were introduced in 1998, with a fourth marker on climate change adaptation being applied to 2010 flows onwards. Rio markers should be applied to all bilateral ODA and non-export credit OOF excluding general budget support, imputed student costs, debt relief except debt swaps, administrative costs, development awareness and refugees in donor countries.

Activities are marked as 'Principal', 'Significant', or 'not relevant' for each Rio marker. The scores applied under the mitigation and adaptation markers then correspond to the percentage of funding reported as climate finance. The following definitions are followed for each of the Rio markers parameters and scores:

Table 7.1: Definitions of parameters

Parameters	
Mitigation	"The activity contributes to the objective of stabilisation of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system

	by promoting efforts to reduce or limit GHG emissions or to enhance GHG sequestration.”
Adaptation	“The activity intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate change adaptation actions.”
Biodiversity	“The activity promotes at least one of the three objectives of the Convention: the conservation of biodiversity, sustainable use of its components (ecosystems, species or genetic resources), or fair and equitable sharing of the benefits of the utilisation of genetic resources.”
Desertification	“The activity aims at combating desertification or mitigating the effects of drought in arid, semi-arid and dry sub-humid areas through prevention and/or reduction of land degradation, rehabilitation of partly degraded land, or reclamation of desertified land.”

Table 7.2: Definitions of scores

Scores	
Principal	“The parameter (e.g. mitigation, adaptation, biodiversity or desertification) is fundamental to the design of the intervention and is an explicit objective of the project / programme.”
Significant	“The parameter (e.g. mitigation, adaptation, biodiversity or desertification) is important to the intervention, but not one of the principal reasons for undertaking the project / programme.”
Not relevant	“The parameter (e.g. mitigation, adaptation, biodiversity or desertification) is not relevant to the intervention or the parameter is relevant but the project / programme has a primarily negative impact.”

ii. Changes to reporting climate finance under the EU Governance Regulation

As of 2020, the EU Regulation on the Governance of the Energy Union and Climate Action²² came into force for all EU Member States, representing a change in how Member States are

²² Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament

required to count and report climate finance. The aim of the change is to streamline climate finance accounting and to provide more comparative and transparent information across the European Commission and all EU Member States.

The Regulation states that: 'By 30 September 2021 and every year thereafter, Member States shall report to the Commission information on support to developing countries, including the information specified in Part 2 of Annex VIII and in accordance with the relevant reporting requirements agreed upon under the UNFCCC and the Paris Agreement.' EU guidance on the application of these requirements recommends that EU Member States apply a coefficient of 40% for funding provided for which a climate policy marker of "Significant" has been assigned.

Up to 2020, Ireland applied a 50% coefficient to climate finance marked as "Significant". The 2019 figures reflect the application of this coefficient. In keeping with EU guidelines, Ireland has applied the 40% coefficient to programmes with a "significant" Rio adaptation or mitigation marker, as of its 2020 climate finance reporting.

iii. Multilateral Climate Finance

Ireland calculates the climate finance it provides through multilateral channels via the imputed multilateral shares for climate development finance set out each year by the OECD. The OECD has developed a set of shares (through percentages) that donor countries can apply to calculate the amount of the funding that they provide to a number of major international organisations and funds that is climate relevant.²³ Ireland applies these shares on the basis of inflows to these funds and organisations.

The level of detail in Ireland's multilateral climate finance reporting has been improved in recent years. Specifically, both climate-specific and core-funding amounts are calculated for all payments where feasible, and closer attention has been paid to the use of unearmarked funding in terms of categorisation e.g. cross-cutting, adaptation, mitigation.

iv. Technology transfer and capacity building methodology

In 2020, Ireland piloted a process of assessing bilateral ODA programmes against UNFCCC guidelines on technology transfer and capacity building. The programmes included in Tables

and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (Text with EEA relevance.)

PE/55/2018/REV/1 <https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ:L:2018:328:TOC&uri=uriserv:OJ.L..2018.328.01.0001.01.ENG>

²³ OECD, 'Climate Change: OECD DAC External Development Finance Statistics' 2000 – 2020,

<https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>

10 and 11 represent the outcome of this process, however, it should be noted that this is not yet fully systematised and that these tables are not an exhaustive list of all technology transfer and capacity building support provided by Ireland in 2020.

As mentioned in the preceding section, Ireland's EU-level reporting requirements have become more specific, and as such Ireland has begun to track more closely whether multilateral and bilateral/regional funding falls under the categories of technology transfer, capacity building or both as part of this reporting.

Similarly, the programmes included in Tables 10 and 11 for 2019 are an indicative sample of Ireland's engagement in technology transfer and capacity building. The DFA is engaged in further streamlining data collection for Ireland's various interrelated reporting obligations on climate finance and ODA at national level and in other fora such as the OECD. As part of this, the options for more systematic reporting on technology transfer and capacity building will be considered.

v. 'New and additional' finance

A definition of 'new and additional' in relation to financial resources provided can be considered in the context of Ireland's national budgeting system. Ireland's approach to budgeting for public funding carries no assumption that funding made available in any given year will again be available in a subsequent year. Consequently, with the exception of a few heavily-caveated multiannual funding arrangements, such as GEF and GCF, all public climate finance provided by Ireland annually is considered new and additional. Even with regard to multiannual funding arrangements, support is conditional on the availability of funding in subsequent years through annual national budgeting process.

7.2 Finance

7.2.1 Introduction

i. Relevant Irish Policies

In 2015, Ireland set a commitment to provide €175m in total in climate finance between 2016 and 2020. Ireland successfully met this commitment by 2018. This chapter provides a detailed overview of Ireland's climate and environment spend in 2019 and 2020, while highlighting new commitments made since NC7 report.

In February 2019, Ireland placed climate action among the four major policy priorities in its international development policy, A Better World. Through this policy, Ireland commits to scaling up our funding on climate action and exploring innovative approaches to climate

finance, risk insurance and climate adaptation. A Better World also commits to continuing to underpin our climate action with institutional learning and capacity building, as well as climate proofing all of our ODA. The delivery of A Better World is closely linked to the Sustainable Development Goals and, in particular, the rallying call to reach those furthest behind.

In June 2019, recognising the unique threat posed by climate change to SIDS, Ireland launched our Strategy for Partnership with Small Island Developing States. This strategy made a number of specific commitments to support climate resilience in SIDS and to respond to climate-induced disaster.

The Programme for Government, agreed in June 2020, reaffirms Ireland's intention to place climate action at the centre of our work, and gives additional impetus to the target in A Better World of doubling the overall percentage of our ODA that counts as climate finance by 2030. At COP26 in Glasgow in 2021, the Taoiseach announced a commitment to go even further and more than double our existing climate finance to €225 million per year by 2025. Ireland's International Climate Finance Roadmap²⁴, published in July 2022, articulates the Government's vision for achieving these targets and reaffirms the Programme for Government committed to 'at a minimum, double the percentage of ODA that counts as climate finance' and to develop a Strategic Roadmap to reach this commitment. Ireland will maintain its focus on supporting adaptation and resilience to climate change in some of the most climate vulnerable countries around the world. The Roadmap also expands the scope of support to areas where Ireland can bring further added value to international climate action, such as ocean protection and the promotion of a sustainable blue economy, and enhancing biodiversity.

7.2.2 Overview of financial support

In 2019, Ireland provided €96,608,106 in climate-specific climate finance, in 2020 this figure was €88,341,095. Ireland's international climate finance is provided by four Government Departments, namely, the DFA, DECC, the DAFM, and the Department of Finance. The respective Departments provide funding through various channels: bilateral programming, support to Irish CSOs and NGOs that are operating in developing countries, international multilateral climate change funds, multilateral financial institutions, and other specialised UN bodies.

²⁴ Irish Aid, 'Ireland's International Climate Finance Roadmap', 2022, <https://irishaid.ie/media/irishaid/publications/2022-Irelands-International-Climate-Finance-Roadmap-Digital.pdf>

Ireland allocates most of its climate finance to LDCs, and focuses predominantly on addressing climate adaptation. The vast majority of Ireland's climate finance continues to be grant-based and ODA-eligible.

The 2020 figure represents a decrease by approximately 8.4% in climate finance as compared to 2019, setting itself apart from the overall trend in Ireland's climate finance, which has steadily increased from 2016 to 2019. The decrease can be explained by two factors: the impact of COVID-19 in 2020 on programming and expenditure; and the introduction across the EU of new accounting methodology, outlined above in Section 7.1(a).

The change in methodology had the largest impact on Ireland's bilateral and regional funding.

7.2.3 Multilateral funding

Multilateral climate change and environment funds are funding mechanisms which have been established for the purposes of supporting international and national climate and environmental action.

The total amount of multilateral climate finance, excluding Multilateral Development Banks (MDBs) and International Finance Institutions (IFIs), provided by Ireland in 2019 was €38,532,141. The climate specific total was €20,239,595. The total amount of multilateral climate finance, also excluding MDBs and IFIs, provided by Ireland in 2020 was €56,717,360.87, representing a 45% increase on 2019. The climate specific total was €23,541,437.

A significant proportion of Ireland's support for multilateral funds falls to those under the UNFCCC, that is, the GCF and the Adaptation Fund (AF). Support is also provided to the UNFCCC process related funds such as the Nationally Determined Contribution (NDC) Partnership, IPCC, and the Climate and Clean Air Coalition Trust Fund. There is also a grant agreement to support Ireland's position as coordinator of the UNFCCC's Structured Expert Dialogue (SED) process from 2020 to 2022.

Ireland has also provided continued support to the United Nations Office for Disaster Risk Reduction (UNISDR), and the GEF and its climate mechanism, the LDCF.

Table 7 (a) and (b) provide an indication of contributions from DECC, Department of Finance, DAFM, and the DFA to the multilateral channels from the previous two financial reporting years, 2019 and 2020.

Further information of Ireland's primary multilateral support is outlined below:

Green Climate Fund (GCF)

The GCF was established under the auspices of the UNFCCC in 2010 to support the efforts of developing countries to respond to the challenge of climate change. The GCF helps developing countries limit or reduce their greenhouse gas emissions and adapt to climate change. The GCF aims to deliver equal amounts of funding to mitigation and adaptation, and is recognised as the main financial mechanism of the Paris Agreement. It is therefore counted as 'cross-cutting' in our reports. In 2020 Ireland agreed a multiannual commitment of €16 million under the first GCF replenishment, GCF-1 from 2020 to 2023.

Adaptation Fund (AF)

The Adaptation Fund (AF) finances projects and programmes that help vulnerable communities in developing countries adapt to climate change. Initiatives are based on country needs, views and priorities. The AF was established under the Kyoto Protocol of the UNFCCC, and has committed USD438 million in 67 countries since 2010 to support climate adaptation and resilience activities. Ireland has steadily increased its annual support to the AF in recent years, providing €300,000 in 2017 to at least €10 million over the 2021 and 2022 period.

Global Environment Facility (GEF)

Some funds, in particular the GEF are mandated to finance the work and effort of the three Rio Conventions – tackling climate change, desertification and biodiversity loss. The GEF was established in 1992 and is supported by Ireland both in the context of its broader environmental scope as well as through its climate mechanism, the LDCF. Ireland has consistently contributed to the GEF through annual instalments over four-year replenishment cycles since 1994. Under GEF-7, Ireland agreed a multiannual commitment totalling €5.73 million. As part of GEF-8 multiannual funding commitment for 2022 to 2026 period, Ireland has pledged €11 million.

Nationally Determined Contributions (NDC) Partnership

The NDC Partnership is an informal platform of countries and international institutions whose objective is to collectively mobilise support for developing country parties to the UNFCCC to develop and implement their NDCs under the Paris Agreement. Ireland seeks to use this policy mechanism both to share international experience, particularly in the areas of adaptation and

agriculture, and to inform its medium to long term policy development in these areas.

Intergovernmental Panel on Climate Change (IPCC)

The IPCC is the international body for assessing the science-related to climate change. It was set up to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. IPCC assessments provide a scientific basis for Governments at all levels to develop climate-related policies, and they underlie negotiations at the UNFCCC.

Climate and Clean Air Coalition (CCAC) Trust Fund

The CCAC Trust Fund is used to build capacity, enable peer-to-peer engagement and support leadership at a national level for Parties who need it for climate pollutants including methane.

United Nations Office for Disaster Risk Reduction (UNISDR)

Ireland and UNISDR were in partnership from 2011 to 2019, with a focus on supporting integration of disaster risk reduction and climate change adaptation into development planning, supporting linkages among Irish supported development programmes, as well as globally through establishing greater synergies between the Sendai Framework and Paris Agreement.

Least Developed Countries Fund (LDCF)

Ireland has collaborated with the LDCF since 2003, providing some \$17.5m in funding. The DFA has strengthened its partnership with the LDCF in recent years, signing a three year multiannual funding arrangement of €1 million per year from 2016 to 2018 and providing a further €1 million in 2019. The Department increased this funding to reach €2 million in 2020 and €2.5 million in 2021. The partnership between Ireland and the LDCF supports vulnerable developing countries, in particular Ireland's Key Partner Countries, to address adaptation needs through the design and implementation of NAPs and National Adaptation Programmes of Action (NAPAs), which also informs Ireland's country strategies.

Additionally, the DAFM is the lead Department for the Government's relationship with the World Food Programme (WFP), the UN's frontline humanitarian agency. The WFP-Ireland Strategic Partnership Agreement 2022-2024, agreed and signed in December 2021, contains

a commitment from Ireland to increase core funding to €75 million. This includes a €5 million per year allocation to WFP's trust fund for hunger-related climate change; and an €8 million annual allocation to the WFP Syrian emergency response.

7.2.4 Multilateral Development Banks and International Financial Institutions

Over the last number of years, MDBs and IFIs have increased their funding for international climate action. The increase is partly due to requests made by the UNFCCC and from countries that contribute to such funds and institutions. As a result, many international financial institutions have worked to ensure that a minimum amount of their development funding is channelled to climate action.

In its climate finance reporting, Ireland has counted payments to MDBs and IFIs such as the World Bank, the Asian Development Bank and the African Development Bank.

The total amount of climate related funding provided through MDBs and IFIs in 2019 was €41,427,883, climate specific was €10,885,380.03. The figure in 2020 was €54,429,654, climate specific was €16,574,227, with all of the funding marked as cross-cutting. The largest share of climate related funding in 2020 was channelled through the World Bank-International Development Association (IDA) which is designed to channel funds to the world's poorest countries. The African Development Bank (AfDB) follows the IDA with provision of €4,083,904 to climate related projects. Ireland joined the AfDB in 2020 which is focused on reducing poverty, improving living conditions and mobilising resources for the Africa's economic and social development.

A more detailed breakdown of funding provided through MDBs and IFIs is outlined in Table 7(a) and (b).

7.2.5 Bilateral, Regional, and Other Channels of funding

The climate finance reported under the bilateral category covers the climate finance administered in-country by Irish Embassies, and that provided via Irish government grants to CSOs operating in developing countries. This channel continues to account for the largest allocation of Ireland's public climate finance and is provided in the form of grants through Irish Aid, Ireland's official overseas development assistance programme. This aid focuses largely on achieving results in the areas of sustainable food and nutrition security, particularly in climate resilient agriculture, improved natural resource management, disaster risk reduction, improving efficient and sustainable energy at the household level, and gender equality.

In the preparation of Ireland's 2019 and 2020 bilateral climate finance overviews for the OECD, which served as the basis for these tables, Ireland utilised the validated Creditor Reporting System (CRS) dataset to derive the analyses required by the report. Initially, the DFA prepared the Development Assistance Committee (DAC) reporting templates that support the creation of the CRS dataset, using information and financial expenditure noted in their internal financial system for 2019 and 2020.

The DFA prepared the reporting template using information and financial expenditure noted in its database of ODA expenditure for 2020. The template also includes definitions and guidance on Rio markers, and their application for international development spending – which is explained in the Methodology section. Through key-term of analysis of the short descriptions and justifications provided, probability analysis of how likely a particular score of 0 (Not Targeted), 1 (Significant) or 2 (Principal) was to occur against a particular OECD DAC Purpose Code, and validation that any prescriptive DAC rules were not broken, key issues were flagged.

Once the templates were finalised, climate finance was calculated for each project and classified as either: adaptation, mitigation or cross-cutting spend to avoid double counting. Table 8 presents these figures for 2019 and 2020 broken down both by purpose and by country, in the case of Embassy-funded programmes, or by organisation, for climate finance provided via CSOs.

The total amount of bilateral and regional climate finance provided by Ireland in 2019 was €65,272,578.03. The majority of bilateral climate spending – approximately 53% – went towards cross-cutting related activities and projects. Adaptation related spending, and activities earmarked as mitigation both accounted for approximately 47% and less than 1% respectively of the overall expenditure through bilateral programming.

The total amount of bilateral climate finance provided by DFA in 2020 was €48,225,431. The 2020 figure represents a 26% decrease on 2019, which can mainly be attributed to the revised EU methodology for programming and projects that were marked Significant. With that said, Irish Aid Missions are continuing to work on strengthening the integration of climate adaptation into broader development programming.

In 2020, the majority of bilateral climate spending went to climate change adaptation and cross-cutting activities. Out of the total climate finance spent bilaterally, approximately 75% was spent on adaptation only related activities and projects while around 22% was spent on cross-cutting support. Mitigation related spending accounted for approximately 3% of the overall expenditure through bilateral programming. Adaptation therefore remains a predominant focus across Ireland's bilateral and CSO programmes and projects.

Ireland is also continuing to step up efforts to bring about climate action co-benefits in programming, including capacity-building, vulnerability and risk assessments, and understanding the climate change implications for social inclusion, agriculture health and gender equality programmes.

Table 8 (a) and (b) provide an indication of contributions from the DECC, Department of Finance, DAFM, and the DFA through bilateral, regional and other channels from the previous two financial reporting years, 2019 and 2020.

The following are detailed examples of the projects supported by Ireland in 2019 and 2020:

- **Malawi**

In 2020, a shared clean cooking initiative between the Embassy of Ireland and Malawi's Ministry of Energy succeeded in meeting an ambitious target, set in 2012, to produce and put into use two million energy saving cook-stoves. This formed part of a worldwide effort orchestrated by the Global Alliance for Clean Cooking to deliver more environmentally friendly, or 'cleaner', cooking options to 100 million households around the world. In Malawi, the initiative sought to address the interlinked challenges of high levels of energy poverty and ensuing dependence on wood and charcoal for daily energy needs, and the negative impacts this has for human health and deforestation. Ireland provided approximately €400,000 per year towards delivering clean cooking initiatives in the country from 2013 to 2021. The benefits of the initiative have included a wood saving of 5.4 million tonnes, a reduction in carbon emissions of 8.1 million tonnes, income generating opportunities for 4,780 people, and at least \$1.34 million in income for stove producers and local retailers.

- **Kenya**

Climate Smart Research and Innovation for Livestock Development in Kenya with a focus on dairying was granted €1m in funding by the Irish Government via its Embassy in Kenya for 30 months (due to finish at end of Q1 2022). An Irish-Kenyan consortium led by Teagasc have made progress in developing and supporting a forage-based research and demonstration program at the Kenyan Agriculture and Livestock Research Organisation (KALRO) to underpin climate-smart dairy production. The project team established an Innovation Support Unit at KALRO and is translating research knowledge for use by extension agents and farmers and supporting its dissemination through five outreach nodes (demo sites), which in turn, are linked to 18 lead farmers. Teagasc working with Sustainable Food Systems Ireland (SFSI) and

the Irish Embassy in Kenya have recently agreed a funding extension to the end of December 2022.

- **Tanzania**

The Irish Embassy in Tanzania is supporting a project entitled 'Greening the Dairy Value Chain in Tanzania: Institutional Relationships and Innovations for Sustainable Milk Production 2021 to 2025'. The project titled locally as "Maziwa Faida" focuses on productivity in dairying and the development of the dairy value chain while promoting green economy principles and climate resilience. Teagasc is initially working closely with SFSI and the Tanzania Livestock Research Institute (TALIRI) in delivering the project. Work is underway to build capability and capacity of the institute and some forage research work has already commenced. The €3m project is expected to run for five years from October 2021. Other future partners expected to be involved include the Livestock Training Agency (LITA) and Sokoine University of Agriculture.

7.2.6 Carbon Funds and Other Investments

Ireland made a number of financial commitments in the 2006-2007 period with a view to achieving compliance with its obligations under the first commitment period of the Kyoto Protocol. The National Treasury Management Agency (NTMA) was appointed under the Carbon Fund Act 2007 to manage Ireland's actions in the carbon market. Ireland invested in three multilateral funds for the purpose of investing in projects aimed at achieving carbon emissions reductions, including the Multilateral Carbon Credit Fund (MCCF) which closed in 2014 with Ireland receiving back €4.7m in August 2014, the Carbon Fund for Europe (CFE) closed in 2018, with Ireland receiving back €98,000 in June 2018, and the BioCarbon Fund which closed in 2021, with Ireland receiving back €415,000 in November 2021.

Separate to these investments, in order to comply with Ireland's obligations under the first period of the Kyoto Protocol (2008-2012), the State bought international credits directly from the market through the NTMA. In 2008 and 2009, 21 trades were made, resulting in the purchase of 5.3m credits, at a total price of €89.6m.

In 2019, as a result of the projected shortfall to the EU ESD targets, the State decided to purchase additional units. The State currently holds 2.9 million units, and plans to purchase an additional 3.8 million units in 2022 under the Carbon Fund Act 2007 to comply with the 2020 target.

7.2.7 International Cooperation on Adaptation

Within the UN climate negotiations, developing countries, and particularly LDCs and SIDS, have been calling for stronger global support for adaptation efforts and resilience building. Global adaptation needs are ten times bigger than the current levels of adaptation finance and only a small portion of existing finance reaches LDCs and SIDS. The agreements reached during COP26 in November 2021 urge countries to double the funding provided for adaptation by 2025.

In keeping with Ireland's focus on LDCs and SIDS, adaptation is a consistent strength and focus of our global climate action. 45% of Ireland's climate finance in 2020 supported adaptation specifically, and a further 53% supported actions with both adaptation and mitigation co-benefits. Ireland is a member of the Champions Group on Adaptation Finance which works towards improving the quantity, quality and accessibility of funding for adaptation. Ireland has endorsed the Principles for Locally-Led Adaptation and supports initiatives promoting grassroots action, notably through funding for the LDC Initiative for Effective Adaptation and Resilience (LIFE-AR).

Building resilience to climate change is an important element of Ireland's food systems approach. In 2021, Ireland joined the ASAP+ initiative of the International Fund for Agricultural Development which is a programme focusing on alleviating the elements of food insecurity, irregular migration and land degradation driven by climate change. Ireland also dedicates a considerable amount of our climate finance to supporting the development and implementation of NAPs in LDCs, particularly through funding to the LDCF and the Least Developed Countries Expert Group (LEG) under the UNFCCC. In 2021, Ireland expanded this support by joining the NAP Global Network. Through our funding and membership of this network, Ireland will help five LDCs and SIDS to develop monitoring, evaluation and learning frameworks and build specific understandings of what adaptation approaches work best for their contexts.

7.3 Technology Development and Transfer

The effective development and transfer of environmentally sound technologies is critical in enabling developing countries to pursue their objectives for sustainable development in a climate-friendly manner. The UNFCCC states that 'promoting the effective development and transfer of environmentally sound technologies is critical to enable developing countries to pursue their objectives for sustainable development in a climate-friendly manner'. Although

wider definitions apply to technology in the development sphere, in the UNFCCC context it is often understood to cover physical technologies, knowledge and techniques.

Ireland does not have a long history of substantial investment in technology development, nor would it be regarded as a major climate technology developing nation when compared to many other countries. As such, large scale technology development or transfer is not usually a strong feature of Ireland's climate support. Notwithstanding this, Ireland supported a number of programmes in 2019 and 2020 that provided technology support to developing country partners. It should also be noted that as our funding to multilateral climate funds, particularly AF, GEF, and GCF, is unearmarked, it may be and is used to support such projects.

For example, Ireland provides support to the Global Environmental Monitoring Scheme (GEMS), implemented by UNEP, provides support to global water flow monitoring, support for the development of new drought resistant seed varieties in Tanzania, and clean technology development through support for start-ups in developing countries through NGO, Climate Knowledge and Innovation Community (Climate-KIC).

Detailed information on other technology development and transfer projects funded by Ireland can be found in Tables 9(a), 9(b), 10(a) and 10(b).

7.4 Capacity Building

Capacity building is a major feature of all Irish supported activities, regardless of modality of support. The relatively low levels of investment in hard infrastructure, and investment capital within the cooperation programme, means that there is already a strong emphasis on building human and institutional capacity, across all sectors. Below are some examples of Irish climate finance that aim to build capacity to adapt to (or mitigate) climate change, which are illustrative of the approach taken across the board.

Through funding to the LEG, and to the Gender Action Plan of the UNFCCC, capacity development support is provided to UNFCCC Focal Points, national counterparts, and Gender and Climate Focal Points on a range of climate issues, as well as specifically on how to formulate and implement NAPs.

Ireland supported a number of capacity building and participation-enhancing initiatives in 2019. At COP25, Ireland supported two young people, both financially and through capacity building, to attend the conference as part of the National Climate Delegation, as well as the provision of support to the Women's Environmental Development Organisation (WEDO) to facilitate developing country attendees. Ireland also began a partnership with Climate-KIC, to

support their Climate Launchpad Programme. This is a green business ideas programme supports businesses and entrepreneurs who lack the institutional support and capacity to bring their ideas to fruition.

Ireland's core support to the International Institute for Environment and Development (IIED) includes a major element of climate-related capacity development. Among these, we include work on supporting sub-national governments in Kenya, Tanzania, and Mali to build systems that can channel climate finance. It also includes support to training members of the LDC Negotiation Bloc in negotiation skills, and in the climate negotiation architecture, with a focus on women negotiators.

In 2019 and 2020, Ireland also invested heavily in developing the capacity of staff, with a strong emphasis on staff in Missions overseas, to integrate climate change into development programmes and projects. The support provided by the new Climate Unit in the DFA helped to anchor this work, and support knowledge sharing and coordination of activities.

Ongoing learning and capacity development among colleagues and partners continued to be supported by IIED, along with the commencement of online policy seminars on topical issues (such as on COP26) for Departmental staff.

Detailed information on capacity-building supporting projects funded by Ireland can be found in Tables 11(a) and 11(b).

7.5 Conclusion

While climate finance expenditure in 2020 decreased from 2019, the overall trend of Ireland's international climate support is that of a net increase between 2016 and 2020. The direction of support has largely been consistent year on year, with climate adaptation and cross-cutting activities remaining the predominant areas of support in Ireland's climate finance.

The two contributing factors to the decrease in bilateral and CSO climate finance – COVID-19 and methodology change – are important in considering the 2020 figure. However, their impact may not be unique to 2020. It will remain important to ensure that the adverse affects of COVID-19 do not impede on medium and longer-term programming that contributes to climate action.

The step-change required for Ireland's future action was captured in Ireland's International Climate Finance Roadmap, with a view to delivering on the quantitative targets whilst also building on best practices to scale up effective and impactful climate finance across bilateral and multilateral channels.

Table 6 (A) Provision of public financial support: summary information in 2019 Year

Allocation channel	Core/ general[3],1 (total core)	Domestic currency				USD[2]				
		Climate-specific[4], 2				Core/ general	Climate-specific,2			
		Mitigation	Adaptation	Cross-cutting[5]	Other[6]		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	€79,960,024.00	€210,554.00	€1,300,000.00	€29,614,421.03						
Multilateral climate change funds[7]	€7,581,530.00		€1,300,000.00	€6,028,430.00						
Other multilateral climate change funds[8]	€1,480,692.00			€1,480,692.00						
Multilateral financial institutions, including regional development banks	€41,427,883.00			€10,885,380.03						
Specialized United Nations bodies	€29,469,919.00	€210,554.00		€11,430,473.00						
Total contributions through bilateral, regional and other channels	€65,272,578.03	€45,291.84	€30,807,287.40	€34,419,998.79						
Total	€145,246,304.03	€96,397,553.05								

[1] Parties should fill in a separate table for each year, namely 20XX-3 and 20XX-2, where 20XX is the reporting year.

[2] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 6, 7 and 8 in the documentation box.

[3] This refers to support provided to multilateral institutions that Parties cannot specify as being climate-specific.

[4] Parties should explain in their national communication how they define funds as being climate-specific.

[5] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[6] Please specify.

[7] Multilateral climate change funds listed in paragraph 52(a) of these guidelines.

[8] Other multilateral climate change funds as referred to in paragraph 52(b) of these guidelines.

Table 6 (B) Provision of public financial support: summary information in 2020 Year										
Allocation channel		Domestic currency				USD[2]				
	Core/ general[3],1 (total core)	Climate-specific[4], 2				Core/ general	Climate-specificd,2			
		Mitigation	Adaptation	Cross-cutting[5]	Other[6]		Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:	€111,147,014.87	€824,314	€3,212,000	€36,079,350						
Multilateral climate change funds[7]	€7,930,000.00		€2,300,000	€5,386,900						
Other multilateral climate change funds[8]	€854,573.36	€41,989	€500,000	€312,584						
Multilateral financial institutions, including regional development banks	€54,429,654.00			€16,574,227						
Specialized United Nations bodies	€47,932,787.51	€782,325	€412,000	€13,805,639						
Total contributions through bilateral, regional and other channels	€48,225,431.00	€1,366,826	€36,197,752	€10,660,853						
Total	€ 159,372,445.87	88, 341,095								

[1] Parties should fill in a separate table for each year, namely 20XX-3 and 20XX-2, where 20XX is the reporting year.

[2] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 6, 7 and 8 in the documentation box.

[3] This refers to support provided to multilateral institutions that Parties cannot specify as being climate-specific.

[4] Parties should explain in their national communication how they define funds as being climate-specific.

[5] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[6] Please specify.

[7] Multilateral climate change funds listed in paragraph 52(a) of these guidelines.

[8] Other multilateral climate change funds as referred to in paragraph 52(b) of these guidelines.

Table 7 (A) Provision of public financial support: contributions through multilateral channels in 2019

Year: 2019									
Donor funding	Total amount				Status	Funding source	Financial instrument	Type of source	Sector
	Core / general		Climate-specific		Committed / Disbursed	ODA / OOF / Other	Grant / Concessional loan / Non-concessional loan / Equity / Other	Mitigation / Adaptation / Cross-cutting / Other	Energy / Transport / Industry / Agriculture / Forestry / Water and sanitation / Cross-cutting / Other / Not applicable
	Domestic currency	USD	Domestic currency	USD					
Multilateral climate change funds									
1. Global Environment Facility	€3,430,000.00		€3,186,900.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	€1,000,000.00		€1,000,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund									
4. Adaptation Fund	€300,000.00		€300,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting
5. Green Climate Fund	€2,000,000.00		€2,000,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities	€841,530.00		€841,530.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	€7,571,530.00		€7,328,430.00						
7. Other multilateral climate change funds	€1,480,692.00		€1,480,692.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	€1,480,692.00		€1,480,692.00						
Multilateral financial institutions, including regional development banks									
1. World Bank	€30,940,000.00		€8,003,800.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank	€5,745,241.00		€1,037,293.43		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other (Council of Europe Development Bank)	€13,702.00				Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
8. Other (Asian Infrastructure Investment Bank)	€4,728,940.00		€1,844,286.60		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	€41,427,883.00		€10,885,380.03						
Specialized United Nations bodies									
1. United Nations Development Programme (specific programmes)	€250,000.00		€250,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme (specific programmes)	€1,525,747.00		€1,525,747.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UN ECE			€185,789.00		Disbursed	ODA	Grant	Mitigation	Cross-cutting
UN Volunteers			€450,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNCCD			24,765		Disbursed	ODA	Grant	Mitigation	
UNEP GEMS			€300,000.00		Disbursed	ODA	Grant	Cross-cutting	
Africa Agrifood	€566,789.00		€566,789.00		Disbursed	ODA	Grant	Cross-cutting	
World Food Programme	€25,700,000.00		€3,700,000.00		Disbursed	ODA	Grant	Cross-cutting	
FAO - Ireland assessed contribution	€1,427,383.00		€1,427,383.00		Disbursed	ODA	Grant	Cross-cutting	

Consultative Group for International Agricultural Research (CGIAR)		€3,000,000.00	Disbursed	ODA	Grant	Cross-cutting	
Subtotal	€29,469,919.00	€11,430,473.00					
Total contributions	€79,960,024.00	€31,124,975.03					

Table 7 (B) Provision of public financial support: contributions through multilateral channels in 2020

Year: 2020									
Donor funding	Total amount				Status	Funding source	Financial instrument	Type of support	Sector
	Core / general		Climate-specific		Committed / Disbursed	ODA / OOF / Other	Grant / Concessional loan / Non-concessional loan / Equity / Other	Mitigation / Adaptation / Cross-cutting / Other	Energy / Transport / Industry / Agriculture / Forestry / Water and sanitation / Cross-cutting / Other / Not-applicable
	Domestic currency	USD	Domestic currency	USD					
Multilateral climate change funds									
1. Global Environment Facility	€1,430,000.00		€1,186,900.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	€2,000,000.00		€2,000,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund									
4. Adaptation Fund	€300,000.00		€300,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting
5. Green Climate Fund	€4,000,000.00		€4,000,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities	€200,000.00		€200,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	€7,930,000.00		€7,686,900.00						
Other multilateral climate change funds									
UNFCCC - Core Budget	€94,925.00		€94,925.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNFCCC - Kyoto Protocol	€14,018.00		€14,018.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNFCCC - International Transaction Log	€8,641.00		€8,641.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNECE Geneva Convention on Long-Range Transboundary Air Pollution (CLRTAP)	€41,989.36		€41,989.36		Disbursed	Other	Grant	Mitigation	Cross-cutting
Intergovernmental Panel on Climate Change	€100,000.00		€100,000.00		Disbursed	Other	Grant	Cross-cutting	Cross-cutting
National Determined Contributions Partnership	€95,000.00		€95,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNFCCC Least Developed Countries Expert Group	€500,000.00		€500,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting
Subtotal	€854,573.36		€854,573.36						
Multilateral financial institutions, including regional development banks									
International Finance Corporation									
Africa Development Bank	€5,006,013.00		€1,401,684.00		Disbursed	ODA	Other - used for mix of instruments	Cross-cutting	Cross-cutting
Africa Development Fund	€8,127,940.00		€2,682,220.00		Disbursed	ODA	Other - used for mix of instruments	Cross-cutting	Cross-cutting
Asian Development Bank	€1,245,139.00		€348,639.00		Disbursed	ODA	Other - used for mix of instruments	Cross-cutting	Cross-cutting
	€4,364,000.00		€698,240.00		Disbursed	ODA	Other - used for mix of instruments	Cross-cutting	Cross-cutting
European Bank for Reconstruction and Development	€ -	€ -							
Inter-American Development Bank	€ -	€ -							
Subtotal	€18,743,092.00		€5,130,783.00						
Other									
European Investment Bank	€2,730,000.00		€1,092,000.00		Disbursed	ODA	Other	Cross-cutting	Cross-cutting

Council of Europe Development Bank	€16,597.00		€10,456.00		Disbursed	ODA	Other	Cross-cutting	Cross-cutting
International Bank for Reconstruction and Development	€4,319,965.00		€1,468,788.00		Disbursed	ODA	Other	Cross-cutting	Cross-cutting
International Development Association	€28,620,000.00		€8,872,200.00		Disbursed	ODA	Other	Cross-cutting	Cross-cutting
Subtotal	€35,686,562.00		€11,443,444.00						
Specialized United Nations bodies									
1. United Nations Development Programme (specific programmes)									
Peacebuilding Fund	€1,750,000.00		€1,680,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Core budget	€7,750,000.00		€7,440,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Subtotal	€9,500,000.00		€9,120,000.00						
2. United Nations Environment Programme (specific programmes)									
Core budget	€476,116.00		€142,834.80		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Vienna CPOL	€3,050.69		€3,050.69		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Montreal Protocol	€18,256.82		€18,256.82		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral Fund	€782,325.00		€782,325.00		Disbursed	ODA	Grant	Mitigation	Cross-cutting
Subtotal	€1,279,748.51		€946,467.31						
3. Other									
FAO - Assessed Contribution	€1,643,839.00		€1,068,496.35		Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Emergency support to improve surveillance and control of Desert Locust invasion	€500,000.00				Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Project to improve food security, nutrition and resilience	€500,000.00		€200,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - COVID-19 response and recovery programme	€419,200.00				Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Social Protection and Agricultural Interventions to enable the adoption of Climate Smart Agriculture	€258,000.00		€258,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture
FAO - Contribution to UN Food Systems Summit in support of work on Action Track 1	€250,000.00		€100,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Livestock Environmental Assessment Programme (LEAP)	€83,000.00		€83,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture
FAO - International Year of Plant Health 2020 fund (extension)	€50,000.00		€20,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture
FAO - Global Alliance for Climate Smart Agriculture (GACSA)	€42,000.00		€42,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture
FAO - Global Agenda for Sustainable Livestock (GASL)	€25,000.00		€25,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture
FAO - EMPPO (project on the development of training materials)	€12,000.00				Disbursed	ODA	Grant	Cross-cutting	Agriculture
International Fund for Agricultural Development	€2,500,000.00		€925,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture
World Food Programme (core)	€25,700,000.00				Disbursed	ODA	Grant	Cross-cutting	Agriculture
World Food Programme (Food Systems Summit)	€400,000.00		€400,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UNCLS	€10,000.00		€4,000.00		Disbursed	ODA	Grant	Adaptation	Other: Oceans
UNCLS	€20,000.00		€8,000.00		Disbursed	ODA	Grant	Cross-cutting	Other: Oceans
UNMTPFO	€500,000.00		€200,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UN OSGEY	€140,000.00		€140,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
UN Volunteers	€1,100,000.00		€440,000.00		Disbursed	ODA	Grant	Cross-cutting	Cross-cutting

Consultative Group for International Agricultural Research (CGIAR)	€3,000,000.00		€1,020,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture
Subtotal	€37,153,039.00		€4,933,496.35						
Total contributions	€111,147,014.87		€40,115,664.02						

Table 8 (A) Provision of public financial support: contributions through bilateral, regional and other channels in 2019

Year: 2019								
Recipient country / region / project / programme / activity	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
	Climate-specific							
	Domestic currency	USD	Committed/ Disbursed	ODA / OOF / Other	Grant / Concessional loan / Non-concessional loan / Equity / Other	Mitigation / Adaptation / Cross-cutting / Other	Energy / Transport / Industry / Agriculture / Forestry / Water and sanitation / Cross-cutting / Other / Not-applicable	
Action Aid	€371,026.10		Disbursed	ODA	Grant	Cross-Cutting	Other	Government & Civil Society.
Concern Worldwide	€9,724,678.00		Disbursed	ODA	Grant	Adaptation	Cross-Cutting	
Eritrea	€90,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Eritrea	€16,000.00		Disbursed	ODA	Other	Mitigation	Agriculture	
Ethiopia	€12,423,250.00		Disbursed	ODA	Grant	Cross-Cutting	Agriculture	Social Infrastructure also dominant.
Ethiopia	€66,000.00		Disbursed	ODA	Other	Adaptation	Agriculture	
Goal	€1,766,506.50		Disbursed	ODA	Grant	Adaptation	Agriculture	Health also dominant.
Humanitarian Unit	€1,267,924.00		Disbursed	ODA	Grant	Adaptation	Other	Emergency Response
In-Country Micro Projects	€9,291.84		Disbursed	ODA	Grant	Mitigation	Energy	
Kenya	€413,113.61		Disbursed	ODA	Grant	Adaptation	Agriculture	Education also dominant.
Kenya	€42,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Kenya	€20,000.00		Disbursed	ODA	Other	Mitigation	Agriculture	
Malawi	€9,205,699.06		Disbursed	ODA	Grant	Cross-Cutting	Other	Agriculture, General Environment Protection & Social Infrastructure.
Misean Cara	€558,980.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Mozambique	€608,851.08		Disbursed	ODA	Grant	Adaptation	Other	Agriculture, Emergency Response & Social Infrastructure.
Palestinian Admin Areas	€5,076,508.88		Disbursed	ODA	Grant	Cross-Cutting	Energy	
Policy Unit	€6,102,768.57		Disbursed	ODA	Grant	Cross-Cutting	Cross-Cutting	
Projects	€213,750.00		Disbursed	ODA	Grant	Adaptation	Agriculture	Financial Services also dominant.
Self Help Africa	€2,013,273.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Sierra Leone	€305,691.12		Disbursed	ODA	Grant	Adaptation	Agriculture	Health also dominant.
Stability Fund	€131,136.88		Disbursed	ODA	Grant	Cross-Cutting	Cross-Cutting	General Environment Protection
Tanzania	€7,930,118.38		Disbursed	ODA	Grant	Adaptation	Other	Health & Emergency Response.
Trocaire	€3,725,394.00		Disbursed	ODA	Grant	Adaptation	Cross-Cutting	
Uganda	€5,323.12		Disbursed	ODA	Grant	Adaptation	Other	Social Infrastructure.
Vietnam	€2,017,000.00		Disbursed	ODA	Grant	Adaptation	Other	Livelihoods & Education.
Vietnam	€3,000.00		Disbursed	Other	Other	Adaptation	Agriculture	
Vita	€253,466.50		Disbursed	ODA	Grant	Cross-Cutting	Agriculture	
World Vision Ireland	€55,684.60		Disbursed	ODA	Grant	Adaptation	Other	Health.
Zambia	€856,142.81		Disbursed	ODA	Grant	Cross-Cutting	Agriculture	Health also dominant.
Total contributions through bilateral, regional and other channels	€65,272,578.03							

Table 8 (B) Provision of public financial support: contributions through bilateral, regional and other channels in 2020

Year: 2020								
Recipient country / region / project / programme / activity	Total amount		Status	Funding source	Financial instrument	Type of support	Sector	Additional information
	Climate-specific							
	Domestic currency	USD	Committed/ Disbursed	ODA / OOF / Other	Grant / Concessional loan / Non-concessional loan / Equity / Other	Mitigation / Adaptation / Cross-cutting / Other	Energy / Transport / Industry / Agriculture / Forestry / Water and sanitation / Cross-cutting / Other / Not-applicable	
Ethiopia								
	€10,009,589.00		Disbursed	ODA	Grant	Adaptation	Agriculture	Other: Social Protection
Ethiopia	€24,000.00		Disbursed	ODA	Grant	Mitigation	Energy	
Malawi								
	€6,582,006.00		Disbursed	ODA	Grant	Adaptation	Agriculture; Other	Other: Social Protection
Malawi	€520,000.00		Disbursed	ODA	Grant	Cross-cutting	Energy	
Malawi	€850.00		Disbursed	ODA	Grant	Mitigation	Other	
Kenya	€174,063.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Mozambique	€1,428,200.00		Disbursed	ODA	Grant	Adaptation	Agriculture; Other	Other: Food systems, conservation, fisheries
Mozambique	€162,000.00		Disbursed	ODA	Grant	Cross-cutting	Water and Sanitation; Other	Other: information systems
Tanzania	€300,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Tanzania	€300,000.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture	
Tanzania	€160,000.00		Disbursed	ODA	Grant	Mitigation	Other	
Uganda	€16,400.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Zambia	€320,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Sierra Leone	€163,995.00		Disbursed	ODA	Grant	Adaptation	Agriculture; Other	Other: flood risk/ DRR
Sierra Leone	€393,607.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture; Other	Other: fisheries, conservation
Sierra Leone	€2,449.00		Disbursed	ODA	Grant	Mitigation	Energy	
Vietnam and Laos	€1,600,380.00		Disbursed	ODA	Grant	Adaptation	Agriculture; Other	Other: water and sanitation
Vietnam and Laos	€164,000.00		Disbursed	ODA	Grant	Crosscutting	Agriculture; Other	Other: DRR
Palestinian Admin Areas	€1,530,000.00		Disbursed	ODA	Grant	Crosscutting	Energy; Other	Other: water and sanitation
South Africa	€40,000.00		Disbursed	ODA	Grant	Adaptation	Other	
South Africa	€80,000.00		Disbursed	ODA	Grant	Crosscutting	Other	
SIDS	€200,000.00		Disbursed	ODA	Grant	Adaptation	Other	
SIDS	€100,391.00		Disbursed	ODA	Grant	Crosscutting	Other	Other: fisheries
Nigeria (micro projects)	€5,351.00		Disbursed	ODA	Grant	Mitigation	Energy	
India (micro projects)	€2,800.00		Disbursed	ODA	Grant	Cross-cutting	Other	
Fellowships	€1,187,487.00		Disbursed	ODA	Grant	Cross-cutting	Other	
Action Aid	€54,040.00		Disbursed	ODA	Grant	Mitigation	Other	
Action Aid	€188,959.00		Disbursed	ODA	Grant	Cross-cutting	Other	
Concern	€4,882,812.00		Disbursed	ODA	Grant	Adaptation	Water and Sanitation; Other	Other: information systems, DRR, agriculture

Concern	€3,091,745.00		Disbursed	ODA	Grant	Cross-cutting	Agriculture; Other	Other: DRR
Goal	€1,541,544.00		Disbursed	ODA	Grant	Adaptation	Other	Other: food and livelihood security, DRR,
Misean Cara	€4,205.00		Disbursed	ODA	Grant	Mitigation	Forestry	
Misean Cara	€593,255.00		Disbursed	ODA	Grant	Adaptation	Agriculture; Water and Sanitation	
Oxfam	€376,784.00		Disbursed	ODA	Grant	Adaptation	Other	
Self Help Africa	€1,779,897.00		Disbursed	ODA	Grant	Adaptation	Agriculture	
Trocaire	€390,089		Disbursed	ODA	Grant	Mitigation	Agriculture; Water and Sanitation; Other	Other: DRR
Trocaire	€3,846,034		Disbursed	ODA	Grant	Adaptation	Agriculture; Water and Sanitation; Other	Other: natural resource management
Trocaire	€617,904		Disbursed	ODA	Grant	Crosscutting	Agriculture; Other	Other: natural resource management
Vita	€69,000		Disbursed	ODA	Grant	Mitigation	Energy	
Vita	€145,973		Disbursed	ODA	Grant	Adaptation	Agriculture	
World Vision	€50,060		Disbursed	ODA	Grant	Adaptation	Other	
War on Want	€46,760		Disbursed	ODA	Grant	Adaptation	Agriculture	
ODI	€60,000		Disbursed	ODA	Grant	Adaptation	Other	
International Alert	€60,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting	IA is one of the world's leading peacebuilding NGOs, with a strong track record both in working in fragile and conflict affected states and in influencing key policies and practices including conflict prevention, conflict-sensitivity, gender, preventing violent extremism, natural resource management, the role of the private sector in peace and conflict, and climate change. IA facilitate multi-stakeholder dialogue processes, support and accompany local partners, design and deliver peacebuilding training, and conduct research and advocacy to inform and influence change.
4SD	€28,471.00		Disbursed	ODA	Grant	Mitigation	Cross-cutting	4SD is a social enterprise specialised in training and mentoring of development practitioners. 4SD has been engaged by the Special Envoy and Summit Secretariat to assist with the Food Systems Summit Dialogues. Ireland's funding has a specific focus on the African Union, the Small Island Developing States (SIDS) and other relevant regional bodies for Least Development Countries (LDCs).
European Institute for Peace	€40,000.00		Disbursed	ODA	Grant	Adaptation	Cross-cutting	EIP is an independent conflict resolution organisation with expertise in mediation, promoting peace and prevention of violent conflict in the Middle East, Central Asia, Africa, Latin America and Europe. EIP's work focuses on thematic issues of relevance to CRU and DFA priorities including elections, sanctions, conflict prevention, justice, refugees and women, peace and security (WPS). EIP also have an increased focus on YPS and climate security. This partnership is focused on the role and influence of the EU as an actor in peace-making.
Teagasc	€628,371.00		Disbursed	ODA	Grant	Mitigation	Agriculture	Teagasc is the national body responsible for agricultural research and knowledge transfer in Ireland. Abroad, it also supports national efforts aimed at strengthening agricultural development and reducing hunger and under-nutrition in developing countries.
Africa Agri Food Development Programme	€40,000.00		Disbursed	ODA	Grant	Adaptation	Agriculture	Africa AgriFood Development Programme funding for a Feasibility Study to assess the viability of constructing a processing facility for smallholder fruit farmers in Ghana. This Project aims to strengthen the position of smallholder farmers through training and integration. Direct employment at the facility is estimated to be 318 people, while 5,000 smallholders and their families will also benefit from increased income.
Secretariat for Regional Pacific Environment Programme	€900,000.00		Disbursed	ODA	Grant	adaptation	Cross-cutting	Irish Aid supports the Secretariat of the Pacific Regional Environment Programme to build resilience of vulnerable communities and government institutions to cope with and plan for climate change. The action builds climate governance systems, such as national meteorological services for better early warning to weather events.
Global - Irish Forum for International Agriculture Development IFIAD	€21,960.00		Disbursed	ODA	Grant	cross-cutting	Agriculture	Funding to Self Help Africa to support their management and hosting of the Irish Forum for International Agricultural Development: a voluntary, multi-disciplinary platform, bringing together actors from the agri-food sector to share knowledge and good practices for the benefit of agricultural development programming and policy in support of Ireland's Development Cooperation objectives.

Climate KIC (Africa and Asia)	€300,000.00		Disbursed	ODA	Grant	cross-cutting	Cross-cutting	The Climate Launchpad (LP) aims to address climate change through supporting technical, innovative ideas and business models that contribute to broader climate action. It organises climate innovation competitions and builds a growing network of entrepreneurs and small businesses. Irish Aid supports the Launchpad in six African countries, and in Vietnam.
LIFE -AR (LDC Initiative for Effective Adpatation and Resilience)	€1,000,000.00		Disbursed	ODA	Grant	adaptation	Cross Cutting	The LIFE AR programme supports locally driven climate change adaptation efforts in the most vulnerable countries and communities. Led by the Least Developed Countries group, the initiative seeks to assist seven of these countries in designing and implementing national climate action plans; to establish mechanisms for peer-to-peer learning and dissemination of best practice; and to support effective and credible climate financing in order to enhance LDC ownership of their adaptation efforts.
Global - IIED Core Support	€1,675,000.00		Disbursed	ODA	Grant	cross-cutting	Cross Cutting	everaging the research expertise of the International Institute for Environment and Development (IIED), this Irish Aid collaboration focuses on integrating climate action and the environment into development programming, poverty reduction and conservation. Support specifically targets the poorest and most vulnerable, particularly people in Least Developed Countries (LDCs), and covers a range of aspects from climate resilience and protection of biodiversity, to gender equality and capacity building.
Global - IIED Learning Platform	€325,000.00		Disbursed	ODA	Grant	cross-cutting	Cross Cutting	The IIED Climate and Development Learning Platform facilitates research studies and knowledge partnerships with Irish Aid Missions which help Missions to build capacity and integrate climate across Ireland's development programmes. In addition, this funding supports LDCs in their participation in UNFCCC Climate Negotiations, and contributes to the annual Community Based Adaptation (CBA) Conferences.
Total contributions through bilateral, regional and other channels	€48,225,431.00							

Table 9 (a)

Description of selected projects or programmes that promoted practicable steps to facilitate and/or finance the transfer of, or access to, environmentally sound technologies -2019

Project/programme title:			
Delivery of Energy-Saving Cookstoves in Partnership with the Ministry of Energy of Malawi			
Purpose:			
To provide energy-poor communities in Malawi with clean, fuel-efficient cook stoves and the means to manufacture and sell the technology themselves			
Recipient country:	Sector:	Total funding:	Years in operation:
Malawi	Energy	Approximately €2.8 million	2013-2020
Description:			
In 2020, a shared clean cooking initiative between the Embassy of Ireland and Malawi's Ministry of Energy succeeded in meeting an ambitious target, set in 2012, to produce and put into use two million energy saving cook-stoves. The technology constitutes locally made, low-cost, low-tech cookstoves, fuelled by biomass, to replace the widespread use of wood-intensive open fire cooking in Malawi. By providing a means of clean, fuel-efficient cooking for these populations, the initiative contributes to addressing a number of interlinked challenges. Malawi's high degrees of energy poverty are reflected in the statistic that only approximately 10% of the population is connected to the electricity grid. Ensuing reliance on wood and charcoal for daily fuel and energy needs has given rise to one of the highest deforestation rates in Africa and also has negative implications for human health. The nature of societal roles means that women are particularly exposed to these impacts, and to the real risk of gender based violence while collecting fire wood. The climate and environmental benefits of the initiative have included a wood saving of 5.4 million tonnes and a reduction in carbon emissions of 8.1 million tonnes. Beyond the provision of cookstoves, this initiative saw many small women's groups around the country successfully learn how to make and market, as well as use, this energy-saving technology. This facilitated the creation of income generating opportunities for 4,780 people between distribution and manufacturing and at least \$1.34 million in income for stove producers and local retailers Based on the 2020 achievement, the Government of Malawi has formulated an <u>Energy Compact</u> which prioritises clean cooking, and has also committed to increase clean cooking technologies in line with SDG 7. With support from different stakeholders, this commitment sets a goal of distributing an additional two million improved biomass cookstoves by 2025 and 3 million more by 2030.			
Factors that led to project/programme's success:			
Strong coordination between stakeholders: The Irish Government supported the strengthening of the MBAULA network comprised of government, NGOs and private sector whose objective was to coordinate all fuel efficient clean cook stove partners. Further, a National Cook Stove Steering Committee was established and provided further support on quality control and establishment of standards, awareness and communication as well technology generation			

- A focus on fostering local expertise.
- Innovative approaches to the manufacturing, distribution and marketing of the stoves, including by making use of existing systems such as the social cash transfer programme to reach some of Malawi's most vulnerable communities.
- Broader complementary partnerships such as tree planting schemes in cooperation with the National Smallholder Farmers' Association of Malawi (NASFAM).

Technology transferred:

Manufacture, use and marketing of energy-saving, biomass-fuelled cookstoves

Impact on greenhouse gas emissions/removals (optional):

Reduction in carbon emissions of 8.1 million tonnes

Wood saving of 5.4 million tonnes

Table 9 (b)

Description of selected projects or programmes that promoted practicable steps to facilitate and/or finance the transfer of, or access to, environmentally sound technologies – 2020

<u>Project/programme title:</u>			
Climate Smart Research and Innovation for Livestock Development in Kenya			
<u>Purpose:</u>			
To contribute to the knowledge and on-farm practice of innovative, climate smart production systems, with a focus on Dairying.			
<u>Recipient country:</u>	<u>Sector:</u>	<u>Total funding:</u>	<u>Years in operation:</u>
Kenya	Agriculture	€1,300,000 million	2019-2022
<u>Description:</u>			
Dairying is the single largest sub-sector in Kenyan agriculture, but it is characterised by low-input, low-yield systems which produce much less than the national herd potential. As demand for dairy products grows in Kenya, there is a need for innovative approaches in the sector that can reconcile growth of output with mitigation of greenhouse gas production and improved adaptation to climate change. The Climate Smart Research and Innovation for Livestock Development initiative is a proof-of-concept project focused on sustainable dairy production at farm level. The project aims to link international research with local knowledge by building relationships between institutions in Africa and Europe. In this way, it seeks to contribute to science-based, climate smart development of the livestock sector in Kenya. The goal of the project is to contribute to knowledge and on-farm practice in the creation and implementation of innovative climate smart and economic production systems. This focuses on the introduction of forage-based animal genetics and the application and use of novel climate smart forage feeding systems. Three key capability-building sub-objectives are being pursued: i) the development of a new cattle breeding programme; ii) the development and demonstration of new, improved forage-based systems of production which are fit to meet 90%+ of the animals' dietary requirement and are resilient to climate change; iii) the development of an Innovation Hub in support of the dairy value chain to build capacity in forage-based production technology. This model operates through existing extension networks and routes with a specific focus on the inclusion of women and young farmers. The consortium delivering the project is led by Teagasc, the Irish agriculture and food development authority, in partnership with its Kenyan counterpart, the Kenya Agriculture and Livestock Research Organisation (KALRO).			
<u>Factors that led to project/programme's success:</u>			
• Compatibility and complementarity with national policies - The project provides important enablers for national policy goals in breeding, value addition and industry skills development. Ireland's involvement in the agri-food sector in Kenya is governed by the bilateral Ireland-Kenya Agri-Food Strategy (IKAFS), a multi-year plan launched in 2017 and developed by the Embassy of Ireland in association with Kenyan and Irish partners. IKAFS identified three priority value			

chains for support, one of which is the dairy sector. It is fully consistent with the Kenyan Government's plans for agricultural development as outlined in Vision 2030 and the Kenya Agriculture Development Strategy 2010-2020.

- **Wide stakeholder network** – in addition to the leadership of Teagasc, and the Kenya Agriculture and Livestock Research Organisation (KALRO), project support is provided by Self Help Africa, Sustainable Food Systems Ireland (SFSI) and Greenfield International. The team also works with Brookside Dairy Ltd. (Kenya's largest dairy processor), International Livestock Research Institute (ILRI), Land O' lakes, a number of smaller dairy co-operatives, and the County Extension Services.
- **Relevant Expertise** - Teagasc partner Greenfield International (GI) is a forage-based livestock systems specialist. The proposed project is also supported in detailed design and implementation by Sustainable Food Systems Ireland (SFSI), the international consultancy group of Ireland's Department of Agriculture, Food and the Marine. Engagement of KALRO and Self Help Africa (SHA) in the project has also been effective in carrying out research and further translating research findings into practice among farmers. This allows replication of best practices, continuous learning and subsequent improvement of project design.

Technology transferred:

- Linking of international research and local knowledge to support the introduction of forage-based animal genetics. Application and use of novel climate smart forage feeding systems for improved climate resilience and reduced emissions in Kenya's dairy sector.
- Information generated by partners from the comparison of different breeds/ strains trials of dairy cattle managed under forage-based system will be used to inform development of and Economic Breeding Index and future breeding policy in Kenya
- The project has so far reached 2146 dairy farmers (1218 males, 928 females) with forage- based technologies for improved productivity
- Based on SHA's monitoring reports, early adopters (50 lead farmers) who are practicing the forage -based system have realised increased milk production of one to two litres of milk per cow per day.
- Innovation support unit at KALRO is working continuously to translate research results into practice through over 2,000 dairy farmers in five innovation nodes (Dairy cooperatives and farmer organizations).

Impact on greenhouse gas emissions/removals (optional):

The Government of Kenya and other researchers have conducted research on the potential of the below dairy practices.¹

Feed management and Nutrition

¹ Ministry of Agriculture, livestock fisheries and cooperative-State department of livestock- Inventory of greenhouse gas emissions from Dairy Cattle in Kenya- 1995-2017 (2020)

2. A new approach for improving emission factors for enteric emission for cattle in smallholder systems of East Africa for Nyando, Western Kenya (Agricultural system) by Goopy, J.P Onyango, and Buffer Bach (2018b)

3. https://www.researchgate.net/publication/322448070_A_new_approach_for_improving_emission_factors_for_enteric_methane_emissions_of_cattle_in_smallholder_systems_of_East_Africa_-_Results_for_Nyando_Western_Kenya

- The project promotes a forage based feeding strategy with improved forages. Changing the dairy animals' diet by altering forage quality leads to high digestibility which has been proved to reduce emission of enteric methane gas

Genetics & Breeding

- The project focuses on genetic selection through breeding which affects enteric methane gas emission in that different breeds emit enteric methane at different levels with the Jersey breed and other small size cross breeds being more efficient (Emitting less methane)

Dairy Management Practices

- The project also promotes good dairy management practices such as manure management through establishing bio-digesters, disease management, good housing, reproduction and fertility management, increasing cow longevity to 3-4 lactations, reducing the age at first calving and reducing calving period all leading to a higher herd productivity and subsequent reduction of enteric methane emissions.

Table 10 (a) Provision of support for technology development and transfer 2019

<i>Recipient country and/or region</i>	<i>Targeted area</i> <i>Mitigation</i> <i>Adaptation</i> <i>Mitigation and adaptation</i>	<i>Measures and activities related to technology transfer</i>	<i>Sector</i> <i>Energy</i> <i>Transport</i> <i>Industry</i> <i>Agriculture</i> <i>Water and sanitation</i> <i>Other</i>	<i>Source of funding for technology transfer</i> <i>Private</i> <i>Public</i> <i>Private and public</i>	<i>Activities undertaken by</i> <i>Private</i> <i>Public</i> <i>Private and public</i>	<i>Status</i> <i>Implemented</i> <i>Planned</i>	<i>Additional information</i>
<i>Kenya</i>	<i>Mitigation</i>	<i>Climate Smart Research and Innovation for Livestock Development in Kenya with a focus on Dairying. Implemented by Teagasc, the Irish agriculture and food development authority.</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	
<i>Eritrea</i>	<i>Mitigation</i>	<i>Developing a climate-smart community dairy model that can be replicated across Eritrea using a pilot model demonstration farm and directly supporting selected dairy farmers. Implemented by Teagasc, the Irish agriculture and food development authority.</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	
<i>Ethiopia</i>	<i>Mitigation</i>	<i>Agricultural Fertility and Environmental Resources - Small project aiming to address the deficiency in crop and soil- specific nutrient advice by developing a prototype decision support tool (DST) for smallholder farmers based on data that</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	

		<i>can easily (e.g. visually) be obtained in the field. Implemented by Teagasc, the Irish agriculture and food development authority</i>					
<i>Global</i>	<i>Adaptation and Mitigation</i>	<i>Funding to UNEP- Trust fund for the Vienna Convention on the Protection of the Ozone Layer</i>	<i>Other</i>	<i>Public</i>		<i>Implementation</i>	
<i>Global</i>	<i>Adaptation and Mitigation</i>	<i>Funding to UNEP – Trust Fund for the Montreal Protocol</i>	<i>Other</i>	<i>Public</i>		<i>Implementation</i>	
<i>Kenya, Nigeria, Mozambique, South Africa, Tanzania, Uganda, Vietnam</i>	<i>Adaptation and Mitigation</i>	<i>Funding to Climate Knowledge and Information Community (Climate-KIC) - a network of expertise that develops, brings to market and scales innovative products and services offering solutions to climate change. Ireland funds the delivery of the ClimateLaunchpad competition for green business ideas and post competition support for early-stage start-ups.</i>	<i>Other</i>	<i>Public</i>		<i>Implemented</i>	
<i>Oceania</i>	<i>Adaptation</i>	<i>Funding to the Secretariat of the Pacific Regional Environment Programme to build resilience of vulnerable communities and government institutions to cope with and plan for climate change. The action builds climate governance systems, such as national meteorological services for better early warning to weather events.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

<i>LDCs</i>	<i>Adaptation</i>	<i>Funding to the Least Developed Countries Fund (LDCF) to assist LDCs in preparing and implementing their National Adaptation Plans, and in integrating climate action into development plans through capacity building, technical assistance, and the promotion of innovation and technology transfer in climate adaptation.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>LDCs</i>	<i>Adaptation</i>	<i>Funding to the Least Developed Countries Expert Group (LEG) - the only body mandated by Parties to the UNFCCC to provide dedicated support to LDCs. The LEG supports these countries in their efforts to design, plan and Implement National Adaptation Plans (NAPs), and facilitates access to financial and technical support.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>LDCs</i>	<i>Adaptation and Mitigation</i>	<i>Funding to the International Institute for Environment and Development (IIED) for the integration of climate action and the environment into development programming, poverty reduction and conservation. Support specifically targets the poorest and most vulnerable,</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

		<i>particularly people in Least Developed Countries (LDCs), and covers a range of aspects from climate resilience and protection of biodiversity, to gender equality and capacity building.</i>					
<i>Mozambique</i>	<i>Adaptation</i>	<i>Funding to ideaLab for the Strengthening Green Entrepreneurship Supporting Ecosystems project to increase the visibility and understanding of green business approaches in Mozambique, and the central role of green woman entrepreneurs</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>Ethiopia</i>	<i>Mitigation</i>	<i>International Research for research in Agro-Forestry – agricultural water resources, rural livelihoods and climate.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>Palestine</i>	<i>Adaptation and Mitigation</i>	<i>Ireland will provide a total of €8.8 million to the Agence Française de Développement and the Palestinian Water Authority for the development of a solar power generation facility to power the North Gaza Emergency Sewage Treatment Plant. The project – which is fully funded by Ireland – will reduce the strain on the Gaza electricity grid, provide energy for wastewater treatment and assist in water table rehabilitation.</i>	<i>Energy</i>	<i>Public</i>		<i>Implementing</i>	

<i>Palestine</i>	<i>Adaptation and Mitigation</i>	<i>Ireland continues to fund Comet-ME, a NGO providing potable water and solar power to isolated communities</i>	<i>Energy</i>	<i>Public</i>		<i>Implementing</i>	
<i>Malawi</i>	<i>Adaptation</i>	<i>International Potato Centre – improved food and nutrition security</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementing</i>	

Table 10 (b) Provision of support for technology development and transfer 2020

<i>Recipient country and/or region</i>	<i>Targeted area</i> <i>Mitigation</i> <i>Adaptation</i> <i>Mitigation and adaptation</i>	<i>Measures and activities related to technology transfer</i>	<i>Sector</i> <i>Energy</i> <i>Transport</i> <i>Industry</i> <i>Agriculture</i> <i>Water and sanitation</i> <i>Other</i>	<i>Source of funding for technology transfer</i> <i>Private</i> <i>Public</i> <i>Private and public</i>	<i>Activities undertaken by</i> <i>Private</i> <i>Public</i> <i>Private and public</i>	<i>Status</i> <i>Implemented</i> <i>Planned</i>	<i>Additional information</i>
<i>Kenya</i>	<i>Mitigation</i>	<i>Climate Smart Research and Innovation for Livestock Development in Kenya with a focus on Dairying. Implemented by Teagasc, the Irish agriculture and food development authority.</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	
<i>Eritrea</i>	<i>Mitigation</i>	<i>Developing a climate-smart community dairy model that can be replicated across Eritrea using a pilot model demonstration farm and directly supporting selected dairy farmers. Implemented by Teagasc, the Irish agriculture and food development authority</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	
<i>Ethiopia</i>	<i>Mitigation</i>	<i>Agricultural Fertility and Environmental Resources - Small project aiming to address the deficiency in crop and soil- specific nutrient advice by developing a prototype decision support tool (DST) for smallholder farmers based on data that can easily (e.g. visually) be</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementation</i>	

		<i>obtained in the field. Implemented by Teagasc, the Irish agriculture and food development authority</i>					
<i>Global</i>	<i>Adaptation and Mitigation</i>	<i>Funding to UNEP- Vienna Convention Trust Fund for Research and Systematic Observations, to strengthen atmospheric research and monitoring activities in order to address the many uncertainties that exist regarding the expected ozone recovery process and interaction between ozone and climate changes</i>	<i>Other</i>	<i>Public</i>		<i>Implementation</i>	
<i>Global</i>	<i>Adaptation and Mitigation</i>	<i>Funding to UNEP – Trust Fund for the Montreal Protocol</i>	<i>Other</i>	<i>Public</i>		<i>Implementation</i>	
<i>Global</i>	<i>Adaptation and Mitigation</i>	<i>Funding to the Nationally Determined Contributions (NDC) Partnership - to assist countries in accessing cutting- edge technical and financial knowledge resources to accelerate climate action</i>	<i>Other</i>	<i>Public</i>		<i>Implementation</i>	
<i>Kenya, Nigeria, Mozambique, South Africa, Tanzania, Uganda, Vietnam</i>	<i>Adaptation and Mitigation</i>	<i>Funding to Climate Knowledge and Information Community (Climate-KIC) - a network of expertise that develops, brings to market and scales innovative products and services offering solutions to climate change. Ireland funds the delivery of the ClimateLaunchpad competition for green</i>	<i>Other</i>	<i>Public</i>		<i>Implemented</i>	

		<i>business ideas and post competition support for early-stage start-ups.</i>					
<i>LDCs – Africa and Asia</i>	<i>Adaptation</i>	<i>Funding to the LIFE-AR programme which supports locally driven climate change adaptation efforts in the most vulnerable countries and communities. Led by the Least Developed Countries group, the initiative seeks to assist seven of these countries in designing and implementing national climate action plans; to establish mechanisms for peer-to-peer learning and dissemination of best practice; and to support effective and credible climate financing in order to enhance LDC ownership of their adaptation efforts.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>Oceania</i>	<i>Adaptation</i>	<i>Funding to the Secretariat of the Pacific Regional Environment Programme to build resilience of vulnerable communities and government institutions to cope with and plan for climate change. The action builds climate governance systems, such as national meteorological</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

		<i>services for better early warning to weather events.</i>					
<i>LDCs</i>	<i>Adaptation</i>	<i>Funding to the Least Developed Countries Fund (LDCF) to assist LDCs in preparing and implementing their National Adaptation Plans, and in integrating climate action into development plans through capacity building, technical assistance, and the promotion of innovation and technology transfer in climate adaptation.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>LDCs</i>	<i>Adaptation</i>	<i>Funding to the Least Developed Countries Expert Group (LEG) - the only body mandated by Parties to the UNFCCC to provide dedicated support to LDCs. The LEG supports these countries in their efforts to design, plan and Implement National Adaptation Plans (NAPs), and facilitates access to financial and technical support.</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>LDCs</i>	<i>Adaptation and Mitigation</i>	<i>Funding to the International Institute for Environment and Development (IIED) for the integration of climate action and the environment into development programming, poverty reduction and conservation. Support specifically targets the poorest and most vulnerable,</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

		<i>particularly people in Least Developed Countries (LDCs), and covers a range of aspects from climate resilience and protection of biodiversity, to gender equality and capacity building.</i>					
<i>Mozambique</i>	<i>Adaptation</i>	<i>Funding to ideiaLab for the Strengthening Green Entrepreneurship Supporting Ecosystems project to increase the visibility and understanding of green business approaches in Mozambique, and the central role of green woman entrepreneurs</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>Mozambique</i>	<i>Adaptation</i>	<i>Pilot to introduce agricultural aquaponics in Mozambique producing fish and vegetable at lower cost than traditional agriculture practices using an enclosed sustainable ecosystem</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	
<i>Ethiopia</i>	<i>Mitigation</i>	<i>Funding for project titled "Developing an innovation and learning platform for enhanced economic opportunities and resilience in Gergera watershed: Action Research Programme." The project aims to improve food security, economy and resilience through developing innovation and learning platform to facilitate informed policy making and informing future design and</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

		<i>scaling of national programmes. The major project activities include adoption of climate smart practices, value chain support, livelihood interventions and research.</i>					
<i>Palestine</i>	<i>Adaptation and Mitigation</i>	<i>Ireland will provide a total of €8.8 million to the Agence Française de Développement and the Palestinian Water Authority for the development of a solar power generation facility to power the North Gaza Emergency Sewage Treatment Plant. The project – which is fully funded by Ireland – will reduce the strain on the Gaza electricity grid, provide energy for wastewater treatment and assist in water table rehabilitation.</i>	<i>Energy</i>	<i>Public</i>		<i>Implementing</i>	
<i>Palestine</i>	<i>Adaptation and Mitigation</i>	<i>Ireland continues to fund Comet-ME, a NGO providing potable water and solar power to isolated communities</i>	<i>Energy</i>	<i>Public</i>		<i>Implementing</i>	
<i>Kenya</i>	<i>Mitigation</i>	<i>Water and sanitation project to provide the population-dense community of Kibera with water points and convincing young people that practicing hygienic practices and good sanitation will benefit their health through advocacy and awareness campaigns. Project activities included construction and</i>	<i>Water and Sanitation</i>	<i>Public</i>		<i>Implemented</i>	

		<i>setting up of 20 solar powered water stations within the community, purchase of water tanks, dissemination of knowledge, and COVID-19 Graffiti at Water Point/Station.</i>					
<i>Malawi</i>	<i>Adaptation</i>	<i>Funding for the 'Root and Tuber Crops for Agricultural Transformation in Malawi (RTC-Action Malawi)' project, which is implemented by the International Potato Centre (CIP) in Malawi, aims to increase the contributions of Root and Tuber Crops (RTCs) to food security, nutrition, and incomes. The key activities include: harnessing advances in RTC research and development and scaling up these interventions as well as facilitating coordination and policy engagement.</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementing</i>	
<i>Malawi</i>	<i>Adaptation</i>	<i>Funding for the installation of a solar pump at an agriculture research station for industrial hemp crop trials. The hemp is grown for use as an eco-fuel, and as an element of climate smart farming practices</i>	<i>Agriculture</i>	<i>Public</i>		<i>Implementing</i>	
<i>Malawi</i>	<i>Adaptation</i>	<i>Funding for the SDG Hotspots Management Platform-an integrated management tool designed to improve decentralised implementation of public services across social, economic and environmental sectors ,</i>	<i>Other</i>	<i>Public</i>		<i>Implementing</i>	

		<i>implemented by UNDP Malawi. Key activities include: establishment of a database for real-time data collection on SDG progress at council level and establishment of a multi-stakeholder platform to share evidence to propel service improvements.</i>					
<i>DRC</i>	<i>Mitigation</i>	<i>Fighting deforestation through the introduction of sustainable biogas technologies and environmental training in Lualaba Province</i>	<i>Energy</i>	<i>Public</i>		<i>Implementing</i>	

Table 11 (a) Provision of capacity-building support 2019

<i>Recipient country/region</i>	<i>Targeted area</i> <i>Mitigation</i> <i>Adaptation</i> <i>Technology development and transfer</i> <i>Multiple areas</i>	<i>Programme or project title</i>	<i>Description of programme or project</i>
Kenya	Mitigation	Teagasc - Climate Smart Research and Innovation for Livestock Development	A proof-of-concept project focused on sustainable dairy production at farm level. The project aims to link international research with local knowledge by building relationships between institutions in Africa and Europe. In this way, it seeks to contribute to science-based, climate smart development of the livestock sector in Kenya. Implemented by Teagasc, the Irish agriculture and food development authority
Eritrea	Mitigation	Teagasc – Dairy project	Developing a climate-smart community dairy model that can be replicated across Eritrea using a pilot model demonstration farm and directly supporting selected dairy farmers. Implemented by Teagasc, the Irish agriculture and food development authority
Ethiopia	Mitigation	Teagasc –Agricultural Fertility and Environmental Resources project	Small project aiming to address the deficiency in crop and soil- specific nutrient advice by developing a prototype decision support tool (DST) for smallholder farmers based on data that can easily (e.g. visually) be obtained in the field. Implemented by Teagasc, the Irish agriculture and food development authority.
Global	Multiple Areas	Ireland Fellows Programme	The Programme enables early to mid-career professionals from eligible countries to undertake a fully funded one-year master's level programme at a higher education institution in Ireland in a field of study aligned with Ireland's policy priorities. The aims of the Programme are to nurture future leaders; to develop in-country capacity to achieve national SDG goals; and to build positive relationships with Ireland.
Oceania	Adaptation	Funding to the Secretariat of the Pacific Regional Environment Programme	This funding contributes to resilience-building of vulnerable communities and government institutions to cope with and plan for climate change. The action builds climate governance systems, such as national meteorological services for better early warning to weather events.
LDCs	Adaptation	Funding to the Least Developed Countries Expert Group	Funding to the Least Developed Countries Expert Group (LEG) - the only body mandated by Parties to the UNFCCC to provide dedicated support to LDCs. The LEG supports these countries in their efforts to

			design, plan and Implement National Adaptation Plans (NAPs), and facilitates access to financial and technical support.
LDCs	Multiple Areas	Funding to the International Institute for Environment and Development (IIED)	Funding to the International Institute for Environment and Development (IIED) for the integration of climate action and the environment into development programming, poverty reduction and conservation. Support specifically targets the poorest and most vulnerable, particularly people in Least Developed Countries (LDCs), and covers a range of aspects from climate resilience and protection of biodiversity, to gender equality and capacity building.
Kenya, Nigeria, Mozambique, South Africa, Tanzania, Uganda, Vietnam	Multiple Areas	Funding to the Climate Knowledge and Information Community (Climate-KIC)	Funding to Climate-KIC - a network of expertise that develops, brings to market and scales innovative products and services offering solutions to climate change. Ireland funds the delivery of the ClimateLaunchpad competition for green business ideas and post competition support for early-stage start-ups.
Global	Mitigation and Adaptation	Funding to UNEP- Vienna Convention Trust Fund for Research and Systematic Observations	Funding to UNEP- Vienna Convention Trust Fund for Research and Systematic Observations, to strengthen atmospheric research and monitoring activities in order to address the many uncertainties that exist regarding the expected ozone recovery process and interaction between ozone and climate changes
Global	Mitigation and Adaptation	Funding to UNEP – Trust Fund for the Montreal Protocol	The Multilateral Fund for the Implementation of the Montreal Protocol provides funds to help developing countries comply with their obligations under the Protocol to phase out the use of ozone-depleting substances (ODS) at an agreed schedule.
Global	Multiple Areas	Funding for the UNFCCC Gender Action Plan	Irish Aid supports the efforts of the UNFCCC Secretariat to mainstream gender in climate action. The project sets out to enhance the knowledge and capacity of UNFCCC stakeholders, including both governments and non-state actors, in creating gender-responsive climate policy and to ensure the full, equal and meaningful participation of women in UNFCCC and national processes.
Kenya	Multiple Areas	Young Scientist Kenya	Young Scientists Kenya (YSK) is a unique initiative that gives young people from across Kenya an opportunity to demonstrate innovation and showcase their scientific talents through a National Science and Technology competition. YSK is based on the premise that a wealth of talent and potential for innovation exists among Kenyan youth and that by providing a platform for them to compete and showcase their own practical

			solutions to the problems faced within their communities, they can be encouraged to pursue careers in science, technology, engineering and Mathematics (STEM). Young Scientists Kenya is an initiative of both the Ministry of Education and the Government of Ireland through its Embassy in Kenya, and with support from BLAZE by Safaricom and other partners.
Mozambique	Adaptation	Strengthening Green Entrepreneurship supporting Ecosystems	Funding to ideaLab to increase the visibility and understanding of green business approaches in Mozambique, and the central role of green woman entrepreneurs
Ethiopia	Adaptation; Multiple Areas	Productive Safety Net Programme	Ireland's longstanding support to the Ethiopian Government's Productive Safety Net Programme focusses on enhancing the resilience of extreme poor and vulnerable households in rural Ethiopia, particularly with regard to food security. The programme aims to improve these households' ability to cope with shocks like failing rains or rising food prices and avoid resorting to short-term coping mechanisms like selling off their livestock. The programme provides predictable cash or food support in return for vital work on projects such as land rehabilitation. It also works to improve farmer capacity and credit provision, as well as to develop food production capacities, value chains and alternative livelihood opportunities with self-sufficiency as the long-term goal. Ireland's support particularly targets households headed by women.
Sierra Leone	Multiple Areas	Linking Agriculture, Natural Resource Management and Nutrition (LANN)	The project, implemented by Welthungerhilfe and Concern Worldwide aims to enhance the ability of vulnerable households to improve Food and Nutrition Security. The objective of the grant is to improve household Food and Nutrition Security among vulnerable households, including by enhancing climate resilience and promoting conservation of biodiversity. The key activities include improved diversity and quality of the household diet, improve hygiene and sanitation, COVID-19 preparedness, prevention and resilience and inter-sectoral learning and coordination.
Malawi	Multiple Areas	Pathways for Strengthened Resilience & Graduation for SCTP beneficiaries (P4R)	The project implemented by Save the Children in Malawi, aims to reduce poverty, deprivation and increase resilience among the poorest and most vulnerable households in Ntcheu district. The key activities include: provision of training in life, vocational and enterprise skills amongst SCTP beneficiaries with productive capacity, capacity building in DRR and climate change adaptation and strengthening community level DRR structures.

Malawi	Adaptation	International Potato Centre – improved food and nutrition security	Improved food and nutrition security
Malawi	Adaptation	Achieving Sustainable Poverty Reduction through Inclusive Resilience and Empowerment (ASPIRE)	Improved Food and Nutrition Security
Tanzania	Adaptation and Mitigation	World Food Programme	Sustainable Agriculture
Myanmar	Multiple Areas	LIFT Fund	A multi-donor fund established in 2009 to strengthen the resilience and sustainable livelihoods of poor and vulnerable groups in Myanmar, particularly women, internally displaced people, migrants, smallholder farmers, landless people, people with disabilities and those vulnerable to trafficking and forced labour
Global	Adaptation	Global Environment Monitoring System for Water (GEMS/Water) (UNEP)	GEMS/Water aims to improve water quality monitoring capacity through the enhancement of approaches to the gathering, dissemination and application of data on water quality.
<i>a To be reported to the extent possible.</i> <i>b</i> Each Party included in Annex II to the Convention shall provide information, to the extent possible, on how it has provided capacity-building support that responds to existing and emerging capacity-building needs identified by Parties not included in Annex I to the Convention in the areas of mitigation, adaptation and technology development and transfer. <i>c</i> Additional information may be provided on, for example, the measure or activity and co-financing arrangements.			

Table 11 (b) Provision of capacity-building support 2020

<i>Recipient country/region</i>	<i>Targeted area</i> <i>Mitigation</i> <i>Adaptation</i> <i>Technology development and transfer</i> <i>Multiple areas</i>	<i>Programme or project title</i>	<i>Description of programme or project</i>
Kenya	Mitigation	Teagasc - Climate Smart Research and Innovation for Livestock Development	A proof-of-concept project focused on sustainable dairy production at farm level. The project aims to link international research with local knowledge by building relationships between institutions in Africa and Europe. In this way, it seeks to contribute to science-based, climate smart development of the livestock sector in Kenya. Implemented by Teagasc, the Irish agriculture and food development authority
Eritrea	Mitigation	Teagasc – Dairy project	Developing a climate-smart community dairy model that can be replicated across Eritrea using a pilot model demonstration farm and directly supporting selected dairy farmers. Implemented by Teagasc, the Irish agriculture and food development authority
Ethiopia	Mitigation	Teagasc – Agricultural Fertility and Environmental Resources project	Small project aiming to address the deficiency in crop and soil- specific nutrient advice by developing a prototype decision support tool (DST) for smallholder farmers based on data that can easily (e.g. visually) be obtained in the field. Implemented by Teagasc, the Irish agriculture and food development authority.
Developing Countries	Adaptation	Goal - Resilience ARC-D	Increasing knowledge and use of resilience measurement in the global humanitarian community
Global	Multiple Areas	Ireland Fellows Programme	The Programme enables early to mid-career professionals from eligible countries to undertake a fully funded one-year master's level programme at a higher education institution in Ireland in a field of study aligned with Ireland's policy priorities. The aims of the Programme are to nurture future leaders; to develop in-country capacity to achieve national SDG goals; and to build positive relationships with Ireland.
Ghana	Multiple Areas	Funding to 4SD for Food Systems Dialogue Support	4SD is a social enterprise specialised in training and mentoring of development practitioners. 4SD has been engaged by the Special Envoy and Summit Secretariat to assist with the Food Systems Summit Dialogues. DFA's funding will have a specific focus on the African Union, the Small Island

			Developing States (SIDS) and other relevant regional bodies for Least Development Countries (LDCs).
Oceania	Adaptation	Funding to the Secretariat of the Pacific Regional Environment Programme	This funding contributes to resilience-building of vulnerable communities and government institutions to cope with and plan for climate change. The action builds climate governance systems, such as national meteorological services for better early warning to weather events.
LDCs	Adaptation	Funding to the Least Developed Countries Expert Group	Funding to the Least Developed Countries Expert Group (LEG) - the only body mandated by Parties to the UNFCCC to provide dedicated support to LDCs. The LEG supports these countries in their efforts to design, plan and Implement National Adaptation Plans (NAPs), and facilitates access to financial and technical support.
LDCs	Multiple Areas	Funding to the International Institute for Environment and Development (IIED)	Funding to the International Institute for Environment and Development (IIED) for the integration of climate action and the environment into development programming, poverty reduction and conservation. Support specifically targets the poorest and most vulnerable, particularly people in Least Developed Countries (LDCs), and covers a range of aspects from climate resilience and protection of biodiversity, to gender equality and capacity building.
Kenya, Nigeria, Mozambique, South Africa, Tanzania, Uganda, Vietnam	Multiple Areas	Funding to the Climate Knowledge and Information Community (Climate-KIC)	Funding to Climate-KIC - a network of expertise that develops, brings to market and scales innovative products and services offering solutions to climate change. Ireland funds the delivery of the ClimateLaunchpad competition for green business ideas and post competition support for early-stage start-ups.
Global	Mitigation and Adaptation	Funding to UNEP- Vienna Convention Trust Fund for Research and Systematic Observations	Funding to UNEP- Vienna Convention Trust Fund for Research and Systematic Observations, to strengthen atmospheric research and monitoring activities in order to address the many uncertainties that exist regarding the expected ozone recovery process and interaction between ozone and climate changes
Global	Mitigation and Adaptation	Funding to UNEP – Trust Fund for the Montreal Protocol	The Multilateral Fund for the Implementation of the Montreal Protocol provides funds to help developing countries comply with their obligations under the Protocol to phase out the use of ozone-depleting substances (ODS) at an agreed schedule.

Global	Mitigation and Adaptation	Funding to the Nationally Determined Contributions (NDC) Partnership	Funding to the Nationally Determined Contributions (NDC) Partnership - to assist countries in accessing cutting-edge technical and financial knowledge resources to accelerate climate action
LDCs- Africa and Asia	Adaptation	Funding to the LIFE-AR programme	The LDC Initiative for Effective Adaptation and Resilience (LIFE-AR) programme supports locally driven climate change adaptation efforts in the most vulnerable countries and communities. Led by the Least Developed Countries group, the initiative seeks to assist seven of these countries in designing and implementing national climate action plans; to establish mechanisms for peer-to-peer learning and dissemination of best practice; and to support effective and credible climate financing in order to enhance LDC ownership of their adaptation efforts.
Global	Multiple Areas	Funding for the UNFCCC Gender Action Plan	Irish Aid supports the efforts of the UNFCCC Secretariat to mainstream gender in climate action. The project sets out to enhance the knowledge and capacity of UNFCCC stakeholders, including both governments and non-state actors, in creating gender-responsive climate policy and to ensure the full, equal and meaningful participation of women in UNFCCC and national processes.
Kenya	Adaptation	Potato Capacity Building Project	The Potato Capacity Building Project aimed at supporting smallholder farmers to increase revenue through training on good agricultural practices, facilitating access to affordable certified potato seeds and creating linkages with formal and non-formal markets for their produce. Implemented by the International Fertilizer Development Centre.
Kenya	Multiple Areas	Young Scientist Kenya	Young Scientists Kenya (YSK) is a unique initiative that gives young people from across Kenya an opportunity to demonstrate innovation and showcase their scientific talents through a National Science and Technology competition. YSK is based on the premise that a wealth of talent and potential for innovation exists among Kenyan youth and that by providing a platform for them to compete and showcase their own practical solutions to the problems faced within their communities, they can be encouraged to pursue careers in science, technology, engineering and Mathematics (STEM). Young Scientists Kenya is an initiative of both the Ministry of Education and the Government of Ireland through its Embassy in Kenya, and with support from BLAZE by Safaricom and other partners.
Mozambique	Adaptation	Strengthening Green Entrepreneurship supporting Ecosystems	Funding to ideaLab to increase the visibility and understanding of green business

			approaches in Mozambique, and the central role of green woman entrepreneurs
Mozambique	Adaptation	Aquaponics for Women Protection	Pilot to introduce agricultural aquaponics in Mozambique producing fish and vegetable at lower cost than traditional agriculture practices using an enclosed sustainable ecosystem. Implemented by Meaningful Consultoria, Lda.
Ethiopia	Adaptation; Multiple Areas	Productive Safety Net Programme	Ireland's longstanding support to the Ethiopian Government's Productive Safety Net Programme focusses on enhancing the resilience of extreme poor and vulnerable households in rural Ethiopia, particularly with regard to food security. The programme aims to improve these households' ability to cope with shocks like failing rains or rising food prices and avoid resorting to short-term coping mechanisms like selling off their livestock. The programme provides predictable cash or food support in return for vital work on projects such as land rehabilitation. It also works to improve farmer capacity and credit provision, as well as to develop food production capacities, value chains and alternative livelihood opportunities with self-sufficiency as the long-term goal. Ireland's support particularly targets households headed by women.
Ethiopia	Multiple Areas	Multi Donor Trust Fund for the Ethiopia Productive Safety Net Programme (PSNP) - Donor Coordination Team (DCT)	"Multi Donor Trust Fund for the Ethiopia Productive Safety Net Programme (PSNP) - Donor Coordination Team (DCT)" for coordinating and facilitating dialogue between donors and government as well as facilitating joint monitoring, providing technical support to government on programme implementation, supporting programme design, and managing research on PSNP.
Ethiopia	Mitigation; Multiple Areas	Developing an innovation and learning platform for enhanced economic opportunities and resilience in Gergera watershed: Action Research Programme.	The project aims to improve food security, economy and resilience through developing innovation and learning platform to facilitate informed policy making and informing future design and scaling of national programmes. The major project activities include adoption of climate smart practices, value chain support, livelihood interventions and research.
Nepal	Adaptation and Mitigation	Community responses to climate change	Support to community user groups (CUGs) in slum areas to address the impact of climate change
Sierra Leone	Multiple Areas	Linking Agriculture, Natural Resource Management and Nutrition (LANN)	The project, implemented by Welthungerhilfe and Concern Worldwide aims to enhance the ability of vulnerable households to improve Food and Nutrition Security. The objective of the grant is to improve household Food and Nutrition Security among vulnerable households, including by enhancing climate resilience and promoting conservation of biodiversity. The key activities include improve diversity and quality of the household diet, improve

			hygiene and sanitation, COVID-19 preparedness, prevention and resilience and inter-sectoral learning and coordination.
Malawi	Multiple Areas	Pathways for Strengthened Resilience & Graduation for SCTP beneficiaries (P4R)	The project implemented by Save the Children in Malawi, aims to reduce poverty, deprivation and increase resilience among the poorest and most vulnerable households in Ntcheu district. The key activities include: provision of training in life, vocational and enterprise skills amongst SCTP beneficiaries with productive capacity, capacity building in DRR and climate change adaptation and strengthening community level DRR structures.
Malawi	Adaptation	Root and Tuber Crops for Agricultural Transformation in Malawi (RTC-Action Malawi)	The project, which is implemented by the International Potato Centre (CIP) in Malawi, aims to increase the contributions of Root and Tuber Crops (RTCs) to food security, nutrition, and incomes. The key activities include: harnessing advances in RTC research and development and scaling up these interventions as well as facilitating coordination and policy engagement.
Malawi	Adaptation	Achieving Sustainable Poverty Reduction through Inclusive Resilience and Empowerment (ASPIRE)	The project is being implemented in Malawi by United Purpose. It aims to increase the resilience of 25,000 poor households to economic, social, and environmental shocks in TAs Kaphuka and Chauma in Dedza District. The key activities include: Disaster Risk Management, enhancing crop and livestock production and productivity and citizens' empowerment in decision making.
Malawi	Adaptation	SDG Hotspots Management Platform	The platform is an integrated management tool designed to improve decentralised implementation of public services across social, economic and environmental sectors, implemented by UNDP Malawi. Key activities include: establishment of a database for real-time data collection on SDG progress at council level and establishment of a multi-stakeholder platform to share evidence to propel service improvements.
Antigua and Barbuda	Adaptation; Multiple Areas	International Federation Of Red Cross And Red Crescent	Funding to build the resilience of communities to deal with climate change including expanding the capacity to respond to complex threats to community health and livelihoods, due to COVID-19 and climate disasters.
Tanzania	Adaptation and Mitigation	Climate Smart Agriculture Programme in Tanzania	The programme, implemented by the World Food Programme aims to support 18,000 smallholder farmers to access profitable Sorghum markets, enhance climate resilience, and improve their incomes. The key activities include, supporting farmers access to: improved financial services, crop insurance, agricultural services and inputs, as well as supporting farmers to practise climate smart agriculture and to diversify crop production, these activities are delivered in partnership with Farm Africa.
Vietnam	Adaptation	Community resilience	Support to community ownership and capacity building for infrastructure maintenance in ethnic minority areas

Myanmar	Multiple Areas	LIFT Fund	A multi-donor fund established in 2009 to strengthen the resilience and sustainability of livelihoods of poor and vulnerable groups in Myanmar, particularly women, internally displaced people, migrants, smallholder farmers, landless people, people with disabilities and those vulnerable to trafficking and forced labour. This includes fostering climate-smart practices in agriculture.
Cabo Verde, Comoros, Mauritius and Sao Tomé and Príncipe	Multiple Areas	"Increasing Transparency and Multi-Stakeholder collaboration in fisheries management among four SIDS in Africa"	The project is implemented by the Fisheries Transparency Initiative (FiTI) in the Seychelles and aims to increase transparency and participation in fisheries governance. The objective of the grant is to support FiTI's outreach, promotion and advocacy in four African SIDS, aligning with Ireland's Strategy for Partnership with SIDS.
DRC	Multiple Areas	Community resilience	The aim of this programme, implemented by Trócaire, is that communities in Aru and Mambasa are better resourced to prepare for, withstand and recover from crises and disaster. Key Activities include communities adopt measures and approaches which strengthen their resilience to cope with crises and disasters. The programme is delivered in partnership with Caritas Mahagi, Caritas Wamba and Sofepadi.
Global	Adaptation	Global Environment Monitoring System for Water (GEMS/Water) (UNEP)	GEMS/Water aims to improve water quality monitoring capacity through the enhancement of approaches to the gathering, dissemination and application of data on water quality.
Developing Countries	Multiple Areas	UNCLS	Voluntary core contribution the Trust Fund to assist developing states to participate in the work of the Intergovernmental Conference on a new legal instrument for the conservation and sustainable development of marine biological diversity in areas beyond national jurisdiction.
Uganda	Adaptation	Strengthening livelihoods, nutrition and climate resilience of smallholder farmers in North East Uganda	The project, implemented with Katakwi Conserve Uganda, Kaberamaido Operation to Save the Needy, Morukakise Integrated Dev Assoc, Olilim Rural Farmers' Association, and Eganganaros Build Tomorrow Group aims to reduce poverty, improve food and nutrition security and climate resilience of smallholder farmers in four districts in the Teso sub-region in North East Uganda.
<i>a To be reported to the extent possible.</i> <i>b Each Party included in Annex II to the Convention shall provide information, to the extent possible, on how it has provided capacity-building support that responds to existing and emerging capacity-building needs identified by Parties not included in Annex I to the Convention in the areas of mitigation, adaptation and technology development and transfer.</i> <i>c Additional information may be provided on, for example, the measure or activity and co-financing arrangements.</i>			

Documentation box

1. Core / general
Core/general refers to un-earmarked support to the general budget of relevant organisations.
2. Climate-specific
For the purposes of this return and in keeping with the guide note provided by the Commission, in the case of funding through bilateral/ regional channels, Ireland's reporting includes only funding for which Rio Climate Markers (adaptation, mitigation, cross-cutting) were a principal or significant objective. In the case of multilateral channels, most of our contributions were Imputed Multilateral Shares and we followed the recommended climate-specific calculations respectively. For those that were not Imputed Multilateral Shares, we used our judgement and determined the payments were climate-specific based on their purpose. We have explained the reasoning behind each payment in the 'Additional information' column in Table 8.
3. Status
Committed and Provided amounts were drawn from Ireland's OECD DAC CRS report and Departmental budget records. Ireland reports to the DAC as 'Commitment derived from Disbursement'.
4. Funding source
The majority of Irish climate finance counts as Official Development Assistance, and Ireland adheres to the OECD DAC Definitions of ODA/OOF. Ireland adheres to the OECD DAC Definitions of ODA/OOF. Climate finance (and ODA) allocations are agreed annually by the Irish Government, through the budgetary cycle. A limited number multi-annual financial commitments have been made (eg to provide €4 million annually to the GCF to 2023).
5. Financial instrument
The majority of this return counts as Official Development Assistance, and 100% of what is ODA is in grant form to multilateral organisations. We also contribute to a number of general trust funds which cover a range of activities by organisations, and have a number of subscriptions. eg. Global Environment Facility.
6. Type of support
Ireland's reporting has adhered to: i) the definitions of the Rio markers contained in the OECD DAC Rio Markers for Climate Handbook for assessing objectives of each activity, and ii) the methodology recommended in section 2.4.2 of the Commission's guidance note for designating an activity as mitigation, adaptation or crosscutting.
7. Sector
Ireland's reporting adheres to the sector categorisation suggested in UNFCCC guidance.
<i>Each Party shall provide an indication of what new and additional financial resources it has provided and clarify how it has determined that such resources are new and additional. Please provide this information in relation to tables 7 and 8.</i>
This is demonstrated in the narrative text of Chapter 7.

Chapter Eight:

Research and Systematic Observation

8. Research and Systematic Observation

8.1 Introduction

Research and systematic observations are essential to understanding and responding to climate change.

Ireland has advanced a series of initiatives to support, develop and coordinate, climate change research as part of a national programme. It has developed a well-structured research programme which is primarily aimed at informing and supporting climate change policy implementation and development and informing actions by stakeholders. Under national legislation, the EPA is responsible for coordinating environmental research in Ireland. The CAPs and the National Adaptation Framework (NAF) enhance the roles of the EPA in coordinating climate research across state-funded bodies. As part of this function, under EPA Research 2030: A Framework for EPA Research 2021-2030, two national Research Coordination Groups were established, one considering all environmental research (National Environmental Research Coordination Group or NERCG) and a second focusing specifically on climate research (Climate Research Coordination Group or CRCG).

Ireland carries out an extensive range of systematic observations of essential climate variables (ECVs) and hosts a range of advanced observations which are part of regional and global networks. These observations are being continually developed by building on existing observation systems in the atmospheric, ocean and terrestrial domains and through investment in new systems. The second 'Status of Ireland's Climate' report, published in 2021, outlines the current status related to systematic observations of ECVs (see section 8.9). Information and analysis from research and systematic observation systems are made available to key stakeholders and the public.

Ireland actively engages with processes at the science to policy interface including contributing to the work of the IPCC and engagement with UNFCCC Subsidiary Body on Scientific and Technical Advice (SBSTA).

8.2 Public Funding of Climate Research and Systematic Observation

It is important for Ireland to have an active research community that is focused on Ireland-specific issues related to climate change and is engaged with European and global research activities. A coherent, well-structured research programme that is designed to address Ireland-specific issues and is linked to EU funding streams is key to enabling this.

It is also essential to ensure that publicly funded research is accessible, broadly disseminated and policy relevant. It should take account of the national climate policy and the objectives and actions contained in the CAPs and the NAF.

At the national level, as the climate change challenge is a cross-sectoral issue, Government funding support for climate-related research, development and innovation is provided by a variety of different Government Departments and agencies and specific programmes.

Collaboration between national, EU and international research programmes and funders also offers the potential to engage in research on transitioning to a low carbon economy.

Ireland's EPA is mandated under Section 71 of the EPA Act 1992 to advise the Minister for the Environment, Climate and Communications of the need for environmental research and to prepare research programmes. It manages and allocates this funding under the EPA Research Framework 2030. Addressing climate change evidence needs is one of four pillars alongside Facilitating a green and circular economy; Delivering a healthy environment and Protecting and restoring our natural environment.

Funding for specific climate change research is provided by the DECC (largely through the EPA), the DAFM (both directly and through Teagasc and the Marine Institute), the Department of Housing, Local Government and Heritage (owing to its responsibility for Met Éireann, Ireland's meteorological service and the systematic observations it carries out within the climate change area), the Department of Further and Higher Education, Research, Innovation and Science (owing to responsibility for Science Foundation Ireland/SFI and the Irish Research Council/IRC) and more recently the Department of Transport. The scope for SFI and IRC to increase funding towards climate and climate related research improved with the update/refresh of the National Research Priority Areas 2018 to 2023, which enhanced the profile of climate change as a priority area for national research funding. In addition, the Government's Research and Innovation Strategy, Impact 2030 positions research and innovation as critical enablers to support delivery of climate action targets and to address wider environmental and sustainability challenges.

Climate related research is also funded by a number of other state bodies including the Sustainable Energy Authority of Ireland (SEAI), the main source of funding for energy research, Geological Survey Ireland, Economic and Social Research Institute (ESRI) (socio-economic research) and Enterprise Ireland (EI) (enterprise orientated research).

Table 8.1: An overview selection of climate-related competitive research funding available in Ireland

Provider	Detail	Stakeholder

DAFM	Competitive research funding programme, restructured approach in 2020, seeking projects across key thematic areas, including climate and biodiversity; sustainable animal and plant health and production; agri-digitalisation and the bioeconomy; and safe, healthy food production and processing. DAFM committed to a number of ERA-Nets; DAFM, in collaboration with DAERA-NI and the US National Institute of Food and Agriculture, launched the 2020 US-Ireland Research and Development Partnership Call for Proposals in Agriculture.	Government Exchequer – DAFM
Department of Transport	Funds and co-funds projects that look at directly applicable solutions to climate mitigation and adaptation, as well as air quality issues.	Government Exchequer – Department of Transport
EPA	EPA Research Programme 2014 – 2020 Under the FYAR required by the CRCG, EPA opened a call for lead authors and support fellowship. Awards made under its strategic partnership with SFI, DAFM, IRC and Fulbright Commission Ireland.	DECC
Irish Research Council	Funds numerous bottom-up research projects (doctoral, post-doctoral and P led) that may include climate change topics. Selected examples of relevant schemes are the IRC Postgraduate Scholarship Scheme 2020 – EPA Co-funded Scholarships Scheme and the COALESCE (Collaborative Alliances for Societal Challenges) research call in 2020.	DFHERIS

MI	Funding awarded under the MI Marine Research Programme in 2020 for Postgraduate Scholarships; Postdoctoral Fellowships; Ship-time Programme access to national research vessels Celtic Explorer and Celtic Voyager); and co-funded actions for marine-related research projects and awards.	DPER
OPW	Carries out research on flood risk and rivers in relation to fluvial and coastal flood risk management. External research is generally procured by a competitive tender process. OPW does not currently have a dedicated research call, but instead procures research through a competitive tender process.	DETE (DFHERIS from 2021)
SFI	SFI has numerous funding programmes available to support individual-led and challenge-based research, partnerships with enterprise, international partnerships and education and public engagement. All may support research related to climate. These include SFI Research Centres, Frontiers for the Future; Research Professorship, Future Research Leaders, Strategic Partnerships and Future Innovator Prize, among others.	DECC
SEAI	The SEAI National Energy Research, Development & Demonstration (RD&D) Funding Programme supports innovative energy RD&D projects that contribute to Ireland's transition to a clean and secure energy future.	DECC
Teagasc	Carries out and administers research and knowledge transfer programmes on animals, crops and grassland management, food and rural development.	

DAERA-NI, Department of Agriculture, Environmental and Rural Affairs – Northern Ireland; DAFM, Department of Agriculture, Forestry and the Marine; DECC, Department of the Environment, Climate and Communications; DETE, Department of Enterprise, Trade and Employment; DFHERIS, Department of Further and Higher Education, Research, Innovation and Science; DHLGH, Department of Housing, Local Government and Heritage; DPER, Department of Public Expenditure and Reform; DT, Department of Transport; EI, Enterprise Ireland; GSI, Geological Survey Ireland; IRC, Irish Research Council; MI, Marine Institute; NPWS, National Parks & Wildlife Service; OPW, Office of Public Works; RD&D, Research, Development & Demonstration; SEAI, Sustainable Energy Authority of Ireland; SFI, Science Foundation Ireland.

8.2.1 National Competitive Research Funding Programmes

i. Environmental Protection Agency

In 2021 the EPA launched its new research framework EPA Research 2030. This is a ten-year high-level framework for the EPA's research programming (2021-2030), designed to be agile, responsive and flexible. EPA-funded research is essential to:

- Supporting the monitoring, assessment, reporting and regulatory activities of the EPA.
- Generating evidence crucial in assisting Ireland in meeting its commitments and requirements under the various international, EU and national policies and strategies.
- Generating the evidence base that supports decision making, behaviour change and policy development.
- Addressing knowledge gaps, providing the evidence-base and responding to priority challenges.
- Supporting multi-disciplinary, cross-sectoral and multi-stakeholder partnership projects.
- Developing environmental research capacity in Ireland, recognising the importance of not only sustaining the research-base but also of building and training the researchers in specific areas.

EPA Research 2030 will further our understanding of our environmental and natural systems. It will enable the outcomes from research to be put in action to protect and improve our natural and built environment.

EPA Research 2030 will generate evidence to support Ireland's response to global challenges, including climate disruption and biodiversity loss, as well as support the implementation of the UN Sustainable Development Goals. It will be an enabler to informing and engaging with citizens and communities.

It will be implemented through Annual Research Calls and supporting thematic Research Areas Assessments, which will be developed in partnership with key stakeholders and at regular intervals to ensure ongoing relevance (at least three cycles over the ten years). EPA

Research 2030 implementation will also be supported by Action Plans, Communication and Knowledge Transfer plans, as well as Performance Reviews.

The scope of EPA-funded research is informed by its relevance to policy and its alignment with the key activities of the EPA. Consideration of the interactions between social, behavioural and economic factors as an integral component of environmental research will lead to enhanced governance and more effective implementation of environmental policies and strategies.

EPA Research 2030 has a thematic structure and comprises four interconnected hubs that bring an integrated and cross-sectoral approach, enabling holistic management and protection of our environment. The four pillars are:

- Addressing climate change evidence needs
- Facilitating a green and circular economy
- Delivering a healthy environment
- Protecting and restoring our natural environment

ii. Sustainable Energy Authority Ireland (SEAI)

SEAI coordinates and funds a range of research, development & demonstration (RD&D) activities relating to the production, supply & use of energy. This stimulates and accelerates the development and deployment of energy related products, processes & systems in the Irish marketplace. It supports solutions that enable technical and other barriers to market uptake of energy related products, processes & systems, to be overcome.

SEAI's RD&D funding is delivered through the following mechanisms:

- SEAI's National Energy RD&D Funding Programme¹
- The SEAI Ocean Energy Prototype Development Fund²
- Supporting participation of Ireland-based researchers in Horizon 2020/Horizon Europe activities³.

iii. Agricultural Research

Research is critical in identifying state of the art technologies to improve both the carbon efficiency and climate resilience of Irish agriculture and also to help develop a circular bioeconomy. Ireland has significant expertise that can help the agri-food sector become a

¹ <https://www.seai.ie/grants/research-funding/research-development-and-demonstration-fund/>

² <https://www.seai.ie/grants/research-funding/ocean-energy-prototype-development-fund/>

³ <https://www.seai.ie/grants/research-funding/horizon-2020/>

world leader in low carbon production systems. Research also has an important role in optimising the mitigation potential within Ireland's forest sector.

Irish agricultural GHG research is focused on developing an improved understanding of the key processes involved in the production of methane and N₂O emissions such as identifying promising mitigation options (such as dietary strategies, manure management, fertiliser technologies as well as future technologies; quantifying the carbon sequestration potential of agricultural soils) and improving the national GHG inventories regarding forestry and agriculture.

In addition, the Department of Agriculture, Food and the Marine (DAFM), together with Teagasc, is active in EU and international research groups on GHGs such as the EU Joint Programming Initiative on Agriculture, Food Security and Climate Change (JPI-FACCE) and the Global Research Alliance (GRA) on mitigating agricultural GHGs. DAFM hosts and chairs a national steering group which provides a forum to help guide Ireland's involvement on both initiatives.

DAFM research funding (which underpins both national and international research) is informed by two Strategic Research Agendas which identify sector research priorities and include relevant climate change mitigation related research areas. These are the Sustainable, Healthy Agri-food Research Plan (SHARP), developed by a cross-funded working group hosted by DAFM and published in June 2015, and Forest Research Ireland (FOI) developed by a working group of the Competitive Forest Research for Development Council and published by DAFM in October 2014. Informed by the two research agendas, DAFM funds competitive calls for 'public good' research through its three research programmes – the Food Institutional Research Measure (FIRM), the Research Stimulus Fund (RSF) for primary agriculture production, and the Programme of Competitive Forest Research for Development (COFORD).

iv. Met Éireann

Met Éireann is Ireland's National Meteorological Service and is maintained by the State under the UN Convention of the World Meteorological Organisation (WMO). It is the public service scientific organisation responsible to the Irish State for:

- The production and communication of authoritative weather and climate services to protect life and property, and to promote wider societal and economic wellbeing;
- Conducting research into weather and climate, to inform decision-making;
- The collection and production of high-quality meteorological data;

- Representing Ireland at the WMO, ECMWF (European Centre for Medium-Range Weather Forecasts) and EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites).

Met Éireann is a Division of the Department of Housing, Local Government and Heritage and works with its colleagues across State Departments and Agencies to support the whole-of-Government approach to delivering Ireland's CAPn. Met Éireann's actions include:

- Informing climate change policy by implementing a climate science programme to understand, analyse and model Ireland's past, current and future climate and disseminating its outputs;
- Supporting climate change impact planning and decision-making by developing and coordinating climate services (i.e. knowledge and tools needed for users to make decisions on climate impacts);
- Monitoring Ireland's climate by delivering advanced, sustainable and long-term climate and environmental monitoring programmes;
- Supporting national climate action capability and capacity building by coordinating climate-related working groups (e.g. GCOS) and implementing a weather and climate research programme;
- Supporting the National Flood Forecasting Warning Service (NFFWS) by building flood forecasting capability;
- Supporting the National Emergency Management during extreme weather events.

Research funding is a key component of Met Éireann's strategic objectives and supports a research programme focused around addressing the societal challenges of climate change and extreme weather in a warming world. Met Éireann's Weather and Climate Research Programme underpins the expertise and knowledge needed to enable the delivery and continuous improvement of national predictive capability in the areas of weather, climate and hydrology and to ensure that, particularly in the climate context, research outputs provide the evidence and tools necessary to inform policy and decision-making.

A Global Climate Observing System (GCOS) National Committee for Ireland (GCOS-Ireland) was established early in 2018 following a joint initiative by the Director of Met Éireann, the Director General of the Environmental Protection Agency, and the Chief Executive of the Marine Institute. The role of GCOS-Ireland is to coordinate and promote the GCOS observing principles relating to Essential Climate Variables (ECVs) of relevance to Ireland. The GCOS-Ireland report 'The Status of Ireland's Climate, 2020'⁴, co-funded by the EPA, the Marine

⁴ <https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020.php>

Institute and Met Éireann, provides the status of climate monitoring in Ireland across land, ocean and the atmosphere.

8.2.2 Research support

In 2020, Met Éireann issued a competitive research call for proposals in the area of climate services entitled TRANSLATE to standardise national climate projections for Ireland, using all available data, and to develop climate services. TRANSLATE, leveraging the wider resource of global and European organisations as well as the significant volume of current and past international research in this area, addresses the recommendation from the CCAC 2019 Annual review for the “development of a common set of climate projections that capture the range of change in future climate projections for use in adaptation, infrastructure and investment planning to 2050 and beyond”.

New competitive research calls continue to answer significant climate challenge questions and contribute to increasing the national climate research capability. In March 2022, Met Éireann announced a four-year project funding aimed at improving our understanding of the North Atlantic climate system and its impact on Ireland.

In addition to funding external research organisations, Met Éireann undertakes its own, core research activities in areas related to climate impacts and adaptation, including work on climate modelling, climate services, climate communications, coastal flood forecasting capability, coastal monitoring, fluvial (river) flooding capability, pluvial flooding capability, national climate monitoring capabilities, coordination of GCOS-Ireland activities and support of the National Emergency Coordination Group.

i. EU/International Context

National research investment is the main funding source for climate change research in Ireland. However, researchers from Ireland have been successful in attracting international funding at the European level. As well as being an important funding source, this enables researchers from Ireland to work with and lead on projects that involve leading international research groups.

Horizon Europe was launched in 2021. This is Europe's main instrument for funding research and development and will run from 2021–2027 with a budget of c. €95 billion. Under Pillar II (Global challenges & European Industrial Competitiveness) climate research can be found under most clusters, in particular cluster 5: Climate, energy and mobility and Cluster 6: Food, bioeconomy, natural resources, agriculture and environment. Five Missions Areas have also been identified. A mission is a portfolio of actions across disciplines intended to achieve a

bold, inspirational and measurable goal within a set timeframe, with impact for society and policy making, as well as relevance for a significant part of the European population and wide range of European citizens. Climate change research is relevant to the five missions, in particular Mission 1 on Adaptation to climate change, including societal transformation and Mission 4 on Climate-neutral and smart cities.

There has also been a continuing engagement with pan European research work through the EU Joint Programming Initiatives (JPIs) and the development of wider international links (see section 8.5).

ii. Core Research Activities (i.e. internally completed research)

In addition to competitive research awards granted through national research funding programmes or leveraged from EU/international funding programmes, some national authorities undertake research activities themselves, i.e. core research activities. These research activities are funded by these organisations and performed in-house. For example, in excess of € 8.2 million was spent on core research activities in 2021 by Met Éireann (MÉ), Marine Institute, Geological Survey Ireland, Central Statistics Office, Department of Transport, National Economic and Social Council and Teagasc.

8.2.3 Five Year Assessment of Research (5YAR)

The first five-year assessment of climate research activities in Ireland was initiated in 2020 and advanced in 2021. The work will update national understanding of climate change, its impacts and response options, and inform policy options in climate mitigation and adaptation and is expected to be completed in 2023. It will also identify, inter alia, evidence gaps and research priorities. Accordingly, the report of this assessment will be a critical source of evidence for the national research prioritisation and planning processes. Six lead author grants and one support fellowship were awarded by EPA in 2020, with a further three lead author grants awarded in 2021 by, SEAI, SFI and Department of Transport.

The key objective of the '5YAR' process is to deliver an assessment of our understanding of climate change based on scientific research and systematic observations in Ireland, and linked EU and global analysis, in a timely manner that can inform decision-making on actions to address climate change. In addition, the process serves to:

- Identify research gaps to inform future research investment needs and priority research issues;

- Utilise and enhance existing and emerging structures that are designed to address climate change; develop national assessment and analysis capacity;
- Enhance engagement with similar developments at European and international levels;
- Establish a structure and process to develop future reports.

The '5YAR' follows the approach of the IPCC by providing a report in a series of thematic volumes with an overarching synthesis report. The volumes broadly reflect the IPCC structure but include an additional volume on realising the benefits and opportunities of the required transition and transformation. Accordingly, the '5YAR' will report under the following four volumes

- Science: Ireland in a changing world;
- Achieving climate neutrality by 2050;
- Being prepared for Ireland's future climate;
- Realising the benefits of transition and transformation.

The reports will build on material provided by the IPCC during its assessment cycles (6th Cycle in '5YAR' currently under way) by merging its findings with Ireland-specific research and analysis. The work will also use data from observations systems in Ireland, as identified under GCOS, as well as information from the Copernicus and similar programmes.

Steering groups from membership of the CRCG have been established for each volume to coordinate the work, including agreeing on the scope. Experts based in State Agencies and bodies, and Departmental officials will oversee the writing and review process. The EPA provides management and secretariat support for the process. Scoping workshops for each of the four volumes under which the work is to be carried out were held in 2021.

The '5YAR' provides a vehicle to further develop national understanding of climate change and to develop required analysis capacity and communication structures. It provides an opportunity to integrate and assess a range of climate-related activities in Ireland and link these to EU and international activities. In aiming to provide a shared understanding, based on the best available science, the '5YAR' can inform the future processes for developing mitigation and adaptation policies, and be pivotal to informing actions by key bodies in Ireland and activities such as the National Dialogue on Climate Action.

8.3 Themes of Irish Climate Change Research

A new thematic approach has been developed in EPA climate change research for the '5YAR' process, with the following four volumes:

- Theme 1: Science: Ireland in a changing world;
- Theme 2: Achieving climate neutrality by 2050;
- Theme 3: Being prepared for Ireland's future climate.
- Theme 4: Realising the benefits of transition and transformation is recognised as a cross-cutting theme to the other three.

8.3.1 Theme 1: Science: Ireland in a Changing World

Research under Theme 1 builds on the information contained in IPCC AR6 WGI report⁵, and the Special Reports on warming of 1.5°C⁶, Climate Change and Land⁷ and Ocean and the Cryosphere in a Changing Climate⁸. It would use relevant information provided at UNFCCC Earth Information days and available from Copernicus⁹. It will also highlight fundamental research carried out in Ireland which contributed to analysis of global change.

- Global changes and trends oceans, atmosphere and land systems
 - Paleoclimate and observed changes including Ireland focused analysis
 - Status of Ireland's climate¹⁰
- Global energy balance and carbon budget
 - Global emissions GHGs and air pollutants and trends
 - Changing the energy balance: including Mace Head analysis
 - Key global cycles Carbon and Nitrogen
 - GHG characteristics, sinks and negative emission
- Future worlds and future Ireland
 - Global emissions scenarios and climate stabilisations
 - Key projections for oceans, land and atmospheres to 2050, 2100, and beyond
 - Ireland specific projections (high, medium and low)
- Thresholds and tipping points
 - Runaway climate change,

⁵ <https://www.ipcc.ch/report/ar6/wg1/>

⁶ <https://www.ipcc.ch/sr15/>

⁷ <https://www.ipcc.ch/srccl/>

⁸ <https://www.ipcc.ch/srocc/>

⁹ <https://www.copernicus.eu/en>

¹⁰ <https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020.php>

- Loss of key glaciers
- Areas of concern for Ireland
 - The stability of the North Atlantic Ocean currents

8.3.2 Theme 2: Achieving Climate Neutrality by 2050

Research under Theme 2 builds on the information contained in IPCC AR6 WGIII report¹¹, and material in the Special Reports on warming of 1.5°C¹², Climate Change and Land¹³. It includes research done to develop the NIR (particularly in Agriculture, Forestry and Other Land Use) and top-down verification of GHG emissions and removals. It includes research to explore global pathways to 2050 and 2100 and Ireland specific analysis of these. Research under theme 2 will respond to the following areas:

- Meeting the Paris Agreement temperature goal (**Link to theme 1**)
 - Global GHG emissions and trends (focus on sectors rather than GHGs)
 - Pathways to net zero and balancing GHG emissions and removals
 - Removals and negative emissions
- Ireland specific analysis
 - Emissions from Ireland trends and changes since 1990
 - Moving from default to Ireland specific emissions analysis
 - Disaggregating emissions from National to Local
 - Linking air quality and GHG emissions data
 - Verification systems and tools (ICOS¹⁴ and ACTRIS¹⁵ European Research Infrastructure)
 - Ireland a platform for verification systems
 - GHG emissions pathways to climate neutrality by 2050 and 2100
- Carbon pricing, markets, supports and ambition (**Link to theme 4**)
 - Carbon pricing, the ETS and its operation
 - Project based mechanisms and key supports
 - Actors and enabling
 - Ambition and ambition leaders
- Sectoral emissions

¹¹ <https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/>

¹² <https://www.ipcc.ch/sr15/>

¹³ <https://www.ipcc.ch/srccl/>

¹⁴ <https://www.icos-cp.eu/>

¹⁵ <https://www.actris.eu/>

- Sectoral analysis and pathways to 2050
- Mitigation technologies and options
- Nature based solutions
- Benefits and opportunities in achievement of climate neutrality (**Link to theme 4**)
 - Social and economic solutions, services and technologies
 - Health and well-being and environmental quality
 - Ecosystem services and natural capital.
- Areas of concern for Ireland
 - Carbon lock-ins
 - Vulnerability of carbon stocks in soils and biomass

8.3.3 Theme 3: Being Prepared for Ireland's Future Climate

Research under Theme 3 builds on the information contained in IPCC AR6 WGII report¹⁶, and material in the AR6 Special Reports mentioned earlier. Research under this theme aims to identify robust information that can be included in Climate Ireland portal to advance the NAF process. Research under Theme 3 will respond to the following areas:

- Impacts of global climate change
 - Current impacts and projected impacts at warming of 1.5°C, 2°C and higher temperature increments
 - Ireland observed impacts and trends
 - Projected Impacts
- Global sectoral and geographical impacts
 - Food production, energy, transport, the built environment, biodiversity, culture and heritage
 - Ireland sectoral and geographical impacts
- Extremes and slow onset changes
 - Storms and sea-level rise, ecosystem change and fragmentation
 - Ireland examples
- Vulnerability, exposure and risk assessment
 - Infrastructures, population displacement, food systems and supply chains
 - Ireland examples and exposures
- Adaptation options and building resilience

¹⁶ <https://www.ipcc.ch/report/ar6/wg2/>

- Risk assessments and adaptation planning
- Nature based solutions
- Ireland plans and procedures
- Benefits and opportunities from planned adaptation (**Link to theme 4**)
 - Social and economic solutions
 - Services and technologies including observations and early warning systems
 - Health and well-being
 - Environment quality and ecosystem services
- Areas of concern for Ireland
 - Sea-level rise and coastal zones
 - Vulnerability of peatland and terrestrial carbon stocks

8.3.4 Theme 4: Realising the Benefits of Transition and Transformation

Research under this theme links to the sections in Themes 2 and 3 that address opportunities. Theme 4 addresses wider issues of national development and sustainable development, finance and financial flows. Research under this theme aims to identify opportunities and benefits for Ireland in the context of global climate change. Research under Theme 4 will respond to the following areas

- Envisioning Ireland economy and society in 2050
 - Cities, towns and conurbations (economy, society and environment)
 - Energy Transport, Communication,
 - Food systems
 - Business and commerce
 - Rural sustainability (economy, society and environment)
- Benefits and opportunities in achievement of climate neutrality (**Link to theme 2**)
 - Social and economic solutions
 - Services and technologies
 - Health and well-being
 - Environment quality and ecosystem services
- Benefits and opportunities from planned adaptation (**Link to theme 3**)
 - Social and economic solutions
 - Services and technologies including warning systems
 - Health and well-being
 - Environment quality and ecosystem services

- Support for action;
 - Financial systems and flows
 - Micro level tools available to individuals, households and small business to invest in transformation
 - Macro level tools to shift investments away from climate vulnerable or high carbon options towards consistency with Paris Agreement (2.1c)
 - Decision support tools and systems
 - Green Budgeting, pricing carbon, measuring carbon
 - Natural Capital Accounting
 - Information systems (Climate Ireland)
- Education, engagement, just transition
 - Education system (all levels)
 - Process for citizen engagement around the transition
 - Exploration and understanding of the just transition across multiple sectors

8.4 Significant Research Outcomes

The following are some of the highlights of climate research activities in Ireland over the last 4 years. Further details of climate research funding can be found in the annual reports of the activities of the CRCG¹⁷.

Table 8.2 below, provides an overview of where to find research publications arising from the funded research projects¹⁸ that were published in 2021, as reported by the CRCG members.

Table 8.2 : Climate change-related CRCG research publications (2021)

Lead funding organisation	Information source/website/publication link
DAFM	https://www.gov.ie/en/publication/bde7d-research/
GSI	https://www.gsi.ie/en-ie/publications/Pages/default.aspx
EPA	https://www.epa.ie/our-services/research/epa-funded-research/epa-research-publications/
MÉ	https://www.met.ie/science; https://www.met.ie/climate/

¹⁷ <https://www.epa.ie/our-services/research/national-environmental-research-coordination/climate-research-coordination-group/crcg-annual-reports-of-activities/>

¹⁸ Accessible to the public from the CRCG members' websites.

Lead funding organisation	Information source/website/publication link
	https://www.met.ie/education
MI	https://www.marine.ie/Home/site-area/publications/marine-institute-open-access-repository
IRC	https://research.ie/funding/ https://research.ie/resources/publications/
NESC	https://www.nesc.ie/publications/
SEAI	https://www.seai.ie/data-and-insights/seai-research/research-database/
IRC	https://research.ie/funding/ https://research.ie/resources/publications/
Teagasc	https://www.teagasc.ie/publications/
SFI	www.sfi.ie https://www.sfi.ie/funding/researcher-database/
CSO	https://www.cso.ie/en/
OPR	https://www.opr.ie/research/ https://www.opr.ie/planning-performance/

8.4.1 Second Status of Ireland's Climate report

The second edition of the 'Status of Ireland's Climate' report was published in 2021¹⁹. It comprises a collation and analysis of data from almost 50 internationally defined essential climate variables (ECVs) observed in the atmospheric, oceanic and terrestrial environments. It also documents the status of Ireland's climate-observing infrastructure, noting where it is robust, where gaps exist and where observing programmes need to be enhanced.

The assessment was conducted in collaboration with State Agencies, universities, research groups and organisations based in both Ireland and abroad as they conduct these systematic observations and submit quality-controlled data to global observation programmes which allows for Irish data to be considered in international analyses.

These observations and their analyses support our understanding of Ireland's changing climate within an international context and informs the assessment of the actions required to reduce carbon emissions and adapt to climate changes appropriately.

¹⁹ <https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020.php>

8.4.2 Support to the National Inventory

The main objective of this research area is to support improvement of the national emissions inventory, projections of future emissions and inform management options. A key aim is to ensure that the national inventory is based on the best possible science and, where feasible, subject to independent scientific verification. Accordingly, research is carried out into bottom-up analysis of emissions (e.g. considering activity and emissions factors) as well as top-down analysis of GHG emissions and sinks based on observations and modelling. Agriculture, forestry and land-use/land-use change are a significant element of Ireland's GHG emissions profile and a lot of research has been focussed on this sector, funded by the research programmes of the EPA, DAFM and Teagasc.

As noted in the previous report approximately 17%-20% of lands in Ireland are peatlands, or have peat as a substrate, where it is estimated that these lands contain between 53-62% of the total soil carbon stock. Both the EPA and DAFM fund a lot of research into GHG emissions and removals associated with peatlands (pristine, degraded, restored, etc.).

i. Bottom-up analysis

The following research projects have been carried out/initiated since the last report:

- Analysis of terrestrial methane emissions and impacts of peatland restoration on Ireland's Carbon Cycle (2022-2024)
- Farm-Carbon: Hedgerows and other non-forest woodland carbon (due to finish end 2022)
- Smart observations of management impacts on peatland function (2019-2023)²⁰
- Soil Organic carbon and Land Use Mapping (final report under review)²¹
- Peatland Properties Influencing GHG Emissions and Removal (2022)²²
- BRIAR: Biomass Retrieval in Ireland using Active Remote sensing (2019)²³
- Scaling Soil GHG Emissions to the National Level (2019)²⁴
- Assessment of Agricultural Activity on Drained Organic Soils (2019)²⁵
- A Review of Livestock Methane Emission Factors (2019)²⁶

²⁰ <http://smartbog.ie/>

²¹ <https://epasolumproject.wixsite.com/solum>

²² <https://www.epa.ie/publications/research/climate-change/research-401-peatland-properties-influencing-greenhouse-gas-emissions-and-removal.php>

²³ <https://www.epa.ie/publications/research/climate-change/research-305--briar-biomass-retrieval-in-ireland-using-active-remote-sensing.php>

²⁴ <https://www.epa.ie/publications/research/climate-change/research-304-scaling-soil-greenhouse-gas-emissions-to-the-national-level.php>

²⁵ <https://www.epa.ie/publications/research/climate-change/research-299-assessment-of-agricultural-activity-on-drained-organic-soils.php>

²⁶ <https://www.epa.ie/publications/research/climate-change/research-288-a-review-of-livestock-methane-emission-factors.php>

- MapEire: National Mapping of GHG and Non-GHG Emissions Sources²⁷

ii. Top down analysis of GHG emissions and sinks

At a macro-scale, there has been long-term work on the application of inverse modelling techniques to ambient measurements of GHGs at the National University of Ireland, Mace Head Atmospheric Research Station on the west coast of Ireland. These observations are supported by Ireland and other European countries including the UK and France. Data from this site are shared through the European Integrated Carbon Observation System (ICOS) Research Infrastructure (RI) <https://www.icos-cp.eu/> data portal and International data bases under the WHO Global Atmospheric Watch (GAW) programme.²⁸

They are widely used in national and international research activities and initiatives including under the EU Copernicus programme and the Global Carbon (GCP). They have been applied to estimate Irish GHG emissions and sinks. The general approach is to develop complementary top-down and intermediate scale analyses in order to develop national systems for the provision of independent verification of GHG emissions and removals as reported to the UNFCCC in the National Inventory report.

In order to support this the EPA has established a national ambient GHG measurement network. This is comprised of three sites, in the North (Malin Head), the South East (Carnsore Point), and the West (Mace Head). Met Eireann has recently established GHG measurements at its Valentia Island regional GAW site in the southwest of Ireland. This effectively provided Ireland with atmospheric GHG data for key boundary locations. These data are complemented by detailed GHG flux measurements at more than 8 ecosystem sites i.e. on grazing land, peat land and forests. These data will also be made available to the ICOS-RI as part of Ireland's contribution to pan-European GHG analysis. The overall aims of ICOS are to:

- Quantify and understand the GHG balances of Europe and neighbouring regions
- Provide long-term observations of atmospheric concentrations
- Produce continuous measurement of fluxes between the atmosphere and both land and ocean surfaces
- Predict future behaviour of the global carbon cycle as well as GHG emissions and concentrations
- Support the knowledge transfer from science to societal innovation

²⁷ <https://www.epa.ie/publications/research/air/research-317-mapeire-national-mapping-of-greenhouse-gas-and-non-greenhouse-gas-emissions-sources-project.php>

²⁸ <https://gawsis.meteoswiss.ch/GAWSIS/#/search/station/stationReportDetails/0-20008-0-MHD>.

Following a Government decision made in July 2022, Ireland intends to apply to become a full member of the ICOS-RI in 2022. A list of ten monitoring sites across the atmosphere, oceanic and terrestrial domains has been compiled and these sites will be proposed for inclusion in the ICOS-RI. While some of these sites will require some capital investment, most of them have been operating for many years at a standard comparable to that required by ICOS, so they will significantly enhance the existing ICOS-RI network which extends across the current fourteen member states.

As part of the Government decision, the EPA has been nominated as the National Focal Point to coordinate and manage Ireland's engagement with the ICOS-RI.

An EPA funded project MapEire²⁹ completed 1km x 1km emissions maps for all GHGs under UNFCCC. This data is used in conjunction with other projects (IMPLiCIt, MIRAGE and VERIFY), which are looking to improve the inversion model capability in Ireland. This offers the opportunity to reconcile the bottom up and top-down approach in order to better understand our national GHG emissions.

The following research projects have been carried out/initiated since the last report:

- Emissions Inventory Research to improve flux estimates of GHGs and nutrients from agricultural and land (started in 2022)
- Top-Down estimates of IRISH GHG emissions using ground and satellite-based observations (started in 2022)
- Developing Ireland's GHG and Transboundary Air Pollution Monitoring Network (2021)³⁰
- Ireland's Atmospheric Composition and Climate Change Network (2020)³¹
- IMPLICIT: Improving inversion model capability in Ireland (2020)³²
- MIRAGE: Improvements in inverse modelling of Ireland's GHG emissions (due to complete May 2022)³³
- Terrain-AI³⁴, jointly funded by SFI and Microsoft, will advance the standards of measurement, monitoring, verification and reporting of carbon stocks and emissions across complex environments

²⁹ <https://www.epa.ie/publications/research/air/research-317-mapeire-national-mapping-of-greenhouse-gas-and-non-greenhouse-gas-emissions-sources-project.php>

³⁰ <https://www.epa.ie/publications/research/climate-change/research-365-developing-irelands-greenhouse-gas-and-transboundary-air-pollution-monitoring-network.php>

³¹ <https://www.epa.ie/publications/research/climate-change/research-357-irelands-atmospheric-composition-and-climate-change-network.php>

³² <https://www.epa.ie/publications/research/climate-change/research-331-implicit-improving-inversion-model-capability-in-ireland.php>

³³ http://www.macehead.org/index.php?option=com_content&view=article&id=239

³⁴ <https://terrainai.com/>

- The EPA is also a partner in the Horizon 2020 VERIFY (Observation-based system for monitoring and verification of GHGs) project³⁵

8.4.3 Downscaled Projections of Climate Change

A number of research projects have recently completed on downscaled projects of climate change for Ireland and support for international climate modelling, in particular CMIP6.

- **EC-Earth Global Climate Simulations: Ireland's Contributions to CMIP6 (2020)**³⁶. This report provides an overview of future global climate projections as simulated by the EC-Earth Earth system model. The global climate simulations described in this report constitute Ireland's contribution to the Coupled Model Intercomparison Project (CMIP) (phase 6) (CMIP6) and will be included for assessment in the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6).
- **High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (2020)**³⁷: In this study, regional climate models were employed to dynamically downscale the coarse information of Global Climate Models to provide detailed projections of 21st-century regional climate change in Ireland. The projections were run at high spatial resolution (4 km grid spacing), allowing a more accurate evaluation of the local impacts of climate change.
- **Towards a Definitive Historical High-resolution Climate Dataset for Ireland – Promoting Climate Research in Ireland (2020)**³⁸: This report describes the available datasets and how, using a variety of available observational datasets, appropriate uncertainty estimates and skill scores have been calculated for the model outputs.

8.4.4 LIFE Peatlands and People project

The Peatlands and People project³⁹ was awarded approximately €9.9 million of EU funding as a LIFE Integrated Project. Working together to restore and rehabilitate peatlands across Ireland's midlands as well as establish a business accelerator programme and design an immersive visitor experience. A 7-year LIFE Integrated Project, Peatlands and People

³⁵ <https://verify.lsce.ipsl.fr/>

³⁶ <https://www.epa.ie/publications/research/climate-change/research-310-ec-earth-global-climate-simulations-irelands-contributions-to-cmip6.php>

³⁷ <https://www.epa.ie/publications/research/climate-change/research-339-high-resolution-climate-projections-for-ireland--a-multi-model-ensemble-approach.php>

³⁸ <https://www.epa.ie/publications/research/climate-change/research-350-towards-a-definitive-historical-high-resolution-climate-dataset-for-ireland--promoting-climate-research-in-ireland.php>

³⁹ <https://peatlandsandpeople.ie/>

collaborates locally, regionally, nationally and internationally to generate and share solutions and knowledge for a better future. Improvements across upwards of 9,900ha of peatlands will be supported within the project itself (with complementary action over circa 28,100ha of peatlands and 40,000ha of grasslands).

8.4.5 Climate change in the Irish mind

The EPA published the first report from its 'Climate Change in the Irish Mind' project⁴⁰, a study on Irish people's beliefs, attitudes, policy preferences and behaviours regarding climate change. The work was undertaken by EPA and the Yale University Program on Climate Change Communication in support of the National Dialogue on Climate Action.

8.4.6 TRANSLATE

TRANSLATE (standardising national climate projections for Ireland and developing climate services to meet the Irish adaptation sector's climate information requirements)⁴¹, is funded by Met Éireann and due to be completed in June 2023.

8.4.7 Blue Carbon

The Marine Institute launched the Blue Carbon call under the Marine Research Programme⁴². Two major research projects were funded to investigate how Ireland's marine habitats store carbon and potentially reduce carbon dioxide concentrations in the atmosphere.⁴³

8.5 International Cooperation on Climate Research and Data Exchange

All meteorological data and products that are produced by WMO Members (national meteorological services) to the WMO are available under the terms of WMO Resolution 40. Such data are freely available without charge, i.e. at no other cost than the cost of reproduction and delivery, without charge for the data and products themselves and with no condition on their use. Other meteorological or climatological data for climate change related research are provided either through a web portal or by request from Met Éireann. All such

⁴⁰ <https://www.epa.ie/environment-and-you/climate-change/what-is-epa-doing/ndcavale-work/climate-change-in-the-irish-mind/>

⁴¹ <https://www.met.ie/translate-project-to-standardise-future-climate-information-for-ireland>

⁴² <https://www.marine.ie/Home/site-area/research-funding/research-funding/blue-carbon-call-2021>

⁴³ <https://www.marine.ie/Home/site-area/news-events/press-releases/investing-blue-carbon>

data are provided free under an open data creative commons license, CC-BY Creative Commons 4.0 Attribution License.

Ireland recognises the international nature of climate change and the need to participate in global efforts. Research groups have strong links to research groups in Europe and beyond. Irish international participation in this regard includes the provision of a focal point to the IPCC by the DECC, and participation managed by the EPA.

8.5.1 JPI Climate

The EPA is a member of the JPI "Connecting Climate Knowledge for Europe" (JPI Climate). It is a pan-European intergovernmental initiative gathering European countries to jointly coordinate climate research and fund new transnational research initiatives that provide useful climate knowledge and services for post-COP26 Climate Action.

Some of the key activities in 2021 for the JPI Climate included:

- Progress made regarding the setting the Knowledge Hubs with the Knowledge Hub on sea-level rise established with JPI Oceans
- Presenting at the EU Forum on Science and Education for Sustainability on Climate Neutrality under the German Presidency
- Scoping Symposium Forum (horizon scanning activities) held virtually in November 2020
- Contributing to the 5th European Climate Change Adaptation Conference (ECCA 2021)
- First Carbon Neutrality Forum held virtually in September 2021
- Three side events at COP 26 including the launch of the next phase of the Joint Knowledge hub on Climate Neutrality.
- Submission of a successful proposal to Horizon Europe for a Coordination Support Action (CSA). The EPA and University College Cork are partners in the consortium. This project will allow for an upgrade of coordination activities on research and systematic observations. It has links to EU and IPCC activities. This CSA also includes an extensive work package of knowledge transfer (science to policy) activities. For example, organisation of ECCA 2023, with Ireland as host, a forum on climate neutrality and knowledge transfer activities related to innovation and infrastructure.
- The CSA SINCERE: Strengthening International Cooperation on climate change research. This CSA finished January 2022. The EPA oversaw the production on two

policy briefs through this CSA, on one climate neutrality and another on the 2021 European Climate Change Adaptation Conference (ECCA 2021).

Under the ERA-NET Cofund AXIS: Assessment of Cross(X)-sectoral climate Impacts and pathways for Sustainable transformation, there was one successful Irish participant in the project CROSSDRO (Cross-sectoral impact assessment of droughts in complex European basins), awarded 2019. Under the SOLSTICE (Enabling Societal Transformation in the Face of Climate Change) joint transnational call, there was one successful Irish participant in the project CCC-Catapult (Challenging the Climate Crisis: Children's Agency to Tackle Policy Underpinned by Learning for Transformation), awarded in 2020.

8.5.2 Water JPI

In 2021, the Water JPI led on a submission of a proposal for the European Water4All Partnership which was successfully submitted under Horizon Europe Cluster 6 and aims to contribute to the objective of the Destination on "Land, ocean and water for climate action". The first joint Transnational call on "Management of water resources: resilience, adaptation and mitigation to hydroclimatic extreme events and management tools" is expected in 2022.

8.5.3 Biodiversa+ European Partnership

The BiodivERsA network led on a submission of a proposal for the European Biodiversa+ Partnership which was successfully submitted under Horizon Europe Cluster and aims to contribute to the objective of the Destination on "Land, ocean and water for climate action". The first Joint Transnational Call on "Supporting the protection of biodiversity and ecosystems across land and sea" was launched in 2021. Climate change also features strongly in the Biodiversa + Strategic Research & Innovation Agenda⁴⁴.

8.5.4 JPI Oceans

JPI Oceans launched a new strategy framework 2021-2025⁴⁵ in 2021, as well as a new joint action on ocean carbon capacities⁴⁶. JPI Oceans and JPI Climate jointly published the governance structure for a new knowledge hub on sea level rise in January 2021⁴⁷.

⁴⁴ <https://www.biodiversa.org/1913/download>

⁴⁵ <https://www.jpi-oceans.eu/en/jpi-oceans-new-strategy-framework-officially-launched>

⁴⁶ <https://www.jpi-oceans.eu/en/jpi-oceans-launches-new-joint-action-ocean-carbon-capacities>

⁴⁷ <https://www.jpi-oceans.eu/sites/jpi-oceans.eu/files/managed/Publications%20files/SLR-GovernanceStructure-updated.pdf>

8.5.5 JPIFACCE

The JPI on Agriculture, Food Security and Climate Change (FACCE-JPI) opened four ERA-NETs Call on circularity. The four ERA-NETs SusAn (Sustainable Animal Production Systems), FACCE ERA-GAS (Monitoring and Mitigation of GHGs from Agriculture and Silviculture), ICT-AGRI-FOOD and SusCrop (Sustainable Crop Production) have coordinated and aligned efforts in areas of mutual interest and established a joint transnational funding initiative in the field of agricultural GHG (GHG) research, focusing on circularity in mixed crops and livestock farming systems with emphasis on climate change mitigation and adaptation⁴⁸. The first external call of European Joint Programme 'EJP SOIL - Towards climate-smart sustainable management of agricultural soils' opened for research proposals in 2021. The objective of this call is to 'foster holistic agricultural soil management practices which will assist in making a shift to diversify farming to include a variety of sustainable and environmental practices'⁴⁹.

The ERA-NETs SUSFOOD2 (SUStainable FOOD production and consumption) and FOSC (Food Systems and Climate) launched their joint call for proposals on 'Innovative solutions for resilient, climate-smart and sustainable food systems'⁵⁰.

FACCE JPI also initiated the MACSUR Science-Policy Knowledge Forum to bring science and policy actors together for the strategic design of responses to climate change adaptation and mitigation challenges in the agri-food sector in Europe⁵¹.

8.5.6 Intergovernmental Panel on Climate Change (IPCC)

The development of national climate research capacity has enabled greater national participation in IPCC activities.

Ireland played a significant role during the IPCC 6th Assessment Cycle. Irish scientists contributed the IPCC reports published in the 6th Assessment Cycle including initiating and promoting the provision of a Special Report on Land.

During the current cycle, in addition to contributing to the election of the IPCC Bureau and participating in IPCC plenary meetings, Ireland:

- Provided direct funding support by contributing to the IPCC Trust Fund

⁴⁸ <https://www.faccejpi.net/en/FACCEJPI/Four-ERA-NETs-Call-on-Circularity-open-for-submission.htm>

⁴⁹ <https://www.faccejpi.net/en/FACCEJPI/First-external-call-of-EJP-SOIL-is-open.htm>

⁵⁰ <https://www.faccejpi.net/en/FACCEJPI/Innovative-solutions-for-food-systems-call-open.htm>

⁵¹ <https://www.faccejpi.net/en/FACCEJPI/Actions/Core-Theme-1/Science-Policy-Knowledge-Forum.htm>

- Hosted an IPCC expert meeting on climate and food production
- Hosted the Scoping meeting and one Lead author meeting for the IPCC SR on Land
- Establish an IPCC Fellowship to support the IPCC WGIII TSU to provide the SR on Land
- Held an event to celebrate 30 years of the IPCC, which was attended by the IPCC Chair⁵²
- Hosted the lead authors meeting for the AR6 Synthesis Report

In addition, under the UNFCCC, Ireland:

- Co-chaired negotiations on the IPCC inputs to the Paris Agreement, Global Stocktake
- Led for the EU on consideration of the findings from the IPCC 1.5C special report
- Co-chaired negotiation on the adequacy of the Long-term Global Goal (Temperature goal) which includes consideration of the information provided by the IPCC

Ireland also supports the EU European Space Agency (ESA) Copernicus programme which aims to provide global to local information on for environmental management and Civil Security and is part of the ESA Earth Observation research programme. Ireland is a member of the GEO and supports its development. These contribute to the development of sustained observations systems as required and in support of Global Atmospheric Observing Systems (GCOS).

8.6 Climate Change Research and Coordination

The CAPs and the NAF enhance the roles of the EPA in coordinating climate research across state-funded bodies. As part of this function, under EPA Research 2030: A Framework for EPA Research 2021-2030⁵³, two national Research Coordination Groups were established, one considering all environmental research (NERCG) and a second focusing specifically on climate research (CRCG).

A key objective of the groups is to advance shared strategic objectives for climate change research and ensure coherence in climate change research investments in Ireland as well as effective linking of these to EU funding streams. CRCG meetings are facilitated by the EPA. Its membership is made up of departmental officials, local authority representatives, state agencies and bodies, and stakeholders, who either fund or use outputs from climate change research.

⁵² An Irish Times special supplement was published for this event.

⁵³ <https://www.epa.ie/publications/research/epa-research-2030/epa-research-2030-a-framework-for-epa-research-2021-2030.php>

8.6.1 Annual reporting of CRCG activities

CAPs require that the CRCG provides an annual report on its activities, and three reports have been published to date, (i) June 2017 – December 2018, (ii) January – December 2019 and (iii) January – December 2020⁵⁴. The draft CRCG report for January – December 2021 includes the following highlights:

- 42 new climate research competitive awards were made during the reporting period, with a total budget commitment of € 23.2 million. In these 42 climate research projects, collaboration between the CRCG members was evident through the co-funding of 21 research projects, with a committed budget of € 3.1 million.
- A total of 86% of the budget for competitive new climate research awards in 2021 went to four institutions: University College Dublin, Teagasc, National University of Ireland, Galway and Maynooth University (when assigning funding for successful projects solely to the lead partner), based on the data provided on national competitive awards. Project awards ranged in size from € 11,472 to € 3.1 million, with an average size of € 551,358.
- In excess of € 8.2 million was also reported to be allocated to as core activities in 2021, i.e. research activities that are funded by the organisation and performed in-house.
- This year's report also identified research commitments of € 56.9 million (over 83 projects) for research into other areas where some of the deliverables would be relevant for climate action
- The Irish research community achieved a drawdown of € 32 million under Horizon 2020/Horizon Europe (46 projects), € 1.7 million from INTERREG (one project), with climate-related research projects. No new climate-related COST Actions or LIFE projects involving Irish partners were approved in 2021.
- 80 climate research communication events and workshops took place in 2021 involving the CRCG members.

In addition to annual report of climate research activities, CAPs require an assessment and a synthesis of key findings from the research programmes, and wider research activities is to be carried out in the '5YAR' process.

⁵⁴ <https://www.epa.ie/our-services/research/national-environmental-research-coordination/climate-research-coordination-group/crcg-annual-reports-of-activities/>

8.7 Modelling and Prediction, Impacts and Adaptation

8.7.1 Observations and Indicators of Climate Change

Given the importance of high-quality observations of the climate in identification of trends and phenomena that are driving climate change, analysis of climate change indicators is ongoing. The first Status of Ireland's Climate report was published in 2013⁵⁵, which provided a comprehensive analysis of the Essential Climate Variables (ECVs) of relevance to Ireland.

The 2013 report has become the baseline for Irish ECV monitoring.

A GCOS Committee was established in Ireland in 2018. Known as GCOS-Ireland, its members are currently drawn from the Marine Institute, the Environmental Protection Agency, Teagasc, Met Éireann and the Earth observation community. The role of GCOS-Ireland is to coordinate and promote the GCOS observing principles in relation to the monitoring of ECVs of relevance to Ireland, thus supporting the ever-increasing demand for localised climate information.

A second status report was published in 2020⁵⁶, building on the 'Status of Ireland's Climate', 2013, incorporating new datasets and analyses as well as reporting ongoing climate observations over the last 7 years. This new, updated, report, endorsed by GCOS-Ireland, sets out the latest status of these ECVs, as well as including some new ECVs that have been added by GCOS in recent years collating almost 50 internationally defined ECVs observed in the atmospheric, oceanic and terrestrial environments. It also documents the status of Ireland's climate-observing infrastructure, noting where it is robust, where gaps exist and where observing programmes need to be enhanced in order to make recommendations for improvements in systematic observations in Ireland that will be invaluable in helping to direct future priorities on climate monitoring.

8.7.2 Climate Change Projections

As outlined in Section 6.1, the output of five CMIP5 global simulations under the four main IPCC RCPs was recently downscaled to Ireland using a number of regional climate models to create a multi-model ensemble which allowed for the uncertainty in these projections to be

⁵⁵ Dwyer, N, 2013, The Status of Ireland's Climate, 2012, Climate Change Research Programme Report 26, Environmental protection Agency, Johnstown Castle, <http://www.epa.ie/pubs/reports/research/climate/ccrpreport26.html>
<http://edepositireland.ie/handle/2262/19699>

⁵⁶ Cámaro García, Walther C. A. and Dwyer, Ned, 2020, The Status of Ireland's Climate, 2020, Research Report 386, Environmental protection Agency, Johnstown Castle, <https://www.epa.ie/publications/research/climate-change/research-386-the-status-of-irelands-climate-2020.php>

partially quantified⁵⁷. These projections were analysed and the results were found to be in broad agreement with previous studies. In summary, for Ireland it was found that by mid-century (2041-2060):

- Temperatures are projected to increase by 1 – 1.6°C compared with the reference period (1981-2000), with an east-west gradient and with the largest increases in the east;
- Warming will be enhanced at the extremes, with Summer daytime and Winter night-time temperatures projected to increase by 1 – 2.4°C;
- The number of frost and ice days are projected to decrease by approximately 50%;
- Summer heatwave events are projected to occur more frequently, with the largest increases in the south;
- Precipitation is expected to become more variable, with substantial projected increases in the occurrence of both dry periods and heavy precipitation events;
- The length of the growing season is projected to increase by between 12% and 16%;
- The energy content of the 120m (turbine height) wind is projected to decrease for all seasons, with the largest decreases in Summer;
- Changes in North Atlantic storm tracks along with decreases in 10m wind speed are also projected by mid-century. Note: as highlighted in the recent IPCC AR6 WG I report, there is considerable uncertainty with regard to North Atlantic storm track projections.

Research for climate modelling to contribute to CMIP phase 6⁵⁸ and to provide long-term, high resolution gridded climate datasets⁵⁹ has also been completed. There is also ongoing research on climate projections of met-ocean conditions including near- and off-shore winds, wave, tides and sea level rise in Ireland., (High-Resolution Coupled Atmosphere-Ocean-Wave Regional Climate Projections for Ireland) by NUIG/ICHEC.

8.7.3 Climate Re-Analysis

Met Éireann has carried out a 35-year very high resolution (2.5 km horizontal grid) regional climate reanalysis⁶⁰ for Ireland using the ALADIN-HIRLAM numerical weather prediction system (www.hirlam.org). This reanalysis spans the period 1981 to August 2019 and includes

⁵⁷ <https://www.epa.ie/publications/research/climate-change/research-339-high-resolution-climate-projections-for-ireland-.php>

⁵⁸ <https://www.epa.ie/publications/research/climate-change/research-310-ec-earth-global-climate-simulations-irelands-contributions-to-cmip6.php>

⁵⁹ <https://www.epa.ie/publications/research/climate-change/research-350-towards-a-definitive-historical-high-resolution-climate-dataset-for-ireland--promoting-climate-research-in-ireland.php>

⁶⁰ Gleeson, E., Whelan, E., and Hanley, J.: "Met Éireann high resolution reanalysis for Ireland", Adv. Sci. Res., 14, 49-61, <https://doi.org/10.5194/asr-14-49-2017> 2017.

surface, near surface and atmospheric parameters and is the first of its kind for Ireland. Overall, the model performed consistently over the 35-year time period and outperforms global reanalysis datasets.⁶¹

8.7.4 Paleoclimatology

Ireland is supporting a range of paleo climate research. Regional climate instabilities and abrupt hemispheric change is an area of interest and specifically, the response of the North Atlantic to climate forcing mechanisms during the Holocene (10,000 years). Studies of atmosphere-ocean circulation systems show their potential role in controlling, propagating, and amplifying climate instabilities into abrupt climate change. This changes of the strength of the Atlantic Meridional Overturning Circulation (AMOC) on multi-decadal to centennial timescales.⁶²

Irish peatland and lake systems provide a rich source of information on long-term climate change. The National University of Ireland Galway (NUIG) based Paleoenvironmental Research Unit⁶³ has a very active research programme on the late-glacial period c. 15,000 to 11,500 years Before Present and Holocene environments in Ireland⁶⁴.

Studies in Trinity College Dublin (TCD) have advanced the application of statistical methods to the reconstruction of past climate, based on pollen analysis⁶⁵. A summary analysis of paleoclimate research has been provided in an analysis of the implications of the EU's two degree climate protection target for Ireland⁶⁶. More recent research within this group has explored the signal of changing precipitation in peat accumulation in Ireland and the contrasting conditions associated with the Medieval Warm Period and the Little Ice Age⁶⁷. University College Dublin has established a state-of-the-art plant growth room facility with full monitoring and control of climatic and atmospheric conditions. The chambers are used to explore plant responses to a range of atmospheric CO₂ (380 to 2000 ppmV), O₂ (9 to 21%) and SO₂ (200 to 2000 ppbV) levels that occurred in pre-Holocene eras. This enables research on plant paleoecology including morphological and anatomical responses, to simulated past or future climatic atmospheric scenario.

61 Eoin Whelan, Emily Gleeson, John Hanley, "An Evaluation of MÉRA, a High-Resolution Mesoscale Regional Reanalysis". J. Appl. Meteor. Climatol., 57, 2179–2196, <https://doi.org/10.1175/JAMC-D-17-0354.1>, 2018.

62 www.nuigalway.ie/our-research/people/geography-and-archaeology/audreymorley/

63 www.nuigalway.ie/pru/

64 Ghilardi, B. and O'Connell, M. 2013. Early Holocene vegetation and climate dynamics with particular reference to the 8.2 ka event: pollen and macrofossil evidence from a small lake in western Ireland. Vegetation History and Archaeobotany, 22, 99–114

65 www.tcd.ie/Statistics/

66 Implications of the EU climate protection target for Ireland McElwain and Sweeney, 2007 ERC Report Series No. 5

67 Charman, D.J., et.al., A 1000-year reconstruction of summer precipitation from Ireland: Calibration of a peat-based palaeoclimate record, Quaternary International (2011),

The recently completed national sea-bed survey by Geological Survey Ireland (www.gsi.ie) and the Marine Institute has provided a detailed morphology of seabed features and information on composition creating a framework for future paleoclimate studies⁶⁸.

A recent EPA study of extreme events provided an opportunity to review synthesis and information on such events from a range of proxy sources including paleo and tree ring data, and unique monastic archives. This study showed a link between pre-instrumental written records of extremely adverse weather conditions in Ireland and regional volcanic events⁶⁹. In 2021, SFI awarded € 28.3 million for phase 2 of iCrag⁷⁰, SFI research centre for applied geosciences. While iCrag's research remit is broad⁷¹, it does include research into paleoclimatology.

8.7.5 Information Systems and Supports for Policy and Decision Making

Climate Ireland (CI)⁷² is Ireland's Climate Information Platform (ICIP) and a central source of climate data and information for adaptation decision making in Ireland.

The platform is a service provided through the Climate Ireland web portal (www.climateireland.ie). It supports capacity building, training and decision making through the provision of scientific and technical advice.

Beginning under the EPA research programme, Climate Ireland was developed by researchers working at MaREI, University College Cork (UCC). Delivery of Climate Ireland sits within the remit of the EPA.

The EPA is responsible for the delivery of an annual Climate Ireland work programme, which is supported by a Technical Advisory Group. The EPA is also responsible for the further development of the platform to enable it to support the continuing evolution of this policy space. Scientific adaptation support is provided to the platform by a team of scientists in UCC.

Climate Ireland aims to deliver climatic and adaptation information that is of direct relevance to climate adaptation planning in Ireland. The key aims of the services are:

⁶⁸ www.gsi.ie/seabed

⁶⁹ Francis Ludlow, et al, 2013, *Medieval Irish chronicles reveal persistent volcanic forcing of severe winter cold events, 431–1649 CE*, Environ. Res. Lett. 8 024035

⁷⁰ <https://www.icrag-centre.org/research/research-challenges/earth-system-change/>

⁷¹ It undertakes research in three areas:

1. Sustainable discovery of energy resources and raw materials required for decarbonisation.
2. Securing and protecting groundwater and marine resources.
3. Protecting society from Earth's hazards such as flooding and landslides.

iCrag hosts (a) a comprehensive suite of analytical and modelling resources and (b) platform facilities in geophysics, geochemistry and 3D modelling

⁷² <https://climateireland.ie/#/>

1. Providing the information and data required for climate adaptation planning at sectoral and local levels in Ireland;
2. Supporting the development of sectoral and local level climate adaptation strategies and plans
3. Creating awareness and building capacity for adaptation decision making

The key functions of Climate Ireland are:

- Information provider
- Data provider/data viewer/information tools
- E-learning platform
- Direct support to decision makers
- Repository (data base) of existing adaptation plans and strategies

A number of tools have been developed to support the delivery of the Climate Ireland aims and functions. The key tool is a data viewer, which represents spatially the observed and projected climate information for Ireland.

The key stakeholders who use Climate Ireland are the local authority sector and government sectors. The local authority sector has engaged predominately through the online e-learning for climate awareness course. The course was developed by Climate Ireland and Climate Action Regional Offices (CAROs) in 2020 and delivered to c. 14, 500 local government staff from Jan 2021-February 2022.

8.7.6 Aerosol Radiative Impacts

Ireland has provided long term support for observation and research on aerosols. Aerosols are at the interface between air pollution, where they are referred to as Particulate Matter (PM), and climate issues. Historically Irish scientists have made important contributions to the development of aerosol science. National research has maintained a focus on aerosol science and aerosol cloud inter-actions. As is illustrated in the contribution of Ireland based authors to the IPCC 6th Assessment Report, Working Group I Report (2021). Aerosol radiative forcing remains a major source of uncertainty in relation to anthropogenic forcing of climate. Mace Head Atmospheric Research Station, operated by the National University of Ireland, Galway, is a key Global Atmospheric Watch site in the North Atlantic Marine Boundary layer. Measurements are carried out of all the GHGs as well as the industrial gases covered under the Montreal Protocol. Activities at Mace Head are funded through national and international

sources. National funding is focused on aerosol studies, e.g. organic and inorganic aerosols, and other short climate forcers such as ozone.

Data from these aerosol measurements at Mace Head are provided to the Global Atmospheric Watch (GAW) data centres⁷³ operated by NILU. Aerosol climate studies at Mace Head have focused on air sea exchange processes and medium and long range transport of aerosols, and their impacts on direct and indirect radiative forcing. The goal is to improve parameterisation of these in regional and global climate models. These data are complemented by aerosol chemistry data collected the Met Eireann regional GAW/EMEP site at Valentia Island. Ireland through the EPA has supported the establishment of advanced observations of aerosol/PM at Mace Head and others mainly urban sites in Ireland (AAMP project).

Recent relevant research includes the following:

- Remote Sensing of Aerosols, Clouds and Wind at Mace Head Atmospheric Research Station (2020)⁷⁴
- Ground-based Remote-sensing Synergy for Cloud Properties and Aerosol-Cloud Interactions (2019)⁷⁵
- Research Support for Integrated Atmospheric Studies at Mace Head (2019)⁷⁶ -
- An Integrated Source Apportionment and Climatic Implications of PM2.5 and PM10 Particulate Matter (2019)⁷⁷

8.7.7 Impacts and Adaptation

The following EPA funded projects have explored the impacts of climate change in Ireland, and subsequent adaption measures.

- Climate Resilient Places (2022 – 2024)
- Infrastructure climate change risk considering Interdependencies and Cascading hazards (2022 – 2023)
- Transboundary Climate Risks for Island of Ireland (2022 – 2023)

⁷³ <https://www.gaw-wdca.org/>

⁷⁴ <https://www.epa.ie/publications/research/air/research-319-remote-sensing-of-aerosols-clouds-and-wind-at-mace-head-atmospheric-research-station.php>

⁷⁵ <https://www.epa.ie/publications/research/climate-change/research-266-ground-based-remote-sensing-synergy-for-cloud-properties-and-aerosol-cloud-interactions.php>

⁷⁶ <https://www.epa.ie/publications/research/air/research-303--research-support-for-integrated-atmospheric-studies-at-mace-head.php>

⁷⁷ <https://www.epa.ie/publications/research/air/research-298-an-integrated-source-apportionment-and-climatic-implications-of-pm25-and-pm10-particulate-matter.php>

- Irish Peatland Resilience to changing climate and increased frequency and severity of drought (end 2023)
- Multifactorial causes of fodder crises in Ireland and risks due to climate change (end date October 2022)
- CROSSDRO -Cross-sectoral impact assessment of droughts in complex European basins (end date April 2023)⁷⁸
- Climate change in the Republic of Ireland: Societal health Impacts and Solutions⁷⁹ (completion date March 2023)
- BE-Resilient: Built Environment Resilient Futures. Best practice in implementing climate adaptation (in press)⁸⁰
- Enhancing Integration of Disaster Risk and Climate Change Adaptation into Irish Emergency Planning⁸¹ (final report under review)
- Achieving Resilience in the Marine and Coastal Environment of Ireland⁸² (final report under review)
- Transboundary Adaptation Learning Exchange (completion date January 2023)⁸³
- CIViC: Critical Infrastructure Vulnerability to Climate Change (2021)⁸⁴
- Assessing Vulnerability to Climate Change: An Approach Illustrated through Large Urban Scale Adaptation (2020)⁸⁵
- National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action (2020)⁸⁶
- Adaptive Responses to Climate Impacts (2019)⁸⁷
- Irish Climate Futures: Data for Decision-making (2019)⁸⁸
- Challenges of Transformative Climate Change Adaptation: Insights from Flood Risk Management (2019)⁸⁹

⁷⁸ <https://crossdro.csic.es/>

⁷⁹ <https://www.ucc.ie/en/eri/projects/climate-change-in-the-republic-of-ireland-societal-health-impacts-and-solutions-crisis.html>

⁸⁰ <http://www.be-resilient.ie>

⁸¹ <https://www.marei.ie/project/integration-disaster-risk-climate-change-adaptation/>

⁸² <https://www.marei.ie/bcomar/>

⁸³ <https://www.talx.ie>

⁸⁴ <https://www.epa.ie/publications/research/climate-change/research-369-civic-critical-infrastructure-vulnerability-to-climate-change.php>

⁸⁵ <https://www.epa.ie/publications/research/climate-change/research-320-assessing-vulnerability-to-climate-change-an-approach-illustrated-through-large-urban-scale-adaptation-urb-adapt.php>

⁸⁶ <https://www.epa.ie/publications/research/climate-change/research-346-national-risk-assessment-of-impacts-of-climate-change-bridging-the-gap-to-adaptation-action.php>

⁸⁷ <https://www.epa.ie/publications/research/climate-change/research-301-adaptive-responses-to-climate-impacts-arc.php>

⁸⁸ <https://www.epa.ie/publications/research/climate-change/research-277-irish-climate-futures-data-for-decision-making.php>

⁸⁹ <https://www.epa.ie/publications/research/climate-change/research-265-challenges-of-transformative-climate-change-adaptation-insights-from-flood-risk-management.php>

8.8 Socio-Economic Analysis and Modelling

Work in this area is solution focussed. It aims to analyse and identify new approaches to mitigation and adaptation. A key aim is to identify pathways for achievement of a carbon/GHG neutral Ireland by 2050. This provides a framework for integrated analysis of solutions including new and emerging technologies. The types of projects in this area include:

- Socio-economic studies and analysis of national and international targets
- Sectoral (energy, transport) and integrated assessment modelling

8.8.1 Socio-Economic Analysis

Research on socio-economic analysis and technologies is advanced by a number of different research programmes and national stakeholders. Socio-economic analysis is funded through the research programmes of a number of national stakeholders including the EPA, SEAI, DAFM and the Irish Research Council. In addition to the Higher Education Institutes, socio-economic analysis is also carried out by the National Economic and Social Council (NESC)⁹⁰, the Economic and Social Research Institute (ESRI)⁹¹ and the Institute of Public Administration (IPA)⁹². The EPA has established research frameworks with both the ESRI and the IPA. Socio-economic analysis is also carried out directly by the EPA, SEAI and Teagasc.

The EPA published the first report from its 'Climate Change in the Irish Mind'⁹³ project, a study on Irish people's beliefs, attitudes, policy preferences and behaviours regarding climate change. The work was undertaken by EPA and the Yale University Program on Climate Change Communication in support of the National Dialogue on Climate Action.

Additionally, in 2021 the EPA published:

- Green Public Procurement guidance for the public sector⁹⁴

EPA research has funded research into the economic and social impacts of climate change as well as factors to support the transformation to a low carbon economy and society

The following EPA research reports have been published since the last report to UNFCCC:

- Policy Coherence in Adaptation Studies: Selecting and Using Indicators of Climate Resilience (2021)⁹⁵

⁹⁰ <https://www.nesc.ie/>

⁹¹ <https://www.esri.ie/>

⁹² <https://www.ipa.ie/>

⁹³ [Climate Change in the Irish Mind | Environmental Protection Agency \(epa.ie\)](https://www.epa.ie/publications/circular-economy/resources/green-public-procurement-guidance.php)

⁹⁴ <https://www.epa.ie/publications/circular-economy/resources/green-public-procurement-guidance.php>

⁹⁵ <https://www.epa.ie/publications/research/climate-change/research-379-policy-coherence-in-adaptation-studies-selecting-and-using-indicators-of-climate-resilience.php>

- Evaluating Ireland's Climate Policy Performance (2021)⁹⁶
- Methodologies for Financing and Costing of Climate Impacts and Future Adaptation Actions: Transport Networks in Ireland (2021)⁹⁷
- Citizens' Views of Climate Action in Ireland: Insights on Media Use, Trusted Sources and Perceptions (2020)⁹⁸
- Greening Transport: Final Report (2020)⁹⁹
- Responding to the Energy Transition in Ireland: The Experience and Capacity of Communities (2020)¹⁰⁰
- Encouraging Environmentally Friendly Behaviour with Insights from Behavioural Economics (2020)¹⁰¹
- Developing the Potential of Community Energy Action Groups in the Transition to a Low-carbon Society (2020)¹⁰²
- Opportunities to Decarbonise the Irish Transport Sector (2020)¹⁰³
- Deepening Public Engagement on Climate Change: Lessons from the Citizens' Assembly (2020)¹⁰⁴
- Fossil Fuel Lock-in in Ireland: How Much Value Is at Risk? (2019)¹⁰⁵
- Climate Change in Irish Media (2019)¹⁰⁶
- Catalysing and Characterising Transition (2019)¹⁰⁷

EPA is also funding the following research:

- Just resilience and adaptation in Ireland: sectors and regions (2022 – 2023)

⁹⁶ <https://www.epa.ie/publications/research/climate-change/research-362-evaluating-irelands-climate-policy-performance.php>

⁹⁷ <https://www.epa.ie/publications/research/climate-change/research-360-methodologies-for-financing-and-costing-of-climate-impacts-and-future-adaptation-actions-transport-networks-in-ireland.php>

⁹⁸ <https://www.epa.ie/publications/research/climate-change/research-344-citizens-views-of-climate-action-in-ireland-insights-on-media-use-trusted-sources-and-perceptions.php>

⁹⁹ <https://www.epa.ie/publications/research/climate-change/research-338-greening-transport-final-report.php>

¹⁰⁰ Responding to the Energy Transition in Ireland: The Experience and Capacity of Communities

¹⁰¹ <https://www.epa.ie/publications/research/climate-change/research-329-encouraging-environmentally-friendly-behaviour-with-insights-from-behavioural-economics.php>

¹⁰² <https://www.epa.ie/publications/research/climate-change/research-327-developing-the-potential-of-community-energy-action-groups-in-the-transition-to-a-low-carbon-society.php>

¹⁰³ <https://www.epa.ie/publications/research/climate-change/research-321-opportunities-to-decarbonise-the-irish-transport-sector.php>

¹⁰⁴ <https://www.epa.ie/publications/research/climate-change/research-314-deepening-public-engagement-on-climate-change-lessons-from-the-citizens-assembly.php>

¹⁰⁵ <https://www.epa.ie/publications/research/climate-change/research-302-fossil-fuel-lock-in-in-ireland-how-much-value-is-at-risk.php>

¹⁰⁶ <https://www.epa.ie/publications/research/climate-change/research-300-climate-change-in-irish-media.php>

¹⁰⁷ <https://www.epa.ie/publications/research/climate-change/research-287-catalysing-and-characterising-transition.php>

8.8.2 Model Development

Modelling and developing an Irish modelling capacity has been a key element of climate and energy research as well as agriculture research. Research in this area has been funded by EPA, SEAI and DAFM. As noted in the previous report to UNFCCC, an Irish TIMES energy systems model has been developed in collaboration with the Economic and Social Research Institute (ESRI), Teagasc, University College Cork and University College Dublin over the period 2009 – 2013. The most recent research carried out to develop integrated assessment models to support the identification of pathways to climate neutrality is the following:

- Develop a LEAP (Low Emissions Analysis Platform) GHG Ireland Analytical Tool for 2050 (2020)¹⁰⁸. This report describes a GHG emissions model of Ireland's energy and agriculture sectors. The Low Emissions Analysis Platform (LEAP) software was used to build the LEAP Ireland 2050 model, which simulates the development of future possible decarbonisation pathways for Ireland.
- The Role of Energy Technology in Climate Mitigation in Ireland: Irish TIMES Phase 3 (2020)¹⁰⁹
- SEQUESTER: Scenarios Quantifying land Use & Emissions Transitions towards Equilibrium with Removals (due to complete September 2022)¹¹⁰.
- Climate Change and Land Use in Ireland (2021)¹¹¹

Cross cutting studies aim to address synergies and trade-offs between policy objectives and sectors. The EPA funded project CON+AIR: Addressing Conflicts of Climate and Air Pollution (2019)¹¹² presents two counterfactual scenarios for emissions and concentrations of air pollutants in Ireland in the year 2030.

8.9 Research and Development on Mitigation and Adaptation Technologies

Improved information and analysis is needed to manage the transition to a climate resilient Ireland. The Environmental Protection Agency supports these developments of Ireland's adaptation and mitigation pathways by providing through research, analysis on the risks, vulnerability and adaptation actions for Ireland.

¹⁰⁸ <https://www.epa.ie/publications/research/climate-change/research-349-develop-a-leap-ghg-ireland-analytical-tool-for-2050.php>

¹⁰⁹ <https://www.epa.ie/publications/research/climate-change/research-326-the-role-of-energy-technology-in-climate-mitigation-in-ireland-irish-times-phase-3.php>

¹¹⁰ <https://www.plantagbiosciences.org/project/sequester/>

¹¹¹ <https://www.epa.ie/publications/research/climate-change/research-371-climate-change-and-land-use-in-ireland.php>

¹¹² <https://www.epa.ie/publications/research/climate-change/research-286-conair-addressing-conflicts-of-climate-and-air-pollution.php>

Research funding on mitigation technologies is advanced by SFI, SEAI, Enterprise Ireland (including the Disruptive Technologies Innovation Fund¹¹³) and DAFM. The following research funded by EPA relate to mitigation technologies:

- IE-NETs: Investigating the Potential for Negative Emissions Technologies (NETs) in Ireland (2020)¹¹⁴

The following EPA funded research related to adaptation technologies are:

- Climate Change Adaptation: Risks and Opportunities for Irish Businesses (2022)¹¹⁵
- ClimAtt: Tools for Climate Change Attribution of Extreme Weather Events (2021)¹¹⁶

The EPA also funded the Irish partners in the following projects from the JPI Climate (ERA4CS) joint transnational call:

- Clim2Power (Translating climate data into power plants operational guidance)¹¹⁷ – UCC was Irish partner.
- WatexR (integration of climate seasonal prediction and ecosystem impact modelling for an efficient adaptation of water resources management to increasing climate extreme events)¹¹⁸ – Marine Institute was Irish partner.
- CoClima (Co-development of Climate Services for adaptation to changing Marine Ecosystems)¹¹⁹

8.10 Systematic Observation

Several national bodies/organisations are engaged in systematic observations including contributions to the GCOS. Met Éireann has primary responsibility for the atmospheric observations listed below, although the National University of Ireland, Galway also coordinates upper-air and composition observations at the Mace Head facility. Responsibility for terrestrial and oceanographic observations is divided among a number of State agencies including the EPA, Marine Institute, universities and other academic institutions.

Following publication of the GCOS 2016 Implementation plan, a GCOS national coordinator has been nominated and a National GCOS committee established. Under the coordination of

¹¹³ <https://enterprise.gov.ie/DTIF>

¹¹⁴ <https://www.epa.ie/publications/research/climate-change/research-354-ie-nets-investigating-the-potential-for-negative-emissions-technologies-nets-in-ireland.php>

¹¹⁵ <https://www.epa.ie/publications/research/climate-change/research-402-climate-change-adaptation-risks-and-opportunities-for-irish-businesses.php>

¹¹⁶ <https://www.epa.ie/publications/research/climate-change/research-384-climatt-tools-for-climate-change-attribution-of-extreme-weather-events.php>

¹¹⁷ <http://jpi-climate.eu/nl/25223439-CLIM2POWER.html>

¹¹⁸ <https://watexr.eu/>

¹¹⁹ <https://www.climateurope.eu/coclima/>

this group, work is on-going on the implementation of the observations action plan for Ireland¹¹⁹. A comprehensive review of Ireland's climate observation system and a report on the trends observed in time-series analysis of all the ECVs of relevance to Ireland was completed in 2012 and will be regularly updated¹²⁰. The report concludes that many elements of a climate observation, analysis and reporting system are in place, but that there are a number of issues that need to be addressed in order to make it more robust and capable of addressing the country's long-term needs with regard to climate monitoring and understanding. A number of recommendations to address these issues are made in the report.

Work has also progressed on re-enforcing elements of the climate observation system across the atmospheric, oceanic and terrestrial domains and these are described in the relevant sections below.

8.10.1 Atmospheric Climate Observation System

Ireland has three main groupings of meteorological observing stations:

- 25 Synoptic Stations
- 78 Climate Stations
- 410 Rainfall Stations

The synoptic station network consists of one Observatory (Valentia), five airport stations, four of which are manned 24 hours, one manned part time but with an Automatic Weather Station (AWS), and nineteen unmanned AWS. The airport synoptic stations operated by Met Éireann provide hourly observations of the standard meteorological parameters. A project to modernise and automate observations at the airports is nearing completion. Automatic Weather Stations provide observations of most of the standard meteorological parameters with a temporal resolution of one minute. Measured parameters include:

- Wind speed and direction (23 locations)
- Atmospheric pressure
- Precipitation
- Air temperature
- Water Vapour
- A range of soil and earth temperatures
- Solar Radiation (22 locations)

The climate station network currently consists of 78 automatic stations which return air temperature, water vapour and precipitation at a temporal resolution of one minute.

Approximately 50% of these stations report soil and earth temperatures at different depths down to 1m below the surface. Twenty manual climate stations return daily values of Dry-bulb, Wet-bulb, Max and Min temperatures, and rainfall. Fourteen climate stations also report daily sunshine. The daily readings are taken at 0900 UTC. Readings are taken by private individuals, Government bodies, local authorities, schools and colleges, etc.

The rainfall station network consists of 385 stations which report daily rainfall at 0900 UTC and 25 stations which report monthly falls. Readings are provided by a variety of bodies and private individuals in the same way as for climate stations. In addition, there are 27 daily and 2 weekly Dines Tilting Syphon Rain Recorders in operation at various locations.

There are also 6 evaporation stations using Class A pan evaporimeters.

Data from all the above networks are archived by Met Éireann. These data are quality controlled and quality assured by the Observations Division. The stations are visited regularly by inspectors to ensure, as much as possible, that the siting of instruments and the accuracy of records adhere to GCOS monitoring principles. Records from some stations span more than 100 years. Much of the data since 1941 from the above stations are held in electronic form.

Valentia Observatory is also an upper air station which measures upper air temperature, water vapour and wind speed twice a day. Total column ozone (O₃) has been measured at Valentia Observatory since 1993 using ground-based optical equipment. Since 1994 vertical ozone profiles are routinely measured using equipment carried on weather balloons. Air quality measurements are undertaken daily at the Observatory; a comprehensive analysis of air (SO₄, NO₃, NH₄, Cl, Mg, Na, Ca, K) and precipitation (SO₄, SO₂, NH₄, NO₃, Na, Ca, Mg, K – including pH and conductivity) is performed by Met Éireann in Dublin for Valentia and a number of other sites on behalf of the EPA and NUIG (air quality); daily and monthly values are provided. A ground based O₃ observational network has been established with 11 sites around the country.

Ireland contributes to space-based observations through membership of the European Space Agency, ESA and the European meteorological satellite organisation EUMETSAT. The Copernicus Climate Change service (Copernicus C3S) is tasked to provide information to increase the knowledge base to support adaptation and mitigation policies. It will in particular contribute to the provision of Essential Climate Variables (ECVs).

The EPA also funded the research project, Assessing potential for National Integrated Atmospheric Research¹²⁰ (final report under review).

8.10.2 Oceanic Climate Observation Systems

i. Ocean surface variables

A number of ocean surface variables are measured by the Irish Marine Data Buoy Observation Network. This network is managed by the Marine Institute in collaboration with Met Éireann and funded by the Department of Agriculture, Food and the Marine. The first buoy was installed in 2000 and the network now comprises 5 offshore buoys including M6 deployed in deep water to the west of Ireland. These buoys return hourly information on:

- Wind speed and direction
- Maximum gust
- Atmospheric pressure and tendency
- Air temperature
- Relative humidity
- Sea surface temperature and salinity
- Significant wave height and period
- Maximum wave height and period
- Mean direction of waves

Sea surface temperature and waves are also observed by some Voluntary Observing Ships (VOS). Currently the Marine Institute's Celtic Explorer is the only automated VOS in the Irish fleet, and reports sea surface temperature hourly while at sea. Other Irish VOS report at lower frequency. A trial project to be run by Met Éireann in 2022 will examine the potential to automate more VOS in the Irish fleet.

ii. Sea level

The Marine Institute, in collaboration with the Office of Public Works, are leading the ongoing development of the National Irish Tide Gauge Network. The network currently consists of 22 stations reporting in real-time. Some stations also record atmospheric pressure and water temperature. One of these stations, Castletownbere, has been fully integrated into the GLOSS network (Global Sea Level Observing System).

¹²⁰ <http://macehead.nuigalway.ie/rt/ANIAR/ANIAR-home>

iii. Subsurface ocean variables

A number of subsurface ocean variables are measured continuously by the Marine Institute's Oceanographic Research Vessels. These are typically temperature, salinity, dissolved oxygen, chlorophyll fluorescence, turbidity and $p\text{CO}_2$. In addition, the annual Southern Rockall Trough Ocean Climate survey collects: Dissolved Inorganic Carbon/Total Alkalinity, Dissolved Inorganic nutrients (phosphate, total oxidised nitrogen, nitrite, silicate), and water current velocities and direction.

In addition to surface variables, the M6 buoy site also collects sub-surface temperature, salinity and currents over the upper 1,000m of the ocean.

A total of 42 Irish Argo floats have been deployed since 2003, with 18 currently active, to complement the around 3,900 floats in use at a global scale. As part of the Euro-Argo European Research Infrastructure Consortium, Ireland is committed to deploying 3 standard temperature and salinity floats per annum.

The Marine Institute operates 2 marine gliders, which can carry out oceanographic survey autonomously for up to 90 days. The gliders are equipped to measure conductivity, temperature, depth, fluorescence, turbidity and dissolved oxygen to depths of 1,000m.

iv. Ocean acidification

In a series of projects since 2008, the Marine Institute and National University of Ireland, Galway have collaborated on repeat hydrographic surveys along a section of the southern Rockall Trough including collection of physical and biogeochemical Essential Ocean Variables. Increasing acidification has been observed in surface and, to a lesser extent, in deeper water masses in the Rockall Trough. In 2020, the Marine Institute submitted data from 24 surveys carried out from 2017-2018 to the SOCAT (Surface Ocean Carbon Atlas) database.

V. Irish EOVS Analyses

An update to the 2010 report on the status of the Irish ocean climate and ecosystem was carried out in 2021, with publication expected in mid-2022.

8.10.3 Terrestrial Climate Observation Systems

i. Soil Moisture

Met Éireann calculate Soil Moisture Deficit (SMD) at 23 synoptic weather stations on a daily basis. SMD is the amount of rain needed to bring the soil moisture content back to field capacity.

A hybrid SMD Model¹²⁶ has been developed which accounts for differences in drainage regimes between different soil types in Ireland. Three soil drainage classes are modelled; (a) well drained, where soil never saturates, (b) moderately drained, where soil may saturate on wet days and (c) poorly drained, where soil saturates on wet days. Soil moisture surpluses are assumed to be removed by drainage and surface run-off over time.

The EPA has also funded a research project, Soil Moisture estimates from Satellite based Earth observations¹²¹, due to complete in 2022.

ii. Phenology

Met Éireann has been involved with the International Phenological Garden (IPG) Network since the 1960's. It oversees the submission of the data from the gardens to both the IPG database and the Pan European Phenology (PEP) database. Historic Plant Phenology dataset is available to download from <https://data.cso.ie/product/ppy>

The EPA has funded two research projects related to phenology:

- (i) PhenoClimate: Impact of Climate Change on Phenology in Ireland, see EPA Research report published 2022¹²².
- (ii) PhenoGrass: The phenology of perennial ryegrass and its potential contribution to grassland carbon sequestration¹²³. This project has completed and the report is expected soon.

iii. Fire Disturbance

The Forest Service maintains a record of forest areas reported as burned in Ireland since 1930. They calculate Fire Disturbance burn area from a combination of damage reports from forest owners, ground observations, and more recently remote sensing imagery¹²⁴. Records are updated by the Forest Service annually and reported to the European Commission and other reporting agencies.

The EPA has also funded the research project, Fire, Land and Atmospheric Remote Sensing of Emissions¹²⁵, which is due to complete in Q3 2022.

The burning of household, garden, commercial or industrial waste is not permitted in Ireland under the Waste Management Regulations. However, since the entry into force of these regulations in 2009, an exemption has been provided that allows farmers to dispose of green waste by burning. This applies to untreated/uncontaminated wood, trees, tree trimmings,

¹²¹ <https://somosat.com/>

¹²² <https://www.epa.ie/publications/research/climate-change/research-404-phenoclimate-impact-of-climate-change-on-phenology-in-ireland.php>

¹²³ <https://www.ucd.ie/ecomodel/phenology.html>

¹²⁴ MODIS Active Fire and Burned Area Products <http://modis-fire.umd.edu/>

¹²⁵ <https://www.ucc.ie/en/flares/>

leaves and brush which were generated by agricultural practices. This exemption has been reviewed on an annual basis and it is not expected to be extended beyond the end of 2022. Alternative treatment options for this waste stream are currently being investigated by DAFM.

8.10.4 Support for Developing Countries to Establish and Maintain Observing Systems and Related Data and Monitoring Systems

i. Irish Aid and Met Éireann

On 01 July 2022, Minister for Overseas Development Aid and Diaspora, Colm Brophy, T.D. announced Irish Aid funding of €4 million to strengthen the ability of developing countries to predict and prepare for extreme weather events. Working in partnership with Met Éireann, this support will enable the work of the Systematic Observations Financing Facility (SOFF), established by the World Meteorological Organisation and the UN. The Facility will work with developing countries, providing funding and technical expertise to help them to address weather and climate information gaps. This will help some of the world's poorest countries to better manage events such as floods, droughts and heatwaves, which are increasing in frequency and intensity as a result of climate change.

Chapter Nine:

Education, Training and Public Awareness

9. Education, Training and Public Awareness

9.1 Introduction

The importance of education, training and the raising of public awareness on environmental issues is recognised in Ireland's framework for sustainable development – Our Sustainable Future. This framework takes a whole-of-Government approach to sustainable development and aims to embed sustainable development in the policy making process across Departments, in order to reap benefits, not only in terms of protecting the environment but also in terms of the Green Economy, Jobs and Growth. Overall, the objective of Our Sustainable Future is to identify and prioritise policy areas and mechanisms where a sustainable development approach will add value and will enable continuous improvement of quality of life for current and future generations.

The framework makes it clear that education and awareness play a crucial role in moving towards a more sustainable society. Education strengthens the capacity of individuals, communities, businesses and governments to make judgements and decisions that take proper account of environmental protection. Our Sustainable Future recognises that education for sustainable development needs to be embedded at every level of the formal and informal education system, and that public awareness measures are vital for sustainable development to be better understood and appreciated. Public authorities need to actively engage with citizens and stakeholders in the development and implementation of policy if we are to effect behaviour change and the transition to a more sustainable society and economy.

A wide range of environmental awareness raising programmes and initiatives are supported by various Government agencies, building on the awareness raising achievements of earlier awareness campaigns, including the An Taisce Green-Schools (ECO-Schools) and Green Campus Climate Action and Awareness Programmes.

9.1.1 International action

Action for Climate Empowerment (ACE) is a term adopted by UNFCCC which involves six elements – education, training, public awareness, public participation, access to information, and international cooperation, to improve the effectiveness of climate action. As outlined in this chapter, Ireland remains committed to increased and deepening levels of engagement with the public on climate action and will promote these approaches and share our learnings with other countries.

All Parties to the UNFCCC are encouraged to appoint a National ACE Focal Point, which Ireland did in 2021, to represent Ireland in ACE workshops and meetings, act as a liaison between the UNFCCC and relevant national policymakers and advocate for climate action supported by the six ACE elements referenced above.

To enable greater awareness and engagement with international climate action, Ireland will support active participation of young people in international climate change policy and processes and ensure Ireland's delegation benefits from perspectives and knowledge from youth in its work. The recent establishment of a Climate Youth Delegate Programme will ensure young people in Ireland have the opportunity to participate as part of the official climate delegation attending international climate meetings such as the climate COP.

9.2 Education

9.2.1 National Strategy on Education for Sustainable Development

The Department of Education published Ireland's first National Strategy on Education for Sustainable Development (ESD) in June 2014. ESD aims to ensure that by 2030 "all learners acquire the knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development" (SDG 4.7). ESD encompasses three aspects; Environmental, Social and Economic. The first ESD Strategy set out Ireland's commitment to further promote education for sustainable development across the formal and non-formal education sectors. Eight 'priority action areas' were identified including leadership and coordination, data collection and baseline measurement, and promoting participation by young people in decisions that affect them. Each of the eight priority areas included a series of recommendations encompassing all areas of the education system, from Early Years through to further and higher education, as well as non-formal and community education, and the Youth sector. Significant work was progressed under the first strategy including:

- Integration of ESD themes and principles across the curriculum at all levels (ESD Audit published in 2018¹²⁶)
- Integration of ESD themes and principles into the assessment and inspection processes

¹²⁶ <https://ncca.ie/media/4899/education-for-sustainable-development.pdf>

- Integration of ESD into Initial Teacher Education 'Céim Standards'¹²⁷
- Integration of ESD into programmes of continuing professional development (CPD) for teachers
- Development of an ESD hub for ESD related resources and information¹²⁸
- Integration of ESD into the System Performance Framework for Higher Education Institutions
- Integration of ESD into research calls.
- An increase in ESD related programmes at Further Education and Training level and in Higher Education.

The Department of Education together with the Department of Further and Higher Education, Research, Innovation and Science are currently in the process of finalising the 2nd National Strategy on ESD to 2030. ESD to 2030 will be aligned with the UNESCO ESD framework¹²⁹ and includes five key priority areas: advancing policy; transforming learning environments, building capacities of educators, empowering and mobilising youth; and accelerating local level actions. ESD to 2030 will build on the foundations laid under the first national strategy, further integrating ESD across the education system, strengthening educator capacity and giving an ever stronger voice to young people.

ESD to 2030 will provide a framework to steer and support the contribution that the education sector is making and will continue to make towards a sustainable future by 2030. It is accompanied by an implementation plan 2022-2025, with an interim review planned in 2026 to evaluate progress and identify any additional required actions to 2030.

The strategy embodies a lifelong learning approach, spanning the continuum from early years to third level education and research, and extending beyond to engage with local communities, youth groups and enterprise. ESD to 2030 will also seek to give learners more opportunity to take action not only as individuals but as members of their local community and as Global Citizens.

Implementation of ESD to 2030 will be co-sponsored by the Department of Education, Department of Further and Higher Education, Research, Innovation and Science and the Department of Children, Equality, Disability, Integration and Youth, and will be overseen by an ESD Advisory Group.

As part of its awareness raising campaign, the Department of Education also issues a quarterly ESD newsletter to all schools and subscribers, covering a wide range of ESD

¹²⁷ <https://www.teachingcouncil.ie/en/news-events/latest-news/ceim-standards-for-initial-teacher-education.pdf>

¹²⁸ <https://www.scoilnet.ie/esd/>

¹²⁹ UNESCO, 'Education for sustainable development: a roadmap', 2020, <https://unesdoc.unesco.org/ark:/48223/pf0000374802>

related issues including research, resources, training opportunities, good practices, awards, competitions, advice and supports.¹³⁰

9.2.2 Primary, Secondary and Higher Education

i. The Green-Schools Programme

The Green-Schools programme is the pre-eminent environmental education programme in Ireland with a participation rate of more than 9% of all Irish Schools – currently 3,706 schools and centres registered for the programme, and 3,398 of these have been awarded at least one green flag. Green-Schools is part of the Eco-Schools programme which is coordinated internationally by the Foundation for Environmental Education. The programme is run in Ireland by the environmental NGO, An Taisce, in partnership with local authorities. The majority of funding for Green-Schools is provided by the Irish Government and State Agencies.

The Green-Schools programme promotes whole school action for the environment and aims to instil a strong sense of environmental responsibility in students that also spreads beyond the classroom into students' homes and the wider community. Schools are visited throughout the year by representatives of An Taisce and local authority Environmental Awareness Officers from local authorities, who advise them on successful implementation of the Green Schools programme. Each year An Taisce runs a series of seminars for teachers involved in the programme.

The National Climate Change Action and Awareness Programme (NCCAAP) has been operating in schools, communities and campuses nationwide since 2017. It is supported by the Green-Schools programme which is operating in over 93% of schools nationwide. The experience of developing and working through the different elements of the programme over these years have provided a great insight and basis for further effective intervention. The programme has benefited hugely from the appointment of Climate Action Officers who have developed resources, workshops and training for participating schools and communities. The programme is now well established with a large network of participants who are eager to continue to undertake climate actions both in schools and the wider community. The NCCAAP focuses on the development and implementation of a number of key actions as set out in the CAP and associated Annex of Actions.

¹³⁰ <https://www.gov.ie/en/collection/a1d6e-education-for-sustainable-development-newsletter/>

An Taisce also commenced a Green Flag for Parks award scheme in 2018. Ireland was awarded a total of 103 Green Flag sites in 2021, comprised of 84 formal public Green Flag Park sites, along with 19 volunteer run Green Community Sites.

Due to the COVID-19 pandemic and its restrictions, there were no in-person school visits during 2020 and 2021. Instead, there was added emphasis placed on engagement with schools, including increased virtual interaction and communication with schools. Online learning was implemented, using innovative ways of delivering programme content using a variety of online tools and platforms. More resources to help schools tackle the challenges that lack of mobility and lack of face-to-face interaction in working on the programme. This included sending tailored themed guidance documents to schools at the beginning of October 2020. This was to reassure schools that they would be supported and that the programme was not expected to run the in the usual way this year.

A variety of events and workshops were held online and adjusted accordingly when school closures occurred during the year. Video content was also greatly increased in order to keep students engaged and immersed and to substitute the lack of in-person activity.

Ireland's fifth Climate Action Week, part of the GreenSchools programme, ran from October 11th to 17th 2021, which included 18 pledges to choose from and a variety of events including "Screening - The True Cost", a ground breaking documentary film that pulls back the curtain on the untold story and asks us to consider, who really pays the price for our clothing?, a discussion on "Fashion Fix" and many competitions & challenges.

ii. Smarter Travel programmes

Ireland's Smarter Travel Workplaces (STW) and Smarter Travel Campus (STC) programmes are national, voluntary programmes that work with large employers and third level institutions to implement workplace travel plans. The STW programme was established in 2009, and is now engaged with 138 large employers, with a potential reach of over 100,000 employees. The STW programme engages with smaller employers on a cluster basis. The STC programme was established in 2012, and is engaged with 24 third levels, including all of the Irish universities and the majority of the Institutes of Technology – a potential reach of over 25,000 employees and over 200,000 students.

Ireland's Green-Schools Travel programme has been operating at a national level since 2008. The theme is funded by the Department of Transport, Tourism and Sport and supported by the National Transport Authority. The aim of the 'travel' theme is to raise awareness of active and sustainable travel as well as promoting modal shift within a two year period.

2,178 schools have been awarded the travel flag since 2008. This equates to the 470,586 pupils and 35,006 teachers.

The follow are some headline achievements from the 2021 scheme:

- 136 schools were invited to take part in Travel/GC travel in 2021
- 87 teacher training seminars were delivered in autumn 2021

iii. Tertiary & Higher Education Sector

Growth in education and training provision to ensure reskilling and upskilling for climate action, including new skills required in the green transition such as retrofitting is ongoing across the Tertiary Education sector. A range of options are available from short courses targeted at awareness building, upskilling and reskilling programmes to full and part-time academic and vocational programmes. The curricula of many other programmes will also include elements and modules targeted to green skills and sustainability components. In the higher education sector, in addition to core education delivery, funding is provided under Springboard+ and the Human Capital Initiative (HCI) to incentivise the delivery of programmes in areas where there are employment opportunities in the economy and skills shortage.

The HCI has provided significant funding for courses that include a focus on the environment, climate change and sustainability.

Across HCI Pillars 1, 12 courses with a specific focus on environment / energy / sustainability / circular economy were approved, providing almost 235 course places for learners.

HCI Pillar 2 funding has targeted 25 additional places on the following course in University of Dublin, Trinity College - B.Sc. in Environmental Engineering or (depending on pathway taken) B.Sc. in Applied Environmental Science. The academic rationale for the course is to uniquely combine the expertise of two Schools (Natural Sciences and Engineering) towards preparing graduates to tackle the global challenges of the world as set out in the UN Sustainable Development Goals.

Under HCI Pillar 3, 3 projects included a specific focus on climate action, with a requirement that funded programmes include consideration of how they can positively assist the diverse and wide-ranging impacts that Climate Change will have on Ireland's environment, society, economic and natural resources. A number of HCI projects with notable components addressing climate action, environment and sustainability were awarded funding under this call and will have wide-reaching impacts, given the multi-partner collaborative approach adopted in many instances. It aims to ensure that courses in areas of skills needs

demonstrate innovative methods of teaching and delivery, which will include flexibility in course provision.

Under Springboard+ 2021/22, there are 14 courses available addressing climate change, in areas such as green skills and sustainability. Courses included Nearly Zero Energy Building (NZEB), Bio-Energy, Clean Technologies and Electric Vehicle Technology providing 318 places. A new round of Springboard+ 2022 courses are due to be launched in Q2 2022, and the call for proposals included sustainability and the low carbon economy as an area of focus for courses under the call.

iv. Green-Campus

Building on the success of the Green-Schools programme, a programme was introduced at third-level to encourage a partnership approach to environmental management in third level institutions. The Green-Campus initiative aims to make environmental awareness and action an intrinsic part of the life and ethos of third-level institutions and other large campuses. The Green-Campus initiative mirrors the principles of Green-Schools and endeavours to extend learning beyond the lecture theatre to develop responsible attitudes and commitment to the environment, both at home and in the wider community.

Green-Campus is an enhancement of traditional environmental management systems which tend to be management driven, it identifies the campus as a community and places significant importance on the inclusion of all sectors of the campus community in its environmental management and enhancement. Green-Campus has been in operation in Ireland since 2007 with University College Cork being the first university in the world to be awarded the status of a Green-Campus in 2010. At present 40 Campuses are formally registered on the Programme, with nineteen awarded the Green Flag including two hospital sites.

It encourages a partnership approach to environmental education, management and action in third level institutions. The Programme primarily aims to ensure that members of a campus community can engage in a meaningful way to enhance sustainability on campus. It must be noted that the Green-Campus initiative does not reward specific environmental projects or implementation of a new technology. Rather it rewards long term commitment to continuous improvement from the campus community.

9.2.3 Green Skills in the Construction Sector

Education and training relevant to the skills needed in the retrofitting and construction sector is delivered across the full remit of the tertiary sector system and through mainstream

education and training as well as through specific programmes such as Springboard+, the HCI and Skillnet Ireland.

Among the 64 apprenticeships currently available at levels 5-10 of the National Framework of Qualifications, qualifications relevant to retrofit activity include plumbing, carpentry and joinery, plastering, painting and decorating and the recently launched scaffolding apprenticeship. Support activities may be facilitated through existing apprenticeships in auctioneering and property services (L6) and logistics (L7-9). Apprenticeships are also in development in roofing and cladding (L5) and advanced quantity surveyor (L9). Kerry Education and Training Board (ETB) has also developed the Wind Turbine Maintenance apprenticeship programme (L6) which has been recently launched.

Recognising the diversity of skills required for retrofit and the variety of apprenticeships available that are already relevant to retrofit, it is considered that the current training options offer a more agile way of meeting labour and skills needs rather than a dedicated apprenticeship programme.

The Further Education and Training Strategy, 2020-2024 recognises that climate change and sustainable development must be a critical focus for FET into the future, and recognises the major contribution that FET can make to the Government's call to action by building on its strong capabilities around energy, building and the environment. It also set forward a vision of the FET College of the Future as a Green-Campus, which will embed sustainable development principles across its operations and provision and ensure its students are equipped with the environmental awareness and green skills which can drive future change. The SOLAS Recovery Skills Response Programme includes the Skills to Compete initiative and the Green Skills Action programme.

Skills to Compete is the Further Education and Training activation and skills response for those who have been impacted by the COVID-19 Pandemic. It aims to improve participants' employability skills as well as supporting and advancing the progression of all relevant learners through three core components - digital skills, transversal skills and sector specific skills provision. With financial support of €75m, the Initiative aims to provide 16,700 learner places by end 2022.

Deliverables under the Green Skills Action programme are 4,550 learners placed on NZEB/green training courses and 60,000 learners placed on green skills awareness modules by the end of 2022. The deliverables are supported by €29 million and €10 million in funding respectively.

The first category of courses are to be delivered through five centres of excellence, two of which are established and operating under Waterford Wexford ETB (WWETB) and Laois

Offaly ETB (LOETB). Two further Centres are expected to be offering courses by the Summer, with the final Centre operating later in the year. To date, 527 learners have been placed on these courses.

The more generic green skills courses are focussed on general awareness, with reference to the sustainable development goals, and will be delivered through the national network of 16 ETBs. A Level 4 micro qualification has been developed in conjunction with 6 ETBs and is being certified by Quality and Qualifications Ireland (QQI). This is expected to be completed by May, at which time the other 10 ETBs can submit an application for QQI certification, which process occurs every two months.

Also, Skillnet Ireland have a number of initiatives aimed specifically at the zero carbon sector, including:

- Green Tech Skillnet a business network for companies of all sizes in the renewable energy and green energy sectors.
- Lean and Green Skillnet provides subsidised training and compliance programmes to embed sustainable and certified staff skills across corporate members to support the growth of the Green Economy.
- SIMI Skillnet a business network supporting the Motor Industry and the transition toward Hybrid and Electric Vehicles.
- Climate Ready Academy supports Irish Businesses in developing skills and talent required to mitigate the effects of our changing climate and environment.

CITA Skillnet and Construction Professional Skillnet run a number of training programmes for professional development in skills relating to zero carbon, including project management, people management, managing sustainable construction, BIM (Building Information Modelling), and communications.

In the FET sector there are some 50+ programmes in areas such as green skills and sustainability, which includes retrofit and NZEB. These training opportunities are provided by the on-site retrofit programmes in Centres of Excellence in LOETB and WWETB. A further three Centres of Excellence are being established in Cork, Limerick-Clare and Mayo-Sligo-Leitrim ETBs. NZEB skills training comprises of one to four days of training which is largely targeted to existing construction professionals. Ongoing innovation in delivery includes a move to a blended model of training in addition to the development of a pilot VR programme which is expected to be operational by year end.

The Green Skills for FET Roadmap 2021-2030 was launched on the 23rd March. It incorporates the National Recovery and Resilience Plan 2021, and the Green Skills Action programme which begun in 2021. The National Recovery and Resilience Plan committed

€29M to NZEB & Retrofit upskilling and reskilling programmes and €10M to Green Skills Modules. Under the Plan, 4,550 retrofit and NZEB standard places and 60,000 green skills places are to be provided by the end of 2022. The percentage breakdown of the places between Retrofit and NZEB places will be determined by the uptake in programmes by existing construction professionals.

In the Higher Education sector funding is provided under Springboard+ and the HCI to support the development of professionals in areas such as building analysis and climate adaptation; sustainable building technology and retrofit, conservation and sustainability. Under Springboard+ 2021/22 there are 17 courses available in green skills and sustainability such as NZEB, Bio-Energy, and Clean Technologies.

In the Higher Education sector funding is provided under Springboard+ (€2.27M) and the HCI (€8.86m) to incentivise the delivery of programmes which support the development of professionals in relevant areas.

Under HCI Pillar 1 (Full-Time Graduate Conversion Courses) there are currently 22 construction and green skill courses with 638 participants. These courses are in areas such as Building Analysis and Climate Adaptation; Sustainable Building Technology and Retrofit, Conservation and Sustainability. The Higher Education Authority, under HCI Pillar 3, has funded five construction focused projects which will promote innovative and responsive models of programme delivery, and will enable the higher education system to respond rapidly to changes in both skills requirements and technology in the construction sector. Springboard+ 2020/21 provided 19 courses in construction related areas with 1107 funded participants. Under Springboard+ 2021/22, there are 25 courses available (634 places) in construction related areas such as NZEB, Energy Management, BIM and Electric Vehicle Technology.

9.3 Public Awareness and Citizen Engagement

9.3.1 National Dialogue on Climate Action

For Ireland to transition to a net zero and climate neutral economy by no later than 2050, changes in our society and economy need to be made, and a collaborative effort is required by government, business, communities, and individuals. Government and the public sector must lead by example, however delivering on this ambition is the responsibility of everyone in society.

The National Dialogue on Climate Action (NDCA) is the primary vehicle through which this will be realised, delivering a systematic means of actively engaging stakeholders and the

public with climate action across Ireland enabling and empowering people at a local and national level.

The NDCA programme is being delivered through three main pillars:

- Improving climate literacy by creating awareness about, and promoting understanding of, climate change through communications and education
- Funding, supporting, and enabling active engagement in climate action at a local and national level, conducting public consultations, and empowering the public to adopt more sustainable behaviours
- Capturing insights from engagement activities and conducting social and behavioural research to inform the CAP and climate policies

Since the launch of its enduring structure in 20, the NDCA has engaged with the public, focusing on groups vulnerable to effects of climate change and climate action, key stakeholders, policy makers and government through the following initiatives:

i. Climate Conversations

In 2021, as part of the NDCA, a series of in-depth climate conversations took place which captured the views of over 3,800 people, including inputs from over 200 individuals, 16 Public Participation Networks (PPNs), 100 young people from 12 Comhairle na nÓg groups, and 70 people from 12 years of age and upwards. These conversations gave voice to a public who are responsive to this crisis and feel a sense of urgency around climate action. It demonstrated an enthusiasm to work with the government, agencies, and organisations across society to deliver on more ambitious targets. It identified areas where people are already making changes and where individuals and communities feel they lack information, knowledge and resources, or the capacity to pursue these changes. In particular, many expressed the view that there is a need for innovation in finance (e.g. removing bureaucracy, providing low-cost finance options), and a need to enhance the capacity of local authorities and the community sector, in order to meet our ambitions. Our experience to date shows that, as we move forward, we need systematic and active engagement with stakeholders and the public across Ireland at local and national level. The NDCA will be the primary vehicle through which this will be delivered

The 2022 Climate Conversations launched in July 2022 and were open until 9 September 2022.

ii. National Climate Stakeholder Forum (NCSF)

The National Climate Stakeholder Forum (NCSF) was established, as a central pillar of the NDCA, by the Department of the Environment, Climate and Communications to function as

a consultative forum on climate issues. The NCSF will meet three times each year, with administrative support being provided by the EPA.

The NCSF met in March and July 2022 and will meet again in November 2022.

The NCSF takes the form of a one-day workshop where stakeholders and policy makers are brought together to explore the challenges and opportunities presented by the transition to carbon neutrality in a fair and equitable manner. Recommendations from the forum go forward to inform the CAP22 and sectoral policies.

iii. National Youth Assembly on Climate

CAP21 included a commitment to establish a Youth Climate Assembly. The first annual National Youth Assembly on Climate was held on 2 March 2022 and was a joint initiative led by the Department of Children, Equality, Disability, Integration and Youth and the Department of the Environment, Climate and Communications under the NDCA.

The Assembly convened online and was opened by Roderic O'Gorman, Minister for Children, Equality, Disability, Integration and Youth. It was hosted by three members of the Youth Advisory Group and 38 young people attended, including 29 sitting National Youth Assembly of Ireland members. The delegates were nominated by organisations, including Comhairle na nÓg, student bodies and community groups.

Four workshops were held, each focusing on the areas of greatest concern to young people. The delegates presented their recommendations directly to the Minister for the Environment, Climate and Communications, Eamon Ryan, followed by a detailed discussion on four key priority areas:

- Community Engagement
- Transport
- Just Transition
- Government Policy

These recommendations will now be used to inform sectoral policies and the CAP22. Four delegates from the National Youth Assembly on Climate also went on to participate in the NCSF held in March.

9.3.2 Citizen's Assembly

Ireland's Oireachtas established a Citizens Assembly ¹³¹ in 2017, a panel representing public opinion charged with examining a range of complex issues requiring cross-sectoral action.

¹³¹ <https://2016-2018.citizensassembly.ie/en/How-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/>

The Citizens Assembly has a mandate to look at a limited number of key issues over an extended time period. The Citizens' Assembly is an exercise in deliberative democracy, placing the citizen at the heart of important legal and policy issues facing Irish society today. One of the issues the Citizens' Assembly is tasked with considering is "How the State can make Ireland a leader in tackling climate change" and deliberations on the topic took place in September and November 2017.

Consideration of this topic by the Assembly has concluded and a Final Report and Recommendations was laid before the Houses of the Oireachtas on Wednesday, 18 April 2018. The recommendations in the Final Report were reached by ballot paper voting and follow two weekends of deliberation which focussed on the energy, transport and agriculture sectors, international best practise and existing national policies and activities. A total of 13 questions appeared on the ballot and the recommendations were reached by majority vote.¹³¹

9.3.3 Climate Change Advisory Council

The Climate Change Advisory Council (CCAC) was established under the Climate Act 2015. It is an independent advisory body tasked with assessing and advising on how Ireland can achieve the transition to a low carbon, climate resilient and environmentally sustainable economy. The CCAC conducts evidence-based analyses on how best to respond to the impact of climate change and provide timely advice on the most effective policies to assist with Ireland's transition to a low carbon and climate resilient economy. As part of this work, the CCAC provides regular reports regarding Ireland's progress in achieving its national policy goals and GHG emissions targets agreed by the EU.

The Council published their fifth Annual Review Report on 8th December 2021, along with a number of specific recommendations.¹³²

9.3.4 Environmental Protection Agency

The EPA is at the front-line of environmental protection and policing in Ireland. The EPA has a wide range of functions including environmental licensing; enforcement of environmental law; environmental planning, education and guidance; monitoring, analysing and reporting on the environment; regulating Ireland's GHG emissions; environmental research development; Strategic Environmental Assessment and Waste Management.

The Climate Act 2015 requires sectors that are required to prepare sectoral adaptation plans consult with the EPA and with the CCAC in the preparation of their sectoral adaptation plans. The CCAC Secretariat, which is based in the EPA, provides corporate and secretarial services to the CCAC to assist them to carry out their statutory functions under the Climate Act 2015.

Climate Act 2021 provides a detailed plan for taking decisive action to achieve a 51% reduction in overall GHG emissions by 2030 and setting us on a path to reach net zero emissions by no later than 2050, as committed to in the Programme for Government and set out in the Climate Act 2021.

A climate change section on the EPA's website¹³⁵ provides a range of information for the public, including the latest research findings from EPA funded climate projects, information from international climate negotiations, links to international and national organisations working on climate change, carbon calculator tools for personal and business use, and answers to frequently asked questions about climate change. The EPA website includes a number of Carbon Calculator tools. The Carbon / CO₂ Calculator allows an individual to calculate the amount of carbon dioxide emitted as a result of their daily actions. The Carbon Management Tool allows businesses to calculate carbon emissions and which shows how those emissions can be reduced. The EPA also manages a Twitter account which highlights climate issues, the account has over 15,000 followers.

The EPA, with the support of the Department of Communications, Climate Action and Environment, provided funding for the popular environmental television series, Eco Eye, which aired over 100 episodes on the national television broadcaster, RTE, and attracts an audience of approximately 500,000 per episode. Eco Eye returned to the TV screens in January 2022 for Season 20. Past episodes for seasons 1 to 20 from 2012 to 2022 are available to the public on the Eco Eye production website.¹³³

i. Climate Change Research and Education

The EPA has publicised the findings of its various research projects through the media and sectoral workshops. Research supported under the Climate Change Research Report Programme has focused on investigating priority issues related to Ireland's response to climate change and has produced valuable insights on a range of issues including adaptation and options for mitigation in various sectors.

In 2021 the EPA embarked on a new project with Yale University's Programme on Climate Change Communications (YPCCC) to research the attitudes, behaviours, policy preferences

¹³³ <http://www.earthhorizon.ie/television/eco-eye>

and beliefs of the Irish public to climate change. The results of this research have been made public with the release of the 'Climate Change in the Irish Mind' Report. It provides a range of fresh insights into the attitudes of the Irish population which will be of benefit to researchers, policymakers, government departments/ agencies, communications experts, and other interested parties.

The project is being facilitated by the National Dialogue on Climate Action (NDCA) in its role as the hub for understanding public climate change knowledge, attitudes, policy preferences, and behaviour, and the underlying psychological and cultural factors that influence the public.

Objectives

- Establish national level baseline on attitudes and behaviours to climate change.
- Identify different segments of the Irish population; nationally, regionally and locally, and how they respond to climate change issues.
- Estimate Irish climate change beliefs, attitudes, policy support and behaviour at sub-national levels.
- Support the development of a communications strategy on the dissemination of the research findings.

Outcomes

Two significant reports are expected from this work:

- The first report 'Climate Change in the Irish Mind' sets out survey results following analysis of the data and was published in 2021
- The second report, expected in 2022 'Global Warming's X Ireland's' will provide insights into the different audience segments and how they each respond to the issue of climate change.
- An interactive mapping tool, also expected in early 2022, will be generated for general usage.

In November 2020 the EPA published "Ireland's Environment – An Integrated Assessment 2020". This is the most recent state of the environment report published by the EPA. The seventh in the series, previous state of the environment reports were published in 1996, 2000, 2004, 2008, 2012 & 2016. The State of the Environment report draws from data and assessments by the EPA and many other public bodies. It provides the public, policy makers, non-governmental organisations, community groups, businesses, teachers and students with the national evidence base about the condition of our environment. The report acts as a key resource for education, training and public awareness. It is a landmark evidence-based document that examines the environment in its totality and offers us the opportunity to reflect and plan for a better future.

The report acts as a key public awareness resource to highlight climate change and the integrated actions needed in Ireland to meet national, European and global targets. The report highlights community engagement as an important part of environmental protection, and advocates for the continued need to inform, engage and support communities in the protection and improvement of the environment.

The Climate Ambassador programme was established in 2017 and it is Ireland's first ever initiative to train and support individuals taking action on climate change. The programme is coordinated by the Environmental Education Unit of An Taisce with support from the Department of Environment, Climate and Communications.

During COVID-19, the programme hosted Network Gatherings on various themes such as permaculture, renewable energy communities, biodiversity, peatlands and lots more.

Recordings can be viewed on the YouTube channel.

Table 9.1: Achievements of EPA funded Climate Ambassador Programme to date

Achievement	Total
No of Climate Ambassadors	597
No of communications	3,471
No of actions identified	2,375
No of people engaged with	1,181,785

The EPA provides a range of environmentally focused educational resources for all levels. <http://www.epa.ie/researchandeducation/education/>. The EPA contributes an annual lesson to the [Science and Technology in Action](#) secondary school pack, distributed to all second level schools.

The EPA BeGreen programme supports resource efficiency activities for the hospitality sector in Ireland and includes the development of educational modules for example in the catering colleges in Ireland in food, water, and energy efficiency¹³⁴.

The major EPA funded research project 'CONSENSUS: A cross-border household analysis of CONsumption, ENVironment and SUStainability' in Ireland yielded valuable educational resources for primary, secondary and tertiary education. CONSENSUS lifestyle survey factsheets were circulated as an educational resource to all schoolteachers and students through the AGTI¹³⁵ website, with a growing number of students taking a sustainable consumption module based on the project's findings.

¹³⁴ <http://www.epa.ie/begreen/>

¹³⁵ [Association of Geography Teachers of Ireland](#)

The EPA worked with An Taisce to develop a Green Home module of the Green-Schools programme. This module involves householders and has widened its reach to include community groups through the Tidy Towns competition. The programme currently focuses on four key household themes of waste prevention, water conservation, energy conservation and sustainable transportation.

The EPA's Climate Change Lecture Series has been running since 2007, as part of its programme of increasing public awareness of climate change issues. The early evening events are free and open to the general public, and hosted by a popular current affairs media personality. The series has included a wide range of international and Irish speakers, who have discussed key aspects of climate change.

- In November 2018 the guest lecturer was Prof. Hugh Montgomery who delivered a presentation on climate change and health impacts.
- In February 2020, Dr Artur Runge-Metzger, the Director at the Directorate General of Climate Action in the EU spoke about the European Green Deal which frames Member State's contributions in the context of a climate-neutral Europe by 2050.
- During 2021 two lectures were held virtually so as to be in line with the government health guidelines because of the COVID-19 pandemic. February saw Dr Kirsten Dunlop of Climate-KIC speak to us about how finance can enable a climate neutral economy and society. And in November Prof. Michael Mann joined us to talk about urgency and agency in the battle to avert a climate crisis, which is in line with his recently published book, "The New Climate War".

Dr. Anthony Leiserowitz gave the most recent lecture in April 2022 which considered the role of the public, consumers and political will as an enabler of climate actions.

An average of 340 people have attended the events in person. The lectures are available for viewing on the EPA's website ¹³⁶ and on the EPA YouTube ¹³⁷ channel).

ii. EPA / IFA Smart Farming programme

Smart Farming is an EPA led collaboration with key agriculture stakeholders including the Irish Farming Organisation, Department of Agriculture, Food and Marine, Teagasc, SEAI and third level institutions, to raise environmental awareness in the agriculture sector. The aim of initiative to enable farmers to adopt sustainable farming practices, including GHG mitigation measures, through knowledge transfer whilst also achieving significant cost co-

¹³⁶ www.epa.ie

¹³⁷ www.youtube.com/epaireland

benefits, and thus improve farm environmental and economic sustainability. Smart Farming¹³⁸ provides access to a range of tools and detailed case studies that demonstrate the adoption of scientifically robust management options which can be implemented at farm scale. A variety of communication platforms are used as out-reach to the farming community including on-line tools and social media, regular print media and advertorials, showcases and seminars are key farming events (including the annual National Ploughing Championship which has attendances in excess of 250,000 people).

iii. National Waste Prevention programme

The National Waste Prevention Programme (NWPP) aims to effect changes towards a vision of 'living well, using less' as articulated in the current strategy Towards a Resource Efficient Ireland. The programme is one of EPA's flagship initiatives and combines direct interventions such as greenbusiness.ie; with support funding to organisations working in the area – such as Community ReUse Network Ireland. The NWPP provides some incentives for technological improvements, but the major emphasis is on prompting behavioural changes. The portfolio of projects within the NWPP is funded by the Irish government and the direction of the programme is overseen by a National Waste Prevention Committee. In recent years, the NWPP has seen an increased focus on areas such as social enterprises and community-based activities. This is due to strategic nudges from national and EU policy (such as the Circular Economy package). Future directions for the programme will continue to be informed through policy drivers and also through the UN SDGs.

In order to get the message to as many people as possible and avoid duplication of effort, NWPP actively pursues opportunities for collaboration with other organisations targeting similar audiences or having mutually beneficial goals, such as trade associations, enterprise agencies and community champions. Programmes developed as part of the NWPP such as Green Business, Smart Farming and Green Healthcare aim to increase resource efficiency in businesses and public sector organisations, including reduction in energy and water consumption and preventing waste generation.

Through the Local Authority Prevention Network, the NWPP also collaborates with local authorities to promote sustainability in local businesses and communities, encouraging reduction of energy and water consumption and preventing waste generation.

Consumers are becoming increasingly aware of food waste and its link to climate change. The EPA's Stop Food Waste campaign aims to prevent food waste by empowering

¹³⁸ <http://smartfarming.ie/>

consumers to rethink how they shop, store cook and eat. In 2017, EPA launched a national charter on food waste which declares the significance of food waste as a pressing environmental and social issue, and commits signatories to taking a strong approach to preventing food waste

Reducing food waste has been recognised as one of the most important global challenges of our time. Ireland, along with almost 200 other countries, has committed to tackle this problem by 2030.

Recently published EPA-funded research¹³⁹ revealed that the food services sector generates over 250,000 tonnes of food waste each year with a very considerable cost in terms of resource-use and business overheads – estimated at over €300M for the hospitality sector alone. This highlights a high-potential area for action towards meeting national targets.

9.3.5 Sustainable Energy Authority of Ireland

SEAI's vision is for Ireland's energy to be sustainable, secure, affordable, and clean. Its role is to help homes, businesses, communities, and industry to be more energy efficient and to support the development of environmentally friendly clean energy technologies.

i. SEAI Schools programme

The SEAI Schools programme¹⁴⁰ aims to excite and inspire teachers and students about sustainable energy and the role they can play in creating a clean energy future¹²⁸. The programme helps teachers to inform attitudes and beliefs on energy and climate change through three strands: curriculum based teaching resources, interactive student workshops and the SEAI One Good Idea energy awareness competition.

By integrating the three strands of the education programme and collaborating with the Department of Education, SEAI can encourage a whole school approach to energy.

SEAI provides rich, curriculum aligned teaching resources for primary and post primary schools. Dublin City University were commissioned to develop the resources for SEAI.

Exploring our Energy provides primary school teachers with resources for teaching energy to pupils from 5 to 12 years, using interactive white board lessons, experiments and investigations. Energy in Action is a teaching resource for post primary students on energy and sustainability and is aligned with Junior Cycle subjects: Science, Home Economics,

¹³⁹ <https://www.epa.ie/news-releases/news-releases-2019/high-levels-of-food-waste-identified-in-irish-food-businesses.php>

¹⁴⁰ <https://www.seai.ie/teaching-sustainability/>

Geography and CSPE. The resources are available for teachers to download from SEAI's website.

Every year SEAI reach over 20,000 primary and post primary students with its workshops. All workshops are hands on, interactive and encourage debate on the topics of energy efficiency and climate change. SEAI, in partnership with the Department of Education, also provide workshops for teachers on integrating SEAI's resources into the various curricula, and working with Science Foundation Ireland, run Summer courses for teachers in various locations throughout Ireland.

SEAI's One Good Idea competition¹⁴¹ encourages students to inspire lifestyle changes to save energy and help tackle climate change. It is open to both primary and post primary students and challenges them to develop awareness campaigns on energy efficiency and climate action. Their campaigns target their peers, other schools in the area or the wider community. In a typical year the competition engages with 580 schools and over 1,500 students, with an additional reach of 500,000 via their campaigns. The enthusiasm and dedication from the students is always inspiring and their understanding of the issues around energy and climate change is very impressive. Some of the campaigns that the students have run have had a lasting impact on the school and in some cases the wider community.

SEAI also works in collaboration with Department of Education and offers a range of supports to help schools to improve energy management, reduce school operating costs and protect the environment through a dedicated website¹⁴². Over 600 schools have availed of energy management training and technical advice. Other resources include step by step guides and workbooks, a dedicated website with factsheets, videos, on-line energy management tools and case studies.

The Department of the Environment, Climate and Communications funds a wide range of programmes operated by the SEAI, which reach all sections of society, raising awareness and guiding behavioural change towards more sustainable energy. Among SEAI's most significant programmes are:

- The Large Industry Energy Network¹⁴³ with over 196 members accounting for more than €1 billion energy spend, many of whom are certified to the international ISO50001 Energy management standard

¹⁴¹ <https://www.seai.ie/teaching-sustainability/one-good-idea/>

¹⁴² <http://www.energyineducation.ie/>

¹⁴³ <https://www.seai.ie/energy-in-business/lien/>

- 80 public bodies are members of SEAI's Public Sector Partnership Programme ¹⁴⁴ covering €480 million energy spend, committed to the highest levels of energy management, with an ultimate target of 33% reduction
- SEAI has developed a growing national network of over 110 Sustainable Energy Communities ¹⁴⁵ with diverse interests and skills all working together to transition to sustainable energy practices and systems. In 2019, SEAI offered grant support to 57 community energy projects to a value of over €60 million. This helped support the upgrade of over 650 homes and 450 community buildings and businesses right across Ireland. The Energy in Education ¹⁴⁶ web portal has an extensive range of support materials, guides, advice and best-practice videos for teachers, principals, boards of management, and contractors. Over 530 schools completed the more intensive support activities on offer, including training combined with energy assessment specifically designed for schools.
- The annual SEAI Sustainable Energy Awards ¹⁴⁷ recognise and reward excellence in all aspects of energy efficiency and renewable energy. Covering nine categories in 2021, the competition is open to organisations in both the Republic of Ireland and Northern Ireland. On average €100 million energy savings are achieved across the more than entrants each year.
- The Triple E Products Register ¹⁴⁸ is a searchable listing of best in class energy efficient products with only the top 10 - 15% most energy efficient products in any technology listed. This is an important support for purchasing capital equipment in the private and public sectors and underpins tax supports from the Irish revenue services.
- SEAI's consumer information programme ¹⁴⁹, engages and motivate consumers to play an active role in energy sustainability. It gives consumers practical steps to becoming more energy-efficient in the home. The consumer information activities typically complement the aims of specific schemes administered by SEAI such as home and electric vehicle energy grants, building energy rating, community programmes, as well as SEAI's market surveillance responsibilities. A range of tools are used including advertising, public relations and public events, with a large amount of supporting advice materials on our website.

¹⁴⁴ <https://www.seai.ie/energy-in-business/public-sector/>

¹⁴⁵ <https://www.seai.ie/sustainable-solutions/community-projects/community-network/>

¹⁴⁶ <http://www.energyineducation.ie/>

¹⁴⁷ <https://www.seai.ie/events/sustainable-energy-awards/>

¹⁴⁸ <https://www.seai.ie/energy-ratings/triple-e-register-for-business/>

¹⁴⁹ <https://www.seai.ie/sustainable-solutions/energy-saving-tips/>

- SEAI makes extensive use of social media as a means to reach motivated and engaged energy users, with 40,000 followers and connections currently across LinkedIn, Twitter Facebook.
- Since 2011, SEAI has participated with the Commission for Energy Regulation and other key Stakeholders in the National Smart Meter Project. The project began in 2019 and has a target to have every electricity meter will have been replaced by a next-generation smart meter, by the end of 2024.
- SEAI provides expertise in the area of citizen engagement and has recently established a unit dedicated to the area of behavioural economics and behavioural science (<https://www.seai.ie/sustainable-solutions/behavioural-insights/>).
- SEAI also maintains an online energy research (RD+D) portal for Ireland (<https://www.seai.ie/sustainable-solutions/research-development-demonstration-andhttps://www.seai.ie/sustainable-solutions/research-development-demonstration-and-innovation/innovation/>) as well as annually publishing a national energy research inventory.

9.3.6 Local Level

i. The Community Environment Action Fund

The Community Environment Action Fund, (previously known as the Local Agenda 21 Environmental Partnership Fund or LA21), promotes sustainable development at a local level by funding small scale, non-profit environmental projects, that make a significant difference in local communities. The objective of the Community Environment Action Fund is to promote sustainable development by assisting environmental projects, including awareness projects at local level. The funding scheme is open to non-profit local and community groups, and is co-financed by local authorities and DECC. A wide variety of projects and schemes have been supported under the Fund in previous years including, for example, community gardens, allotments and compost schemes, rainwater conservation schemes, educational initiatives and environmental exhibitions.

ii. Tidy Towns

The Tidy Towns competition is a long-running awards scheme which encourages community involvement in improving towns and villages, and which incorporates natural environment elements, including biodiversity. The competition is run by the Department of Rural and Community Development with sponsorship from a national retailer. The TidyTowns

initiative has been very successful in encouraging voluntary effort throughout the country and it promotes a sense of pride in communities and the local environment. The competition includes a specific Climate Change award and an Air Quality Award, funded by the Department of the Environment, Climate, and Communications.

iii. Environmental Awareness Officers

Local Authority Environmental Awareness Officers promote positive Environmental Action at local level. The Awareness Officers raise awareness of environmental issues with schools, community groups and the public in general. DECC facilitates the Environmental Awareness Officers' Network, which provides opportunities for exchange of best practice.

9.4 Involvement of Public and Non-Governmental Organisations

9.4.1 Support for Environmental NGOs

The Department of the Environment, Climate and Communications continues to engage with and provide funding to the environmental NGO Sector in order to support them in the role they play in protecting the environment, raising awareness, promoting sustainability and participating in environmental policy development. DECC funds the Irish Environmental Network (IEN) an umbrella organisation of environmental NGOs in Ireland and core funding provided by DECC is distributed to the IEN's 30 member organisations. Funding provided to the IEN has almost doubled since 2020.

i. ECO-UNESCO

ECO-UNESCO is an environmental NGO which is affiliated to the World Federation of UNESCO Clubs, Centres and Associations. ECO-UNESCO raises environmental awareness, promotes environmental protection and encourages active citizenship in children and young people across Ireland. Its programmes receive support from various Government Departments and Agencies. ECO-UNESCO has an extensive network and works with young people, teachers, local authorities, business and community leaders as well as participants from the environmental, youth, community and international NGOs.

ECO-UNESCO provides a range of youth and education programmes including training programmes, environmental workshops and peer education programmes. It also supports teachers and youth leaders by providing various educational resources. Along with its youth programmes, ECO-UNESCO also provides accredited and non-accredited adult training in areas such as sustainable development, community gardening and environmental education.

ECO-UNESCO also runs the Young Environmentalist Awards which is aimed at promoting environmental responsibility among young people aged 10 to 18. The programme culminates in an annual National showcase and awards ceremony which is partly funded by the Department of Communications, Climate Action & Environment.

ii. Local Authorities and Community Action

The Local Authorities have a particularly important role in the delivery of both climate mitigation and adaptation.

This is reflected in the provisions of the Climate Act 2021, under which Local Authorities will have to prepare CAPs. These Plans will set out the mitigation and adaptation policies, measures and actions required at local level to drive the achievement of our national climate ambition.

In 2018, the DECC entered into a five-year financial commitment of €10 million to establish four Climate Action Regional Offices (or CAROs). The CAROs coordinate actions between Local Authorities and assist in the development and monitoring of implementation of 31 Local Climate Adaptation Strategies which are currently being delivered.

Since 2019, the DECC has also funded and engaged with the CAROs in relation to the implementation of an extensive Local Authority climate action training programme. Over 13,000 Local Authority staff received training in 2021 and further courses are in development.

iii. Role of Communities and supports from DECC

Empowering local communities to address the challenges they face in transitioning to carbon neutrality is central to the delivery of the CAP. The National Dialogue for Climate Action is the key mechanism through which climate actions related to public engagement, participation, community action, networking and capacity building are delivered.

As well as acting as the coordinating structure facilitating societal engagement on climate action, the NDCA also provided financial supports for local innovations through the Climate Action Fund.

In November 2021 the Community Climate Action Programme (CCAP) was launched, with funding of €60 million over 3 years from the Climate Action Fund. The purpose of this funding is to facilitate eligible organisations to collaboratively develop supports, tools, know-how and approaches to assist local communities to take climate action.

As part of the NDCA, conversations are held at local level through PPNs and through targeted focus groups. The outputs of local engagement activities and the climate conversations will be analysed and inform the programme for a National Climate

Conversation on Local Actions (NCCLA). The NCCLA will be a forum to allow communities and organisations to showcase projects, engage in practical discussions, share best practice, and explore the scalability of local activity or individual innovations. This event will be held annually and take the form of workshops hosted in various locations around the country. This will serve to critically reflect on activities, build capacity, examine best practice and its scalability, inform policy, and provide insights which will feed into the annual CAP and the NDCA work programme cycle. The first NCCLA is due to take place in October 2022.

Annex A.1.1 CO₂ eq Emission Trends 1990-2020

(Sheet 1 of 6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	(kt CO ₂ eq)																				
Total (net emissions) ⁽²⁾	61015.92	61015.92	61789.70	61517.04	62316.73	63708.76	66301.79	68123.78	68881.87	71301.50	72735.99	76541.71	79806.86	77424.94	78168.03	76146.74	78517.44	78072.62	76120.59	75065.89	68804.36
1. Energy	31021.68	31021.68	31873.35	31764.02	31943.40	32914.40	33830.04	35449.00	36564.14	38780.32	40174.33	42481.08	44588.27	43367.51	44002.10	43799.99	45703.69	45218.41	45150.80	45257.20	40786.14
A. Fuel combustion (sectoral approach)	30915.84	30915.84	31776.89	31672.29	31847.90	32820.23	33735.41	35354.05	36471.36	38700.92	40055.57	42397.91	44435.70	43293.38	43260.45	43717.43	45630.00	45132.91	45056.80	45168.52	40702.22
1.1. Energy industries	11223.13	11223.13	11684.22	12345.63	12361.50	12698.96	13383.63	14103.62	14761.01	15141.54	15800.05	16116.30	17334.22	16419.83	15725.70	15335.11	15828.51	15076.62	14583.00	14706.49	13117.52
1.2. Manufacturing industries and construction	4099.22	4099.22	4187.43	3864.16	4073.08	4313.88	4333.07	4199.98	4543.14	4526.01	4696.36	5481.55	5446.46	5109.41	5223.46	5294.08	5473.49	5262.38	5350.08	5159.78	4136.65
1.3. Transport	5145.01	5145.01	5324.69	5753.91	5731.39	5985.66	6283.52	7340.19	7724.43	9075.31	9749.53	10789.18	11312.00	11504.53	11706.10	12423.80	13131.99	13809.26	14394.37	13666.42	12446.38
1.4. Other sectors	10448.47	10448.47	10580.55	9708.58	9681.93	9821.72	9735.19	9710.26	9442.78	9958.06	9809.63	10010.88	10343.02	10259.61	10605.18	10664.43	11196.01	10984.65	10729.35	11635.82	11001.67
1.5. Other	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Fugitive emissions from fuels	105.84	105.84	96.46	91.73	95.50	94.17	94.63	94.95	92.78	79.41	118.76	83.17	152.57	74.13	741.65	82.56	73.69	85.51	94.00	88.68	83.92
1.1. Solid fuels	55.56	55.56	44.93	40.74	37.63	35.25	33.33	31.52	30.14	28.96	27.91	27.02	26.19	25.42	24.75	24.15	23.55	23.05	22.53	22.08	21.66
1.2. Oil and natural gas and other emissions from energy production	50.28	50.28	51.53	50.99	57.87	58.92	61.30	63.43	62.64	50.45	90.85	56.15	126.38	48.71	716.90	58.41	50.14	62.46	71.48	66.60	62.26
1.3. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	3310.16	3310.16	3012.41	2938.95	2946.28	3227.87	3218.42	3400.47	3863.37	3667.02	3775.35	4559.26	4604.05	4076.69	3484.17	3669.58	3965.36	3893.00	3945.39	3662.69	2812.49
A. Mineral industry	1116.73	1116.73	992.39	932.97	951.13	1081.70	1084.18	1198.39	1384.92	1288.13	1353.71	1908.78	2061.44	2063.38	2342.32	2507.06	2552.80	2538.74	2580.43	2301.58	1485.32
B. Chemical industry	1985.55	1985.55	1811.31	1784.56	1727.19	1837.62	1754.44	1703.85	1854.12	1839.80	1723.82	1663.30	1602.91	1091.77	0.30	NO	NO	NO	NO	NO	NO
C. Metal industry	26.08	26.08	23.44	20.56	26.08	21.28	24.80	27.28	26.96	28.64	26.80	28.80	12.00	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	94.64	94.64	82.69	82.80	81.35	83.18	73.78	90.36	84.15	81.40	81.94	134.30	91.37	86.81	87.47	95.92	146.81	106.33	120.19	102.11	100.74
E. Electronic industry	1.17	1.17	15.15	29.13	57.08	85.04	145.33	201.00	258.21	138.05	286.01	491.70	424.71	344.12	393.08	285.75	310.12	249.41	238.87	179.86	107.30
F. Product uses as ODS substitutes	NO	NO	NO	NO	13.13	27.37	42.92	87.01	152.91	196.68	197.83	254.84	311.16	390.43	540.14	679.87	854.28	896.59	902.79	991.92	1024.91
G. Other product manufacture and use	64.84	64.84	65.95	67.14	68.24	69.28	70.35	70.68	81.44	71.76	81.76	56.08	79.61	72.32	88.45	70.41	71.24	71.85	73.30	55.70	59.80
H. Other	21.16	21.16	21.48	21.80	22.09	22.40	22.63	21.90	20.66	22.56	23.48	21.45	20.85	27.87	32.41	30.55	30.11	30.08	29.80	31.52	34.42
3. Agriculture	18939.30	18939.30	19155.95	19277.19	19631.01	19762.61	20345.96	20843.90	20958.42	21547.49	21301.19	20404.25	20125.91	19815.85	20115.28	19811.36	19685.20	19565.25	18997.59	18818.99	18513.52
A. Enteric fermentation	10893.92	10893.92	11129.92	11336.82	11467.68	11460.73	11563.52	11959.71	12256.42	12546.82	12272.30	11772.80	11743.74	11610.47	11635.52	11621.15	11598.86	11686.83	11303.62	11269.91	11067.87
B. Manure management	1776.98	1776.98	1821.31	1860.40	1882.29	1884.13	1897.05	1981.15	2041.79	2090.00	2031.14	1954.77	1978.29	1979.40	1968.81	1944.53	1986.65	2006.75	1927.26	1932.23	1911.62
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	5816.68	5816.68	5789.94	5706.29	5823.86	6049.40	6304.54	6331.81	6154.09	6509.71	6510.99	6218.45	5934.96	5871.29	6045.70	5938.01	5772.14	5549.06	5339.04	5287.66	5137.68
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	355.04	355.04	315.15	255.60	357.30	269.64	494.60	484.03	423.49	305.58	383.23	366.38	385.28	273.90	386.76	240.80	266.73	254.86	376.77	262.21	307.32
H. Urea application	96.68	96.68	99.63	118.09	99.88	98.72	86.27	87.19	82.63	95.37	103.53	91.84	83.64	80.81	78.48	66.86	60.81	64.76	50.90	66.97	89.02
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry ⁽²⁾	6192.73	6192.73	6115.18	5838.66	6047.76	6011.04	7078.19	6721.93	6063.31	5831.09	6004.41	7604.35	8883.28	8454.65	8801.03	7355.06	7838.45	8044.18	7153.58	6600.99	6143.66
A. Forest land	-2538.60	-2538.60	-2598.55	-2043.51	-2058.78	-1692.38	-1300.64	-1070.76	-1916.98	-1495.20	-1300.92	-223.34	-572.63	-550.19	-638.97	-1292.75	-1085.21	-1578.08	-1456.52	-2469.07	-2457.64
B. Cropland	-100.37	-100.37	-32.16	-18.70	28.44	-40.49	17.07	-27.76	5.99	-44.43	-4.58	16.55	274.97	190.97	41.16	62.67	-8.02	-101.60	12.39	178.03	-100.98
C. Grassland	7249.98	7249.98	7357.73	6767.74	6411.72	6258.71	6463.22	6121.19	6524.00	6253.31	6186.42	6844.48	6722.70	7100.37	6797.94	6467.17	6745.93	6601.90	6608.51	6856.02	7036.31
D. Wetlands	1907.13	1907.13	1720.49	1601.81	2173.64	2016.81	2435.46	2323.10	2060.95	1818.75	1790.02	1823.23	3237.87	2336.20	3386.00	2778.03	2854.58	2430.27	2543.29	2154.40	2009.89
E. Settlements	86.75	86.75	76.32	90.85	77.99	112.92	119.37	136.05	150.83	166.94	183.05	212.10	276.45	268.43	332.10	363.30	391.40	477.89	597.32	499.04	302.34
F. Other land	0.89	0.89	0.97	1.06	1.14	1.22	23.41	29.84	32.39	34.95	37.50	54.59	59.88	62.27	64.66	67.05	69.44	1487.72	46.86	70.73	62.21
G. Harvested wood products	-413.04	-413.04	-409.63	-560.58	-586.40	-645.76	-679.70	-789.72	-793.88	-903.23	-887.09	-1123.25	-1115.95	-953.41	-1181.87	-1090.41	-1129.67	-1273.92	-1198.27	-688.16	-708.49
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	1552.05	1552.05	1632.81	1698.23	1748.28	1792.85	1829.18	1708.48	1432.63	1475.58	1480.70	1492.77	1605.35	1710.23	1765.47	1510.75	1324.74	1351.78	873.23	726.01	548.56
A. Solid waste disposal	1318.08	1318.08	1398.58	1461.43	1510.59	1556.07	1592.76	1471.87	1212.72	1263.43	1261.29	1268.16	1364.47	1437.64	1457.14	1190.85	1007.00	1049.30	615.99	463.84	284.80
B. Biological treatment of solid waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.81	5.83	8.11	34.15	46.54	37.30	36.87	48.64	47.98
C. Incineration and open burning of waste	97.74	97.74	97.88	98.66	99.47	100.12	100.59	100.61	84.72	66.67	74.52	79.51	88.68	114.68	161.65	149.26	132.48	130.08	84.02	69.06	70.55
D. Waste water treatment and discharge	136.24	136.24	136.35	138.14	138.22	136.66	135.83	136.01	135.19	145.48	144.90	145.10	148.38	152.08	138.57	136.49	138.72	135.09	136.34	144.46	145.22
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:																					
International bunkers	1139.11	1139.11	1156.49	966.49	1524.96	1322.63	1536.76	1572.56	1773.82	1834.68	2124.20	2312.96	2726.68	2811.22	2841.42	2654.31	2841.37	3298.88	3425.01	3071.63	2555.37
Aviation	1081.75	1081.75	1048.35	912.46	1352.58	1198.36	1163.55	1068.16	1291.49	1329.95	1574.56	1830.13	2211.73	2351.47	2295.57	2175.19	2507.68	2890.37	3064.37	2848.50	2248.60
Navigation	57.36	57.36	108.14	54.03	172.38	124.26	373.21	504.40	482.32	504.74	549.65	482.83	514.95	459.74	545.85	479.12	333.69	408.52	360.64	223.13	306.77
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO ₂ emissions from biomass	500.82	500.82	479.54	424.19	429.20	431.66	424.65	467.71	493.25	587.22	557.22	597.82	654.24	643.32	612.42	715.32	902.10	931.08	1005.80	1	

Note: All footnotes for this table are given at the end of the table on

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IRELAND

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
											%
70007.23	64996.05	65264.41	65737.95	64944.27	68034.08	69541.55	70611.94	69509.49	67044.94	64958.54	6.46
40458.11	36913.21	37000.79	35850.07	35190.44	36856.71	38370.28	37063.78	36840.84	35264.07	33156.29	6.88
40371.15	36833.61	36922.73	35773.89	35102.75	36768.10	38280.53	36968.90	36745.62	35173.31	33064.92	6.95
13378.89	11981.82	12824.57	11462.15	11257.28	11866.26	12,589.59	11,816.30	10,554.99	9,349.84	8,647.71	-22.95
4150.37	3681.67	3759.97	3954.67	4179.99	4271.91	4,343.73	4,465.73	4,671.51	4,589.12	4,521.07	10.29
11531.38	11222.53	10834.89	11059.81	11342.45	11821.90	12,305.04	12,026.46	12,202.06	12,210.07	10,295.64	100.11
11310.51	9947.59	9503.31	9297.27	8323.03	8808.03	9,042.17	8,660.41	9,317.06	9,024.28	9,600.50	-8.12
IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0.00
86.96	79.60	78.06	76.18	87.68	88.61	89.76	94.88	95.21	90.76	91.37	-13.67
21.23	20.87	20.50	20.15	19.84	19.54	19.24	18.36	18.12	17.88	17.66	-68.21
65.73	58.73	57.56	56.03	67.85	69.07	70.51	76.52	77.09	72.89	73.70	46.58
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2595.90	2483.12	2687.98	2640.39	3051.13	3242.18	3468.92	3481.15	3229.61	3188.98	2895.75	-12.52
1299.05	1167.27	1391.97	1301.70	1650.45	1830.36	1,968.40	2,039.86	2,094.55	2,057.67	1,907.16	70.78
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
88.07	88.88	86.43	88.98	91.70	95.47	97.00	101.61	102.69	105.07	100.91	6.63
68.19	41.13	31.55	34.63	20.27	46.84	57.04	67.08	77.72	92.85	89.37	7553.47
1044.10	1081.33	1072.25	1103.04	1183.13	1160.34	1,234.24	1,147.64	832.85	813.81	688.58	100.00
56.45	64.29	60.05	62.65	63.49	64.42	64.91	65.93	62.37	54.50	50.92	-21.47
40.04	40.22	45.73	49.41	42.09	44.75	47.33	59.04	59.44	65.08	58.80	177.92
18588.38	17963.47	18810.75	19653.42	19195.22	19711.00	20192.42	20890.04	21676.90	20790.65	21074.57	11.27
10783.01	10654.54	11316.47	11431.87	11373.23	11754.48	12,073.38	12,495.63	12,777.20	12,450.47	12,605.24	15.71
1873.26	1870.44	2022.70	2029.48	1984.12	2067.65	2,127.98	2,190.61	2,261.36	2,168.53	2,200.00	23.81
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5405.94	5007.55	5195.83	5629.28	5392.25	5423.46	5,478.35	5,787.06	6,088.52	5,735.76	5,760.45	-0.97
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
427.93	360.68	229.40	515.69	391.07	401.15	433.60	332.75	461.06	343.90	399.48	12.52
98.24	70.27	46.35	47.09	54.55	64.27	79.11	83.99	88.76	91.98	109.40	13.16
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
7830.78	7018.05	6226.04	6900.40	6628.57	7265.99	6543.50	8232.09	6847.39	6886.93	6926.20	11.84
-2088.21	-2302.98	-2842.83	-3161.81	-2714.96	-3232.36	-2,747.98	-1,869.57	-1,983.46	-1,925.53	-2,085.31	-17.86
-209.89	-17.56	61.62	-33.47	-86.96	-93.53	-113.72	-92.82	-198.71	-139.54	-110.80	10.39
6935.07	6906.66	7049.24	7433.44	6906.53	6923.76	6,949.32	6,964.42	7,020.56	7,012.70	6,895.05	-4.90
3635.31	2985.14	2241.86	3128.61	3102.37	4199.15	3,059.06	3,868.94	2,618.80	2,549.20	2,760.01	44.72
315.10	126.47	322.78	134.08	122.96	138.46	143.84	175.82	164.28	199.27	239.32	175.87
62.13	62.04	61.96	61.88	61.80	59.23	56.68	54.12	51.57	49.02	46.90	5186.37
-818.73	-741.72	-668.59	-662.33	-763.17	-728.72	-803.70	-868.83	-825.66	-858.19	-818.98	98.28
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
534.06	618.20	538.87	693.68	878.91	958.19	966.43	944.88	914.75	914.31	905.73	-41.64
278.65	381.56	302.79	460.97	648.10	726.93	749.56	717.91	692.71	676.88	667.94	-49.32
48.86	48.68	44.24	44.65	41.46	40.55	39.96	45.60	44.49	47.90	47.90	100.00
62.09	45.00	48.32	45.16	41.68	42.43	25.04	27.46	23.91	32.53	29.70	-69.62
144.46	142.96	143.51	142.89	147.66	148.29	151.86	153.91	153.65	157.00	160.20	17.59
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2760.31	2423.40	2153.86	2469.38	2664.73	3034.62	3099.50	3547.47	3846.74	3789.22	1669.26	46.54
2325.59	2085.98	1752.55	2022.07	2242.25	2538.12	2,603.03	3,062.72	3,309.35	3,347.33	1,187.51	9.78
434.72	337.42	401.30	447.31	422.48	496.50	496.47	484.74	537.40	441.89	481.76	739.85
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
1338.09	1362.01	1448.18	1681.50	1892.74	1885.69	2,089.26	2,385.20	2,649.06	2,693.82	2,699.79	439.08
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	0.00
62176.45	57978.00	59038.38	58837.56	58315.70	60768.09	62998.05	62379.85	62662.10	60158.01	58032.34	5.85
70007.23	64996.05	65264.41	65737.95	64944.27	68034.08	69541.55	70611.94	69509.49	67044.94	64958.54	6.46
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Annex A.1.2 CO₂ Emission Trends 1990-2020

(Sheet 2 of 6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	30148.21	30148.21	31013.44	30963.46	31135.14	32107.08	32995.06	34539.01	35626.43	37763.66	39452.60	41738.42	43826.47	42629.58	42603.12
A. Fuel combustion (sectoral approach)	30148.21	30148.21	31013.43	30963.45	31135.13	32107.08	32995.05	34538.99	35626.42	37763.64	39414.30	41738.38	43770.38	42629.54	42603.07
1. Energy industries	11145.01	11145.01	11604.43	12263.69	12282.24	12618.22	13301.42	14016.85	14674.03	15057.14	15713.09	16028.39	17239.00	16314.64	15610.99
2. Manufacturing industries and construction	4079.63	4079.63	4167.70	3847.35	4055.40	4296.38	4315.23	4181.06	4523.78	4505.52	4675.61	5457.38	5421.25	5085.29	5198.55
3. Transport	5029.63	5029.63	5207.47	5621.83	5583.61	5805.74	6058.86	7027.28	7347.91	8620.64	9533.50	10561.82	11079.03	11279.12	11489.06
4. Other sectors	9893.94	9893.94	10033.83	9230.59	9213.88	9386.73	9319.54	9313.79	9080.69	9580.33	9492.10	9690.78	10031.10	9950.49	10304.48
5. Other	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Fugitive emissions from fuels	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	38.29	0.04	56.09	0.04	0.04
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	38.29	0.04	56.09	0.04	0.04
C. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	2248.91	2248.91	2150.40	2061.76	2026.91	2265.26	2178.90	2260.86	2589.90	2479.62	2428.83	2975.73	3226.93	2989.04	2462.57
A. Mineral industry	1116.73	1116.73	992.39	932.97	951.13	1081.70	1084.18	1198.39	1384.92	1288.13	1353.71	1908.78	2061.44	2063.38	2342.32
B. Chemical industry	990.23	990.23	1030.32	1003.56	946.19	1056.63	973.44	922.85	1073.12	1058.81	942.82	882.30	1041.18	810.90	0.30
C. Metal industry	26.08	26.08	23.44	20.56	26.08	21.28	24.80	27.28	26.96	28.64	26.80	28.80	12.00	NO	NO
D. Non-energy products from fuels and solvent use	94.64	94.64	82.69	82.80	81.35	83.18	73.78	90.36	84.15	81.40	81.94	134.30	91.37	86.81	87.47
E. Electronic industry															
F. Product uses as ODS substitutes															
G. Other product manufacture and use	0.07	0.07	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.08
H. Other	21.16	21.16	21.48	21.80	22.09	22.40	22.63	21.90	20.66	22.56	23.48	21.45	20.85	27.87	32.41
3. Agriculture	451.71	451.71	414.77	373.69	457.18	368.36	580.86	571.22	506.12	400.95	486.76	458.23	468.92	354.70	465.24
A. Enteric fermentation															
B. Manure management															
C. Rice cultivation															
D. Agricultural soils															
E. Prescribed burning of savannas															
F. Field burning of agricultural residues															
G. Liming	355.04	355.04	315.15	255.60	357.30	269.64	494.60	484.03	423.49	305.58	383.23	366.38	385.28	273.90	386.76
H. Urea application	96.68	96.68	99.63	118.09	99.88	98.72	86.27	87.19	82.63	95.37	103.53	91.84	83.64	80.81	78.48
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry ⁽²⁾	5520.40	5520.40	5448.78	5237.32	5366.38	5340.09	6351.76	5959.23	5367.36	5168.28	5369.49	6879.72	7872.97	7723.06	7809.61
A. Forest land	-2754.72	-2754.72	-2817.02	-2264.76	-2292.78	-1934.98	-1561.49	-1350.42	-2178.89	-1756.20	-1565.45	-501.79	-873.46	-833.65	-948.72
B. Cropland	-100.44	-100.44	-32.20	-18.72	28.39	-40.55	16.99	-27.85	5.94	-44.46	-4.60	16.49	274.50	190.93	40.92
C. Grassland	6964.36	6964.36	7048.05	6507.08	6122.06	6001.01	6205.08	5863.55	6263.63	5996.92	5957.18	6592.77	6426.36	6821.32	6505.42
D. Wetlands	1742.97	1742.97	1588.30	1489.87	2022.91	1856.09	2241.03	2114.21	1907.11	1696.58	1675.59	1660.56	2869.60	2218.77	3061.11
E. Settlements	80.46	80.46	70.46	83.62	71.37	103.43	109.11	124.58	138.29	153.24	168.18	194.13	247.80	234.56	287.78
F. Other land	0.81	0.81	0.82	0.83	0.84	0.85	20.74	24.88	25.15	25.42	25.69	40.80	44.12	44.54	44.96
G. Harvested wood products	-413.04	-413.04	-409.63	-560.58	-586.40	-645.76	-679.70	-789.72	-793.88	-903.23	-887.09	-1123.25	-1115.95	-953.41	-1181.87
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	95.59	95.59	95.70	96.41	97.15	97.74	98.16	98.19	82.53	64.74	71.99	76.75	85.30	108.26	153.18
A. Solid waste disposal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Biological treatment of solid waste															
C. Incineration and open burning of waste	95.59	95.59	95.70	96.41	97.15	97.74	98.16	98.19	82.53	64.74	71.99	76.75	85.30	108.26	153.18
D. Waste water treatment and discharge															
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items:															
International bunkers	1129.47	1129.47	1146.61	958.28	1512.01	1311.40	1523.26	1558.44	1758.11	1818.40	2105.46	2292.81	2703.13	2787.17	2816.94
Aviation	1072.69	1072.69	1039.57	904.80	1341.40	1188.41	1153.87	1059.22	1280.75	1318.86	1561.48	1814.97	2193.50	2332.15	2276.70
Navigation	56.78	56.78	107.04	53.48	170.61	122.99	369.39	499.22	477.36	499.54	543.98	477.85	509.63	455.02	540.24
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO ₂ emissions from biomass	500.82	500.82	479.54	424.19	429.20	431.66	424.65	467.71	493.25	587.22	557.22	597.82	654.24	643.32	612.42
CO ₂ captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Indirect N ₂ O															
Indirect CO ₂ ⁽³⁾	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE
Total CO ₂ equivalent emissions without land use, land-use change and forestry	32944.42	32944.42	33674.31	33495.32	33716.36	34838.45	35852.99	37469.27	38804.99	40708.97	42440.18	45249.12	47607.61	46081.59	45684.11
Total CO ₂ equivalent emissions with land use, land-use change and forestry	38464.82	38464.82	39123.09	38732.64	39082.75	40178.54	42204.75	43428.50	44172.35	45877.25	47809.68	52128.84	55480.58	53804.65	53493.71
Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: All footnotes for this table are given at the end of the table on sheet 6.

Inventory 2020
Submission 2022 v2
IRELAND

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
(kt)																	%
43081.88	44970.77	44483.79	44423.11	44530.79	40092.94	39779.21	36285.19	36379.63	35234.29	34581.98	36240.15	37719.42	36433.71	36182.36	34629.95	32548.15	7.96
43081.83	44970.73	44483.74	44423.04	44530.73	40092.88	39779.14	36285.13	36379.58	35234.24	34581.93	36239.75	37718.05	36428.95	36182.16	34629.66	32547.82	7.96
15234.55	15719.02	14959.15	14458.89	14555.15	12972.03	13227.94	11844.52	12683.36	11331.16	11126.21	11737.50	12,442.58	11,666.79	10,401.87	9,199.84	8,513.14	-23.61
5267.08	5442.78	5233.45	5322.08	5133.85	4114.99	4127.72	3662.21	3742.09	3936.28	4158.69	4250.61	4,323.05	4,443.65	4,648.60	4,567.65	4,500.43	10.31
12209.41	12922.27	13606.32	14203.90	13518.34	12312.92	11408.18	11101.36	10717.21	10938.34	11217.10	11689.60	12,165.17	11,887.71	12,059.16	12,064.45	10,169.20	102.19
10370.81	10886.66	10684.82	10438.17	11323.38	10692.94	11015.31	9677.04	9236.92	9028.46	8079.93	8562.04	8,787.26	8,430.80	9,072.54	8,797.73	9,365.05	-5.35
IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0.00
0.05	0.04	0.05	0.06	0.06	0.07	0.07	0.06	0.06	0.05	0.04	0.41	1.37	4.76	0.21	0.29	0.33	5464.61
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.05	0.04	0.05	0.06	0.06	0.07	0.07	0.06	0.06	0.05	0.04	0.41	1.37	4.76	0.21	0.29	0.33	5464.61
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2633.61	2729.78	2675.22	2730.49	2435.28	1620.54	1427.21	1296.42	1524.18	1440.12	1784.29	1970.63	2112.77	2200.55	2256.70	2227.86	2066.91	-8.09
2507.06	2552.80	2538.74	2580.43	2301.58	1485.32	1299.05	1167.27	1391.97	1301.70	1650.45	1830.36	1,968.40	2,039.86	2,094.55	2,057.67	1,907.16	70.78
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
95.92	146.81	106.33	120.19	102.11	100.74	88.07	88.88	86.43	88.98	91.70	95.47	97.00	101.61	102.69	105.07	100.91	6.63
0.07	0.07	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.02	0.04	0.04	-52.51
30.55	30.11	30.08	29.80	31.52	34.42	40.04	40.22	45.73	49.41	42.09	44.75	47.33	59.04	59.44	65.08	58.80	177.92
307.65	327.55	319.61	427.67	329.18	396.34	526.18	430.94	275.75	562.78	445.62	465.41	512.70	416.74	549.82	435.88	508.89	12.66
240.80	266.73	254.86	376.77	262.21	307.32	427.93	360.68	229.40	515.69	391.07	401.15	433.60	332.75	461.06	343.90	399.48	12.52
66.86	60.81	64.76	50.90	66.97	89.02	98.24	70.27	46.35	47.09	54.55	64.27	79.11	83.99	88.76	91.98	109.40	13.16
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6511.79	6986.08	7201.12	6326.73	5771.23	5278.98	6530.37	5962.20	5299.62	5839.53	5545.79	6242.94	5575.88	6949.18	5812.74	5874.13	5895.94	6.80
-1599.58	-1381.80	-1888.09	-1772.92	-2782.60	-2765.77	-2435.07	-2654.00	-3157.58	-3485.61	-3038.39	-3555.32	-3,069.41	-2,241.35	-2,320.19	-2,252.76	-2,419.15	-12.18
62.15	-8.13	-101.62	12.39	178.01	-100.99	-209.91	-17.56	61.62	-33.47	-86.96	-93.53	-113.72	-92.82	-198.73	-139.55	-110.80	10.32
6203.72	6485.74	6347.36	6346.84	6592.02	6761.03	6546.24	6573.70	6714.74	7070.05	6543.25	6573.53	6,616.56	6,596.15	6,683.11	6,683.87	6,543.52	-6.04
2579.29	2643.70	2250.47	2393.96	2022.77	1865.22	3207.72	2736.68	2087.00	2877.86	2827.16	3969.24	2,863.53	3,444.49	2,375.47	2,311.46	2,529.40	45.12
311.24	330.44	416.58	535.25	429.56	216.87	229.04	54.02	251.36	61.97	52.83	66.96	72.09	101.29	88.76	119.58	162.46	101.93
45.38	45.80	1450.34	9.49	19.62	11.10	11.09	11.08	11.07	11.06	11.06	10.79	10.52	10.25	9.98	9.71	9.49	1069.38
-1090.41	-1129.67	-1273.92	-1198.27	-688.16	-708.49	-818.73	-741.72	-668.59	-662.33	-763.17	-728.72	-803.70	-868.83	-825.66	-858.19	-818.98	98.28
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
143.64	128.50	126.04	83.07	68.01	69.48	61.02	43.82	47.60	44.56	41.12	41.85	24.65	27.04	23.49	31.97	29.25	-69.40
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
143.64	128.50	126.04	83.07	68.01	69.48	61.02	43.82	47.60	44.56	41.12	41.85	24.65	27.04	23.49	31.97	29.25	-69.40
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2631.47	2817.33	3271.00	3396.21	3045.95	2533.71	2736.75	2402.76	2135.23	2448.09	2641.91	3008.60	3072.90	3517.27	3813.96	3757.11	1654.51	46.49
2157.28	2487.09	2866.67	3039.24	2825.10	2230.10	2306.51	2068.83	1738.08	2005.42	2223.80	2517.25	2,581.59	3,037.56	3,282.14	3,319.81	1,177.76	9.79
474.19	330.25	404.32	356.97	220.86	303.61	430.24	333.93	397.15	442.67	418.11	491.35	491.32	479.71	531.82	437.30	476.75	739.71
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
715.32	902.10	931.08	1005.80	1075.42	1202.18	1338.09	1362.01	1448.18	1681.50	1892.74	1885.69	2,089.26	2,385.20	2,649.06	2,693.82	2,699.79	439.08
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.00
NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	NO,NE,IE	0.00
46166.78	48156.60	47604.66	47664.33	47363.26	42179.31	41793.62	38056.38	38227.16	37281.75	36853.01	38718.04	40369.54	39078.03	39012.37	37325.66	35153.20	6.70
52678.57	55142.68	54805.78	53991.07	53134.49	47458.28	48323.99	44018.58	43526.77	43121.28	42398.80	44960.98	45945.42	46027.22	44825.10	43199.79	41049.14	6.72
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.00

Annex A.1.3 CH₄ Emission Trends 1990-2020

(Sheet 3 of 6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. Energy	24.74	24.74	24.01	21.22	20.90	19.12	17.93	17.98	16.40	16.55	14.11	14.18	14.34	13.17	39.39
A. Fuel combustion (sectoral approach)	20.50	20.50	20.16	17.55	17.08	15.36	14.15	14.18	12.69	13.37	10.90	10.86	10.48	10.21	9.73
1. Energy industries	0.27	0.27	0.27	0.27	0.29	0.29	0.31	0.36	0.37	0.37	0.40	0.44	0.46	0.43	0.41
2. Manufacturing industries and construction	0.27	0.27	0.27	0.23	0.24	0.24	0.24	0.26	0.26	0.28	0.28	0.33	0.35	0.34	0.35
3. Transport	1.95	1.95	2.00	2.05	1.94	1.89	1.87	1.87	1.76	1.84	1.81	1.69	1.66	1.53	1.45
4. Other sectors	18.02	18.02	17.61	15.00	14.61	12.94	11.72	11.70	10.29	10.89	8.41	8.40	8.02	7.90	7.53
5. Other	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Fugitive emissions from fuels	4.23	4.23	3.86	3.67	3.82	3.77	3.78	3.80	3.71	3.18	3.22	3.33	3.86	2.96	29.66
1. Solid fuels	2.22	2.22	1.80	1.63	1.51	1.41	1.33	1.26	1.21	1.16	1.12	1.08	1.05	1.02	0.99
2. Oil and natural gas and other emissions from energy production	2.01	2.01	2.06	2.04	2.31	2.36	2.45	2.54	2.50	2.02	2.10	2.24	2.81	1.95	28.67
C. CO ₂ transport and storage															
2. Industrial processes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
A. Mineral industry															
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Electronic industry															
F. Product uses as ODS substitutes															
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	487.28	487.28	498.02	507.49	513.36	512.96	517.22	535.46	548.82	561.78	549.22	527.11	526.61	521.10	521.70
A. Enteric fermentation	435.76	435.76	445.20	453.47	458.71	458.43	462.54	478.39	490.26	501.87	490.89	470.91	469.75	464.42	465.42
B. Manure management	51.53	51.53	52.82	54.02	54.65	54.54	54.67	57.07	58.56	59.91	58.33	56.20	56.86	56.68	56.28
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming															
H. Urea application															
I. Other carbon-containing fertilizers															
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	18.25	18.25	17.20	15.99	18.60	17.76	18.34	19.99	16.68	15.77	14.93	17.72	26.26	15.68	23.97
A. Forest land	2.14	2.14	1.99	1.92	2.23	2.38	2.71	3.23	2.48	2.29	2.28	2.61	3.24	2.42	3.30
B. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
C. Grassland	10.80	10.80	10.87	10.37	11.47	10.17	9.36	10.03	9.14	9.38	8.79	9.73	11.26	9.16	10.15
D. Wetlands	5.31	5.31	4.33	3.71	4.91	5.22	6.27	6.73	5.06	4.10	3.87	5.38	11.74	4.10	10.52
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products															
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	55.21	55.21	58.44	60.98	62.96	64.79	66.27	61.42	50.96	53.28	53.07	53.29	57.28	60.43	60.73
A. Solid waste disposal	52.72	52.72	55.94	58.46	60.42	62.24	63.71	58.87	48.51	50.54	50.45	50.73	54.58	57.51	58.29
B. Biological treatment of solid waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.09	0.14	0.19
C. Incineration and open burning of waste	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.06	0.07	0.09	0.18	0.24
D. Waste water treatment and discharge	2.44	2.44	2.46	2.48	2.49	2.50	2.51	2.50	2.40	2.70	2.56	2.50	2.52	2.61	2.01
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH ₄ emissions without CH ₄ from LULUCF	567.23	567.23	580.48	589.69	597.22	596.88	601.42	614.86	616.17	631.61	616.41	594.59	598.22	594.70	621.82
Total CH ₄ emissions with CH ₄ from LULUCF	585.48	585.48	597.67	605.69	615.82	614.64	619.75	634.85	632.85	647.38	631.34	612.31	624.48	610.38	645.79
Memo items:															
International bunkers	0.02	0.02	0.02	0.02	0.03	0.02	0.05	0.06	0.06	0.06	0.07	0.06	0.07	0.06	0.07
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Navigation	0.01	0.01	0.01	0.00	0.02	0.01	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO ₂ emissions from biomass															
CO ₂ captured															
Long-term storage of C in waste disposal sites															
Indirect N ₂ O															
Indirect CO ₂ ⁽³⁾															

Note: All footnotes for this table are given at the end of the table on sheet 6.

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Annex A.1.4 N₂O Emission Trends 1990-2020

(Sheet 4 of 6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	(kt)													
1. Energy	0.86	0.86	0.87	0.91	0.96	1.10	1.30	1.55	1.77	2.02	1.24	1.30	1.35	1.37
A. Fuel combustion (sectoral approach)	0.86	0.86	0.87	0.91	0.96	1.10	1.30	1.55	1.77	2.02	1.24	1.30	1.35	1.37
1. Energy industries	0.24	0.24	0.25	0.25	0.24	0.25	0.25	0.26	0.26	0.25	0.26	0.26	0.28	0.32
2. Manufacturing industries and construction	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.05
3. Transport	0.22	0.22	0.23	0.27	0.33	0.45	0.60	0.89	1.12	1.37	0.57	0.62	0.64	0.63
4. Other sectors	0.35	0.35	0.36	0.35	0.35	0.37	0.41	0.35	0.35	0.35	0.36	0.37	0.37	0.37
5. Other	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Fugitive emissions from fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	NO	0.00	NO
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	NO	0.00	NO
C. CO ₂ transport and storage														
2. Industrial processes	3.45	3.45	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.00	1.06
A. Mineral industry														
B. Chemical industry	3.34	3.34	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	1.89	0.94
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Electronic industry														
F. Product uses as ODS substitutes														
G. Other product manufacture and use	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	21.16	21.16	21.11	20.86	21.27	22.05	22.94	23.11	22.59	23.83	23.77	22.71	21.78	21.59
A. Enteric fermentation														
B. Manure management	1.64	1.64	1.68	1.71	1.73	1.75	1.78	1.86	1.94	1.99	1.92	1.84	1.87	1.89
C. Rice cultivation														
D. Agricultural soils	19.52	19.52	19.43	19.15	19.54	20.30	21.16	21.25	20.65	21.84	21.85	20.87	19.92	19.70
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming														
H. Urea application														
I. Other carbon containing fertilizers														
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	0.72	0.72	0.79	0.68	0.73	0.76	0.90	0.88	0.94	0.90	0.88	0.95	1.19	1.14
A. Forest land	0.55	0.55	0.57	0.58	0.60	0.61	0.65	0.67	0.67	0.68	0.70	0.72	0.74	0.75
B. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Grassland	0.05	0.05	0.13	0.01	0.01	0.01	0.08	0.02	0.11	0.07	0.03	0.03	0.05	0.17
D. Wetlands	0.11	0.11	0.08	0.06	0.09	0.10	0.13	0.14	0.09	0.07	0.06	0.09	0.25	0.05
E. Settlements	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.10	0.11
F. Other land	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06
G. Harvested wood products														
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.26	0.26	0.27	0.28	0.30	0.31
A. Solid waste disposal														
B. Biological treatment of solid waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	0.01
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
D. Waste water treatment and discharge	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.26	0.27	0.28	0.29	0.29
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N ₂ O emissions without N ₂ O from LULUCF	25.72	25.72	24.96	24.75	25.22	26.13	27.21	27.63	27.35	28.85	28.02	27.03	25.43	24.33
Total direct N ₂ O emissions with N ₂ O from LULUCF	26.44	26.44	25.76	25.43	25.95	26.89	28.11	28.52	28.28	29.75	28.90	27.97	26.62	25.47
Memo items:														
International bunkers	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08
Aviation	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06
Navigation	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO ₂ emissions from biomass														
CO ₂ captured														
Long-term storage of C in waste disposal sites														
Indirect N ₂ O	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE
Indirect CO ₂ ⁽³⁾														

Note: All footnotes for this table are given at the end of the table on sheet 6.

Inventory 2020
Submission 2022 v2
IRELAND

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
																		%
1.39	1.33	1.38	1.37	1.34	1.33	1.22	1.20	1.13	1.12	1.08	1.07	1.09	1.18	1.19	1.23	1.23	1.12	31.25
1.39	1.33	1.38	1.37	1.34	1.33	1.22	1.20	1.13	1.12	1.08	1.07	1.09	1.18	1.19	1.23	1.23	1.12	31.25
0.35	0.31	0.34	0.36	0.39	0.48	0.46	0.48	0.44	0.45	0.42	0.42	0.41	0.47	0.47	0.48	0.47	0.42	73.18
0.05	0.06	0.07	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	1.04
0.61	0.60	0.58	0.57	0.53	0.40	0.36	0.34	0.34	0.34	0.35	0.37	0.40	0.43	0.43	0.45	0.46	0.40	79.07
0.38	0.37	0.39	0.37	0.36	0.39	0.34	0.33	0.31	0.29	0.27	0.24	0.24	0.25	0.25	0.26	0.26	0.26	-24.51
IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	100.00
0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	-95.67
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	41.98
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
22.17	21.78	21.29	20.59	19.77	19.62	19.09	19.92	18.56	19.39	20.82	19.92	20.12	20.36	21.46	22.59	21.25	21.35	0.91
1.89	1.85	1.92	1.96	1.86	1.88	1.85	1.78	1.76	1.95	1.93	1.82	1.92	1.97	2.04	2.16	2.00	2.02	23.29
20.29	19.93	19.37	18.62	17.92	17.74	17.24	18.14	16.80	17.44	18.89	18.09	18.20	18.38	19.42	20.43	19.25	19.33	-0.97
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
1.32	1.18	1.23	1.26	1.27	1.36	1.45	1.82	1.64	1.60	1.73	1.73	1.69	1.61	1.80	1.62	1.59	1.55	113.94
0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.84	0.84	0.85	0.85	0.86	0.87	0.87	0.87	0.88	60.49
0.00	0.00	0.00	0.00	NO,IE	0.00	0.00	0.00	NO,IE	0.00	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00	0.00	-92.05
0.13	0.05	0.05	0.05	0.07	0.09	0.12	0.27	0.27	0.31	0.37	0.36	0.35	0.30	0.30	0.27	0.26	0.24	353.15
0.21	0.11	0.12	0.09	0.07	0.05	0.05	0.26	0.11	0.04	0.11	0.12	0.08	0.05	0.23	0.08	0.06	0.05	-48.11
0.15	0.17	0.20	0.21	0.21	0.23	0.29	0.29	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.27	0.26	1121.24
0.07	0.07	0.08	0.13	0.13	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.15	0.15	0.14	0.13	0.13	49416.36
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.32	0.35	0.37	0.36	0.36	0.38	0.38	0.39	0.38	0.37	0.37	0.38	0.38	0.40	0.41	0.41	0.42	0.42	65.13
0.01	0.05	0.07	0.05	0.05	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	100.00
0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-72.09
0.30	0.30	0.30	0.30	0.31	0.31	0.31	0.32	0.31	0.31	0.31	0.32	0.32	0.34	0.35	0.35	0.36	0.36	42.47
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
24.00	23.58	23.17	22.44	21.61	21.47	20.83	21.65	20.21	21.02	22.41	21.51	21.72	22.08	23.20	24.37	23.04	23.05	-10.38
25.31	24.76	24.40	23.71	22.88	22.83	22.28	23.47	21.85	22.62	24.14	23.24	23.42	23.69	25.00	25.99	24.63	24.60	-6.97
0.08	0.07	0.08	0.09	0.09	0.08	0.07	0.07	0.07	0.06	0.07	0.07	0.08	0.08	0.10	0.10	0.10	0.04	46.64
0.06	0.06	0.07	0.08	0.08	0.08	0.06	0.06	0.06	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.03	9.79
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	752.70
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NE,NO	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00

Annex A.1.5 HFCs, PFCs, SF₆, and NF₃ Emission Trends 1990-2020

(Sheet 5 of 6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Emissions of HFCs and PFCs - (kt CO₂ equivalent)	0.71	0.71	10.63	20.55	53.52	87.60	142.84	224.01	327.49	280.37	464.09	667.73	694.60	660.71	829.43	916.40
Emissions of HFCs - (kt CO₂ equivalent)	0.59	0.59	0.76	0.94	14.41	28.99	45.23	90.72	158.48	201.15	209.27	269.97	315.09	392.81	543.48	681.59
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO	NO	NO	NO	0.01	0.02	0.03	0.06	0.10	0.13	0.12	0.14	0.14	0.15	0.19	0.20
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs ⁽⁴⁾ - (kt CO ₂ equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of PFCs - (kt CO₂ equivalent)	0.12	0.12	9.87	19.62	39.11	58.61	97.61	133.29	169.01	79.22	254.82	397.76	379.51	267.89	285.95	234.81
CF ₄	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
C ₂ F ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.02	0.02	0.02
C ₃ F ₈	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C ₄ F ₁₀	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C-C ₄ F ₈	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
C ₅ F ₁₂	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C ₆ F ₁₄	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C ₁₀ F ₁₈	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C-C ₃ F ₆	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs ⁽⁴⁾ - (kt CO ₂ equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO₂ equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of SF₆ - (kt CO₂ equivalent)	33.88	33.88	38.87	43.86	52.90	61.95	79.11	97.46	126.12	88.74	64.19	51.76	64.63	64.48	109.95	65.33
SF ₆	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF₃ - (kt CO₂ equivalent)	NO	NO	NO	NO	NO	NO	4.37	4.72	6.11	4.19	3.79	49.17	21.78	46.58	46.63	18.08
NF ₃	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: All footnotes for this table are given at the end of the table on sheet 6.

Inventory 2020

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2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change from base to latest reported year
(kt)																%
1073.48	1091.54	1075.18	1132.65	1112.24	1094.88	1100.31	1084.61	1114.75	1187.27	1184.67	1273.33	1197.35	887.70	882.17	764.39	107292.36
857.10	900.58	907.08	996.51	1028.61	1048.30	1084.43	1075.05	1106.43	1183.70	1164.17	1235.97	1150.16	837.84	819.12	694.17	117158.45
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	866.02
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.06	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.10	0.11	0.12	0.12	0.08	0.08	0.07	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.24	0.25	0.25	0.27	0.28	0.29	0.30	0.29	0.29	0.30	0.28	0.29	0.28	0.26	0.22	0.18	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.02	0.03	0.02	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
216.39	190.96	168.10	136.14	83.63	46.58	15.88	9.56	8.32	3.56	20.50	37.36	47.20	49.86	63.05	70.22	58526.16
0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	262072.08
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11617.21
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00
96.76	60.19	62.92	54.67	39.18	33.09	45.48	37.41	43.55	37.41	44.49	39.29	39.21	40.92	33.57	18.49	-45.43
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-45.43
28.38	28.21	37.67	NO	NO	NO	NO	0.78	0.90	0.96	0.96	0.96	1.26	1.32	1.38	1.46	100.00
0.00	0.00	0.00	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

Annex A.1.6 Summary GHG Emission Trends 1990-2020

(Sheet 6 of 6)

GREENHOUSE GAS EMISSIONS	Base year ⁽¹⁾	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	CO ₂ equivalent (kt)										
CO ₂ emissions without net CO ₂ from LULUCF	32944.42	32944.42	35852.99	45249.12	48156.60	41793.62	38056.38	38227.16	37281.75	36853.01	38718.04
CO ₂ emissions with net CO ₂ from LULUCF	38464.82	38464.82	42204.75	52128.84	55142.68	48323.99	44018.58	43526.77	43121.28	42398.80	44960.98
CH ₄ emissions without CH ₄ from LULUCF	14180.75	14180.75	15035.41	14864.77	14420.44	12804.32	12751.90	13424.56	13717.90	13828.30	14346.45
CH ₄ emissions with CH ₄ from LULUCF	14637.07	14637.07	15493.87	15307.76	14905.80	13561.01	13318.99	13874.72	14262.93	14395.22	14864.98
N ₂ O emissions without N ₂ O from LULUCF	7663.43	7663.43	8108.88	8054.82	6903.34	6450.55	6023.93	6263.86	6678.70	6408.76	6473.48
N ₂ O emissions with N ₂ O from LULUCF	7879.45	7879.45	8376.85	8336.45	7270.34	6994.26	6512.69	6740.12	7194.54	6924.62	6978.00
HFCs	0.59	0.59	45.23	269.97	857.10	1048.30	1084.43	1075.05	1106.43	1183.70	1164.17
PFCs	0.12	0.12	97.61	397.76	216.39	46.58	15.88	9.56	8.32	3.56	20.50
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF ₆	33.88	33.88	79.11	51.76	96.76	33.09	45.48	37.41	43.55	37.41	44.49
NF ₃	NO	NO	4.37	49.17	28.38	NO	NO	0.78	0.90	0.96	0.96
Total (without LULUCF)	54823.19	54823.19	59223.60	68937.37	70678.99	62176.45	57978.00	59038.38	58837.56	58315.70	60768.09
Total (with LULUCF)	61015.92	61015.92	66301.79	76541.71	78517.44	70007.23	64996.05	65264.41	65737.95	64944.27	68034.08
Total (without LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF, with indirect)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ⁽¹⁾	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	CO ₂ equivalent (kt)										
1. Energy	31021.68	31021.68	33830.04	42481.08	45703.69	40458.11	36913.21	37000.79	35850.07	35190.44	36856.71
2. Industrial processes and product use	3310.16	3310.16	3218.42	4559.26	3965.36	2595.90	2483.12	2687.98	2640.39	3051.13	3242.18
3. Agriculture	18939.30	18939.30	20345.96	20404.25	19685.20	18588.38	17963.47	18810.75	19653.42	19195.22	19711.00
4. Land use, land-use change and forestry ⁽⁵⁾	6192.73	6192.73	7078.19	7604.35	7838.45	7830.78	7018.05	6226.04	6900.40	6628.57	7265.99
5. Waste	1552.05	1552.05	1829.18	1492.77	1324.74	534.06	618.20	538.87	693.68	878.91	958.19
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)⁽⁵⁾	61015.92	61015.92	66301.79	76541.71	78517.44	70007.23	64996.05	65264.41	65737.95	64944.27	68034.08

⁽¹⁾ The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different column of this table.

⁽²⁾ Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

⁽³⁾ In accordance with the UNFCCC reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

⁽⁴⁾ In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data), they should be reported as "unspecified mix of HFCs and PFCs".

⁽⁵⁾ Includes net CO₂, CH₄ and N₂O from LULUCF.

Documentation box:

- Parties should provide detailed explanations on emissions trends in chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 8 of the national inventory report (NIR). Use this column of the NIR if any additional information and further details are needed to understand the content of this table.
- Use the documentation box to provide explanations if potential emissions are reported.

Documentation box: F-gases: 1.D.2: 1.D.4: 2.: 2.A.1:

Inventory 2020
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IRELAND

2016	2017	2018	2019	2020	Change from base to latest reported year
					(%)
40369.54	39078.03	39012.37	37325.66	35153.20	6.70
45945.42	46027.22	44825.10	43199.79	41049.14	6.72
14735.24	15148.97	15456.87	15048.01	15226.57	7.37
15224.29	15895.63	16009.97	15587.60	15794.69	7.91
6579.69	6915.01	7262.92	6867.22	6868.23	-10.38
7058.27	7451.26	7744.49	7340.43	7330.38	-6.97
1235.97	1150.16	837.84	819.12	694.17	117158.45
37.36	47.20	49.86	63.05	70.22	58526.16
NO	NO	NO	NO	NO	0.00
39.29	39.21	40.92	33.57	18.49	-45.43
0.96	1.26	1.32	1.38	1.46	100.00
62998.05	62379.85	62662.10	60158.01	58032.34	5.85
69541.55	70611.94	69509.49	67044.94	64958.54	6.46
NA	NA	NA	NA	NA	0.00
NA	NA	NA	NA	NA	0.00

-18.2%

-5804.19

2016	2017	2018	2019	2020	Change from base to latest reported year
					(%)
38370.28	37063.78	36840.84	35264.07	33156.29	6.88
3468.92	3481.15	3229.61	3188.98	2895.75	-12.52
20192.42	20890.04	21676.90	20790.65	21074.57	11.27
6543.50	8232.09	6847.39	6886.93	6926.20	11.84
966.43	944.88	914.75	914.31	905.73	-41.64
NO	NO	NO	NO	NO	0.00
69541.55	70611.94	69509.49	67044.94	64958.54	6.46

base year is used to calculate the percentage change in the final

ata, lack of disaggregation), this row could be used for

documentation box to provide references to relevant sections of

Annex A.2

QA/QC Activities

Paul Duffy has overall responsibility for the coordination of the activities below.

The tables below provides details of the QA/QC activities for Ireland's emissions inventory. There are three types of activity presented separately:

- General activities which cover the General compilation practices and procedures which need setting up and maintaining
- Annual activities which should be undertaken on an Annual basis
- Periodic activities which should be undertaken in response to specific events in the inventory activities

The status column shows the current status of the QA/QC activities in the plan

The Guidance and records column in the tables below provides links to more detailed guidelines and templates for recording QA/QC information relevant to the specific headings

This file with its associated sheets can be used to track QA/QC activities as they are undertaken throughout the year and should be archived at the end of each inventory year and a new file started. Where QA/QC procedures are changed, modifications should

QA/QC Activity Name	QA/QC Activity Description	Deadline	Note	Date completed	Trigger	Activity Type	Responsibility	Guidance, records and templates	Output & Link to output
General Inventory QA/QC Management Activities									
Review and update roles and responsibilities.	Definition and Maintenance of Terms of Reference for Responsibilities for inventory planning, preparation and management.	31 December	Has this been reviewed for this submission?	30/12/2020	Beginning of inventory compilation cycle	Documentation	PD	see Responsibilities	see "Responsibilities"
Review management practices	Improve and maintain good data management practices including archiving. E.g. file naming and use of defined and shared directory structure, documentation and archiving	31 December	Update	30/12/2020	Update as necessary to track progress. Use as reference for consistent working practice	Procedure to follow	All, PD	see Archiving & Data Management	See DataManagement
Implement and check implementation of QA/QC template for calculation sheets	Use of QA/QC forms for inventory spreadsheet tools and outputs & transparent documentation of inventory methodologies. Check that all spreadsheets have an up-to-date QA/QC sheet	31 December	Some calculation sheets need QA/QC updating.	30/12/2020	Creation of a new spreadsheet or update of methodology	Documentation	All, PD	See QA/QC TemplateSheet	
Maintain master list of calculation sheets	List of calculation spreadsheets/tools & status monitor	31 December	Update	30/12/2020	Update as necessary to track progress	Documentation	All, PD	See CalculationSheetsList	
Maintain Improvement Log/Plan	Development and maintenance of Inventory Improvement log & co-ordinate annual improvements	ongoing (amend/review as necessary)	Update	Ongoing	update as improvement needs or possibilities are identified	Documentation	PD	See ImprovementPlan	
Training activities for staff	Development and maintenance of Training and Induction procedures and material	ongoing (amend/review as necessary)	Update, if possible	Ongoing	New Staff or new activities	Procedure to follow	All, PD	see Training	
Periodic Peer Review	Periodic Peer Review	As needed	Update, if possible	Ongoing	New Methods developed or as needed.	Review	PD	See log of planned and completed Peer reviews. See QA/QC sheets of calculation sheets.	
Verification Activities	Verification Activities	ongoing (amend/review as necessary)	Update, if possible	Ongoing	Identification of new data, inventories, measurements.	Review	PD	See Verification	

Annual QA/QC Activities: Lists the annual activities in order of appearance (Planning and Preparation Activities)									
General QA/QC									
Inventory planning, preparation and management review. Are procedures and guidelines in place for data quality review and checking on the inventory. Review the data quality objectives in the "DataQualityObjectives" sheet	Inventory planning, preparation and management review. Are procedures and guidelines in place for data quality review and checking on the inventory. Review the data quality objectives in the "DataQualityObjectives" sheet. Review data quality objectives and any issues with errors or lack of transparency in previous submission.	April		30/04/2013	Completion of previous inventory	Review	PD	Document review and record actions required for new inventory preparation year. (Amend QA/QC documents as necessary)	Revised QA/QC documents & updated Data Quality Objectives
Review the data supplied last year and the data compilation needs this year	Review the data supplied last year and the data compilation needs this year. Check any new methods and/or plans for new/revised methods needing new data.	April		30/04/2013	Planning the annual inventory update	Review/Check	PD	See ImprovementPlan	
Review the data supplied last year and the data compilation needs this year	Review the data supplied last year and the data compilation needs this year. Check for updates to reference sources of emission factors – IPCC, EMEP-CORINAIR, USEPA AP-42, National organisations / EFs	April		30/04/2022	Planning the annual inventory update	Review	PD	See ImprovementPlan	
Planning review and agree on inventory improvements to be undertaken including timings and resources necessary	Planning review and agree on inventory improvements to be undertaken including timings and resources necessary.	April		30/04/2022	Planning the annual inventory update	Review	PD	See ImprovementPlan	
Check all requests have been made.	Check all requests have been made. Review of previous year's raw data & key data suppliers and check that all requests for data have been made.	July		31/05/2022	Request annual data	Check	All, Paul Duffy, Emilia Hanley, Bernard Hyde	See Stakeholder List	Acceptance that all foreseen data sources are included
Archive source data.	Archive source data. As data arrives archive and reference for use in estimates. Update Stakeholder list with any updates to data received.	July/August		30/08/2022	Receipt of source data	Documentation	All, Paul Duffy, Emilia Hanley, Bernard Hyde		List of source data in this file
Check & Document Final Inventory;- transparent methods, data sources and assumptions	5) Check that transparent information is provided in the National Inventory Report (NIR) on methods, data sources & significant trends, completeness, accuracy and uncertainty and changes to the inventory and that notation keys, as indicated in UNFCCC guidelines, and appropriate source sector breakdowns are used for reporting data in the CRF.	November			Finished all Sector Calculations	Check	Paul Duffy		Checking cells & Checking summary in spreadsheets
Check & Document Final Inventory;- consistency	6) Check that there is consistency between the CRF and NIR (on completion of the NIR)	November			Finished all Sector Calculations	Check	Paul Duffy		Checking cells & Checking summary in spreadsheets
Official review of the Final Inventory;- Review	Review by stakeholders co-ordinated by OCLR prior to submission.	November			Finished all Sector Calculations	Review	Paul Duffy	See Stakeholder List	Checking cells & Checking summary in spreadsheets
Official review of the Final Inventory;- documentation of changes	Document Changes in the NIR Sectoral chapters: Compile a concise list of changes and overview of the reasons/justification and the impacts on National totals for chapter 10 of the NIR.	December			Annual inventory finalised	Documentation	Paul Duffy	Sector by Sector report for significant inventory changes + description in NIR	Checking cells & Checking summary in spreadsheets

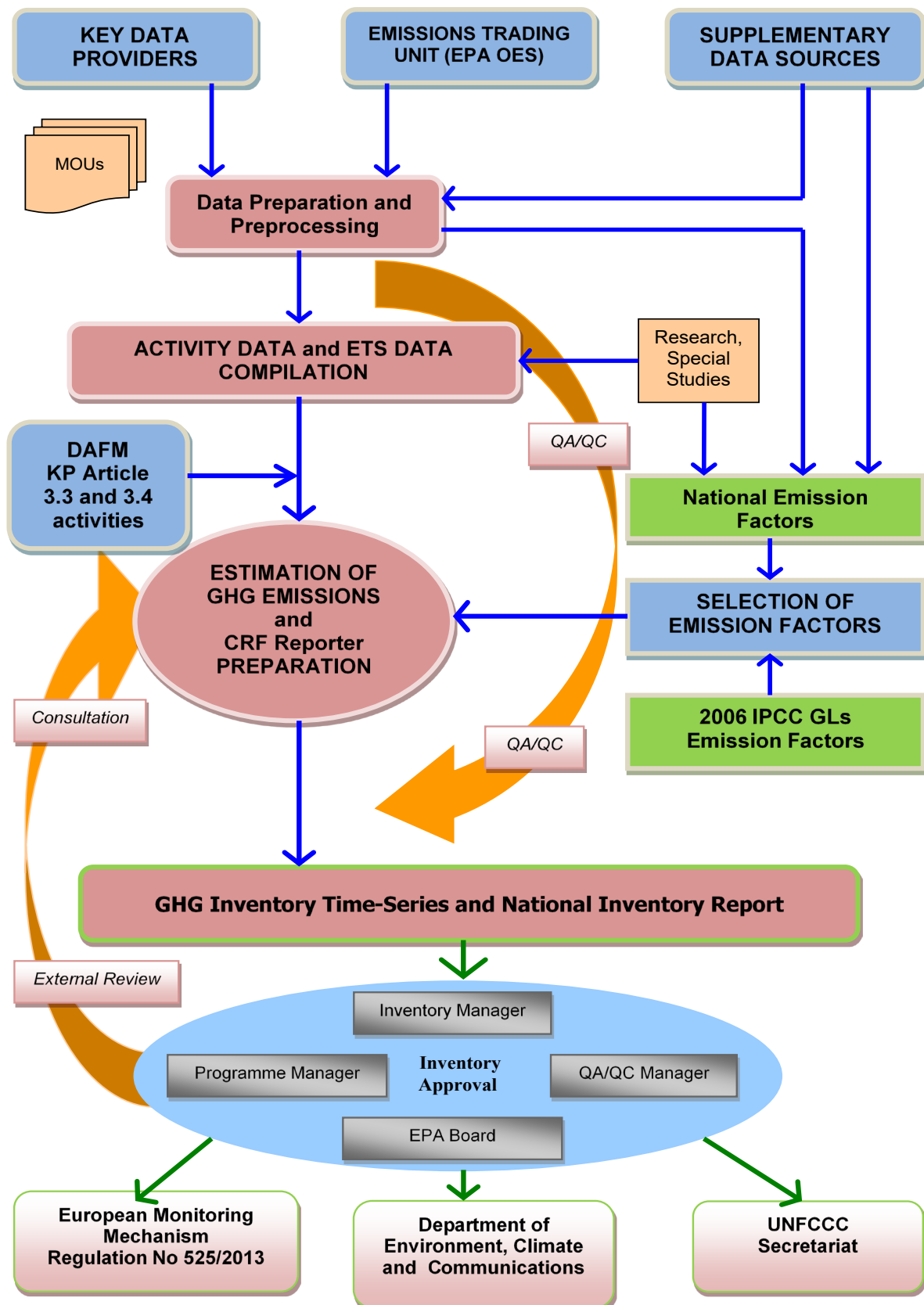
Official review of the Final Inventory:- Checking reporting tables	Check Reporting tables	January +1			Compiled reporting tables	Check	All, PD	Include annotated checking cells in reported sheets or in checking sheets linked to reporting sheets	Checking cells & Checking summary in spreadsheets
Review and update QA/QC Plan & procedures	QA/QC Coordinator annually compiles and updates an overview of QA/QC procedures	March +1			Annual inventory finalised	Documentation	Paul Duffy	see QA-QC overview	Year-specific overview document
Archiving	Archiving inventory material	March +1			Inventory Reported	Documentation/ Archiving	All, PD	see Archiving & Data Management	
Sector Specific QA/QC: Documentation to be included in individual calculation and data source checking sheets of the current inventory.									
Check source data received:- vs Last year	Are the numbers similar to last year:- If not, Look for reasons as to why they should be different. Check with data supplier	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Units	Are the activity consistent with last years or the EFs used:- If not, Convert units	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Geographic Coverage	Does the data represent the National activity:- If not, Need additional data or data to aggregate up	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Sector Coverage	Are all the required sectors included (Do the numbers include the same sectors as last year):- If not, Discuss with data source getting the same sectors included or consider revising the methodology (this will need to be done for the full timeseries)	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Sector Detail	Is the necessary sector detail included (Is there the same detail as last year):- If not, Ask the data source for the required detail or consider revising the methodology (This will need to be done for the full timeseries)	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Data Source Reliability	Check about bias in the data. Is the data likely to have a deliberate or incidental bias (e.g. is survey/EF data representative of national average):- If not, Discuss with data source methods to estimate a national average.	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Reality Checking	Do the numbers make sense when compared with other data or common sense (i.e. do they look realistic, do energy values compare with published data for the same group of sectors or fuels):- If not, Ask the data source to confirm or clarify the numbers	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Transparency	Is sufficient documentation (enabling a full understanding of the source and assumptions associated with the data) available and archived in the inventory archive:- If not, Ask the data supplier for further clarification	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets

Check source data received:- Timeseries	are numbers for previous years in any timeseries of data supplied the same as was used in last years inventory:- If not, revise the timeseries data were revised by the data source	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Tier 3 fuel combustion categories	Cross check sum of site based fuel use is consistent with energy statistics by fuel type :- If not, Are there sites missing or a sector miss match between the point source based definition and the national statistics	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Tier 3 timeseries consistency	Check reported emissions against last year are broadly consistent:- If not, check emission units and reported data for both years for errors or inconsistencies	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check source data received:- Check against independent AD	e.g. for road vehicles cross check vehicle KM derived fuel consumption vs Energy consumption data are broadly consistent:- If not, Ensure road transport energy consumption data does not include off road fuel use. Check assumptions on fuel consumption per vehkm.	August			Receipt of annual data update	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check Calculations:- Formulae & Sensible results	Are formulae working correctly, calculations producing sensible & logical results. Can a sample of the calculations be reproduced:- If not, Query with compiler & fix or document further	November			Finished Sector Calculations	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check Calculations:- Units	Are emission units correct. Have activity and emission factor units been used correctly. Are units labeled in calculation sheets:- If not, Get further clarification from the compiler and amend calculations and annotations.	November			Finished Sector Calculations	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check Calculations:- Assumptions and Transparency	Are all assumptions sensible and the transparency of calculations clear (e.g. use of formulas, no paste values, referencing of data sources). Check bibliographical references are correct and up-to-date:- If not, Get further clarification from the compiler	November			Finished Sector Calculations	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check Calculations:- Coverage	Have all sectors been included for which there is input data. Is the inventory complete?:- If not, Get all sectors included	November			Finished Sector Calculations	Check	PD-Energy BH-Agriculture DF-Transport AMR-IPPU	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check & Document Final Inventory;- completeness	3) Check that all sources are included (compare totals with last year's totals)	November			Finished all Sector Calculations	Check	PD	See individual calculation sheets	Checking cells & Checking summary in spreadsheets

Check & Document Final Inventory;- categorisation	4) Check that the detailed sectors are aggregated to the right aggregation sectors.	November			Finished all Sector Calculations	Check	PD	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check Calculations:- Consistency	Are all emission factors used up-to-date and consistent across the timeseries:- If not, Update with more recent emission factors	November			Finished Sector Calculations	Check	All, PD	See individual calculation sheets	Checking cells & Checking summary in spreadsheets
Check & Document Final Inventory;- timeseries	2) Check for significant dips and jumps in the timeseries and document the reasons in chapter 2 of the NIR.	November			Finished all Sector Calculations	Check	PD	See individual calculation sheets	Chapter 2 of the NIR and checking cells & Checking summary in spreadsheets
See individual calculation sheets for additional sector specific QA/QC.								See individual calculation sheets	
Document calculations, assumptions, data used and checks made.	Documentation of methods, data sources, assumptions and QA/QC for calculations in individual calculation spreadsheets.	September/October			Make Calculations: (Update or compile new estimates)	Documentation	All, PD	QA-QC TemplateSheet	Spreadsheet annotations and documentation

QA/QC Activity	Deadline		Status	Trigger	Activity Type	Responsibility	Guidance, records and templates	Output & Link to output
Peer review the new method (e.g. with industry or other sector experts)	Periodically for Key Categories in rotation		Annual activity Complete for Inventory	New /Un-peer reviewed Key Category methodology or new source estimate	Review of new Road Transport Model COPERT 5.5 for 1990-2020		see PeriodicPeerReview	
Inform data users, issue revision, make note to prevent error next year	Special		QA/QC Under Development	Errors found in published data	Procedure to follow	PD	Keep records of errors, and inform users	
Institutional QA/QC audits (e.g. ISO 9001 2000)	Periodically		Not Started	Organisation audit	Review	PD	Keep records of audits, dates, personnel and findings	
Government Audits	Periodically		Not Started	National Audits	Review	PD	Keep records of audits, dates, personnel and findings	

Annex A.3 Institutional Arrangements for Compilation of Emissions Inventories



Annex A.4.1 Key Category Analysis Level Assessment 1990 (excluding LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	1990 Estimate (kt CO ₂ eq)	Level assessment (%)	Cumulative Total (%)
1	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH ₄	5,811.98	10.60	10.60
2	3.D.1	Agricultural Soils - Direct Soil Emissions	N ₂ O	5,261.17	9.60	20.20
3	1.A.1	Energy Industries - Solid Fuels	CO ₂	4,844.66	8.84	29.03
4	1.A.3.b	Road Transport - Liquid Fuels	CO ₂	4,690.42	8.56	37.59
5	3.A.1	Enteric Fermentation - Dairy Cattle	CH ₄	3,398.51	6.20	43.79
6	1.A.1	Energy Industries - Peat Fuel	CO ₂	3,164.78	5.77	49.56
7	1.A.4.b	Residential - Peat Fuel	CO ₂	3,123.37	5.70	55.26
8	1.A.4.b	Residential - Solid Fuels	CO ₂	2,483.42	4.53	59.79
9	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO ₂	2,335.38	4.26	64.05
10	1.A.1	Energy Industries - Gaseous Fuels	CO ₂	1,880.66	3.43	67.48
11	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO ₂	1,735.45	3.17	70.64
12	3.A.2	Enteric Fermentation - Sheep	CH ₄	1,604.20	2.93	73.57
13	5.A	Solid Waste Disposal	CH ₄	1,318.08	2.40	75.98
14	1.A.1	Energy Industries - Liquid Fuels	CO ₂	1,254.90	2.29	78.26
15	1.A.4.b	Residential - Liquid Fuels	CO ₂	1,172.96	2.14	80.40
16	2.B.2	Chemical Industry - Nitric Acid Production	N ₂ O	995.32	1.82	82.22
17	2.B.1	Chemical Industry - Ammonia Production	CO ₂	990.23	1.81	84.03
18	2.A.1	Cement Production	CO ₂	884.00	1.61	85.64
19	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO ₂	873.02	1.59	87.23
20	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO ₂	871.24	1.59	88.82
21	1.A.4.c	Agriculture/Fishing - Liquid Fuels	CO ₂	747.23	1.36	90.18
22	3.D.2	Agricultural Soils - Indirect Soil Emissions	N ₂ O	555.51	1.01	91.20
23	3.B.1.1	Manure Management - Non-Dairy Cattle	CH ₄	545.22	0.99	92.19
24	3.B.1.1	Manure Management - Dairy Cattle	CH ₄	375.67	0.69	92.88
25	3.G.1	Liming - Limestone CaCO ₃	CO ₂	355.04	0.65	93.52
26	1.A.4.b	Residential - Gaseous Fuels	CO ₂	269.73	0.49	94.02
27	1.A.4.b	Residential - Peat Fuel	CH ₄	227.65	0.42	94.43
28	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO ₂	223.49	0.41	94.84
29	2.A.2	Lime Production	CO ₂	214.08	0.39	95.23

Annex A.4.2 Key Category Analysis Level Assessment 2020 (excluding LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	2020 Estimate (kt CO ₂ eq)	Level assessment (%)	Cumulative Total (%)
1	1.A.3.b	Road Transport - Liquid Fuels	CO ₂	9,591.65	16.53	16.53
2	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH ₄	6,828.71	11.77	28.30
3	1.A.1	Energy Industries - Gaseous Fuels	CO ₂	5,450.94	9.39	37.69
4	3.D.1	Agricultural Soils - Direct Soil Emissions	N ₂ O	5,193.96	8.95	46.64
5	3.A.1	Enteric Fermentation - Dairy Cattle	CH ₄	4,619.05	7.96	54.60
6	1.A.4.b	Residential - Liquid Fuels	CO ₂	3,963.36	6.83	61.43
7	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO ₂	2,824.25	4.87	66.29
8	2.A.1	Cement Production	CO ₂	1,769.64	3.05	69.34
9	1.A.4.b	Residential - Gaseous Fuels	CO ₂	1,387.18	2.39	71.73
10	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO ₂	1,190.47	2.05	73.79
11	1.A.1	Energy Industries - Peat Fuel	CO ₂	1,080.11	1.86	75.65
12	3.A.2	Enteric Fermentation - Sheep	CH ₄	1,057.32	1.82	77.47
13	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO ₂	1,012.79	1.75	79.21
14	1.A.4.b	Residential - Peat Fuel	CO ₂	811.20	1.40	80.61
15	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO ₂	805.96	1.39	82.00
16	1.A.4.b	Residential - Solid Fuels	CO ₂	788.05	1.36	83.36
17	1.A.1	Energy Industries - Solid Fuels	CO ₂	755.41	1.30	84.66
18	3.B.1.1	Manure Management - Non-Dairy Cattle	CH ₄	725.62	1.25	85.91
19	5.A	Solid Waste Disposal	CH ₄	667.94	1.15	87.06
20	1.A.1	Energy Industries - Liquid Fuels	CO ₂	630.35	1.09	88.15
21	1.A.1	Energy Industries - Other Fuels	CO ₂	596.34	1.03	89.17
22	1.A.4.c	Agriculture/Fishing - Liquid Fuels	CO ₂	594.52	1.02	90.20
23	2.F.1	Product Uses as Substitutes for ODS -Refrigeration and air-con	HFC	571.83	0.99	91.18
24	3.D.2	Agricultural Soils - Indirect Soil Emissions	N ₂ O	566.49	0.98	92.16
25	3.B.1.1	Manure Management - Dairy Cattle	CH ₄	430.78	0.74	92.90
26	3.G.1	Liming - Limestone CaCO ₃	CO ₂	399.48	0.69	93.59
27	1.A.3.d	Navigation - Liquid Fuels	CO ₂	319.29	0.55	94.14
28	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO ₂	301.38	0.52	94.66
29	3.B.2.1	Manure Management - Non-Dairy Cattle	N ₂ O	271.92	0.47	95.13

Annex A.4.3 Key Category Analysis Level Assessment 1990 (including LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	1990 Estimate (kt CO ₂ eq)	1990 Estimate for LULUCF (kt CO ₂ eq)	Absolute Values (kt CO ₂ eq)	Level assessment (%)	Cumulative Total (%)
1	4.C	LULUCF - Grassland	CO2	0.00	6,591.45	6,591.45	9.71	9.71
2	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH4	5,811.98	0.00	5,811.98	8.56	18.27
3	3.D.1	Agricultural Soils - Direct Soil Emissions	N2O	5,261.17	0.00	5,261.17	7.75	26.02
4	1.A.1	Energy Industries - Solid Fuels	CO2	4,844.66	0.00	4,844.66	7.14	33.16
5	1.A.3.b	Road Transport - Liquid Fuels	CO2	4,690.42	0.00	4,690.42	6.91	40.07
6	3.A.1	Enteric Fermentation - Dairy Cattle	CH4	3,398.51	0.00	3,398.51	5.01	45.07
7	1.A.1	Energy Industries - Peat Fuel	CO2	3,164.78	0.00	3,164.78	4.66	49.73
8	1.A.4.b	Residential - Peat Fuel	CO2	3,123.37	0.00	3,123.37	4.60	54.33
9	4.A.1	LULUCF - Forest land Remaining Forest Land	CO2	0.00	-2,922.13	2,922.13	4.30	58.64
10	1.A.4.b	Residential - Solid Fuels	CO2	2,483.42	0.00	2,483.42	3.66	62.30
11	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO2	2,335.38	0.00	2,335.38	3.44	65.74
12	1.A.1	Energy Industries - Gaseous Fuels	CO2	1,880.66	0.00	1,880.66	2.77	68.51
13	4.D	LULUCF - Wetlands	CO2	0.00	1,742.97	1,742.97	2.57	71.08
14	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	1,735.45	0.00	1,735.45	2.56	73.63
15	3.A.2	Enteric Fermentation - Sheep	CH4	1,604.20	0.00	1,604.20	2.36	75.99
16	5.A	Solid Waste Disposal	CH4	1,318.08	0.00	1,318.08	1.94	77.94
17	1.A.1	Energy Industries - Liquid Fuels	CO2	1,254.90	0.00	1,254.90	1.85	79.78
18	1.A.4.b	Residential - Liquid Fuels	CO2	1,172.96	0.00	1,172.96	1.73	81.51
19	2.B.2	Chemical Industry - Nitric Acid Production	N2O	995.32	0.00	995.32	1.47	82.98
20	2.B.1	Chemical Industry - Ammonia Production	CO2	990.23	0.00	990.23	1.46	84.44
21	2.A.1	Cement Production	CO2	884.00	0.00	884.00	1.30	85.74
22	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO2	873.02	0.00	873.02	1.29	87.03
23	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO2	871.24	0.00	871.24	1.28	88.31
24	1.A.4.c	Agriculture/Fishing - Liquid Fuels	CO2	747.23	0.00	747.23	1.10	89.41
25	3.D.2	Agricultural Soils - Indirect Soil Emissions	N2O	555.51	0.00	555.51	0.82	90.23
26	3.B.1.1	Manure Management - Non-Dairy Cattle	CH4	545.22	0.00	545.22	0.80	91.03
27	4.G	LULUCF - Harvested wood products	CO2	0.00	-413.04	413.04	0.61	91.64
28	3.B.1.1	Manure Management - Dairy Cattle	CH4	375.67	0.00	375.67	0.55	92.19
29	4.C	LULUCF - Drained organic soils from rewetted organic soils	CO2	0.00	370.03	370.03	0.55	92.74
30	3.G.1	Liming - Limestone CaCO ₃	CO2	355.04	0.00	355.04	0.52	93.26
31	1.A.4.b	Residential - Gaseous Fuels	CO2	269.73	0.00	269.73	0.40	93.66
32	4.C	LULUCF - Drained organic soils from forest to grasslands	CH4	0.00	258.15	258.15	0.38	94.04
33	1.A.4.b	Residential - Peat Fuel	CH4	227.65	0.00	227.65	0.34	94.37
34	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	223.49	0.00	223.49	0.33	94.70
35	2.A.2	Lime Production	CO2	214.08	0.00	214.08	0.32	95.02

Annex A.4.4 Key Category Analysis Level Assessment 2020 (including LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	2020 Estimate (kt CO ₂ eq)	2020 Estimate for LULUCF (kt CO ₂ eq)	Absolute Values (kt CO ₂ eq)	Level assessment (%)	Cumulative Total (%)
1	1.A.3.b	Road Transport - Liquid Fuels	CO2	9,591.65	0.00	9,591.65	13.18	13.18
2	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH4	6,828.71	0.00	6,828.71	9.38	22.56
3	4.C	LULUCF - Grassland	CO2	0.00	6,141.42	6,141.42	8.44	31.00
4	1.A.1	Energy Industries - Gaseous Fuels	CO2	5,450.94	0.00	5,450.94	7.49	38.49
5	3.D.1	Agricultural Soils - Direct Soil Emissions	N2O	5,193.96	0.00	5,193.96	7.14	45.62
6	3.A.1	Enteric Fermentation - Dairy Cattle	CH4	4,619.05	0.00	4,619.05	6.35	51.97
7	1.A.4.b	Residential - Liquid Fuels	CO2	3,963.36	0.00	3,963.36	5.45	57.41
8	4.A.2	LULUCF - Land Converted to Forest Land	CO2	0.00	-2,984.34	2,984.34	4.10	61.51
9	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO2	2,824.25	0.00	2,824.25	3.88	65.39
10	4.D	LULUCF - Wetlands	CO2	0.00	2,529.40	2,529.40	3.48	68.87
11	2.A.1	Cement Production	CO2	1,769.64	0.00	1,769.64	2.43	71.30
12	1.A.4.b	Residential - Gaseous Fuels	CO2	1,387.18	0.00	1,387.18	1.91	73.21
13	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO2	1,190.47	0.00	1,190.47	1.64	74.84
14	1.A.1	Energy Industries - Peat Fuel	CO2	1,080.11	0.00	1,080.11	1.48	76.32
15	3.A.2	Enteric Fermentation - Sheep	CH4	1,057.32	0.00	1,057.32	1.45	77.78
16	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	1,012.79	0.00	1,012.79	1.39	79.17
17	4.G	LULUCF - Harvested wood products	CO2	0.00	-818.98	818.98	1.13	80.29
18	1.A.4.b	Residential - Peat Fuel	CO2	811.20	0.00	811.20	1.11	81.41
19	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	805.96	0.00	805.96	1.11	82.52
20	1.A.4.b	Residential - Solid Fuels	CO2	788.05	0.00	788.05	1.08	83.60
21	1.A.1	Energy Industries - Solid Fuels	CO2	755.41	0.00	755.41	1.04	84.64
22	3.B.1.1	Manure Management - Non-Dairy Cattle	CH4	725.62	0.00	725.62	1.00	85.63
23	5.A	Solid Waste Disposal	CH4	667.94	0.00	667.94	0.92	86.55
24	1.A.1	Energy Industries - Liquid Fuels	CO2	630.35	0.00	630.35	0.87	87.42
25	1.A.1	Energy Industries - Other Fuels	CO2	596.34	0.00	596.34	0.82	88.24
26	1.A.4.c	Agriculture/Fishing - Liquid Fuels	CO2	594.52	0.00	594.52	0.82	89.05
27	2.F.1	Product Uses as Substitutes for ODS - Refrigeration and air-con	HFC	571.83	0.00	571.83	0.79	89.84
28	3.D.2	Agricultural Soils - Indirect Soil Emissions	N2O	566.49	0.00	566.49	0.78	90.62
29	4.A.1	LULUCF - Forest land Remaining Forest Land	CO2	0.00	565.20	565.20	0.78	91.39
30	3.B.1.1	Manure Management - Dairy Cattle	CH4	430.78	0.00	430.78	0.59	91.99
31	3.G.1	Liming - Limestone CaCO ₃	CO2	399.48	0.00	399.48	0.55	92.53
32	4.C	LULUCF - Drained organic soils from rewetted organic soils	CO2	0.00	396.23	396.23	0.54	93.08
33	1.A.3.d	Navigation - Liquid Fuels	CO2	319.29	0.00	319.29	0.44	93.52
34	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO2	301.38	0.00	301.38	0.41	93.93
35	4.C	LULUCF - Drained organic soils from forest to grasslands	CH4	0.00	278.37	278.37	0.38	94.31
36	3.B.2.1	Manure Management - Non-Dairy Cattle	N2O	271.92	0.00	271.92	0.37	94.69
37	3.B.1.3	Manure Management - Swine	CH4	269.86	0.00	269.86	0.37	95.06

Annex A.4.5 Key Category Analysis Trend Assessment 1990-2020 (excluding LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	1990 Estimate (kt CO ₂ eq)	2020 Estimate (kt CO ₂ eq)	Trend Assessment (%)	Contribution to Trend (%)	Cumulative total (%)
1	1.A.3.b	Road Transport - Liquid Fuels	CO2	4,690.42	9,591.65	7.53	12.44	12.44
2	1.A.1	Energy Industries - Solid Fuels	CO2	4,844.66	755.41	7.12	11.76	24.19
3	1.A.1	Energy Industries - Gaseous	CO2	1,880.66	5,450.94	5.63	9.30	33.50
4	1.A.4.b	Residential - Liquid Fuels	CO2	1,172.96	3,963.36	4.43	7.32	40.81
5	1.A.4.b	Residential - Peat Fuel	CO2	3,123.37	811.20	4.06	6.71	47.52
6	1.A.1	Energy Industries - Peat Fuel	CO2	3,164.78	1,080.11	3.70	6.10	53.62
7	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO2	873.02	2,824.25	3.09	5.11	58.73
8	1.A.4.b	Residential - Solid Fuels	CO2	2,483.42	788.05	3.00	4.95	63.68
9	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO2	2,335.38	1,190.47	2.09	3.45	67.13
10	1.A.4.b	Residential - Gaseous Fuels	CO2	269.73	1,387.18	1.79	2.96	70.09
11	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	1,735.45	805.96	1.68	2.77	72.86
12	3.A.1	Enteric Fermentation - Dairy	CH4	3,398.51	4,619.05	1.66	2.75	75.61
13	2.A.1	Cement Production	CO2	884.00	1,769.64	1.36	2.24	77.85
14	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	223.49	1,012.79	1.26	2.09	79.94
15	5.A	Solid Waste Disposal	CH4	1,318.08	667.94	1.18	1.96	81.89
16	1.A.1	Energy Industries - Liquid Fuels	CO2	1,254.90	630.35	1.14	1.88	83.77
17	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH4	5,811.98	6,828.71	1.10	1.82	85.59
18	3.A.2	Enteric Fermentation - Sheep	CH4	1,604.20	1,057.32	1.04	1.72	87.31
19	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO2	871.24	301.38	1.01	1.67	88.98
20	1.A.1	Energy Industries - Other Fuels	CO2	-	596.34	0.97	1.60	90.58
21	2.F.1	Product Uses as Substitutes for ODS -Refrigeration and air-con	HFC	-	571.83	0.93	1.54	92.12
22	3.D.1	Agricultural Soils - Direct Soil Emissions	N2O	5,261.17	5,193.96	0.61	1.01	93.13
23	1.A.3.d	Navigation - Liquid Fuels	CO2	84.90	319.29	0.37	0.62	93.74
24	1.A.4.c	Agriculture/Fishing - Liquid Fuels	CO2	747.23	594.52	0.32	0.53	94.27
25	1.A.2	Manufacturing Industries & Construction - Non-Renewable waste	CO2	-	184.34	0.30	0.50	94.77
26	1.A.4.b	Residential - Peat Fuel	CH4	227.65	59.46	0.30	0.49	95.26

Annex A.4.6 Key Category Analysis Trend Assessment 1990-2020 (including LULUCF)

Ranking	IPCC Category code	IPCC Category	Greenhouse Gas	1990 Estimate (kt CO ₂ eq)	2020 Estimate (kt CO ₂ eq)	Trend Assessment (%)	Contribution to Trend (%)	Cumulative total (%)
1	1.A.3.b	Road Transport - Liquid Fuels	CO2	4,690.42	9,591.65	5.85	10.10	10.10
2	1.A.1	Energy Industries - Solid Fuels	CO2	4,844.66	755.41	5.69	9.83	19.93
3	1.A.1	Energy Industries - Gaseous	CO2	1,880.66	5,450.94	4.40	7.61	27.54
4	4.A.2	LULUCF - Land Converted to Forest Land	CO2	167.41	2,984.34	3.59	6.21	33.75
5	1.A.4.b	Residential - Liquid Fuels	CO2	1,172.96	3,963.36	3.47	5.99	39.74
6	4.A.1	LULUCF - Forest land Remaining Forest Land	CO2	2,922.13	565.20	3.29	5.69	45.43
7	1.A.4.b	Residential - Peat Fuel	CO2	3,123.37	811.20	3.25	5.62	51.05
8	1.A.1	Energy Industries - Peat Fuel	CO2	3,164.78	1,080.11	2.96	5.12	56.17
9	1.A.2	Manufacturing Industries & Construction - Gaseous Fuels	CO2	873.02	2,824.25	2.42	4.18	60.35
10	1.A.4.b	Residential - Solid Fuels	CO2	2,483.42	788.05	2.40	4.15	64.50
11	1.A.2	Manufacturing Industries & Construction - Liquid Fuels	CO2	2,335.38	1,190.47	1.68	2.91	67.41
12	1.A.4.b	Residential - Gaseous Fuels	CO2	269.73	1,387.18	1.41	2.43	69.84
13	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	1,735.45	805.96	1.35	2.34	72.18
14	3.A.1	Enteric Fermentation - Dairy	CH4	3,398.51	4,619.05	1.25	2.16	74.34
15	4.C	LULUCF - Grassland	CO2	6,591.45	6,141.42	1.19	2.05	76.39
16	2.A.1	Cement Production	CO2	884.00	1,769.64	1.05	1.82	78.21
17	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	223.49	1,012.79	0.99	1.71	79.92
18	5.A	Solid Waste Disposal	CH4	1,318.08	667.94	0.95	1.65	81.57
19	1.A.1	Energy Industries - Liquid Fuels	CO2	1,254.90	630.35	0.92	1.58	83.16
20	3.A.2	Enteric Fermentation - Sheep	CH4	1,604.20	1,057.32	0.85	1.47	84.62
21	4.D	LULUCF - Wetlands	CO2	1,742.97	2,529.40	0.85	1.46	86.09
22	1.A.2	Manufacturing Industries & Construction - Solid Fuels	CO2	871.24	301.38	0.81	1.40	87.49
23	3.A.1	Enteric Fermentation - Non-Dairy Cattle	CH4	5,811.98	6,828.71	0.77	1.32	88.81
24	1.A.1	Energy Industries - Other Fuels	CO2	-	596.34	0.76	1.32	90.13
25	2.F.1	Product Uses as Substitutes for ODS -Refrigeration and air-con	HFC	-	571.83	0.73	1.27	91.40
26	3.D.1	Agricultural Soils - Direct Soil Emissions	N2O	5,261.17	5,193.96	0.57	0.99	92.39
27	4.G	LULUCF - Harvested wood	CO2	413.04	818.98	0.48	0.83	93.22
28	1.A.3.d	Navigation - Liquid Fuels	CO2	84.90	319.29	0.29	0.51	93.72
29	1.A.4.c	Agriculture/Fishing - Liquid	CO2	747.23	594.52	0.26	0.46	94.18
30	1.A.4.b	Residential - Peat Fuel	CH4	227.65	59.46	0.24	0.41	94.59
31	1.A.2	Manufacturing Industries & Construction - Non-Renewable waste	CO2	-	184.34	0.24	0.41	95.00

Annex A.5.1 Tier 1 Uncertainty Estimates 2020 (excluding LULUCF)

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)	
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	1880.66	5450.94	1.00	2.50	2.69	0.01	0.06	0.06	0.10	0.14	0.16	0.04	
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	1254.90	630.35	1.00	2.50	2.69	0.00	0.00	0.01	0.01	0.02	0.03	0.00	
3	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CO2	0.00	596.34	1.00	5.00	5.10	0.00	0.00	0.01	0.01	0.02	0.05	0.00	
4	1.A.1 Fuel combustion - Energy Industries - Peat	CO2	3164.78	1080.11	1.00	5.00	5.10	0.09	0.01	0.04	0.02	0.03	0.21	0.04	
5	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	4844.66	755.41	1.00	5.00	5.10	0.20	0.00	0.08	0.01	0.02	0.40	0.16	
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	873.02	2824.25	2.50	2.50	3.54	0.00	0.03	0.03	0.05	0.18	0.09	0.04	
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	2335.38	1190.47	10.00	2.50	10.31	0.19	0.04	0.02	0.02	0.31	0.06	0.10	
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.00	184.34	1.00	5.00	5.10	0.00	0.00	0.00	0.00	0.00	0.02	0.00	
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CO2	0.00	0.00	2.00	5.00	5.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	871.24	301.38	2.00	5.00	5.39	0.01	0.00	0.01	0.01	0.02	0.06	0.00	
11	1.A.3.a Domestic Aviation	CO2	47.98	13.27	1.00	2.50	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	1.A.3.b Road Transportation	CO2	4690.42	9591.65	1.25	3.00	3.25	0.08	0.29	0.08	0.17	0.31	0.25	0.16	
13	1.A.3.c Railways	CO2	133.19	97.34	1.00	1.00	1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
14	1.A.3.d Domestic Navigation - Liquid Fuels	CO2	84.90	319.29	1.00	2.00	2.24	0.00	0.00	0.00	0.01	0.01	0.01	0.00	
15	1.A.3.e Other Transportation	CO2	73.14	147.65	1.00	2.50	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
16	1.A.4 Other Sectors - Gaseous Fuels	CO2	493.22	2399.96	2.50	2.50	3.54	0.00	0.02	0.03	0.04	0.15	0.09	0.03	
17	1.A.4 Other Sectors - Liquid Fuels	CO2	3655.64	5363.83	10.00	5.00	11.18	0.56	1.07	0.03	0.10	1.38	0.14	1.93	
18	1.A.4 Other Sectors - Peat	CO2	3259.11	811.20	10.00	20.00	22.36	1.77	0.10	0.05	0.01	0.21	0.96	0.97	
19	1.A.4 Other Sectors - Solid Fuels	CO2	2485.97	790.05	5.00	10.00	11.18	0.26	0.02	0.03	0.01	0.10	0.34	0.12	
20	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO2	0.01	0.33	1.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
21	2.A.1 Cement Production	CO2	884.00	1769.64	1.50	1.50	2.12	0.00	0.00	0.00	0.03	0.07	0.02	0.01	
22	2.A.2 Lime Production	CO2	214.08	135.51	1.50	1.50	2.12	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
23	2.A.3 Glass Production	CO2	13.33	0.00	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
24	2.A.4 Other Process Uses of Carbonates	CO2	5.32	2.02	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
25	2.B.1 Ammonia Production	CO2	990.23	0.00	1.00	5.00	5.10	0.01	0.00	0.02	0.00	0.00	0.10	0.01	
26	2.C Metal Production	CO2	26.08	0.00	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
27	2.D Non-energy Products from Fuels and Solvent Use	CO2	115.87	159.75	30.00	5.00	30.41	0.00	0.01	0.00	0.00	0.12	0.00	0.02	
28	3.G Liming	CO2	355.04	399.48	5.00	50.00	50.25	0.11	0.12	0.00	0.01	0.05	0.02	0.00	
29	3.H Urea Application	CO2	96.68	109.40	5.00	50.00	50.25	0.01	0.01	0.00	0.00	0.01	0.01	0.00	
30	5.C Incineration and Open Burning of Waste	CO2	95.59	29.25	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.01	0.01	0.00	
Total CO2			32944.42	35153.20				3.291	1.795					3.644	
Level uncertainty, CO2									1.814	1.340	Trend uncertainty, CO2				1.909

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)
1	1.A.1 Fuel combustion - Energy Industries - Biomass	CH4	0.00	4.31	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
2	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CH4	3.43	2.49	1.00	70.00	70.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CH4	0.39	0.20	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CH4	0.00	2.92	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.A.1 Fuel combustion - Energy Industries - Peat	CH4	1.90	0.68	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CH4	0.91	0.14	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CH4	1.91	4.48	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CH4	0.40	1.26	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CH4	2.20	1.02	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CH4	0.00	0.17	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CH4	0.00	0.00	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CH4	2.30	0.80	2.00	50.00	50.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	1.A.3.a Domestic Aviation	CH4	0.03	0.01	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.A.3.b Road Transportation	CH4	48.23	6.02	1.25	71.00	71.01	0.00	0.00	0.00	0.00	0.00	0.06	0.00
15	1.A.3.c Railways	CH4	0.19	0.14	1.00	60.00	60.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1.A.3.d Domestic Navigation - Liquid Fuels	CH4	0.20	0.76	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1.A.3.e Other Transportation	CH4	0.03	0.07	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1.A.4 Other Sectors - Biomass	CH4	14.08	13.82	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	1.A.4 Other Sectors - Gaseous Fuels	CH4	1.12	5.34	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1.A.4 Other Sectors - Liquid Fuels	CH4	10.80	17.06	10.00	66.00	66.75	0.00	0.00	0.00	0.00	0.00	0.01	0.00
21	1.A.4 Other Sectors - Peat	CH4	227.98	59.46	10.00	50.00	50.99	0.04	0.00	0.00	0.00	0.02	0.17	0.03
22	1.A.4 Other Sectors - Solid Fuels	CH4	196.51	61.24	5.00	50.00	50.25	0.03	0.00	0.00	0.00	0.01	0.13	0.02
23	1.B.1 Fugitive emissions from Solid Fuels	CH4	55.56	17.66	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.04	0.00
24	1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH4	0.21	0.33	10.00	50.00	50.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	50.06	73.04	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.02	0.02	0.00
26	3.A.1 Enteric Fermentation-Dairy Cattle	CH4	3398.51	4619.05	1.00	15.00	15.03	0.87	1.43	0.02	0.08	0.12	0.28	0.09
27	3.A.1 Enteric Fermentation-Non-Dairy Cattle	CH4	5811.98	6828.71	1.00	15.00	15.03	2.54	3.13	0.01	0.12	0.18	0.18	0.07

28	3.A.2 Enteric Fermentation-Sheep	CH4	1604.20	1057.32	1.00	30.00	30.02	0.77	0.30	0.01	0.02	0.03	0.35	0.12
29	3.A.3 Enteric Fermentation-Swine	CH4	41.37	56.22	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00
30	3.A.4 Enteric Fermentation-Other Animals	CH4	37.87	43.94	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	3.B.1.1 Manure Management-Dairy Cattle	CH4	375.67	430.78	1.00	15.00	15.03	0.01	0.01	0.00	0.01	0.01	0.01	0.00
32	3.B.1.1 Manure Management-Non-Dairy Cattle	CH4	545.22	725.62	1.00	15.00	15.03	0.02	0.04	0.00	0.01	0.02	0.04	0.00
33	3.B.1.2 Manure Management-Sheep	CH4	99.19	65.48	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
34	3.B.1.3 Manure Management-Swine	CH4	206.49	269.86	1.00	30.00	30.02	0.01	0.02	0.00	0.00	0.01	0.03	0.00
35	3.B.1.4 Manure Management-Other Animals	CH4	61.58	105.58	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
36	5.A Solid Waste Disposal	CH4	1318.08	667.94	34.64	34.64	48.99	1.39	0.32	0.01	0.01	0.60	0.46	0.57
37	5.B Biological treatment of solid waste: Composting and AD	CH4	0.00	29.37	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.01	0.02	0.00
38	5.C Incineration and Open Burning of Waste	CH4	1.05	0.14	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	5.D Wastewater Treatment and Discharge	CH4	61.10	53.14	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Total CH4			14180.75	15226.57				5.706	5.262					0.904
								Level uncertainty, CH4		2.389	2.294	Trend uncertainty, CH4		0.951
Combined CO2 and CH4			47125.17	50379.77				8.997	7.058					4.548
								Level uncertainty, CO2 and CH4		3.000	2.657	Trend uncertainty, CO2 & CH4		2.133

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)	
1	1.A.1 Fuel combustion - Energy Industries - Biomass	N2O	0.00	13.36	1.00	63.00	63.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	
2	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	N2O	10.21	85.55	1.00	50.00	50.01	0.00	0.01	0.00	0.00	0.00	0.07	0.00	
3	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	N2O	1.47	0.57	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	N2O	0.00	4.65	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	1.A.1 Fuel combustion - Energy Industries - Peat	N2O	52.07	18.49	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	
6	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	N2O	7.74	1.21	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	N2O	3.04	7.23	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	N2O	0.47	1.50	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	N2O	5.16	2.37	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	N2O	0.00	0.40	1.00	20.00	20.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	N2O	0.00	0.00	2.00	50.00	50.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	N2O	4.12	1.42	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
13	1.A.3.a Domestic Aviation	N2O	0.39	0.11	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
14	1.A.3.b Road Transportation	N2O	50.12	105.35	1.25	68.00	68.01	0.00	0.02	0.00	0.00	0.00	0.06	0.00	
15	1.A.3.c Railways	N2O	15.49	11.32	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
16	1.A.3.d Domestic Navigation - Liquid Fuels	N2O	0.67	2.60	1.00	90.00	90.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
17	1.A.3.e Other Transportation	N2O	0.04	0.08	1.00	25.00	25.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
18	1.A.4 Other Sectors - Biomass	N2O	2.23	2.18	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
19	1.A.4 Other Sectors - Gaseous Fuels	N2O	0.27	1.27	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
20	1.A.4 Other Sectors - Liquid Fuels	N2O	76.59	68.12	10.00	50.00	50.99	0.01	0.00	0.00	0.00	0.02	0.01	0.00	
21	1.A.4 Other Sectors - Peat	N2O	13.22	3.31	5.00	50.00	50.25	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
22	1.A.4 Other Sectors - Solid Fuels	N2O	11.72	3.66	5.00	50.00	50.25	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
23	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	N2O	0.00	0.00	1.00	150.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
24	2.B.2 Nitric Acid Production	N2O	995.32	0.00	1.00	10.00	10.05	0.03	0.00	0.02	0.00	0.00	0.19	0.04	
25	2.G Other Product Manufacture and Use	N2O	31.34	44.50	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
26	3.B.2.1 Manure Management -Dairy Cattle	N2O	56.06	57.82	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.02	0.00	0.00	
27	3.B.2.1 Manure Management -Non-Dairy Cattle	N2O	201.51	271.92	11.22	50.00	51.24	0.04	0.06	0.00	0.00	0.08	0.05	0.01	
28	3.B.2.2 Manure Management -Sheep	N2O	22.67	16.18	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
29	3.B.2.3 Manure Management -Swine	N2O	10.08	13.03	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
30	3.B.2.4 Manure Management -Deer	N2O	0.24	0.02	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
31	3.B.2.4 Manure Management -Goats	N2O	0.65	0.33	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
32	3.B.2.4 Manure Management -Horses	N2O	3.44	4.93	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
33	3.B.2.4 Manure Management -Mules & Asses	N2O	0.32	0.38	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
34	3.B.2.4 Manure Management -Poultry	N2O	3.81	5.91	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
35	3.B.2.4 Manure Management -Fur Animals	N2O	2.72	0.73	50.00	50.00	70.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
36	3.B.2.5 Indirect N2O emissions	N2O	187.33	231.42	11.22	100.00	100.63	0.12	0.16	0.00	0.00	0.07	0.06	0.01	
37	3.D.1.1 Inorganic N Fertilizer	N2O	2158.39	2155.95	1.00	50.00	50.01	3.88	3.45	0.00	0.04	0.06	0.12	0.02	
38	3.D.1.2 Organic N Fertilizers	N2O	666.08	861.14	11.22	100.00	100.63	1.49	2.23	0.00	0.02	0.25	0.28	0.14	
39	3.D.1.3 Urine and Dung Deposited by Grazing Animals	N2O	1272.54	1281.31	11.18	50.00	51.23	1.41	1.28	0.00	0.02	0.37	0.06	0.14	
40	3.D.1.4 Crop Residues	N2O	388.22	195.23	10.00	100.00	100.50	0.51	0.11	0.00	0.00	0.05	0.39	0.16	
41	3.D.1.5 Mineralization/Immobilization Associated with Loss/Gain of Soil Organic Matter	N2O	17.48	17.72	22.57	100.00	102.52	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
42	3.D.1.6 Cultivation of Organic Soils	N2O	758.45	682.61	12.22	100.00	100.74	1.94	1.40	0.00	0.01	0.22	0.22	0.09	
43	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	555.51	566.49	11.18	50.00	51.23	0.27	0.25	0.00	0.01	0.16	0.02	0.03	
44	5.B Biological treatment of solid waste: Composting	N2O	0.00	18.53	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
45	5.C Incineration and Open Burning of Waste	N2O	1.10	0.31	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
46	5.D Wastewater Treatment and Discharge	N2O	75.14	107.06	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.03	0.01	0.00	
Total N2O			7663.43	6868.23	Level uncertainty, N2O				9.708	8.978					0.645
									3.116	2.996					0.803
Combined CO2, CH4 and N2O			54788.60	57248.00	Level uncertainty, CO2, CH4 & N2O				18.705	16.036					5.193
									4.325	4.004	0.000	0.000	Trend uncertainty, CO2, CH4 & N2O		2.279

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO ₂ eq)	Emissions in 2020 (kt CO ₂ eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)
1	2.E Electronics Industry & 2.F Product Uses and Substitutes for ODS	Aggregate	1.17	777.95	20.00	10.00	22.36	0.00	0.09	0.01	0.01	0.40	0.14	0.18
2	2.G Other Product Manufacture and Use	Aggregate	33.42	6.38	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total F-gases			34.59	784.34				0.000	0.090					0.181
								0.006	0.300					0.426
TOTAL for all gases			54823.19	58032.34				18.705	16.126					5.375
								4.325	4.016	0.000	Total trend unc	Total trend uncertainty for all GHGs		2.318

Annex A.5.2 Tier 1 Uncertainty Estimates 2020 (including LULUCF)

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)	
1	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO2	1880.66	5450.94	1.00	2.50	2.69	0.01	0.05	0.06	0.09	0.13	0.14	0.04	
2	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO2	1254.90	630.35	1.00	2.50	2.69	0.00	0.00	0.01	0.01	0.01	0.03	0.00	
3	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CO2	0.00	596.34	1.00	5.00	5.10	0.00	0.00	0.01	0.01	0.01	0.05	0.00	
4	1.A.1 Fuel combustion - Energy Industries - Peat	CO2	3164.78	1080.11	1.00	5.00	5.10	0.07	0.01	0.04	0.02	0.03	0.19	0.04	
5	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO2	4844.66	755.41	1.00	5.00	5.10	0.16	0.00	0.07	0.01	0.02	0.36	0.13	
6	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO2	873.02	2824.25	2.50	2.50	3.54	0.00	0.02	0.03	0.05	0.16	0.08	0.03	
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO2	2335.38	1190.47	10.00	2.50	10.31	0.16	0.04	0.02	0.02	0.28	0.05	0.08	
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CO2	0.00	184.34	1.00	5.00	5.10	0.00	0.00	0.00	0.00	0.00	0.02	0.00	
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CO2	0.00	0.00	2.00	5.00	5.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO2	871.24	301.38	2.00	5.00	5.39	0.01	0.00	0.01	0.00	0.01	0.05	0.00	
11	1.A.3.a Domestic Aviation	CO2	47.98	13.27	1.00	2.50	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
12	1.A.3.b Road Transportation	CO2	4690.42	9591.65	1.25	3.00	3.25	0.06	0.23	0.08	0.16	0.28	0.23	0.13	
13	1.A.3.c Railways	CO2	133.19	97.34	1.00	1.00	1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
14	1.A.3.d Domestic Navigation - Liquid Fuels	CO2	84.90	319.29	1.00	2.00	2.24	0.00	0.00	0.00	0.01	0.01	0.01	0.00	
15	1.A.3.e Other Transportation	CO2	73.14	147.65	1.00	2.50	2.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
16	1.A.4 Other Sectors - Gaseous Fuels	CO2	493.22	2399.96	2.50	2.50	3.54	0.00	0.02	0.03	0.04	0.14	0.08	0.03	
17	1.A.4 Other Sectors - Liquid Fuels	CO2	3655.64	5363.83	10.00	5.00	11.18	0.45	0.85	0.02	0.09	1.24	0.12	1.56	
18	1.A.4 Other Sectors - Peat	CO2	3259.11	811.20	10.00	20.00	22.36	1.43	0.08	0.04	0.01	0.19	0.87	0.79	
19	1.A.4 Other Sectors - Solid Fuels	CO2	2485.97	790.05	5.00	10.00	11.18	0.21	0.02	0.03	0.01	0.09	0.30	0.10	
20	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO2	0.01	0.33	1.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
21	2.A.1 Cement Production	CO2	884.00	1769.64	1.50	1.50	2.12	0.00	0.00	0.01	0.03	0.06	0.02	0.00	
22	2.A.2 Lime Production	CO2	214.08	135.51	1.50	1.50	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
23	2.A.3 Glass Production	CO2	13.33	0.00	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
24	2.A.4 Other Process Uses of Carbonates	CO2	5.32	2.02	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
25	2.B.1 Ammonia Production	CO2	990.23	0.00	1.00	5.00	5.10	0.01	0.00	0.02	0.00	0.00	0.09	0.01	
26	2.C Metal Production	CO2	26.08	0.00	5.00	2.50	5.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
27	2.D Non-energy Products from Fuels and Solvent Use	CO2	115.87	159.75	30.00	5.00	30.41	0.00	0.01	0.00	0.00	0.11	0.00	0.01	
28	3.G Liming	CO2	355.04	399.48	5.00	50.00	50.25	0.09	0.10	0.00	0.01	0.05	0.02	0.00	
29	3.H Urea Application	CO2	96.68	109.40	5.00	50.00	50.25	0.01	0.01	0.00	0.00	0.01	0.01	0.00	
30	4.A.1 Forest Land Remaining Forest Land	CO2	-2922.13	565.20	51.00	114.00	124.89	35.77	1.18	0.06	0.01	0.67	6.87	47.67	
31	4.A.2 Land Converted to Forest Land	CO2	167.41	-2984.34	51.00	114.00	124.89	0.12	32.92	0.05	0.05	3.53	5.91	47.36	
32	4.B.1 Cropland Remaining Cropland	CO2	-100.44	-110.80	20.59	69.15	72.15	0.01	0.02	0.00	0.00	0.05	0.00	0.00	
33	4.C. Grassland	CO2	6964.36	6543.52	12.22	90.00	90.83	107.47	83.71	0.01	0.11	1.85	1.28	5.08	
34	4.D. Wetlands	CO2	1742.97	2529.40	21.49	101.45	103.70	8.78	16.31	0.01	0.04	1.26	1.12	2.84	
35	4.E.2 Land Converted to Settlements	CO2	80.46	162.46	39.97	81.83	91.07	0.01	0.05	0.00	0.00	0.15	0.10	0.03	
36	4.F.2 Land Converted to Other Land	CO2	0.81	9.49	51.93	75.00	91.23	0.00	0.00	0.00	0.00	0.01	0.01	0.00	
37	4.G Harvested Wood Products	CO2	-413.04	-818.98	25.00	26.92	36.74	0.06	0.21	0.01	0.01	0.47	0.17	0.25	
38	5.C Incineration and Open Burning of Waste	CO2	95.59	29.25	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.01	0.01	0.00	
Total CO2			38464.82	41049.14				154.88	135.83					106.19	
Level uncertainty, CO2									12.45	11.65	Trend uncertainty, CO2				10.30

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)
1	1.A.1 Fuel combustion - Energy Industries - Biomass	CH4	0.00	4.31	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CH4	3.43	2.49	1.00	70.00	70.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CH4	0.00	0.20	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CH4	0.00	2.92	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.A.1 Fuel combustion - Energy Industries - Peat	CH4	1.90	0.68	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CH4	0.91	0.14	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CH4	1.91	4.48	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CH4	0.40	1.26	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CH4	2.20	1.02	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	CH4	0.00	0.17	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CH4	0.00	0.00	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CH4	2.30	0.80	2.00	50.00	50.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	1.A.3.a Domestic Aviation	CH4	0.03	0.01	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.A.3.b Road Transportation	CH4	48.23	6.02	1.25	71.00	71.01	0.00	0.00	0.00	0.00	0.00	0.05	0.00
15	1.A.3.c Railways	CH4	0.19	0.14	1.00	60.00	60.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1.A.3.d Domestic Navigation - Liquid Fuels	CH4	0.20	0.76	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1.A.3.e Other Transportation	CH4	0.03	0.07	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1.A.4 Other Sectors - Biomass	CH4	14.08	13.82	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	1.A.4 Other Sectors - Gaseous Fuels	CH4	1.12	5.34	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1.A.4 Other Sectors - Liquid Fuels	CH4	10.80	17.06	10.00	66.00	66.75	0.00	0.00	0.00	0.00	0.00	0.01	0.00
21	1.A.4 Other Sectors - Peat	CH4	227.98	59.46	10.00	50.00	50.99	0.04	0.00	0.00	0.00	0.01	0.15	0.02

22	1.A.4 Other Sectors - Solid Fuels	CH4	196.51	61.24	5.00	50.00	50.25	0.03	0.00	0.00	0.00	0.01	0.12	0.01
23	1.B.1 Fugitive emissions from Solid Fuels	CH4	55.56	17.66	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.03	0.00
24	1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH4	0.21	0.33	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	50.06	73.04	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.02	0.02	0.00
26	3A1 Enteric Fermentation-Dairy Cattle	CH4	3398.51	4619.05	1.00	15.00	15.03	0.70	1.14	0.02	0.08	0.11	0.25	0.07
27	3A1 Enteric Fermentation-Non-Dairy Cattle	CH4	5811.98	6828.71	1.00	15.00	15.03	2.05	2.50	0.01	0.11	0.16	0.18	0.05
28	3A2 Enteric Fermentation-Sheep	CH4	1604.20	1057.32	1.00	30.00	30.02	0.62	0.24	0.01	0.02	0.02	0.32	0.10
29	3A3 Enteric Fermentation-Swine	CH4	41.37	56.22	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00
30	3A4 Enteric Fermentation-Other Animals	CH4	37.87	43.94	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	3B1.1 Manure Management-Dairy Cattle	CH4	375.67	430.78	1.00	15.00	15.03	0.01	0.01	0.00	0.01	0.01	0.01	0.00
32	3B1.1 Manure Management-Non-Dairy Cattle	CH4	545.22	725.62	1.00	15.00	15.03	0.02	0.03	0.00	0.01	0.02	0.04	0.00
33	3B1.2 Manure Management-Sheep	CH4	99.19	65.48	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
34	3B1.3 Manure Management-Swine	CH4	206.49	269.86	1.00	30.00	30.02	0.01	0.02	0.00	0.00	0.01	0.02	0.00
35	3B1.4 Manure Management-Other Animals	CH4	61.58	105.58	1.00	30.00	30.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
36	4.A LULUCF - Forest Land	CH4	53.54	72.91	30.00	100.00	104.40	0.01	0.01	0.00	0.00	0.05	0.03	0.00
37	4.B LULUCF - Cropland	CH4	0.05	0.00	100.00	39.10	107.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	4.C LULUCF - Grassland	CH4	270.04	280.91	96.40	91.20	132.70	0.34	0.33	0.00	0.00	0.63	0.01	0.39
39	4.D LULUCF - Wetlands	CH4	132.70	214.29	86.00	66.50	108.71	0.06	0.13	0.00	0.00	0.43	0.08	0.19
40	5.A Solid Waste Disposal	CH4	1318.08	667.94	34.64	34.64	48.99	1.12	0.25	0.01	0.01	0.54	0.42	0.46
41	5.B Biological treatment of solid waste: Composting and AD	CH4	0.00	29.37	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.01	0.01	0.00
42	5.C Incineration and Open Burning of Waste	CH4	1.05	0.14	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	5.D Wastewater Treatment and Discharge	CH4	61.10	53.14	10.00	30.00	31.62	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Total CH4			14637.07	15794.69				5.02	4.67					1.32
			Level uncertainty, CH4						2.24	2.16	Trend uncertainty, CH4			1.15
Combined CO2 and CH4			53101.89	56843.83				159.90	140.50	Trend uncertainty, CO2 & CH4				107.51
			Level uncertainty, CO2 and CH4						12.65	11.85	Trend uncertainty, CO2 & CH4			10.37

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)
1	1.A.1 Fuel combustion - Energy Industries - Biomass	N2O	0.00	13.36	1.00	63.00	63.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
2	1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	N2O	10.21	85.55	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.06	0.00
3	1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	N2O	1.47	0.57	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	N2O	0.00	4.65	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	1.A.1 Fuel combustion - Energy Industries - Peat	N2O	52.07	18.49	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00
6	1.A.1 Fuel combustion - Energy Industries - Solid Fuels	N2O	7.74	1.21	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
7	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	N2O	3.04	7.23	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	N2O	0.47	1.50	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	N2O	5.16	2.37	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Other Fossil Fuels	N2O	0.00	0.40	1.00	20.00	20.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	N2O	0.00	0.00	2.00	50.00	50.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	N2O	4.12	1.42	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	1.A.3.a Domestic Aviation	N2O	0.39	0.11	1.00	66.00	66.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.A.3.b Road Transportation	N2O	50.12	105.35	1.25	68.00	68.01	0.00	0.01	0.00	0.00	0.00	0.06	0.00
15	1.A.3.c Railways	N2O	15.49	11.32	1.00	50.00	50.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	1.A.3.d Domestic Navigation - Liquid Fuels	N2O	0.67	2.60	1.00	90.00	90.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1.A.3.e Other Transportation	N2O	0.04	0.08	1.00	25.00	25.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	1.A.4 Other Sectors - Biomass	N2O	2.23	2.18	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	1.A.4 Other Sectors - Gaseous Fuels	N2O	0.27	1.27	2.50	50.00	50.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	1.A.4 Other Sectors - Liquid Fuels	N2O	76.59	68.12	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.02	0.01	0.00
21	1.A.4 Other Sectors - Peat	N2O	13.22	3.31	5.00	50.00	50.25	0.00	0.00	0.00	0.00	0.00	0.01	0.00
22	1.A.4 Other Sectors - Solid Fuels	N2O	11.72	3.66	5.00	50.00	50.25	0.00	0.00	0.00	0.00	0.00	0.01	0.00
23	1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	N2O	0.00	0.00	1.00	150.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	2.B.2 Nitric Acid Production	N2O	995.32	0.00	1.00	10.00	10.05	0.03	0.00	0.02	0.00	0.00	0.17	0.03
25	2.G Other Product Manufacture and Use	N2O	31.34	44.50	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
26	3.B.2.1 Manure Management -Dairy Cattle	N2O	56.06	57.82	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.02	0.00	0.00
27	3.B.2.1 Manure Management -Non-Dairy Cattle	N2O	201.51	271.92	11.22	50.00	51.24	0.03	0.05	0.00	0.00	0.07	0.05	0.01
28	3.B.2.2 Manure Management -Sheep	N2O	22.67	16.18	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.01	0.00
29	3.B.2.3 Manure Management -Swine	N2O	10.08	13.03	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	3.B.2.4 Manure Management -Deer	N2O	0.24	0.02	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	3.B.2.4 Manure Management -Goats	N2O	0.65	0.33	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	3.B.2.4 Manure Management -Horses	N2O	3.44	4.93	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	3.B.2.4 Manure Management -Mules & Asses	N2O	0.32	0.38	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	3.B.2.4 Manure Management -Poultry	N2O	3.81	5.91	11.22	50.00	51.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	3.B.2.4 Manure Management -Fur Animals	N2O	2.72	0.73	50.00	50.00	70.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	3.B.2.5 Indirect N2O emissions	N2O	187.33	231.42	11.22	100.00	100.63	0.10	0.13	0.00	0.00	0.06	0.05	0.01
37	3.D.1.1 Inorganic N Fertilizer	N2O	2158.39	2155.95	1.00	50.00	50.01	3.13	2.75	0.00	0.04	0.05	0.12	0.02
38	3.D.1.2 Organic N Fertilizers	N2O	666.08	861.14	11.22	100.00	100.63	1.21	1.78	0.00	0.01	0.22	0.25	0.11
39	3.D.1.3 Urine and Dung Deposited by Grazing Animals	N2O	1272.54	1281.31	11.18	50.00	51.23	1.14	1.02	0.00	0.02	0.33	0.06	0.11
40	3.D.1.4 Crop Residues	N2O	388.22	195.23	10.00	100.00	100.50	0.41	0.09	0.00	0.00	0.05	0.36	0.13
41	3.D.1.5 Mineralization/Immobilization Associated with Loss/Gain of Soil Organic Matter	N2O	17.48	17.72	22.57	100.00	102.52	0.00	0.00	0.00	0.00	0.01	0.00	0.00
42	3.D.1.6 Cultivation of Organic Soils	N2O	758.45	682.61	12.22	100.00	100.74	1.57	1.12	0.00	0.01	0.19	0.20	0.08
43	3.D.2 Indirect N2O Emissions From Managed Soils	N2O	555.51	566.49	11.18	50.00	51.23	0.22	0.20	0.00	0.01	0.15	0.02	0.02

44	4.A LULUCF - Forest Land	N2O	162.58	260.93	30.00	100.00	104.40	0.08	0.18	0.00	0.00	0.18	0.14	0.05	
45	4.B.1 LULUCF - Cropland remaining Cropland	N2O	0.02	0.00	100.00	100.00	141.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
46	4.C.1 LULUCF - Grassland Remaining Grassland	N2O	15.58	70.62	91.02	100.00	135.22	0.00	0.02	0.00	0.00	0.15	0.09	0.03	
47	4.D LULUCF - Wetlands	N2O	31.46	16.32	86.00	100.00	131.89	0.00	0.00	0.00	0.00	0.03	0.03	0.00	
48	4.E.1. LULUCF-Settlements remaining settlements	N2O	6.29	71.33	45.24	54.69	70.98	0.00	0.01	0.00	0.00	0.07	0.06	0.01	
49	4.E.2 LULUCF - Land Converted to Settlements	N2O	6.29	71.33	45.24	54.69	70.98	0.00	0.01	0.00	0.00	0.07	0.06	0.01	
50	4.F LULUCF -Other Land	N2O	0.08	37.41	30.00	100.00	104.40	0.00	0.00	0.00	0.00	0.03	0.06	0.00	
51	5.B Biological treatment of solid waste: Composting	N2O	0.00	18.53	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
52	5.C Incineration and Open Burning of Waste	N2O	1.10	0.31	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
53	5.D Wastewater Treatment and Discharge	N2O	75.14	107.06	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.02	0.00	0.00	
Total N2O			7879.45	7330.38				7.920	7.374					0.626	
			Level uncertainty, N2O						2.814	2.716	Trend uncertainty, I				0.791
Combined CO2, CH4 and N2O			60981.33	64174.21				167.819	147.874					108.133	
			Level uncertainty, CO2, CH4 & N2O						12.955	12.160	Trend uncertainty, CO2, CH4 & N2O				10.399

	CATEGORIES OF EMISSIONS AND REMOVALS	Gas	Emissions in 1990 (kt CO2eq)	Emissions in 2020 (kt CO2eq)	Activity Data (AD) Uncertainty (%)	Emission Factor (EF) Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Base Year	Contribution to Variance by Category in Year 2020	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in Trend in Total Emissions due to AD (%)	Uncertainty in Trend in Total Emissions due to EF (%)	Uncertainty into the Trend in Total Emissions (%)	
1	2.E Electronics Industry & 2.F Product Uses and Substitutes for ODS	Aggregate F-gases	1.17	777.95	20.00	10.00	22.36	0.00	0.07	0.01	0.01	0.36	0.13	0.15	
2	2.G Other Product Manufacture and Use	Aggregate F-gases	33.42	6.38	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Total F-gases			34.59	784.34				0.000	0.072					0.146	
			Level uncertainty, F-gases						0.005	0.268	Trend uncertainty, I				0.382
TOTAL for all gases			61015.92	64958.54				167.819	147.945					108.279	
			Total level uncertainty for all GHGs						12.955	12.163	Total trend uncertainty for all GHGs				10.406



Rialtas na hÉireann
Government of Ireland

Ireland's 5th Biennial Report to the United Nations Framework on Climate Change

2023

Prepared by the Department of
The Environment, Climate and Communications
gov.ie

1. Introduction

As a party to the United Nations Framework Convention on Climate Change (UNFCCC), Ireland is required to report regularly on its implementation of the Convention via National Communications every four years. Ireland's most recent National Communication (NC7) was submitted in 2018 and included Ireland's Third Biennial Report (BR3) as an annex in accordance with UNFCCC guidelines.

In 2010 at the 16th Conference of the Parties (COP16) to the Convention in Cancun, Parties decided to enhance reporting progress in achieving emissions reductions and on the provision of financial, technology and capacity building support, through a biennial reporting process. COP16 also decided to develop a Common Tabular Format (CTF) for the electronic reporting of information. At COP17 in Durban, in Decision 2/CP.17, Parties adopted the guidelines for this enhanced reporting and the following year, COP18 in Doha adopted the CTF contained in FCCC/CP/8/Add.3 through Decision 19/CP.18.

This is Ireland's final and Fifth Biennial Report (BR5) under the UNFCCC and has been elaborated in accordance with the Decisions 2/CP.17 and 19/CP.18. The electronic information contained in the CTF is submitted separately.

COP17 also agreed the modalities and procedures for the International Assessment and Review of emissions and removals in a rigorous, robust and transparent manner with a view to promoting comparability and building confidence. The Review process consists of a Technical Expert Review of reported information and participation in a multilateral assessment process. This Biennial Report is informed by lessons learned from Ireland's second, third, and fourth biennial reports submitted in 2016, 2018 and 2020 respectively, their subsequent Technical Expert Reviews, resulting reports, and Multilateral Assessments.

2. Information on Greenhouse Gas Emissions and Trends

Ireland's GHG emission inventory represents the official annual report of all anthropogenic emissions and removals of greenhouse gases in Ireland. It measures Ireland's progress against obligations under the UNFCCC, the Kyoto Protocol, and the Climate and Energy obligations of the European Union.

Ireland's most recent information on GHG emissions as communicated to the UNFCCC is set out in Chapter 3 of Ireland's Eight National Communication. The National Communication also outlines the main components of Ireland's national system and a description of the structure and functions of Ireland's national registry. The information contained in the tables for Ireland's fifth Biennial Report summarises this information, accounting for Ireland's emissions by gas and by sector.

3. Quantified Economy-Wide Emissions Reduction Target

3.1 The EU target under the Convention

As a Member State of the European Union, Ireland has committed to a quantified economy-wide emission reduction target through the pledge submitted by the EU and its Member States to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20 per cent below the 1990 level by 2020 ('the Cancun pledge'). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the EU 2020 target together with the 27 EU Member States.

3.2. The EU target compliance architecture

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision (ESD). The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

As outlined in the Eight National Communication, Ireland has a smaller heavy industry sector than most EU Member State and lower energy intensity industries, including the food, chemical, pharmaceutical, and electronic sectors account for over 80% of Ireland's industry output.¹

¹ Chapter 2.8, Ireland's Eight National Communication.

4. Progress in Achievement of Quantified Economy-Wide Emissions

Reduction Target – Information on Mitigation Actions and their Effects

4.1 Introduction

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 and UK compared to the base year 1990 or 1.94 billion tons of CO₂e (carbon dioxide equivalent). The overall EU objective for the second commitment period of the Kyoto Protocol (2013-2020) was to reduce emissions by 20% compared to 1990 levels, by 2020.

Annual binding emission reduction targets for EU Member States for the period 2013 to 2020 are set out in the EU Effort Sharing Decision (ESD) No. 406/2009/EC.

The annual targets – based as CO₂eq units known as Annual Emission Allocations (AEAs) - follow a line between a defined starting point in 2013 and the target for 2020. These targets cover emissions from sectors outside of the EU Emissions Trading System, such as agriculture, transport, buildings and waste. Ireland's contribution to the overall EU target is for its non-EU Emissions Trading System emissions to be 20% below their value in 2005, by 2020.

Ireland's target is jointly the most demanding 2020 reduction target allocated to EU Member States, which is shared only with Denmark and Luxembourg.

The legislative framework of the ESD provides for a number of compliance options beyond direct emissions reductions, including using banked excess AEAs from earlier years, purchasing international carbon credits, and trading of surplus AEAs between Member States.

Ireland will achieve its obligations under the second commitment period of the Kyoto Protocol (2013 to 2020) by complying with the Annual Emission Allocations requirements set out in the Effort Sharing Decision. Under the second commitment period, Ireland was compliant from 2013 to 2018 from direct emissions reductions and the ability to carry forward allowances from overachieving in the earlier years (2013 to 2015). For 2019 Ireland used 5.29m ESD-eligible international credits towards compliance. For the final year covered by the ESD (2020), Ireland will meet its compliance obligations by the compliance deadline of 17 February 2023 by using both international carbon credits and AEAs from trading with Member States that have a surplus.

5. Summary of Key Variables and Assumptions Used in the Projections Analysis

Projections of Ireland's greenhouse gas emissions can be found in Chapter 5 of the National Communication.

The National Climate Change Strategy (2007) designated the Environmental Protection Agency (EPA) responsible for developing annual national emission projections for greenhouse gases (GHG) for all key sectors of the economy, in collaboration with relevant State and other bodies. Projections are compiled to inform national policy development and to meet EU reporting obligations (Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action).

Since Ireland's 7th National Communication, a number of changes have been made to the approach used to produce these emissions projections. These changes include both updates to reflect newer source data, and methodological changes made to improve the accuracy and repeatability of the results. In this report the starting point for that was the latest inventory available (1990-2020). The key methodological change is a new model for producing energy demand projections, a key input dataset that used to produce the final energy demand projections. This new model, called the "Ireland Environment, Energy and Economy" model (I3E) reproduces the structure of the economy in its entirety. The model is described in detail in Section 5.8. As before, the output from this model is adjusted to consider the projected impact of energy related policies and measures.

In relation to the input assumptions the latest projections for 2021-2040 (published by the EPA in June 2022) uses two scenarios: With Existing Measures (WEM) and With Additional Measures (WAM):

- The first scenario, WEM, forecasts Ireland's emissions including all national policies and measures implemented by the end of 2020. This is the cut off point for which the latest national greenhouse gas emission inventory data is available, known as the 'base year' for projections. Implemented measures in the National Development Plan (NDP) and Climate Action Plan 2019 are included in this scenario.
- The second scenario, WAM, has a higher level of ambition and includes government policies and measures to reduce emissions such as those in Ireland's Climate Action Plan 2021. This was published in November 2021 and the included measures have not yet moved into implementation phase. As implementation happens the measures will be migrated into the WEM scenario.

For the projections Ireland has not developed a 'without measures' scenario or estimated indirect GHG projections for carbon monoxide, nitrogen oxides, non-methane volatile organic compounds, and sulphur oxides. The preparation of a 'without measures' scenario and projections for indirect GHG projections for carbon monoxide, nitrogen oxides, non-methane volatile organic compounds, and sulphur oxides is being kept under consideration.

6. Information on Updated Greenhouse Gas Projections (With Measures, With Additional Measures)

Chapter 5 of Ireland's Eight National Communication gives a detailed outline of the process by which Ireland complies with its reporting requirements under EU and UN obligations. The EPA produces greenhouse gas emission projections on an annual basis for all sectors of the economy in collaboration with relevant State and other bodies. Ireland's most recent projections for 2020 to 2040, finalised in March 2022, indicate that total emissions by 2030 will decrease by 5.4% or 24.1% on 1990 levels under the With Existing Measures and With Additional Measures scenarios respectively. By 2040 these decreases will be 11.6% and 36.2% under each scenario respectively.

Further details in this regard are outlined in the previous section of the BR5 and in the aforementioned Chapter 5 of the Eight National Communication.

7. Provision of financial, technological and capacity-building support to developing country Parties

7.1 Provision of Public Financial Support

Ireland has a strong record of providing climate finance to developing countries, with significant progress achieved in the delivery of this climate finance in recent years. Ireland's International Climate Finance Roadmap, published in July 2022, articulates the Government's vision for achieving these targets. Ireland will maintain its focus on supporting adaptation and resilience to climate change in some of the most climate vulnerable countries around the world.

Ireland's public funding for climate action includes on-going support for mitigation and adaptation action in developing countries, mainly through bilateral assistance to Ireland's key partner countries in sub-Saharan Africa and through funding for Civil Society Organisations (CSOs). Ireland also provides contributions to multilateral funds established under the auspices of the UNFCCC, including the Least Developed Countries Fund, the Least Developed Countries Expert Group, the Global Environment Facility, the Adaptation Fund and the Green Climate Fund.

In 2019, the provided €96,397,553.05 in overall climate finance, in 2020 this figure was €88,341,095. The detail of these payments and a breakdown of multilateral, bilateral and other payments is provided in Chapter 7 of the Eight National Communication. Table 7 also provides a detailed breakdown of Ireland's multilateral and bilateral public financial support.

The level of detail in Ireland's multilateral climate finance reporting has been improved in recent years due to changes in EU-level reporting requirements. Specifically, both climate-specific and core-funding amounts are calculated for all payments where feasible, and closer attention has been paid to the use of unearmarked funding in terms of categorisation eg. cross-cutting, adaptation, mitigation.

7.2 Provision of Technology Development and Transfer Support

The effective development and transfer of environmentally sound technologies is critical in enabling developing countries to pursue their objectives for sustainable development in a climate-friendly manner. Technology in the context of the UNFCCC can include physical technologies, knowledge and techniques. Ireland's examples of support include activities which have a significant research component along with activities supporting new technologies.

As discussed in Section 7.3 of Chapter 7 of the Eight National Communication, Ireland does not have a long history of substantial investment in technology development, nor would it be regarded as a major climate technology developing nation when compared to many other countries. As such, large scale technology development or transfer is not usually a strong feature of Ireland's climate support. Notwithstanding this, Ireland supported a number of programmes in 2019 and 2020 that provided technology support to developing country partners.

Table 8 provides Ireland's most up-to-date examples of support for technology development and transfer.

7.3 Provision of Capacity Building Support

Table 9 of Ireland's Fifth Biennial Report provides up-to-date examples of capacity-building support since the submission of the Fourth Biennial Report. While the UNFCCC asks Parties to report on capacity-building support, there is an absence of an agreed methodology. The majority of Ireland's overseas support programmes are administered by Irish Aid and include some level of capacity building.

The examples included in Table 9 reflect a specific focus on training individuals and groups in engaging with climate change activities and on building institutional capacity.