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MALTA'S 5TH BIENNIAL REPORT

The Fifth Biennial report of Malta under the United Nations Framework Convention on Climate Change

MALTA'S FIFTH BIENNIAL REPORT

Report pursuant to Decision 2/CP.17 'Outcome of the work of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention'.

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INTRODUCTION

At the 16th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) held in Cancun, Mexico, in 2010, it was decided that "*Developed countries should submit* [...] *biennial reports on their progress in achieving emission reductions, including information on mitigation actions to achieve their quantified economy-wide emission targets and emission reductions achieved, projected emissions and the provision of financial, technology and capacity-building support to developing country Parties*"[1].

At the subsequent Conference of the Parties held in Durban, South Africa, in 2011, a decision was taken for Annex I Parties to submit these biennial reports prepared in accordance with guidelines established under Decision 2/CP.17[2]. Developed country Parties are required to submit their fifth biennial report by 1 January 2023.

This is the fifth biennial report of Malta. This written report is accompanied by data and information submitted electronically in Common Tabular Format (CTF) tables.

[1] Decision 1/CP.16 'The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention', FCCC/CP/2010/7/Add.1.
[2] Decision 2/CP.17 'Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention', FCCC/CP/2011/9/Add.1.

CHAPTER 1 NATIONAL CONTEXT

1.1 OVERVIEW OF RELEVANT GEOGRAPHIC, CLIMATIC, DEMOGRAPHIC AND ECONOMIC PARAMETERS OF MALTA.

1.1.1 Geographic context

Malta is an archipelago made up of three inhabited islands, namely Malta, Gozo and Comino, and several small uninhabited islands (Cominotto, Filfla, St Paul's Islands) and islets situated close to the coastline of the main islands.

The Maltese archipelago is situated in the middle of the Mediterranean Sea (Figure 1.1), approximately 90 kilometres to the south of Sicily, Italy, and 290 kilometres from the North African mainland. Towards the west, the Straits of Gibraltar are at a distance of almost 1,850 kilometres, while the Suez Canal is around 1,500 kilometres to the southeast.

The total combined area of the Maltese islands (Figure 1.1) is 316 square kilometres, with a total shoreline of 271 kilometres. Topographically, the coastline facing the African mainland, is dominated by cliffs, with the land sloping down to a low-lying shoreline on the northern coast. The northern areas of Malta, and Gozo, are marked by low hills, with plains predominant towards the southern parts of the island of Malta. There are no mountains and no rivers; seasonal water courses may appear after heavy rainfall.

Being a small island state presents specific policy issues when dealing with climate change.

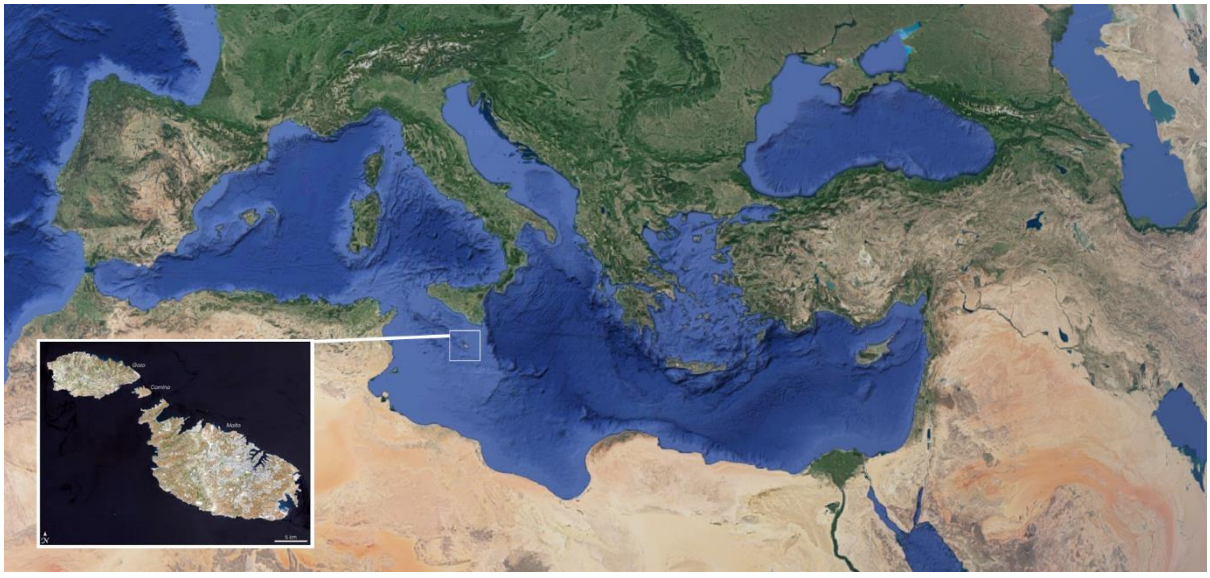


Figure 1.1 Map of the Mediterranean Sea and the Maltese islands showing the geographical location of Malta (adapted from Google Maps and NASA Earth Observatory).

Almost a third of the area of the country is urban, mainly of a residential nature, but also incorporating other developments such as the airport, ports, and industrial and commercial sites. Agricultural land accounts for approximately half of the land area with the rest being natural vegetated land. In the housing sector, there is a growing trend in favour of concentrating residential units in blocks of two units or more on the same site, shifting away from the more traditional terraced house construction practices earlier.

Forest coverage in Malta is very low, with the only remaining forest remnants occurring in localized pockets. The two main such areas are Buskett and Miżieb, both of which are the result of afforestation, Buskett going back as far as the presence of the Knights of St. John, and Miżieb at a much later stage. Maquis and garigue habitats are also present.

1.1.2 Natural Resources

Limestone is one of the few mineral resources that Malta can boast of, used principally by the local construction industry. It has been estimated that in 2006, 1.2% of Malta's total land area was taken up by the hard stone and soft-stone quarries where stone extraction takes place (NSO, 2011).

Water is a fundamental need; however, the sourcing of water is not an easy matter in a country where permanent above-ground water bodies do not exist and where rainfall is rather limited. Most of the naturally occurring freshwater is found in underground aquifers from where it can be extracted via pumping stations and boreholes. Until the late 1960's this was the only manner in which potable water for local consumption was produced. Following a period of a few years where distillation was utilised to a limited extent to complement groundwater extraction, the early 1980's saw the introduction of desalination of sea water (using Reverse Osmosis technology; in itself an energy intensive process, energy consumption estimated at 4.62 kWh/m^3 in 2011 (WSC, 2012)) which today accounts for more than half of the production of potable water in the country, through three desalination plants located along the coast of the island of Malta.

In recent years, total annual potable water production in Malta has been at just below 30 million m^3, a substantial decrease compared to the peak of more than 50 million m^3 seen in 1992-93. In the meantime, a number of groundwater extracting pumping stations and boreholes have had to be shut down due mainly to nitrate contamination or chloride intrusion, putting an even greater onus on desalination plants. The desalinised water is stored in 24 reservoirs around the Maltese Islands, which have a total capacity of 400,000 m^3. The water distribution system in Malta a network of over 2136 km of pipes, pumps, reservoirs and valves, that lead to approximately 142,000 water service connections to homes, business, industries, hotels, schools and so on (Water production - Water Services Corporation (wsc.com.mt). The households sector accounts for the bulk of the demand for water, accounting for almost 70% of total billed consumption.

In an attempt to achieve good groundwater status in all groundwater bodies in the Maltese islands by 2021, the 'New Water' programme was launched with the aim of producing a capacity of 7 million m^3 of high-quality water suitable for crop irrigation, thus potentially addressing up to 35% of the current total water demand of the agriculture sector (wsc.com.mt). New Water is created from treated waste-water which is filtered from bacteria, chemicals and any remaining pollutants.

The Maltese Islands being surrounded by sea, sea salt also deserves a mention in any discussion of local mineral resources. Sea salt continues to be produced using the age-old technique of evaporation of sea water in salt pans, of which a number may be found in coastal areas in various parts of Malta and Gozo.

1.1.3 Malta's Climate

The climate of the Maltese Islands can be described as typically Mediterranean, with hot, dry summers and relatively mild winters. The most common wind direction continues to be north-westerly (292.5° -337.5° , centred at 315°), followed by westerly (247.5° -292.5° , centred at 270°) and the easterly (67.5° -112.5° , centred at 90°)(NSO 2022) The National Statistics Office published a report *'The State of Climate 2022'* where is states that Malta's mean maximum ambient temperature has increased by 1.5°C since 1952, equivalent to a warming of 0.2°C per decade. This is due to an increase in the frequency of months that are much warmer than average. The report elaborates more in discussing the occurrence of dry years which as this is very likely to be due to a combination of long-term natural variability and changes in regional circulation caused by increased greenhouse gas levels in the atmosphere.

1.1.4 Population

By the end of 2020, the population of the Maltese Islands stood at 516,100 (NSO, 2022), which is more than double the population of a hundred years earlier (Figure 1.3). This produced a population density of around 1,633 persons per km^2, one of the highest country population densities in the world.

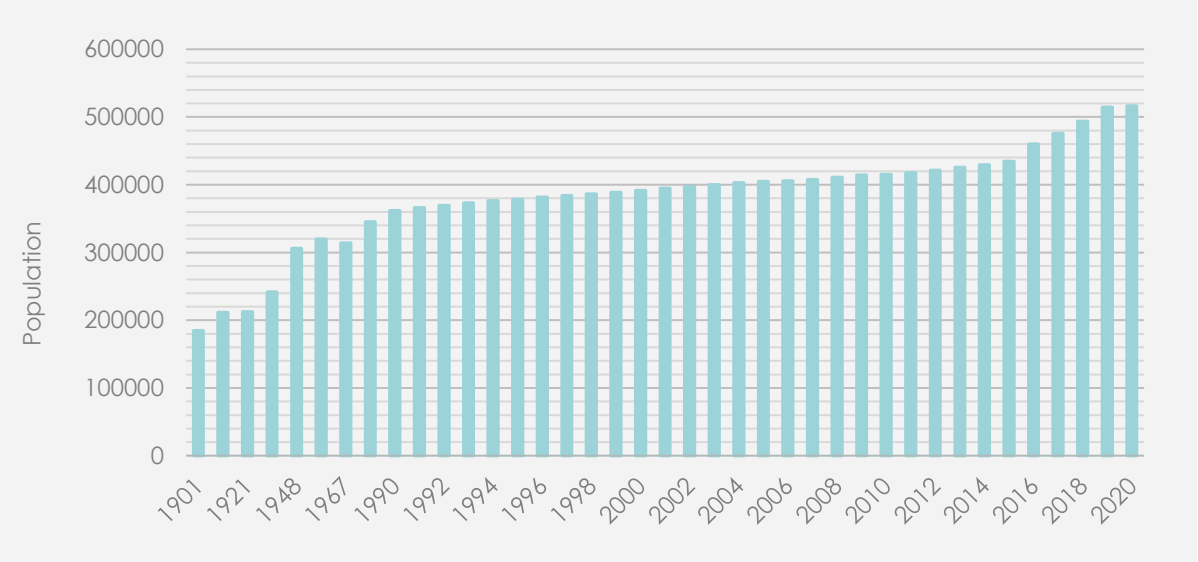


Figure 1.2 Population growth since 1901 (NSO, 2012; NSO, 2021; EUROSTAT, 2021)

Distribution of the population across the islands that make up the Maltese archipelago varies. The largest concentration of the population is found in the relatively low-lying area around the harbours flanking the capital city of Valletta. The Northern Harbour district (the area to the west of Valletta) and the Southern Harbour district (the area lying to the east and south-east of Valletta, also including the capital city) together form a population agglomeration that accounts for almost half of the total population of the country. At the other end of the scale, the islands of Gozo and Comino account for just 6.7% of the total population.

Population density differences between Malta and Gozo are highly contrasting, with the former having a density of 1,952 persons per km^2, and the latter having a density of 514 persons per km^2. This also correlates with the extent of built-up area on the two islands.

The population is projected to reach 588,691 by 2030 and increase further to 668,373 by 2050.

The age profile for the population of Malta shows that the population had been aging over time since 2005, with the number of 15-24 year olds decreasing and the number of over 55s increasing sharply. But it also shows that there has been an influx of younger people in the country in the past 5 years, meaning those in the 25-34 range in particular. Life expectancy at birth in 2020 was 80.3 for males and 84.5 for females (NSO,2021)

1.1.5 Economic Profile

Historically, agriculture was a very important economic activity in Malta, though one can also note an important element of services-oriented activity, not least due to the presence of established British forces on the islands until the late 1970's, which necessitated a number of ancillary services. The service sector now serves as the mainstay of the country's economy, with manufacturing also contributing.

Apart from traditional activities in tourism, education, health, retailing and banking, the services industry has in recent decades expanded towards some higher value-added activities. These incorporate the financial services sector, more specialised forms of tourism, such as that associated with language schools and diving centres, maritime and aviation activity, information technology and gaming. Large scale industrial establishments are few, with the largest, and the most relevant from a greenhouse gas emissions perspective, being the electricity generation plants. The manufacturing sector has largely developed into high value areas, such as microelectronics and pharmaceuticals

Malta's economy has strong trade ties with the European Union. The trend in Gross Domestic Product (GDP) since 1990 has been relatively consistent in showing continued growth, except for 2009, where the trend was negative, recuperating again in 2010.

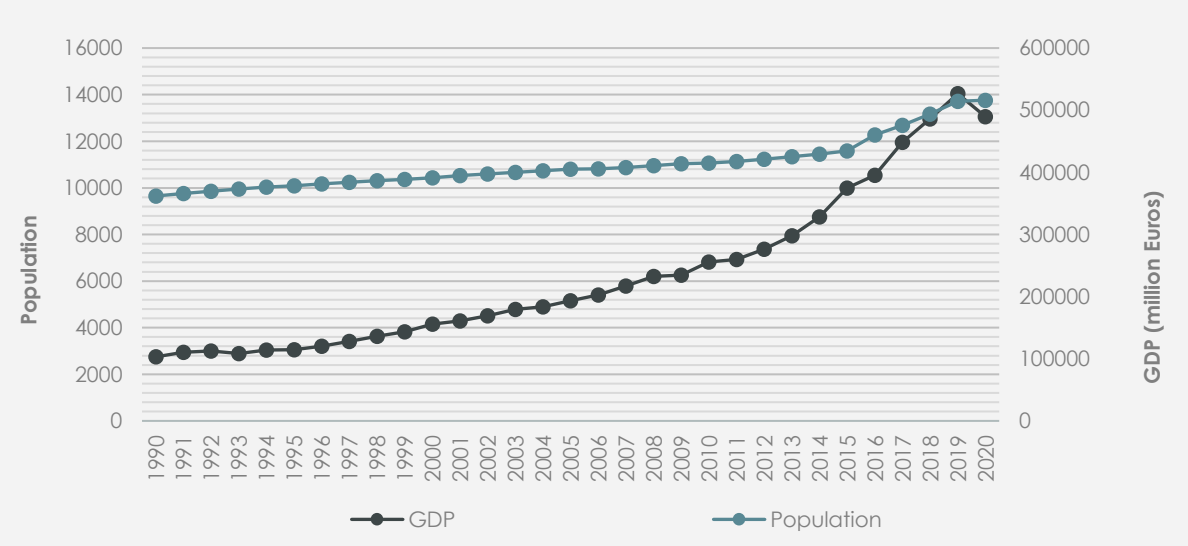


Figure 1.3 Population and GDP trends 1990 – 2020

(data adapted from EUROSTAT and the National Statistics Office websites, accessed October 2019).

Overall, Malta's GDP has grown from €2.749 billion in 1990 to €14.056 billion in 2019 (NSO, 2021). Per capita GDP, moreover, stood at around €27,316 in 2019 (NSO, 2021), with this indicator also showing a steady increase over time.

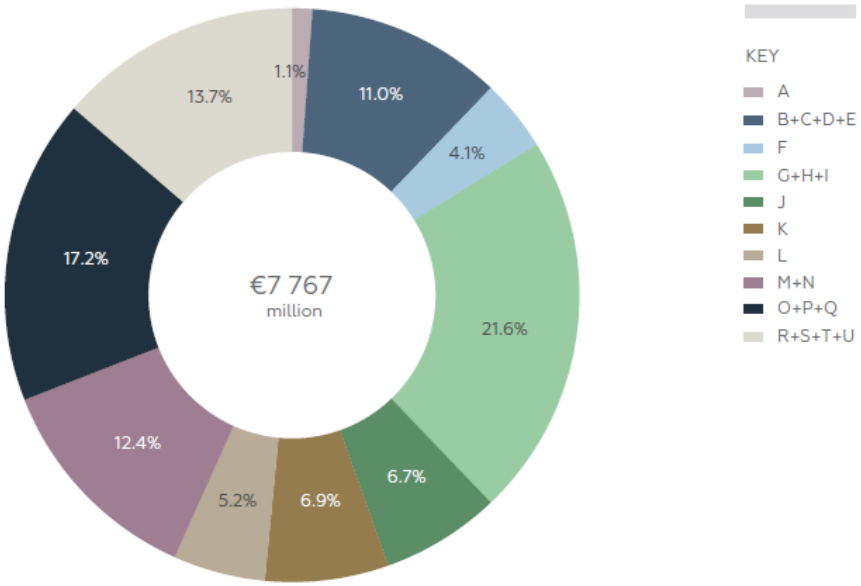


Figure 1.4 Percentage contribution of economic sectors (by NACE code[3]) to Gross Added Value for 2015 (NSO, 2021).

In 2019, Malta had a Gini Coefficient of 28.0 (EUROSTAT, 2021), making it the 15th most equal country in the world in terms of equivalised disposable income. Malta also has a high Human Development index of 0.895, 28th in the world, this being an indicator that takes into account health and education outcomes as well as per capita income. Energy intensity level of primary energy (MJ/$2011 PPP GDP) in Malta was reported at 1.37 MJ/USD in 2019, according to the World Bank collection of development indicators, compiled from officially recognized sources.

[3] NACE Codes:
A: Agriculture, forestry and fishing;
B-E: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities;
F: Construction;
G-I: Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities;
J: Information and communication;
K: Financial and insurance activities;
L: Real estate activities;
M-N: Professional, scientific and technical activities; administrative and support service activities;
O-Q: Public administration and defence; compulsory social security; education; human health and social work activities;

CHAPTER 2 INFORMATION ON GREENHOUSE GAS EMISSIONS AND TRENDS

2.1 INTRODUCTION

With emissions from anthropogenic sources being considered as a prime culprit in observed changes in climatic conditions, climate change mitigation policy will not effectively deliver on its goals unless a system is available to determine where we are with respect to emissions and removals, and to measure progress towards reaching emission limitation or reduction targets, in a quantified manner and on an ongoing basis - the national inventory is a crucial tool in this respect.

The national inventory of greenhouse gas emissions from sources and removals from sinks (hereafter also referred to as the "national GHG inventory") is elaborated in fulfilment of Malta's reporting obligations under the UNFCCC and Kyoto Protocol, as Annex I Party. The compilation of such an inventory also meets obligations arising from the country's membership in the European Union, principally Regulation (EU) No 525/2013[4], the so-called "Monitoring Mechanism".

This chapter describes the approach currently in place to prepare the national GHG inventory and gives a brief overview of emission trends for the period covering the years 1990 to 2015, including trends by gas and category. 1990 represents the default starting year for presentation of inventories of greenhouse gas emissions and removals. GHG emissions and removals data discussed here are based on the latest available national GHG inventory (MRA, 2017). More detailed information on Malta's GHG inventory, including in-depth discussions of methodological approaches to inventory compilation, may be found in the annual GHG inventory submissions of Malta to the UNFCCC. Summary tables of the CRF have been annexed in Section 7 Information on National inventory arrangements can be found under sections 2.2 and 2.8.

2.1.1 What is a national greenhouse gas inventory?

A national greenhouse gas inventory provides a detailed mathematical picture of emissions of greenhouse gases by sources and removals by sinks from anthropogenic activities taking place in a country.

Two types of greenhouse gases are reported in national greenhouse gas inventories. Direct greenhouse gases contribute directly to climate change due to their positive radiative forcing effect; that is, their presence in the atmosphere tends to lead to an increase in atmospheric temperature. Greenhouse gas inventories cover seven categories of such gases, namely:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);

[4] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism form monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/20014/EC.

- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6); and,
- Nitrogen trifluoride (NF_3).

The radiative forcing effect for each GHG species is usually denoted as the Global Warming Potential (GWP). For purposes of aggregation of estimated emissions or removals of different greenhouse gases into a single total, and to facilitate comparison between different gases, quantities of greenhouse gases emitted or removed are often also presented in terms of 'CO_2 equivalents', whereby a quantity of a particular gas is multiplied by the GWP of that gas. Thus, 1 tonne of CH_4 can also be represented as 25 tonnes of CO_2 equivalents (GWP of methane being 25); 1 tonne of N_2O can be represented as 298 tonnes CO_2 equivalents (GWP of nitrous oxide being 298), and so on.
Indirect greenhouse gases, also known as precursors, do not directly induce an increase in atmospheric temperature as such; however, their release into the atmosphere results in their chemical conversion into species that have an effect similar to the direct greenhouse gases mentioned above. The indirect greenhouse gases included in national greenhouse gas inventories are:

- Nitrogen oxides (NOx; reported as NO_2);
- Carbon monoxide (CO);
- Non-methane volatile organic compounds (NMVOCs); and,
- Sulphur dioxide (SO_2).

This latter group of gases, albeit subject to similar reporting requirements as for the direct greenhouse gases, are not however aggregated with the direct greenhouse gases and are usually discussed separately from the direct greenhouse gases.

Five main sectors of sources and sinks of greenhouse gases are covered by the national GHG inventory. Each sector is further disaggregated into categories for each of which separate estimations of emissions or removals are carried out in accordance with accepted methodologies and depending on their occurrence in the country. These sectors are:

- Energy (CRF sector 1);
- Industrial Processes and Other Product Use (IPPU; CRF sector 2);
- Agriculture (CRF sector 3);
- Land Use, Land-Use Change and Forestry (LULUCF; CRF sector 4); and,
- Waste (CRF sector 5).

Also, forming part of an inventory submission are estimates of emissions from additional categories known as 'Memo Items'. Emission estimates for these categories which include, *inter alia*, emissions from international maritime and aviation bunkering activities, are however not considered as part of 'national totals' of emissions and removals.

2.2 GREENHOUSE GAS INVENTORY PREPARATION IN MALTA

Any Annex I Party to the UNFCCC has an obligation to establish a National Greenhouse Gas Inventory System, defined by Decision 20/CP.7[5] as:

[5] Decision 20/CP.7 'Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol'; FCCC/CP/2001/13/Add.3.

> "*all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information*."

This obligation has also been transposed into EU law (Article 5 of Regulation (EU) No 525/2013).

Malta's accession to Annex I status, the ratification requirements of the Doha Amendments to the Kyoto Protocol and the obligations arising from EU law make it imperative that a fully functioning national inventory system that meets the legal requirements is established. As a result, the "National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removals by Sinks Regulations of 2015" establish a national system for greenhouse gas inventories[6]. The legal notice (LN 259/2015) forms part of a wider legislative framework being established specifically for climate action in Malta, with the main underpinning legal instrument being the Climate Action Act, 2015 (Chap. 543)[7].

The legal notice, among other aspects, formally identifies the Minister responsible for climate change as the Single National Entity (SNE) in accordance with the relevant UNFCCC requirements and provides for the formal designation of an inventory agency (IA). Under the same legal notice, the Malta Resources Authority has been designated, through Government Notice No. 1036 of 27th October 2015, as the Inventory Agency. The legal notice gives the Single National Entity overall responsibility for the national inventory system and the mandate to ensure that the national system operates in accordance with relevant decisions of the UNFCCC bodies and with relevant EU legislation. The Inventory Agency is set specific functions relating to inventory preparation and management. The legal notice also establishes rules for the relationship between the Single National Entity and the Inventory Agency on one hand, and data providers on the other. The Minister responsible for climate change is also required to lay before Parliament the annual greenhouse gas inventory.

By virtue of its designation as national Inventory Agency, MRA is responsible for the planning, preparation and management of the national GHG inventory. The Climate Change Unit within MRA performs duties related to the inventory, including: the preparation of the annual greenhouse gas inventory submission of Malta, performing most of the functions involved, starting from the gathering of data from the relevant data providers, to estimating sectoral emissions or removals of greenhouse gases; drafting of this report and the inputting of data into the Common Reporting Format (CRF) Reporter software; and, final submission to the European Commission, the European Environment Agency and the UNFCCC Secretariat. As necessary, the Unit also engages outside contributors to assist in the preparation of submissions.

With the legislative formalisation of the national institutional arrangements via LN 259/2015, the next important step for the national system was the elaboration of documented quality assurance and quality control procedures. Significant progress has been achieved in this respect during the course of 2017, as MRA adopted a quality plan for its inventory processes. The plan builds on the ISO 9001:2015 'Quality Management Systems –

[6] Legal Notice 259 of 2015, National System For The Estimation Of Anthropogenic Greenhouse Gas Emissions By Sources And Removals By Sinks Regulations, 2015; Subsidiary Legislation 543.01.

[7] Climate Action Act, 2015, Chapter 543; 7th July 2015.

Requirements' approach. All business processes required for the compilation of national GHG inventories by MRA have been established, mapped and documented as part of MRA's inventory Quality Management System. The documented quality management system includes an 'Operations & Quality Manual', which defines the overarching quality policy of MRA, sets out a number of quality objectives for the ongoing monitoring and evaluation of performance, and presents high-level responsibilities of all roles within MRA involved in the annual compilation of the national greenhouse gas inventory. A number of Quality System Procedures provide detailed instructions addressing such matters as document control, treatment of non-conformities and competency management. Quality Operational Procedures then cover the entire inventory preparation and management cycle starting with the internal organization of work to dealing with EU and UNFCCC reviews of Malta's inventory submissions. Procedures are accompanied by forms and other controlled documents that ensure good record-keeping on actions taken.

2.3 NATIONAL INVENTORY ARRANGEMENTS

Any Annex I Party to the UNFCCC has an obligation to establish a National Greenhouse Gas Inventory System, defined by decision 19/CMP.1 'Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol' as:

> "*all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information*."

The legal requirements for Malta's national inventory system are established through the 'National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removal by Sinks Regulations, 2015'[8].

This legal notice formally identifies the Minister responsible for climate change (via the Ministry for Environment, Energy and Enterprise) as the Single National Entity (SNE) with overall responsibility for the national inventory system and a mandate to ensure that the national system operates in accordance with relevant decisions of the UNFCCC bodies and with applicable European Union legislation. Official approval of greenhouse gas inventory submission is issued by the SNE.

The same legal notice provides also for the designation of an Inventory Agency, with specific responsibility for the preparation of annual inventories. The Malta Resources Authority (MRA) is at present the body designated as inventory agency.

The legal notice also established rules for the relationship between the Single National Entity and the Inventory Agency on one hand, and data providers on the other.

As the national Inventory Agency, the MRA is responsible for planning, preparation and management of the national GHG inventory. Sector inventory compilers within the Climate Change Unit of the MRA carry out the various stages of the inventory cycle, starting from gathering of data from relevant data providers, to estimating emissions or removals of greenhouse gases, inputting of data, and generation of, Common Reporting Formal (CRF) tables, compilation of the National Inventory Report (NIR), and final

[8] Legal Notice 259 of 2015 (Subsidiary Legislation 543.01), National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removal by Sinks Regulations, 2015; http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12393&l=1.

submission to the UNFCCC Secretariat, in accordance with respective EU and UNFCCC requirements.

Data collection involves liaising with various data providers, including public entities, such as the National Statistics Office, Ministries, and government departments, authorities and agencies, and, in a number of, instances private establishments, according to the nature of the data associated with specific activity category calculation methodologies.

An important development within the context of the national inventory system is the recent adoption, by the MRA, of a documented quality management system (QMS), based on the ISO 9001:2015 'Quality Management Systems – Requirements' approach. All business processes required for the preparation and submission of national GHG inventories by the MRA have been established, mapped and documented as part of this QMS. ISO certification of this QMS was obtained in 2018.

Furthermore, national greenhouse gas inventories are subject to two important peer review processes: the first being the annual review under the EU Monitoring Mechanism[9], focussing particularly on those emissions subject to the Effort-sharing Decision of the EU[10]; the second being the review under UNFCCC rules, which takes place almost annually and which covers all aspects of the inventory process and the entire scope of the inventory.

A more detailed discussion of the national inventory system, the planning, preparation and management of national inventories, additional information on institutional, legal and procedural arrangements in Malta for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks, and further description of the MRA's QMS, may be found in chapter 1 of the national inventory report submitted as part of annual inventory submissions. Sector specific chapters of the NIR provide detailed information on methodologies for the estimation of emissions and removals for activity categories and sub-categories, sourcing of data, and quality assurance and control activities undertaken in the compilation of national inventories.

RELEVANT CONTACT DETAILS

Single National Entity:

Office of the Permanent Secretary - Ministry for Environment, Energy and Enterprise,

Postal Address: 6, Triq Ħal Qormi, Santa Venera SVR 1301, Malta

Website: https://msdec.gov.mt

Inventory Agency:

Malta Resources Authority,

Postal Address: Millennia Building, Aldo Moro Road, Marsa, MRS 9065, Malta

Website: www.mra.org.mt

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

[10] Refer to chapter 3 of this report for more details on the Effort-sharing Decision of the European Union.

2.4 General Trends in Greenhouse Gas Emissions and Removals

This section gives an overview of general trends in total greenhouse gas emissions for Malta, trends of emissions by gas and by sector, and a discussion of the correlation between national emissions and basic national indicators, namely population and Gross Domestic Product.

2.4.1 Overview of emission trends

National emissions of greenhouse gases for select years over the period 1990 to 2020 ("with" and "without" LULUCF) are presented in Table 2.1 It is pertinent to note that the main focus of the discussion in this chapter is on national emissions, and emissions from 'memo items' are included only where this is specifically indicated in the text or captions.

The change in total emissions between the base year (1990) and the latest reported year (2020) for the without-LULUCF estimates show a decrease of 18.38%, while for the with-LULUCF estimates this represents a decrease of 18.21%.

The general trend for the combined emissions (in CO_2 equivalent) shows a persistent general increase up until 2012 with a reversal of the trend over the subsequent period of years. With the sector Energy being a dominant contributor to overall GHG emissions in Malta compared to other sectors, it is thus expected that trends for that sector will greatly influence the overall trend. This trend can be more easily observed in Figure 2.1.

Table 2.1 Total emissions with/without LULUCF for the period 1990 to 2015 (Gg CO2 equivalent).

	Total (with LULUCF)	Total (without LULUCF)	Difference from base year (with LULUCF)	Difference from base year (without LULUCF)
	Gg CO2 eq.	Gg CO2 eq.	%	%
1990	2591.13	2599.28		
1991	2443.82	2452.20	-5.69%	-5.66%
1992	2512.05	2517.18	-3.05%	-3.16%
1993	3100.29	3105.26	19.65%	19.47%
1994	2881.92	2886.55	11.22%	11.05%
1995	2678.31	2682.41	3.36%	3.20%
1996	2797.32	2801.45	7.96%	7.78%
1997	2811.58	2815.94	8.51%	8.34%
1998	2774.32	2778.45	7.07%	6.89%
1999	2858.84	2863.79	10.33%	10.18%
2000	2784.67	2789.72	7.47%	7.33%
2001	2933.73	2936.20	13.22%	12.96%
2002	3007.30	2986.06	16.06%	14.88%
2003	3286.72	3265.49	26.85%	25.63%
2004	3143.53	3143.89	21.32%	20.95%
2005	2979.97	2980.54	15.01%	14.67%
2006	3039.45	3041.21	17.30%	17.00%
2007	3132.00	3133.52	20.87%	20.55%

2008	3083.79	3071.84	19.01%	18.18%
2009	2899.25	2887.88	11.89%	11.10%
2010	2956.11	2944.94	14.09%	13.30%
2011	2947.95	2949.96	13.77%	13.49%
2012	3130.58	3132.39	20.82%	20.51%
2013	2793.52	2795.16	7.81%	7.54%
2014	2796.46	2800.66	7.92%	7.75%
2015	2118.58	2122.41	-18.24%	-18.35%
2016	1831.96	1835.78	-29.30%	-29.37%
2017	2016.17	2018.05	-22.19%	-22.36%
2018	2028.88	2030.02	-21.70%	-21.90%
2019	2130.39	2131.76	-17.78%	-17.99%
2020	2119.41	2121.59	-18.21%	-18.38%

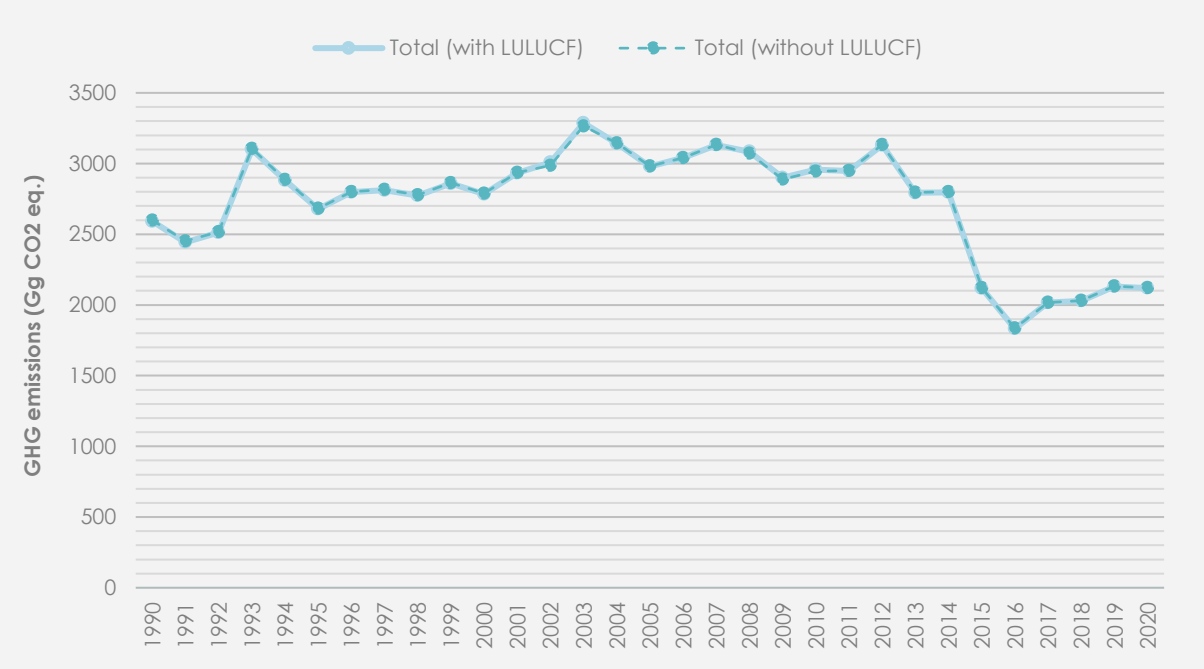


Figure 2.1 Total Emissions of greenhouse gases, with and without LULUCF, for 1990 – 2020. Note: The difference between these categories is very small and is not clear in the graph.

The year-on-year increases (or decreases) in the overall emissions (with-LULUCF) are illustrated in Figure 2.2. It reflects the overall trend in total emissions as shown in Figure 2.1, for the years up to and including 2020. As can be seen, most of the year-on-year changes are positive (i.e. year-on-year increases). One may note that despite the large variation in the level of individual year-on-year changes, the general trend is that the year-on-year increases observed in the later years are lower than for earlier years. Indeed, the occurrence of year-on-year decreases in emissions also tends to become more frequent with time.

Substantial decreases in year-on-year emissions can be observed for the years 2014-2015 (-24.24%) and 2015-2016 (-13.53%) to the extent that they are also significantly larger than any year-on-year change observed in previous years. The highest increase in year-on-year emissions can be observed for the years 1992-1993 (23.42%).

Figure 2.2 Annual percentage increase or decrease in total greenhouse gas emissions (based on total emissions including LULUCF).

2.4.2 Emission trends and population growth

A comparison of emissions with the demographic development of a country can serve as a useful indicator of the progress in emissions control over a set period.

Malta's population has seen a sustained growth over the period covered in this discussion, and a concomitant increasing per capita trend in emissions was observed until 2012. However, a marked drop in this trend can be observed for the years 2013 onwards, as shown in Figure 2.3. This reduction has been reflected in per capita emissions, whereby 2016 has seen the lowest per capita emissions since the base year (1990).

In 1990, the per capita emissions stood at 7.16 tCO2eq. During the period 1990 – 2012, per capita emissions fluctuated between a maximum of 8.31 tCO2eq. (1993) and a minimum of 6.68 tCO2eq. (1991). However, this trend was reversed in 2013, where emissions started decreasing from 6.51 tCO2eq. (in 2013), while population started rapidly increasing. Per capita emissions plummeted to 3.98 tCO2eq. in 2015, where they remained relatively constant until 2020 (4.11 tCO2eq.). The level of per capita emissions in 2016 is the lowest since 1990 and stood at 3.98 tCO2eq. per capita.

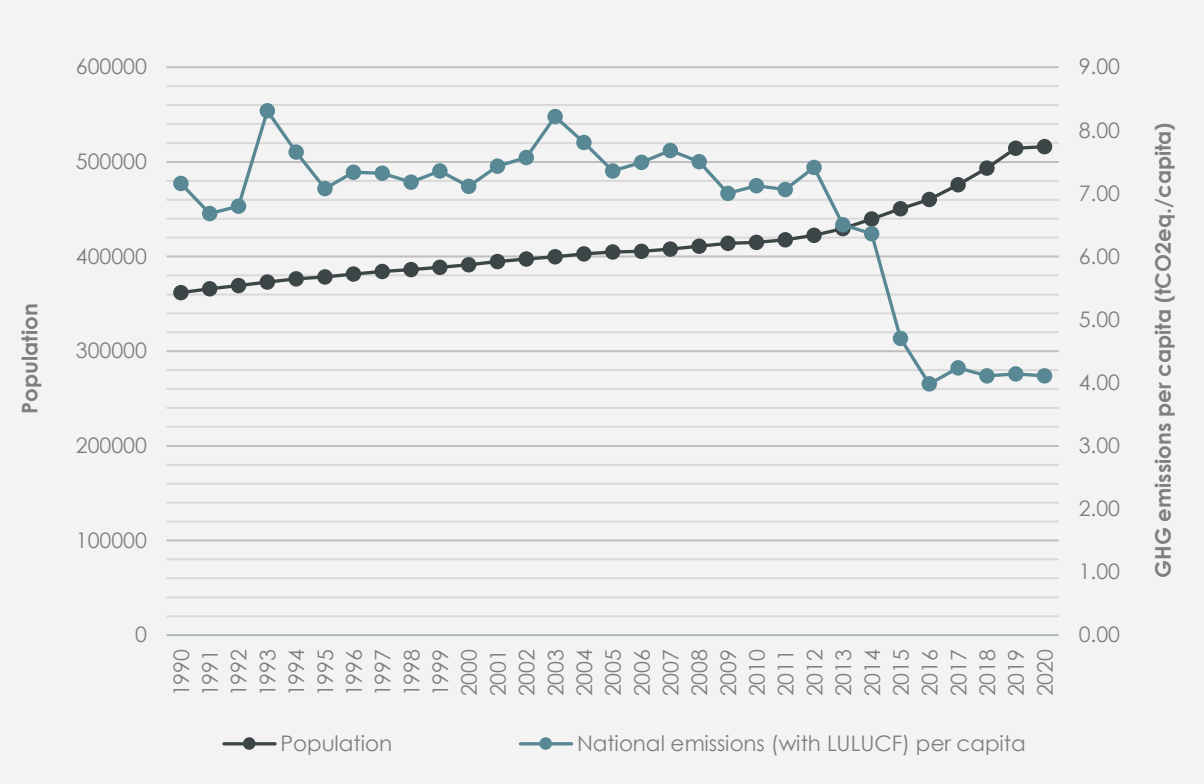


Figure 2.3 GHG emissions per capita [Source of population data: Eurostat].

This decoupling between GHG emissions and population in the later years implies that population statistics alone cannot directly explain the changes in GHG emissions over the whole period under consideration. However, it could be that greater demand for major emitting activities in Malta, particularly energy generation and mobility (road transport), as population grew, could have contributed to increasing emissions at least until 2012, as these activities have been the major contributors to overall national total emissions in absolute terms. But it is true to say that, up to this point, a fast-increasing population has not precluded emissions reductions.

2.4.3 Emission trends and economic development

Another important indicator compares the trend in emissions of greenhouse gases and the economic activity of the country, the latter being represented in terms of Gross Domestic Product (GDP).

The relationship between these two parameters, or the 'emissions intensity' of Malta's economy, indicates that the emissions intensity has seen a generally consistent downward trend, as seen in Table 2.2 GHG emissions per unit of GDP (tCO2 eq./GDP) at 5-year intervals (with/without LULUCF).

	1990	1995	2000	2005	2010	2015	2020
Emissions/GDP (with LULUCF)	942.42	875.36	670.46	577.60	433.71	211.93	162.28
Emissions/GDP (without LULUCF)	945.39	876.70	671.68	577.71	432.08	212.31	162.45

. The continued improvement in the emission intensity trend of the Maltese economy may be due to a combination of reasons, including increased efficiency, from an emissions perspective, of the activities covered by the inventory, as well as a push to a more service-based economy, which is associated with less emissions to output.

Table 2.2 GHG emissions per unit of GDP (tCO2 eq./GDP) at 5-year intervals (with/without LULUCF).

	1990	1995	2000	2005	2010	2015	2020
Emissions/GDP (with LULUCF)	942.42	875.36	670.46	577.60	433.71	211.93	162.28
Emissions/GDP (without LULUCF)	945.39	876.70	671.68	577.71	432.08	212.31	162.45

Figure 2.4 Trend in emissions per GDP compared to GDP trend

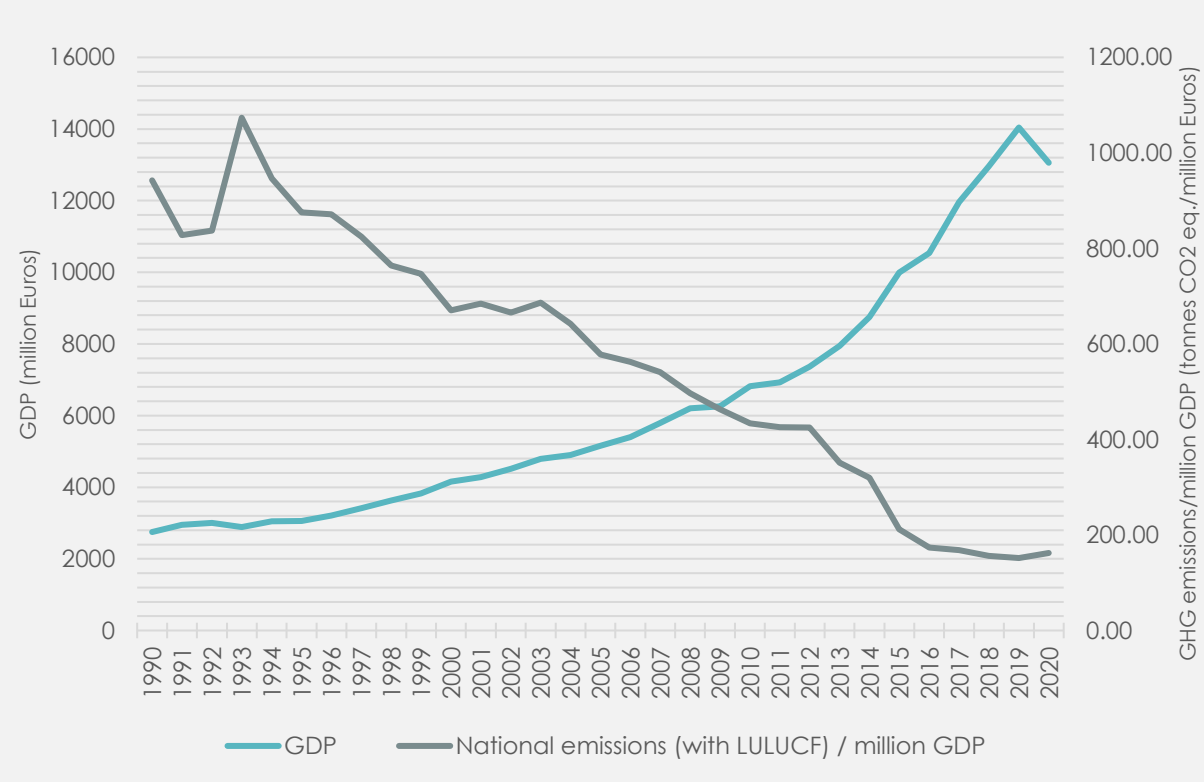


Figure 2.4 shows how GHG emissions per unit million GDP changes over the 1990-2020 time-series. The figure below also gives the trend for GDP. Overall, apart from the years 1990 to 1995, the trend is a continuous decrease in the emissions intensity of Malta's economy. Between 1990 and 2020, Malta's GDP saw an overall increase of 375%, while GHG emissions per unit million GDP in 2020 were 82.8% lower than in 1990.

While overall GDP has been decoupled from total emissions, some industries still show a correlation with GDP, whose emissions have continued to grow in line with GDP over time. This is mainly seen in the transport and IPPU sectors, and with international bunkers, (which includes international maritime and aviation emissions). Figure 2.5 shows this correlation; GDP and emissions were scaled, relative to their own average, to obtain a clearer comparison of the two. The decoupling achieved has been managed through policy

intervention, and this will need to continue in earnest to maintain an emissions-decoupled economy in future.

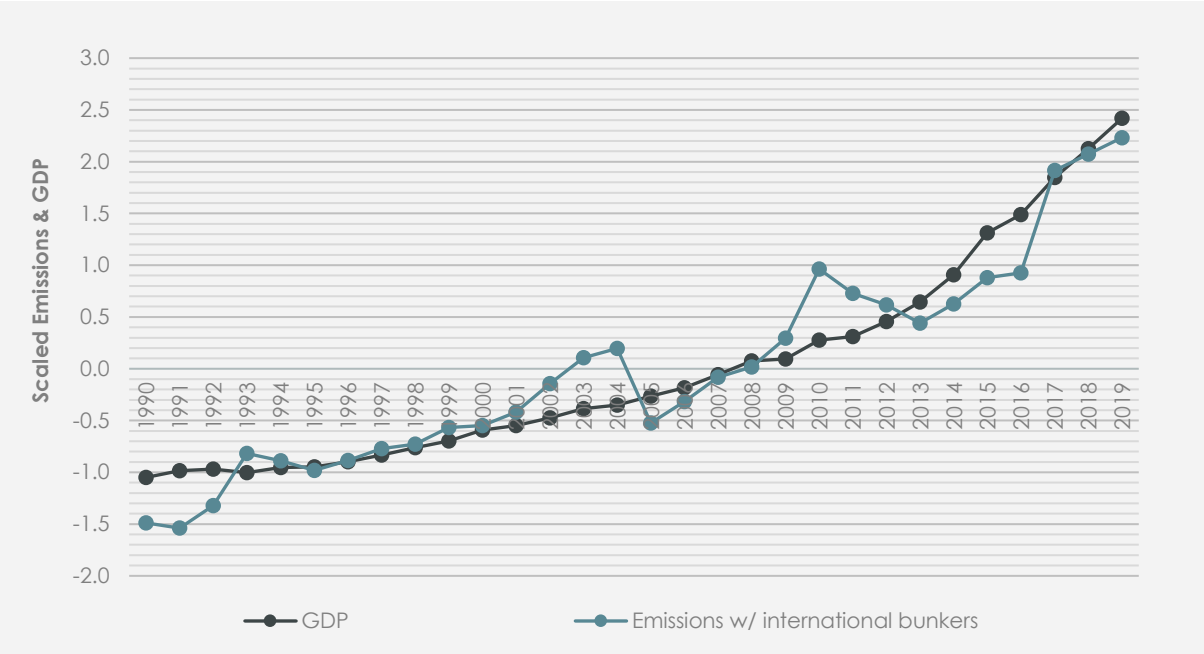


Figure 2.5 GDP vs national emissions without international bunkers (standardised) from 1990-2019 [Source of GDP data: Eurostat].

2.5 TRENDS IN GREENHOUSE GAS EMISSIONS BY GAS

This section will discuss emission trends for each gas covered by the national GHG inventory.

2.5.1 Overview of emission trends by gas

Emission trends for each greenhouse gas covered by this inventory are presented in Table 2.3 below. Table 2.4 provides an overview of the changes in emissions between the latest year covered by this inventory and the base year 1990.

Table 2.4 makes very obvious the major contribution that carbon dioxide has in total national emissions. The status of this greenhouse gas as the highest contributor has been maintained throughout the years. This can also be observed in Figure 2.6 and Figure 2.7. The relative contribution of CO_2 emissions to total national emissions represents the strong influence that this gas has on the national emissions trends, to the extent that the trend for national emissions runs almost parallel to the trend for CO_2 emissions. One does however note that with time, the relative contribution of CO_2 has tended to decrease somewhat, especially in more recent years, due to the trend of CO2 emissions *per se* in conjunction with changes in relative contributions of other emitted gases, primarily the substantial increase in the share of emissions of HFCs.

Table 2.3 Greenhouse gas emission trends by gas for 1990-2020 (Gg CO_2 equivalent).

	1990	1995	2000	2005	2010	2015	2020
CO2	2385.86	2435.10	2502.02	2643.89	2600.14	1661.32	1597.28

CO2 (without LULUCF)	2394.19	2439.42	2507.26	2644.67	2589.13	1665.29	1599.58
CH4	125.21	157.25	190.46	219.56	147.76	171.09	193.81
CH4 (without LULUCF)	125.19	157.23	190.44	219.54	147.76	171.09	193.81
N2O	80.04	84.52	84.01	76.60	65.36	55.64	55.58
N2O (without LULUCF)	79.89	84.32	83.85	76.40	65.20	55.51	55.47
HFC	0.00	0.00	6.70	38.36	141.07	230.25	272.34
PFC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SF6	0.01	1.44	1.47	1.56	1.79	0.28	0.40
National (with LULUCF)	2591.13	2678.31	2784.67	2979.97	2956.11	2118.58	2119.41
National (without LULUCF)	2599.28	2682.41	2789.72	2980.54	2944.94	2122.41	2121.59

[NA – Not Applicable (emissions of that gas cannot occur from a specific activity); NE – Not Estimated; NO – Not Occurring (the activity does not occur in Malta); IE – Included Elsewhere (emissions from an activity are included with those for another activity)]

Table 2.4 Emissions of greenhouse gases by gas for the years 1990 and 2020 (Gg CO_2 equivalent).

	1990			2020			% Change in emissions (1990-2020)
	Emissions	% Share (without-LULUCF)	% Share (with-LULUCF)	Emissions	% Share (without-LULUCF)	% Share (with-LULUCF)	
CO2	2,385.86	-	92%	1597.28	-	75%	-33%
CO2 (without LULUCF)	2,394.19	92%	-	1599.58	75%	-	-33%
CH4	125.21	-	5%	193.81	-	9%	55%
CH4 (without LULUCF)	125.19	5%	-	193.81	9%	-	55%
N2O	80.04	-	3%	55.58	-	3%	-31%
N2O (without LULUCF)	79.89	3%	-	55.47	3%	-	-31%
HFC	0.00	0%	0%	272.34	13%	13%	
PFC	0.00	0%	0%	0.00	0%	0%	
SF6	0.01	0%	0%	0.40	0%	0%	3684%
National (with LULUCF)	2,591.13		100%	2119.41		100%	-18%
National (without LULUCF)	2,599.28	100%		2121.59	100%		-18%

[NA – Not Applicable (emissions of that gas cannot occur from a specific activity); NE – Not Estimated; NO – Not Occurring (the activity does not occur in Malta); IE – Included Elsewhere (emissions from an activity are included with those for another activity)]

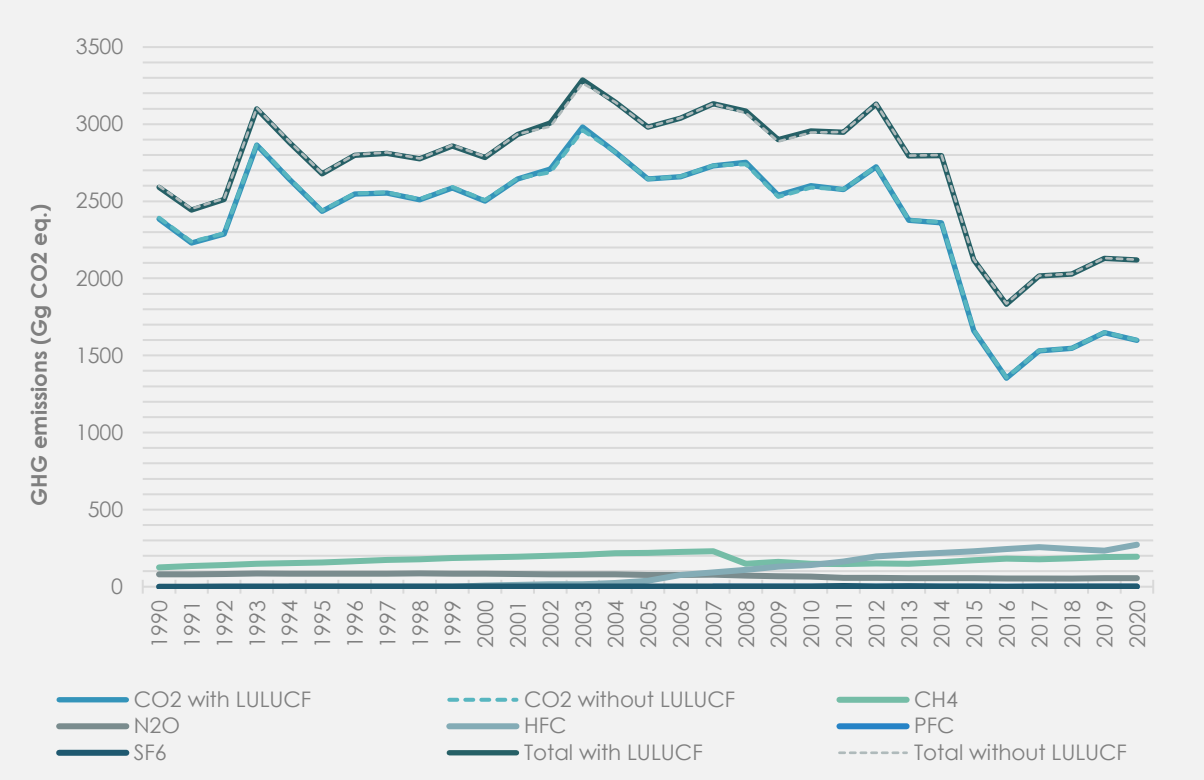


Figure 2.6 Emissions of greenhouse gases by type of gas, including LULUCF, for 1990 – 2020.

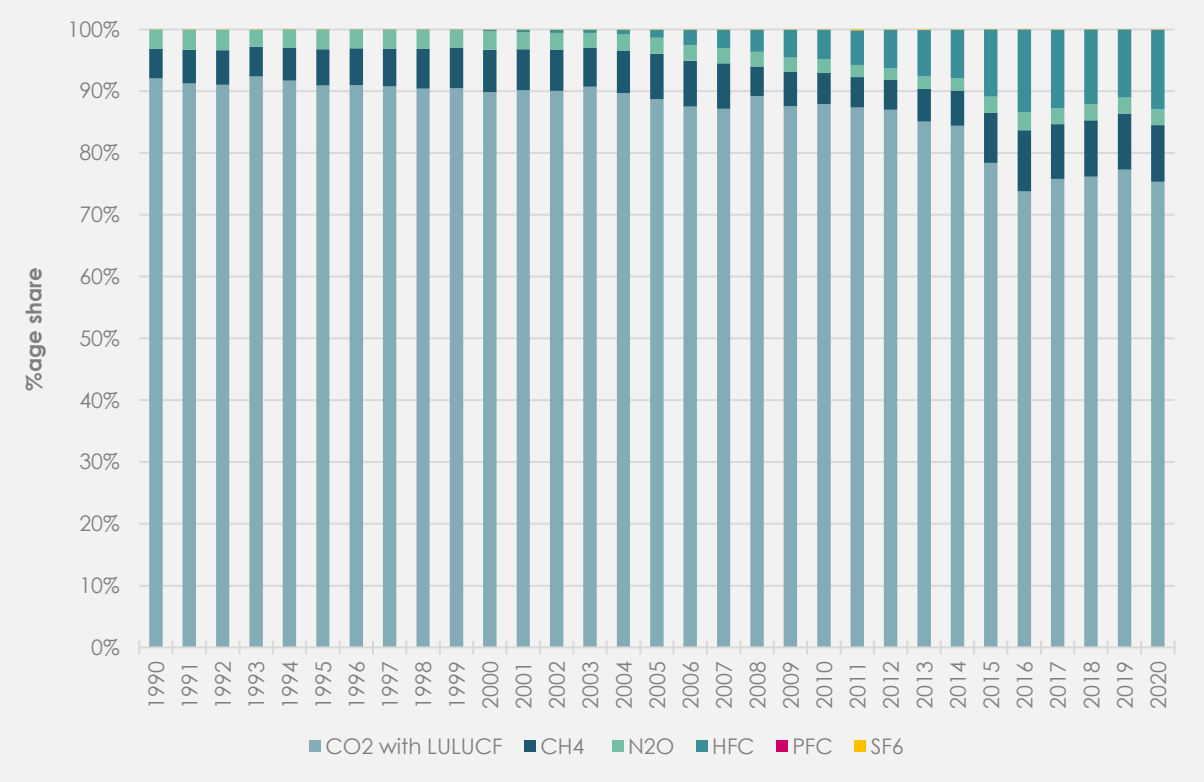


Figure 2.7 Percentage contribution of each greenhouse gas to total national greenhouse gas emissions (with-LULUCF).

2.5.2 Carbon dioxide

The overall profile of carbon dioxide emissions by sources and removals by sinks is presented in Figure 2.8. It is obvious that emissions far outweigh removals – indeed, removals of carbon dioxide by the LULUCF sector only offset a very minimal amount of emissions of this gas.

Sectorally, the principal contributor to carbon dioxide emissions is the Energy sector (CRF sector 1). Carbon dioxide emissions from this sector account for 99.6% of total gross national carbon dioxide emissions. Within this sector, the source category Energy Industries (1A1) represents the highest overall contribution of carbon dioxide emissions, followed by source category Transport (1A3). Trends are greatly dependent on the relative strength of emitting sources and removal sinks: it is not surprising therefore that the category Energy Industries influences the trend of CO_2 emissions to the highest extent.

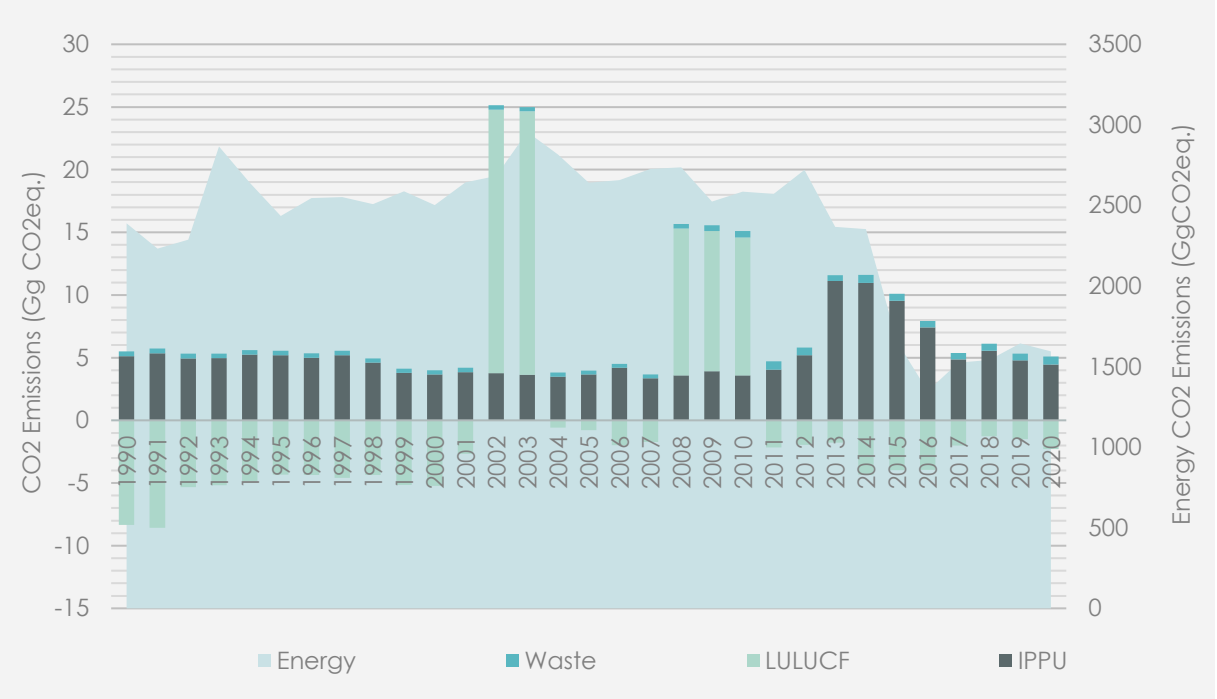


Figure 2.8 Trends in emissions by sources and removals by sinks for carbon dioxide.

(CO2 emissions from Waste, LULUCF and IPPU are shown on the primary y-axis, while CO2 emissions from Energy are shown on the secondary y-axis).

2.5.3 Methane

For most of the period under consideration, methane had the second highest share of national total emissions (in terms of CO_2 equivalent). This situation has however changed since 2012, with methane being replaced by HFCs as the class of greenhouse gases with the second highest share of overall national emissions (see Figure 2.7).

Figure 2.9 shows the general trend up to 2007 reflected an increase in emissions of methane; this however has changed in subsequent years. This change is due to the reduction in emissions of this greenhouse gas from the sector Waste (CRF sector 5), as a

result of increased flaring of methane in local managed landfilling activities - category Managed Waste Disposal on Land (5A1).

Agriculture is another important emitter of methane through emissions from source categories Enteric Fermentation (4A) and Manure Management (4B). Estimated absolute emissions of methane from this sector peaked in 2000, with estimated emissions in 2015 being the lowest recorded since 1990.

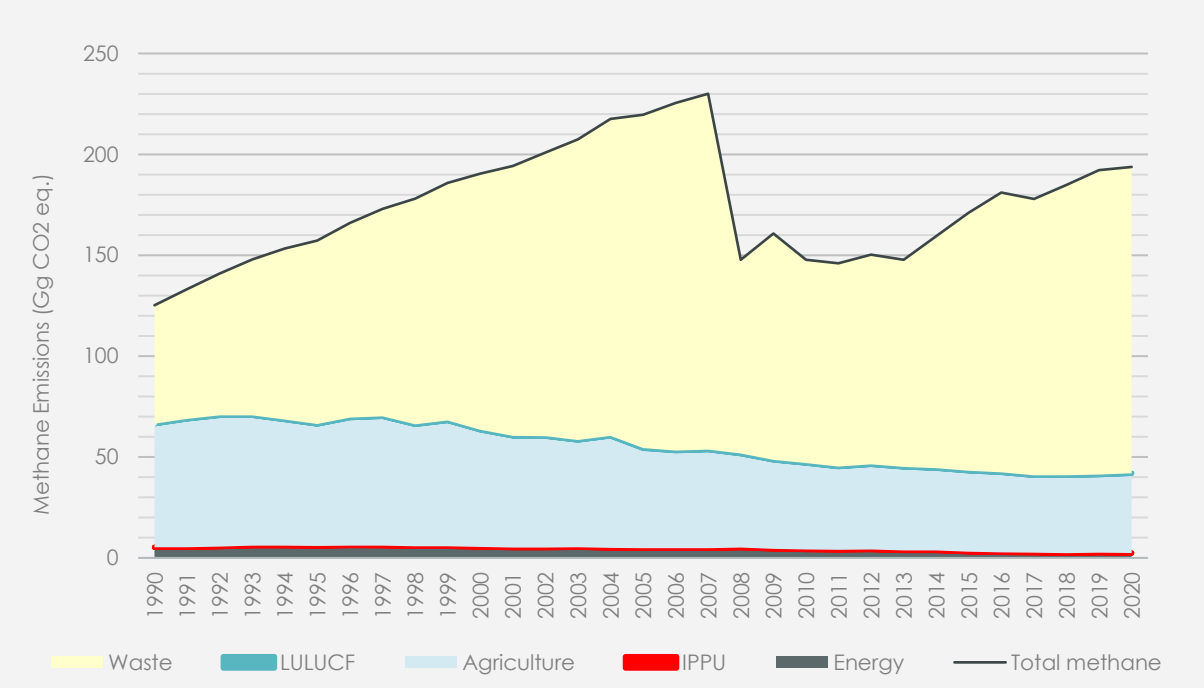


Figure 2.9 Trend in total and sectoral emissions of methane.

2.5.4 Nitrous oxide

Until 2005, nitrous oxide was the gas with the third highest share of total national emissions (in terms of CO_2 equivalent); its share has fallen down in the overall classification over time (Figure 2.7).

Figure 2.10 presents the general trend of nitrous oxide emissions (in Gg N_2O). Estimated emissions peaked in 1994. Sectorally, the highest contributor is sector Agriculture (CRF sector 3), with emissions of this greenhouse gas mainly from source category Agricultural Soils (3D), and, to a lesser extent, source category Manure Management (3B). Further contributions to national total nitrous oxide emission are given by sectors Waste (CRF sector 5), Energy (CRF sector 1) and Industrial Processes and Other Product Use (CRF sector 2).

2.5.5 Fluorinated greenhouse gases

Whereas for a large part of the period covered by this report, fluorinated greenhouse gas emissions had a minimal share in total national emissions, their contribution increased significantly in more recent years, to the extent that the combined share of such gases (in terms of CO_2 equivalent) in total national emissions in 2011 was second highest behind carbon dioxide. The main driving force behind this change is the substantial increase

observed for hydrofluorocarbons (see Figure 2.11) with the utilisation of such gases as replacements for ozone depleting substances and increased volumes used in refrigeration and air-conditioning equipment. The high global warming potentials of fluorinated gases further bolster their overall share in total emissions.

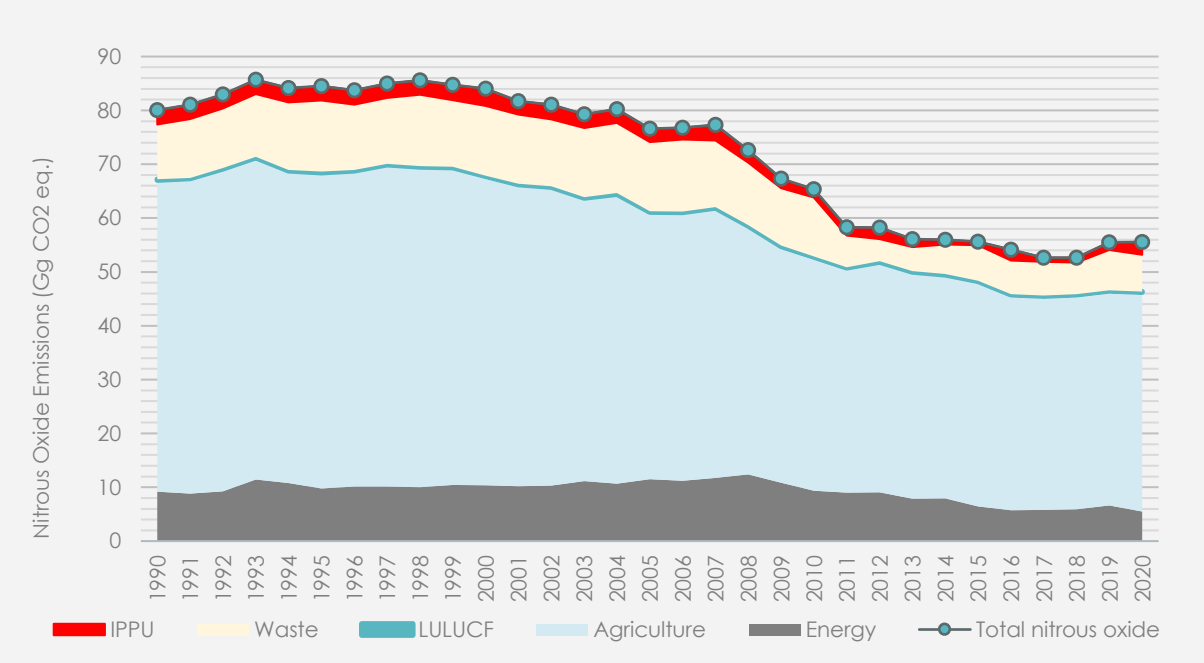


Figure 2.10 Trends in total and sectoral emissions of nitrous oxide.

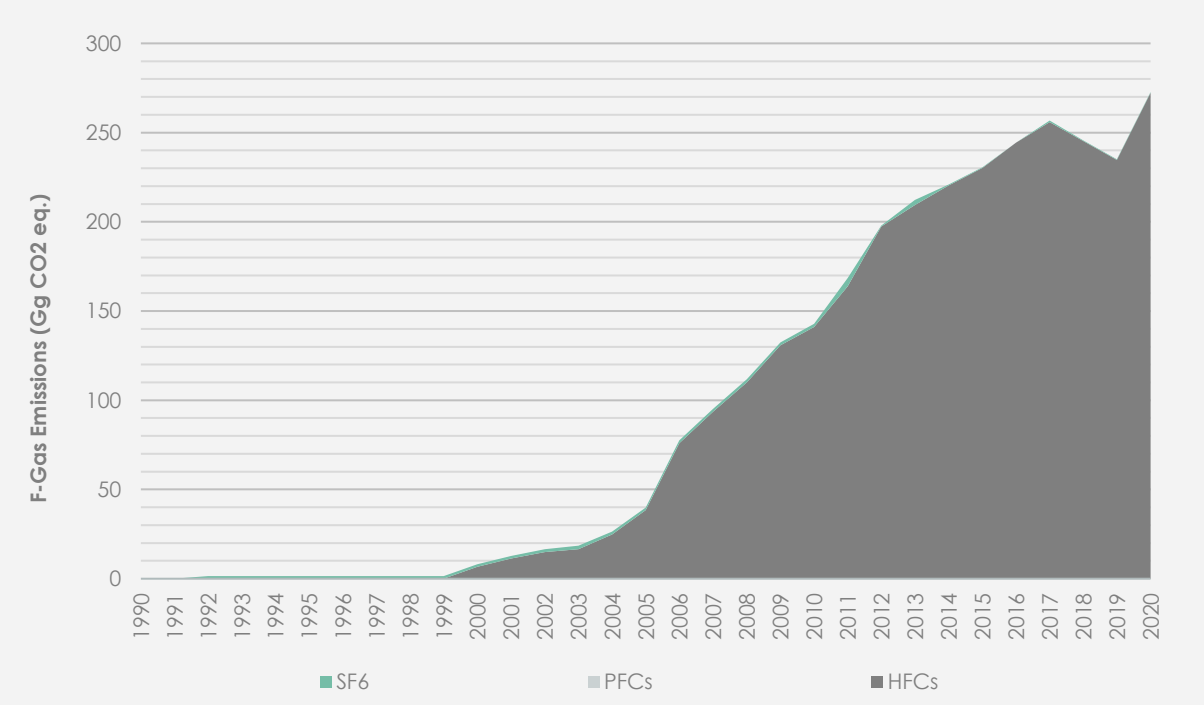


Figure 2.11 Trends in emissions of fluorinated greenhouse gases.

2.5.6 Indirect greenhouse gases

Emissions of indirect greenhouse gases are illustrated in Figure 2.12.

Among these four gases, the most significant trends are those of CO and NOx. Both gases show trends that are closely correlated to the trends in activities that result in emissions of such gases, in particular energy generation (category 1A1a) and road transport (category 1A3b).

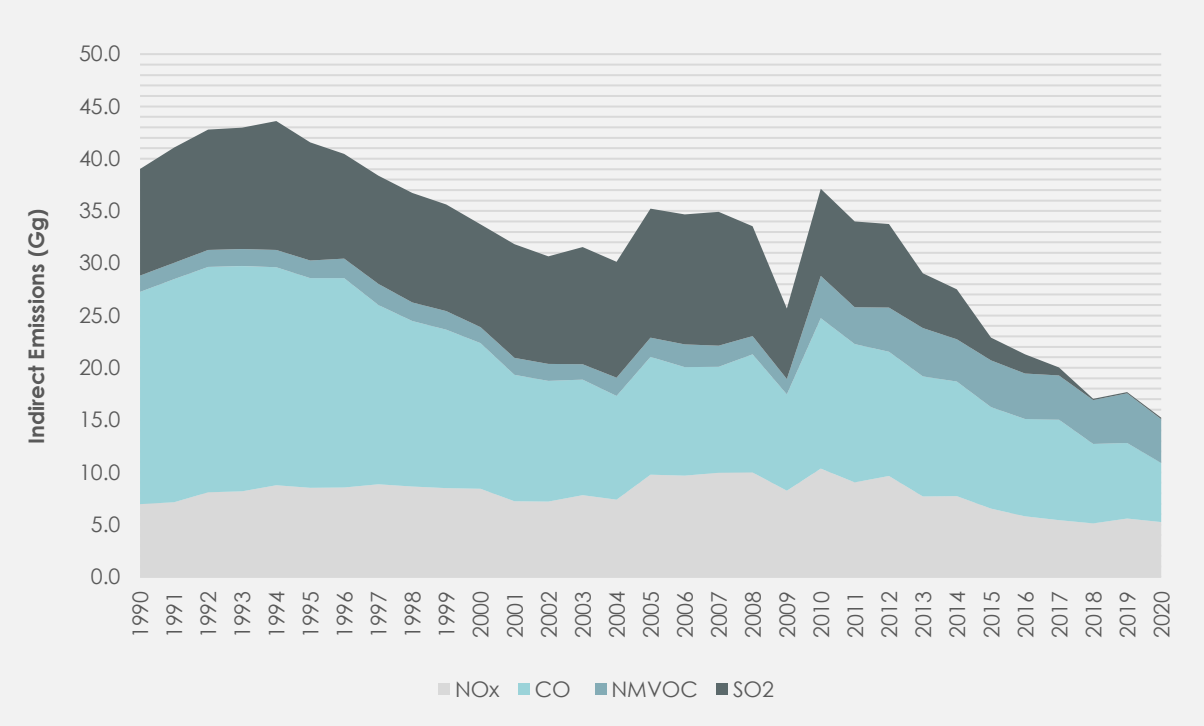


Figure 2.12 Emission trends for indirect greenhouse gases.

2.6 TRENDS IN GREENHOUSE GAS EMISSIONS BY SECTOR

This section will discuss sectoral trends in greenhouse gas emissions. Greenhouse emissions from all sectors covered by this inventory over the time series concerned are presented in Table 2.5 and illustrated in Figure 2.14 and Figure 2.15.

Table 2.5 Emissions of greenhouse gases by sector for the years 1990 to 2020 (Gg CO_2 equivalent).

	Energy	IPPU	Agriculture	LULUCF	Waste	Total with LULUCF	Total without LULUCF
				Gg CO2 eq.			
1990	2403.14	7.78	119.07	-8.15	69.30	2591.13	2599.28
1995	2449.55	9.29	119.04	-4.10	104.53	2678.31	2682.41
2000	2519.12	14.99	115.41	-5.05	140.20	2784.67	2789.72

2005	2657.05	46.03	99.11	-0.56	178.34	2979.97	2980.54
2010	2598.51	147.96	86.21	11.17	112.26	2956.11	2944.94
2011	2585.43	174.13	83.08	-2.00	107.31	2947.95	2949.95
2012	2733.55	205.18	85.04	-1.81	108.62	3130.58	3132.39
2013	2379.19	224.81	83.48	-1.63	107.68	2793.53	2795.16
2014	2364.46	232.78	82.25	-4.20	121.17	2796.46	2800.66
2015	1664.68	241.26	81.95	-3.84	135.05	2119.11	2122.95
2016	1356.84	253.84	79.65	-3.82	145.45	1831.96	1835.78
2017	1533.82	262.41	78.12	-1.88	143.70	2016.17	2018.05
2018	1549.09	252.06	78.44	-1.14	150.43	2028.87	2030.01
2019	1653.05	241.25	78.58	-1.37	158.87	2130.39	2131.76
2020	1602.33	279.62	80.24	-2.18	159.41	2119.41	2121.59

The overall impact that the Energy sector has on total national emissions has already been mentioned. In recent years, emissions of this sector have started to decrease in general. On the other hand, emissions from the IPPU sector, strongly represented by emissions of HFCs, are showing a substantial rate of increase, particularly since 2000. The relative share of emissions of IPPU has therefore grown compared to those of the Energy sector as shown in Figure 2.13. The table below provides a summary of the percentage contribution of Malta's total GHG emissions by sector for the reporting year 2020.

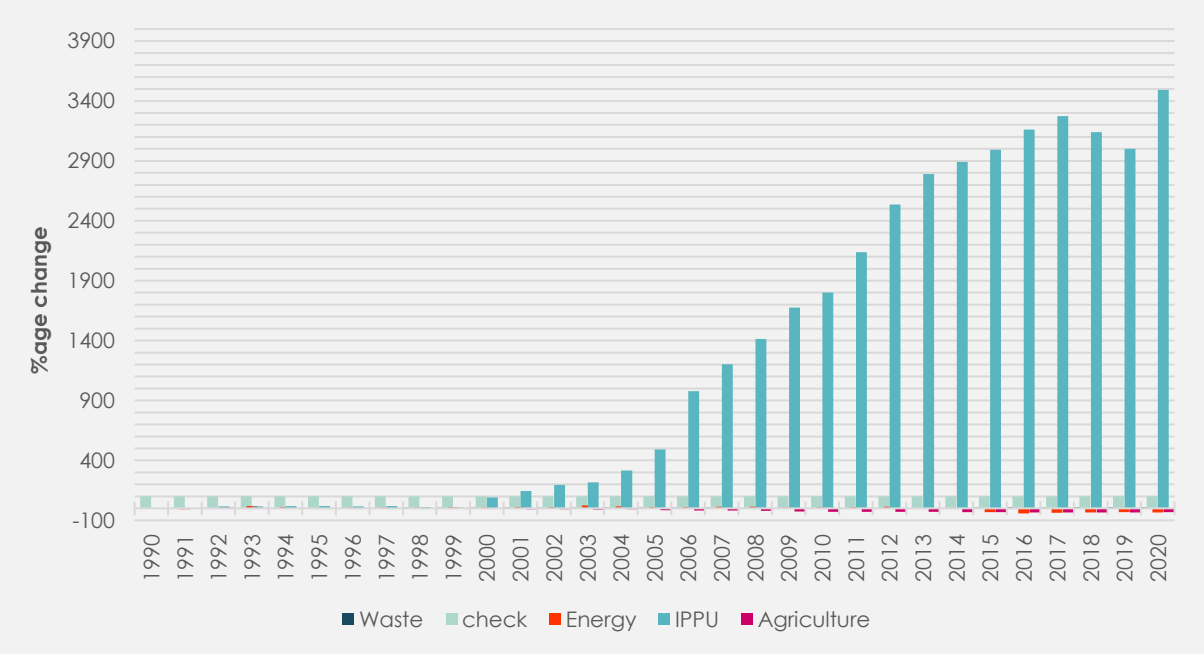


Figure 2.13 Annual Percentage change compared to 1990, by sector.

The most obvious feature that comes out of Figure 2.14 and Figure 2.15 is the predominance of emissions from the Energy sector in total national emissions. This has

been the case throughout the period covered by this report. Indeed, there is a strong correlation between the profile of total national emissions and that of emissions from the energy sector, indicating that the volume of emissions attributed to this sector strongly determines the year-on-year trend in total national emissions. All other source sectors contribute substantially less to overall emissions, while LULUCF is associated with a minor removal effect.

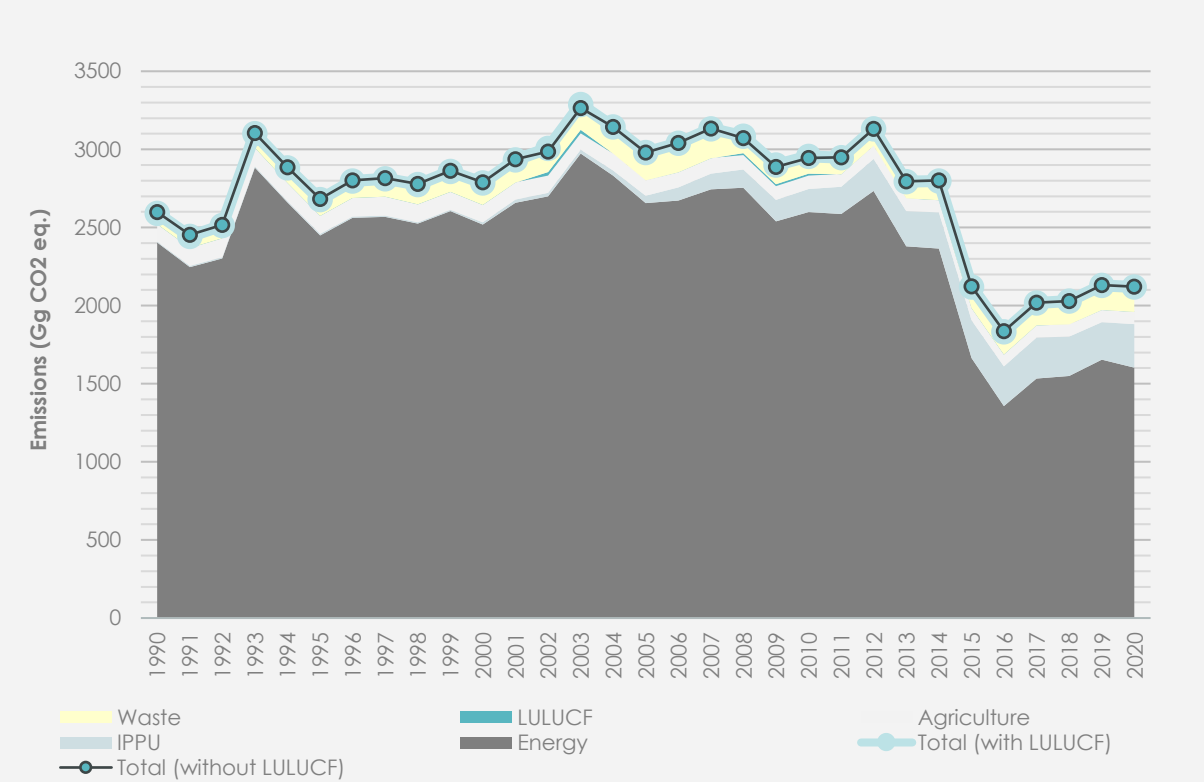


Figure 2.14 National total greenhouse gas emission trends (total; by sector)

Overall sectoral trends as a percentage change between year 1990 and year 2020 are provided in the table below. After a long period (until 2012) during which the general trend was of increasing emissions, the Energy sector, in recent years, started showing a gradual decrease in overall emissions, particularly evident between 2014 and 2015. This decrease is such that emissions in 2015 are even less than what they were in 1990. The trend in overall emissions for the sector Energy reflects primarily changes in the mix of sources used to meet electricity demand in the country, the impact of which even superseding emission trends for other categories included in this sector (e.g. road transport).

The increase for the sector Industrial Processes and Other Product Use is explained by the substantial increase in emissions of HFCs, as already explained in an earlier section. The overall trend for the sector Agriculture represents a decrease in emissions between 1990 and 2020, though one may observe a number of fluctuations throughout the period. Sector Waste also shows an increase in emissions between the base year and 2020, though fluctuations may also be observed for this sector over the period, not least during the latter half of the time series.

Table 2.6 Emissions of greenhouse gases by sector for the years 1990 and 2020 and the corresponding change between the two years (Gg CO_2 equivalent).

	1990			2020			% Change in emissions (1990-2020)
	Emissions $GgCO_2eq.$	% Share (without-LULUCF)	% Share (with-LULUCF)	Emissions $GgCO_2eq.$	% Share (without-LULUCF)	% Share (with-LULUCF)	
Energy	2,403.14	92%	93%	1,602.33	76%	76%	-33%
Industrial Processes and other product use	7.78	0%	0%	279.62	13%	13%	3494%
Agriculture	119.07	5%	5%	80.24	4%	4%	-33%
LULUCF	-8.15		0%	-2.18	0%	0%	-73%
Waste	69.30	3%	3%	159.41	8%	8%	130%
Total (with LULUCF)	2591.13		100%	2119.41	100%	100%	-18%
Total (without LULUCF)	2599.28	100%		2121.59	100%	100%	-18%

The level of emissions from sector LULUCF can be said to have remained relatively stable over the time series, varying between a minimum 1.23 Gg CO_2 (2002) equivalent and a maximum 4.74 Gg CO_2 equivalent (1991). More information on the reasons underpinning the observed sectoral trends can be obtained from the annual submissions of Malta's GHG inventory.

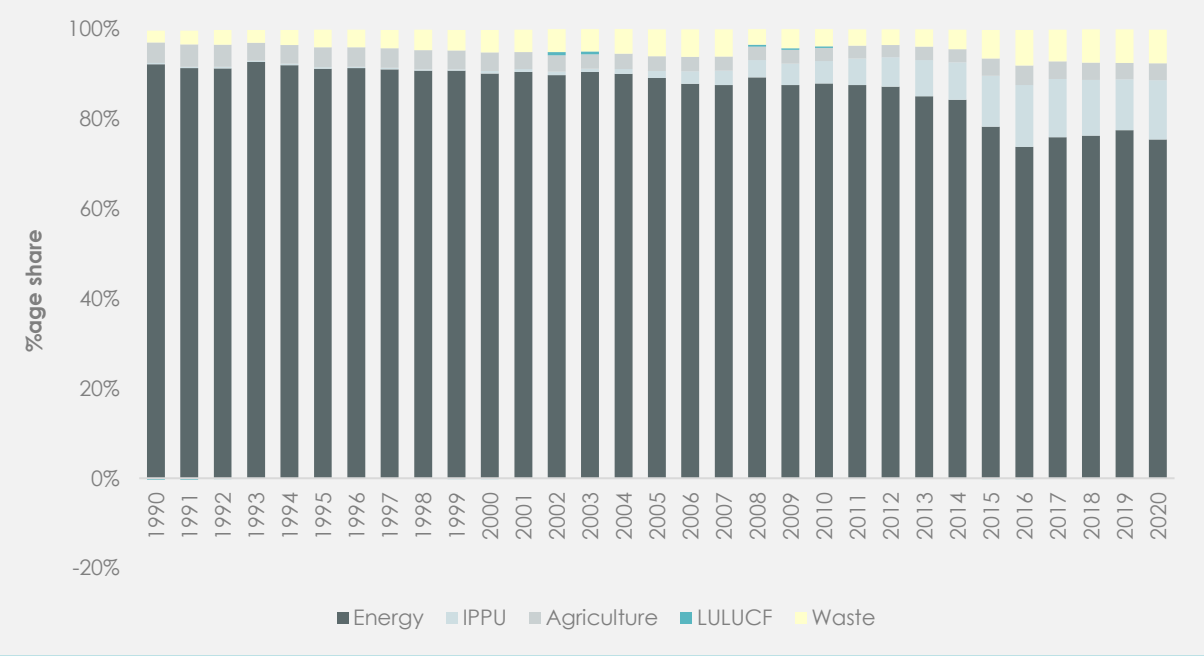


Figure 2.15 Annual percentage share of national emissions for each sector.

2.6.1 Energy (CRF sector 1)

The trend profile for the Energy sector can be split into two main sub-trends, namely a general increase in emissions up to 2012, followed by a rapid decrease over the space of the subsequent few years until 2016, with emissions growing again in 2017. As estimated for year 2020, the energy sector contributes to 75.60% of Malta's total GHG emissions.

Up to 2012, the growth in emissions reflects growing demand for energy, especially electricity generation and transport. The significant efficiency gains achieved in the energy generation sector post-2012 have then impacted on the overall sector emissions in recent years: these gains have been achieved primarily through technical developments taking place in recent years, including investment in new, more efficient local generation capacity, the sourcing of electricity through an interconnector with mainland Europe, and fuel switches including the discontinuation of use of heavy fuel oil. The increase in emissions observed in 2017 compared to 2016 is mainly due to a renewed shift towards indigenous electricity generation, as opposed to outside sourcing, though the impact is markedly subdued because of the shift to natural gas as the main generation fuel.

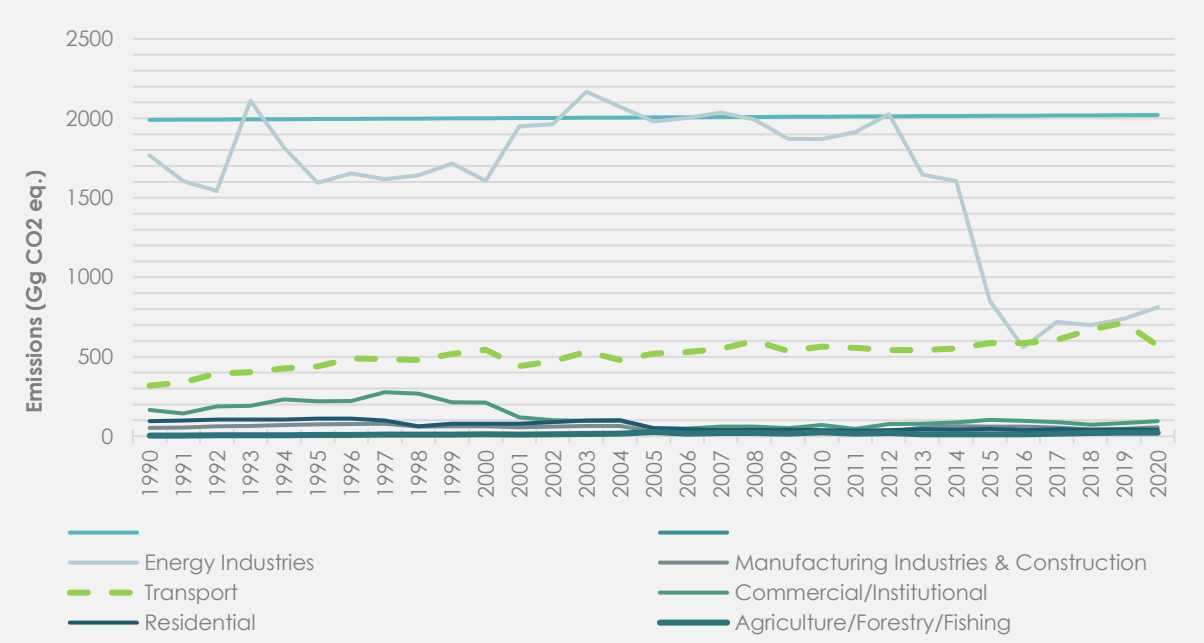


Figure 2.16 Emission trends for sector Energy

The sharp change in the trend for emissions from category Energy Industries (1A1) clearly shows the potentially high impact of focussed policies and measures targeted towards an activity which is defined by a relatively small number of clearly identifiable point sources, especially in the context of a small country such as Malta. It is to note that up to 2016, Public Electricity Production was concentrated in two power generation plants, the Marsa Power Station and what was formerly called the Delimara Power Station. In 2017, the latter was split into two separate commercial enterprises with a fourth new installation built adjacent. Thus, Malta now has four distinct electricity generation plants, with the Marsa plant operating in a much-reduced form and run only on stand-by basis for emergency use.

Emissions from the Transport category (1.A.3) include road transportation, civil aviation and national navigation within the Maltese Islands. Emissions estimated from International

Bunker activities are considered as "Memo Items" and are not considered in terms of Malta's emissions of greenhouse gases. These memo items refer to fuels used for international marine navigation and for international aviation purposes that are combusted outside of Maltese territory, territorial waters, or airspace respectively. This category also includes CO_2 emitted from biofuel used for 1.A.3.b.i Cars, 1.A.3.b.ii Light-Commercial Vehicles, 1.A.3.b.iii Heavy Duty Vehicles and buses and for 1.A.3.d Domestic Navigation (thus such emissions are excluded from the respective categories).

The contribution of the transport sector towards total national emissions in recent years is comparable to that of category Energy Industries. In general, Transport emissions show a sustained gradual increase over the whole time series (Figure 2.17). In 2020 a decrease of 20% in total transport emissions, compared to 2019, was observed mainly due to the covid-19 pandemic.

Table 2.7 Total GHG emissions in kt CO_2 eq from category 1.A.3-Tranport

1.A.3 Transport										
Greenhouse Gas Emissions (in kt CO2 eq.)										
GHG Source Category	**1.A.3. Transport**	**a. Domestic Aviation [a]**	**b. Road Transportation [a,c]**	Passenger Cars	Light-Duty Vehicles	Heavy Duty Vehicles & Buses	Motorcycles	**c. Railways**	**d. Domestic Navigation [a,b]**	**e. Other Transportation (Off-Road)**
1990	**318.45**	1.21	305.23	211.54	37.37	52.04	4.28	NA	12.02	IE
1995	**438.63**	2.04	416.61	269.81	59.35	79.5	7.95	NA	19.98	IE
2000	**544.17**	2.08	520.36	329.24	72.33	112.03	6.76	NA	21.73	IE
2005	**519.39**	1.87	489.51	309.95	67.08	108.4	4.09	NA	28	IE
2010	**564.52**	2.71	508.05	331.4	74.81	98.88	2.96	NA	53.75	IE
2015	**585.46**	1.44	546.02	365.74	70.99	106	3.29	NA	37.99	IE
2016	**585.25**	1.73	549.07	371.08	73.97	100.34	3.68	NA	34.46	IE
2017	**606.15**	1.69	564.92	379.07	76.59	105.33	3.92	NA	39.54	IE
2018	**671.39**	0.55	632.82	405.96	92.53	130.08	4.25	NA	38.02	IE
2019	**714.37**	0.27	662.49	432.01	94.58	131.41	4.49	NA	51.61	IE
2020	**570.59**	0.15	533.37	355.84	73.16	100.58	3.78	NA	37.07	IE

Notes:

a.) Excludes emissions from military equipment, which are reported under sub-category 1.A.5-Other (Not Specified Elsewhere)

b.) Excludes emissions from fishing vessels which are reported under sub-category 1.A.4.c.iii-Fishing

c.) Includes off-road emissions.

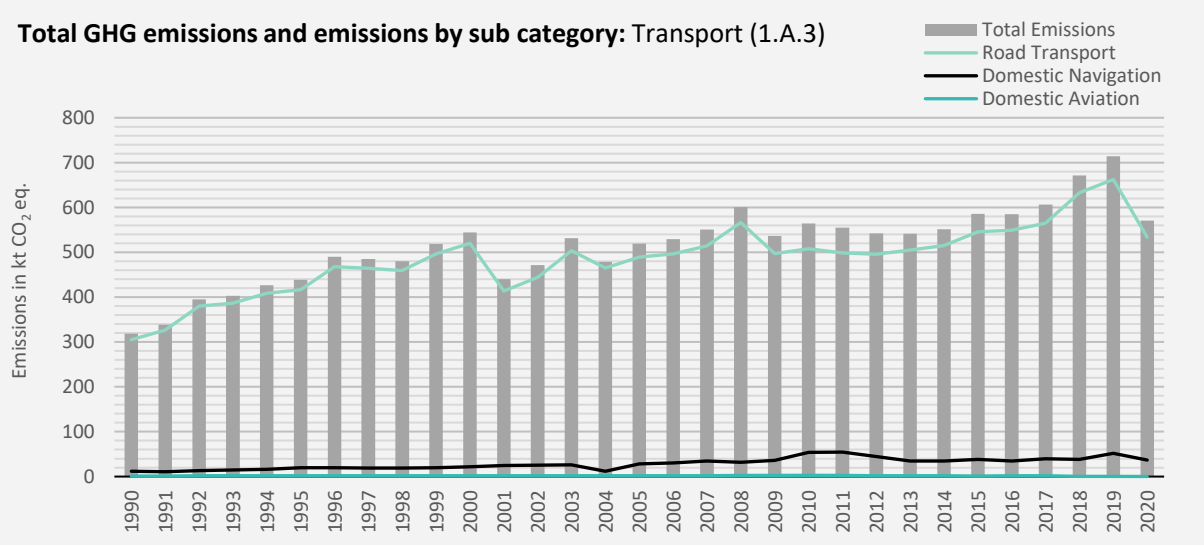


Figure 2.17: Total Greenhouse gas emissions (Transport 1.A.3)

Sub-category Road Transport (1A3b) is by far the biggest contributor to national total emissions among the three Transport sub-categories mentioned above. This reflects primarily the continued growth in the number of road vehicles. The bulk of emissions from the Transport sector are carbon dioxide; in 2020, emissions of methane and nitrous oxide for this sector accounted for 0.17% and 0.65% respectively. Figure 2.18 shows the emissions by gas for road transportation for the period 1990-2020.

The trend of road transport emissions has increased proportionally with the increase in Malta's car fleet. The stock of licenced vehicles in Malta stood at 402,427 by Q4 of 2020. According to a National Statistics Office News Release entitled 'Motor Vehicles: Q4/2020', a total of 5,373 newly licensed vehicles were added to Maltese roads in 2020 with the majority or 70% being passenger cars.

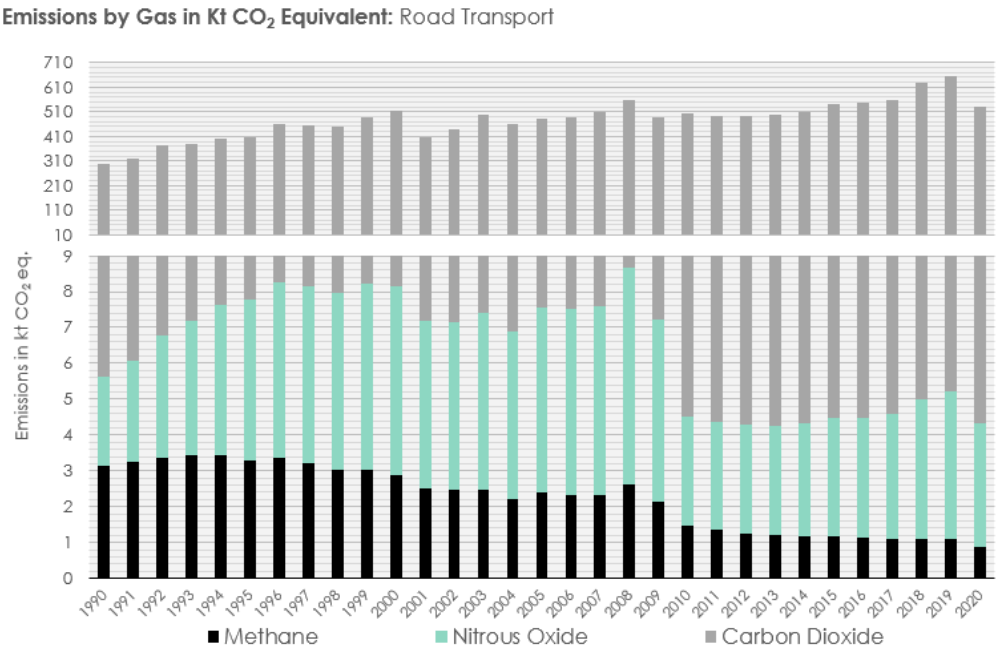


Figure 2.18: Greenhouse gas emissions by Gas (Road Transport)

The total emissions arising from domestic navigation in 2020 was 37 kt of CO_2 eq. (6.5% of total transport emissions). This sub-category includes all GHG emissions from domestic marine transport (including boats, yachts, pleasure craft, jet skis) and passenger ferries. Emissions from fuel consumed by fishing vessels are not included under this category. Emissions from domestic navigation are presented in Figure 2.19.

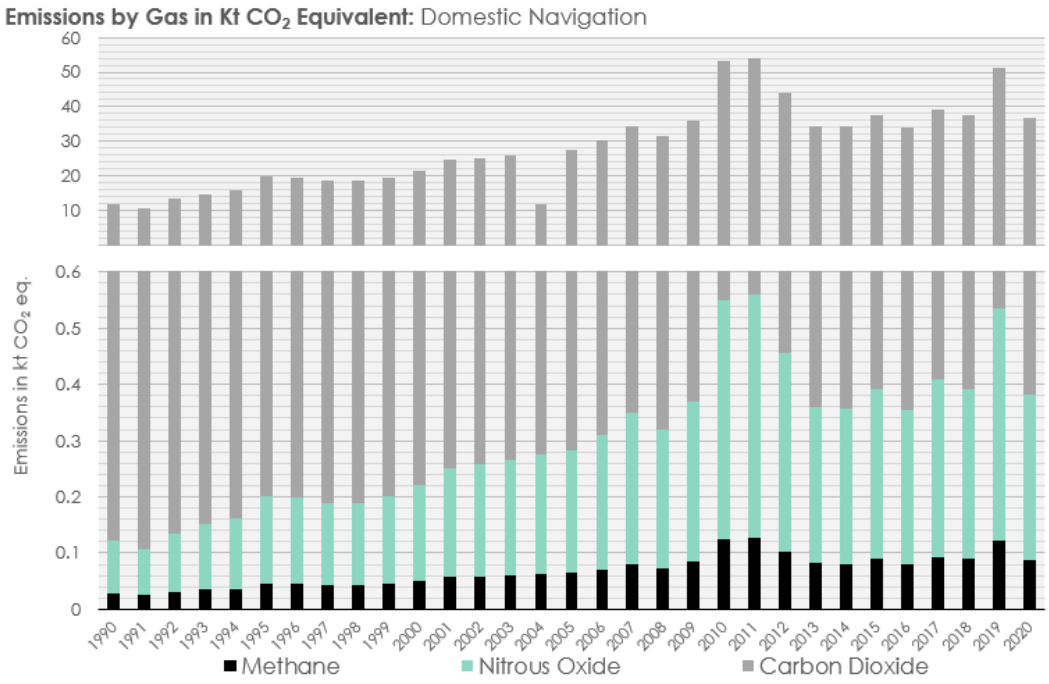


Figure 2.19: Greenhouse gas emissions by Gas (Domestic Navigation)

Domestic Aviation is a very small contributor to the total transport emissions, accounted for 0.15 kt of CO_2 eq. in 2020. Emission by gas for domestic aviation are presented in Figure Figure 2.20.

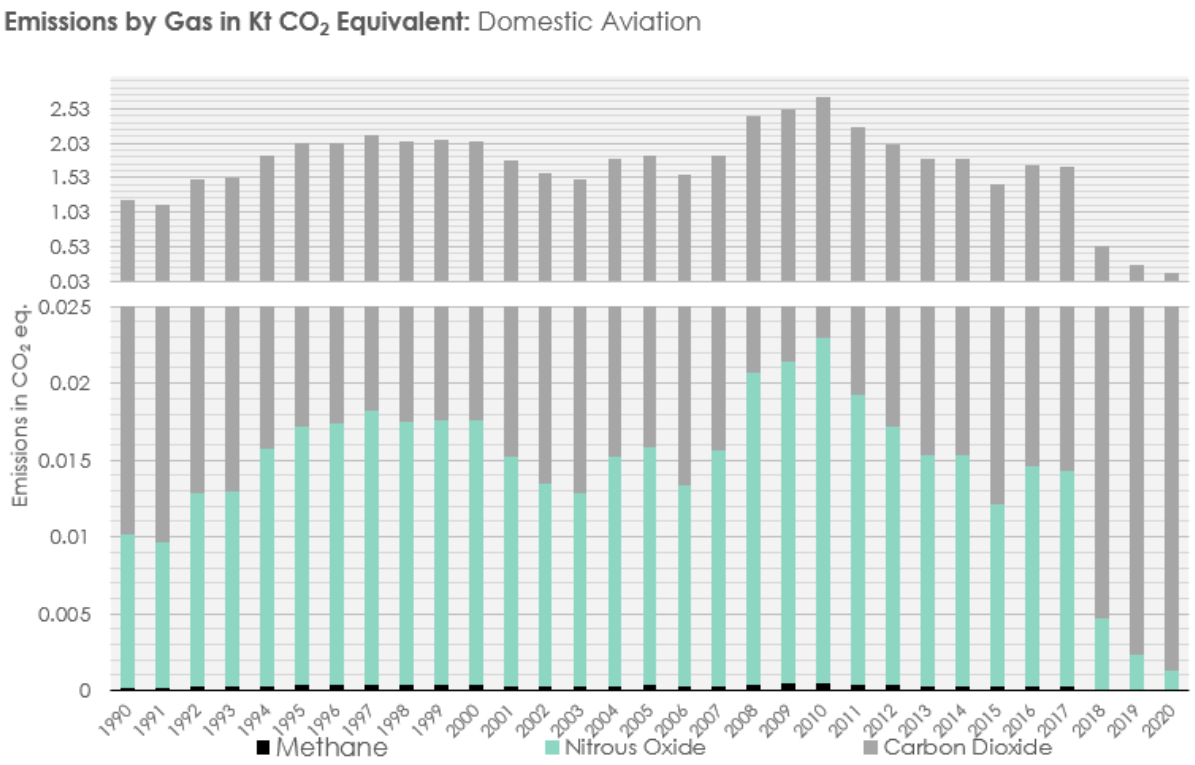


Figure 2.20: Greenhouse gas emissions by Gas (Domestic Aviation)

2.6.2 Industrial Processes and Other Product Use (IPPU; CRF sector 2)

The trend profile for sector IPPU (Figure 2.21) is clearly dominated by the emissions trend of HFCs, particularly from category Refrigeration and Air-conditioning (CRF 2.F.1). Emissions of HFCs, and, consequently, IPPU emissions, have increased from the early 2000s. The main contributor towards HFC emissions, category Refrigeration and Air-conditioning, accounted for 94.64% of all direct greenhouse gas emissions estimated for the IPPU sector in 2020. Emissions from other industrial processes are minimal or even non-existent, considering the nature of the industrial sector in Malta, where industrial activities found in other countries either do not exist or only take place at very small scales.

The emissions contribution from the IPPU sector to the total national GHG emissions in Malta amounted to 13.19% in 2020.

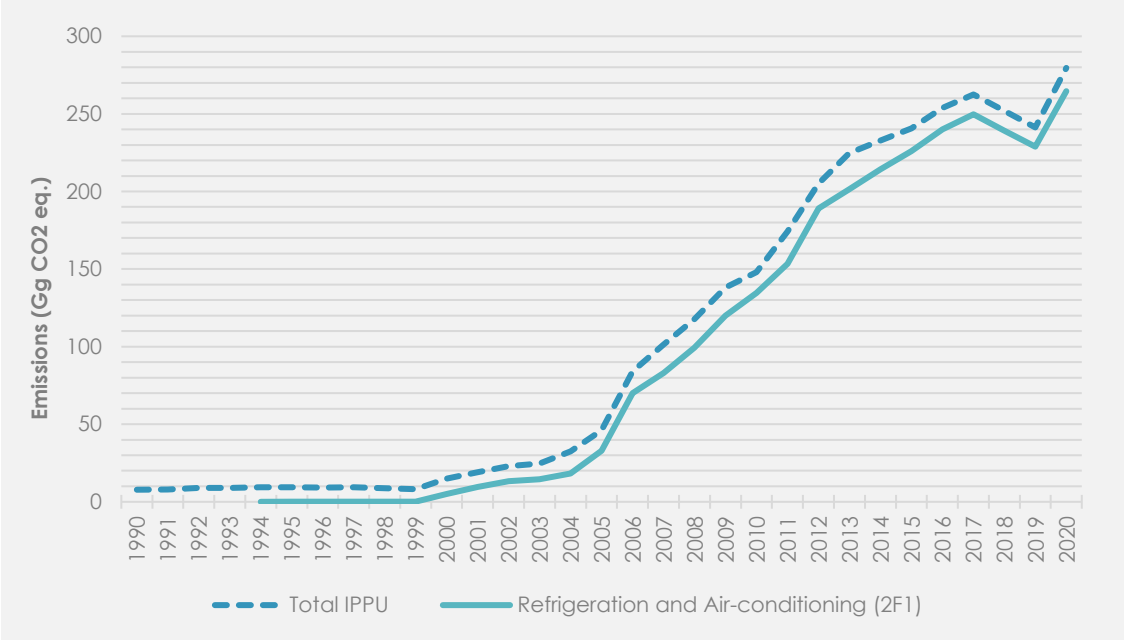


Figure 2.21 Emission trends for the sector IPPU

2.6.3 *Agriculture (CRF sector 3)*

In general, the agriculture sector is certainly not a major contributor towards total national emissions. The trend in emissions is highly influenced by changes in livestock population and land, as described in section 2.12. The sector has seen a decrease in emissions of around 33% over the 1990-2020 period. Within this sector (Figure 2.22) the category Enteric Fermentation (3A) has always had the highest share of total sector emissions. In 2020, Enteric Fermentation accounted for less than half of the agriculture emissions (43%) (Figure 2.23), while manure management accounted for 27% and agricultural soils accounted for 30% of total emissions. In agriculture only two gases are being reported, Nitrous oxide and methane. Methane emissions originate from enteric fermentation and manure management, while nitrous oxide emissions are emitted from manure management and agricultural soils.

Methane emissions accounted for 49% of total agriculture emissions, while nitrous oxide accounted for 51% respectively. Enteric fermentation accounted for 87% of total methane emissions, whereas those coming from the management of manure accounted for 13%. Manure management was responsible for 40% of nitrous oxide emissions, while 60% of N2O emissions originated from Agricultural soils.

GHGs from manure management and agricultural soils are emitted both directly and indirectly, the latter of which occurs through atmospheric deposition and through leaching and runoff. During 2020, indirect emissions from atmospheric deposition and leaching/runoff totalled to 6.50 GgCO2eq, while direct emissions amounted to 17.74 GgCO2eq. Although in the Maltese agricultural sector both inorganic (synthetic fertilizer) and organic fertilizer (animal manure) is applied to soils, animal manure is applied for the most part. In 2020, it estimated that around 2385528 KgN of animal manure were applied per hectare, while 586140 KgN of synthetic fertilizer were applied per hectare, equating to a total of 13.92 GgCO2eq.

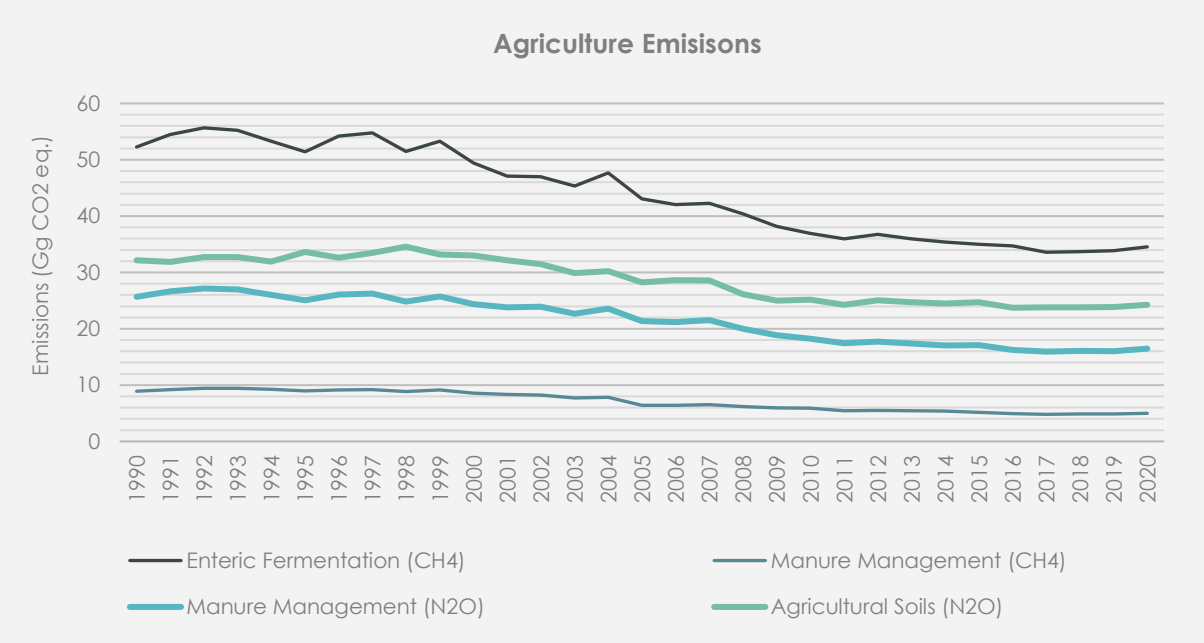


Figure 2.22 Emissions from Agriculture.

Livestock populations have decreased significantly compared to 1990 levels. These changes could be attributed to the rise in the import of meat and dairy products. As a result of these changes in livestock populations and manure management systems, methane emissions from Enteric Fermentation and Manure Management have also declined. The total agricultural area, UAA and fodder crop land, have also decreased; consequently, so have the nitrogen application rates and the Nitrous Oxide emissions.

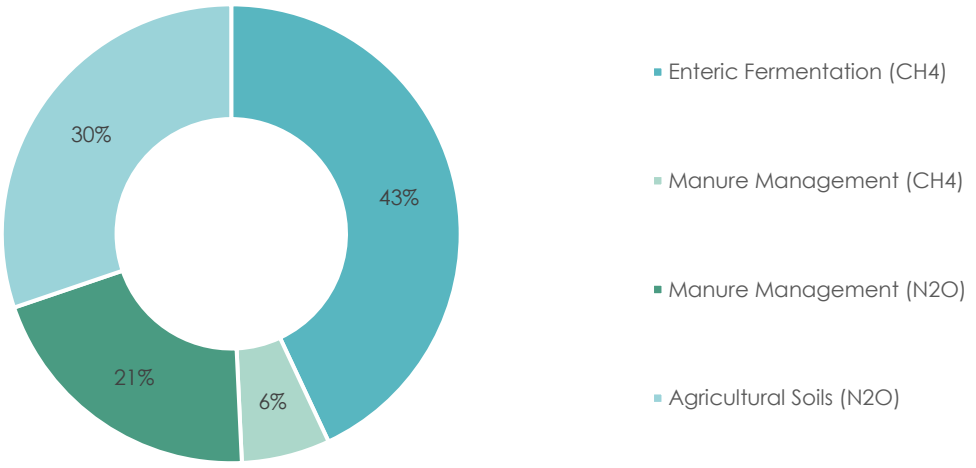


Figure 2.23 Percentage share of agriculture emissions by gas and category.

2.6.4 Land Use, Land-use Change and Forestry (CRF sector 4)

For the latest submission, the LULUCF sector has undergone updates with regards to the land use matrix, to better represent the land use representation, in view of the addition of estimates in the Forest Land and Wetland categories. Moreover, the methodology related to biomass was revised to address a recommendation for an issue which was raised in the Centralized Review of the 2021 annual submission of Malta. As a result of these updates, the estimations were recalculated for the whole timeseries of the LULUCF sector. The LULUCF sector is the lowest contributor to the total profile of the GHG Inventory of Malta. CO2 is the main greenhouse gas emission source and sink from the various categories. Non- CO2 emissions also occur in the sector including N2O and CH4. The sector trend in Malta represents a net removal of -8.15 ktCO2 eq. in 1990, decreasing to -2.182 ktCO2 eq. by 2020. The sector accounted for –0.10% of Malta's total GHG emissions in 2020.

CO2 is the main greenhouse gas emission source and sink from the various categories. Non- CO2 emissions also occur in the sector including N2O and CH4. From the figure one can notice the trend for Cropland varying throughout the years. This is mainly due to some large area conversions occurring in the Cropland sector, which lead to high emissions in certain years, where these Cropland areas are based on national statistics received and do vary from year to year. The spikes that are occurring in the estimations in the sector, to the category Land Converted to Cropland in some of the years, are due to the big annual changes occurring in Annual Cropland, where in some of the years, national statistics for 2001, 2003, 2005, 2007 and 2010 etc. are present, while assuming a linear interpolation for the years without data. Unfortunately, this presents an issue and is very challenging to solve, since getting rid of these spikes would mean changing national statistics data. Although the compilers are aware of these big annual changes, work is currently ongoing on the collaboration project with MCAST to acquire an improved land use representation data, and thus update the land use time series as necessary.

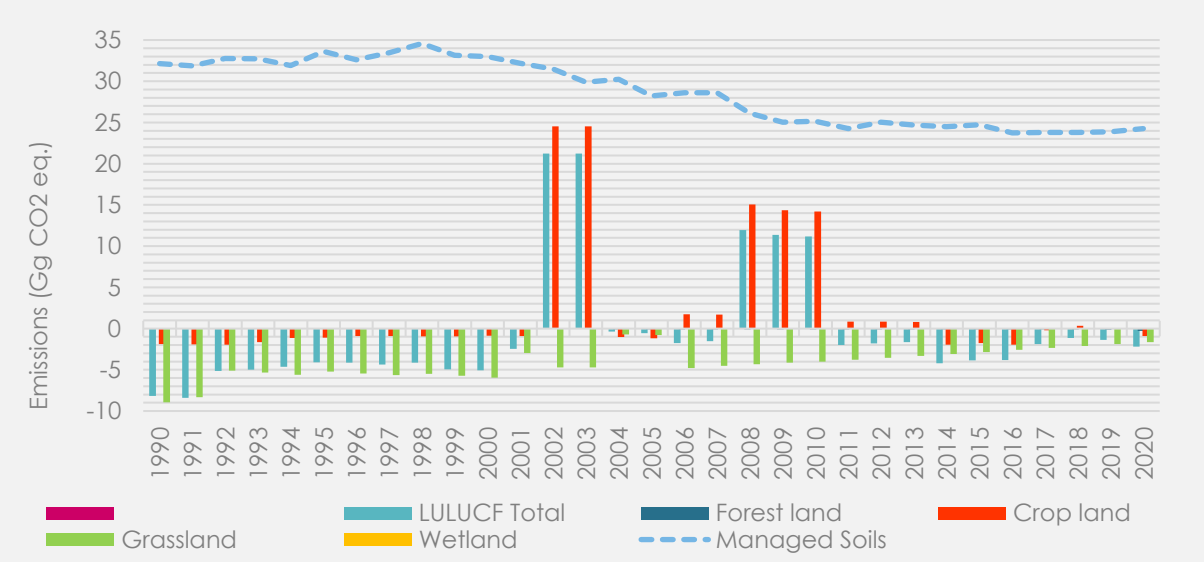


Figure 2.24 Emission Trends for sector LULUCF.

2.6.5 Waste (CRF sector 5)

The general profile of the trend of emissions from sector Waste is evidently greatly influenced by the profile of emissions for category Solid Waste Disposal (5A), this also being the category with the highest share of emissions in this sector. Until the upsurge in IPPU emissions, Waste was the second highest contributing sector towards total national emissions in Malta.

In 2020, 91.26% of all sector Waste emissions were generated by the category Solid Waste Disposal (refer to Figure 2.25 below). Methane emissions from this category are also the predominantly emitted greenhouse gas in this sector; emissions of nitrous oxide and carbon dioxide have relatively small shares of total sector emissions. In fact, a relatively large proportion of emissions reported are emitted from landfill operations.

As estimated for year 2020, the Waste sector contributes to 7.52% of Malta's total GHG emissions.

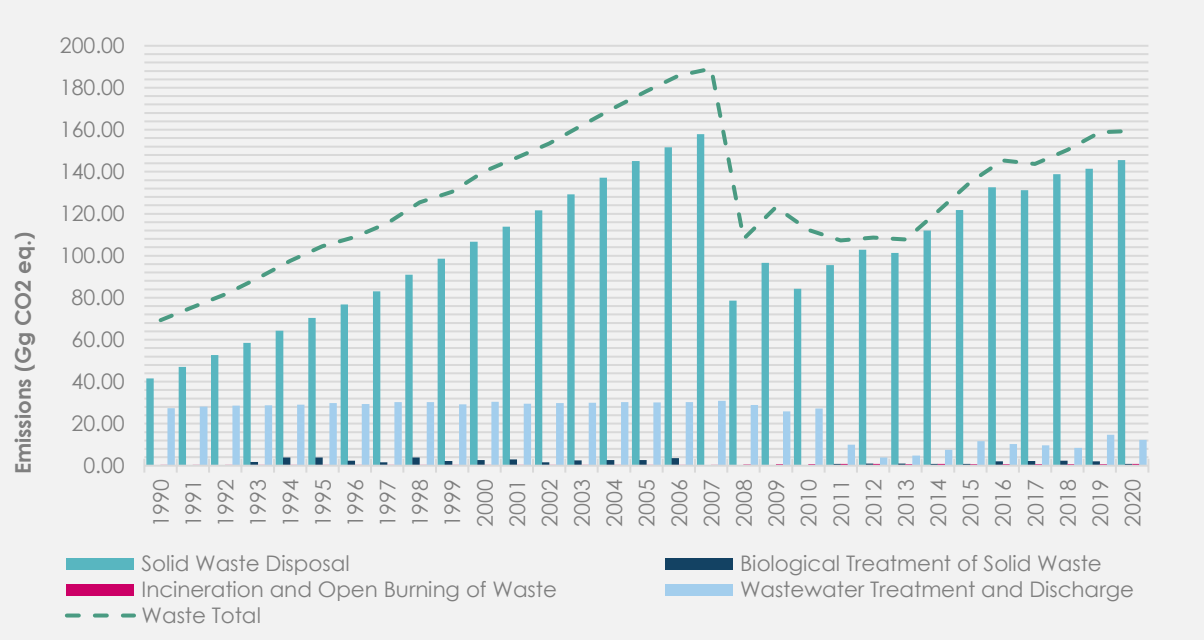


Figure 2.25 Emission trends for the Waste sector

As presented in Figure 2.26 below, the trend in the waste sector displays a growth of emissions throughout the period up to year 2007. However, a drastic decrease in emissions is manifest in year 2008, mainly in the Solid Waste Disposal on Land category (5.A). The reasons behind this abrupt change of trends are further explained in detail in the sector-specific sections describing the respective categories (refer to section 7.2). However, the rapid change can be summarised as the effect of the entry in operation of specific installations aimed at reducing emissions from these sectors. Nonetheless, and despite showing a number of year-to-year fluctuations, emissions from the waste sector continue to show a general increase over the years following 2009, mainly due to the continuation of landfilling practices.

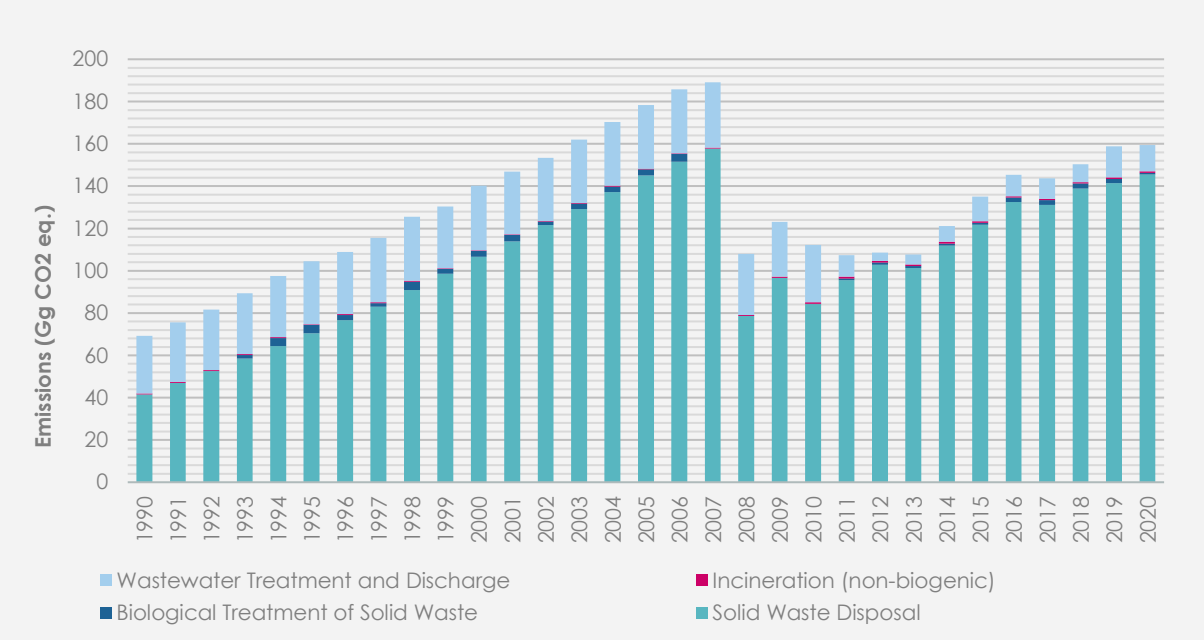


Figure 2.26 Total GHG emissions from waste management overview by activity for sector Waste.

Furthermore, Figure 2.27 below shows the contribution in carbon dioxide equivalents (CO_2 eq.) of carbon dioxide, methane and nitrous oxide emissions in the latest inventory year. As shown, a large proportion of percentage share is from CH_4 emissions resulting mostly from solid waste disposal on land category. SWD on land is then followed by methane emissions in wastewater treatment and discharge category, biological treatment of solid waste, and incineration. The second percentage share of emissions are N2O from wastewater treatment and discharge category and incineration, and then followed by CO_2 emissions from incineration.

However, waste management practices are continuously being improved with newer technologies being planned and implemented mainly in the solid waste treatment sector, with an increased amount of organic fraction being directed to alternative processes (such as bio-digestion), increased recycling and material recovery and aerobic treatment of liquid waste. The need to divert organics in general from solid waste disposal is the main reason behind such trends. Please refer to the sector-specific sector section 7.1 regarding waste facilities in Malta.

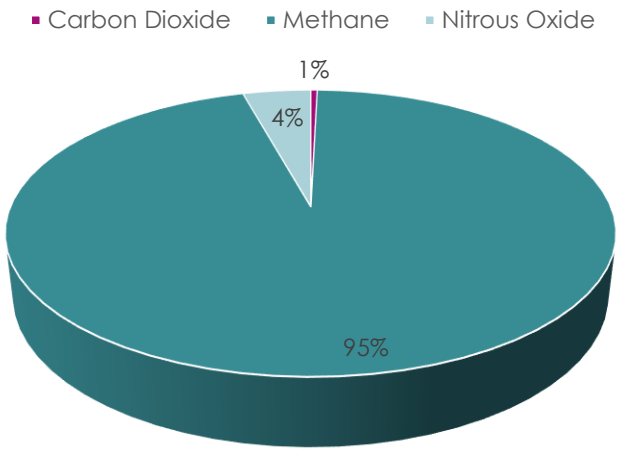


Figure 2.27 Share of emissions, by gas, for sector Waste (% share by gas, based on CO2 equivalents).

The direct greenhouse gases estimated for the waste sector, as presented in the inventory, are illustrated in Table 2.8 below, including the base year (1990) and the reporting year (2020), according to the GHG emissions and the source category or sub-sector, as applicable.

Table 2.8 GHG emissions from the Waste sector.

		Year								
		1990	1995	2000	2005	2010	2015	2018	2019	2020
		Gg								
GHG	CO2	0.37	0.37	0.35	0.32	0.52	0.57	0.55	0.55	0.65
	CH4	2.35	3.64	5.08	6.61	4.03	5.11	5.76	6.03	6.08
	N2O	0.03	0.04	0.04	0.04	0.04	0.02	0.02	0.03	0.02
	Total	2.75	4.05	5.46	6.97	4.59	5.71	6.34	6.61	6.74
		Gg CO2 eq.								
Waste sector category	Solid Waste Disposal	41.50	70.41	106.66	145.12	84.22	121.83	138.82	141.42	145.47
	Biological Treatment of Solid Waste	0.00	3.92	2.66	2.75	0.15	0.83	2.40	2.01	0.81
	Incineration and Open Burning of Waste	0.43	0.43	0.40	0.32	0.73	0.73	0.69	0.69	0.81
	Wastewater Treatment and Discharge	27.37	29.77	30.48	30.15	27.15	11.67	8.52	14.75	12.31
	Total	69.30	104.53	140.20	178.34	112.26	135.05	150.43	158.87	159.41

2.7 KEY CATEGORY ANALYSIS AND UNCERTAINTY

A 'key category' is an individual source or sink category that warrants prioritisation within the national inventory system because it has a significant influence on the national inventory concerned, in terms of the absolute level of emissions or removals, the trend in

emissions or removals, contribution to uncertainty, or any combination of these. There are two approaches to identify key categories described in the 2006 IPCC Guidelines (Volume 1, Chapter 4), named "approach 1" and "approach 2".

Under approach 1, "level" key categories are those which cumulatively account for 95% of the total inventory emissions (in CO_2-eq.) when sorted in descending order of magnitude. "Trend" key categories are those for which the trend over time significantly differs from the trend in total inventory emissions. The with-LULUCF key category assessment includes values relating to estimated removals in the LULUCF sector, taking into consideration the absolute values regardless of the sign (removals can be considered as being equivalent to negative emissions). The without-LULUCF assessment excludes estimates of removals from the LULUCF sector.

Under approach 2, the contributions of each category to the approach 1 level and trend assessments are multiplied by the category's percentage uncertainty in emissions, and categories sorted in order of their contribution to uncertainty in the level or trend. Key categories are those cumulatively contributing 95% of the total uncertainty across all categories. The robustness of the Approach 2 analysis depends on the quality of uncertainty estimates for emissions from each category, which in turn result from estimates of uncertainty for underlying activity data and emission factors. Indeed, the key category analysis decision tree in the 2006 IPCC Guidelines (Vol 1, Ch 4) only recommends performing Approach 2 assessment when country-specific uncertainty estimates are available for each source category.

At present, Malta does not have country-specific uncertainty estimates for all important source categories, so in this section, Malta presents the results of key category analysis from approach 1 only.

For illustrative purposes, Malta also presents the results of approach 2 key category analysis in Annex 1, using IPCC default uncertainty values where necessary. However, these results are not currently used to determine choice of sectoral methodology or improvement priorities. In future, Malta plans to improve country-specific uncertainty estimates to allow the results of approach 2 key category analysis, although there are currently no concrete timelines for this.

As may be seen in the discussion under subsequent sub-titles, there are a number of categories that consistently appear in the lists of key categories. Their important influence on level and trend of Malta's national greenhouse gas inventory warrants particular attention in ensuring robustness of the related emission estimates. Sector-specific details on steps being taken to ensure high levels of quality will be discussed in the respective sectoral chapters.

Reference has already been made to the use of verified fuel consumption data from annual reports submitted by operators of the local electricity generation plants under the EU ETS. This data covers all fuel consumption relating to indigenous public electricity generation. Operators of such installations are required to submit to the EU ETS competent authority annual data which has been duly verified as satisfactory by an independent, competent verifier. Verifiers have to be accredited specifically for EU ETS purposes, by a recognized national accreditation body of a Member State of the European Union, in

accordance with the appropriate rules and procedures set out in EU law (including the Commission regulation on EU ETS accreditation and verification). Furthermore, the monitoring of activity data and emissions under the EU ETS must be undertaken in accordance with the relevant EU regulations on monitoring and reporting, which includes rules on monitoring methodologies, sampling, analysis of fuel parameters, and assessment of uncertainty. Verified data is available as of 2005, the first year of operation of the EU ETS: in the case of Malta this covers liquid fuels used in public energy industries throughout the period since 2005 and, for 2017, the start of utilisation of natural gas.

The utilisation of COPERT modelling for the determination of emissions from road transport has been an important step towards improving estimations for this category. Efforts will be undertaken in future with the relevant transport regulatory body and with the National Statistics Office and involving the air pollutants inventory team at the Environment and Resources Authority, to analyse in greater depth the national data on the vehicle fleet and find means of formatting this data in a way that makes it more efficient to use for statistical and inventory purposes.

Meanwhile, for other fuel combustion activities, such as those occurring in categories Manufacturing Industries and Construction and Other Sectors, collaboration between several entities is focussing on national surveys to obtain a better picture of fuel use in different economic sectors and activities.

In sector Agriculture, for which category Enteric Fermentation has been identified as a level key category, discussions are in course to improve the availability of local data to derive reliable country-specific calculation parameters.

Similar efforts to improve the estimation of emissions of F-gases and emissions from sector Waste have also been undertaken in recent years, focussing on the methodological aspects. Next steps for the future may focus on improving the sourcing of activity data.

One of the recent improvements recently undertaken by the Malta Resources Authority with support from external consultants (Aether Ltd., UK), was the setting up of a tool that provides a detailed Key Category Analysis (KCA) of Malta's national GHG inventory. This KCA tool allows for a more detailed assessment level than the KCA which to-date had been derived directly from the CRF Reporter system. The new tool assesses the key category status of source and sink categories at a more disaggregated level and with a higher confidence level than the KCA provided by the CRF Reporter.

An example of the difference in disaggregation between the KCA tool and the CRF Reporter is the 'Other sectors' category of the Energy sector, where the CRF Reporter KCA combines the sub-categories of commercial/industrial, residential and agriculture/forestry/fishing into 'Other sectors' while the new KCA tool splits the category 'Other sectors' into the respective sub-categories: commercial/industrial, residential or agriculture/forestry/fishing.

Annex 1 to this report provides KCA tables, with Approach 1 methodology for the 'with' and the 'without' LULUCF data, for the base year and year X-2, and with Approach 2 methodology for year X-2. For each KCA approach, a 'level' and 'trend' assessment are provided.

2.7.1 Key categories: level assessment

The level assessment of key categories represents the contribution of each source or sink category to the total national inventory.
A detailed level assessment of the key categories, as derived from the KCA tool, is presented in Annex I to this report.

As illustrated in Annex 1, the sub-category with the highest key category for both the base year (1990) and the latest year (2020) with and without LULUCF, for approach 1, refers to the public electricity and heat production category from the Energy sector; liquid fuels and gaseous fuels CO_2.

The consideration, or not, of LULUCF emissions does not make a difference in the classification of level key categories. More important are the differences that can be seen between 1990 and 2020 (refer to Annex 1). The 1990 classification under the level assessment includes CO_2 emissions from solid fuel use in the energy industries category. However, this does not appear in the level assessment of the latest year (2020), since this type of fuel is no longer being used. Moreover, emissions of F-gases from refrigeration and air-conditioning gain importance, with their inclusion as an important key category in 2020 as opposed to 1990 (when no emissions are reported from this activity).

2.7.2 Key categories: trend assessment

A trend assessment takes into account the trend in emissions or removals of a category over time in addition to the level of emissions or removals for that category. This assessment approach can highlight categories that may not appear to be key categories under a level assessment but whose trend is significantly divergent from that of the overall inventory, thus requiring further attention. As a trend assessment requires an analysis against a previous year's inventory (usually against the base year), a trend assessment for 1990 cannot of course be presented.

A detailed trend assessment of key categories is presented in Annex 1 to this report.

Similarly, to the level assessment, as illustrated in Annex 1, for the trend assessment, the sub-category with the highest trend key category score for the latest year (2020) with and without LULUCF is 'Public electricity and heat production' from Liquid Fuels from the Energy sector.

As for the level assessment, the trend assessment without or with LULUCF emissions does not influence the classification of key categories.

2.7.3 Key categories: with LULUCF assessment

The below Table 2.9 refers to the key categories with LULUCF both for year 1990 and 2020 including level and trend assessment both from approach 1 and approach 2.

Table 2.9 KCA including Approach 1 for base year (1990) and latest year (2020) with LULUCF both Level and Trend Assessment

CRF Code	Category	Classification	GHG	Identification Criteria	
				1990	2020
1A1	Public electricity and heat production	Liquid fuels	CO_2	L1	L1, T1
1A1	Public electricity and heat production	Solid fuels	CO_2	L1	T1
1A1	Public electricity and heat production	Gaseous fuels	CO_2		L1
1A2	Manufacturing industries and construction	Liquid fuels	CO_2	L1	L1
1A3b	Road Transportation	Liquid Fuels	CO_2	L1	L1, T1
1A3d	Domestic Navigation	Liquid fuels	CO_2	L1	L1, T1
1A4a	Commercial/Institutional	Liquid fuels	CO_2	L1	L1, T1
1A4b	Residential	Liquid fuels	CO_2	L1	L1, T1
1A4c	Agriculture/Forestry/Fishing	Liquid fuels	CO_2		L1
2F1	Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning		HFC		L1
3A	Enteric Fermentation	Cattle	CH_4	L1	L1
3D1	Direct N2O Emissions from Managed soils	Organic N/Manure	N2O	L1	
5A1	Managed Waste Disposal Sites (Anaerobic)		CH_4		L1
5A2	Unmanaged Waste Disposal Sites		CH_4	L1	T1
5D1	Wastewater Treatment and Discharge - Domestic wastewater		CH4	L1	

L1 = Level Assessment Approach 1, T1 = Trend Assessment Approach 1

2.7.4 Key categories: without LULUCF assessment

The below Table 2.10 refers to the key categories without LULUCF both for year 1990 and 2020 including level and trend assessment from approach 1.

Table 2.10 KCA including Approach 1 for base year (1990) and latest year (2020) without LULUCF both Level and Trend Assessment

CRF Code	Category	Classification	GHG	Identification Criteria	
				1990	2020
1A1	Public electricity and heat production	Liquid fuels	CO_2	L1	L1, T1
1A1	Public electricity and heat production	Solid fuels	CO_2	L1	T1
1A1	Public electricity and heat production	Gaseous fuels	CO_2		L1
1A2	Manufacturing industries and construction	Liquid fuels	CO_2	L1	L1
1A3b	Road Transportation	Liquid Fuels	CO_2	L1	L1, T1
1A3d	Domestic Navigation	Liquid fuels	CO_2		L1, T1
1A4a	Commercial/Institutional	Liquid fuels	CO_2	L1	L1, T1

1A4b	Residential	Liquid fuels	CO_2	L1	L1, T1
1A4c	Agriculture/Forestry/Fishing	Liquid fuels	CO_2		L1
2F1	Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning		HFC		L1
3A	Enteric Fermentation	Cattle	CH_4	L1	L1
4E	Settlements	Total	CO_2		
5A1	Managed Waste Disposal Sites (Anaerobic)		CH_4		L1
5A2	Unmanaged Waste Disposal Sites		CH_4	L1	T1
5D1	Wastewater Treatment and Discharge - Domestic wastewater		CH4	L1	

L1 = Level Assessment Approach 1, T1 = Trend Assessment Approach 1

2.8 National systems in accordance with Article 5, paragraph 1, of the Kyoto Protocol

A first national GHG inventory was compiled as a stand-alone exercise in the context of the preparation of Malta's First National Communication to the UNFCCC, submitted and published in 2004. At the time, Malta was a non-Annex I party to the Convention and reporting obligations were those applicable to such a status. This first inventory was carried out by a team of inventory compilers coordinated by the University of Malta.

In 2004, Malta acceded to full membership of the European Union (EU). Despite retaining the non-Annex I status under the UNFCCC, reporting obligations relating to greenhouse gas emissions and removals became more stringent, and in line with the EU's Monitoring Mechanism *(Formerly Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol; replaced by Regulation (EU) No 525/2013)*, which included the requirement to report a national GHG inventory on an annual frequency with strict timeframes, namely: the submission of a 'provisional' inventory on 15th January of each year to the European Commission, covering the time series from 1990 (as base year) to the year before last (X-2); a 'final' inventory submission by the following 15th March, that may include changes to the January submission; and the submission under the UNFCCC by 15th April.

As of 2010 Malta's status under the UNFCCC changed to that of Annex I Party, which means that reporting obligations relating to such a status became fully applicable to Malta.

The inventory reporting requirements under EU legislation, and then also under Annex I status, made it necessary to establish a process whereby annual inventory reporting could be fulfilled. The Malta Environment and Planning Authority (MEPA) was initially entrusted to take on this obligation, subsequently followed by a migration of this and other climate action responsibilities to the Malta Resources Authority (MRA) as of 2010. Thus, the Climate Change Unit at MRA is currently responsible for the preparation of the national GHG inventory, including this submission.

Political ownership and overall responsibility of the national GHG inventory is vested in the Ministry responsible for climate change policy, this being the Ministry for the Environment, Energy and Enterprise (MEEE).

Any Annex I Party to the UNFCCC has an obligation to establish a National Greenhouse Gas Inventory System, defined by decision 19/CMP.1 "Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol" as:

> *"all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information."*

This obligation has also been transposed into EU law. A first recommendation for the setting up of a national inventory system was made in 2005, following discussions with inventory experts from the Federal Environment Agency of Austria. This led to the recruitment of staff to work on national inventories (greenhouse gases and air quality) and the first steps towards a more structured inventory compilation process. In 2007/2008 MEPA commissioned a more in-depth assessment of inventory compilation practices in place at the time to draw up recommendations for the formal establishment of a national inventory system that would be in accordance with requirements under the Kyoto Protocol; the intention was to integrate inventory reporting relating to both climate change and air quality obligations. Unfortunately, due to several reasons, this assessment and its recommendations could not be followed-up with concrete action. Malta's accession to Annex I status, the ratification requirements of the Doha Amendments to the Kyoto Protocol and the obligations arising from EU law make it imperative that a fully functioning national inventory system that meets the requirements of decision 19/CMP.1 is established. To this effect, the Climate Change Unit at MRA had taken the initiative, in 2013 to submit a report "Establishing a National Greenhouse Gas Inventory System for Malta" (Climate Change Unit-Malta Resources Authority; 30th May 2013) to the relevant local authorities to instigate and inform the decision-making process. As a result of this initiative, the "National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removals by Sinks Regulations of 2015" establish a national system for greenhouse gas inventories *(Legal Notice 259 of 2015, National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removals by Sinks Regulations, 2015 (Subsidiary Legislation 543.01)*.

The legal notice forms part of a wider legislative framework being established specifically for climate action in Malta, with the main underpinning legal instrument being the Climate Action Act, 2015 (Chap. 543). The Act sets the development, updating and publication of national greenhouse gas inventories as an obligation on the Maltese Government (Article 5, sub-article (2), point (a) *("In fulfilling its duties [to protect the climate for the present and future generations] the Government shall, inter alia: (a) develop, periodically update and publish national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases in order to monitor progress towards achieving its quantified emission limitation or reduction commitments pursuant to international treaties ad its obligations as a Member State of the European Union […]."*)

The national inventory system legal notice, among other aspects, formally identifies the Minister responsible for climate change as the Single National Entity (SNE) in accordance with the relevant UNFCCC requirements. The SNE "*shall have overall responsibility for the national greenhouse gas inventory system*" and shall ensure that the national system is operated in accordance with criteria set out in Schedule 1 to the legal notice and with relevant international and European Union requirements. The SNE shall define and allocate specific responsibilities in the inventory preparation process specifying the roles of, and cooperation between, government agencies and other entities involved in the preparation of the inventory, as well as the institutional, legal and procedural arrangements made to prepare the inventory, shall establish quality objectives for the national system, establish processes for the independent review, official consideration and approval of national greenhouse gas inventory reports and ensure timely submissions.

The legal notice also provides for the formal designation of an inventory agency. The responsibilities of the inventory agency are laid out in regulation 5 of the Legal Notice as follows:

> *"The Inventory Agency shall, annually, and in accordance with deadlines established by the COP and, or the COP/MOP and deadlines set out in Regulation (EU) No 525/2013, prepare a national greenhouse gas inventory report in accordance with relevant decisions of the COP and, or, the COP/MOP, and Regulation (EU) 525/2013."*

Through a Government Notice (No 1036 of 27th October 2015) published pursuant to this same legal notice, the Malta Resources Authority has been designated as Malta's Inventory Agency. Specific functions relating to inventory preparation and management are laid out in Schedule 2 of Legal Notice 259 of 2015.

2.9 National Registry

According to the Kyoto Protocol reporting guidelines (para 32), each Annex I Party shall provide a description of how its national registry performs functions defined in the annexes to decisions 13/CMP.1[11] and 5/CMP.1[12], and conformity with the requirements of the technical standards for data exchange (DES).

The name of the Registry Administrators designated by the Party of Malta to maintain the national registry are Mr. Saviour Vassallo and Mr. Alexander Said. The contact information of the Maltese National Registry Administrator is the following (+356) 21220720 / (+356) 21240290. The Internet address of the interface to its national registry is https://unionregistry.ec.europa.eu/euregistry/MT/index.xhtml.

Publicly accessible information relating to the registry may be accessed at: https://unionregistry.ec.europa.eu/euregistry/MT/public/reports/publicReports.xhtml.

[11] Decision 13/CMP.1. Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol.
[12] Decision 5/CMP.1. Modalities and procedures for afforestation and reforestation project activities under the clean development
mechanism in the first commitment period of the Kyoto Protocol.

Further information on accounts opened in the Maltese registry may also be accessed through the public page of the European Union Transaction Log (EUTL), at: https://ec.europa.eu/clima/ets/welcome.do;EUROPA_EUTLPUBLI001_PRD_JSESSIONID=dH87SEbDD6CKyHh3R2zy9f_zWJ3eeparkVa8U0gvRot7kisDw8W3!-1210492530.

CHAPTER 3 QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGET

3.1 THE EU TARGET UNDER THE UNFCCC

Under the UNFCCC, the EU and its Member States committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20% 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 joint EU 2020 target together with the 27 EU Member States.

Table 3.1 Key facts of the joint Convention target of the European Union for 2020

Parameters	Objective
Base year	1990
Target year	2020
Emission reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	AR4
Sectors covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
Land Use, Land-Use Change, and Forests (LULUCF)	Accounted under the Kyoto Protocol, reported in EU inventories under the Convention.
Use of international credits (JI and CDM)	Possible, but subject to quantitative and qualitative limits.
Other elements	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

The following assumptions and conditions apply to the EU's 20% target under the UNFCCC:

- The EU Convention pledge does not include emissions/removals from LULUCF, but it is estimated to be a net sink over the relevant period. EU inventories include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol.
- The target refers to 1990 as the single base year for all gases and all Member States.
- Emissions from international aviation to the extent that they are included in the EU Emissions Trading System (EU ETS) are included in the target.
- A limited number of international credits (Certified Emission Reduction (CER) units; Emission Reduction Units (ERUs); temporary CERs (tCERs) or long-term CERs (lCERs) from afforestation or reforestation projects) and units from new market-based

mechanisms may be used to achieve the target. In the EU ETS, the use of international credits is capped (up to 50 % of the reduction required from EU ETS sectors by 2020). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. For emissions under the Effort Sharing Decision (ESD), the annual use of international credits is limited to up to 3% of each Member State's ESD emissions in 2005, with a limited number of Member States being permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.

- The Global Warming Potentials (GWPs) used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the IPCC when the target was submitted. In its submission to clarify the 2020 target from 20 March 2012, the EU announced that the implications of the CMP Decision to revise the GWPs to those from the IPCC Fourth Assessment Report (AR4) are under review. This review has been completed and revised GWPs from AR4 were adopted for the EU ETS. For the revision of ESD targets the revised GWPs were taken into account. For the implementation until 2020, GWPs from AR4 will be used consistently with the UNFCCC reporting guidelines for GHG inventories.
- The target covers the gases CO2, CH4, N2O, HFCs, PFCs and SF6.

3.2 THE EU'S COMPLIANCE ARCHITECTURE FOR 2020

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)[13] and the sectors under the Effort Sharing Decision (ESD)[14]. Binding national targets were set for Member States under the Effort Sharing Decision. 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.

The package of legislation introduced a clear approach to achieving the 20% reduction of total GHG emissions from 1990 levels, with year 2005 chosen as the base year for the internal compliance approach. The 20% target based on 1990 levels translates to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between two sub-targets, separately covering emissions within the scope of the EU's Emissions Trading System and emissions falling within the scope of the Effort Sharing Decision. These two sub-targets are:

- a 21 % reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);

[13] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC; OJ L 275, 25.10.2003.
[14] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas reduction commitments up to 2020; OJ L 140, 5.6.2009.

- a 10 % reduction target compared to 2005 for ESD sectors, shared between the 28 EU Member States through individual national GHG targets.

Additional detail of this legislative package may be found in Malta's 8th National Communication to the UNFCCC, being submitted at the same time as this 5th Biennial Report.

Other targets forming part of the overall package relate to the share of renewable energy (20% of EU energy from renewables) and energy efficiency (20% improvement in energy efficiency). All the targets forming part of the 2020 climate and energy package were adopted by the Heads of Government of the EU Member States in 2007, giving them a solid policy basis.

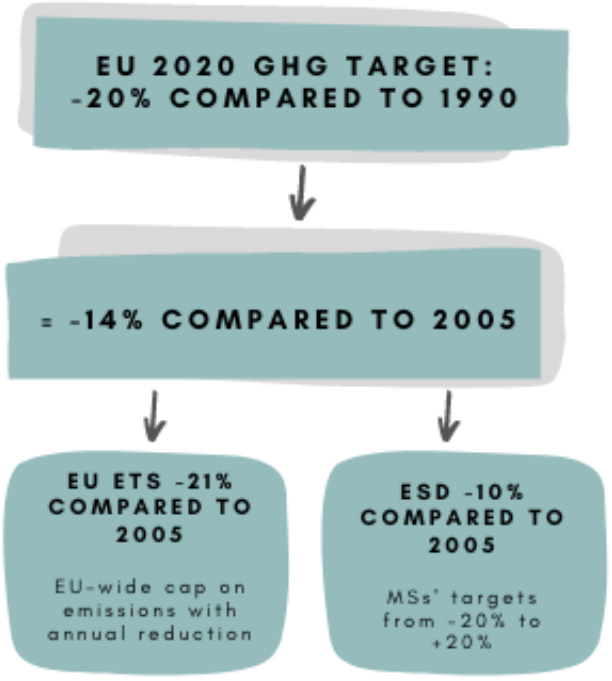


Figure 3.1 Achieving the EU 2020 GHG objectives

In the context of the overall goals of the package, the EU ETS Directive[15] was amended[16] with a view to achieving a more harmonized approach. A single cap on the total allowances to be made available for all the stationary installations participating in the system is set, covering all the EU Member States and the three additional participating non-EU Member States, Norway, Iceland and Liechtenstein. For the period 2013 to 2020, the cap decreases by 1.74% annually (starting from the average level of allowances issued by Member States for the EU ETS period 2008-2012), thus serving as the principal means of ensuring that these installations reduce their collective emissions. The allowances are made available to operators of installations either through auctioning according to purposely established auctioning rules, or, for eligible sectors and sub-sectors, by free allocation based on harmonized EU-wide rules and criteria. Operators of installations are

[15] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC; OJ L 275, 25.10.2003.

[16] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community; OJ L 140, 5.6.2009.

required to annually monitor, and report verified emissions, and to surrender sufficient allowances to account for all reported emissions. Operators may buy allowances if they have a shortfall of allowances, or, if they have a surplus, sell allowances. A limited quantity of international credits may also be utilized, subject to the credits used meeting the applicable quality criteria.

Emissions from domestic and international aviation activities, to or from, or within EU countries had been incorporated into the EU ETS by a previous amendment to the EU ETS Directive. In this manner, aviation is also giving a fair and tangible contribution towards mitigation of climate change. In order to facilitate subsequent negotiations that started within the International Civil Aviation Organization (ICAO), leading to the adoption of rules on a global market-based system for international aviation, the EU later decided to limit the monitoring, reporting, verification and accounting obligations only flights within the European Economic Area

The EU ETS is estimated to cover around 45% of European Union greenhouse gas emissions. The remaining 55% of domestic emissions fall within the scope of the Effort Sharing Decision [17] (ESD; that is, all non-ETS emissions, not including emissions from domestic aviation and emissions and removals from land use, land-use change and forestry. The ESD thus covers a diverse range of emitters: transport (road, national navigation), buildings, small industrial installations, fugitive emissions from the energy sector, fluorinated gases, agriculture and waste.

The ESD emissions reduction objective requires national-level reduction or limitation efforts in accordance with targets set for individual Member States. These targets are expressed are percentage changes by 2020 compared to Member State's respective 2005 emission levels, translated into binding quantified annual emission trajectories for the years 2013 to 2020, and quantified into absolute Annual Emission Allocations (AEAs) [18] [19]. The percentage 2020 targets of Member States range from the most stringent 20% reduction obligation for Luxembourg, Denmark and Ireland to the least stringent 20% limit on the increase in emissions for Bulgaria. The targets were determined as a correlation with the economic situation of each Member State, with GDP/capita as a proxy criterion, with the more prosperous States having the more negative (i.e. reduction) targets and those Member States with a less developed economic status having the positive (i.e. limited increase) targets (Figure 3.2).

Achieving the ESD targets is mainly expected to come from domestic action by the individual Member States. Where this is not possible, a number of flexibility mechanisms facilitate compliance with the targets: these mechanisms include the possibility to acquire additional AEAs from States with a surplus (emission in a year being lower than the annual emission allocation for that year) and use these to account for those emission exceeding the target, or the limited use of international credits (up to 3% of the Member States' ESD emission in 2005; in total, around 750 million credits may be used by all Member States throughout the 2013-2020 period).

[17] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas reduction commitments up to 2020; OJ L 140, 5.6.2009.

[18] Commission Decision 2013/162/EU of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council; OJ L 90, 28.3.2013.

[19] The AEAs set in Commission Decision 2013/162/EU were subsequently adjusted, in accordance with Decision 406/2009/EC, as published in Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period 2017 to 2020; OJ L 209, 12.8.2017.

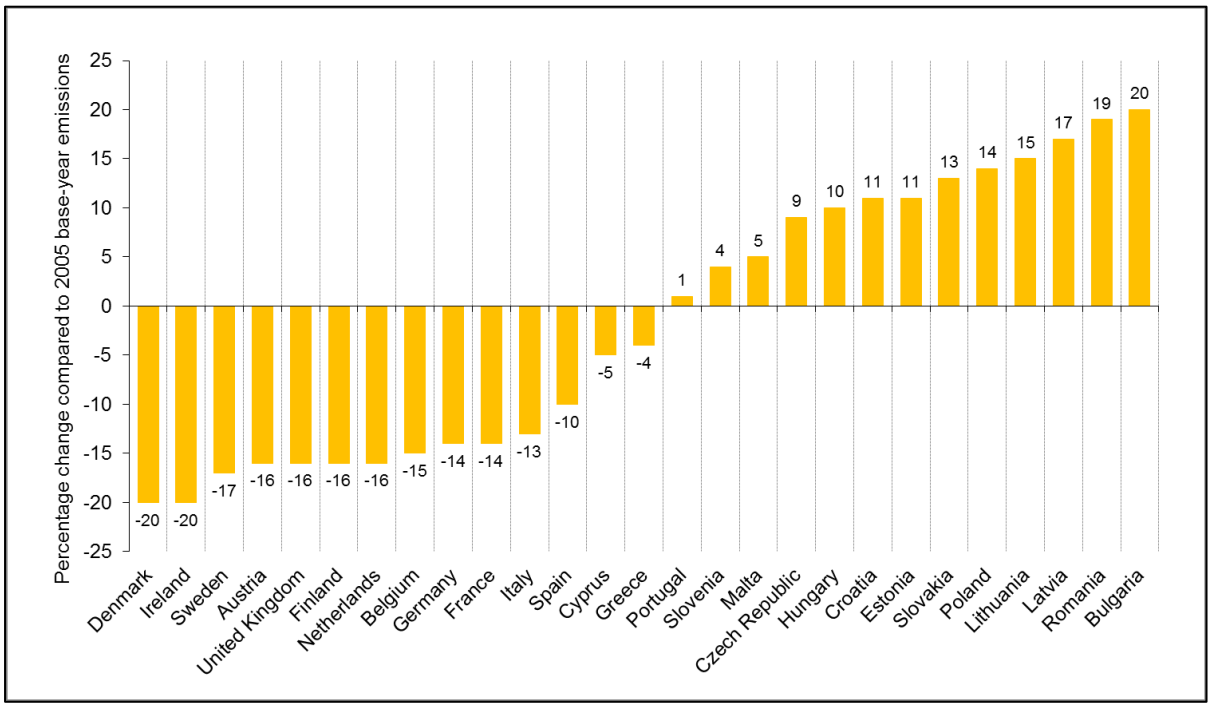


Figure 3.2 National 2020 GHG emission limits under the ESD, relative to 2005 emissions levels

(adapted from Decision 406/2009/EC).

3.3 MONITORING OF PROGRESS TOWARDS THE 2020 GHG TARGETS

The monitoring and assessment of progress towards the overall 2020 greenhouse gas emission targets are underpinned by the monitoring mechanisms established by EU law.

Robust monitoring of emissions is an inherent part of the EU ETS process. Operators of stationary installations and aircraft operators are required to monitoring their EU ETS emissions in accordance with approved monitoring plans, meeting the requirements set out in law[20]. Reports must be verified by independent, competent verification bodies holding a formal accreditation from the accreditation body of an EU Member State.

Assessment of progress towards Member States' respective targets is based on a comprehensive reporting system, including annual inventories of greenhouse gas emissions and removals and biennial reporting on policies and measures and on projections. Legal requirements for such reporting are established through the Monitoring Mechanism Regulation[21] and related subsidiary legislation. Compliance with annual ESD targets is established through the annual greenhouse gas inventory submissions, subject to a European peer review procedure. The European Commission also assesses, on an

[20] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emission pursuant to Directive 2003/87/EC of the European Parliament and of the Council; OJ L 181, 12.7.2012). Verification and accreditation requirements under the EU ETS are established by Commission Regulation (EU) 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council; OJ L 181, 12.7.2012.

[21] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to the climate change and repealing Decision NO 280/2004/EC; OJ L 165, 18.6.2013.

annual basis, the progress being made by the Union collectively, and by the member States, with a view to determining the progress being made in respect of international commitments.

3.4 MALTA AND THE 2020 GHG TARGETS

Malta is party to the collective European Union efforts to achieve the joint EU economy-wide emissions reduction target of 20% compared to 1990 emission levels, by 2020.

The existing energy industry plants fall within the scope of the EU Emissions Trading System and are thus subject to the monitoring and reporting and emission accounting obligations of the EU ETS, in respect of carbon dioxide emissions. There are no other industrial activities in Malta that are in the EU ETS. These plants are the same electricity generation installations that account for the emissions reported under activity category Energy Industries in Malta's greenhouse gas inventory.

Aviation emissions to or from the Maltese airport are also subject to the requirements of the EU ETS Directive as applied to aviation activities. Other than activities that are exempted from the EU ETS by virtue of exemptions set out in the EU ETS Directive, flights to or from Malta operated on intra-EEA routes are monitored and reported to the relevant State administering the respective operators.

Under the Effort Sharing Decision, Malta's target was to limit its emissions growth to not more than 5% over 2005 emission levels by 2020. As already discussed above, this target applies to national emissions not covered by the EU ETS, and also excluding carbon dioxide emissions from domestic aviation and emissions or removals relating to LULUCF. The 2020 ESD target translates into a linear trajectory of binding quantified annual emission allocations for the years from 2013 to 2020, the trajectory starting from 2009 on the average of (ESD) greenhouse gas emissions during 2008, 2009 and 2020 and ending in 2020 on the 5% limit. The quantified AEAs for Malta are presented in Table 3.2 [22].

The flexibility mechanisms available to Malta for meeting its annual ESD targets, in case emissions cannot be domestically maintained within the limits set by the annual emission allocations, include:

- utilisation of AEAs acquired from other Member States;
- annual use of international credits from project activities up to a quantity equal to 3% of the (ESD) greenhouse gas emissions figure for 2005, which would be equivalent to a total of around 264 kilotonnes CO_2 equivalent over the entire period.

Table 3.2 Annual emission allocations of Malta, under the Effort Sharing Decision

Annual emission allocation (tonnes CO_2 eq.)							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
1 168 514	1 166 788	1 165 061	1 163 334	1 174 524	1 173 666	1 172 808	1 171 950

It is worth noting that after the adoption of the 2020 Climate and Energy Package, the EU later adopted a new suite of legislative instruments intended towards reaching the objective of a domestic 40% reduction in overall EU greenhouse gas emissions, compared to 1990 levels, by 2030, in the context of the EU strategy towards achieving a low-carbon

[22] AEA values sourced from Commission Decision 2013/162/EU and, as adjusted for years 2017 to 2020 in accordance with Decision 406/2009/EC, from Commission Decision (EU) 2017/1471.

economy by 2050. The EU's ambitions were subsequently further enhanced in the form of the concept of climate neutrality by 2050, requiring a concerted and more ambitious effort towards decarbonisation of the Union's economy. This meant that the 2030 GHG emissions mitigation ambitions also had to be increased. At the time of preparing this report, the European Union institutions are finalizing a new package of legislation directed towards the achievement of a domestic 55% reduction in overall EU greenhouse gas emissions, by 2030, over 1990 levels (the so-called Fit-for-55 Package)[23].

In the context of both the 40% reduction and 55% reduction objectives, Malta's emission mitigation obligations under the Effort-sharing Regulation (replacing the ESD) is set as a 19% reduction in emissions covered by the ESR (same scope as for the ESD) by 2030, compared to 2005 emissions levels. Furthermore, the LULUCF Regulation requires Malta, as is also the case for the other EU Member States, to achieve a 'no debit' status, that is that by 2030, emissions from the LULUCF sector must be at least offset by removals from the same sector.

[23] A detailed presentation of the evolution of EU greenhouse gas emissions mitigation policy is provided in the 8th National Communication to the UNFCCC (chapter 4 thereof), submitted at the same time as this 5th Biennial Report.

CHAPTER 4 PROGRESS IN ACHIEVEMENT OF QUANTIFIED ECONOMY-WIDE EMISSIONS REDUCTION TARGETS AND RELEVANT INFORMATION

The UNFCCC asks Parties to adopt policies and measures aimed at limiting or reducing greenhouse gas emissions by sources, and to enhance the removal effect of sinks. This requirement was furthermore inscribed in EU legislation, with the Monitoring Mechanism obliging all Union Member States to report, on a biennial basis, on policies and measures implemented, adopted or planned to control emissions of greenhouse gases.

This chapter looks at the suite of policies and measures adopted in Malta which directly or indirectly address greenhouse gas emissions and removals. This discussion, and thus also the discussion in the subsequent chapter on projections, presents and reflects the state of play of greenhouse gas mitigation policies and measures as at the end of 2021.

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 + UK compared to the base year 1990 or 1.94 billion tons of CO_2eq.

4.2 POLICY CONTEXT

The overarching policy context up to 2012 has to be seen in light of the fact that Malta had not taken on any greenhouse gas emission limitation or reduction obligations in the context of the UNFCCC or the Kyoto Protocol. With the agreed extension of the Protocol until 2020, this situation changed, with a target of 20% reduction in overall greenhouse gas emissions, as compared to emission levels in 1990, inscribed for Malta in respect of the Second Commitment Period under the Protocol. This target reflects the overall 20% reduction commitment, compared to 1990, that the EU has made as its contribution towards global efforts to control greenhouse gas emissions until 2020.

Malta's strategic direction promotes the transition to a low-carbon economy, primarily through the pursuit of upholding national GHG emissions reduction commitments, and by continuing to deploy all viable indigenous renewable energy sources.

The Climate Action Act of 2015 (CAP 543[24]), establishes the main legal framework for climate change mitigation and adaptation in Malta. It aims to provide for action that contributes to the mitigation of climate change by limiting anthropogenic emissions of greenhouse gases and protecting and enhancing greenhouse gas sinks and reservoirs, and to contribute to the prevention, avoidance and reduction of the adverse impacts of

[24] http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12336&l=1

climate change and the reduction of vulnerability, enhancement of resilience, and adaptation to the adverse effects of climate change.

The Climate Action Act defines the duties and obligations of citizens and of the Government of Malta with respect to climate action, together with guiding principles for the fulfilment of such duties and obligations. *Inter alia*, the Act makes it the duty of "*every person together with the Government to protect the climate and to assist in the taking of preventive and remedial measures to protect the climate*". The Government shall also "*formulate, implement, publish and update policies regarding measures to mitigate climate change by limiting, and, to the extent possible, reducing anthropogenic greenhouse gas emissions by sources, and by enhancing removals of greenhouse gases by sinks*".

The Act requires the periodic preparation of a Low Carbon Development Strategy and a National Adaptation Strategy and provides for regular review and updating of these strategies. It also establishes a Climate Action Board, which shall, among others, supervise the implementation of the provisions of the Act and monitor the fulfilment by all relevant parties of their respective duties under the Act. The Act further establishes a Climate Action Fund, to support climate action in Malta. Powers are given to the Minister responsible for climate action to enact regulations under this Act.

Malta's contribution towards the EU's 2020 and 2030 emission reduction objectives is achieved through the compliance by a number of large local installations under the EU Emissions Trading System (ETS), and by compliance with the obligations for Malta under the Effort-sharing Decision (in respect of the period 2013-2020), and the Effort-sharing Regulation[25] (ESR; in respect of the period 2021-2030).

The quantified target inscribed for Malta in the ESD is a limit of 5% increase on emissions (excluding emissions covered by the EU ETS, emissions from domestic aviation, and emissions/removals related to LULUCF) by 2020 compared to 2005 levels. The current iteration of the ESR as in force, reflects the EU's collective target of 40% reduction of GHG emissions by 2030 compared to 1990 levels, adopted by the European Council in 2014. This translates into a target for Malta of 19% reduction in non-EU ETS emissions by 2030 compared to 2005 emission levels. This target is expected to remain the same even in the context of the higher 2030 ambition, that is the 55% reduction objective for 2030, as the next milestone towards climate neutrality by 2050.

The Energy Union Governance Regulation[26] pushes for an integrated approach to climate and energy policy planning by the Member States, addressing the 5 dimensions of the European Energy Union: dimension Decarbonisation; dimension Energy Efficiency; dimension Energy Security; dimension Internal Energy Market; dimension Research, Innovation and Competitiveness. This requires Member States to prepare a National Energy and Climate Plan (NECP) every ten years, with a mid-term update; and biennial reporting by States on the status of implementation of their NECPs.

[25] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013.

[26] 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 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.

The LCDS, which was published toward the end of 2021, lays out the country's decarbonisation journey up to 2050. The strategy is spearheaded by the Ministry for Environment, Energy and Enterprise (MEEE), with inter-ministerial collaboration. For this strategy, several mitigation measures were researched, possible abatement levels were quantified through a Marginal Abatement Cost Curve (MACC) modelling, and stakeholders were consulted to finally arrive to a list of realistic and cost-effective measures. This strategy is set to help in reaching the targets and obligations set by the Effort Sharing Regulation, as well as other obligations under the EU and Paris Agreement. The LCDS sets out a set of attainable measures, designed with Malta's specificities in mind, to achieve significant reductions by 2050, and meeting the current ESR target in 2030. The national target under the ESR in 2030 is set at 826,687 tCO2eq., equating to a 19% reduction in emissions since 2005. The measures and initiatives have been set to meet this target; indicative milestones in 2040 and 2050 reflect 60% and 80% reductions from 1990 levels, respectively.

4.3 POLICY-MAKING PROCESS

The Malta Resources Authority (MRA) is the entity currently holding the role of compiling biennial Policies and Measures (PAMs) and Projections Reports. The Ministry for the Environment, Energy and Enterprise (MEEE) has overall official responsibility for the reporting.

Information for the preparation of such reports is sourced from various sources, including publicly available policy documents, entities responsible for sectoral policy planning and implementation, and, as already mentioned above, national policy planning documents such as the National Energy and Climate Plan and the Low Carbon Development Strategy (LCDS).

Projections for the Energy sector are the responsibility of the Energy and Water Agency (EWA) and Transport Malta (TM). The MRA has responsibility for the modelling of activity and emissions projections for the sectors IPPU, Agriculture and LULUCF. The MEEE is responsible for the modelling of activity projections related to solid waste management, with the MRA the converting activity data projections into the greenhouse gas emissions projections.

The modelling of emission sources and sinks in the various economic sectors and the estimation of emission projections are based on macroeconomic factors and on the proposed PAMs. Over the past years, these modelling efforts have benefitted from extensive capacity building support provided through projects of the European Commission in the context of initiatives such as those related to the compilation of Member States' first NECPs. These projects have focused primarily on ensuring the building of national capacity for the preparation of the first NECP, including through development of tools for projections, and subsequent review of these tools.

Capacity building support on modelling tools is envisaged to continue during the next years. This will often be linked to capacity building support efforts related to the compilation of annual greenhouse gas emissions inventories. Among these efforts, the emphasis should be not only on the technical aspects of reporting but also on establishing, to the extent desirable, a formalized national system for reporting on policies and

measures and on projections. Such a national system would preferably integrate the different policy planning and reporting efforts arising from the obligations of the Governance Regulation, such as the preparation of integrated NECPs and Long-term Strategies, the reporting of biennial integrated progress reports and the biennial reporting under Article 18 of the Governance Regulation (i.e. this report and the accompanying documentation).

One must appreciate that the reporting obligations arising from the EU acquis, especially where it relates to climate and energy matters is very extensive and places a significant burden on the limited human resources available in a small country like Malta. The emphasis has been on ensuring quality reporting in a timely manner. For the future, the lessons learnt from the structures adopted for the preparation of Malta's NECP, the comprehensive approach used for the preparation of such policy documents and the LCDS and the national environment strategy, and the experience gained with the establishment and maintaining of a national system for the reporting of national greenhouse gas inventories, should provide the building blocks for a sound national system for reporting on policies and measures and on projections.

4.3.1 Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures

A detailed discussion of relevant arrangements and procedures is provided in Chaptr 4 of the 8th National Communication to the UNFCCC, submitted at the same time as this 5th Biennial Report.

In brief, there are two main levels of arrangements: the European Union climate acquis, incorporating the extensive suite of legislation addressing compliance with the obligations arising thereof; the national legislative framework, and in particular, the Climate Action Act (CAO 543). The former sets out obligations on activities falling within the scope of the EU Emissions Trading System and establishes the rules for Member States' compliance with their respective individual ESD targets whilst also providing for flexibility mechanisms to facilitate such compliance. The national framework provides the basis for strategic policymaking across the sectors and activities that contribute towards Malta's efforts in GHG emissions mitigation.

4.4 POLICIES AND MEASURES AND THEIR EFFECT

This section provides an overview of a number of policies and measures that have contributed to national efforts to control emissions, and, as far as possible, achieve economy-wide emission reduction targets. More often than not, one will note that policies and measures described are not specifically intended to address greenhouse gas emissions; it is often the case that the reduction or limitation of emissions from the sector or sectors covered by the particular policy or measure is one of a number of co-benefits of the implementation of a policy or measure, albeit an important benefit.

4.4.1 Policies and Measures - Energy

The Energy sector is the largest contributor to total national greenhouse gas emissions, with emissions from energy industries and transport being the activity categories with the highest share of sector and national emissions.

Malta has no indigenous fossil-based energy resources and depends on imported fuels and electricity, and any indigenous generation from renewable resources, for all its energy needs. Petroleum exploration efforts, started in the 1950's continue to the present, mainly offshore. To-date, no commercially viable discoveries have been made, though good drillable prospects have been identified, yet remain untested. The discovery of commercially viable fossil-fuel deposits around Malta would provide an opportunity for reducing the country's dependence on foreign sources for such energy resources, though reliance on refinery facilities in other countries would remain.

4.4.1.1 Electricity generation and sourcing

Until recent years, the sourcing of electricity was fully dependent on local generation capacity, primarily based on coal (in the seventies, eighties and early nineties), then oil. Since 2017, natural gas-fired plant has come into operation and now meets a substantial part of electricity demand of the country. Meanwhile, what used to be a system completely isolated from any mainland electricity grid, has now been connected to the European grid via an interconnector with Italy. Renewable energy sources have seen a steady growth.

Figure 4.1 presents an overview of the trends of consumption of different fossil fuels in the local electricity generation plants since 2005. Heavy fuel oil was the main energy source until 2016, complemented by smaller quantities of diesel. Generation until 2016 was dependent on two installations, Marsa Power Station and Delimara Power Station. Since then, Marsa Power Station has been largely decommissioned and only one generation unit remains operational, kept on stand-by in case of emergency. The older parts (known as Delimara 1) of the then-Delimara Power Station have also been decommissioned, and the remaining plant split into two distinct commercial entities, Delimara (2) Power Station and D3 Power Plant (D3PP) in 2017. Another generation plant, Delimara 4 CCGT Power Plant and LNG Terminal (D4PP) was commissioned and started operations in 2017, with natural gas as its fuel, and including a floating storage unit to meet the natural gas demands of Delimara 4 and Delimara 3.

The present make-up of local public generation capacity is thus:

- Marsa Power Station: 1 open cycle gas turbine, diesel-fired, total rated thermal input (MW(th)): 121;
- Delimara 2 Power Station: 2 open cycle gas turbines and 2 combined cycle gas turbines, all diesel-fired, total 484 MW(th);
- Delimara 3 Power Plant: 4 combined cycle diesel engines operating on diesel only, 4 dual fuel (diesel or gas) combined cycle diesel engines, total 330 MW(th);
- Delimara 4 Power Plant: 3 combined cycle gas turbines, gas-fired, total 432 MW(th).

Trends of consumption of the different fossil fuels prevalent for the period 2005 till 2020, and related emissions of carbon dioxide are presented in Figure 4.1.

The existing conventional power generation capacity is complemented by a 200MW (220kV HVAC) submarine cable laid between Malta and Sicily (Italy), providing greater

flexibility in the sourcing of electricity within the context of security of supplies. The first sourcing of electricity through this interconnector was in 2015, peaking in 2016, and then decreasing somewhat as the new local generation plants came into operation.

The combination of new generation plant and utilisation of the interconnector has seen the emissions intensity of electricity generated in Malta (without accounting for electricity generated through renewables) decrease from 0.81 $kgCO_2/kWh$ in 2005 to 0.40 $kgCO_2/kWh$ in 2018.

Important future developments in energy generation in Malta would be the laying of a gas pipeline connecting Malta with the European gas network and the laying and commissioning of a second interconnector to Europe. These projects are currently undergoing the necessary technical assessments with a view to the taking of final decisions and proceeding with the actual works.

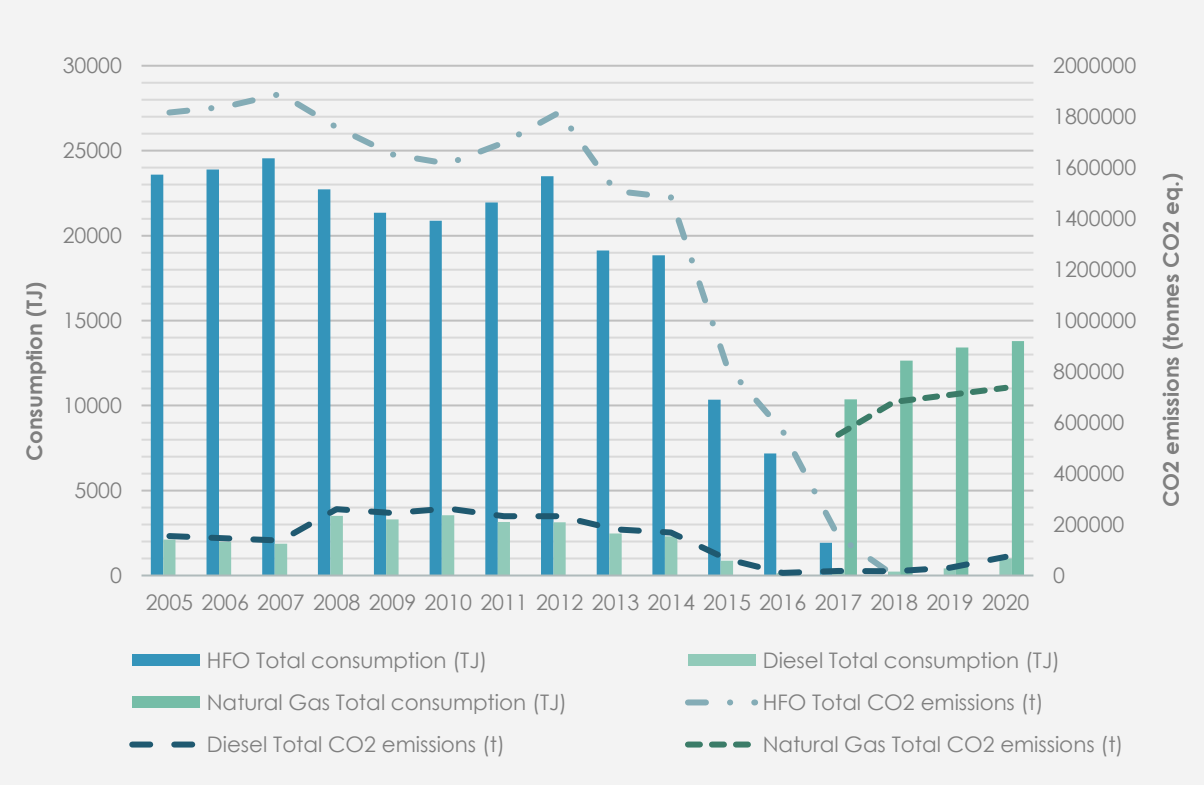


Figure 4.1 Trends in consumption and CO_2 emissions for Heavy Fuel Oil (HFO), Diesel and Natural Gas used in conventional electricity generation in Malta's power stations, for the years from 2005 to 2020 (adapted from data submitted by operators of electricity generation plants in accordance with reporting requirements pursuant to the EU ETS Directive).

4.4.1.2 Renewable energy sources

Sourcing of energy from indigenous renewable energy sources (RES) is mainly via electricity generation by solar photovoltaics and the replacement of grid electricity for water heating in solar water heaters. In line with Directive 2009/28/EC[27], Malta is required to meet a 10% renewable energy share in gross final consumption of energy by 2020.

[27] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC; OJ L 140, 5.6.2009.

Malta is expected to meet its target mainly through indigenous sources and through the use of statistical transfers. A higher-than-envisaged increase observed in electricity and energy demand in the very short term reflects the overall increase in population and economic and tourist activity. Efforts to increase the renewable energy share are ongoing: the share of renewable energy in relation to gross final electricity consumption is estimated to have reached 6.6% by 2017. The full exploitation of RES within the technical and geographical limitations of a small country with a high population density is however not enough to keep up with the steep increase in demand, due to the increase in population, increased tourism activity and relatively high economic growth.

The National Renewable Energy Action Plan of 2017[28] sets out the RES mix that is expected to deliver the 10% target by 2020, the trajectory towards 2020 and the measures to reach the target. A number of underlying principles have been defined, including, among others:

- RES obligations to be honoured;
- Energy efficiency to be a priority;
- RES can contribute to a green economy through the creation of green jobs;
- A holistic approach should be taken when considering RES and conventional energy sources;
- Aiming towards full exploitation of a mix of indigenous RESs;
- Cooperating with other countries and use of flexibility mechanisms provided for in EU law to address any shortfalls in reaching the 2020 RES target;
- Improving the knowledge base and supporting research and innovation; and,
- Incentivizing investment in renewable energy technologies.

Solar photovoltaics (PV) are deemed to be the most viable and robust indigenous form of renewable energy. Uptake of this technology has been high in all sectors: industry, commercial and residential. Financial support by central government is currently provided through grants towards the capital investment involved. Further initiatives part of loans for the installation of solar PV (and solar water heating) as part of loans, providing access to communal PV farms to consumers who cannot themselves directly invest in PV technology, and working with stakeholders in the construction and real estate sectors to incentivize the inclusion of PVs in new or newly refurbished buildings.

Solar water heaters offer another opportunity for investment in RES. In fact, a number of grant schemes facilitated a high rate of installations of solar water heaters every year, though this has seen a gradual increase in recent years, primarily due to increased preference for PVs and market saturation.

Wind energy is another potentially significant source of energy. Large wind farm installations could have a significant contribution towards meeting Malta's renewable energy targets; however, proposals made to-date have been shown to not be financially or environmentally feasible. Uptake of micro or medium sized win turbine technology has been limited mainly to a number of installations for research purposes, with further uptake constrained by uncertainties about energy yields, relatively high installation costs and planning permitting issues.

Waste is also considered as a potential source of energy, with several initiatives already in place or planned to be in place shortly, including the generation of energy from biogas

[28] The National Renewable Energy Action Plan 2015-2020; The Energy and Water Agency, 2017 (accessed at: https://ec.europa.eu/energy/en/topics/renewable-energy/national-renewable-energy-action-plans-2020).

produced in waste treatment facilities. Planning is also currently in hand for a major waste incineration facility which will also be capable of generating electricity.

4.4.1.3 Energy efficiency

The National Energy Efficiency Action Plan of 2017 (NREAP-2017)[29], determines the energy efficiency savings projected for 2020, to be met via four main policy approaches:

- energy efficiency obligation on the national electricity supplier, to apply a progressive (rising block) residential tariff system which would incentivize efficient use of electricity, facilitated by nation-wide smart metering, which is nearing completion;
- financial support and fiscal incentives for economic (industrial, commercial, residential and transport) sectors to adopt energy efficient technologies;
- regulatory action and voluntary agreements with high energy consumers, encouraging them towards energy efficient technologies and practices; and,
- the public sector leading by example with government and public entities practicing energy efficiency.

The energy efficiency measures discussed in the NREAP-2017 are estimated to lead to a cumulative end-use energy saving in 2020 of 934.7 GWh.

4.4.2 Transport

While it is an activity category with a relatively high share of total national greenhouse gas, transport may potentially offer a substantial contribution towards the reduction of emissions.

The National Transport Strategy sets out the vision for transport in Malta, with a view towards 2050. A number of key strategic goals are identified:

- transport to support economic development;
- transport to promote environmental and urban sustainability;
- transport to provide accessibility and mobility;
- transport to support social development and inclusion;
- transport to remain safe and secure; and,
- transport to work towards improved public health.

The goals of the Transport Strategy are further developed, for the short to medium term, through the 'Transport Master Plan 2025'[30]. The Master Plan sets operational objectives for different modes of transport for the period up to 2025 guided by principles such as: efficient utilisation of the existing transport system; creating modal shift; integrated approach to planning and design; encouraging use of greener fuels and vehicles; modernisation and development of the transport network; investing in education, information, human resources, research and innovation; and, ensuring sustainable financing. Among the measures identified, which are already being implemented or are planned for implementation in the near future, the following may be mentioned:

[29] Malta's National Energy Efficiency Action Plan; Office of the Prime Minister (Energy & Projects), 2017 (accessed at: https://ec.europa.eu/energy/sites/ener/files/documents/mt_neeap_2017.pdf).

[30] Transport Master Plan – 2025; Transport Malta, 2016 (accessed at: https://www.transport.gov.mt/strategies/strategies-policies-actions/national-transport-strategy-and-transport-master-plan-1343.

- free school transport for primary and secondary school students, free use of public transport for youths and students between 16 and 20 years old, and extension of free public transport services for the elderly;
- infrastructural improvements to the existing road network, including a number of projects in key areas as part of the TEN-T network that will ensure smoother vehicle passage and, among others, lead to a reduction in emissions;
- support to car sharing and transport on demand schemes;
- incentivizing cycling through infrastructural improvements in the road network (e.g. integrating dedicated cycle lanes in road improvement projects) and financial support for the acquisition of bicycles;
- provision of ferry services between towns located around the major harbours (e.g. Valletta to Sliema) and improvements in ferry services provided between Malta and Gozo.

A potentially significant development in the road transport sector will be the decision, due in the forthcoming future, on a date after which internal combustion engine cars will no longer be placed on the Maltese market. The necessary studies and consultations are currently ongoing to come to a final decision. This may be expected to, among others, drive the shift to electrification, complemented by other actions already being taken, such as financial grants and fiscal support measures by the government in favour of the purchase of electric vehicles and infrastructural works to install charging points. Complementary actions include government grants for the scrapping of conventional internal combustion engines and purchase of electric vehicles, reduced circulation tax rates for electric vehicles compared to conventional vehicles, reduced registration fees, priority parking near charging points and preferential incentives with respect to controlled vehicular access areas and use of bus lanes.

The use of biofuels in road transport is supported by the introduction, in 2011, of a substitution obligation on importers and wholesalers of automotive fuels, with a 10% share of biofuels in road transport fuels expected by 2020. The approach being used at present in the blending of biodiesel and hydrotreated vegetable oil (HVO) with diesel. On the other hand, bioethanol is currently not used, due to the warm Maltese climate which creates technical difficulties for the blending of bioethanol with petrol. The addition of bioethanol to petrol in low percentages increases the vapour pressure of the fuel blend and therefore increases the possibility of emissions of benzene and volatile organic compounds, particularly in high ambient temperatures. Therefore, unless petrol with a sufficiently low Reid Vapour Pressure (RVP) is readily available in relatively small volumes and competitive prices, the warm climate in Malta would drive the vapour pressure of bioethanol-petrol blends above the limit determined by EN 228.

The use of Autogas as a fuel in vehicles is underpinned by legislative instruments regulating the retrofitting of conventional vehicle engines to Autogas use, complements by codes of practice for installers. A number of service stations have also installed Autogas storage and dispensing facilities while owners of petrol vehicles who wish to convert to Autogas may benefit from rebates on the cost of conversion.

Information technology is an important element in supporting efficient mobility. A number of initiatives are being taken or are planned, including:

- intelligent transport system, encompassing a number of independent systems such as closed-circuit television network covering a number of key areas, dynamic message sign network, electronic parking guidance systems, urban traffic

management and control systems and flood alert systems in flood-prone urban areas;
- deployment of a national traffic control centre to manage transport across all the country and facilitate transit of buses;
- controlled vehicular access system put in place in the capital city (Valletta), which is very prone to traffic congestion due to being a major administrative and commercial hub.

In addition, the promotion of e-working and teleworking, initiatives established towards incentivizing a modal shift, particularly towards mass public transport modes and initiatives taken by individual organisations and entities, such as green travel plans implemented by the University of Malta (a major educational institution in Malta with a large student population concentrated in one localized campus), further complement the measures already mentioned above.

Domestic aviation in Malta is limited mainly to irregular flights between Malta and Gozo, flight schools and private flying for leisure and recreative purposes, in all instances using small aircraft. Overall emissions from domestic aviation are minimal.

International aviation, on the other hand, is a crucial means of transport from and to the Maltese Islands, being a mainstay of the local tourism industry, business-related travel, carriage of goods and having an important social dimension as it allows the Maltese population easy and ready access to the world. From a policy perspective, it is to note that many international flights to or from Malta's sole international airport would fall within the scope of the EU's Emissions Trading System as applied to aviation activities. Indeed, several aircraft operators based in Malta and providing international aviation services are subject to the obligations (monitoring and reporting of annual verified emissions; surrender of allowances to account for reported emissions) of the EU ETS. Similarly, flights to or from Malta performed by other operators who fall within the scope of the EU ETS are subject to the same obligations, these obligations being incumbent on the operators performing such services and as attributed to Member States for administrative purposes in accordance with attribution criteria set out in the EU ETS Directive.

Malta has, together with the other EU Member States, declared a commitment to start implementing ICAO's Carbon Offsetting and Reduction System for International Aviation (CORSIA) as of the start of this global market-based measure in 2021. CORSIA will require aeroplane operators performing international flights to monitor and report annual verified emissions and to offset emissions, above a pre-determined baseline, with the overall aim being of limiting international aviation emissions to a level not higher than 2020 levels. Implementation preparatory work for CORSIA are already in hand, underpinned by the legislative framework set out at EU level. Again, several local aeroplane operators will fall within the scope of CORSIA and will have obligations accordingly. Most international flights to and from Malta will be within the scope of CORSIA and thus subject to monitoring, reporting and offsetting obligations.

The maritime sector is another important economic activity which has a long historical association with Malta and provides a critical economic and social service to the country. The maritime sector is dominated by international activities relating largely to the transport of goods and fuel bunkering services. The tourism sector also benefits, with Malta serving

as an important hub, or stop-over, place in the Mediterranean for a number of major cruise line companies.

As of 1 January 2018, large ships over 5 000 gross tonnage loading or unloading cargo or passengers at ports in the European Economic Area were required to monitor and report their related carbon dioxide emissions and other relevant information. The relevant obligations are set out in Regulation (EU) 2015/757[31] (Shipping MRV Regulation). The Shipping MRV Regulation provides for three main implementation steps:

- Monitoring: From 1 January 2018, shipping companies monitor, for each of their ships undertaking maritime transport activities to or from port in the European Economic Area: CO_2 emissions, fuel consumption and other parameters, such as distance travelled, time at sea and cargo carried on a per voyage basis;, so as to gather annual data into an emissions report submitted to an accredited MRV shipping verifier.
- Emissions reporting: From 2019, and each year, companies submit an annual emission report to an accredited shipping MRV verifier, and subsequently report to the European Commission and to the State in which each ship is registered (the flag State) verified data from their maritime activities covered by the Regulation's geographical scope;
- Document of compliance: From 2019, companies are to ensure that all their ships that have performed activities to or from ports in the European Economic Area carry on board a document of compliance, with Member States' authorities checking fulfilment of this obligation by inspections on ships.

The MRV Regulation in itself may not directly lead to reductions in emissions from maritime activities; however, it will provide a crucial basis for future policy making in this area, as it will provide the data necessary for the European Union to decide whether, and if so, to what extent, tangible objectives may be set out for the maritime sector. In fact, the MRV Regulation is but the first step in the three-step strategy for the maritime sector that the EU is contemplating: MRV; greenhouse gas reduction targets for the shipping sector; further measures, including market-based measures in the medium to longer term.

There are important synergies between the EU strategy on maritime transport activities and recent development at the international level. The International Maritime Organization (IMO) has established an IMO Data Collection System. This system requires owners of large ships, engaged in international shipping, to report information on fuel consumption of their ships to the respective ship flag State. The flag States then report aggregated data to the IMO, which shall produce an annual summary report to the IMO Marine Environment Protection Committee (MEPC). This system started operating in 2019, with the first annual monitoring cycle. So as to take into account these international developments, the EU's Shipping MRV Regulation is currently undergoing a revision to align it to the international system.

[31] Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC; OJ L 123 19.5.2015.

4.4.3 Policies and measures – Industrial Processes and Product Use (IPPU)

A justification of action in the IPPU sector is two-fold: this sector has an important share overall total national greenhouse gas emissions; and, emissions from this sector see a high rate of increase year-to-year. Trends in this sector are dominated to a very high extent by emissions of fluorinated gases, especially HFCs from refrigeration and air conditioning equipment. Refrigeration and air conditioning are crucial for the type of climate that Malta experiences, and such equipment is ubiquitous in industrial, commercial and residential sectors.

The measure that would be expected to contribute most to the limitation and reduction of emissions of fluorinated gases is the EU's F-gas Regulation: Regulation (EU) No 517/201432. The Regulation aims at transitioning the market towards untilisation of F-gases with lower global warming potentials, while setting end-dates for the placing on the market of gases with high global warming potential. It also establishes a pan-EU ssystem of quotas for the production and importation of F-gases, while also sets out mimum qualification requirements for technical personnel involved in the handling of such gases (e.g. for technicians involved in the servicing of refrigeration and air-conditioning equipment). The F-gas Regulation have been implemented locally by Legal Notice 143 of 201833.

4.4.4 Policies and measures – Agriculture

Future GHG emission trends in the agriculture sector may be influenced both by measures taken to directly address emissions or measures that indirectly contribute towards decreasing emissions, and by inherent trends in activity in the sector. The restructuring of the animal husbandry sector to conform to animal welfare, food safety, veterinary and waste management requirements, will lead to both direct and indirect reductions in emissions, in particular with more efficient practices.

Addressing Malta's obligations under EU legislation, particularly the Nitrates Directive (91/676/EC)[34], N_2O emissions from the use of fertiliser is expected to decrease over time as improved cultivation practices are adopted, mainly through the Nitrates Action Programme (more information is provided below). Furthermore, Malta benefited from the European Agricultural Fund for Rural Development, a financial instrument under the reform of the Common Agricultural Policy with the aim of strengthening the EU's rural development policy and simplifying its implementation.

The Agricultural Policy for the Maltese Islands 2018-2028[35], published in 2018, identifies six strategic policy objectives which form the basis for the development of policy measures in the short to medium term. These strategic policy objectives are:

- Food presentation, labelling and traceability;
- Consolidation of land holdings;
- Sustaining water and key resources;

32 Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation EC) No 842/2006;
33 Fluorinated Greenhouse Gases (Implementing) Regulations (Subsidiary Legislation 427.94): http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12826&l=1.
34 Directive 91/676/EC on the protection of waters against pollution caused by nitrates from agricultural sources.
35 Agriculture Policy for the Maltese Islands 2018-2028; Parliamentary Secretariat for Agriculture, Fisheries and Animal Rights, 2018; https://agriculture.gov.mt/en/agric/Pages/nationalAgriPolicy.aspx.

- Competitiveness and diversification;
- Adaptation to and mitigation of geo-climatic conditions; and
- Research and development.

Most of these strategic objectives have an important climate dimension, not least the objectives 'sustaining water and key resources' and 'adaptation to, and mitigation of, geo-climatic conditions'.

The policy also includes seventy policy measures organised in four sets of operational objectives, namely economic objectives, social regeneration, resources and governance. The quantification of the effect of these policy measures has yet to be developed and at this stage it is not possible to quantify directly the impact on greenhouse gas emissions of these measures.

Farm waste management in Malta is governed by the requirements of several EU Directives, in particular the Nitrates Directive as transposed into national law. The relevant national legal instruments provide for the designation of the entire territory of Malta and Gozo as Nitrate Vulnerable Zones, the formulation of Code(s) of Good Agricultural Practice and the preparation of Action Programmes in respect of the designated vulnerable zones. The Waste Framework Directive 2008/98/EC, as transposed by the Waste Regulations, 2011 (L.N. 184 of 2011), is also to be complied with.

National agriculture waste management planning requires the development of a national system for manure management which will address a number of market failures, including the insufficient availability of cultivated land where manure can be applied, the vulnerability of the entire territory to nitrates contamination and the practical difficulties faced in terms of appropriate manure management by the typically small and fragmented farm holdings in Malta. Several research studies are also currently being conducted by the recently established Governance of Agricultural Bio-resources Agency to analyse possible ways of managing manure. An amount of liquid manure from cattle farms and dry manure from poultry farms is also treated in the Malta North Mechanical Biological Treatment (MBT) facility which started operations in 2016.

This Malta Nitrates Action Programme [36] addresses the protection of waters against pollution caused by nitrates from agricultural sources. This may also contribute towards the limitation of emissions of nitrous oxide from agriculture activities. The drawing up of a Code of Good Agriculture Practice (CoGAP) for Malta [37] is an important action towards controlling nitrates from the agriculture sector in accordance with the EU's Nitrates Directive. Further complementary measures include the formulation of fertilizer plans, an information and communication campaign (InfoNitrates LIFE+ Project) on the good use and management of nitrates in crop cultivation and livestock husbandry in Malta, training to and ongoing monitoring of farmers to ensure that the application of fertilisers is in compliance with relevant provisions, and the setting up of a Nitrates Database for the registration of farm holdings and better control of nitrates in the sector.

36 Nitrates Action Programme – Malta; 2011; https://agriculture.gov.mt/en/agricultural_directorate/Pages/nitratesActionProg.aspx

37 The Maltese Code of Good Agricultural Practices; Agricultural Services and Rural Development Division, 2003; https://agriculture.gov.mt/en/agricultural_directorate/Documents/nitratesActionProgrammeRegulations/ntr001.pdf

The Rural Development Programme (RDP) 2014-2020 [38] has climate mitigation and adaptation actions as one of the main cross-cutting objectives. The RDP 2014-2020 identified five 'themes':

- Theme 1: Water, wastes and energy: improving sustainable use and generating renewable energy;
- Theme 2: Maltese quality produce: improving quality, traceability, strategic marketing, adding value, branding and promotion;
- Theme 3: Sustainable livestock: improving resource efficiency, competitiveness and productivity, and welfare;
- Theme 4: Landscape and environment: managing habitats and features; and,
- Theme 5: Wider rural economy and quality of life: developing rural tourism, rural skills and promoting social inclusion;

themes 1, 3 and 4 of which have a direct, or at least indirect, relationship with climate action policy. Under these themes a number of measures relating to climate change were developed:

- Measure 2 - advisory services, farm management and farm relief services: this covers advisory services and training to farmers on such topics as water management, nutrients budgeting and management of fertiliser application, organic waste, improving soil management and the relationship with the wider biodiversity;
- Measure 4 – investments in physical assets: provides support for more efficient water-saving devices and systems in farms, improving water and waste storage and better waste handling and collection facilities and processes;
- Measure 11 - organic farming: provides support to farmers already practicing or interested in starting organic farming, taking into consideration the specific context of the Maltese agriculture sector, such as the small size of fields and fragmentation of cultivated land, the risk of cross-contamination from agricultural practices in neighbouring holdings and the climatic conditions which may make it more difficult to control and contain certain pests and diseases in an organic manner;
- Measure 16 – Cooperation: supporting joint action between different actors in the agricultural sector in such areas as climate change and bioenergy.

4.4.5 Policies and measures – Land Use, Land Use Change and Forestry

The LULUCF sector's contribution towards the EU's overall greenhouse gas mitigation effort is governed primarily by Decision No 529/2013/EU[39] and Regulation (EU) 2018/841[40].

Regulation (EU) 2018/841 in particular, requires EU Member States to ensure that any greenhouse gas emissions from land use, land use change or forestry are offset by at least

38 https://eufunds.gov.mt/en/EU%20Funds%20Programmes/European%20Agricultural%20Fund/Documents/RDP%202014-2020/Malta%27s%20Rural%20Development%20Programme%202014-2020.pdf

39 Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities; OJ L 165, 18.6.2013.

40 Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU; OJ L 156, 19.6.2018.

an equivalent removal of CO_2 from the atmosphere, the so-called 'no debit' rule, in the period 2021 to 2030. Accounting under the LULUCF Regulation is split over two compliance periods, 2021 to 2025 and 2026 to 2030, with Member States being required to show that over each of these compliance periods, they are abiding by the no debit rule. If this cannot be achieved by actions in the sector, the Regulation also provides for flexibility mechanisms by which Member States can close any gaps that it may have in respect of the no debit rule: the use of respective annual emission allowances allocated to the Member States under the Effort Sharing Regulation or buying net removals from other Member States who have successfully increased their rate of net removals beyond their respective commitment. This Regulation should incentivize Malta to enhance removals or reduce emissions in the LULUCF sector.

In view of the high population density of the Maltese Islands and the limited land availability, and to a certain extent the local climatic conditions (such as limited rainfall), the potential for further reduction of CO_2 emissions through carbon sequestration in vegetation is envisaged to be minimal. The woodland areas of the Maltese Islands total about 200 hectares. Native forest is all but extinct, cut down by early colonisers for wood and to clear the land for agriculture and building. Residual woodland areas are now protected by legislation. In recent years, afforestation projects have been undertaken, and have had an effect on the area covered by permanent vegetation, particularly trees; however, the CO_2 removals have not been estimated, given that data availability is, to-date, sparse.

Action in this sector is primarily targeted towards enhancing tree coverage on the Maltese Islands and safeguarding the integrity of the existing, albeit limited, forested areas by good management.

A number of afforestation efforts are undertaken by a number of entities, two such being the 34U Campaign, whose objectives are the planting of indigenous trees in various areas of the Maltese islands, thus increasing the surface area covered by permanent vegetation and recreating tracts of Mediterranean woodland, and efforts by the Ministry of Gozo to plant trees and shrubs (from 2010, over 6,103 trees and over 60,714 shrubs/climbers/perennials have been planted) in various areas of the island of Gozo. Recent declarations have been made by central government regarding future plans to extend existing tree plantations, and to include tree planting activities as part of major infrastructural projects.

The Foresta 2000 afforestation project involves the restoration of an area of natural habitat to a Mediterranean woodland. This long-term project, sited in the North of the island of Malta, commenced in 2003 and is a collaboration between a number of local non-governmental organizations and the government, which at present amounts to a total of 44 hectares of afforested land.

Management plans for existing woodland areas aim towards conserving existing woodland habitats and, to the extent possible extend their coverage. Management plans often involve the close collaboration of public and private entities and non-governmental organisations. A typical example is the il-Buskett, one of a handful of extensive woodland areas remaining in Malta. This area is managed by the central government through the recently established Ambjent Malta agency, with parts of the woodland managed directly by a private entity under a public-private partnership. Among the actions undertaken are works relating to soil stabilization, cleaning, site surveillance, restoration

and rebuilding of rubble walls, regeneration of exposed ground and re-afforestation by re-cultivation from seeds of indigenous species found in the area.

The RDP 2014-2020 includes several measures that relate to LULUCF, in the context of restoring, preserving and enhancing ecosystems. Among relevant measures, one may note the following:

- Measure 8 - Investments in forest area development and improvement of the viability of forests: providing support for the creation and sustainable management of woodlands so as to contribute towards climate change mitigation, improve biodiversity, ensure woodland sustainability and enhance carbon sequestration; and,
- Measure 10 – Agri-environment-climate: includes a number of sub-measures that contribute to a number of key objectives including, among others, enhancing soil conservation and soil quality. Increasing tree coverage and greening of denuded landscapes, supporting biological and mechanism pest control and promoting biodiversity conservation of indigenous species of plants.

Where such measures result in an increase in above-ground biomass or soil depth and carbon content, they will thus be contributing to climate mitigation via enhanced carbon storage and sequestration

4.4.6 Policies and measures – Waste

Until early 2004, solid waste was deposited in unmanaged landfills. One of three such landfills (Wied Fulija) was closed in 1996, and the other two landfills, Magħtab (in Malta) and Qortin (in Gozo) were closed in 2004.

Between 2004 and 2007, municipal solid waste was disposed of in a managed landfill at Ta' Żwejra, and subsequently in the Għallis managed landfill which started operating in the beginning of 2007. These landfills are operated by WasteServ Malta Ltd., a company set up by the Government of Malta in 2002 to organise, manage and operate national waste management systems.

Malta's waste-water handling infrastructure consists of two main networks that collect both domestic and industrial wastewater as well as some storm water runoff. The sewerage system has been upgraded with the building of three new sewage treatment plants, which process started in 2006 and ended in 2011. Two of the plants came into operation in 2008, while the third became fully operational in 2011. The bulk of sewage is now treated.

4.4.6.1 Solid waste management

The Waste Management Plan for the Maltese Islands – A Resource Management Approach 2014 – 2020[41] provides a roadmap that Malta is envisaging to follow to move waste management in Malta towards increased prevention, re-use, recycling and recovery. The waste management plan addresses a number of key issues and challenges: low rates of recycling; high landfilling rates; unsustainable waste management; breaking

41Waste Management Plan for the Maltese Islands – A Resource Management Approach 2014 – 2020; Ministry for Sustainable Development, the Environment and Climate Change, 2014; http://environment.gov.mt/en/document%20repository/waste%20management%20plan%202014%20-%202020%20-%20final%20document.pdf

the link between economic growth and waste generation, moving towards sustainable waste management through prevention of waste generation, and diverting waste management away from landfilling and towards reuse, recycling and recovery.

A number of measures have been put into action to directly address emissions from landfilling sites. Though closed for a long time, the Magħtab and Qortin landfills remain a source of methane emissions due to the decaying of the biological waste placed there over the years. Landfill gas extraction infrastructure was installed to treat odour and noxious gas emissions from these closed sites in a regenerative thermal oxidiser. This is coupled with re-contouring works to improve the stability of the waste mass, better control emissions and rehabilitate the sites for eventual future alternative use. Landfill gas extraction is expected to continue for around another 10 years. The managed landfill of Ta' Żwejra and Għallis incorporate landfill gas management measures in accordance with the permitted conditions of operation. Waste cells are capped, and gases extracted.

The diversion of waste from landfilling to other waste management options is a crucial step in Malta's waste management plan as a whole. The Sant' Antnin Waste Treatment Plant includes a biological treatment plant for the anaerobic digestion of biodegradable municipal solid waste, resulting in the production of biogas. The biogas produced is used for the generation of electricity by combustion in a Combined Heat and Power (CHP) plant, for own use by the plant, with heat generated used directly for the heating of a therapeutical pool in the vicinity used in the care of disabled persons, with any excess electricity fed to the national electricity grid.

A Mechanical Biological Treatment plant has started operations in 2016 in the North of Malta for the treatment of municipal solid waste (MSW). This facility extracts the organic fraction and the Refuse Derived Fuel (RDF) from delivered waste, with the residual waste then disposed of in the landfill. This facility has the potential of also treating animal manure.

A crucial development achieved in the past few years is the separate of waste at source, the Maltese households. A pilot project was launched in July 2015, with 9 localities taking part initially; the scheme was then extended to all localities in the Maltese islands as of October 2018. In this way, a substantial fraction of food waste and other organic waste is separated from other municipal waste and directed to existing anaerobic treatment facilities. It is worth noting that the entire country is covered by system for the collection, not only of separated organic waste, but also the collection of mixed recyclables. This is further complemented by bring-in-sites across all localities and within easy reach of households and centralized civil amenity sites for the deposition of various types of wastes.

4.4.6.2 Wastewater management

Wastewater management is dependent on the existing network for the collection of sewage and treatment of the bulk of sewage in three wastewater treatment plants, which have come into operation since 2008. 80% of all sewage undergoes aerobic treatment in these plants, with the resultant clean water either distributed for agricultural use or discharged into the sea. Work continues on improving the infrastructure to reduce further the share of untreated sewage, often the result of exceptional disruptions to the operations of the plants or unintentional bypassing. The Malta South Urban Wastewater

Treatment Plant (Malta South UWWTP) is the largest of the three sewage treatment plants and features anaerobic sludge digestion with biogas production. The biogas is combusted for energy recovery, meeting a share of the plant's own operating demand. Waste heat is also used in internal operations, to maintain the optimal sludge digestion temperature.

4.4.6.3 Waste-to-Energy

The future of waste management in Malta may lie with the commissioning of a waste-to-energy facility that would be able to treat a substantial part of local solid waste while generating energy. Studies carried out to-date have identified a plant with the capacity of processing, through incineration, more than 100 000 tonnes of waste and recover almost 70 000 MWh of energy every year. The commissioning of such a plant will not mean that other waste minimisation solutions will not be required; indeed, the operation of such a facility will have to be complemented by recovery and recycling measures.

4.5 ASSESSMENT OF THE ECONOMIC AND SOCIAL CONSEQUENCES OF RESPONSE MEASURES

As a small country, Malta's policy action would not, in itself, be expected to have major adverse impacts on third counties, including developing countries. Notwithstanding, Malta takes a proactive approach through actions that offset, to the highest extent possible, any adverse impacts that may occur.

Malta is a fully committed participant in the global action on climate mitigation. The Kyoto Protocol, in its very nature, aims at addressing in tangible terms the anthropogenic causes of observed climate change, through emission reduction or limitation efforts that contribute towards alleviating the harmful consequences of climate change for, among others, developing countries. Malta is an Annex I Party to the UNFCCC and thus has taken on emission limitation obligations under the Protocol as part of the joint fulfilment of the European Union's overall commitments. Though not a Party inscribed into Annex II of the Convention, still, Malta provides financial support to developing countries through both bilateral and multilateral channels (refer to chapter 'Provision of Financial, Technological and Capacity-building Support to Developing Country Parties' below for more details).

One may also reflect on the fact that Malta's contribution towards international climate action started at the very beginning of the international political process that eventually led to the adoption of the UNFCCC, the Kyoto Protocol and the more recent Paris Agreement. In 1988, Malta had introduced an item on the agenda of the General Assembly of the United Nations entitled '*Conservation of Climate as part of the Common Heritage of Mankind*', eventually leading to the adoption of Resolution 43/53 on the '*Protection of Global Climate for Present and Future Generations of Mankind*'. The resolution requested that action be taken that would eventually lead to recommendations on elements for inclusion in a future international convention on climate; the Framework Convention on Climate Change was eventually adopted in 1992.

As already noted in a previous chapter, Malta's climate policy and legislative framework reflects, to a large extent, and builds on, policy and legislation enacted within the European Union. Any legislation proposed at EU level is subject to a formal process of impact assessment, that also looks at economic and social impacts of the proposed legislation. EU climate policy provides for emission mitigation action across all economic activities. All classes of Kyoto Protocol greenhouse gases are addressed.

Apart from the overarching policy framework at EU level ensuring the proper assessment of impacts of policy decisions, there are also important examples of sector-specific legislation that incorporate requirements that directly or indirectly may safeguard against adverse impacts to third countries. One such example is that for biofuels to count towards mandatory national renewable energy targets under EU law, they must comply with sustainability criteria that include that biofuels cannot be grown in areas converted from land with previously high carbon stock such as wetlands or forests and cannot be produced from raw materials obtained from land with high biodiversity such as primary forests or highly biodiverse grasslands. These conditions are, among other, aimed at protecting these important ecosystems, including in developing countries.

Further to its participation in international and EU efforts that already strive to be in line with the principle in Article 3, paragraph 4, of the Kyoto Protocol, Malta also undertakes direct action with developing third countries in areas of capacity building and transfer of technology and knowledge. Such action includes financial support for the implementation of alternative technologies, adaptation and capacity building and education, the latter including the provision of post-graduate scholarships in climate action at a major Maltese tertiary education institution (refer to chapter 'Provision of Financial, Technological and Capacity-building Support to Developing Country Parties').

CHAPTER 5 PROJECTIONS

5.1 INTRODUCTION

This chapter provides a detailed analysis of the impact of the policies and measures in reducing GHG emissions over a time-period covering 2021 - 2040.

The elaboration of projections of greenhouse gas emissions is a responsibility distributed among different entities, according to the sector concerned. Recent years have seen several important changes in modelling approaches and capacity across all sectors and within all entities involved, and the work to improve Malta's capabilities in this area are expected to continue, driven by a combination of new reporting obligations, ongoing work in policy planning (NECP), the need to cater for important new sectoral developments in recent and forthcoming years, and access to capacity building opportunities.

The development of capacity for the elaboration of projections of activity data and emissions is a continuous process that has yet to reach maturity. Because of this, changes in the approaches used have occurred in recent years and are expected to continue in the foreseeable future. This includes updating of modelling tools. Malta has benefited and continues to benefit from a number of initiatives, at all levels, that lead to improved capabilities to project activity data and associated emission trends. Such initiatives include the Structural Reform Support Services programme of the European Commission, which targeted work related to the preparation of National Energy and Climate Plans and the Commission's Projections Support Project wherein a number of models were reviewed and revised.

For the purpose of this submission, historic data presented in the March 2022 National Greenhouse Gas Inventory Submission (time series 1990-2020) feeds into the sectoral models for the estimation of GHG emissions projections. Projections start from the year 2021 onwards. Two policy scenarios have been projected: a 'without measures' (WOM) scenario, which assumes that no further measures are implemented after a defined reference or base year and a 'with existing measures' (WEM) scenario, which considers the abatement potentials reported in the LCDS (2021). Measures that were previously reported as WEM scenario have been included under the WOM scenario. Recently published projections in the Low Carbon Development Strategy are also included in the WEM scenario. A list of the policies and measures upon which the projections in this chapter have been based, have been included in the Annex.

5.2 DESCRIPTION OF MODELLING FRAMEWORK

As noted previously measures that were historically reported as WEM have been reported as WOM in this report. A description of the sectoral models for the WOM projections are provided below. On the other hand, WEM projections have been based on the Abatement Potential values reported in the Low Carbon Development Strategy. In this case, the method used to estimate WEM projections was WOM – LCDS Abatement Potentials. The starting date and ending date of implementation of each measure was kept in mind when calculating the projections, to make sure no under/over underestimation is done. It should also be noted that no measures, and hence, no abatement potentials were presented in the LCDS for the IPPU and LULUCF sectors, and that thus, the projections for the WEM scenario include projections for the sectors Energy, Waste and Agriculture. Information on the modelling framework used in the LCDS to develop projections and abatement potentials can be found in the Malta Low Carbon

Development Strategy (2021), created by EY and Eunomia for the Ministry for Environment, Energy and Enterprise.

5.3 Model Description of the Without Measures Scenarios

5.3.1 Energy Model

For the WOM projections of emissions derived from the Energy Sector, six models were used, two of which are non-transport models. All models were developed by the Energy and Water Agency (EWA) and Transport Malta (TM). Projections on power generation were generated through an electricity dispatch model, which is driven by Energy demand (model), electricity and gas price and affects Natural Gas, gasoil and electricity. For the Manufacturing industries subsector, commercial and Institutional services, Residential services and Agriculture, Forestry and Fisheries subsectors, non-transport fuel consumption models were used. These were driven by Gross Value Added (GVA), with the exception of the Residential Sector Model which was driven by population. A PV production model was also developed, which estimated the potential of residential and non-residential PVs using past trends, cost projections, feed-in tariffs and an independent study carried out by EWA on investigating PV technical potential.

With regards to transport, two road transport models were developed. Of which, one modelled the consumption of biofuels, driven by a substitution obligation of -14% to be reached by 2030. The second road transport model projected the consumption of diesel and petrol, using population and GVA as drivers. In conclusion, a model for inland navigations (excluding fishing vessels) and another model for aviation were developed. Emissions resulting from gasoil, diesel and petrol used in national navigation were modelled based on GDP taking into consideration the changes due to fast ferry and Gozo tunnel being proposed. Projections for international navigation were not estimated. For the aviation sector, emissions from Jet A1 were projected on the basis of the number of departures (departure projections developed by the Malta International Airport). These projections include both domestic and international aviation and they are both reported under memo items, because at present it is not possible to differentiate between the two. However, it should be noted that emissions from domestic aviation activities are not expected to increase in significance compared to historic trends due the limited domestic aviation capacity. Projections derived from transport models mentioned above, include fuels used by military.

It is to be noted that forecasts of macroeconomic indicators used in the energy models were developed by EPD in collaboration with Cambridge Econometric, using a short-term quarterly forecasting econometric model specifically for Malta (STEMM). This model is basically composed of six blocks, one of which is the value-added block disaggregated at sectoral level. The value-added sectors which are modelled in this block are mainly:

- Goods sectors:
    - Manufacture of Chemical and Chemical products, basic pharmaceutical products and pharmaceuticals operations (NACE 19-21) (CHEMPHAR)
    - Manufacture of Computer, Electronic and Optical Products, manufacture of Electrical Equipment and Manufacture of Machinery and Equipment n.e.c (NACE 26-28) (EM)
    - Construction sector and Real Estate Activities sector (NACE 41-43, 68)*. (RCONS) (F,L)
    - Other Goods sectors (all the A-F sectors not included in the previous/other domestic sectors) (OG)
    - Services sectors:
    - Government Sector; O-Q sectors (NACE 84-88) (PS) (O-Q)
    - Financial and Insurance Activities sector (NACE 64-66) (FIS) (K)

- Other Business Services Sector (NACE 69-75) (OBS) (M)
- Gaming Sector (NACE 92) (RG) (R)
- Accommodation and food service activities (NACE 55-56) (TOUR) (G,H,I)
- Wholesale and retail trade; repair of motor vehicles and motorcycles, transportation and storage sectors (NACE 45-54) (WRT) (G,H,I)
- Other services sector (all the G-U sectors not includes above/other domestic sectors) (OS) (J)
- Other Domestic Sectors (includes the A, B, D and N sectors) (OD)

5.3.2 Industrial Process and Product Use (IPPU) Model

Over the year 2015, a model was developed to project GHG emissions from the industrial processes and product use sector. Since, in recent years, the emissions of HFCs from CRF category *2.F.1 Refrigeration and Air conditioning*, add up to almost the entirety of the GHG emissions from the IPPU sector, the said model is limited to project emissions from this category alone.

The model takes into consideration five different groups of activities, namely, residential (domestic), commercial, ships, transport and stationary. Based on historical data, including demand, imports, stock and emissions, the model estimates the stock and imports of a list of refrigerants (imported and used in the groups listed above) the emissions of which contribute to global warming.

The base year on which WOM projections are estimated is the year 2018, as submitted in Malta's National Inventory of Greenhouse Gas Emissions and Removals, 2020. An exception to this is the emissions from stationary air conditioning. In particular, a different set of data has been used in the estimation of the stock accumulated from F-gas in pre-charged equipment. It should also be pointed out that since emissions from categories other than CRF category *2.F.1* were not projected, the historical emissions for the year 2018 were not reported.

The current model used for projections estimates the emissions from the stock using the stock in the base year. This methodology is not congruent with the methodology used to estimate historic emissions. This results in emissions for the base year that are lower than historic emissions. It is the intention of the Inventory Agency to analyse this aspect of the current model further such that the emissions estimated in the projections model are more consistent with historic emissions.

A brief description of the equations underpinning the key factors making up the IPPU model is presented under the following sub-titles:

5.3.2.1 Forecasting stock

$$stock\ in\ base\ year \times (1 - emission\ factor + reuse) + imports$$

The stock forecast depends on the stock in existence from previous year, the amount escaped through emissions and the amount reused. This is subsequently added to the amount imported.

5.3.2.2 Forecasting imports

$$stock\ in\ base\ year \times (1 + activity\ growth) \times exp(efficiency\ improvement) - (1 - emission\ factor + reuse)$$

The forecast of imports depends on the stock level from the previous year, the sector or activity growth rate and the improvement in efficiency which increases exponentially. It also depends on its emission factor or fugitives which have to be replaced and the amount of gases that will be reused and thus deducted from the amount to be imported.

5.3.2.3 Forecasting activity growth

The forecast of activity growth depends on the activity indicators and its stock elasticity to the activity indicator.

Domestic sector: private consumption × elasticity of activity growth to household consumption

Commercial sector: GDP × elasticity of activity growth to GDP

In case of the domestic sector, the activity indicator used is disposable income, whilst GDP is used for the commercial sector.

5.3.3 Agriculture Model

The model being used to produce the WOM projections reported in this report has been developed in 2018 and has been verified by experts from ICF and Aether as part of capacity-building projects undertaken by the Climate Change Unit at the Malta Resources Authority. The model, which covers projections of GHG emissions over a period spanning from 2016 – 2030, based on historic data from 1990 – 2015, has been quality controlled to ensure compliance with the IPCC's TCCAA principles. The 'Without Measures' (WOM) scenario presented in this communication takes into consideration the Mechanical Biological Treatment Plant, which treats 35,000T and 4,000T of cattle and poultry manure respectively. These values were introduced into equations calculating the nitrogen excretion rates of cattle and sheep, which ultimately affect the emissions emanating from the management of manure. The projections of cattle and poultry manure treated, and manure remaining were calculated based on the historical cattle and poultry populations and projected N excretion. The N excretion is calculated by multiplying the default N_{rate} (given in the 2006 IPCC guidelines) by the weight of the animal/1000 * 365 days. Since animal weight and N_{rate} remain constant throughout the time period, there is no projection of the value. The following process gives the method of how emissions are re-estimated integrating the measure of cattle and poultry manure treatment.

$$Cattle\ manure\ produced = \frac{BAU\ Nexcretion}{N\ content\ in\ manure}$$

The N content in cattle manure is taken as 0.0056, while 0.0207 is used for poultry as specified in the NAP schedule.

Cattle manure treated = 35,000,000 kg

Poultry manure treated = 4,000,000 kg

$$Manure\ remaining\ (kg) = Manure\ produced - Manure\ treated$$

$$Manure\ remaining\ (kgN) = \ Manure\ Remaining\ (kg) * N\ content$$

The percentage dairy cattle manure and other cattle manure is worked out from the total BAU cattle N excretion, to give DC manure % and OC manure %. The same is done for Layers and Broilers and Other Poultry.

$$MBT\ N\ excretion = \ Manure\ Remaining * Manure\ \%$$

Emissions are then worked out according to 2006 IPCC Guidelines

$$Nvol = \frac{MBT\ N\ excretion * FracGasMS}{100}$$

$Frac_{GasMS}$ DC = 30%, OC = 45%

$Frac_{GasMS}$ Layers = 55%, Broilers & Other Poultry = 40%

$$N\ lost\ as\ N_2O\ (kgN_2O) = cattle\ manure\ remaining * EF_3$$

EF_3 Cattle = 0.005 kgN20-N

EF_3 Poultry = 0.001 kgN20-N

$$MBT\ Direct\ N_2O\ emissions = \left(\frac{N\ lost\ as\ N_2O * \left(\frac{44}{28}\right)}{10^6}\right) * 298$$

$$MBT\ Indirect\ N_2O\ emissions = NvolTotal * EF4 * \frac{\frac{44}{28}}{10^6}$$

EF_4 Cattle = 0.01 kgN20-N

EF_4 Poultry = 0.01 kgN20-N

It should be noted that projections for the WOM scenario start from 2019, where thus the historic data is taken for 1990-2018.

The model and its projections for the agriculture sector have been developed in alignment with the national inventory system by integrating the model within the inventory's workbook itself. The values from the national inventory are taken into the model, processed and projections are then developed based on the base year chosen. The projections update whenever the historic data is updated, hence producing a more realistic projection with every submission which is based on actual historic data rather than past projections.

A number of quality assurance and quality control checks have been implemented in the worksheets and model of the Agriculture sector which tackle calculations for both the National GHG inventory Report and the PAMS and Projections Report. Such quality checks have been integrated through a full automation of the agricultural sector workbooks to

reduce human error, data analysis checks, model performance checks to ensure that numbers projected are correct, and full transparency of the model calculations.

5.3.4 Land Use, Land-use Change and Forestry

The LULUCF model was developed to construct projections related to the LULUCF sector to analyse the variations between the projected emissions within the sector, as well as development of related scenarios. The projections were developed based on the information available associated with land and forest related measures which are in place on a national scale that could affect the sequestration rates from the land-uses. The model illustrates a series of projections which were analysed based on the national information available. The historic data was acquired from the data presented in the LULUCF sector of the GHG Inventory report.

The growth in the level of sequestration of carbon in the LULUCF sector is not expected to be major, with minimum variations between the different projections presented. This is due to the fact that the national afforestation projects implemented do not cover a large tract of land, and when comparing the extent of the area of these plantations to the other categories in the LULUCF sector, the level of sequestration from these projects is as a result quite minimal.

The LULUCF sector projections model was developed through the assistance of an expert from the International Institute for Applied Systems Analysis (IIASA). The model works in a spreadsheet and aims to develop projections of LULUCF emissions and removals. The sheet also allows for the analysis and construction of various scenario-based projections. The model works by taking into account changes in activity rates or emission factors that the user specifies to develop projection estimates. All projections that are reported in the model are based on the general equation (1) for calculating emission projections as proposed in: *GHG Projection Guidelines. Part A: General Guidance. CLIMA.A.3/SER/2010/0004*. Emissions and removals are estimated by multiplying the activity rate with the associated emission factor, thereby assuming a linear relationship between the intensity of an activity and the resulting emission. Emission factors and activity rates can be changed over time in the model but only the linear relationship between activity and emission rates is currently implemented.

Moreover, a Forest Land category projections model was developed, to be attribute to the overall LULUCF sector projections model. This was done as a result of the National Forestry Accounting Plan (NFAP), where new data on Forest Land was acquired to compile the necessary calculations within this category to facilitate the compilation of the NFAP report. The Forest Land projections model was developed through the assistance provided from the ICF during the capacity building workshop on the NFAP. The Forest Land category model is largely based on the NFAP model (developed also on excel spreadsheet), since similar parameters and forest areas considered for the NFAP are being utilised for the Forest Land category. The Forest Land model was further updated and finalised, thus the projections from this category were included in the whole LULUCF sector.

The LULUCF models and projections are aligned with the national inventory system be means of the model incorporating data from the national inventory workbook into the projections model workbook. Values from the national inventory are utilised to develop projections based on the year of the projection.

QA/QC check in the LULUCF model were implemented within the model workbook. The quality checks were developed by means of equations and automated checks in the workbook, thus, to allow for the comparison of future activity rates with historical reporting, checking for internal consistency issues within a scenario, as well as to compare the outcome between scenarios.

5.3.5 Waste Model

Projections of waste generation activity data have been compiled by the Ministry for Environment, Energy and Enterprise, which also includes waste management policy under its portfolio.

The projection of waste generation is based on the relation between a relevant driver trend between 2013 and 2016, and the actual trend in waste generation 2013-2016. This relation is represented by a constant which is multiplied by the projected macroeconomic driver to result in a projected waste generation for that particular year. This exercise has been repeated for all waste streams as published in the National Statistics Office waste statistics, with each waste stream associated with a specific relevant driver.

Table 5.1 EWC-STAT driver association EWC-Stat code

	Description	Selected Driver
1.1	Spent solvents	Gross Domestic Product
1.3	Used oils	Gross Domestic Product
1.4, 2, 3.1	Chemical wastes	Gross Domestic Product
1.4, 2, 3.1	Chemical wastes	Gross Domestic Product
3.2	Industrial effluent sludges	Gross Domestic Product
3.2	Industrial effluent sludges	Gross Domestic Product
3.3	Sludges & liquid wastes from waste treatment*	Population
5	Health care and biological wastes	Population
5	Health care and biological wastes	Population
7.2	Paper and cardboard wastes	Disposable Income
7.3	Rubber wastes	Gross Domestic Product
7.4	Plastic wastes	Gross Domestic Product
7.5	Wood wastes	Gross Domestic Product
7.6	Textile wastes	Disposable Income
8 (excl. 8.1, 8.41)	Discarded equipment	Disposable Income
8 (excl. 8.1, 8.41)	Discarded equipment	Gross Domestic Product
8.1	Discarded vehicles	Disposable Income
8.41	Batteries and accumulators waste	Gross Domestic Product
8.41	Batteries and accumulators waste	Gross Domestic Product
9.1	Animal and mixed food waste	Population
9.2	Vegetal wastes	Population
9.3	Animal faeces, urine and manure	Gross Domestic Product
10.1	Household and similar wastes	Disposable Income
10.2	Mixed and undifferentiated materials	Population

10.2	Mixed and undifferentiated materials	Population
10.3	Sorting residues*	Gross Domestic Product
11	Common sludges	Gross Domestic Product
12.1	Mineral waste from construction & demolition	Gross Domestic Product
12.1	Mineral waste from construction & demolition	Gross Domestic Product
12.2, 12.3, 12.5	Other mineral wastes	Gross Domestic Product
12.2, 12.3, 12.5	Other mineral wastes	Gross Domestic Product
12.4	Combustion wastes	Gross Domestic Product
12.4	Combustion wastes	Gross Domestic Product
12.7	Dredging spoils	Gross Domestic Product
12.8, 13	Mineral waste from waste treatment & stabilised waste*	Gross Domestic Product
12.8, 13	Mineral waste from waste treatment & stabilised waste*	Gross Domestic Product

Following the completion of a waste generation scenario, each waste stream was portioned into the different waste treatment options based on the reference or policy scenario. In the reference scenario, the capacity of existing options is respected, with the remainder being directed to landfilling. In both scenarios, it is assumed that landfilling space will not run out at any moment and that capacity of present plants will be retained all along the period. This means that if any plant included in the reference ceases to operate in the timeframe of the projection, a similar plant in terms of technology and capacity will replace it immediately. The difference between the reference and policy scenarios, is due to shifting of waste streams from one option (e.g. landfilling) to another option higher in the waste hierarchy (e.g. waste to energy, biodigestion or recycling). To date, the model does not account for behavioural changes that induce quantitative waste generation changes, thus waste avoidance is not accounted for at this stage. This is mainly due to the low confidence and inability to model behavioural change induced by measures included both in the reference and policy scenario.

The waste sector will see a relevant decrease in the waste going to landfill, especially for municipal wastes which will be diverted to either biological treatment or incineration. The advent of the incineration of municipal waste will appear as a net increase in emissions for the year of application, with a gradual but constant decrease in emissions from landfilling becoming more accentuated in the later period. This trade off comes due to Malta's obligation to address other targets in the waste sector, and land space issues caused by ever expanding landfill sites.

Following this distribution, the waste quantities were converted into emissions through inventory models based on the IPCC 2006 guidelines. The methodologies used for this conversion are the same as those discussed in detail in the 2020 annual National GHG inventory submissions.

5.4 Assessment of aggregate effects of policies and measures

Table 5.2 shows the emission projections split by sector and by gas for the years 1990, 2005, 2020, 2025, 2030, 2035 and 2040 for the WEM scenario.

The aggregated effect of the policies and measures is illustrated in Figure 5.1 and Figure 5.2. The measures implemented in the energy sector have a significant impact on total national emissions as clearly reflected in the drop in projected emissions from 2030 onwards. This downwards shift in emissions is largely due to various electrification measures in the transport sector, the installation of additional interconnectors, and increased use of renewables and energy efficient appliances in both the residential and non-residential buildings.

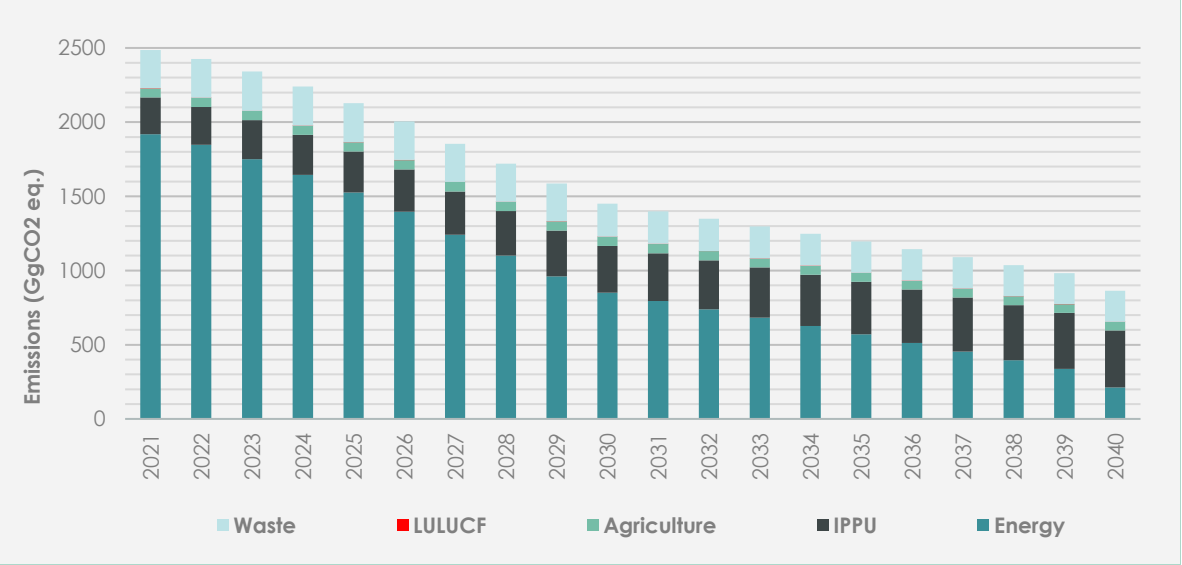
Table 5.2 Emissions projections by sector and by gas for the 'with existing measures' scenario

Sector	Gas	1990	2005	2020	2025	2030	2035	2040
Energy total	CO2	2388.70	2640.70	1594.47	1515.41	839.79	559.92	201.61
	CH4	5.24	4.85	2.37	4.48	4.48	4.47	4.42
	N2O	9.20	11.49	5.49	5.57	5.70	5.80	5.86
	Total	2403.14	2657.05	1602.33	1525.47	849.97	570.18	211.89
IPPU	CO2	5.13	3.65	4.46	0.00	0.00	0.00	0.00
	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N2O	2.64	2.46	2.42	0.00	0.00	0.00	0.00
	HFC	0.00	38.36	272.34	276.85	315.55	353.10	384.48
	PFCs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SF6	0.01	1.56	0.40	0.00	0.00	0.00	0.00
	Total	7.78	46.03	279.62	276.85	315.55	353.10	384.48
Agriculture	N2O	0.00	0.00	0.00	NO	NO	NO	NO
	CH4	61.21	49.52	39.53	33.32	33.53	31.06	28.60
	N2O	57.86	49.59	40.71	29.20	29.48	29.49	29.49
	Total	119.07	99.11	80.24	62.52	63.01	60.55	58.08
LULUCF	CO2	-8.33	-0.78	-2.29	0.71	0.56	0.49	0.43
	CH4	0.02	0.02	0.00	NO	NO	NO	NO
	N2O	0.15	0.19	0.11	NO	NO	NO	NO
	Total	-8.15	-0.56	-2.18	0.71	0.56	0.49	0.43
Waste	CO2	0.37	0.32	0.65	10.40	10.46	10.52	10.56
	CH4	58.74	165.17	151.92	250.85	209.73	201.41	196.92
	N2O	10.19	12.86	6.84	0.20	0.20	0.21	0.21
	Total	69.30	178.34	159.41	261.46	220.40	212.14	207.69
National (with LULUCF)		2591.13	2979.97	2119.41	2127.01	1449.49	1196.46	862.58
National (without LULUCF)		2599.28	2980.54	2121.59	2126.30	1448.94	1195.97	862.15

As shown in Figure 5.1, the highest decrease will be in the energy sector, while drops in emissions in the agriculture and waste sectors are not expected to be significant. No

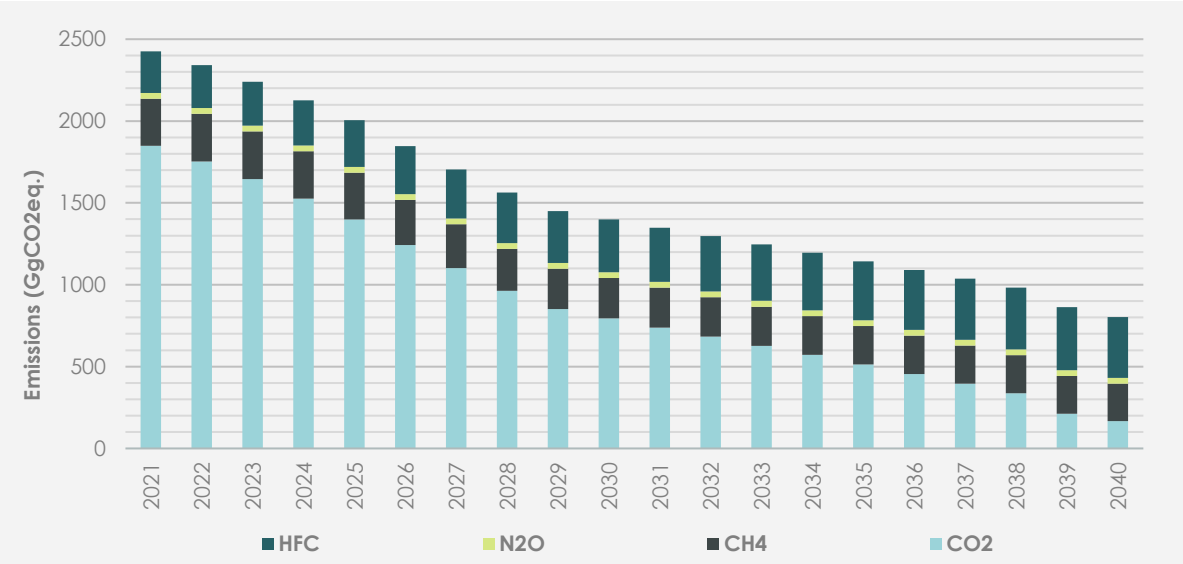
further changes are expected in IPPU and LULUCF, since no measures have been included in the LCDS for these 2 sectors.

Figure 5.1 Projections (WEM) of total emissions differentiated by sector.



As shown in Figure 5.2, the gas which is expected to experience the biggest change is carbon dioxide. This is due to the fact that most carbon dioxide is emitted from the energy sector, which happens to be the sector with the most measures, and the largest drop in total emissions. HFCs are expected to increase over time, however the implementation of the F-gas regulation is expected to curb emissions from this sector.

Figure 5.2 Projections (WEM) of total emissions differentiated by gas.



5.5 PROJECTIONS BY SECTOR

This section provides an analysis of the sectoral projections

5.5.1 Energy

Table 5.3 gives a summary of the projected WEM emissions for the Energy sector, by gas. Emissions are expected to decrease significantly from 2030 onwards, as a result of the LCDS measures. The drop will be most significant in CO2 emissions, leading to the energy sector emissions to drop to 211.89GgCO2 eq. in 2040.

The drop in transport emissions is due to the measures given in the national Low Carbon Development Strategy, which can be summarized in three main categories:

- Support of electrification transition: (Electrification of private vehicles supported by grant schemes, government fleet, goods carrying vans, route buses, installation of extended network of EV charging spots)
- Public and Active transport: This is assumed to arise from a suite of measures, including the extension of free public transport services, and improvements in public transport services. Regarding active transport, sustained investment taking place throughout the strategy period in infrastructure will support cycling (e.g. bikes, e-bikes, pedelecs) and walking.
- Teleworking: Encouraging teleworking, and remote working and further promotion of Government online services to reduce and avoid the need to travel, especially to and from specific 'traffic hotspots', and especially during peak hours

Figure 5.3 Projected BAU and WEM scenarios for the energy sector, by gas

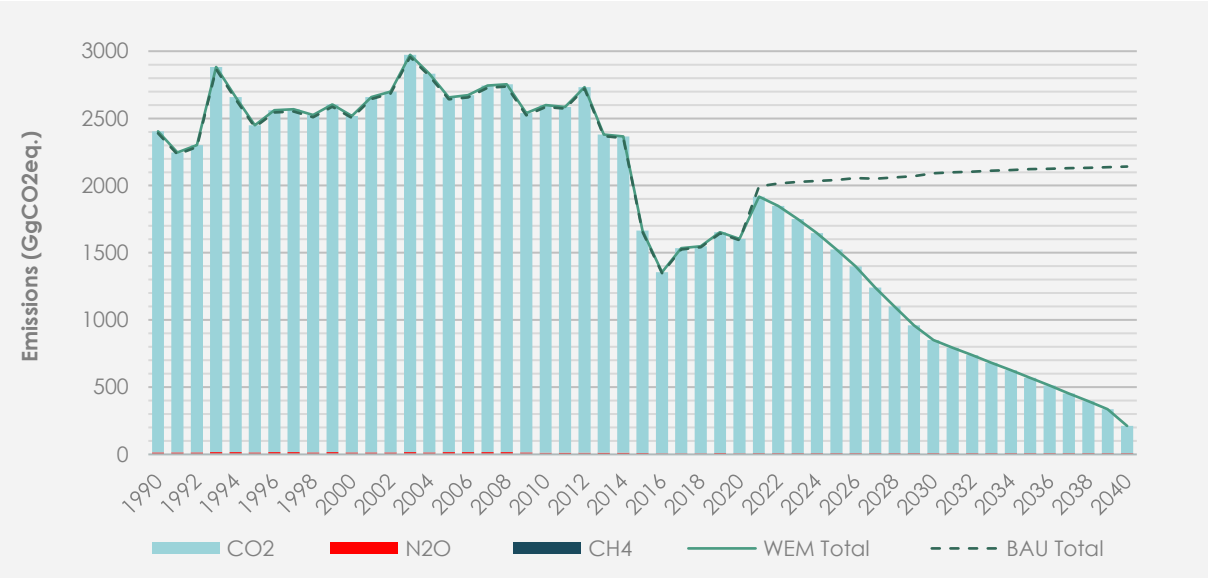


Table 5.3 Projected emissions in GgCO2eq. for sector energy, by gas (WEM)

Sector	Gas	1990	2005	2020	2025	2030	2035	2040
Energy total	CO2	2388.70	2640.70	1594.47	1515.41	839.79	559.92	201.61
	CH4	5.24	4.85	2.37	4.48	4.48	4.47	4.42
	N2O	9.20	11.49	5.49	5.57	5.70	5.80	5.86
	Total	**2403.14**	**2657.05**	**1602.33**	**1525.47**	**849.97**	**570.18**	**211.89**

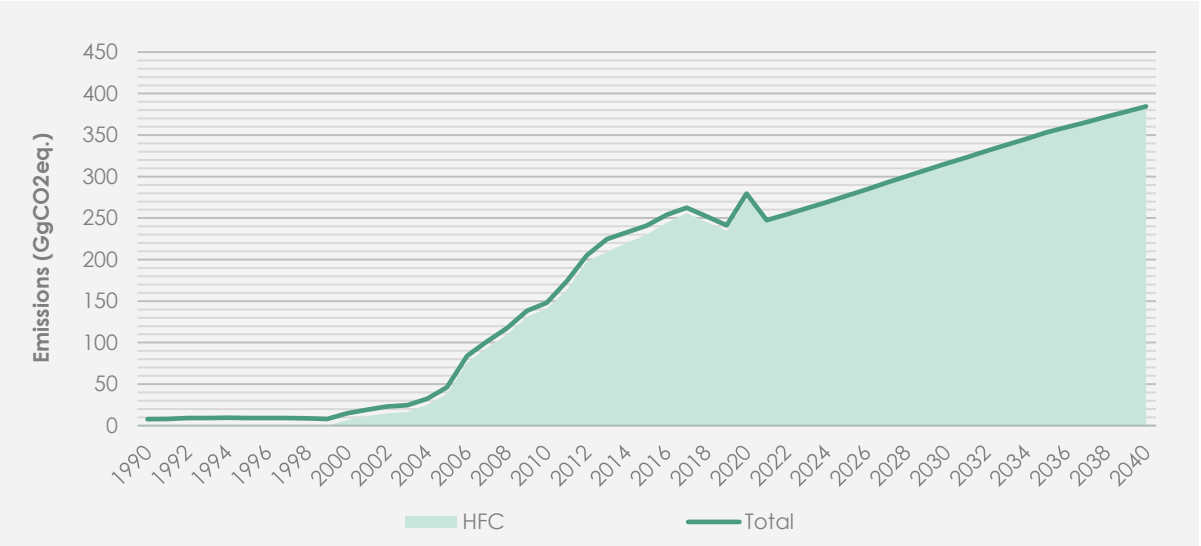
5.5.2 Industrial Processes and Product Use (IPPU)

The main measure that is expected to curb emissions from this sector is the implementation of the F-gas Regulation. This is expected to have a considerable positive influence on the manner and the extent to which fluorinated gases are used in the future. However, the implementation of this measure has not been analysed quantitatively, as yet. Consequently, the BAU scenario and the WEM scenario are identical. No measure was included in the LCDS for the IPPU sector.

Table 5.4 Projected emissions in Kt CO_2eq. for sector IPPU, by gas (WEM)

	Gas	1990	2005	2020	2025	2030	2035	2040
IPPU	CO2	5.13	3.65	4.46	NE	NE	NE	NE
	CH4	0.00	0.00	0.00	NO, NA	NO, NA	NO, NA	NO, NA
	N2O	2.64	2.46	2.42	NE	NE	NE	NE
	HFC	0.00	38.36	272.34	276.85	315.55	353.10	384.48
	PFCs	0.00	0.00	0.00	NE	NE	NE	NE
	SF6	0.01	1.56	0.40	NE	NE	NE	NE
	Total	**7.78**	**46.03**	**279.62**	**276.85**	**315.55**	**353.10**	**384.48**

Figure 5.4 Projected HFC BAU scenario for sector IPPU



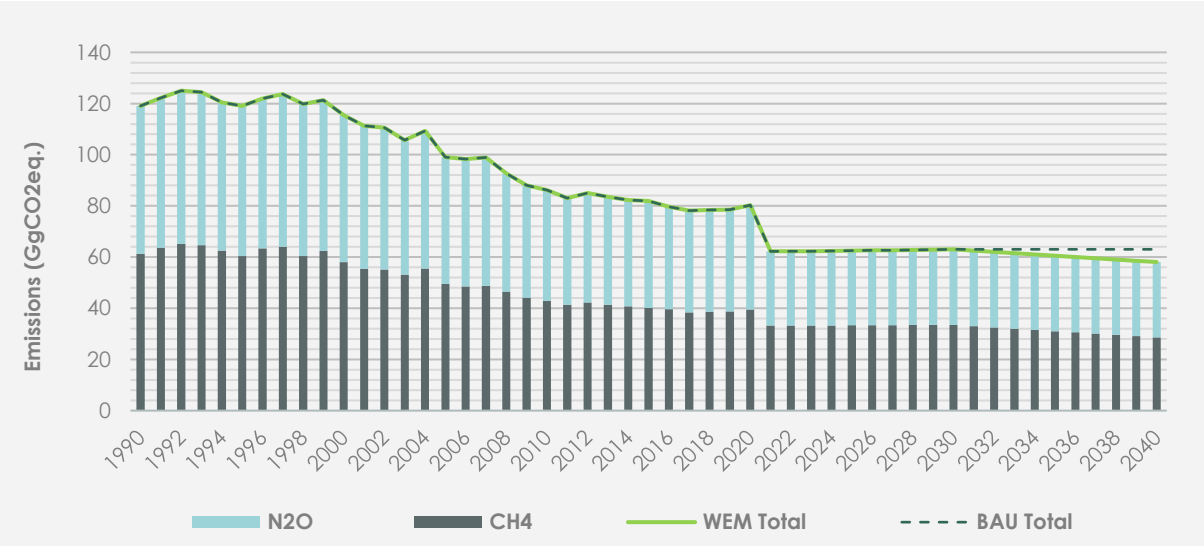
5.5.3 Agriculture

Measures listed in the Malta LCDS (2021) are expected to contribute to a decrease of around 8% (~5 GgCO2eq.) in emissions by 2040. The measures are expected to impact both methane and nitrous oxide. The application of aquaponics is expected to reduce N2O emissions caused due to soil carbon loss and application of synthetic fertiliser to land, while the administration of methane inhibiting vaccines is expected to reduce methane emissions from livestock.

Table 5.5 Projected emissions in Kt CO2eq. for sector Agriculture, by gas (WEM)

	Gas	1990	2005	2020	2025	2030	2035	2040
Agriculture	N2O	0.00	0.00	0.00	NO	NO	NO	NO
	CH4	61.21	49.52	39.53	33.32	33.53	31.06	28.60
	N2O	57.86	49.59	40.71	29.20	29.48	29.49	29.49
	Total	**119.07**	**99.11**	**80.24**	**62.52**	**63.01**	**60.55**	**58.08**

Figure 5.5 WEM scenario projections for the agriculture sector, by gas



5.5.4 LULUCF

Much of the projections arise from projects related to afforestation and plantations, noting the fact that there are limitations. This is due to the high population density of the Maltese Islands and the limited land availability, as well as the unfavourable local climatic conditions, where the potential to mitigate emissions and maintain or increase the removals is, as a result, highly restrained.

The 'Without Measures' or 'Business-as-Usual' (BAU) projection was developed to analyse the impact of the upcoming national afforestation projects discussed which have begun to be implemented or implemented in the coming years. It is to note that some of the projects could not be quantified in the projection since some of the plantations will be implemented on a small scale or else planned to be planted separately in groups around several different locations. As a result, these are not foreseen to fall under the Forest Land criteria or threshold. As already stated not all measures could be quantified in this projection in the LULUCF model due that the extent of the projects implemented do not cover a large tract of land, and when comparing the extent of the area of these plantations to the other categories in the LULUCF sector. Moreover, in relation to other projects, entities did not have enough relevant information at this stage, such as area of project or total trees planted, that could be utilised to develop the projection. The series of projects included in this projection are: Ta' Qali National Park project; Wied Fulija National Park project; Various afforestation/planting projects in sites, including Natura

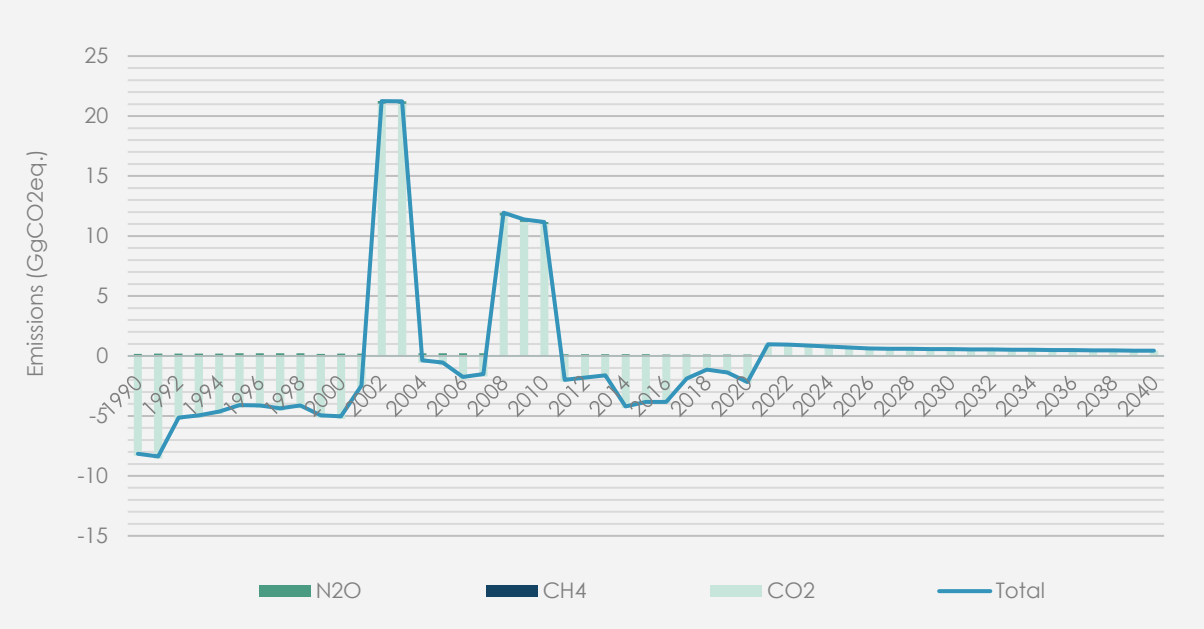
2000 & Protected Areas, Golf il-Kbir, San Anard, Fort Madliena, rural areas & Heritage Malta site; Tree 4U Campaign afforestation, afforestation in Foresta 2000 sites; and Benghajsa afforestation. Measures that have been adopted or implemented before the adoption of the LCDS have been included in the Without Measures scenario. A WEM projection scenario does not exist for LULUCF given that no measures were included in the LCDS for the LULUCF sector.

The figure below shows the series of projections developed and analysed in the LULUCF model.

Table 5.6 Projected emissions and removals in Kt CO2eq. for sector LULUCF, by gas (BAU)

	Gas	2018	2019	2020	2025	2030	2035	2040
LULUCF	CO2	-8.33	-0.78	-2.29	0.71	0.56	0.49	0.43
	CH4	0.02	0.02	0.00	NO	NO	NO	NO
	N2O	0.15	0.19	0.11	NO	NO	NO	NO
	Total	**-8.15**	**-0.56**	**-2.18**	**0.71**	**0.56**	**0.49**	**0.43**

Figure 5.6 BAU Projections of greenhouse gas emissions for LULUCF



5.5.5 Waste

The categories within the waste sector which are applicable for projections include landfilling, incineration, and biological treatment. There are no projections for the wastewater category. As a result. The historical emission trajectory in the BAU scenario does not include emissions from wastewater.

Landfill emissions are projected to decrease whereas the incineration and biological treatment emissions will increase. However, the increase in the incineration and biological treatment categories is expected to occur from year 2023 onwards, where waste will be

diverted into the Waste-to-Energy (WtE) facility. Moreover, the treatment of waste in the biodigester (Anaerobic Digestion (AD)), is considered to be more effective.

Table 5.7 Projected emissions in Kt CO2eq. for sector Waste, by gas (WEM)

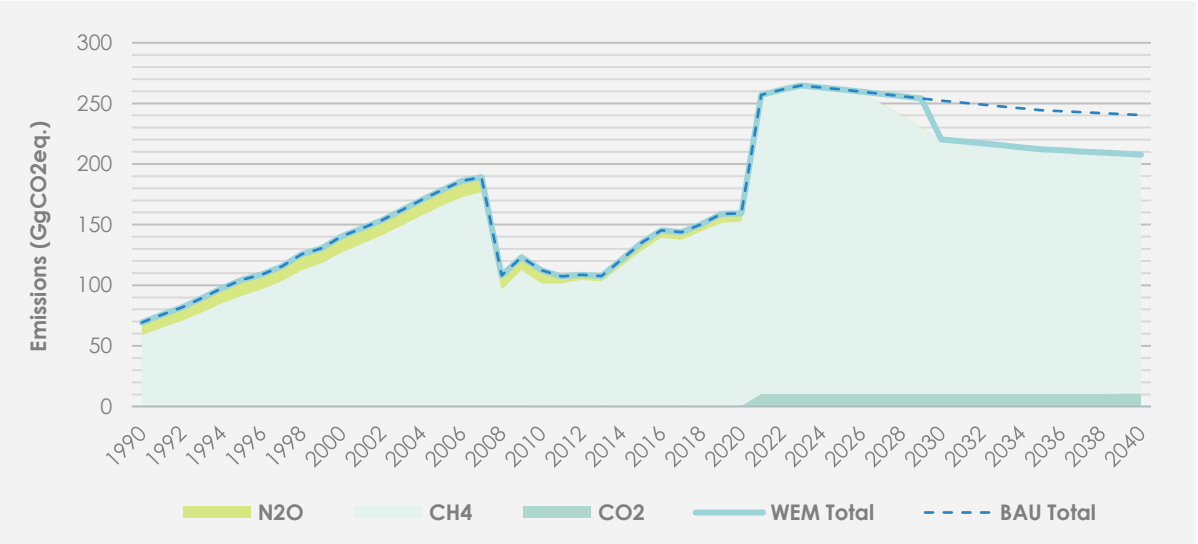
	Gas	1990	2005	2020	2025	2030	2035	2040
Waste	CO2	0.37	0.32	0.65	10.40	10.46	10.52	10.56
	CH4	58.74	165.17	151.92	250.85	209.73	201.41	196.92
	N2O	10.19	12.86	6.84	0.20	0.20	0.21	0.21
	Total	**69.30**	**178.34**	**159.41**	**261.46**	**220.40**	**212.14**	**207.69**

The projections of BAU emissions from the waste sector have been based on the model described in the previous section. It also builds upon a 'decomposition' model which 'assigns' the expected waste generation to waste treatment plants, incinerator and landfilling, respectively according to their capacity. A number of assumptions have been taken into consideration, including the following:

- The trend in MSW/Capita and Industrial Waste/GDP are maintained throughout the projected time;
- MSW composition values (%) for landfilling have been updated;
- Landfilling amounts do not take into consideration whether the specific active landfill is exhausted or not. It is assumed that all future landfills are managed to the same standard as the landfill currently in use;
- All methane generated from biological treatment of waste is flared and all resulting emissions are considered biogenic.
- The actual and projected emissions from the waste sector take into account all measures related to this sector, including solid waste. It is projected that the biggest saving will be due to saved methane emissions from landfills.

On the other hand, the WEM projections are based on abatement potentials presented in the Malta LCDS (2021), from 3 measures (High Biowaste capture, and Biogas upgrade; Incineration pre-sorting; and waste prevention). The below graph shows that the projected WEM scenario for the waste sector will decrease when compared with the Business as Usual (BAU) scenario (a decrease of 14% in year 2040).

Figure 5.7 BAU & WEM projections for the Waste Sector



5.6 MEETING GREENHOUSE GAS EMISSION COMMITMENTS

Projected emissions are evaluated against emission reduction targets applicable for Malta under the Effort Sharing Decision. This Decision sets a target for Malta limiting emissions to a level not higher than 5% over 2005 levels, by 2020. Furthermore, the Decision establishes a trajectory of interim targets for the years up to 2020, in which , in the case of Malta, is in accordance with the rule that "*each Member State with a positive limit under Annex II* [to the Effort-Sharing Decision] *shall ensure* [...] *that its greenhouse gas emissions in 2013 do not exceed a level defined by a linear trajectory, starting in 2009 on its average annual greenhouse gas emissions during 2008, 2009 and 2010,* [...] *ending in 2020 on the limit for that Member State as specified in Annex II*".

Figure 5.8 below compares the total emissions, as reviewed in accordance with the applicable compliance procedures of the EU, from the sectors and activities covered by the Effort Sharing Decision with the trajectory under this Decision.

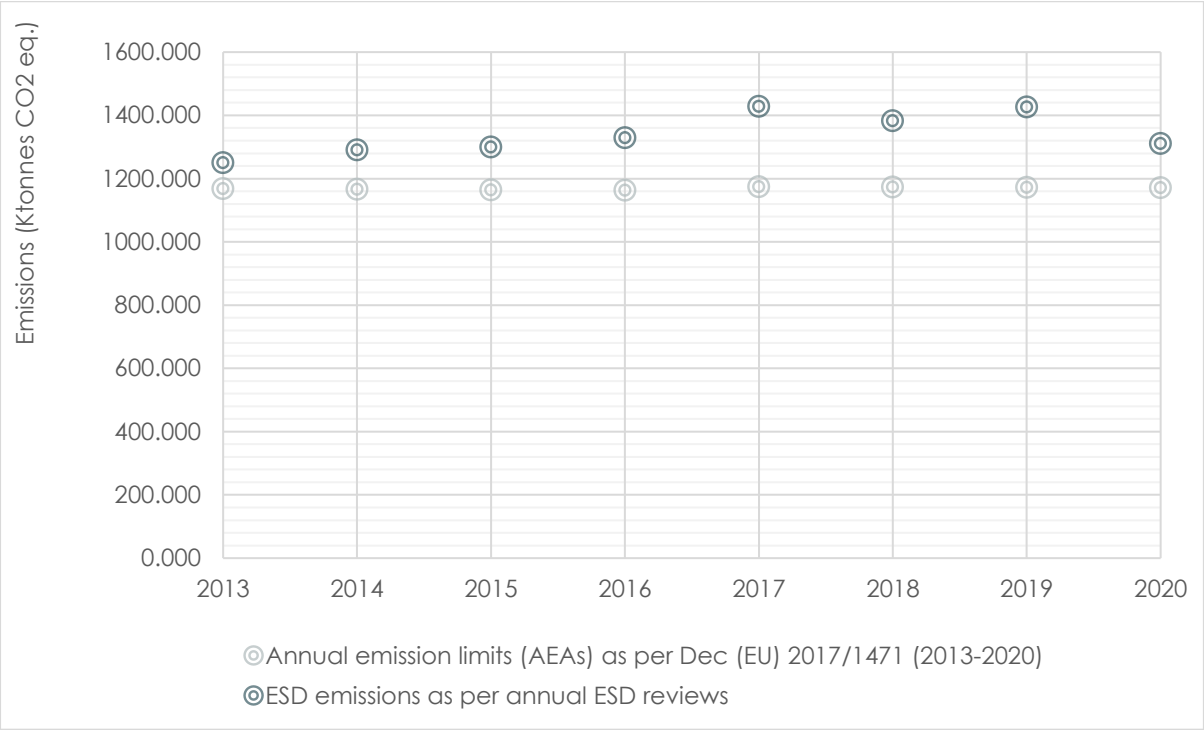


Figure 5.8 Comparison of Malta's emissions covered by the Effort-sharing Decision with annual emission limits.

While Malta was not able to limit ESD emissions to levels not greater than the annual limits as established in accordance with the trajectory under the Decision, Malta has used the flexibility mechanisms provided for by the Decision, namely the purchase of additional annual emission allocations from other Member States. Thus, Malta has achieved compliance with the obligations of the ESD throughout the period.

CHAPTER 6 PROVISION OF FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT TO DEVELOPING COUNTRY PARTIES.

6.1 INTRODUCTION

Despite it being a small country with constrained financial capabilities, and despite not being an Annex II Party to the Framework Convention on Climate Change, Malta has started to also contribute financial and capacity support for climate action in developing third countries, including support resulting in the transfer of technologies and know-how. This chapter discusses the efforts made, using examples of projects that have been supported during the years 2013 and 2020. Malta is not a Party included in Annex II to the Convention and is therefore not obliged to adopt measures and fulfil obligations as defined in Article 4, paragraphs 3, 4, and 5 of the Convention.

Malta is a fully committed participant in the global action on climate mitigation. The Kyoto Protocol, in its very nature, aims at addressing in tangible terms the anthropogenic causes of observed climate change, through emission reduction or limitation efforts that contribute towards alleviating the harmful consequences of climate change for, among others, developing countries. Malta is an Annex I Party to the UNFCCC and thus has taken on emission limitation obligations under the Protocol as part of the joint fulfilment of the European Union's overall commitments. Though not a Party inscribed into Annex II of the Convention, still, Malta provides financial support to developing countries through both bilateral and multilateral channels.

Malta is a fully committed participant in the global action on climate mitigation. The Kyoto Protocol, in its very nature, aims at addressing in tangible terms the anthropogenic causes of observed climate change, through emission reduction or limitation efforts that contribute towards alleviating the harmful consequences of climate change for, among others, developing countries. Malta is an Annex I Party to the UNFCCC and thus has taken on emission limitation obligations under the Protocol as part of the joint fulfilment of the European Union's overall commitments. Though not a Party inscribed into Annex II of the Convention, still, Malta provides financial support to developing countries through both bilateral and multilateral channels.

6.2 SUPPORT THROUGH PUBLIC FINANCES

Further to its participation in international and EU efforts that already strive to be in line with the principle in Article 3, paragraph 4, of the Kyoto Protocol, Malta also undertakes direct action with developing third countries in areas of capacity building and transfer of technology and knowledge. Such action includes financial support for the implementation of alternative technologies, adaptation and capacity building and education, the latter including the provision of post-graduate scholarships in climate action at a major Maltese tertiary education institution.

The UNFCCC, in Article 4, requests that developed country Parties listed in Annex II to the Convention provide financial resources to meet the costs incurred by developing country Parties in complying with their commitments under the UNFCCC, to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation, and to promote, facilitate and finance the transfer of and access to environmentally sound technologies and expertise to other Parties, especially supporting the development of endogenous capacity and technologies of developing country Parties.

Malta is not inscribed in Annex II to the Convention. Notwithstanding, it still provides support to developing countries in the sphere of mitigation and adaptation actions and capacity building. Since 2013, Malta has provided financial support for climate action totalling €926,694, through both bilateral and multilateral funding channels (Table 15 1). Multilateral funding contributions primarily relate to the Green Climate Fund (GCF), a fund set up by the UNFCCC in 2010 and dedicated towards helping developing countries reduce their greenhouse gas emissions and enhance their ability to respond to climate change.

Support to developing countries between 2013 and 2016 has been primarily focussed on grants by the government for specific projects related to climate change mitigation or adaptation activities. During 2015, a total amount of €105,953 (US$125,559 [42]) was disbursed on projects in Ethiopia, Uganda, and Guatemala. A similar sum of money was granted in 2016 for projects in Ethiopia and Eritrea. This funding of projects serves as the country's contribution to the pledge made by developed country Parties during the Conference of the Parties to the UNFCCC held in 2009 in Copenhagen, to provide new and additional resources to support mitigation and adaptation activities in developing countries. The collective pledge of US$30 billion for the period 2010 to 2012 is often referred to as Fast Start Finance.

In 2015 and 2016, part of the finances was allocated to a Climate Action Scholarship intended to bring students from third world countries to study in Malta. Unfortunately, no eligible students were found for these scholarships in these years. In 2017 however, four students from Palau, Botswana, Grenada, and Zambia, were awarded a Climate Action Scholarship (€18,060 each) for Masters programmes in Built Environment, Sustainable Energy, and Sustainable Development (two students took up the latter). Projects were selected through a call for project proposals. Following the assessment of eligibility of proposed projects by a purposely constituted adjudication board, the government formalized the financial support through agreements with the respective organizations.

In 2017 public financial support was provided for two projects. The Ministry for Energy, the Environment and Enterprise, provided direct funding to the University of Malta to coordinate and administer a Master of Science or Master of Arts by research focusing on climate action including adaptation, mitigation, and governance. (Lead - International & EU Office, University of Malta). The second project involved the construction of a borehole to provide access to safe water to the inhabitants of Bouar, Central African Republic, through the St. Jeanne Antide Foundation. From 2018 till 2020, €100,000 per annum were contributed towards the Green Climate Fund, a fund set up by the UNFCCC in 2010 and dedicated towards helping developing countries reduce their greenhouse gas emissions and enhance their ability to respond to climate change A summary of projects sponsored

[42] For the purposes of this discussion, the currency exchange rate 0.84 Euro for 1 USD as on 23 November 2017.

through grants given by Malta from 2017 to 2020 is given from 2017 to 2020 is given from Table 6.9 to 6.11. Subsequent sections provide more detailed information on the individual project.

Table 6.1 Provision of public financial support: summary information in 2017

Allocation channels	Year 2017									
	European - EUR					National currency				
		Climate-specific					Climate-specific			
	Core/ general	Mitigation	Adaptation	Cross-cutting	Other	Core/ general	Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:										
Multilateral climate change funds[e]	0.00	0.00	0.00	0.00	0.00					
Other multilateral climate change funds[f]		0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	0.00	0.00	0.00	0.00	0.00					
Specialized United Nations bodies	20,000.00	0.00	0.00	0.00	0.00					
Total contributions through bilateral, regional and other channels		0.00	9,265.20	60,000.00	0.00					
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		0.00	9,265.20	150,000.0	0.00					

Total climate specific by funding source (EUR)	
ODA	69,265.20
OOF	0.00
Other	90,000.00

Total climate specific by financial instrument (EUR)	
Grant	159,265.20
Concessional loan	0
Non-concessional loan	0
Equity	
Other	

Table 6.2 Provision of public financial support: summary information in 2018

Allocation channels	Year 2018									
	European - EUR					National currency				
		Climate-specific					Climate-specific			
	Core/ general	Mitigation	Adaptation	Cross-cutting	Other	Core/ general	Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:										
Multilateral climate change funds[e]	0.00	0.00	0.00	100,000	0.00					
Other multilateral climate change funds[f]		0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	0.00	0.00	0.00	0.00	0.00					
Specialized United Nations bodies	20,000.00	0.00	0.00	0.00	0.00					
Total contributions through bilateral, regional and other channels		0.00	0.00	0.00	0.00					
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		0.00	0.00	100,000	0.00					

Total climate specific by funding source (EUR)	
ODA	
OOF	
Other	100,000

Total climate specific by financial instrument (EUR)	
Grant	100,000
Concessional loan	0
Non-concessional loan	0
Equity	
Other	

Table 6.3 Provision of public financial support: summary information in 2019

Allocation channels	Year 2019									
	European - EUR					National currency				
		Climate-specific					Climate-specific			
	Core/ general	Mitigation	Adaptation	Cross-cutting	Other	Core/ general	Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:										
Multilateral climate change funds[e]	0.00	0.00	0.00	100,000	0.00					
Other multilateral climate change funds[f]		0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	0.00	0.00	0.00	0.00	0.00					
Specialized United Nations bodies	20,000.00	0.00	0.00	0.00	0.00					
Total contributions through bilateral, regional and other channels		0.00	0.00	0.00	0.00					
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		0.00	0.00	100,000	0.00					

Total climate specific by funding source (EUR)	
ODA	
OOF	
Other	100,000

Total climate specific by financial instrument (EUR)	
Grant	100,000
Concessional loan	0
Non-concessional loan	0
Equity	
Other	

Table 6.4 Provision of public financial support: summary information in 2020

Allocation channels	Year 2020									
	European - EUR					National currency				
		Climate-specific					Climate-specific			
	Core/ general	Mitigation	Adaptation	Cross-cutting	Other	Core/ general	Mitigation	Adaptation	Cross-cutting	Other
Total contributions through multilateral channels:										
Multilateral climate change funds[e]	0.00	0.00	0.00	100,000	0.00					
Other multilateral climate change funds[f]		0.00	0.00	0.00	0.00					
Multilateral financial institutions, including regional development banks	0.00	0.00	0.00	0.00	0.00					
Specialized United Nations bodies	20,000.00	0.00	0.00	0.00	0.00					
Total contributions through bilateral, regional and other channels		0.00	0.00	0.00	0.00					
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)		0.00	0.00	100,000	0.00					

Total climate specific by funding source (EUR)	
ODA	
OOF	
Other	100,000

Total climate specific by financial instrument (EUR)	
Grant	100,000
Concessional loan	0
Non-concessional loan	0
Equity	
Other	

Table 6.5 Provision of public financial support: contribution through multilateral channels in 2017

Donor funding	Total amount				Status: disbursed, committed[c, 3]	Funding source: ODA, OOF, Other[4]	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[c,6]	Sector[d, 7]
	Core/general[a, 1]		Climate-specific [2]						
	European euro - EUR	National currency	European euro - EUR	National currency					
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			€90,000	Euro	Disbursed	Other	Grant	Crosscutting	Channel Parent Category 4700 and Chennel ID 41317 (DAC-CRS)
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
1. World Bank									
2. International Finance Corporation									

3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other									
Specialized United Nations bodies									
1. United Nations Development Programme	€20,000	Euro	0	n/a	Disbursed	ODA	Grant	Crosscutting	General Unspecified Code 998
2. United Nations Environment Programme									
3. Other - UNICEF									
Total contributions through multilateral channels	20,000.00	Euro	90,000.00	Euro					

Table 6.6 Provision of public financial support: contribution through multilateral channels in 2018

Donor funding	Total amount				Status: disbursed, committed[-3]	Funding source: ODA, OOF, Other[4]	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[c,6]	Sector[d, 7]
	Core/general[a, 1]		Climate-specific [2]						
	European euro - EUR	National currency	European euro - EUR	National currency					
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			€100,000	Euro	Disbursed	Other	Grant	Crosscutting	Parent
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									

5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other									
Specialized United Nations bodies									
1. United Nations Development Programme		Euro	0	n/a	Disbursed	ODA	Grant	Crosscutting	General Unspecified Code 998
2. United Nations Environment Programme									
3. Other - UNICEF									
Total contributions through multilateral channels		Euro	100,000.00	Euro					

Table 6.7 Provision of public financial support: contribution through multilateral channels in 2019

Donor funding	Total amount				Status: disbursed, committed[-3]	Funding source: ODA, OOF, Other[4]	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[c,6]	Sector[d, 7]
	Core/general[a, 1]		Climate-specific [2]						
	European euro - EUR	National currency	European euro - EUR	National currency					
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			€100,000	Euro	Disbursed	Other	Grant	Crosscutting	Parent
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									

5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other									
Specialized United Nations bodies									
1. United Nations Development Programme		Euro	0	n/a	Disbursed	ODA	Grant	Crosscutting	General Unspecified Code 998
2. United Nations Environment Programme									
3. Other - UNICEF									
Total contributions through multilateral channels		Euro	100,000.00	Euro					

Table 6.8 Provision of public financial support: contribution through multilateral channels in 2020

Donor funding	Total amount				Status: disbursed, committed[-3]	Funding source: ODA, OOF, Other[4]	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[c,6]	Sector[d, 7]
	Core/general[a, 1]		Climate-specific [2]						
	European euro - EUR	National currency	European euro - EUR	National currency					
Multilateral climate change funds									
1. Global Environment Facility									
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			€100,000	Euro	Disbursed	Other	Grant	Crosscutting	Parent
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds									
Multilateral financial institutions, including regional development banks									
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									

5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other									
Specialized United Nations bodies									
1. United Nations Development Programme		Euro	0	n/a	Disbursed	ODA	Grant	Crosscutting	General Unspecified Code 998
2. United Nations Environment Programme									
3. Other - UNICEF									
Total contributions through multilateral channels		Euro	100,000.00	Euro					

Table 6.9 Provision of public financial support: contribution through bilateral, regional and other channels in 2017.

Recipient country/ region/project/programme	Total amount		Status: disbursed, committed[3]	Funding source: ODA, OOF, Other	Financial instrument: grant, concessional loan, non-concessional loan, equity, other5	Type of support: Mitigation, adaptation, crosscutting, other[a, 6]	Sector[b, 7]	Additional information [c]
	Climate-specific[2]							
	European euro - EUR	national currency						
Scholarships in Climate Action Offered by the Government of Malta for Postgraduate Studies at the University of Malta	60,000	euro - EUR	Disbursed	Other	Grant	Crosscutting	Education (DAC 114, CRS 11420)	
The Ministry for the Environment, Energy and Eneterprise, provided direct funding to the University of Malta to coordinate and administer a Master of Science or Master of Arts by research focusing on climate action including adaptation, mitigation and governance. (Lead - International & EU Office, University of Malta)								
Construction of a borehole in Bouar, Central African Republic'	9,265	euro - EUR	Disbursed	ODA	Grant	Adaptation	CRS 14020	
This project involved the construction of a bore hole to provide access to safe water to the inhabitants of Bouar, Central African Republic, through the St. Jeanne Antide Foundation								
Total contributions through bilateral, regional and other channels	69,265.20	euro - EUR						

Table 6.10 Provision of public financial support: contribution through bilateral, regional and other channels in 2018

Recipient country/ region/project/programme	Total amount		Status: disbursed, committed[3]	Funding source: ODA, OOF, Other	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[a 6]	Sector[b,7]	Additional information [c]
	Climate-specific[2]							
	European euro - EUR	national currency						
Total contributions through bilateral, regional and other channels	0.00	euro - EUR						

Table 6.11 Provision of public financial support: contribution through bilateral, regional and other channels in 2019

Recipient country/ region/project/programme	Total amount		Status: disbursed, committed[3]	Funding source: ODA, OOF, Other	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[a 6]	Sector[b,7]	Additional information [c]
	Climate-specific[2]							
	European euro - EUR	national currency						
Total contributions through bilateral, regional and other channels	0.00	euro - EUR						

Table 6.12 Provision of public financial support: contribution through bilateral, regional and other channels in 2020

Recipient country/ region/project/programme	Total amount		Status: disbursed, committed[3]	Funding source: ODA, OOF, Other	Financial instrument: grant, concessional loan, non-concessional loan, equity, other[5]	Type of support: Mitigation, adaptation, crosscutting, other[a 6]	Sector[b,7]	Additional information [c]
	Climate-specific[2]							
	European euro - EUR	national currency						
Total contributions through bilateral, regional and other channels	0.00	euro - EUR						

CHAPTER 7 REFERENCES

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CHAPTER 8 ANNEXES

8.1 SUMMARY REPORTS

Table 8.1 Summary Report for CO_2 Equivalent Emissions in 1990.

GREENHOUSE GAS SOURCE AND	CO_2[(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[(1)]	2385.86	125.21	80.04	NO,NE,NA	NO,NA	0.01	NA,NO	NA	2591.13
1. Energy	2388.70	5.24	9.20						2403.14
A. Fuel combustion (sectoral approach)	2388.70	5.24	9.20						2403.14
1. Energy industries	1758.52	1.21	5.78						1765.51
2. Manufacturing industries and construction	52.67	0.05	0.12						52.83
3. Transport	312.69	3.17	2.60						318.45
4. Other sectors	263.69	0.81	0.69						265.19
5. Other	1.14	0.00	0.01						1.16
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.13	NO,NA	2.64	NO,NE,NA	NO,NA	0.01	NA,NO	NA	7.78
A. Mineral industry	1.44								1.44
B. Chemical industry	0.17	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.17
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.52	NA	NA						3.52
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				NO,NE	NO				NO,NE
G. Other product manufacture and use			2.64		NO	0.01			2.65
H. Other									
3. Agriculture	NE,NO	61.21	57.86						119.07
A. Enteric fermentation		52.30							52.30
B. Manure management		8.91	25.70						34.61
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.16						32.16
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[(1)]	-8.33	0.02	0.15						-8.15
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.91	NO	0.02						-1.89
C. Grassland	-8.96	NO	NO						-8.96
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	2.05	NO	0.09						2.14
F. Other land	0.57	NO	0.05						0.62
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	58.74	10.19						69.30
A. Solid waste disposal	NO,NA	41.50							41.50
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		17.20	10.17						27.37
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[(2)]									
International bunkers	1152.96	2.72	7.40						1163.08
Aviation	196.96	0.69	0.49						198.14
Navigation	956.00	2.03	6.91						964.94
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.04						
Indirect CO_2 [(3)]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2599.28
Total CO_2 equivalent emissions with land use, land-use change and forestry									2591.13
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.2 Summary Report for CO_2 Equivalent Emissions in 1991

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2229.54	133.23	81.04	NO,NE,NA	NO,NA	0.01	NA,NO	NA	2443.82
1. Energy	2232.39	5.21	8.81						2246.41
A. Fuel combustion (sectoral approach)	2232.39	5.21	8.81						2246.41
1. Energy industries	1599.05	1.15	5.09						1605.29
2. Manufacturing industries and construction	54.61	0.05	0.12						54.78
3. Transport	332.20	3.26	2.93						338.39
4. Other sectors	245.44	0.75	0.65						246.84
5. Other	1.08	0.00	0.01						1.10
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.35	NO,NA	2.65	NO,NE,NA	NO,NA	0.01	NA,NO	NA	8.01
A. Mineral industry	1.50								1.50
B. Chemical industry	0.34	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.34
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.51	NA	NA						3.51
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				NO,NE	NO				NO,NE
G. Other product manufacture and use			2.65		NO	0.01			2.66
H. Other									
3. Agriculture	NE,NO	63.66	58.51						122.17
A. Enteric fermentation		54.47							54.47
B. Manure management		9.19	26.65						35.84
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	31.86						31.86
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-8.57	0.02	0.16						-8.38
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.95	NO	0.02						-1.93
C. Grassland	-8.31	NO	NO						-8.31
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.26	NO	0.10						1.35
F. Other land	0.52	NO	0.05						0.57
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	64.34	10.92						75.62
A. Solid waste disposal	NO,NA	46.99							46.99
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		17.30	10.90						28.20
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1148.54	2.84	7.91						1159.28
Aviation	186.11	0.65	0.47						187.22
Navigation	962.43	2.18	7.44						972.06
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.55						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2452.20
Total CO_2 equivalent emissions with land use, land-use change and forestry									2443.82
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.3 Summary Report for CO_2 Equivalent Emissions in 1992

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2286.75	140.89	82.97	NO,NE,NA	NO,NA	1.43	NA,NO	NA	2512.04
1. Energy	2286.77	5.52	9.21						2301.50
A. Fuel combustion (sectoral approach)	2286.77	5.52	9.21						2301.50
1. Energy industries	1536.25	1.15	4.72						1542.13
2. Manufacturing industries and construction	63.49	0.06	0.14						63.69
3. Transport	388.51	3.40	3.51						395.42
4. Other sectors	297.28	0.91	0.82						299.01
5. Other	1.23	0.00	0.01						1.25
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.94	NO,NA	2.65	NO,NE,NA	NO,NA	1.43	NA,NO	NA	9.02
A. Mineral industry	1.27								1.27
B. Chemical industry	0.17	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.17
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.50	NA	NA						3.50
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				NO,NE	NO				NO,NE
G. Other product manufacture and use			2.65		NO	1.43			4.07
H. Other									
3. Agriculture	NE,NO	65.10	59.90						125.00
A. Enteric fermentation		55.67							55.67
B. Manure management		9.43	27.15						36.58
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.75						32.75
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-5.33	0.02	0.17						-5.14
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.98	NO	0.02						-1.97
C. Grassland	-5.11	NO	NO						-5.11
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.29	NO	0.10						1.39
F. Other land	0.56	NO	0.06						0.62
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	70.25	11.04						81.66
A. Solid waste disposal	NO,NA	52.64							52.64
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		17.57	11.03						28.59
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1449.85	3.59	9.93						1463.38
Aviation	244.15	0.85	0.61						245.61
Navigation	1205.71	2.74	9.32						1217.77
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			24.01						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2517.18
Total CO_2 equivalent emissions with land use, land-use change and forestry									2512.04
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.4 Summary Report for CO_2 Equivalent Emissions in 1993

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2865.23	147.95	85.69	NO,NE,NA	NO,NA	1.43	NA,NO	NA	3100.29
1. Energy	2865.07	6.01	11.43						2882.52
A. Fuel combustion (sectoral approach)	2865.07	6.01	11.43						2882.52
1. Energy industries	2101.83	1.54	6.57						2109.94
2. Manufacturing industries and construction	65.16	0.06	0.15						65.37
3. Transport	395.87	3.48	3.87						403.23
4. Other sectors	300.88	0.93	0.82						302.63
5. Other	1.33	0.00	0.02						1.35
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.96	NO,NA	2.65	NO,NE,NA	NO,NA	1.43	NA,NO	NA	9.04
A. Mineral industry	1.28								1.28
B. Chemical industry	0.21	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.21
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.47	NA	NA						3.47
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				NO,NE	NO				NO,NE
G. Other product manufacture and use			2.65		NO	1.43			4.08
H. Other									
3. Agriculture	NE,NO	64.67	59.74						124.41
A. Enteric fermentation		55.24							55.24
B. Manure management		9.43	27.01						36.44
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.73						32.73
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-5.17	0.02	0.18						-4.97
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.66	NO	0.01						-1.64
C. Grassland	-5.35	NO	NO						-5.35
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.32	NO	0.10						1.42
F. Other land	0.60	NO	0.06						0.67
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	77.24	11.68						89.29
A. Solid waste disposal	NO,NA	58.43							58.43
B. Biological treatment of solid waste		0.99	0.70						1.69
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		17.78	10.96						28.74
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1716.95	4.21	11.97						1733.12
Aviation	250.28	0.88	0.63						251.78
Navigation	1466.67	3.33	11.34						1481.34
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.93						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3105.26
Total CO_2 equivalent emissions with land use, land-use change and forestry									3100.29
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.5 Summary Report for CO_2 Equivalent Emissions in 1994

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2643.09	153.26	84.14	0.00	NO,NA	1.43	NA,NO	NA	2881.92
1. Energy	2642.32	6.04	10.80						2659.15
A. Fuel combustion (sectoral approach)	2642.32	6.04	10.80						2659.15
1. Energy industries	1809.12	1.41	5.35						1815.89
2. Manufacturing industries and construction	70.49	0.07	0.16						70.72
3. Transport	418.83	3.48	4.33						426.64
4. Other sectors	342.45	1.07	0.94						344.46
5. Other	1.43	0.00	0.02						1.45
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.24	NO,NA	2.65	0.00	NO,NA	1.43	NA,NO	NA	9.32
A. Mineral industry	1.55								1.55
B. Chemical industry	0.23	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.23
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.45	NA	NA						3.45
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.00	NO				0.00
G. Other product manufacture and use			2.65		NO	1.43			4.08
H. Other									
3. Agriculture	NE,NO	62.55	57.93						120.49
A. Enteric fermentation		53.30							53.30
B. Manure management		9.26	26.03						35.29
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	31.90						31.90
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.84	0.02	0.18						-4.63
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.16	NO	0.01						-1.15
C. Grassland	-5.59	NO	NO						-5.59
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.35	NO	0.11						1.46
F. Other land	0.65	NO	0.07						0.71
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	84.64	12.57						97.58
A. Solid waste disposal	NO,NA	64.33							64.33
B. Biological treatment of solid waste		2.23	1.60						3.83
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		18.04	10.96						28.99
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1812.96	4.50	12.41						1829.87
Aviation	308.37	1.08	0.77						310.21
Navigation	1504.59	3.42	11.64						1519.65
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.12						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2886.54
Total CO_2 equivalent emissions with land use, land-use change and forestry									2881.92
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.6 Summary Report for CO_2 Equivalent Emissions in 1995

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2435.10	157.25	84.52	0.00	NO,NA	1.44	NA,NO	NA	2678.31
1. Energy	2433.86	5.92	9.78						2449.55
A. Fuel combustion (sectoral approach)	2433.86	5.92	9.78						2449.55
1. Energy industries	1590.47	1.46	3.98						1595.91
2. Manufacturing industries and construction	75.31	0.07	0.17						75.55
3. Transport	430.62	3.34	4.67						438.63
4. Other sectors	335.80	1.04	0.94						337.79
5. Other	1.65	0.00	0.02						1.67
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.19	NO,NA	2.65	0.00	NO,NA	1.44	NA,NO	NA	9.29
A. Mineral industry	1.51								1.51
B. Chemical industry	0.25	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.25
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.43	NA	NA						3.43
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.00	NO				0.00
G. Other product manufacture and use			2.65		NO	1.44			4.09
H. Other									
3. Agriculture	NE,NO	60.39	58.66						119.04
A. Enteric fermentation		51.40							51.40
B. Manure management		8.99	25.03						34.03
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	33.62						33.62
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.32	0.02	0.19						-4.10
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-1.09	NO	0.01						-1.08
C. Grassland	-5.21	NO	NO						-5.21
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.38	NO	0.11						1.49
F. Other land	0.69	NO	0.07						0.76
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	90.92	13.24						104.53
A. Solid waste disposal	NO,NA	70.41							70.41
B. Biological treatment of solid waste		2.28	1.63						3.92
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		18.19	11.59						29.77
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1858.02	4.63	12.66						1875.31
Aviation	329.72	1.15	0.82						331.69
Navigation	1528.31	3.47	11.83						1543.62
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			22.96						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2682.41
Total CO_2 equivalent emissions with land use, land-use change and forestry									2678.31
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.7 Summary Report for CO_2 Equivalent Emissions in 1996

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2546.18	165.93	83.75	0.00	NO,NA	1.45	NA,NO	NA	2797.32
1. Energy	2545.18	6.14	10.10						2561.43
A. Fuel combustion (sectoral approach)	2545.18	6.14	10.10						2561.43
1. Energy industries	1646.98	1.60	3.82						1652.39
2. Manufacturing industries and construction	75.96	0.07	0.17						76.21
3. Transport	481.37	3.40	5.08						489.85
4. Other sectors	339.33	1.06	1.02						341.41
5. Other	1.55	0.00	0.02						1.57
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.98	NO,NA	2.66	0.00	NO,NA	1.45	NA,NO	NA	9.09
A. Mineral industry	1.40								1.40
B. Chemical industry	0.14	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.14
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.44	NA	NA						3.44
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.00	NO				0.00
G. Other product manufacture and use			2.66		NO	1.45			4.10
H. Other									
3. Agriculture	NE,NO	63.35	58.65						122.00
A. Enteric fermentation		54.23							54.23
B. Manure management		9.12	26.06						35.18
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.59						32.59
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.35	0.02	0.19						-4.13
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.91	NO	0.01						-0.91
C. Grassland	-5.45	NO	NO						-5.45
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.41	NO	0.12						1.52
F. Other land	0.69	NO	0.07						0.76
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	96.42	12.15						108.94
A. Solid waste disposal	NO,NA	76.71							76.71
B. Biological treatment of solid waste		1.38	0.99						2.37
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		18.28	11.14						29.42
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	1898.25	4.72	12.99						1915.96
Aviation	326.62	1.14	0.82						328.58
Navigation	1571.63	3.57	12.18						1587.38
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.38						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2801.45
Total CO_2 equivalent emissions with land use, land-use change and forestry									2797.32
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.8 Summary Report for CO_2 Equivalent Emissions in 1997

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2552.15	173.00	84.98	0.00	NO,NA	1.45	NA,NO	NA	2811.58
1. Energy	2551.17	6.12	10.15						2567.44
A. Fuel combustion (sectoral approach)	2551.17	6.12	10.15						2567.44
1. Energy industries	1611.63	1.56	3.73						1616.92
2. Manufacturing industries and construction	78.30	0.08	0.18						78.56
3. Transport	476.81	3.27	5.09						485.17
4. Other sectors	382.71	1.21	1.13						385.04
5. Other	1.72	0.00	0.02						1.74
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.19	NO,NA	2.66	0.00	NO,NA	1.45	NA,NO	NA	9.30
A. Mineral industry	1.54								1.54
B. Chemical industry	0.22	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.22
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.43	NA	NA						3.43
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.00	NO				0.00
G. Other product manufacture and use			2.66		NO	1.45			4.11
H. Other									
3. Agriculture	NE,NO	63.98	59.75						123.73
A. Enteric fermentation		54.76							54.76
B. Manure management		9.22	26.27						35.49
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	33.48						33.48
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.58	0.02	0.19						-4.36
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.92	NO	0.01						-0.91
C. Grassland	-5.64	NO	NO						-5.64
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.37	NO	0.11						1.48
F. Other land	0.69	NO	0.07						0.77
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.37	102.87	12.24						115.48
A. Solid waste disposal	NO,NA	83.04							83.04
B. Biological treatment of solid waste		0.97	0.69						1.66
C. Incineration and open burning of waste	0.37	0.04	0.02						0.43
D. Waste water treatment and discharge		18.82	11.53						30.35
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2075.60	5.14	14.28						2095.03
Aviation	342.97	1.20	0.86						345.02
Navigation	1732.64	3.94	13.42						1750.00
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.69						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2815.94
Total CO_2 equivalent emissions with land use, land-use change and forestry									2811.58
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.9 Summary Report for CO_2 Equivalent Emissions in 1998

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2509.23	178.03	85.59	0.01	NO,NA	1.47	NA,NO	NA	2774.32
1. Energy	2508.64	5.77	10.04						2524.45
A. Fuel combustion (sectoral approach)	2508.64	5.77	10.04						2524.45
1. Energy industries	1636.41	1.59	3.79						1641.78
2. Manufacturing industries and construction	59.72	0.06	0.13						59.91
3. Transport	471.68	3.08	5.08						479.84
4. Other sectors	339.23	1.05	1.01						341.29
5. Other	1.60	0.00	0.02						1.62
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.60	NO,NA	2.66	0.01	NO,NA	1.47	NA,NO	NA	8.73
A. Mineral industry	0.96								0.96
B. Chemical industry	0.20	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.20
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.43	NA	NA						3.43
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.01	NO				0.01
G. Other product manufacture and use			2.66		NO	1.47			4.13
H. Other									
3. Agriculture	NE,NO	60.35	59.43						119.79
A. Enteric fermentation		51.48							51.48
B. Manure management		8.88	24.85						33.73
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	34.58						34.58
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.36	0.02	0.20						-4.13
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.94	NO	0.01						-0.93
C. Grassland	-5.47	NO	NO						-5.47
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	1.40	NO	0.11						1.52
F. Other land	0.73	NO	0.08						0.81
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	111.88	13.26						125.48
A. Solid waste disposal	NO,NA	90.92							90.92
B. Biological treatment of solid waste		2.29	1.64						3.94
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		18.62	11.60						30.22
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2184.27	5.37	15.20						2204.83
Aviation	329.56	1.15	0.82						331.54
Navigation	1854.70	4.22	14.37						1873.29
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.20						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2778.45
Total CO_2 equivalent emissions with land use, land-use change and forestry									2774.32
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.10 Summary Report for CO_2 Equivalent Emissions in 1999

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2586.69	185.90	84.77	0.01	NO,NA	1.47	NA,NO	NA	2858.84
1. Energy	2587.69	5.73	10.45						2603.87
A. Fuel combustion (sectoral approach)	2587.69	5.73	10.45						2603.87
1. Energy industries	1709.52	1.66	3.96						1715.14
2. Manufacturing industries and construction	63.46	0.06	0.14						63.67
3. Transport	510.12	3.07	5.36						518.55
4. Other sectors	302.99	0.93	0.97						304.90
5. Other	1.60	0.00	0.02						1.62
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.79	NO,NA	2.89	0.01	NO,NA	1.47	NA,NO	NA	8.15
A. Mineral industry	0.28								0.28
B. Chemical industry	0.14	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.14
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.37	NA	NA						3.37
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				0.01	NO				0.01
G. Other product manufacture and use			2.89		NO	1.47			4.35
H. Other									
3. Agriculture	NE,NO	62.42	58.91						121.33
A. Enteric fermentation		53.28							53.28
B. Manure management		9.14	25.75						34.89
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	33.16						33.16
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-5.14	0.02	0.16						-4.96
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.94	NO	0.01						-0.94
C. Grassland	-5.72	NO	NO						-5.72
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.87	NO	0.07						0.94
F. Other land	0.73	NO	0.08						0.82
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	117.73	12.37						130.44
A. Solid waste disposal	NO,NA	98.53							98.53
B. Biological treatment of solid waste		1.32	0.95						2.27
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		17.83	11.40						29.23
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2367.00	5.80	16.57						2389.36
Aviation	338.17	1.18	0.85						340.20
Navigation	2028.83	4.62	15.72						2049.17
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	0.00								0.00
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			23.43						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2863.79
Total CO_2 equivalent emissions with land use, land-use change and forestry									2858.84
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.11 Summary Report for CO_2 Equivalent Emissions in 2000

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2502.02	190.46	84.02	6.70	NO,NA	1.47	NA,NO	NA	2784.67
1. Energy	2503.26	5.50	10.36						2519.12
A. Fuel combustion (sectoral approach)	2503.26	5.50	10.36						2519.12
1. Energy industries	1602.33	1.56	3.73						1607.62
2. Manufacturing industries and construction	62.44	0.06	0.14						62.64
3. Transport	535.78	2.95	5.45						544.17
4. Other sectors	301.11	0.93	1.03						303.06
5. Other	1.61	0.00	0.02						1.63
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.65	NO,NA	3.17	6.70	NO,NA	1.47	NA,NO	NA	14.99
A. Mineral industry	0.21								0.21
B. Chemical industry	0.09	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.09
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.35	NA	NA						3.35
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				6.70	NO				6.70
G. Other product manufacture and use			3.17		NO	1.47			4.63
H. Other									
3. Agriculture	NE,NO	58.04	57.37						115.41
A. Enteric fermentation		49.44							49.44
B. Manure management		8.60	24.38						32.98
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.98						32.98
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-5.23	0.02	0.17						-5.05
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.88	NO	0.00						-0.87
C. Grassland	-5.96	NO	NO						-5.96
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.90	NO	0.07						0.97
F. Other land	0.78	NO	0.09						0.86
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	126.90	12.96						140.20
A. Solid waste disposal	NO,NA	106.66							106.66
B. Biological treatment of solid waste		1.55	1.11						2.66
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		18.65	11.83						30.48
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2567.48	6.25	18.22						2591.95
Aviation	325.29	1.14	0.81						327.24
Navigation	2242.19	5.11	17.41						2264.70
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			22.57						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2789.72
Total CO_2 equivalent emissions with land use, land-use change and forestry									2784.67
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.12 Summary Report for CO_2 Equivalent Emissions in 2001

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2645.06	194.19	81.74	11.26	NO,NA	1.49	NA,NO	NA	2933.73
1. Energy	2643.53	5.14	10.21						2658.89
A. Fuel combustion (sectoral approach)	2643.53	5.14	10.21						2658.89
1. Energy industries	1943.92	1.89	4.51						1950.33
2. Manufacturing industries and construction	56.46	0.05	0.13						56.64
3. Transport	432.89	2.57	4.88						440.34
4. Other sectors	208.58	0.62	0.68						209.88
5. Other	1.68	0.00	0.02						1.70
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.84	NO,NA	2.51	11.26	NO,NA	1.49	NA,NO	NA	19.10
A. Mineral industry	0.20								0.20
B. Chemical industry	0.20	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.20
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.44	NA	NA						3.44
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				11.26	NO				11.26
G. Other product manufacture and use			2.51		NO	1.49			4.00
H. Other									
3. Agriculture	NE,NO	55.39	55.98						111.37
A. Enteric fermentation		47.07							47.07
B. Manure management		8.32	23.81						32.13
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	32.17						32.17
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-2.66	0.02	0.17						-2.47
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	-0.91	NO	0.00						-0.91
C. Grassland	-2.95	NO	NO,NE						-2.95
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.57	NO	0.07						0.65
F. Other land	0.71	NO	0.09						0.80
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	133.63	12.86						146.84
A. Solid waste disposal	NO,NA	113.85							113.85
B. Biological treatment of solid waste		1.77	1.27						3.04
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		17.97	11.58						29.55
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2596.96	6.25	18.69						2621.90
Aviation	274.65	0.96	0.69						276.29
Navigation	2322.31	5.29	18.01						2345.61
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			22.15						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2936.20
Total CO_2 equivalent emissions with land use, land-use change and forestry									2933.73
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.13 Summary Report for CO_2 Equivalent Emissions in 2002

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2708.83	200.95	81.04	14.98	NO,NA	1.50	NA,NO	NA	3007.30
1. Energy	2683.69	5.07	10.32						2699.08
A. Fuel combustion (sectoral approach)	2683.69	5.07	10.32						2699.08
1. Energy industries	1956.86	1.91	4.55						1963.32
2. Manufacturing industries and construction	59.59	0.06	0.13						59.78
3. Transport	464.08	2.52	4.90						471.50
4. Other sectors	201.56	0.59	0.71						202.86
5. Other	1.59	0.00	0.02						1.61
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.75	NO,NA	2.74	14.98	NO,NA	1.50	NA,NO	NA	22.97
A. Mineral industry	0.20								0.20
B. Chemical industry	0.17	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.17
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.38	NA	NA						3.38
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				14.98	NO				14.98
G. Other product manufacture and use			2.74		NO	1.50			4.23
H. Other									
3. Agriculture	NE,NO	55.21	55.40						110.61
A. Enteric fermentation		46.97							46.97
B. Manure management		8.24	23.94						32.18
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	31.46						31.46
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	21.04	0.02	0.18						21.24
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	24.53	NO	0.02						24.55
C. Grassland	-4.69	NO	NO						-4.69
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.57	NO	0.07						0.65
F. Other land	0.71	NO	0.09						0.80
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	140.65	12.41						153.40
A. Solid waste disposal	NO,NA	121.55							121.55
B. Biological treatment of solid waste		0.96	0.69						1.66
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		18.09	11.70						29.79
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	3026.85	7.20	22.14						3056.19
Aviation	254.37	0.89	0.64						255.90
Navigation	2772.48	6.31	21.50						2800.29
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			22.30						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2986.06
Total CO_2 equivalent emissions with land use, land-use change and forestry									3007.30
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.14 Summary Report for CO_2 Equivalent Emissions in 2003

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2981.55	207.36	79.29	16.46	NO,NA	2.06	NA,NO	NA	3286.73
1. Energy	2956.56	5.33	11.14						2973.04
A. Fuel combustion (sectoral approach)	2956.56	5.33	11.14						2973.04
1. Energy industries	2159.66	2.11	5.03						2166.80
2. Manufacturing industries and construction	64.04	0.06	0.14						64.24
3. Transport	523.94	2.55	5.15						531.63
4. Other sectors	207.39	0.61	0.80						208.79
5. Other	1.55	0.00	0.02						1.57
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.62	NO,NA	2.57	16.46	NO,NA	2.06	NA,NO	NA	24.72
A. Mineral industry	0.13								0.13
B. Chemical industry	0.09	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.09
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.40	NA	NA						3.40
E. Electronic Industry				0.15		NO	NO		0.15
F. Product uses as ODS substitutes				16.31	NO				16.31
G. Other product manufacture and use			2.57		NO	2.06			4.63
H. Other									
3. Agriculture	NE,NO	53.10	52.56						105.66
A. Enteric fermentation		45.36							45.36
B. Manure management		7.74	22.69						30.43
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	29.87						29.87
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	21.02	0.02	0.19						21.24
A. Forest land	-0.01	NO	NO						-0.01
B. Cropland	24.50	NO	0.03						24.53
C. Grassland	-4.69	NO	NO						-4.69
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.57	NO	0.07						0.65
F. Other land	0.72	NO	0.09						0.81
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	148.90	12.82						162.07
A. Solid waste disposal	NO,NA	129.20							129.20
B. Biological treatment of solid waste		1.45	1.04						2.49
C. Incineration and open burning of waste	0.35	0.04	0.02						0.40
D. Waste water treatment and discharge		18.21	11.77						29.98
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	3203.34	7.60	23.50						3234.44
Aviation	255.45	0.89	0.64						256.98
Navigation	2947.89	6.71	22.86						2977.45
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			21.08						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3265.49
Total CO_2 equivalent emissions with land use, land-use change and forestry									3286.73
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.15 Summary Report for CO_2 Equivalent Emissions in 2004

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2819.38	217.58	80.23	24.79	NO,NA	1.54	NA,NO	NA	3143.53
1. Energy	2816.16	4.99	10.65						2831.80
A. Fuel combustion (sectoral approach)	2816.16	4.99	10.65						2831.80
1. Energy industries	2065.53	2.01	4.80						2072.34
2. Manufacturing industries and construction	64.18	0.06	0.15						64.39
3. Transport	471.73	2.29	4.89						478.91
4. Other sectors	213.04	0.63	0.79						214.46
5. Other	1.66	0.00	0.02						1.68
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.49	NO,NA	2.56	24.79	NO,NA	1.54	NA,NO	NA	32.39
A. Mineral industry	0.18								0.18
B. Chemical industry	0.16	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.16
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.15	NA	NA						3.15
E. Electronic Industry				0.43		NO	NO		0.43
F. Product uses as ODS substitutes				24.36	NO				24.36
G. Other product manufacture and use			2.56		NO	1.54			4.11
H. Other									
3. Agriculture	NE,NO	55.52	53.79						109.31
A. Enteric fermentation		47.69							47.69
B. Manure management		7.83	23.56						31.38
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	30.23						30.23
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-0.58	0.02	0.19						-0.36
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	-1.05	NO	0.03						-1.03
C. Grassland	-0.70	NO	NO						-0.70
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.57	NO	0.07						0.65
F. Other land	0.74	NO	0.09						0.83
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.32	157.05	13.04						170.40
A. Solid waste disposal	NO,NA	137.14							137.14
B. Biological treatment of solid waste		1.57	1.12						2.69
C. Incineration and open burning of waste	0.32	0.00	0.00						0.32
D. Waste water treatment and discharge		18.33	11.92						30.25
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	3414.24	8.10	25.13						3447.47
Aviation	260.97	0.91	0.65						262.53
Navigation	3153.28	7.19	24.48						3184.94
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			21.53						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3143.90
Total CO_2 equivalent emissions with land use, land-use change and forestry									3143.53
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.16 Summary Report for CO_2 Equivalent Emissions in 2005

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2643.89	219.56	76.60	38.36	NO,NA	1.56	NA,NO	NA	2979.97
1. Energy	2640.70	4.85	11.49						2657.05
A. Fuel combustion (sectoral approach)	2640.70	4.85	11.49						2657.05
1. Energy industries	1973.48	1.92	4.57						1979.97
2. Manufacturing industries and construction	27.76	0.03	0.06						27.85
3. Transport	511.53	2.46	5.40						519.39
4. Other sectors	126.27	0.45	1.44						128.15
5. Other	1.67	0.00	0.02						1.69
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.65	NO,NA	2.46	38.36	NO,NA	1.56	NA,NO	NA	46.03
A. Mineral industry	0.06								0.06
B. Chemical industry	0.26	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.26
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.34	NA	NA						3.34
E. Electronic Industry				NO		NO	NO		NO
F. Product uses as ODS substitutes				38.36	NO				38.36
G. Other product manufacture and use			2.46		NO	1.56			4.02
H. Other									
3. Agriculture	NE,NO	49.52	49.59						99.11
A. Enteric fermentation		43.09							43.09
B. Manure management		6.43	21.38						27.81
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	28.22						28.22
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-0.78	0.02	0.19						-0.56
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	-1.19	NO	0.03						-1.16
C. Grassland	-0.78	NO	NO						-0.78
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.57	NO	0.07						0.65
F. Other land	0.75	NO	0.09						0.85
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.32	165.17	12.86						178.34
A. Solid waste disposal	NO,NA	145.12							145.12
B. Biological treatment of solid waste		1.60	1.15						2.75
C. Incineration and open burning of waste	0.32	0.00	0.00						0.32
D. Waste water treatment and discharge		18.44	11.71						30.15
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2379.09	4.88	18.59						2402.55
Aviation	266.45	0.05	2.16						268.66
Navigation	2112.64	4.82	16.43						2133.89
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			19.78						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2980.54
Total CO_2 equivalent emissions with land use, land-use change and forestry									2979.97
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.17 Summary Report for CO_2 Equivalent Emissions in 2006

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2659.69	225.44	76.81	75.85	NO,NA	1.67	NA,NO	NA	3039.45
1. Energy	2657.14	4.77	11.22						2673.13
A. Fuel combustion (sectoral approach)	2657.14	4.77	11.22						2673.13
1. Energy industries	1994.88	1.94	4.62						2001.44
2. Manufacturing industries and construction	30.66	0.03	0.06						30.75
3. Transport	521.19	2.41	5.45						529.05
4. Other sectors	108.59	0.40	1.06						110.05
5. Other	1.82	0.00	0.02						1.84
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.20	NO,NA	2.23	75.85	NO,NA	1.67	NA,NO	NA	83.95
A. Mineral industry	0.18								0.18
B. Chemical industry	0.09	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.09
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.93	NA	NA						3.93
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				75.85	NO				75.85
G. Other product manufacture and use			2.23		NO	1.57			3.81
H. Other									
3. Agriculture	NE,NO	48.46	49.80						98.26
A. Enteric fermentation		42.04							42.04
B. Manure management		6.43	21.19						27.62
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	28.61						28.61
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.97	0.02	0.19						-1.76
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	1.69	NO	0.03						1.72
C. Grassland	-4.77	NO	NO						-4.77
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.55	NO	0.07						0.62
F. Other land	0.70	NO	0.09						0.79
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.32	172.17	13.37						185.86
A. Solid waste disposal	NO,NA	151.62							151.62
B. Biological treatment of solid waste		2.08	1.49						3.58
C. Incineration and open burning of waste	0.32	0.00	0.00						0.32
D. Waste water treatment and discharge		18.47	11.88						30.34
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2671.73	5.56	20.88						2698.17
Aviation	258.90	0.05	2.10						261.04
Navigation	2412.83	5.51	18.78						2437.12
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			19.84						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3041.21
Total CO_2 equivalent emissions with land use, land-use change and forestry									3039.45
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.18 Summary Report for CO_2 Equivalent Emissions in 2007

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2729.57	230.04	77.30	93.42	0.00	1.67	NA,NO	NA	3132.00
1. Energy	2727.63	4.82	11.73						2744.17
A. Fuel combustion (sectoral approach)	2727.63	4.82	11.73						2744.17
1. Energy industries	2028.67	1.97	4.70						2035.34
2. Manufacturing industries and construction	36.86	0.03	0.07						36.96
3. Transport	542.73	2.39	5.56						550.68
4. Other sectors	117.33	0.42	1.37						119.13
5. Other	2.05	0.00	0.02						2.07
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.35	NO,NA	2.89	93.42	0.00	1.67	NA,NO	NA	101.34
A. Mineral industry	0.07								0.07
B. Chemical industry	0.10	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.10
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.19	NA	NA						3.19
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				93.42	NO				93.42
G. Other product manufacture and use			2.89		0.00	1.58			4.48
H. Other									
3. Agriculture	NE,NO	48.78	50.11						98.89
A. Enteric fermentation		42.26							42.26
B. Manure management		6.52	21.52						28.03
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	28.60						28.60
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.73	0.02	0.19						-1.51
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	1.68	NO	0.04						1.72
C. Grassland	-4.51	NO	NO						-4.51
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.55	NO	0.07						0.62
F. Other land	0.70	NO	0.09						0.79
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.32	176.42	12.38						189.11
A. Solid waste disposal	NO,NA	157.85							157.85
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.32	0.00	0.00						0.32
D. Waste water treatment and discharge		18.57	12.38						30.94
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	2978.56	6.22	23.24						3008.02
Aviation	274.97	0.05	2.23						277.25
Navigation	2703.58	6.17	21.01						2730.77
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			20.07						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3133.52
Total CO_2 equivalent emissions with land use, land-use change and forestry									3132.00
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.19 Summary Report for CO_2 Equivalent Emissions in 2008

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2751.63	147.76	72.60	109.96	0.00	1.84	NA,NO	NA	3083.79
1. Energy	2735.96	5.10	12.38						2753.45
A. Fuel combustion (sectoral approach)	2735.96	5.10	12.38						2753.45
1. Energy industries	1985.75	1.94	4.61						1992.30
2. Manufacturing industries and construction	36.86	0.03	0.07						36.96
3. Transport	591.35	2.70	6.30						600.35
4. Other sectors	119.89	0.42	1.37						121.69
5. Other	2.11	0.00	0.02						2.14
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.58	NO,NA	2.31	109.96	0.00	1.84	NA,NO	NA	117.69
A. Mineral industry	0.05								0.05
B. Chemical industry	0.06	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.06
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.47	NA	NA						3.47
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				109.96	NO				109.96
G. Other product manufacture and use			2.31		0.00	1.75			4.06
H. Other									
3. Agriculture	NE,NO	46.57	46.12						92.70
A. Enteric fermentation		40.39							40.39
B. Manure management		6.18	19.99						26.17
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	26.13						26.13
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	11.74	0.02	0.18						11.94
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	15.01	NO	0.04						15.05
C. Grassland	-4.32	NO	NO						-4.32
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.49	NO	0.06						0.56
F. Other land	0.69	NO	0.08						0.77
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.35	96.06	11.60						108.01
A. Solid waste disposal	NO,NA	78.60							78.60
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.35	0.00	0.16						0.51
D. Waste water treatment and discharge		17.46	11.44						28.90
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	3207.12	6.74	25.06						3238.92
Aviation	282.67	0.05	2.29						285.01
Navigation	2924.45	6.68	22.77						2953.90
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			18.37						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3071.84
Total CO_2 equivalent emissions with land use, land-use change and forestry									3083.79
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.20 Summary Report for CO_2 Equivalent Emissions in 2009

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2538.80	160.70	67.35	130.81	0.00	1.59	NA,NO	NA	2899.25
1. Energy	2523.23	4.43	10.84						2538.50
A. Fuel combustion (sectoral approach)	2523.23	4.43	10.84						2538.50
1. Energy industries	1864.55	1.82	4.33						1870.70
2. Manufacturing industries and construction	21.47	0.02	0.04						21.52
3. Transport	528.59	2.22	5.40						536.21
4. Other sectors	106.39	0.38	1.04						107.81
5. Other	2.23	0.00	0.02						2.26
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.92	NO,NA	1.83	130.81	0.00	1.59	NA,NO	NA	138.15
A. Mineral industry	0.11								0.11
B. Chemical industry	0.10	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.10
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.72	NA	NA						3.72
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				130.81	NO				130.81
G. Other product manufacture and use			1.83		0.00	1.50			3.33
H. Other									
3. Agriculture	NE,NO	44.15	43.88						88.04
A. Enteric fermentation		38.19							38.19
B. Manure management		5.97	18.87						24.84
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	25.01						25.01
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	11.17	0.02	0.18						11.37
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	14.32	NO	0.04						14.36
C. Grassland	-4.13	NO	NO						-4.13
D. Wetlands	-0.07	0.02	NO						-0.05
E. Settlements	0.44	NO	0.05						0.49
F. Other land	0.68	NO	0.08						0.76
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.48	112.08	10.63						123.19
A. Solid waste disposal	NO,NA	96.59							96.59
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	0.48	0.00	0.21						0.68
D. Waste water treatment and discharge		15.50	10.42						25.92
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	3364.01	7.11	26.22						3397.34
Aviation	266.48	0.05	2.16						268.69
Navigation	3097.52	7.06	24.06						3128.65
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	NO								NO
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			17.31						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2887.88
Total CO_2 equivalent emissions with land use, land-use change and forestry									2899.25
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.21 Summary Report for CO_2 Equivalent Emissions in 2010

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2600.14	147.76	65.35	141.07	0.00	1.79	NA,NO	NA	2956.11
1. Energy	2585.03	4.11	9.37						2598.51
A. Fuel combustion (sectoral approach)	2585.03	4.11	9.37						2598.51
1. Energy industries	1862.00	1.82	4.33						1868.14
2. Manufacturing industries and construction	30.75	0.03	0.06						30.84
3. Transport	559.43	1.58	3.51						564.52
4. Other sectors	130.41	0.68	1.45						132.54
5. Other	2.44	0.01	0.03						2.47
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	3.58	NO,NA	1.53	141.07	0.00	1.79	NA,NO	NA	147.96
A. Mineral industry	0.18								0.18
B. Chemical industry	0.10	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.10
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.30	NA	NA						3.30
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				141.07	NO				141.07
G. Other product manufacture and use			1.53		0.00	1.69			3.22
H. Other									
3. Agriculture	NE,NO	42.84	43.37						86.21
A. Enteric fermentation		36.96							36.96
B. Manure management		5.88	18.21						24.09
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	25.16						25.16
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	11.01	NO	0.16						11.17
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	14.15	NO	0.04						14.20
C. Grassland	-4.02	NO	NO						-4.02
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.34	NO	0.04						0.38
F. Other land	0.63	NO	0.07						0.70
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.52	100.81	10.92						112.26
A. Solid waste disposal	NO,NA	84.22							84.22
B. Biological treatment of solid waste		0.15	NO,NA						0.15
C. Incineration and open burning of waste	0.52	0.00	0.21						0.73
D. Waste water treatment and discharge		16.44	10.72						27.15
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	4952.67	10.67	38.53						5001.88
Aviation	291.84	0.05	2.36						294.26
Navigation	4660.84	10.62	36.17						4707.62
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	5.11								5.11
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			16.87						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2944.94
Total CO_2 equivalent emissions with land use, land-use change and forestry									2956.11
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.22 Summary Report for CO_2 Equivalent Emissions in 2011

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2575.04	146.07	58.30	163.86	0.00	4.69	NA,NO	NA	2947.95
1. Energy	2572.48	3.93	9.02						2585.43
A. Fuel combustion (sectoral approach)	2572.48	3.93	9.02						2585.43
1. Energy industries	1907.54	1.86	4.43						1913.82
2. Manufacturing industries and construction	15.27	0.01	0.03						15.31
3. Transport	550.20	1.47	3.47						555.15
4. Other sectors	96.27	0.58	1.06						97.92
5. Other	3.19	0.01	0.03						3.23
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.03	NO,NA	1.55	163.86	0.00	4.69	NA,NO	NA	174.13
A. Mineral industry	0.17								0.17
B. Chemical industry	0.13	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.13
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	3.73	NA	NA						3.73
E. Electronic Industry				NO		0.09	NO		0.09
F. Product uses as ODS substitutes				163.86	NO				163.86
G. Other product manufacture and use			1.55		0.00	4.59			6.15
H. Other									
3. Agriculture	NE,NO	41.38	41.71						83.08
A. Enteric fermentation		35.95							35.95
B. Manure management		5.43	17.44						22.87
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	24.26						24.26
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-2.15	NO	0.15						-2.00
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	0.79	NO	0.04						0.84
C. Grassland	-3.78	NO	NO						-3.78
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.31	NO	0.04						0.35
F. Other land	0.62	NO	0.07						0.69
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.69	100.75	5.87						107.31
A. Solid waste disposal	NO,NA	95.50							95.50
B. Biological treatment of solid waste		0.88	NO,NA						0.88
C. Incineration and open burning of waste	0.69	0.00	0.18						0.87
D. Waste water treatment and discharge		4.37	5.68						10.06
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	4595.40	9.83	35.75						4640.98
Aviation	302.88	0.05	2.45						305.39
Navigation	4292.53	9.78	33.30						4335.60
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	8.08								8.08
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			16.24						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2949.95
Total CO_2 equivalent emissions with land use, land-use change and forestry									2947.95
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.23 Summary Report for CO_2 Equivalent Emissions in 2012

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2724.25	150.23	58.24	197.32	0.00	0.54	NA,NO	NA	3130.58
1. Energy	2720.41	4.11	9.04						2733.55
A. Fuel combustion (sectoral approach)	2720.41	4.11	9.04						2733.55
1. Energy industries	2018.99	1.97	4.69						2025.65
2. Manufacturing industries and construction	27.75	0.02	0.05						27.83
3. Transport	537.14	1.37	3.38						541.89
4. Other sectors	133.63	0.75	0.88						135.26
5. Other	2.90	0.01	0.03						2.93
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.19	NO,NA	2.13	197.32	0.00	0.54	NA,NO	NA	205.18
A. Mineral industry	0.90								0.90
B. Chemical industry	0.03	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.03
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	4.25	NA	NA						4.25
E. Electronic Industry				0.56		0.09	NO		0.65
F. Product uses as ODS substitutes				196.77	NO				196.77
G. Other product manufacture and use			2.13		0.00	0.45			2.58
H. Other									
3. Agriculture	NE,NO	42.24	42.80						85.04
A. Enteric fermentation		36.75							36.75
B. Manure management		5.49	17.75						23.24
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	25.05						25.05
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.96	NO	0.15						-1.81
A. Forest land	-0.07	NO	NO						-0.07
B. Cropland	0.78	NO	0.05						0.83
C. Grassland	-3.55	NO	NO						-3.55
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.28	NO	0.03						0.32
F. Other land	0.61	NO	0.07						0.68
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.62	103.87	4.13						108.62
A. Solid waste disposal	NO,NA	102.83							102.83
B. Biological treatment of solid waste		1.04	NO,NA						1.04
C. Incineration and open burning of waste	0.62	0.00	0.17						0.78
D. Waste water treatment and discharge		NO,IE,NA	3.97						3.97
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	4107.97	8.74	31.99						4148.71
Aviation	298.51	0.06	2.42						300.99
Navigation	3809.46	8.68	29.58						3847.72
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	14.97								14.97
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			16.64						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									3132.39
Total CO_2 equivalent emissions with land use, land-use change and forestry									3130.58
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.24 Summary Report for CO_2 Equivalent Emissions in 2013

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2377.42	147.80	56.08	209.46	0.00	2.77	NA,NO	NA	2793.53
1. Energy	2367.60	3.69	7.90						2379.19
A. Fuel combustion (sectoral approach)	2367.60	3.69	7.90						2379.19
1. Energy industries	1639.93	1.60	3.81						1645.33
2. Manufacturing industries and construction	53.48	0.05	0.12						53.65
3. Transport	537.01	1.28	3.35						541.64
4. Other sectors	133.90	0.75	0.59						135.25
5. Other	3.28	0.01	0.03						3.32
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	11.13	NO,NA	1.45	209.46	0.00	2.77	NA,NO	NA	224.81
A. Mineral industry	2.54								2.54
B. Chemical industry	0.03	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.03
C. Metal industry	NO	NO				NO			NO
D. Non-energy products from fuels and solvent use	8.56	NA	NA						8.56
E. Electronic Industry				1.33		0.09	NO		1.42
F. Product uses as ODS substitutes				208.13	NO				208.13
G. Other product manufacture and use			1.45		0.00	2.68			4.12
H. Other									
3. Agriculture	NE,NO	41.40	42.09						83.48
A. Enteric fermentation		35.96							35.96
B. Manure management		5.43	17.40						22.83
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	24.69						24.69
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.77	NO	0.14						-1.63
A. Forest land	-0.08	NO	NO						-0.08
B. Cropland	0.77	NO	0.05						0.82
C. Grassland	-3.31	NO	NO						-3.31
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.26	NO	0.03						0.29
F. Other land	0.60	NO	0.06						0.66
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.46	102.71	4.50						107.68
A. Solid waste disposal	NO,NA	101.26							101.26
B. Biological treatment of solid waste		1.01	NO,NA						1.01
C. Incineration and open burning of waste	0.46	0.00	0.18						0.65
D. Waste water treatment and discharge		0.43	4.32						4.75
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	4144.23	8.76	32.23						4185.22
Aviation	322.15	0.06	2.61						324.81
Navigation	3822.09	8.70	29.62						3860.41
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	21.13								21.13
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			16.30						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2795.16
Total CO_2 equivalent emissions with land use, land-use change and forestry									2793.53
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.25 Summary Report for CO_2 Equivalent Emissions in 2014

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	2360.05	159.50	55.96	220.27	0.00	0.68	NA,NO	NA	2796.46
1. Energy	2352.79	3.72	7.96						2364.46
A. Fuel combustion (sectoral approach)	2352.79	3.72	7.96						2364.46
1. Energy industries	1599.32	1.56	3.71						1604.59
2. Manufacturing industries and construction	62.70	0.06	0.13						62.89
3. Transport	546.68	1.25	3.45						551.38
4. Other sectors	140.56	0.85	0.62						142.03
5. Other	3.54	0.01	0.03						3.58
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	10.95	NA,NO	0.88	220.27	0.00	0.68	NA,NO	NA	232.78
A. Mineral industry	2.48								2.48
B. Chemical industry	0.07	NO,NA	NO,NA	NA,NO	NA	NA	NA	NA	0.07
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	8.41	NA	NA						8.41
E. Electronic Industry				0.34		0.09	NO		0.43
F. Product uses as ODS substitutes				219.93	NO				219.93
G. Other product manufacture and use			0.88		0.00	0.58			1.47
H. Other									
3. Agriculture	NE,NO	40.75	41.50						82.25
A. Enteric fermentation		35.37							35.37
B. Manure management		5.38	17.03						22.41
C. Rice cultivation		NA,NO							NA,NO
D. Agricultural soils		NA,NE	24.48						24.48
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-4.33	NO	0.14						-4.20
A. Forest land	-0.08	NO	NO						-0.08
B. Cropland	-2.00	NO	0.05						-1.95
C. Grassland	-3.07	NO	NO						-3.07
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.23	NO	0.03						0.26
F. Other land	0.59	NO	0.06						0.65
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.64	115.04	5.49						121.17
A. Solid waste disposal	NA,NO	111.95							111.95
B. Biological treatment of solid waste		0.91	NA,NO						0.91
C. Incineration and open burning of waste	0.64	0.00	0.17						0.82
D. Waste water treatment and discharge		2.18	5.31						7.49
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	4278.86	9.03	33.29						4321.17
Aviation	340.42	0.06	2.76						343.24
Navigation	3938.44	8.96	30.53						3977.93
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	29.00								29.00
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.90						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2800.66
Total CO_2 equivalent emissions with land use, land-use change and forestry									2796.46
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.26 Summary Report for CO_2 Equivalent Emissions in 2015

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1661.32	171.09	55.64	230.78	0.00	0.28	NA,NO	NA	2119.11
1. Energy	1655.18	3.08	6.42						1664.68
A. Fuel combustion (sectoral approach)	1655.18	3.08	6.42						1664.68
1. Energy industries	850.11	0.83	1.97						852.91
2. Manufacturing industries and construction	59.70	0.06	0.13						59.89
3. Transport	580.57	1.26	3.62						585.46
4. Other sectors	160.94	0.93	0.66						162.53
5. Other	3.86	0.01	0.04						3.90
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	9.54	NA,NO	0.66	230.78	0.00	0.28	NA,NO	NA	241.26
A. Mineral industry	1.89								1.89
B. Chemical industry	0.07	NO,NA	NO,NA	NA,NO	NA	NA	NA	NA	0.07
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	7.58	NA	NA						7.58
E. Electronic Industry				0.24		0.09	NO		0.33
F. Product uses as ODS substitutes				230.54	NO				230.54
G. Other product manufacture and use			0.66		0.00	0.19			0.85
H. Other									
3. Agriculture	NE,NO	40.15	41.80						81.95
A. Enteric fermentation		35.01							35.01
B. Manure management		5.14	17.07						22.21
C. Rice cultivation		NA,NO							NA,NO
D. Agricultural soils		NA,NE	24.73						24.73
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-3.97	NO	0.13						-3.84
A. Forest land	-0.10	NO	NO						-0.10
B. Cropland	-1.81	NO	0.05						-1.76
C. Grassland	-2.83	NO	NO						-2.83
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.21	NO	0.02						0.23
F. Other land	0.58	NO	0.06						0.64
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.57	127.86	6.62						135.05
A. Solid waste disposal	NA,NO	121.83							121.83
B. Biological treatment of solid waste		0.83	NA,NO						0.83
C. Incineration and open burning of waste	0.57	0.00	0.16						0.73
D. Waste water treatment and discharge		5.20	6.47						11.67
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Memo items:[2]									
International bunkers	5300.61	11.33	41.24						5353.18
Aviation	357.68	0.07	2.90						360.65
Navigation	4942.93	11.26	38.34						4992.54
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	27.57								27.57
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			16.14						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2122.95
Total CO_2 equivalent emissions with land use, land-use change and forestry									2119.11
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.27 Summary Report for CO_2 Equivalent Emissions in 2016

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1352.40	181.00	54.13	244.29	0.00	0.14	NO,NA	NA	1831.96
1. Energy	1348.42	2.69	5.73						1356.84
A. Fuel combustion (sectoral approach)	1348.42	2.69	5.73						1356.84
1. Energy industries	557.55	0.54	1.29						559.38
2. Manufacturing industries and construction	59.51	0.05	0.13						59.69
3. Transport	580.40	1.22	3.64						585.25
4. Other sectors	146.98	0.88	0.64						148.50
5. Other	3.97	0.01	0.04						4.02
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	7.41	NO,NA	2.00	244.29	0.00	0.14	NO,NA	NA	253.84
A. Mineral industry	1.13								1.13
B. Chemical industry	0.03	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.03
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	6.25	NA	NA						6.25
E. Electronic Industry				0.10		0.09	NO		0.19
F. Product uses as ODS substitutes				244.19	NO				244.19
G. Other product manufacture and use			2.00		0.00	0.05			2.05
H. Other									
3. Agriculture	NO,NE	39.66	39.99						79.65
A. Enteric fermentation		34.69							34.69
B. Manure management		4.96	16.26						21.22
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	23.74						23.74
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-3.95	NO	0.13						-3.82
A. Forest land	-0.10	NO	NO						-0.10
B. Cropland	-2.00	NO	0.05						-1.95
C. Grassland	-2.59	NO	NO						-2.59
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.18	NO	0.02						0.20
F. Other land	0.57	NO	0.06						0.63
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.52	138.65	6.28						145.45
A. Solid waste disposal	NO,NA	132.51							132.51
B. Biological treatment of solid waste		2.04	NO,NA						2.04
C. Incineration and open burning of waste	0.52	0.00	0.14						0.67
D. Waste water treatment and discharge		4.09	6.13						10.23
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*									
Memo items:[2]									
International bunkers	6032.10	12.91	46.89						6091.90
Aviation	392.30	0.07	3.18						395.54
Navigation	5639.80	12.84	43.71						5696.35
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	27.53								27.53
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.24						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									1835.78
Total CO_2 equivalent emissions with land use, land-use change and forestry									1831.96
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.28 Summary Report for CO_2 Equivalent Emissions in 2017

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1528.88	177.88	52.65	255.77	0.00	0.99	NO,NA	NA	2016.17
1. Energy	1525.51	2.54	5.77						1533.82
A. Fuel combustion (sectoral approach)	1525.51	2.54	5.77						1533.82
1. Energy industries	717.61	0.41	0.68						718.71
2. Manufacturing industries and construction	53.50	0.05	0.11						53.66
3. Transport	601.15	1.20	3.79						606.15
4. Other sectors	149.15	0.87	1.14						151.16
5. Other	4.09	0.01	0.04						4.14
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.86	NO,NA	0.79	255.77	0.00	0.99	NO,NA	NA	262.41
A. Mineral industry	0.29								0.29
B. Chemical industry	0.04	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.04
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	4.53	NA	NA						4.53
E. Electronic Industry				0.30		0.09	NO		0.39
F. Product uses as ODS substitutes				255.47	NO				255.47
G. Other product manufacture and use			0.79		0.00	0.90			1.69
H. Other									
3. Agriculture	NO,NE	38.39	39.72						78.12
A. Enteric fermentation		33.59							33.59
B. Manure management		4.81	15.95						20.75
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	23.78						23.78
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-2.00	NO	0.12						-1.88
A. Forest land	-0.10	NO	NO						-0.10
B. Cropland	-0.25	NO	0.05						-0.20
C. Grassland	-2.35	NO	NO						-2.35
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.15	NO	0.02						0.17
F. Other land	0.56	NO	0.05						0.61
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.51	136.95	6.24						143.70
A. Solid waste disposal	NO,NA	131.21							131.21
B. Biological treatment of solid waste		2.18	NO,NA						2.18
C. Incineration and open burning of waste	0.51	0.00	0.14						0.65
D. Waste water treatment and discharge		3.56	6.10						9.66
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*									
Memo items:[2]									
International bunkers	7305.08	15.72	56.78						7377.58
Aviation	434.01	0.09	3.51						437.61
Navigation	6871.07	15.64	53.26						6939.97
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	30.88								30.88
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.18						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2018.05
Total CO_2 equivalent emissions with land use, land-use change and forestry									2016.17
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.29 Summary Report for CO_2 Equivalent Emissions in 2018

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1545.69	184.95	52.65	245.29	0.00	0.30	NO,NA	NA	2028.87
1. Energy	1540.84	2.34	5.90						1549.09
A. Fuel combustion (sectoral approach)	1540.84	2.34	5.90						1549.09
1. Energy industries	697.33	0.32	0.40						698.06
2. Manufacturing industries and construction	43.21	0.04	0.08						43.33
3. Transport	665.98	1.17	4.24						671.39
4. Other sectors	130.66	0.80	1.14						132.61
5. Other	3.66	0.01	0.03						3.70
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	5.55	NO,NA	0.92	245.29	0.00	0.30	NO,NA	NA	252.06
A. Mineral industry	0.20								0.20
B. Chemical industry	0.04	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.04
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	5.31	NA	NA						5.31
E. Electronic Industry				0.30		NO	NO		0.30
F. Product uses as ODS substitutes				244.99	NO				244.99
G. Other product manufacture and use			0.92		0.00	0.30			1.22
H. Other									
3. Agriculture	NO,NE	38.59	39.85						78.44
A. Enteric fermentation		33.72							33.72
B. Manure management		4.87	16.06						20.93
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	23.79						23.79
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.26	NO	0.12						-1.14
A. Forest land	-0.10	NO	NO						-0.10
B. Cropland	0.29	NO	0.06						0.35
C. Grassland	-2.11	NO	NO						-2.11
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.13	NO	0.01						0.14
F. Other land	0.55	NO	0.05						0.60
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.55	144.02	5.86						150.43
A. Solid waste disposal	NO,NA	138.82							138.82
B. Biological treatment of solid waste		2.40	NO,NA						2.40
C. Incineration and open burning of waste	0.55	0.00	0.13						0.69
D. Waste water treatment and discharge		2.80	5.72						8.52
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*									
Memo items:[2]									
International bunkers	7580.29	16.27	58.95						7655.52
Aviation	478.92	0.10	3.88						482.89
Navigation	7101.38	16.17	55.08						7172.62
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	39.96								39.96
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.30						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2030.01
Total CO_2 equivalent emissions with land use, land-use change and forestry									2028.87
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.30 Summary Report for CO_2 Equivalent Emissions in 2019

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1647.70	192.11	55.49	234.77	0.00	0.33	NO,NA	NA	2130.39
1. Energy	1643.86	2.56	6.63						1653.05
A. Fuel combustion (sectoral approach)	1643.86	2.56	6.63						1653.05
1. Energy industries	739.17	0.35	0.46						739.98
2. Manufacturing industries and construction	47.12	0.04	0.09						47.25
3. Transport	708.63	1.21	4.54						714.37
4. Other sectors	145.32	0.95	1.51						147.78
5. Other	3.63	0.01	0.03						3.67
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.77	NO,NA	1.39	234.77	0.00	0.33	NO,NA	NA	241.25
A. Mineral industry	0.18								0.18
B. Chemical industry	0.03	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.03
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	4.56	NA	NA						4.56
E. Electronic Industry				0.06		NO	NO		0.06
F. Product uses as ODS substitutes				234.70	NO				234.70
G. Other product manufacture and use			1.39		0.00	0.33			1.71
H. Other									
3. Agriculture	NO,NE	38.73	39.85						78.58
A. Enteric fermentation		33.87							33.87
B. Manure management		4.86	16.00						20.86
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	23.86						23.86
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-1.49	NO	0.12						-1.37
A. Forest land	-0.14	NO	NO						-0.14
B. Cropland	-0.11	NO	0.06						-0.05
C. Grassland	-1.87	NO	NO						-1.87
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.10	NO	0.01						0.11
F. Other land	0.54	NO	0.05						0.59
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.55	150.81	7.50						158.87
A. Solid waste disposal	NO,NA	141.42							141.42
B. Biological treatment of solid waste		2.01	NO,NA						2.01
C. Incineration and open burning of waste	0.55	0.00	0.14						0.69
D. Waste water treatment and discharge		7.38	7.37						14.75
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*									
Memo items:[2]									
International bunkers	7791.97	16.68	60.62						7869.27
Aviation	514.23	0.10	4.16						518.49
Navigation	7277.74	16.58	56.45						7350.77
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	44.40								44.40
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.23						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2131.76
Total CO_2 equivalent emissions with land use, land-use change and forestry									2130.39
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

Table 8.31 Summary Report for CO_2 Equivalent Emissions in 2020

GREENHOUSE GAS SOURCE AND	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Unspecified mix of HFCs and PFCs	NF_3	Total
SINK CATEGORIES	**CO_2 equivalent (kt)**								
Total (net emissions)[1]	1597.28	193.81	55.58	272.34	0.00	0.40	NO,NA	NA	2119.41
1. Energy	1594.47	2.37	5.49						1602.33
A. Fuel combustion (sectoral approach)	1594.47	2.37	5.49						1602.33
1. Energy industries	809.85	0.41	0.58						810.83
2. Manufacturing industries and construction	56.74	0.05	0.12						56.91
3. Transport	565.89	0.97	3.73						570.59
4. Other sectors	157.61	0.93	1.03						159.57
5. Other	4.39	0.01	0.04						4.44
B. Fugitive emissions from fuels	NO	NO	NO						NO
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO	NO	NO						NO
C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	4.46	NO,NA	2.42	272.34	0.00	0.40	NO,NA	NA	279.62
A. Mineral industry	0.19								0.19
B. Chemical industry	0.00	NO,NA	NO,NA	NO,NA	NA	NA	NA	NA	0.00
C. Metal industry	NO	NO							NO
D. Non-energy products from fuels and solvent use	4.27	NA	NA						4.27
E. Electronic Industry				0.18		NO	NO		0.18
F. Product uses as ODS substitutes				272.16	NO				272.16
G. Other product manufacture and use			2.42		0.00	0.40			2.82
H. Other									
3. Agriculture	NO,NE	39.53	40.71						80.24
A. Enteric fermentation		34.52							34.52
B. Manure management		5.00	16.47						21.47
C. Rice cultivation		NO,NA							NO,NA
D. Agricultural soils		NA,NE	24.24						24.24
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		NO,NA	NO,NA						NO,NA
G. Liming	NO								NO
H. Urea application	NE								NE
I. Other carbon-containing fertilizers	NO								NO
J. Other		NA	NA						NA
4. Land use, land-use change and forestry[1]	-2.29	NO	0.11						-2.18
A. Forest land	-0.29	NO	NO						-0.29
B. Cropland	-0.97	NO	0.06						-0.91
C. Grassland	-1.63	NO	NO						-1.63
D. Wetlands	-0.02	NO	NO						-0.02
E. Settlements	0.07	NO	0.01						0.08
F. Other land	0.53	NO	0.05						0.57
G. Harvested wood products	NO								NO
H. Other	NO	NO	NO						NO
5. Waste	0.65	151.92	6.84						159.41
A. Solid waste disposal	NO,NA	145.47							145.47
B. Biological treatment of solid waste		0.81	NO,NA						0.81
C. Incineration and open burning of waste	0.65	0.00	0.16						0.81
D. Waste water treatment and discharge		5.63	6.68						12.31
E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1.A)*									
Memo items:[2]									
International bunkers	7225.41	16.05	56.15						7297.61
Aviation	198.17	0.04	1.60						199.81
Navigation	7027.24	16.01	54.54						7097.80
Multilateral operations	NO	NO	NO						NO
CO_2 emissions from biomass	53.36								53.36
CO_2 captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N_2O			15.69						
Indirect CO_2 [3]	NO,NE,NA								
Total CO_2 equivalent emissions without land use, land-use change and forestry									2121.59
Total CO_2 equivalent emissions with land use, land-use change and forestry									2119.41
Total CO_2 equivalent emissions, including indirect CO_2, without land use, land-use change and forestry									NA
Total CO_2 equivalent emissions, including indirect CO_2, with land use, land-use change and forestry									NA

8.2 EMISSION TRENDS BY GAS

Note:

(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 base year is used to calculate the percentage change in the final column of this table.

Table 8.32 Emission Trends by Gas (in kt equivalent to CO_2) for 1990.

GREENHOUSE GAS EMISSIONS	Base year(3)	1990	Change from base to latest reported year
CO_2 emissions without net CO_2 from LULUCF	2394.19	2394.19	0.00
CO_2 emissions with net CO_2 from LULUCF	2385.86	2385.86	0.00
CH_4 emissions without CH_4 from LULUCF	125.19	125.19	0.00
CH_4 emissions with CH_4 from LULUCF	125.21	125.21	0.00
N_2O emissions without N_2O from LULUCF	79.89	79.89	0.00
N_2O emissions with N_2O from LULUCF	80.04	80.04	0.00
HFCs	NO,NE,NA	NO,NE,NA	0.00
PFCs	NO,NA	NO,NA	0.00
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	0.00
SF_6	0.01	0.01	0.00
NF_3	NA	NA	0.00
Total (without LULUCF)	2599.28	2599.28	0.00
Total (with LULUCF)	2591.13	2591.13	0.00

Table 8.33 Emission Trends by Gas (in kt equivalent to CO2) for 1991.

GREENHOUSE GAS EMISSIONS	Base year(3)	1991	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2238.11	-6.52
CO_2 emissions with net CO_2 from LULUCF	2385.86	2229.54	-6.55
CH_4 emissions without CH_4 from LULUCF	125.19	133.21	6.40
CH_4 emissions with CH_4 from LULUCF	125.21	133.23	6.40
N_2O emissions without N_2O from LULUCF	79.89	80.88	1.24
N_2O emissions with N_2O from LULUCF	80.04	81.04	1.25
HFCs	NO,NE,NA	NO,NE,NA	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	0.01	-98.95
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2452.20	-5.66
Total (with LULUCF)	2591.13	2443.82	-5.69

Table 8.34 Emission Trends by Gas (in kt equivalent to CO_2) for 1992.

GREENHOUSE GAS EMISSIONS	Base year(3)	1992	Change from base to previous year
CO_2 emissions without net CO_2 from LULUCF	2394.19	2292.08	-4.27
CO_2 emissions with net CO_2 from LULUCF	2385.86	2286.75	-4.15
CH_4 emissions without CH_4 from LULUCF	125.19	140.87	12.53
CH_4 emissions with CH_4 from LULUCF	125.21	140.89	12.52
N_2O emissions without N_2O from LULUCF	79.89	82.80	3.65
N_2O emissions with N_2O from LULUCF	80.04	82.97	3.66
HFCs	NO,NE,NA	NO,NE,NA	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.43	-29.03
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2517.18	-3.16
Total (with LULUCF)	2591.13	2512.04	-3.05

Table 8.35 Emission Trends by Gas (in kt equivalent to CO2) for 1993.

GREENHOUSE GAS EMISSIONS	Base year(3)	1993	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2870.40	19.89
CO_2 emissions with net CO_2 from LULUCF	2385.86	2865.23	20.09
CH_4 emissions without CH_4 from LULUCF	125.19	147.92	18.16
CH_4 emissions with CH_4 from LULUCF	125.21	147.95	18.16
N_2O emissions without N_2O from LULUCF	79.89	85.51	7.04
N_2O emissions with N_2O from LULUCF	80.04	85.69	7.06
HFCs	NO,NE,NA	NO,NE,NA	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.43	-52.60

NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3105.26	19.47
Total (with LULUCF)	2591.13	3100.29	19.65

Table 8.36 Emission Trends by Gas (in kt equivalent to CO2) for 1994.

GREENHOUSE GAS EMISSIONS	Base year(3)	1994	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2647.93	10.60
CO_2 emissions with net CO_2 from LULUCF	2385.86	2643.09	10.78
CH_4 emissions without CH_4 from LULUCF	125.19	153.23	22.40
CH_4 emissions with CH_4 from LULUCF	125.21	153.26	22.40
N_2O emissions without N_2O from LULUCF	79.89	83.95	5.09
N_2O emissions with N_2O from LULUCF	80.04	84.14	5.11
HFCs	NO,NE,NA	0.00	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.43	-64.31
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2886.54	11.05
Total (with LULUCF)	2591.13	2881.92	11.22

Table 8.37 Emission Trends by Gas (in kt equivalent to CO2) for 1995.

GREENHOUSE GAS EMISSIONS	Base year(3)	1995	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2439.42	1.89
CO_2 emissions with net CO_2 from LULUCF	2385.86	2435.10	2.06
CH_4 emissions without CH_4 from LULUCF	125.19	157.23	25.59
CH_4 emissions with CH_4 from LULUCF	125.21	157.25	25.59
N_2O emissions without N_2O from LULUCF	79.89	84.33	5.55
N_2O emissions with N_2O from LULUCF	80.04	84.52	5.59
HFCs	NO,NE,NA	0.00	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.44	-71.33
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2682.41	3.20
Total (with LULUCF)	2591.13	2678.31	3.36

Table 8.38 Emission Trends by Gas (in kt equivalent to CO2) for 1996.

GREENHOUSE GAS EMISSIONS	Base year(3)	1996	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2550.53	6.53
CO_2 emissions with net CO_2 from LULUCF	2385.86	2546.18	6.72
CH_4 emissions without CH_4 from LULUCF	125.19	165.91	32.53
CH_4 emissions with CH_4 from LULUCF	125.21	165.93	32.52
N_2O emissions without N_2O from LULUCF	79.89	83.56	4.60
N_2O emissions with N_2O from LULUCF	80.04	83.75	4.64
HFCs	NO,NE,NA	0.00	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.45	-75.92
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2801.45	7.78
Total (with LULUCF)	2591.13	2797.32	7.96

Table 8.39 Emission Trends by Gas (in kt equivalent to CO2) for 1997.

GREENHOUSE GAS EMISSIONS	Base year(3)	1997	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2556.73	6.79
CO_2 emissions with net CO_2 from LULUCF	2385.86	2552.15	6.97
CH_4 emissions without CH_4 from LULUCF	125.19	172.97	38.17
CH_4 emissions with CH_4 from LULUCF	125.21	173.00	38.16
N_2O emissions without N_2O from LULUCF	79.89	84.79	6.14
N_2O emissions with N_2O from LULUCF	80.04	84.98	6.17
HFCs	NO,NE,NA	0.00	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.45	-79.36
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2815.94	8.34
Total (with LULUCF)	2591.13	2811.58	8.51

Table 8.40 Emission Trends by Gas (in kt equivalent to CO_2) for 1998.

GREENHOUSE GAS EMISSIONS	Base year(3)	1998	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2513.58	4.99
CO_2 emissions with net CO_2 from LULUCF	2385.86	2509.23	5.17
CH_4 emissions without CH_4 from LULUCF	125.19	178.01	42.19
CH_4 emissions with CH_4 from LULUCF	125.21	178.03	42.18
N_2O emissions without N_2O from LULUCF	79.89	85.38	6.88
N_2O emissions with N_2O from LULUCF	80.04	85.59	6.92
HFCs	NO,NE,NA	0.01	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.47	-81.71
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2778.45	6.89
Total (with LULUCF)	2591.13	2774.32	7.07

Table 8.41 Emission Trends by Gas (in kt equivalent to CO2) for 1999.

GREENHOUSE GAS EMISSIONS	Base year(3)	1999	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2591.82	8.25
CO_2 emissions with net CO_2 from LULUCF	2385.86	2586.69	8.42
CH_4 emissions without CH_4 from LULUCF	125.19	185.88	48.48
CH_4 emissions with CH_4 from LULUCF	125.21	185.90	48.47
N_2O emissions without N_2O from LULUCF	79.89	84.62	5.92
N_2O emissions with N_2O from LULUCF	80.04	84.77	5.91
HFCs	NO,NE,NA	0.01	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.47	-83.74
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2863.79	10.18
Total (with LULUCF)	2591.13	2858.84	10.33

Table 8.42 Emission Trends by Gas (in kt equivalent to CO_2) for 2000.

GREENHOUSE GAS EMISSIONS	Base year(3)	2000	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2507.26	4.72
CO_2 emissions with net CO_2 from LULUCF	2385.86	2502.02	4.87
CH_4 emissions without CH_4 from LULUCF	125.19	190.44	52.12
CH_4 emissions with CH_4 from LULUCF	125.21	190.46	52.11
N_2O emissions without N_2O from LULUCF	79.89	83.85	4.96
N_2O emissions with N_2O from LULUCF	80.04	84.02	4.96
HFCs	NO,NE,NA	6.70	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.47	-85.32
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2789.72	7.33
Total (with LULUCF)	2591.13	2784.67	7.47

Table 8.43 Emission Trends by Gas (in kt equivalent to CO2) for 2001.

GREENHOUSE GAS EMISSIONS	Base year(3)	2001	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2647.72	10.59
CO_2 emissions with net CO_2 from LULUCF	2385.86	2645.06	10.86
CH_4 emissions without CH_4 from LULUCF	125.19	194.16	55.10
CH_4 emissions with CH_4 from LULUCF	125.21	194.19	55.08
N_2O emissions without N_2O from LULUCF	79.89	81.57	2.10
N_2O emissions with N_2O from LULUCF	80.04	81.74	2.12
HFCs	NO,NE,NA	11.26	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.49	-86.47
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2936.20	12.96
Total (with LULUCF)	2591.13	2933.73	13.22

Table 8.44 Emission Trends by Gas (in kt equivalent to CO2) for 2002.

GREENHOUSE GAS EMISSIONS	Base year(3)	2002	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2687.78	12.26
CO_2 emissions with net CO_2 from LULUCF	2385.86	2708.83	13.54
CH_4 emissions without CH_4 from LULUCF	125.19	200.93	60.50
CH_4 emissions with CH_4 from LULUCF	125.21	200.95	60.49
N_2O emissions without N_2O from LULUCF	79.89	80.86	1.22
N_2O emissions with N_2O from LULUCF	80.04	81.04	1.25
HFCs	NO,NE,NA	14.98	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.50	-87.55
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2986.06	14.88
Total (with LULUCF)	2591.13	3007.30	16.06

Table 8.45 Emission Trends by Gas (in kt equivalent to CO2) for 2003.

GREENHOUSE GAS EMISSIONS	Base year(3)	2003	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2960.53	23.65
CO_2 emissions with net CO_2 from LULUCF	2385.86	2981.55	24.97
CH_4 emissions without CH_4 from LULUCF	125.19	207.33	65.61
CH_4 emissions with CH_4 from LULUCF	125.21	207.36	65.60
N_2O emissions without N_2O from LULUCF	79.89	79.10	-0.99
N_2O emissions with N_2O from LULUCF	80.04	79.29	-0.94
HFCs	NO,NE,NA	16.46	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	2.06	-84.15
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3265.49	25.63
Total (with LULUCF)	2591.13	3286.73	26.85

Table 8.46 Emission Trends by Gas (in kt equivalent to CO2) for 2004.

GREENHOUSE GAS EMISSIONS	Base year(3)	2004	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2819.96	17.78
CO_2 emissions with net CO_2 from LULUCF	2385.86	2819.38	18.17
CH_4 emissions without CH_4 from LULUCF	125.19	217.56	73.78
CH_4 emissions with CH_4 from LULUCF	125.21	217.58	73.77
N_2O emissions without N_2O from LULUCF	79.89	80.04	0.19
N_2O emissions with N_2O from LULUCF	80.04	80.23	0.24
HFCs	NO,NE,NA	24.79	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.54	-88.98
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3143.90	20.95
Total (with LULUCF)	2591.13	3143.53	21.32

Table 8.47 Emission Trends by Gas (in kt equivalent to CO2) for 2005.

GREENHOUSE GAS EMISSIONS	Base year(3)	2005	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2644.67	10.46
CO_2 emissions with net CO_2 from LULUCF	2385.86	2643.89	10.81
CH_4 emissions without CH_4 from LULUCF	125.19	219.54	75.36
CH_4 emissions with CH_4 from LULUCF	125.21	219.56	75.35
N_2O emissions without N_2O from LULUCF	79.89	76.40	-4.36
N_2O emissions with N_2O from LULUCF	80.04	76.60	-4.31
HFCs	NO,NE,NA	38.36	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.56	-89.58
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2980.54	14.67
Total (with LULUCF)	2591.13	2979.97	15.01

Table 8.48 Emission Trends by Gas (in kt equivalent to CO2) for 2006.

GREENHOUSE GAS EMISSIONS	Base year(3)	2006	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2661.66	11.17
CO_2 emissions with net CO_2 from LULUCF	2385.86	2659.69	11.48
CH_4 emissions without CH_4 from LULUCF	125.19	225.41	80.06
CH_4 emissions with CH_4 from LULUCF	125.21	225.44	80.04
N_2O emissions without N_2O from LULUCF	79.89	76.62	-4.09
N_2O emissions with N_2O from LULUCF	80.04	76.81	-4.04
HFCs	NO,NE,NA	75.85	NO,NE,NA
PFCs	NO,NA	NO,NA	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.67	-89.60
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3041.21	17.00
Total (with LULUCF)	2591.13	3039.45	17.30

Table 8.49 Emission Trends by Gas (in kt equivalent to CO2) for 2007.

GREENHOUSE GAS EMISSIONS	Base year(3)	2007	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2731.30	14.08
CO_2 emissions with net CO_2 from LULUCF	2385.86	2729.57	14.41
CH_4 emissions without CH_4 from LULUCF	125.19	230.02	83.74
CH_4 emissions with CH_4 from LULUCF	125.21	230.04	83.72
N_2O emissions without N_2O from LULUCF	79.89	77.11	-3.48
N_2O emissions with N_2O from LULUCF	80.04	77.30	-3.43
HFCs	NO,NE,NA	93.42	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.67	-90.16
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3133.52	20.55
Total (with LULUCF)	2591.13	3132.00	20.87

Table 8.50 Emission Trends by Gas (in kt equivalent to CO2) for 2008.

GREENHOUSE GAS EMISSIONS	Base year(3)	2008	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2739.89	14.44
CO_2 emissions with net CO_2 from LULUCF	2385.86	2751.63	15.33
CH_4 emissions without CH_4 from LULUCF	125.19	147.73	18.01
CH_4 emissions with CH_4 from LULUCF	125.21	147.76	18.01
N_2O emissions without N_2O from LULUCF	79.89	72.41	-9.36
N_2O emissions with N_2O from LULUCF	80.04	72.60	-9.30
HFCs	NO,NE,NA	109.96	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.84	-89.78
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3071.84	18.18
Total (with LULUCF)	2591.13	3083.79	19.01

Table 8.51 Emission Trends by Gas (in kt equivalent to CO2) for 2009.

GREENHOUSE GAS EMISSIONS	Base year(3)	2009	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2527.63	5.57
CO_2 emissions with net CO_2 from LULUCF	2385.86	2538.80	6.41
CH_4 emissions without CH_4 from LULUCF	125.19	160.67	28.34
CH_4 emissions with CH_4 from LULUCF	125.21	160.70	28.34
N_2O emissions without N_2O from LULUCF	79.89	67.18	-15.91
N_2O emissions with N_2O from LULUCF	80.04	67.35	-15.86
HFCs	NO,NE,NA	130.81	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.59	-91.65
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2887.88	11.10
Total (with LULUCF)	2591.13	2899.25	11.89

Table 8.52 Emission Trends by Gas (in kt equivalent to CO2) for 2010.

GREENHOUSE GAS EMISSIONS	Base year(3)	2010	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2589.13	8.14
CO_2 emissions with net CO_2 from LULUCF	2385.86	2600.14	8.98
CH_4 emissions without CH_4 from LULUCF	125.19	147.76	18.03
CH_4 emissions with CH_4 from LULUCF	125.21	147.76	18.01
N_2O emissions without N_2O from LULUCF	79.89	65.20	-18.39
N_2O emissions with N_2O from LULUCF	80.04	65.35	-18.35
HFCs	NO,NE,NA	141.07	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	1.79	-91.07
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2944.94	13.30
Total (with LULUCF)	2591.13	2956.11	14.09

Table 8.53 Emission Trends by Gas (in kt equivalent to CO2) for 2011.

GREENHOUSE GAS EMISSIONS	Base year(3)	2011	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2577.20	7.64
CO_2 emissions with net CO_2 from LULUCF	2385.86	2575.04	7.93
CH_4 emissions without CH_4 from LULUCF	125.19	146.07	16.68
CH_4 emissions with CH_4 from LULUCF	125.21	146.07	16.65
N_2O emissions without N_2O from LULUCF	79.89	58.15	-27.22
N_2O emissions with N_2O from LULUCF	80.04	58.30	-27.17
HFCs	NO,NE,NA	163.86	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	4.69	-77.70
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2949.95	13.49
Total (with LULUCF)	2591.13	2947.95	13.77

Table 8.54 Emission Trends by Gas (in kt equivalent to CO2) for 2012.

GREENHOUSE GAS EMISSIONS	Base year(3)	2012	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2726.21	13.87
CO_2 emissions with net CO_2 from LULUCF	2385.86	2724.25	14.18
CH_4 emissions without CH_4 from LULUCF	125.19	150.23	20.00
CH_4 emissions with CH_4 from LULUCF	125.21	150.23	19.98
N_2O emissions without N_2O from LULUCF	79.89	58.09	-27.28
N_2O emissions with N_2O from LULUCF	80.04	58.24	-27.24
HFCs	NO,NE,NA	197.32	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	0.54	-97.53
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	3132.39	20.51
Total (with LULUCF)	2591.13	3130.58	20.82

Table 8.55 Emission Trends by Gas (in kt equivalent to CO2) for 2013.

GREENHOUSE GAS EMISSIONS	Base year(3)	2013	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2379.19	-0.63
CO_2 emissions with net CO_2 from LULUCF	2385.86	2377.42	-0.35
CH_4 emissions without CH_4 from LULUCF	125.19	147.80	18.06
CH_4 emissions with CH_4 from LULUCF	125.21	147.80	18.04
N_2O emissions without N_2O from LULUCF	79.89	55.94	-29.98
N_2O emissions with N_2O from LULUCF	80.04	56.08	-29.93
HFCs	NO,NE,NA	209.46	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	2.77	-87.97
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2795.16	7.54
Total (with LULUCF)	2591.13	2793.53	7.81

Table 8.56 Emission Trends by Gas (in kt equivalent to CO2) for 2014.

GREENHOUSE GAS EMISSIONS	Base year(3)	2014	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	2364.39	-1.25
CO_2 emissions with net CO_2 from LULUCF	2385.86	2360.05	-1.08
CH_4 emissions without CH_4 from LULUCF	125.19	159.50	27.41
CH_4 emissions with CH_4 from LULUCF	125.21	159.50	27.38
N_2O emissions without N_2O from LULUCF	79.89	55.83	-30.12
N_2O emissions with N_2O from LULUCF	80.04	55.96	-30.08
HFCs	NO,NE,NA	220.27	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	0.68	-97.19
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2800.66	7.75
Total (with LULUCF)	2591.13	2796.46	7.92

Table 8.57 Emission Trends by Gas (in kt equivalent to CO2) for 2015.

GREENHOUSE GAS EMISSIONS	Base year(3)	2015	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1665.29	-30.44
CO_2 emissions with net CO_2 from LULUCF	2385.86	1661.32	-30.37
CH_4 emissions without CH_4 from LULUCF	125.19	171.09	36.66
CH_4 emissions with CH_4 from LULUCF	125.21	171.09	36.64
N_2O emissions without N_2O from LULUCF	79.89	55.51	-30.52
N_2O emissions with N_2O from LULUCF	80.04	55.64	-30.49
HFCs	NO,NE,NA	230.78	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NA,NO	NA,NO
SF_6	0.01	0.28	-98.88
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2122.95	-18.33
Total (with LULUCF)	2591.13	2119.11	-18.22

Table 8.58 Emission Trends by Gas (in kt equivalent to CO2) for 2016

GREENHOUSE GAS EMISSIONS	Base year(3)	2016	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1356.35	-43.35
CO_2 emissions with net CO_2 from LULUCF	2385.86	1352.40	-43.32
CH_4 emissions without CH_4 from LULUCF	125.19	181.00	44.58
CH_4 emissions with CH_4 from LULUCF	125.21	181.00	44.55
N_2O emissions without N_2O from LULUCF	79.89	54.00	-32.40
N_2O emissions with N_2O from LULUCF	80.04	54.13	-32.38
HFCs	NO,NE,NA	244.29	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NO,NA	NA,NO
SF_6	0.01	0.14	-99.47
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	1835.78	-29.37
Total (with LULUCF)	2591.13	1831.96	-29.30

Table 8.59 Emission Trends by Gas (in kt equivalent to CO2) for 2017

GREENHOUSE GAS EMISSIONS	Base year(3)	2017	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1530.88	-36.06
CO_2 emissions with net CO_2 from LULUCF	2385.86	1528.88	-35.92
CH_4 emissions without CH_4 from LULUCF	125.19	177.88	42.09
CH_4 emissions with CH_4 from LULUCF	125.21	177.88	42.06
N_2O emissions without N_2O from LULUCF	79.89	52.53	-34.25
N_2O emissions with N_2O from LULUCF	80.04	52.65	-34.22
HFCs	NO,NE,NA	255.77	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NO,NA	NA,NO
SF_6	0.01	0.99	-96.34
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2018.05	-22.36
Total (with LULUCF)	2591.13	2016.17	-22.19

Table 8.60 Emission Trends by Gas (in kt equivalent to CO2) for 2018

GREENHOUSE GAS EMISSIONS	Base year(3)	2018	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1546.95	-35.39
CO_2 emissions with net CO_2 from LULUCF	2385.86	1545.69	-35.21
CH_4 emissions without CH_4 from LULUCF	125.19	184.95	47.74
CH_4 emissions with CH_4 from LULUCF	125.21	184.95	47.71
N_2O emissions without N_2O from LULUCF	79.89	52.53	-34.25
N_2O emissions with N_2O from LULUCF	80.04	52.65	-34.23
HFCs	NO,NE,NA	245.29	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NO,NA	NA,NO
SF_6	0.01	0.30	-98.93
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2030.01	-21.90
Total (with LULUCF)	2591.13	2028.87	-21.70

Table 8.61 Emission Trends by Gas (in kt equivalent to CO2) for 2019

GREENHOUSE GAS EMISSIONS	Base year(3)	2019	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1649.19	-31.12
CO_2 emissions with net CO_2 from LULUCF	2385.86	1647.70	-30.94
CH_4 emissions without CH_4 from LULUCF	125.19	192.11	53.45
CH_4 emissions with CH_4 from LULUCF	125.21	192.11	53.42
N_2O emissions without N_2O from LULUCF	79.89	55.37	-30.69
N_2O emissions with N_2O from LULUCF	80.04	55.49	-30.68
HFCs	NO,NE,NA	234.77	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NO,NA	NA,NO
SF_6	0.01	0.33	-98.87
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2131.76	-17.99
Total (with LULUCF)	2591.13	2130.39	-17.78

Table 8.62 Emission Trends by Gas (in kt equivalent to CO2) for 2020

GREENHOUSE GAS EMISSIONS	Base year(3)	2020	Change from base to previous year (%)
CO_2 emissions without net CO_2 from LULUCF	2394.19	1599.58	-33.19
CO_2 emissions with net CO_2 from LULUCF	2385.86	1597.28	-33.05
CH_4 emissions without CH_4 from LULUCF	125.19	193.81	54.81
CH_4 emissions with CH_4 from LULUCF	125.21	193.81	54.78
N_2O emissions without N_2O from LULUCF	79.89	55.47	-30.57
N_2O emissions with N_2O from LULUCF	80.04	55.58	-30.56
HFCs	NO,NE,NA	272.34	NO,NE,NA
PFCs	NO,NA	0.00	NO,NA
Unspecified mix of HFCs and PFCs	NA,NO	NO,NA	NA,NO
SF_6	0.01	0.40	-98.66
NF_3	NA	NA	NA
Total (without LULUCF)	2599.28	2121.59	-18.38
Total (with LULUCF)	2591.13	2119.41	-18.21

8.3 EMISSION TRENDS BY SECTOR

Note:

(2) 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 base year is used to calculate the percentage change in the final column of this table.
(3) Includes net CO_2, CH_4 and N_2O from LULUCF.

Table 8.63 Emission Trends by Sector (in kt equivalent to CO_2) for 1990.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(4)	1990	Change from base to previous year (%)
1. Energy	2403.14	2403.14	0
2. Industrial processes and product use	7.78	7.78	0
3. Agriculture	119.07	119.07	0
4. Land use, land-use change and forestry(5)	-8.15	-8.15	0
5. Waste	69.30	69.30	0
6. Other	NA	NA	NA
Total (including LULUCF)(5)	2591.13	2591.13	0

Table 8.64 Emission Trends by Sector (in kt equivalent to CO_2) for 1991.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1991	Change from base to previous year (%)
1. Energy	2403.14	2246.41	6.98
2. Industrial processes and product use	7.78	8.01	-2.82
3. Agriculture	119.07	122.17	-2.54
4. Land use, land-use change and forestry[5]	-8.15	-8.38	-2.73
5. Waste	69.30	75.62	-8.36
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2443.82	6.07

Table 8.65 Emission Trends by Sector (in kt equivalent to CO_2) for 1992.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1992	Change from base to previous year (%)
1. Energy	2403.14	2301.50	4.42
2. Industrial processes and product use	7.78	9.02	-13.73
3. Agriculture	119.07	125.00	-4.74
4. Land use, land-use change and forestry[5]	-8.15	-5.14	58.73
5. Waste	69.30	81.66	-15.14
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2512.04	3.23

Table 8.66 Emission Trends by Sector (in kt equivalent to CO_2) for 1993.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1993	Change from base to previous year (%)
1. Energy	2403.14	2882.52	-16.63
2. Industrial processes and product use	7.78	9.04	-13.90
3. Agriculture	119.07	124.41	-4.30
4. Land use, land-use change and forestry[5]	-8.15	-4.97	64.15
5. Waste	69.30	89.29	-22.39
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3100.29	-16.33

Table 8.67 Emission Trends by Sector (in kt equivalent to CO_2) for 1994.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1994	Change from base to previous year (%)
1. Energy	2403.14	2659.15	-9.63
2. Industrial processes and product use	7.78	9.32	-16.55
3. Agriculture	119.07	120.49	-1.18
4. Land use, land-use change and forestry[5]	-8.15	-4.63	76.11
5. Waste	69.30	97.58	-28.99
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2881.92	-9.95

Table 8.68 Emission Trends by Sector (in kt equivalent to CO_2) for 1995.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1995	Change from base to previous year (%)
1. Energy	2403.14	2449.55	-1.89
2. Industrial processes and product use	7.78	9.29	-16.21
3. Agriculture	119.07	119.04	0.02
4. Land use, land-use change and forestry[5]	-8.15	-4.10	98.69
5. Waste	69.30	104.53	-33.71
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2678.31	-3.07

Table 8.69 Emission Trends by Sector (in kt equivalent to CO_2) for 1996.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1996	Change from base to previous year (%)
1. Energy	2403.14	2561.43	-6.18
2. Industrial processes and product use	7.78	9.09	-14.38
3. Agriculture	119.07	122.00	-2.40
4. Land use, land-use change and forestry[5]	-8.15	-4.13	97.27
5. Waste	69.30	108.94	-36.39
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2797.32	-7.16

Table 8.70 Emission Trends by Sector (in kt equivalent to CO_2) for 1997.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1997	Change from base to previous year (%)
1. Energy	2403.14	2567.44	-6.40
2. Industrial processes and product use	7.78	9.30	-16.33
3. Agriculture	119.07	123.73	-3.76
4. Land use, land-use change and forestry[5]	-8.15	-4.36	86.85
5. Waste	69.30	115.48	-39.99
6. Other	NA	NA	NA

Total (including LULUCF)[5]	2591.13	2811.58	-7.59

Table 8.71 Emission Trends by Sector (in kt equivalent to CO_2) for 1998.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1998	Change from base to previous year (%)
1. Energy	2403.14	2524.45	-4.81
2. Industrial processes and product use	7.78	8.73	-10.85
3. Agriculture	119.07	119.79	-0.60
4. Land use, land-use change and forestry[5]	-8.15	-4.13	97.27
5. Waste	69.30	125.48	-44.78
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2774.32	-6.31

Table 8.72 Emission Trends by Sector (in kt equivalent to CO_2) for 1999.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	1999	Change from base to previous year (%)
1. Energy	2403.14	2603.87	-7.71
2. Industrial processes and product use	7.78	8.15	-4.56
3. Agriculture	119.07	121.33	-1.86
4. Land use, land-use change and forestry[5]	-8.15	-4.96	64.48
5. Waste	69.30	130.44	-46.87
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2858.84	-9.05

Table 8.73 Emission Trends by Sector (in kt equivalent to CO_2) for 2000.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2000	Change from base to previous year (%)
1. Energy	2403.14	2519.12	-4.60
2. Industrial processes and product use	7.78	14.99	-48.09
3. Agriculture	119.07	115.41	3.17
4. Land use, land-use change and forestry[5]	-8.15	-5.05	61.58
5. Waste	69.30	140.20	-50.57
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2784.67	-6.59

Table 8.74 Emission Trends by Sector (in kt equivalent to CO_2) for 2001.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2001	Change from base to previous year (%)
1. Energy	2403.14	2658.89	-9.62
2. Industrial processes and product use	7.78	19.10	-59.27
3. Agriculture	119.07	111.37	6.91
4. Land use, land-use change and forestry[5]	-8.15	-2.47	229.91
5. Waste	69.30	146.84	-52.81
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2933.73	-11.30

Table 8.75 Emission Trends by Sector (in kt equivalent to CO_2) for 2002.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2002	Change from base to previous year (%)
1. Energy	2403.14	2699.08	-10.96
2. Industrial processes and product use	7.78	22.97	-66.13
3. Agriculture	119.07	110.61	7.65
4. Land use, land-use change and forestry[5]	-8.15	21.24	-138.37
5. Waste	69.30	153.40	-54.83
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3007.30	-13.44

Table 8.76 Emission Trends by Sector (in kt equivalent to CO_2) for 2003.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2003	Change from base to previous year (%)
1. Energy	2403.14	2973.04	-19.17
2. Industrial processes and product use	7.78	24.72	-68.52
3. Agriculture	119.07	105.66	12.69
4. Land use, land-use change and forestry[5]	-8.15	21.24	-138.39
5. Waste	69.30	162.07	-57.24
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3286.73	-20.77

Table 8.77 Emission Trends by Sector (in kt equivalent to CO_2) for 2004.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2004	Change from base to previous year (%)
1. Energy	2403.14	2831.80	-15.14
2. Industrial processes and product use	7.78	32.39	-75.98
3. Agriculture	119.07	109.31	8.93

4. Land use, land-use change and forestry[5]	-8.15	-0.36	2137.79
5. Waste	69.30	170.40	-59.33
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3143.53	-17.13

Table 8.78 Emission Trends by Sector (in kt equivalent to CO_2) for 2005.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2005	Change from base to previous year (%)
1. Energy	2403.14	2657.05	-9.56
2. Industrial processes and product use	7.78	46.03	-83.10
3. Agriculture	119.07	99.11	20.13
4. Land use, land-use change and forestry[5]	-8.15	-0.56	1351.31
5. Waste	69.30	178.34	-61.14
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2979.97	-12.55

Table 8.79 Emission Trends by Sector (in kt equivalent to CO_2) for 2006.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2006	Change from base to previous year (%)
1. Energy	2403.14	2673.13	-10.10
2. Industrial processes and product use	7.78	83.95	-90.73
3. Agriculture	119.07	98.26	21.17
4. Land use, land-use change and forestry[5]	-8.15	-1.76	363.94
5. Waste	69.30	185.86	-62.72
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3039.45	-14.22

Table 8.80 Emission Trends by Sector (in kt equivalent to CO_2) for 2007.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2007	Change from base to previous year (%)
1. Energy	2403.14	2744.17	-12.43
2. Industrial processes and product use	7.78	101.34	-92.32
3. Agriculture	119.07	98.89	20.40
4. Land use, land-use change and forestry[5]	-8.15	-1.51	438.43
5. Waste	69.30	189.11	-63.36
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3132.00	-16.73

Table 8.81 Emission Trends by Sector (in kt equivalent to CO_2) for 2008.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2008	Change from base to previous year (%)
1. Energy	2403.14	2753.45	-12.72
2. Industrial processes and product use	7.78	117.69	-93.39
3. Agriculture	119.07	92.70	28.45
4. Land use, land-use change and forestry[5]	-8.15	11.94	-168.25
5. Waste	69.30	108.01	-35.84
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3083.79	-15.39

Table 8.82 Emission Trends by Sector (in kt equivalent to CO_2) for 2009.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2009	Change from base to previous year (%)
1. Energy	2403.14	2538.50	-5.33
2. Industrial processes and product use	7.78	138.15	-94.37
3. Agriculture	119.07	88.04	35.25
4. Land use, land-use change and forestry[5]	-8.15	11.37	-171.70
5. Waste	69.30	123.19	-43.75
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2899.25	-9.97

Table 8.83 Emission Trends by Sector (in kt equivalent to CO_2) for 2010.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2010	Change from base to previous year (%)
1. Energy	2403.14	2598.51	-7.52
2. Industrial processes and product use	7.78	147.96	-94.74
3. Agriculture	119.07	86.21	38.12
4. Land use, land-use change and forestry[5]	-8.15	11.17	-173.00
5. Waste	69.30	112.26	-38.27
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2956.11	-11.67

Table 8.84 Emission Trends by Sector (in kt equivalent to CO_2) for 2011.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2011	Change from base to previous year (%)

1. Energy	2403.14	2585.43	-7.05
2. Industrial processes and product use	7.78	174.13	-95.53
3. Agriculture	119.07	83.08	43.31
4. Land use, land-use change and forestry[5]	-8.15	-2.00	307.30
5. Waste	69.30	107.31	-35.42
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2947.95	-11.39

Table 8.85 Emission Trends by Sector (in kt equivalent to CO_2) for 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2012	Change from base to previous year (%)
1. Energy	2403.14	2733.55	-12.09
2. Industrial processes and product use	7.78	205.18	-96.21
3. Agriculture	119.07	85.04	40.02
4. Land use, land-use change and forestry[5]	-8.15	-1.81	349.78
5. Waste	69.30	108.62	-36.20
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	3130.58	-16.53

Table 8.86 Emission Trends by Sector (in kt equivalent to CO_2) for 2013.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2013	Change from base to previous year (%)
1. Energy	2403.14	2379.19	1.01
2. Industrial processes and product use	7.78	224.81	-96.54
3. Agriculture	119.07	83.48	42.62
4. Land use, land-use change and forestry[5]	-8.15	-1.63	399.89
5. Waste	69.30	107.68	-35.64
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2793.53	-6.42

Table 8.87 Emission Trends by Sector (in kt equivalent to CO_2) for 2014.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2014	Change from base to previous year (%)
1. Energy	2403.14	2364.46	1.64
2. Industrial processes and product use	7.78	232.78	-96.66
3. Agriculture	119.07	82.25	44.76
4. Land use, land-use change and forestry[5]	-8.15	-4.20	94.14
5. Waste	69.30	121.17	-42.81
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2796.46	-6.48

Table 8.88 Emission Trends by Sector (in kt equivalent to CO_2) for 2015.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2015	Change from base to previous year (%)
1. Energy	2403.14	1664.68	44.36
2. Industrial processes and product use	7.78	241.26	-96.78
3. Agriculture	119.07	81.95	45.29
4. Land use, land-use change and forestry[5]	-8.15	-3.84	112.45
5. Waste	69.30	135.05	-48.69
6. Other	NA	NA	NA
Total (including LULUCF)[5]	2591.13	2119.11	23.45

Table 8.89 2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2016	Change from base to previous year (%)
1. Energy	2403.14	1356.84	77.11
2. Industrial processes and product use	7.78	253.84	-96.93
3. Agriculture	119.07	79.65	49.49
4. Land use, land-use change and forestry[5]	-8.15	-3.82	113.15
5. Waste	69.30	145.45	-52.36
6. Other	NA		NA
Total (including LULUCF)[5]	2591.13	1831.96	42.86

Table 8.90 2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[4]	2017	Change from base to previous year (%)
1. Energy	2403.14	1533.82	56.68
2. Industrial processes and product use	7.78	262.41	-97.03
3. Agriculture	119.07	78.12	52.42
4. Land use, land-use change and forestry[5]	-8.15	-1.88	334.51
5. Waste	69.30	143.70	-51.78
6. Other	NA		NA
Total (including LULUCF)[5]	2591.13	2016.17	29.86

Table 8.91 2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(4)	2018	Change from base to previous year (%)
1. Energy	2403.14	1549.09	55.13
2. Industrial processes and product use	7.78	252.06	-96.91
3. Agriculture	119.07	78.44	51.80
4. Land use, land-use change and forestry(5)	-8.15	-1.14	615.63
5. Waste	69.30	150.43	-53.94
6. Other	NA		NA
Total (including LULUCF)(5)	2591.13	2028.87	29.09

Table 8.92 2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(4)	2019	Change from base to previous year (%)
1. Energy	2403.14	1653.05	45.38
2. Industrial processes and product use	7.78	241.25	-96.77
3. Agriculture	119.07	78.58	51.52
4. Land use, land-use change and forestry(5)	-8.15	-1.37	495.16
5. Waste	69.30	158.87	-56.38
6. Other	NA		NA
Total (including LULUCF)(5)	2591.13	2130.39	22.99

Table 8.93 2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(4)	2020	Change from base to previous year (%)
1. Energy	2403.14	1602.33	49.98
2. Industrial processes and product use	7.78	279.62	-97.22
3. Agriculture	119.07	80.24	48.40
4. Land use, land-use change and forestry(5)	-8.15	-2.18	274.07
5. Waste	69.30	159.41	-56.53
6. Other	NA		NA
Total (including LULUCF)(5)	2591.13	2119.41	23.67

8.4 POLICIES AND MEASURES (2020/2030 PROJECTIONS IN NATIONAL COMMUNICATIONS REPORT, 2022)

8.4.1 Energy Sector

8.4.1.1 Electricity Generation

Malta's electricity sector was, until relatively recently, completely isolated from the European grid. Whilst such isolation has been tackled through a 200MW interconnector with mainland Europe via Italy, the small size of the Maltese internal market and the location of Malta at the periphery of mainland Europe, remain an important factor for electricity generation in Malta. This is acknowledged by Directive 2009/72/EC8[43] which, pursuant to Article 44, ensured that Malta could benefit from several derogations from the full implementation of the Electricity & Gas Directives.

Electricity supply in the Maltese Islands in recent years has been maintained through three main sources: the local electricity generation plants, electricity imported through the interconnector, and electricity generated by distributed renewable energy plants, a mix of residential and commercial solar energy installations being the main contributors.

Conventional fossil fuel generation of electricity is concentrated in four installations with a combined generation capacity of 548 MW and producing electricity from a mix of diesel and natural gas, the latter being now the main energy source for local electricity generation. The use of heavy fuel oil, prevalent since the use of coal was stopped in the mid 1990's, was discontinued after 2017.

It is to note that all four electricity generation installations referred to above fall within scope of the EU Emissions Trading Scheme Directive[44] . A number of inter-linked technical measures have been implemented across these installations, including the decommissioning of most of the generation plant at Marsa Power Station (operated by Enemalta plc), with remaining plant only operated on a stand-by basis for exceptional emergency use, the phasing out of the oldest generation equipment at Delimara Power Station leaving generation units that are incorporated into the plant known as Delimara 2 Power Station (also operated by Enemalta plc), the conversion of diesel-fired plant at Delimara 3 Power Plant (D3PP, operated by D3PG Ltd) to dual-duel fired capability, being thus able to operate using either natural gas or diesel, and the commissioning of the new D4PP (operated by Electrogas Ltd), solely run using natural gas, and starting its operations in 2017. The Delimara 4 Power Plant project consists of a new highly efficient generating CCGT Power Plant, an LNG Floating Storage Unit and an onshore Regasification Unit. Natural gas is also supplied to D3PP for its own use in the dual-fuel fired units there.

[43] 8 Directive 2009/72/EC of the European Parliament and the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

[44] 9 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

8.4.1.2 Submarine electrical interconnection to the European network (200MW)

The commissioning of an electrical interconnection to the European energy grid complements the local generation capacity and offers greater flexibility in meeting local. The extent that local generation of electricity is replaced by electricity sourced through the interconnector, greenhouse gas emissions related to electricity generation would be saved in Malta, though obviously an equivalent amount of emissions would be generated at source. The 200MW 220kV HVAC interconnector started being used in 2015, following completion of infrastructural works (including the laying of the submarine cable itself) and testing and commissioning. It should be noted that the nature of this technology is not without its risks. Indeed, in late 2019, the submarine interconnector was accidentally damaged by a marine vessel, leading not only to a short period of national blackout, but also to lengthy and delicate repair work which shifted meeting the local electricity demand through conventional generation.

8.4.1.3 Renewable energy in electricity

Meeting Malta's renewable energy sourcing targets and its obligations vis-à-vis the EU overall renewable objectives will require the continued application, and even extension, of measures and development of new initiatives tailored to the local circumstances. Renewable energy policies in Malta are governed by a specific national RE strategy in line with the NECP and the LCDS, The LCDS review process (and other structures in place within other governance frameworks) will ensure that the developments in Malta's renewable energy strategy are fully aligned with LCDS objectives.

Solar PV continues to be the most viable and robust form of indigenous source of renewable energy and has been able to successfully penetrate across all sectors. According to the NECP, the technical limitation on the roll out of solar PV will be reached by 2030 – c. 9,127 new PV systems by 2030 will enable Malta to reach the 11.5% target share of RES in gross final energy consumption (by 2030). The NECP also points out that this technical limitation should be reviewed on a 5 yearly basis to assess further potential expansion of solar PV as technologies and/or understanding of the technical limitations evolve.

Non-government entities play an important role in the development of local renewable energy capacities. In parallel, the Government is increasing its efforts to ensure that public rooftop spaces are fully utilised, where possible. For instance, Malta Industrial Parks (MIP), which manages state-owned industrial premises, is promoting the use of roofs in industrial zones for the installation of PV systems. A Strategy focusing on the integration of renewable energy was launched by MIP in December 2018. This includes mapped scenarios for increased penetration of solar PV on tenants' rooftops. One-to-one discussions and surveys with tenants are also being conducted with the aim of identifying potential barriers and encouraging the installation of RES. Future collaboration between MIP and relevant Government entities is envisaged with a view to also encourage tenants to make improvements in energy efficiency and further integrate renewables.

The Government will continue to engage with key stakeholders to encourage their involvement in the increased deployment of renewable energy technologies, particularly solar PV. This also in view of development trends which highlight the prioritisation of multi-apartment dwellings and high-rise buildings, that is, buildings with an increasing height to floor (roof) ratio. Discussions with key stakeholders may identify ways in which to better incorporate renewable technologies, thus increasing local renewable capacity and the energy performance of the building.

There is growing recognition of the potential of waste as a resource, including a source of energy. Organic waste is expected to continue being treated through anaerobic digestion plants. Projections of renewable electricity and/or heat generated by waste-to-energy plants from biodegradable waste content are based on projections of waste generation and are projected to remain largely constant or the foreseeable future. In reality, it is expected that the treatment of the bio-organic fraction of waste can slightly increase in the future to reflect an increase in population. The Government is carrying out studies to assess the potential of increasing capacity of treatment of organic waste.

A new waste-to-energy thermal treatment plant is expected to be commissioned in 2024. The share of the bio-origin content of the waste input is yet to be determined but given that the input stream is expected to be mainly refuse-derived fuel and rejects, the bio-fraction is expected to be minimal.

8.4.1.4 Renewable energy in Heating and Cooling

The share of RES in heating and cooling is made up of different technologies, which apart from the heat generated by the waste-to-energy plants referred to above, also include solar water heaters, heat pump water heaters, air-to-air heat pumps and biomass imports.

Regarding renewable water heating, the grant schemes outlined in the NECP should be fully implemented and the roll out of SWHs and solar water heat pumps (SWHPs) should be monitored to ensure the market is changing as needed for the trajectory towards 2030. A more ambitious uptake is required beyond that in the NECP by 2030 and beyond to move towards climate neutrality. Besides economic and financial challenges in this pathway, there are also technical challenges as number of such technologies that require roof space in Malta. There is therefore "competition" for space between solar PV and SWH/ SWHPs, as well as other possible measures regarding building energy performance such as roof top solar reflectors.

8.4.1.5 Renewable energy from wind and wave

The physical constraints of Malta's territory and potential barriers to standard renewable technologies were fully reviewed during the NECP assessment. Furthermore, novel technologies were considered in the LCDS given its 2050 timeframe. These include technologies where pilot-scale installations have been developed and where the market is expected to develop in an accelerated manner by 2030 and beyond. In addition to some additional capacity of land-based solar PV – on buildings where SWHs have not been installed – consideration was given to offshore floating technologies (offshore floating wind (OFW) and offshore floating solar PV (OFSPV)).

Moving offshore for renewable power generation has many advantages, but there are also challenges include conflict with other environmental obligations such as Natura 2000 sites, sites of community importance (SCIs) which are designated for the protection of marine habitats and species pursuant to the EU Nature Directive. Moreover, there are also expected additional costs arise from the need to stabilise platforms and bring grid connections onshore. Indeed, with technology breakthrough in offshore Malta Low Carbon Development Strategy 40 marine renewables (coupled with other instruments and measures), Malta could aim to target higher RE shares beyond 2030.

8.4.1.6 Energy efficiency in Buildings

Buildings in Malta generally utilise electricity for lighting, space heating and cooling, water heating, and for powering appliances and equipment. Unlike other European states, in Malta there is no gas supply network passing through towns and villages. Additionally, the design of a building affects the levels of heating and cooling that are required to be produced through different appliances. Modelling energy demand from building design changes, achieved either via retrofit or by marginal changes to future building stock was not carried out under this study but referred to through work undertaken for the LTRS.

In line with the LTRS, a range of measures were chosen that related to the main energy using equipment in a building, to be representative of the types of changes in energy demand that might be seen from improving EE in Malta's building stock.

The three policy initiatives being considered, in line with LTRS are:

- EE single measures and retrofitting to achieve Nearly Zero Energy Building (NZEB) level
- Measures, supported by schemes, for deep renovation
- EE measures in public buildings

The most significant level of abatement from the measures modelled in 2030 is expected to come from ensuring domestic appliances have a high energy performance rating and are therefore very energy efficient. In addition, the use of EE office equipment and the installation of light sensors (mainly in non-residential buildings) to optimise lighting usage would be expected to generate further abatement. Some additional abatement could be achieved through greater usage of roof and wall insulation to ensure buildings stay cool and air-conditioning use is minimised during summer months, as well as maximising any heating required during winter months; this was not specifically modelled but would represent some additional abatement - as the grid decarbonises this becomes less impactful in emission terms. Measures to drive a full switch to LED lighting could provide some additional abatement; however, the levels are not significant as other types of EE bulbs are highly pervasive in the market by 2030, and the savings from a switch of such bulbs to LEDs are not as significant as they would be where the switch is made from incandescent bulbs. Other changes to building design – as well as the building's integral energy-using equipment - will also contribute to abatement over and above the measures listed above.

In line with the policy initiatives referred to earlier, a list of measures is being proposed to support the abatement of GHG emissions from the buildings sector in Malta (split between residential and non-residential buildings), which fall under the three packages of EE and renovation measures outlined above.

Residential building measures include the improvement of EE appliances, installation of roof insulation and an increase in use of LED lighting.

Measures related to non-residential buildings (including offices, government buildings and other buildings considered as non-residential) include the installation of roof insulation, an increase in use of LED lighting and automated lighting and the increase in EE office and IT equipment.

8.4.1.7 Energy Efficiency in Residential Buildings

In terms of improving the EE of household appliances, NECP initiatives to provide support to vulnerable and energy poor households to replace old appliances with new efficient units should be fully rolled out as early as 2030. Grant funding should be capped on an annual basis and increased over time as necessary to ensure the maximum switch possible by 2030. Alternatively, grants could be implemented through the use of discount vouchers for EE appliances until these achieve parity with the inefficient appliances.

The government will also consider providing small installation cost grants for residential properties when installing insulation and double glazing. Maximum grant levels can be set and increased over time if further uptake is required.

As there are easy and cost-effective replacements for lighting efficiency in residential buildings, scope for added policy initiatives will be assessed if deemed necessary. The aim is to achieve a wholesale shift to LEDs by 2030. This would equally apply to bulbs used in residential and non-residential buildings.

Air conditioners account for a good proportion of electricity usage in buildings; these are assumed to be gradually replaced through private household and/or business decisions. This could, however, also be captured in policies that cover a wider range of approaches e.g. energy audits, grants.

Through schemes for deep renovation (e.g. 'Irrestawra Darek' scheme), buildings of a historical value and privately-owned buildings located in urban conservation areas and/or scheduled as grade 1 or grade 2 can benefit from sustainable renovation and restoration works. Besides preserving the aesthetic and historical value of such buildings, this policy initiative could feature retrofitted green initiatives, enhancing EE (e.g. installation of double glazing on existing original façade timber fixtures or roof insulation). The LTRS assumes that with such a measure, 12,000 units of building stock can be renovated by 2030.

Several of the single EE and retrofitting initiatives, together with initiatives mentioned under the section on Energy systems, can be collated into one package of measures that are aimed at achieving NZEB levels. These measures include roof and wall insulation (LTRS assumes 14,000 units by 2030); SWHs and heat pumps (LTRS assumes 24,000 units by 2030) as outlined in the LTRS; and window double glazing. The inclusion of sustainable building

materials is also being recommended within such package. It is deemed difficult to achieve the targeted uptake without regulatory measures complimenting such package.

In terms of the design of residential buildings for energy efficiency, as mentioned above, there are different considerations regarding existing buildings compared to new buildings that have not yet been constructed.

For new buildings, government will consider implementing EE standards to drive up performance in household buildings (for both electricity and heat). Government, as a follow up to the LTRS and LCDS, will undertake detailed feasibility work to set out the scope and ambition of the standards, and how these will affect both the likely abatement of GHG emissions and the balance between increased upfront costs – from higher house prices – and the savings householders would eventually realise over time from reduced energy bills. If necessary, subsidies could be provided to lower- and middle-income houses e.g. in the form of reduced property taxes (e.g. stamp duty, sales tax), or help-to-buy housing schemes.

In addition to the technology specific initiatives outlined above, broader policies regarding education and awareness-raising of energy usage in household will be supported, building on similar examples such as the roll out of smart meters across the country, or the provision of energy saving bulbs. For example, awareness raising campaigns and voluntary energy audits could be supported through providing local authorities with financial support.

8.4.1.8 Energy Efficiency in Non- residential Buildings

The set of measures outlined above will also be incentivised by the policy initiatives set out in the NECP. For example:

- Providing greater access to financial support schemes for those disclosing verified energy savings;
- A requirement that non-SMEs with an annual consumption exceeding 800 tonnes of oil equivalent (toe) to implement an ISO certified management system;
- Regulation 10 of LN 196 of 2014 makes it mandatory for, and the responsibility of, non-SMEs registered and doing business in Malta to carry out energy audits to the established quality level and frequency;
- Financial support for business clusters on EE;
- Grants to help SMEs carry out energy audits of their premises/ processes/ plants/ transport fleet; and
- Regular training sessions and seminars.

The private sector is already actively participating in the country's move towards decarbonisation, but further effort is still needed. The Government intends to continue promoting investment towards further uptake of energy efficiency measures in buildings and equipment used for industrial and services operations in Malta.

Policy measures such as EE certificates for buildings such as offices and hotels will be further assessed, to further improve their energy performance. The use of ambitious criteria within these certificates is particularly important where the construction of new buildings

is concerned, given the relatively high cost of retrofitting EE measures. In relation to hospitality, government is aware of the current hardships caused by the COVID-19 pandemic, and is therefore aware of the need to carefully assess the impact of such measures.

As also indicated in the NECP and LTRS, government and public bodies are aware of their key role in promoting EE. In this regard, central government will continue to lead by example through its continued commitments towards the ongoing programme of implementing EE and renovation measures in public buildings. Government has already installed and will continue looking into measures such as: EE lighting systems, use of LEDs; smart meter installations & energy management systems; replacement of ACs to inverter integrated ACs; sustainable procurement of appliances and equipment; behavioural changes; and roof and wall insulation/double glazing or glass tinting.

The most important period for the implementation of EE measures from an emissions abatement perspective, the most important timeframe for implementation and effect is whilst electricity is still being supplied locally. A particular focus should be on those measures relating to EE standards for the construction of new buildings. This will help to ensure that expensive renovation is not required from 2030 to 2050. A particular focus should be on those measures relating to EE standards for the construction of new buildings. This will help to ensure that expensive renovation is not required from 2030 to 2050. Whilst it may hold true that the carbon abatement effect of EE measures diminishes as the grid decarbonises, the ability of higher EE in buildings would still ensure more affordable energy use for basic households needs (e.g. heating and cooking). This ensuring that the proportion of household income spent on energy in the dwelling is reduced, allowing a lower income band to move away from the risk of (energy) poverty.

8.4.1.9 Energy efficiency in industry sector

Malta is characteristically lacking carbon intensive industries such as metal production or pulp and paper production. In reality, direct industrial emissions make up only a minimal part of the GHG portfolio. There are a number of industrial facilities across Malta, ranging in scale – some operated by local SMEs, and others by large enterprises, including some owned by FDI companies. Some facilities sit alone whilst some are situated near each other on industrial parks. Most are primarily concerned with manufacturing – including plastic products, medicines, electronics, and food and beverages.

Such manufacturing operations mostly consume energy in the form of electricity14, thus generating emissions indirectly from energy consumption. According to the NECP, this consumption amounted to around 10% of the island's total energy consumption in 2015. Opportunities for improving industrial EE are therefore of interest in the pursuit of territorial GHGEs reductions.

In Malta, the main energy-consuming industrial processes emerge from refrigeration or cooling for machinery, injection or blow moulding, compressed air, motors and drivers, and water heaters or boilers.

Overall, the industrial sector in Malta already has a fair understanding of available efficiency measures and has made efforts to implement some of them. This is helped by the fact that many of the larger manufacturing sites are Maltese subsidiaries of large international companies and are therefore required to comply with company-wide environmental management systems and policies. Nonetheless, a large number of SMEs,

due to their small size, find it not cost-effective to invest in such technologies (including EE measures) or may find difficulties with the initial outlay required.

Within this sector, examples of positive efficiency actions include the implementation fo switch-off routines for machinery, the replacements of moulds with state-of-the-are designs, as well as the introduction of variable speed drives on motors. The utilisation of waste heat from air compression processes and the utilisation of LED lighting will also help in this regard.

The available technology for each of these processes is improving every year. For example, the base load consumption of electric injection equipment is a fraction of that of the hydraulic alternative, providing significant overall energy savings15. In addition to these technological improvements, some site-specific ideas arose during consultation with local industry. This included an idea for providing an industrial park with a shared seawater cooling facility which would cut the energy needs for all facilities in the park. Government, through entities such as Malta Enterprise and Indis Malta, are committed to work with industry to find decarbonisation solutions.

8.4.2 Transport Sector

The transport sector is the second-largest contributor to GHG emissions. The main contributor is road transport with this category's GHG emissions accounting for 93% of overall transport sector emissions (in 2020), while national marine transport accounts for around 6% and domestic aviation account for just 0.03% of total sector emissions. This sector is dominated by emissions from road transport, with CO_2 being the gas that accounts for the bulk of overall GHG emissions from road transport fuel combustion. The road transport fuel market is mostly shared between petrol and diesel, with smaller amounts of biofuel and Autogas. Diesel is the principal fuel for national marine navigation and a small portion of petrol is also used. Jet kerosene (Jet A1) and aviation gasoline are used in domestic aviation.

The following sub-sections present a brief overview of the many actions that are already being taken or that are being considered in the context of national transport policy planning. The overview does not purport to be exhaustive, nor is it intended to go into detailed descriptions and discussions of each action. The point is to show a range of different actions aimed at identifying and using all possible available potential for more sustainable internal mobility and improving the environmental performance of this crucial sector. Action is being taken on different but complementary approaches, in recognition of the fact that a mix of solutions is needed.

8.4.2.1 Renewable energy sources in transport

Since 2011, Malta had in place a substitution obligation on importers of petrol and diesel to blend an increasing share of biofuels in their mix with the aim of meeting the target of a 10% share of RES in transport in 2020 as per Article 3(4) of Directive 2009/28/EC. In line with Article 25 of Directive (EU) 2018/2001, the Government extended the current substitution obligation framework until 2030, by gradually increasing the obligation of biofuel blending on importers of petrol and diesel from 10% in 2020 to 14% in 2030, by

energy content, as a share of renewable energy supplied for final consumption in the road transport sector. The obligation will additionally require importers of petrol and diesel to increase the share of advanced biofuels from 0.1% in 2020 to 3.5% in 2030, with the share in 2022 and 2025 being 0.2% and 1% respectively.

For the scope of meeting the requirements of Article 25 of Directive (EU) 2018/2001, Malta considered biofuels from feedstocks listed in Annex IX of the Directive; these may be considered as twice their energy content for calculating the share of biofuels for transport. Local importers and wholesalers of petrol and diesel will likely meet their post-2020 substitution obligation by blending EN 590 diesel with Fatty Acid Methyl Esters (FAME) biodiesel (EN 14214) and hydrotreated vegetable oil (HVO) (EN 15940), as is the current practice. In recent years, the latter has been prioritised by local fuel suppliers as it offers several advantages over FAME biodiesel. HVO parameters are within EN 590 specifications (except for lower density), it has a higher energy content and good solvency when blending, without any temperature issues. It can be typically blended with EN 590 up to 30% by volume, whereas FAME biodiesel can be blended with EN 590 diesel up to a maximum of 7% by volume.

Bioethanol is currently not available for consumption in Malta. This is due to the Maltese hot climate which creates technical difficulties for the blending of bioethanol with petrol. The addition of bioethanol to petrol in low percentages increases the vapour pressure of the fuel blend and therefore increases the possibility of emissions of benzene and volatile organic compounds, particularly in high ambient temperatures. Therefore, unless petrol with a sufficiently low reid vapour pressure (RVP) is readily available in relatively small volumes and at competitive prices, the warm climate in Malta would drive the vapour pressure of bioethanol-petrol blends above the limit determined by EN 228. Malta has introduced an obligation on fuel importers to blend 0.1% share of advanced biofuel in their mix in 2020. This obligation has been introduced even if advanced biofuels tend to be available in relatively small volumes globally and their price projections demonstrate a sustained substantially higher cost over conventional biofuels and mineral fuels. Furthermore, all biofuels placed on the market will be required to fulfil the applicable sustainable criteria.

8.4.2.2 National Transport Strategy and Transport Master Plan (2016)

A National Transport Strategy, 2050 (NTS) and Transport Master Plan, 2025 (TMP) have been developed to cover all relevant transport modes (land, public transport, sea and air) for the short, medium and long term for Malta. The NTS consists of a vision outlining where Malta wants to be in the long term, the strategic goals, the strategic direction on how to get there and the indicators necessary to measure the progress of this strategy. Six strategic goals define what the transportation system should achieve. These goals are based on sustainable development principles considering economic, social and environmental factors.

- Transport to support economic development
- Transport to promote environmental and urban sustainability
- Transport to provide accessibility and mobility
- Transport to support social development and inclusion

- Transport to remain safe and secure
- Transport to work towards improved public health

The goal to promote environmental and urban sustainability defines specific aspects, one of which is to reduce and mitigate greenhouse gas emissions. The TMP builds on the strength of long-term vision, goals and guiding principles established in the NTS. The Master Plan sets out the framework and the overall priorities which will guide transport investment in air, sea and land transport sectors over the next 10 years. It defines clear project pipelines for studies, operational changes, infrastructural and organisational measures and identifies where funds from national, European Union and other financing sources can most effectively be invested, where needed, in our transport system so as to help attain the long-range strategic targets. The Principles Guiding the Master Plan are as follows:

- Efficient utilisation of the existing transport system - traffic management, logistics planning and Enforcement;
- Creating modal shift;
- Integrated approach to planning and design;
- Encouraging use of greener fuels and vehicles;
- Modernisation, development and revitalisation of the strategic transport network to improve territorial cohesion;
- Investment in education, information and human resources;
- Making room for innovation and research;
- Sustainable financing and fair competition. The TMP identifies and prioritises low carbon transport measures. The measures identified relate solely to the short-term measures that have been identified in the Partnership Agreement and Operational Programme I (2014 - 2020). These are:
- Multi-modal transport;
- Other seaports;
- Clean urban transport and infrastructure;
- Intelligent transport systems.

A number of measures indicated in the Master Plan have been implemented since 2017.

8.4.2.3 Infrastructural developments to improve traffic flows and reduce emissions

Several major road infrastructure improvement projects are being undertaken to improve the flow of road traffic in critical areas. The improved flow of traffic is expected to save on greenhouse gas emissions, at least in so far as traffic bottlenecks are concerned. Three crucial road projects that have been completed in recent years are:

- TEN-T Kappara (completed in 2017);

• TEN-T Santa Venera (completed in 2018);

• TEN-T Marsa (completed in 2021).

A 'MODUS - Encouraging a modal shift in land transportation' project looked at intelligent system approaches to transport management, as a means to address infrastructural limitations on efficient traffic flows, with a number of different elements:

• Introduction of new accessible bus interchanges that will connect public transport routes together making it easier for commuters to shift from one route to another without having to go all the way to Valletta as the previous centralised system required;

• Park and Ride facility at Marsa that enables commuters to park their cars at facility and travel using public transport to their end destination;

• introduction of new bus priority lanes;

• Intelligent Transport Management System (ITS) that allows Transport Malta (TM) to monitor the traffic situation all on Maltese roads in real time, all day, every day.

8.4.2.4 Electromobility

The National Strategy for the Introduction of Electromobility in Malta and Gozo may be considered as a first step towards national policy planning for the electrification of road transport in Malta. The Strategy notes the importance of electric mobility and its relevance to land transport in Malta and Gozo.

The use of electric vehicles start being promoted as an alternative means of transportation, since 2011. The use and purchase of such vehicles was initially encouraged through (i) a decrease in their registration tax and (ii) new owners of M1 electric vehicles may apply for a grant of 25% or €4000 of the purchase price. The LCDS further supports the electrification transition by enhancing the previous grant scheme in place to incentivise the purchase of electric vehicles. An indicative target of uptake of 5,000 battery electric vehicles (BEVs) by 2020 was set, as a first contribution to the realisation of targets both with respect to air pollution and mitigation of GHG emissions. According to the National Statistics office the total number of Electric and hybrid licensed vehicles by end of 2020 was 6,017.

A number of European countries have already announced bans on Internal Combustion Engines (ICE). Malta has also announced an intention to impose a full ICE ban/ ICE cut-off date, with a Clean Vehicles Commission being set up to advise on the nature and timing of such a decision. For this strategy, an ICE cut-off date for beyond 2030 is being considered. In addition to a ban on petrol and diesel cars, the implementation of measures that ensure attitude changes favourably towards EVs is needed for the required level of uptake to be achieved. This can be done through grants and other instruments that bridge the cost differential between technologies as well as ensuring infrastructure is adapted to the uptake of EVs. In this respect, a draft national strategy for EV charging infrastructure has been launched which looks at the installation of charging facilities at multiple venues - publicly, at home, en route and at the final destination. Education and information on the technology and its use (e.g. on battery lifetime and battery-end-of-life disposal/replacement), as well as incentive schemes (for purchase of EVs, purchase of equipment by large fleet operators to repair EVs, and electricity charging tariffs), will be

essential to further ensure the targeted uptake is met - ad hoc policy initiatives may subsequently be applied in this regard.

Furthermore, upskilling the workforce and collaborations/ partnerships with educational institutions and automotive companies are being looked into to push further this electrification transition in our local markets (e.g. readiness to repair and maintain EVs). Malta aspires to have introduced c. 65,000 EVs, including plug-in hybrid EVs (PHEV), by 2030.

The main limitations for uptake especially in the pre-ICE ban phase include the price convergence between EVs and ICE vehicles, the availability of vehicles and infrastructure (charging infrastructure), and perception of the quality of the vehicle. It is assumed that the availability of c. 6,500 charging points introduced by 2030 will be adequately supporting the infrastructure needed to support the uptake of EVs on a national scale. This transition towards electrification of ICE vehicles across the nation will impact all stakeholders, from government to industry and the private sector, civil society and citizens.

Electrification of government fleet

In addition to bans on ICE vehicles of private and commercial use, government will be leading by example and commit to the electrification of the government fleet. This would entail the replacement of c. 1,800 government ICE vehicles (c. 1,400 M1 vehicles, c. 400 N1 vehicles) by 2030. Such exercise would also be complemented by the installation of charging points at respective Ministries/ government departments.

Electrification of route buses

The first measure to address the environmental impact of traditional public transport was the introduction of electric buses in Gozo, supported by the introduction of solar vehicle charging points and charging infrastructure. In order to further support the national electrification drive and drive down national emissions, this measure is extended to the electrification of all public transport bus fleet (a total of 370 buses) to electric ones by 2030. Similar to the exercise involving the electrification of private EVs and the government fleet, this exercise would be complemented by the installation of the necessary charging infrastructure.

Electrification of Heavy Goods Vehicles

The decarbonisation of road freight was assumed to take place through the electrification of heavy goods vehicles.

Public transport

Measures, such as free school transport for all primary and secondary school students and free use of public transport for youths and students between 16-20 years old, took off in October 2018. Although the effect of these measures on emissions reductions has yet to be assessed, it is estimated that this measure has led to a reduction of circa 6,300 cars. Free public transport fares was extended to all full-time students of all ages and it is expected to be extended in 2022 for additional categories.

Further efforts on decarbonization relate to measures to increase public transport uptake. The LCDS assumed that the overall public transport service is further improved through the introduction of more bus services, dedicated bus lanes and the introduction of traffic priority measures designed to improve journey times and service reliability. In addition to this improved logistical framework, the extension of free public transport services would provide a further incentive to increase take-up. At the same time, research shows that some form of disincentive needs to be put in place in order to lead to a sufficiently high change in behaviour. At the time of writing, a National Household Travel Survey (NHTS) will shortly be commissioned by Transport Malta. This will provide vital information on current travel patterns and behaviour, as well as changes in transport trends that have emerged over the last 30 years. The qualitative part of the NHTS is also designed to quantify public opinion and views on any new potential transport policies and measures being explored by government. This survey data would guide Transport Malta in finding the optimal policy mix to achieve more sustainable mobility through modal shift towards greener and more sustainable means of transport. The collected data will later be used to update Malta's National Transport Model (four-stage macro model) for a more detailed technical assessment of future policies and measures and their impacts on traffic congestion and any related externalities.

In addition, in 2018, the Government rolled out a car-sharing scheme consisting of 150 cars at 450 different locations spread around Malta, which allows citizens to book an electric vehicle (EV) through an online app.

Active Transport

The promotion of cycling as an alternative mode of personal transport underpinned initially by a 'National Cycling Strategy and Action Plan for the Maltese Islands' published in 2018/19 is further supported by the LCDS Two cycle corridors: 1) St. Julians-Sliema-Valletta and 2) Three Cities-Fgura-Valletta was introduced by 2020. This measure reflects the strong level of support for alternative modes and modal shift from car to other sustainable modes of transport in the hub area. The LCDS supports the shift to active transport by a sustained investment taking place throughout the strategy period in infrastructure to support cycling (e.g. bikes, e-bikes, pedelecs) and walking.

Evidence from other countries (such as Denmark) confirms that the provision of support to both active transport and public transport is likely to result in a larger shift from car use than supporting only one of these areas. Cycling in Malta is assumed to increase as a result of sustained investment in active travel infrastructure taking place over the next 30 years, alongside a large increase in the use of e-bikes and pedelecs (which are deemed key in such a measure given Malta's hilly topography and warm climate). Infrastructure includes cycle tracks and lanes, bike parking facilities, bike charging points, footpaths, pedestrianised areas, widened sidewalks and investment in traffic management systems (and associated signage) to give bikes/pedestrians priority - where practicable - on existing roads. In addition, the promotion of active modes of transport will also be incentivised through the use of marketing tools and the launch of further specific programmes, incentives/grants or schemes (including with and for industry) to sustain a cultural and social shift that would spur citizens away from private car use. These efforts will build on some Government's recent efforts, including the use of smaller vehicles for

urban mobility, such as pedelecs and category L vehicles (e.g. mopeds, motorcycles, tricycles and quadricycles), aimed at a lower environmental impact from transport. Active commuting such as walking will also be incentivised, such as implementation of safe routes for students

8.4.2.5 Mass Transport

The development of a Mass Transport System is currently being considered by government. Having completed the preliminary study phase and conceptual design, government is now proceeding with the second phase of the study which will also include a more detailed economic and financial business case and which will also take into consideration the impacts of COVID 19 era. This phase will also include the confirmation of the proposed network through other studies that need to be carried out.

At this stage of the LCDS, no data required to compile its MAC is readily available and the impact of this measure has not yet been modelled. In future LCDS cycles - as new and detailed information becomes available – the performance of such a measure will be analysed further.

Furthermore, other non-conventional solutions to global warming and curbing emissions from transport, such as hydrogen fuel cells, biofuels, and synthetic fuels, ammonia, and sustainable aviation fuel need be further studied and looked into, including on an international level, before being adopted and modelled for the local scenario. Similarly, retrofitting transport systems are still being studied.

8.4.2.6 Sustainable urban mobility

Tele- or remote working is a means to ensure that while work continues to be performed, the need to move from the place of residence to the place of work is avoided. This could significantly impact on road traffic, especially in critical times of the day, with an effect on road transport emissions both directly (the saving of emissions from vehicles not utilised) and indirectly (reduced congestion and thus improved traffic flows). The Government leads by example in this area through a teleworking policy that facilitates the uptake of such working arrangements.

In 2008 a teleworking policy was published by government which took into consideration feedback received from a research project carried out together with the National Commission for the Promotion of Equality (NCPE). The purpose of this policy was to set up a formal framework for the administration of telework in the public administration of Malta and the policy document outlines the general principles on which telework should be administered in the Public Administration of Malta. Over the years, other institutions have come up with their own initiatives to support sustainable mobility. One example is the University of Malta, the main tertiary institution in Malta hosting thousands of students, academic and administrative staff and situated close to the main urban agglomeration. The University has a number of smart travel initiatives ranging from information on travelling to the University, investment in walking and cycling infrastructure, and flexibility and teleworking opportunities for staff.

In the LCDS this approach is extended by encouraging teleworking, and remote working and further promotion of Government online services. Additional to modes of active transport (that shift movement to a less carbon intensive mode of transport), government will continue to consider initiatives that avoid altogether the need to move. One of the few positive outcomes of the COVID-19 pandemic is that it forced employers, including government, to implement infrastructure that supports teleworking/ remote working, thus decoupling the need to commute from the ability to produce. During COVID-19, it is estimated that around 33% of the local workforce worked remotely, and it is expected that post-COVID-19, half of the time worked will continue be carried out in this way. Studies covering foreign countries show an enormous appetite for remote working from the part of both employers and employees. Government policy has been underlining the need to ensure the possibility of teleworking as a family-friendly measure for decades. This strategy considers the teleworking/remote working possibility as a GHG reduction measure, addressing the dependency of productivity and transport. To support this further, government will be looking into:

i. promoting and incentivising further remote working amongst the workforce, including through remote workspaces for public officials across Malta and Gozo; and
ii. improved provision of online services.

8.4.2.7 Vehicle Circulation Fees for more efficient vehicles

Circulation fees are calculated depending on the year of registration, based on engine size, year of make, CO2 emissions, particulate matter (PM) emissions and fuel type. For private petrol vehicles, this fee ranges between €100 for a new petrol-powered vehicle with between 0-100g per km CO2 emissions to €1,125 for a vehicle 14 years old or more with over 250g per km CO2 emissions. For private diesel vehicles, the fee ranges between €100 for a new car with 0-100g per km CO2 emissions and with particulate matter emissions up to 0.005g per km, to €1,225 for an old vehicle older than 14 years which emits more than 250g per km with particulate matter emissions exceeding 0.035g per km. These rates have declined over the years. In 2012, the fee on petrol vehicles older than 14 years with over 250g per km CO2 emissions was €1,474, while the fee on diesel vehicles older than 14 years with 250g per km CO2 emissions and PM emissions higher than 0.036g per km was €1,706.

The annual circulation license fee also applies to electric and hybrid electric motor vehicles. Vehicles for disabled persons, vehicles owned by the State or vehicles which belong to official diplomatic staff are exempt from the fee. 3.4.7 Vehicle Registration Tax System Reform26 In the past few years, Government initiated a reform with the aim of having cleaner, smaller and newer cars on the Maltese roads. In 2009, the registration tax and licensing of vehicles was reformed. Through this reform registration tax and licensing of vehicles are now calculated on carbon dioxide emissions, the length of the vehicle, Euro standard and its value. Incentives are also given to hybrid cars and electric vehicles. Since 2011, registration taxes for commercial vehicles with emission standards lower than EURO 3 were increased to encourage purchase of newer and less polluting vehicles. In January 2012, this measure was extended to non-commercial vehicles.

Exemptions also apply to special purpose vehicles (such as ambulances) and to vehicles brought into Malta with the intention of being re-exported or exported. From April 2013, hybrid cars (M1 vehicles) are subject to the registration tax, but the CO2 value included in the Certificate of Conformity is lowered by 30%.

8.4.3 Industrial Processes and Product Use (IPPU)

The direct GHGs emitted by this sector are CO_2, N_2O, HFCs, PFCs and SF_6. NMVOC emissions also occur in this sector. According to Malta's National Inventory of Greenhouse Gas Emissions and Removals, 2022, for the timeseries 1990 to 2020, the direct greenhouse gases identified as being emitted under the industrial processes and product use sector were emitted from the following categories or sub-categories:

- fluorinated substitutes of ODS used in refrigeration and air conditioning, fire protection and aerosols, as well as foam blowing agents;
- lubricant use;
- electrical equipment;
- nitrous oxide from product use;
- paraffin use;
- electronics industry;
- carbide use;
- uses of carbonates;
- road paving with asphalt;
- lime production; and
- other uses of SF_6 and PFC.

The main contributor to the GHG emissions from this sector is the refrigeration and air-conditioning category. The main measure that is expected to curb emissions from the IPPU sector and, more specifically, from the refrigeration and air-conditioning category, is the implementation of Regulation (EU) No 517/2014[45] - known as the F-gas Regulation - which should also provide more information on the activity in this sector.

8.4.3.1 Implementation of the F-gas Regulation

The current F-gas Regulation[46] strengthens the original F-gas Regulation[47] and introduces additional provisions aimed at reducing the emissions of F-gas, as well as their global warming potential (GWP) value. The implementing Regulations of the original F-gas Regulation remain in force and continue to apply until new acts are adopted. One of the requirements of the original F-gas Regulation is the establishment of minimum qualifications for personnel who make use of such substances. This requirement has been implemented through the establishment of sector-specific subsidiary Regulations which have been published locally as follows:

[45] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation EC) No 842/2006

[46] Regulation (EU) No 517/2014: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN

[47] Regulation (EC) No 842/2006: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R0842&from=EN

- Minimum qualification course required by Article 12(3) of implementing Regulation (EC) No. 303/2008 [48] and Article 4(2) of implementing Regulation (EC) No. 307/2008[49] (Fixed air conditioning and refrigeration equipment, and vehicle air conditioning);
- Minimum qualification course required by Article 7(1) of implementing Regulation (EC) No. 305/2008[50] (High voltage switchgear); and
- Minimum qualifications course required by Article 12(3) of implementing Regulation (EC) No. 304/2008[51] (Fire protection equipment).

The provisions of the current F-gas Regulation have been implemented locally by Legal Notice 143 of 2018[52]. The new F-gas Regulation strengthens the original F-gas Regulation and introduces a phase-down of the consumption of HFCs through the allocation of quotas, which take into consideration the global warming potentials of the respective HFCs. It is expected that this shall result in a transition to refrigerants with a lower GWP, leading to a reduction in HFC consumption and, consequently, in the emissions of F-gas, in the EU.

8.4.4 Agriculture

The Maltese agriculture sector accounts for a very small share of national GHG emissions, with a contribution of around 3% from emissions of CH_4 and N_2O from enteric fermentation, manure management and agricultural soils.[53] In agriculture, future GHG emission trends may be influenced both by measures taken to directly address emissions or measures that indirectly contribute towards decreasing emissions, and by inherent trends in activity in the sector. The restructuring of the animal husbandry sector to conform to animal welfare, food safety, veterinary and waste management requirements, will lead to both direct and indirect reductions in emissions, due to reduced activity and more efficient practices.

The policy and legislative context for animal waste management are guided by existing national and European waste management plans and strategies that have been formulated over the last few years. Important legislation on this matter includes the below:

- Waste Management Plan for the Maltese Islands 2014 – 2020
- Council Directive 91/676 of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources as transposed by Legal Notice 343 of 2001 Protection of Waters against Pollution Caused by Nitrates

[48] Commission Regulation (EC) No 303/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases.
[49] Commission Regulation (EC) No 307/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements for training programmes and the conditions for mutual recognition of training attestations for personnel as regards air-conditioning systems in certain motor vehicles containing certain fluorinated greenhouse gases.
[50] Commission Regulation (EC) No 305/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of personnel recovering certain fluorinated greenhouse gases from high-voltage switchgear.
[51] Commission Regulation (EC) No 304/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary fire protection systems and fire extinguishers containing certain fluorinated greenhouse gases.
[52] Fluorinated Greenhouse Gases (Implementing) Regulations (Subsidiary Legislation 427.94): http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12826&l=1
53 National Greenhouse Gas Inventory CRF MLT_2022_1_Inventory

from Agricultural Sources Regulations, 2003 and the Nitrates Action Programme (NAP)
- Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment as transposed into Legal Notice 340 of 2001 Urban Wastewater Treatment Regulations, 2001
- Council Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy transposed into Maltese legislation as Legal Notice 194 of 2004 (Water Policy Framework Regulations, 2004)
- Council Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives as transposed by Legal Notice 184 of 2011 The Waste Regulations, 2011 as amended
- Council Directive 2008/56/EC of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
- EC Regulation 1069/2009 laying down health rules concerning Animal By-Products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation)
- Legal Notice 139 of 2002, Sewage Discharge Control Regulations, 2002
- Legal Notice 106 of 2007 Waste Management (Activity Registration) Regulations, 2007 –
- Legal Notice 321 of 2011 Nitrates Action Programme Regulations, 2011 as amended
- The Nitrates Action Programme, 2011
- The Code of Good Agricultural Practice (CoGAP) - The Water Catchment Management Plan for the Maltese Islands, 2015
- Partnership Agreement of Malta 2014-2020
- The Draft Rural Development Programme 2014-2020
- Programming of European Funds for Malta 2014-2020
- A Proposal for a National Energy Policy, 2009
- Rural Policy & Design Guidance, 2014
- Malta's Biennial Report on Policies and Measures and Projected Greenhouse Gas Emissions 2009.

By addressing Malta's obligations under EU legislation, particularly the Nitrates Directive (91/676/EC)[54], N_2O emissions from the use of fertiliser are expected to decrease over time as improved cultivation practices are adopted, mainly through the Nitrates Action Programme. The below sections give more information on national plans that were implemented to address the issue of animal waste management in Malta.

8.4.4.1 National Agriculture Policy for the Maltese Islands (2018 – 2028)

An Agricultural Policy for the Maltese Islands, which brings together the EU requirements to have a Waste Management Plan as well as a Waste prevention Plan, was published in 2018, covering until the year 2028. The policy is intended to provide direction to all relevant stakeholders ranging from public entities to private entities involved in the agricultural scene who intend to invest or diversify their business. An overarching objective for this Agricultural Policy was identified and agreed between government entities, representatives of the private sector and the farming community. The policy designed to

54 Directive 91/676/EC on the protection of waters against pollution caused by nitrates from agricultural sources.

target competitiveness of active farmers and livestock breeders, facilitating entry of young farmers, sustainable farming activities through adaptation of geo-climatic conditions and ensuring genuine management of farmland.

The policy presents a total of seventy policy measures organised in four sets of operational objectives, namely economic objectives, social regeneration, resources and governance. one can also find a set of actions, relevant to climate change mitigation, which were approved in the Climate Change adaptation Strategy (2012), and which were set to be implemented by the Directorate of Agriculture. While these policies and actions are very relevant to Malta's circumstances and should contribute towards the mitigation of GHG emissions from the agriculture sector, such contributions cannot be accounted for or included in the projections, given that no tangible information is available.

8.4.4.2 Agricultural Waste Management Plan for the Maltese Islands

The Agriculture Waste Management Plan for the Maltese Islands (AWMP) was drawn up to address the management practices of cattle manure and pig slurry. It proposes the development of a national system for manure management which will address a number of market failures, including the insufficient availability of cultivated land where manure can be applied, the vulnerability of the entire territory to nitrates contamination and the practical difficulties faced in terms of appropriate manure management by the typically small and fragmented farm holdings in Malta.

The Malta North Mechanical Biological Treatment facility started its operations in 2016. The plant, which has a capacity of 76,000 tonnes per year, includes an anaerobic digester and a bulky waste plant able to handle a further 47,000 tonnes per year, while its waste transfer station can handle 11,800 tonnes per year. This plant processes organic waste and then uses bacteria to produce methane gas, which is used as fuel to produce heat and electricity. The first step in this process is mixing the organic waste with water to convert it into a pulp which is then fed to the digesters within the Anaerobic Digestion Plant. This breaks down the pulp through bio-kinetic processes taking place within the digestors to produce a 'digestate'.

In terms of manure treatment, only liquid manure produced in cattle farms (35 kt/annum) and dry manure from layer/poultry and broilers farms (4 kt/annum) are treated (an estimated 80kt/a surplus is projected to require treatment in the future; however, this will not take place in the MBT). 52,069 tonnes are sent to the Mechanical Biological Treatment Plant (MBT), which is able to process either mixed municipal waste or, ideally, source-separated bio-waste in a series of mechanical and biological treatment steps. The input received by the MBT is:

- Landfilled (35,155 tonnes);
- Further treated in the anaerobic digester (17,420 tonnes); or
- Sent to the Material Recovery Facility (MRF) which treats recyclable waste like plastic and carton.

(This measure is included in the BAU Agriculture Projections).

8.4.4.3 Nitrates Action Programme (2011)[55]

The Nitrates Directive (Council of the European Communities, 1991) has the general purpose of "reducing water pollution caused or induced by nitrates from agricultural sources and

55 https://agriculture.gov.mt/en/agric/Documents/Nitrates%20Action%20Programme.pdf

preventing further such pollution" (Art.1). A threshold nitrate concentration of 50 mg/l is set as the maximum permissible level, and the Directive limits the application of livestock manure to land to a maximum of 170 kg N/ha/yr, approximately as specified in Table 8.94 below.

Table 8.94. Nitrates Action Plan approximate application rates of different manures to comply with 170kgN/ha.

Livestock	Nitrogen content in manure	Maximum rate of manure to be applied (tons/ha)
Cattle	0.56%	30
Pig	0.81%	21
Layer	1.52%	11
Broiler	2.62%	6
Rabbit	0.83%	20
Sheep	0.90%	19

This Malta Nitrates Action Programme (NAP) contains the second Action Programme for Malta pursuant to the Nitrates Directive, basically addresses the protection of waters against pollution caused by nitrates from agricultural sources.

A key milestone in the implementation of the Nitrates Directive was the development of a Code of Good Agriculture Practice for Malta (CoGAP). The CoGAP was adopted in 2004 and covers all aspects of agricultural production. The CoGAP includes measures that directly address the implementation of the Nitrates Directive and it is these measures that constituted the first Nitrates Action Programme for the period from 2004 to 2007 (the first reporting cycle for Malta following EU accession).

The implementation and monitoring of the Nitrates Action Programme took effect upon accession of Malta to the EU through Cross Compliance Controls and it is still ongoing. Cross-compliance checks were carried out on all land based and livestock farmers selected in the Risk Sample, that were eligible under the control provisions established in the Nitrates Action Programme Regulations (S.L. 504.108) which transposes the Nitrates Directive and provides the legal framework in the setting up of a Nitrates Database amongst other things.

To implement the requirements of the Nitrates Directive, the NAP (LN 321 of 2011), requires that:

- All holdings greater than 0.5 of a tumolo prepare a fertiliser plan in accordance with the requirements of the regulations;
- Storage facilities for livestock manure must have a capacity of 5 months production of manure and must be leak proof and connected to a cesspit that must also be leak proof and have a capacity for 15 days of urine and washings;
- Livestock manure can only be spread on fields between 16th March and 14th October if dry matter is at least 30% in accordance with the requirements of the regulations;
- Livestock manure is stored on fields subject to the provisions of the regulations;
- Land application of slurry is not permitted;
- For holdings greater than 1 hectare of continuous agricultural land a Nutrient Management Plan must be formulated in accordance with the requirements of the regulations;
- Farmers must keep farm records;
- Fertiliser users must be registered and trained;
- The drawing up of a National Nitrates Database by the responsible Government entity.

Even though the Nitrates Action Plan requires farmers to report their Fertiliser Plan, no data is available to understand how much fertilizer is being applied to soils or how much is projected to be applied in the future, and thus the projections presented in this report cannot incorporate the contributions of measures emanating from the Nitrates Actions Plan. Nonetheless, it is taken as a general rule that after the implementation of the Nitrates Directive, the application of swine slurry to soils was revised. In fact, it is assumed that the rate of swine slurry application decreased to 5% from 10%. Moreover, due to the recent setting up of the Farm Advisory Services, the Agriculture Department under the Ministry for Agriculture, Fisheries and Aquaculture, is planning on undertaking a study (or survey) to collect and analyse all the information that has been and is being reported in the Fertiliser Plans. This study is planned to be conducted during 2021.

Effects resulting from the Agriculture Waste Management Plan and the Nitrates Action Programme have been included in our Business as usual (BAU) scenario.

Our WEM scenario now considers the emission reduction potentials reported in the recently published Malta Low Carbon Development Strategy (LCDS, 2021). The report indicates that the potential abatement of this sector is small compared to other sectors. While the report notes that, for the agriculture sector, 4 measures were listed in the National Energy and Climate Plan (2021) (i. Modification of ruminant diets, ii. methane inhibiting vaccines, iii. manure and slurry management and iv. Aquaponics), **the abatement potentials reported in the LCDS only consider the Methane-inhibiting vaccines ad Aquaponics (Table 8.95).**

8.4.4.4 Malta Low Carbon Development Strategy (LCDS)

LCDS: Methane-inhibiting vaccines

The LCDS notes that this future option that may be implementable after 2040, targets methane-producing microorganisms in the rumen of livestock (methanogens). Such vaccines are currently in the early stages of development, and a fully developed vaccine is not expected before 2030. However, it should be noted that the emergence of such a technology is, however, not guaranteed. If a vaccine is to be developed and obtain the necessary regulatory approval, it will need to overcome practical challenges such as ensuring the vaccine has no unintended adverse effects (e.g. reduced productivity, different product taste, compromised food safety). Additionally, in the EU, the European Medicines Agency regulates the use of veterinary vaccines, reviewing applications for market authorisation approval. Any prospective vaccine would need to clear this authorisation process. Regarding implementation, the cost to farmers is expected to be low - given that farmers already vaccinate livestock to prevent disease, adding another vaccine would be simple and cheap to administer.

LCDS: Aquaponics

There are opportunities for Malta's agricultural sector to reduce its emissions through diversification of food production methods, shifting towards forms of agricultural production which require reduced inputs of fertilisers, water resources and energy relative to conventional agriculture. One such method is the use of aquaponics, a portmanteau of aquaculture and hydroponics, which combines these two agricultural techniques. An

aquaponic agricultural system involves the recirculation of water from fish tanks through filtration units and into soil-less hydroponic beds in which crops are grown. Locally, the current aquaculture activity will be leveraged in order to feed into aquaponics activities. Features of aquaponics which lead to lower GHG impact per unit yield of fruit and vegetable include:

- no soil loss which might lead to emissions through loss of soil-organic carbon;
- heavily reduced synthetic fertiliser input; and
- reduced water use.

One area where aquaponics is more energy intensive than conventional agriculture is in the use of electricity due to lighting, aeration and pumping requirements. However, it should be noted that as Malta's grid carbon intensity decreases over time, the impact of this difference will be negated. At present, the Maltese Diversification and Competitiveness Directorate is participating in an EU PRIMA Project called Self-sufficient Integrated Multi-Trophic Aquaponics (SIMTAP). The main goal of the project is to define, design, set up and test aquaponics systems that reduce fish feed inputs and other resource consumption including water and energy. The project intends to undertake a Life Cycle Assessment (LCA) to quantify the environmental impacts with greater certainty. Once a system has been defined which can operate successfully in Malta, and with confirmed emissions abatement benefits, then government will provide support. The Diversification and Competitiveness Directorate might consider seeking funding to provide grants or loans for equipment and training programmes for those in horticultural and aqua cultural sectors to upskill so as to consider the use of aquaponics

LCDS: Modification of ruminant diets

The modification of ruminant diets in the dairy and beef sectors, through improvements of the digestibility of forage, use of high-fat diets and use of nitrate as a feed additive, is another additional measure. Of these three approaches, the use of a nitrate feed additive is anticipated to have the greatest potential impact upon enteric fermentation emissions. This measure involves the dosing of nitrate into the rumen of livestock which can then act as a sink for excess hydrogen, through conversion to ammonia, which would otherwise be available for production of methane. Nitrate is administered as a feed additive in the form of calcium nitrate. Thorough mixing with the rest of the feed intake is required, and so this measure is only suitable for livestock fed a total mixed ration. Implementation might involve the creation of minimum standards for animal feed in terms of the nitrate content. Improving the digestibility of forage and higher-fat diets should also be considered. There are already some efforts underway locally by the sole supplier of dairy cattle feed in Malta to optimise the fat content of cattle diets, considering the impact that fat content has on the milk produced. In addition, progressive farms are exploring opportunities to improve the quality of forage to improve cows' average daily gain and reduce enteric methane emissions. Government will continue to monitor the progress of these efforts and facilitate knowledge sharing between farmers and feed producers to increase uptake of these measures.

LCDS: Manure and slurry management

In terms of emissions arisings from manure and slurry, the Maltese Agency for the Governance of Agricultural Bio-Resources is updating and further developing its Agricultural Waste Management Strategy, to better manage livestock farms that generate slurry. A treatment option is to dewater the slurries and process the resulting liquid fraction and the solid fraction separately. The main emission reduction resulting from this measure will be through the stabilisation of the solid fraction while the liquid fraction will undergo further treatment technologies.

Table 8.95. Agriculture LCDS Measures Abatement Potentials (LCDS, 2021)

	Abatement Potential (KtCO2eq./yr)		
	2030	**2040**	**2050**
Total	0	4.933	6.762

8.4.5 Land use, land use change and forestry (LULUCF)

The latest Malta's End of Period Progress Report on Information on Land Use, Land Use Change and Forestry Actions (MRA,2020), submitted in 2020, pursuant to Article 10 (4) of Decision No 529/2013/EU[56] of the European Parliament and of the Council, provides detailed information on actions relating to LULUCF activities and LULUCF actions plans in the Maltese Islands. It provides information on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land use change and forestry and information concerning actions relating to those activities.

Considering the limitations of the Maltese Islands due to its high population density of the Maltese Islands and the limited land availability, and to a certain extent the local climatic conditions (such as limited rainfall), the potential to mitigate emissions and maintain or increase the removals is, as a result, highly restrained. The potential of LULUCF activities aimed to mitigate climate change and enhance or preserve the sinks include;

- Afforestation projects and Forest Management of existing woodlands
- Sustainable activity and management of land.

The success of afforestation projects which can further enhance the sinks and as a result also potentially lead to a reduction in GHG emissions are based on the following factors: the geographic specificities of the Maltese islands need to be taken into account in order to implement the measures; the limiting factors in implementing LULUCF measures to further enhance and safeguard the sector; limited land availability; lack of water; lack of rainfall; and, high population density. Moreover, safeguarding the existing woodlands through sustainable forest management is of equal importance to preserve and maintain the limited remnants and corpses of woodlands which remain today.

Throughout the years Malta has established several afforestation projects implemented around parts of the Maltese Islands. Various restoration projects were carried out in existing public gardens as well as forestation projects in a number of localities in Malta. Projects also included the re-establishment of derelict countryside sites across the Maltese Islands, as well as soil conservation, through the reconstruction of collapsed walls and sites re-instated to their original state. The afforestation projects carried out and their management will be discussed in detail in the following sections. A number of afforestation

[56] Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities

projects are undertaken by a number of entities as further detailed below. Several budget measures also address restoration of public gardens and parks and afforestation measures.

8.4.5.1 Tree 4U Campaign

Tree planting is an important, and highly visible way of contributing towards mitigation of climate change. The Tree 4U campaign was launched in January 2005 and gives an opportunity to individuals, NGOs, and companies alike to plant indigenous trees in afforestation areas around the Maltese Islands. Afforestation areas include Foresta 2000 in Mellieħa, Buskett woodland, Salini National Park, Ta' Qali National Park, Xrobb l-Għaġin Park, rehabilitation of Magħtab closed landfill and various other projects in conjunction with Local Councils, schools and other entities.

Planting indigenous trees further enhances the effectiveness of this action, by supporting the diffusion of species that are associated with the Maltese landscape and that are best suited to local conditions. The campaign contributes to increasing the surface area with permanent vegetation and recreating tracts of Mediterranean woodland, in order to encourage biodiversity in Malta.

Ambjent Malta are responsible for the initial planting and careful nurturing of trees, including replacement of any dead trees.

Moreover, the Ministry for Gozo has conducted various ecological restoration projects. As from 2010 over 6,103 trees and over 60,714 shrubs/climbers/perennials were planted through the Simbiotic EU Project in places such as Chambray Grove, Three Hills Garden, Il-Qortin ta' Isopu and Nadur.

8.4.5.2 Natura 2000 Management Plan

Malta was granted €1.3 million through the European Agricultural Fund for Rural Development to co-finance a project in order to meet the obligations emanating from the Habitats and Birds Directives. The overall aim of this project, entitled "Natura 2000 Management Planning for Malta and Gozo" was to establish management plans and legal provisions for the management of all terrestrial Natura 2000 sites in the Maltese Islands and to increase awareness of Natura 2000 amongst the general public and stakeholders. The management planning exercise involved gathering information, carrying out surveys, defining conservation objectives, and identifying management measures, with intensive stakeholder involvement throughout the entire process.

Currently there are 34 terrestrial Natura 2000 sites designated in the Maltese Islands. The consideration of site management for such sites emanates from a legal requirement to prepare conservation measures for protected sites under the Environment Protection Act (CAP. 549)[57] and the Flora, Fauna and Natural Habitats Protection Regulations (S.L. 549.44), which as transposed from the EC Habitats Directive (92/43/EEC)[58].

While management plans were compiled for most of the sites forming part of the terrestrial Natura 2000 Network, Conservation Orders were considered to be a more appropriate

[57] Environment Protection, Chapter 549, Environment Protection Act
[58] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

tool for some of the sites. The management plans include detailed site descriptions, evaluation and conservation objectives, management actions, a work plan structure and a reporting and review plan.

8.4.5.3 Il-Buskett Management

Land management at Il-Buskett is particularly unique in Malta. It is one of a handful of sites that are actively managed by the Government. The site is managed by the Ambjent Malta agency. Certain parts of the woodland are under direct management of the Environment Landscape Consortium under a Private-Public Partnership agreement with the Government of Malta. There are a number of plans to rehabilitate the area.

One of the most important objectives of the il-Buskett Management Plan is to ensure that each of the habitats identified in the Buskett area are conserved and, where necessary, improved. For those habitats where the conservation status has been described as excellent, management efforts should be directed towards maintaining this high standard. For those habitats that have not been assigned an excellent status, the Management Plan seeks to manage those factors affecting to reduce negative impacts and eventually improve the overall habitat. Several Legal Notices and Subsidiary Legislations are in place representing the relevant regulations for the trees and woodlands protection.

With reference to management and conservation of the Buskett area, an EU LIFE+ Nature project was granted in 2012 to the PARKS Unit within the Ministry for Environment, Energy and Enterprise (formerly MRRA; the PARKS unit is presently amalgamated within Ambjent Malta Agency), titled 'Soil stabilisation measures to protect Annex I habitats in Buskett Girgenti Natura 2000 site' (LIFE12 NAT/MT/000182) scheduled from July 2013 to May 2018. The project targeted the following Annex I habitats: 5230 – Arborescent matorral with Laurus nobilis; 92A0 – Salix alba and Populus alba galleries; 9320 – Olea and Ceratonia forests; 9340 – Quercus ilex and Quercus rotundifolia forests; and 9540 – Mediterranean pine forests with endemic Mesogean pines.

Several other management practices were also implemented, such as soil stabilization and soil amendments on the area where due to the breaches in the rubble walls in certain areas have resulted in the reinstating of a more natural slope profile and the reconnection between isolated trees and shrubs through the regeneration of exposed ground. The control and eradication/removal of alien species is carried out especially on species such as Ailanthus altissima, Vitis sp. and Agave sp. to preserve the habitats found in the area.

The re-afforestation project has aimed at the expansion and enhancement of the respective Annex I habitat types within which the plantings will take place. This regeneration project includes the collection of seeds from indigenous trees found at Buskett in order to retain present tree DNA. The collection of seeds of protected species will be subject to a Nature Permit. It is also noted that the combination of tree species in either location proposed for tree regeneration will be compatible to the autochthonous vegetation present. Also focusing on the restoration of species, the Riparian Woodland restoration is an important aspect for the Buskett area for the planting of indigenous trees and shrub species with the aim to increase habitats 92A0, 9320 and 9340.

The site is currently managed by Ambjent Malta. Before 2015, management was carried out by the same agency, however under the former PARKS Directorate. Management activities included cleaning, site surveillance, restoration and rebuilding of collapsed rubble retaining walls in various locations, and liaison with the then MEPA in obtaining all necessary permits to cut dead and semi-collapsed trees. Presently all pruned trees are partially carted away from Buskett, however the larger parts of tree trunks are left on site to decompose naturally. Through the years 2015 to 2017 under the LIFE+ Saving Buskett Project, a planting area of 3.85ha was performed with species typical of habitats 9540, 9320, 92A0, 9340 and 5230.

8.4.5.4 Foresta 2000 Management

The northern flank of the SAC, at is-Sdieri, below the ridge is under the joint management of an NGO (Birdlife Malta) and the Government, being the focus of an afforestation project: Foresta 2000. Foresta 2000 is an area of natural habitat which has been restored as a Mediterranean woodland. Foresta 2000 is a long-term project, commenced in 2003 with the aim to recover an area and plant a Mediterranean forest that would become an attraction for both Maltese and foreigners wanting to explore and enjoy nature. The Foresta 2000 initiative is being run by BirdLife Malta, in collaboration with Din l-Art Helwa and the former PARKS which was the afforestation department of the Ministry for Environment, Energy and Enterprise (now 'Ambjent Malta' Agency) and involves the environmental improvement of a site of approximately 104 ha located on the west slope of Marfa Ridge, with the project aiming to establish a Mediterranean forest on site (Cassar & Conrad, 2014).

Planting of tree species and shrubs in the Foresta 2000 afforestation site began in 2004, as was confirmed by the Ambjent Malta agency, which up until now amounts to a total of 44 hectares of afforested land. Ambjent Malta also confirmed that the trees afforested where already 2 years of age when these were planted. The project has drawn on the participation of several individuals, schools and corporations, and on the work of volunteers. It has also benefited from contributions of external partners – the project website mentions, for example, that the Italian Corpo Forestale dello Stato have provided 8000 trees and shrubs over three years. As per details provided on the same website, the project has succeeded in planting some 20,000 trees and shrubs. The project has, however, unfortunately been subject to vandalism, with an early attack in 2004 involving the cutting down of some 100 trees, a second major attack in 2007 destroying around 3000 trees, and with further damage to 104 trees and saplings during a 2010 attack (Cassar & Conrad, 2014).

Management practices take place throughout the year and address natural and human-caused threats to the area. Due to the geographical conditions and location of Foresta 2000, most parts of the area are exposed to rough weather conditions, such as surface water run off resulting in soil erosion and stunted vegetation. Other management practices address threats caused by human interactions, which include illegal bird hunting and trapping, spreading fire, unrestricted access by vehicles, vandalism - particularly cutting down trees, and littering. Where damage of the natural environment occurs, mitigation measures, security checks and reconstruction take place regularly as part of management practices. Direct actions include regular surveillance of the area to identify destructions by reserve wardens, tree and plant inspections to identify diseases and other

threats to vegetation, volunteer and student works to recreate natural state as well as to undertake scientific research of the area and its natural assets (Ambjent Malta & ERA, 2018).

8.4.5.5 Benghajsa Afforestation

In summer 2019, the Maltese Government announced that an undeveloped area behind the Freeport in Birzebbugia is set to be transformed into around a 3-hectare park with 8,000 trees. The afforestation project, which was announced in May is projected to cost €400,000 and will see the site in Benghajsa turned into an area which can be used for picnics, camping and tourism purposes. The project will be split into three phases: the afforestation itself, the creation of a camping site, and the converting of an underground bunker in the area into a tourist attraction. The management of the planting of 8,000 endemic trees was entrusted to the Ministry for Tourism under the auspices of Infrastructure Malta in 2020.

In 2020, Infrastructure Malta was completing the planting of over 2,200 indigenous trees and shrubs in a new grove in Bengħajsa, Birżebbuġa. This new 'green lung' in southern Malta forms part of Infrastructure Malta's long-term environmental commitment to plant thousands of trees in different rural and urban public spaces. After planting 8,719 trees in over 40 locations in 2019, in 2020 it planted 4,130 new trees and some 3,000 shrubs in several other locations. Following a recent public call for location suggestions, Infrastructure Malta was working to add many more new trees and shrubs in several localities by the end of the year.

The new grove in Benghajsa was formed on a 15,000-metre-squared area of disturbed land, more than twice the size of a football ground, next to the Malta Freeport. Infrastructure Malta's contractors planted over 300 aleppo pine trees, 350 olive trees, 260 holm oak trees, 220 sandaric gum trees (gharghar; Malta's national tree) and another 12 species of trees and shrubs such as judas trees, cypresses, carob trees, pomegranate trees, bay laurel and white mulberry trees. It is also installing an irrigation system to facilitate the regular watering of these trees. It will continue taking care of the grove for several years, until it is fully established and can be opened to the public.

The Bengħajsa grove will eventually form part of a larger environmental complex that Government is developing on adjacent lands. This park will include pathways, benches, picnic areas, camping grounds and other outdoor wellbeing and leisure facilities. More trees will be planted in other areas of this complex as well. During the last few months, the agency formed the tree planting areas by depositing and sifting 55,000 tonnes of soil, primarily utilizing soil it had recovered from several ongoing or recently completed road projects. As part of its environmental commitment, Infrastructure Malta keeps all soil excavated during its infrastructural projects so that it can reuse it for other afforestation and landscaping projects. It is currently also providing soil for the development of the new Malta National Park, at Ta' Qali.

8.4.5.6 Ta' Qali National Park

proposed national park in Ta' Qali, which was announced in 2019, will see a tract of land which will be transformed into an open space in an investment of €20 million. The land

previously housed an abandoned concrete factory that was demolished by the Planning Authority enforcement section. The park is set to spread over 45 hectares (450,000sqm). The existing national park is previsied to double in size, with 80,000 new trees being planted.

8.4.5.7 Wied Fulija National Park

Another project announced in 2019 is a disused rubbish dump in the outskirts of Zurrieq, which was earmarked to become a wooded park. Around 45,000 plants – mostly indigenous shrubs – will replace tons of glass and construction waste in Wied Fulija. It was announced that "hundreds" of three-metre trees will be included in the Wied Fulija project. The project will not be finalised for another four years. The landfill of Wied Fulija is currently going through rehabilitation transforming into a 95,000 sqm nature park in Żurrieq. The rehabilitation of the site started in March 2019 and they are seen to wind up by December 2020. The rehabilitation is set to cost some €4 million.

The site was first used as a landfill in 1979 and stopped accepting waste in 1996. During its operational period, it is estimated that some 1.85 million tons of waste were deposited in the valley during which every type of waste, including dangerous waste, was dumped and spread by the cliffs and ended up at sea.

An intensive strategy to reduce the spreading of waste at sea and to limit other pollution was implemented. The rehabilitation, apart from visually integrating the landfill with the surrounding landscape, will reduce rain infiltration to minimise the production of leachate which impacts on the water quality.

8.4.5.8 Other Planting Projects

Several other afforestation/planting projects were carried out around locations in Malta in 2018 and 2019. Much of the of the planting projects occurred in valley systems, Natura 2000 sites and protected areas and rural areas for the purpose of habitat restoration. Furthermore, other plantings took place in gardens and parks for landscaping and in urban greening areas. In 2020, numerous planting projects also took place in some of the same sites where planting was performed in 2019, as well as new plantings in various other sites. Habitat restoration planting took place in valleys, Natura 2000 and protected sites and in rural areas. In designated parks and gardens, planting took place for landscaping purposes, whereas in other parks/gardens planting took place for conversion in other land uses changes.

Since Infrastructure Malta launched its nationwide tree-planting programme in summer 2019, it has now introduced over 11,800 indigenous trees in 80 different roadside strips and other urban and rural areas in Malta. Infrastructure Malta aims to extend this initiative in other localities. Through this environmental commitment, the agency also contracted the services required to water and take care of these trees for several years, until they are fully established in their environment. Infrastructure Malta also planted some 1,800 perennial shrubs, some of which can eventually be trained into trees as well. Many of the new trees planted were in green zones along existing roads or new ones being built through the Agency's projects. In February and March 2020, Infrastructure Malta added several trees along the newly rebuilt roads, as well as in roadside green areas.

In another locality the agency planted over 1,000 trees in 11 streets this year, and in addition through similar collaborations, the agency added some 145 trees in two other localities. Infrastructure Malta is planning to plant another 580 trees in these two localities and in one other locality, in and around the arterial road corridor it is upgrading through the Central Link Project. The tree selection for each site includes over 30 indigenous tree species such as tamarisk, olives, cypress, European dwarf palms, lentisk, holm oaks, Aleppo pines, myrtle, sandarac gum trees and carobs, amongst others51.

The planting in other localities such as Natura 2000 and Protected areas sites as well in rural areas will also follow after 2020, continuing in 2021, and some of them planting will also continue until 2024. The main purpose of the planting is habitat restoration and landscaping. It is envisaged that around 17,000 trees and shrubs will be planted around these sites and will be completed by the PARKS Malta and Ambjent Malta entities.

8.4.5.9 Quantification of LULUCF Measures

The growth in the level of sequestration of carbon in the LULUCF sector is not expected to be major, with minimum variations between the different projections. This is due to the fact that the national afforestation projects implemented do not cover a large tract of land, and when comparing the extent of the area of these plantations to the other categories in the LULUCF sector, the level of sequestration from these projects is as a result quite minimal.

The projections were developed to analyse the impact of the upcoming national afforestation projects discussed in the previous Sections which have begun to be implemented or implemented in the coming years. It is to note that some of the projects could not be quantified in the projection since some of the plantations will be implemented on a small scale or else planned to be planted separately in groups around several different locations. As a result, these are not foreseen to fall under the Forest Land criteria or threshold. As already stated not all measures could be quantified in this projection in the LULUCF model due that the extent of the projects implemented do not cover a large tract of land, and when comparing the extent of the area of these plantations to the other categories in the LULUCF sector. Moreover, in relation to other projects, entities did not have enough relevant information at this stage, such as area of project or total trees planted, that could be utilised to develop the projection. The series of projects included in this projection are: Ta' Qali National Park project; Wied Fulija National Park project; Various afforestation/planting projects in sites, including Natura 2000 & Protected Areas, Golf il-Kbir, San Anard, Fort Madliena, rural areas & Heritage Malta site; Tree 4U Campaign afforestation, afforestation in Foresta 2000 sites; and Benghajsa afforestation. Table 8.96 quantifies the estimates of mitigation impact of the several projects mentioned.

Table 8.96 Mitigation impact of LULUCF policies and measures.

Name of policy or measure	GHG affected	Estimate of mitigation impact, by gas (Kt CO2 eq.)			
		2025	2030	2035	2040

Afforestation project in location of Benghajsa	CO2	-0.001	-0.001	-0.002	-0.005
Afforestation project in location of Ta' Qali.	CO2	-0.022	-0.044	-0.066	-0.147
Afforestation project in location of Wied Fulija.	CO2	-0.005	-0.009	-0.014	-0.031
Various afforestation/planting projects in sites – Natura 2000 & Protected Areas, Golf il-Kbir, San Anard, Fort Madliena, rural areas & Heritage Malta site, etc.	CO2	-0.002	-0.004	-0.007	-0.014

8.4.6 Waste

8.4.6.1 Waste Management Plan for the Maltese Islands 2021-2030

The Ministry responsible on the Environment has developed a Waste Management Plan for the Maltese Islands 2021-2030, as mandated under the European Union Waste Framework Directive and as transposed in local legislation. The measures set out in the WMP are included in the Low Carbon development Strategy.

The Waste Management Plan for the Maltese Islands 2021-2030 has been developed in compliance with Article 28 of the EU Waste Framework Directive, which stipulates that each Member State shall establish a Waste Management Plan which "shall set out an analysis of the current waste management situation in the geographical entity concerned, as well as the measures to be taken to improve environmentally sound preparing for re-use, recycling, recovery and disposal of waste and an evaluation of how the plan will support the implementation of the objectives and provisions of this Directive. This plan will not only support Malta's overall transition towards a circular economy but will also support Malta's compliance with the Waste Framework Directive and the achievement of EU waste and recycling targets.

Key priority areas for the Waste Management Plan 2021-2030 have been identified in alignment with the strategic objectives. These are as follows:

- Waste Prevention
- Increasing Infrastructural Capacity
- Expanding Extended Producer Responsibility
- Modernising Waste Collection
- Regulating Commercial Waste
- Exploring Economic Instruments
- Strengthening Compliance and Enforcement

Through the Waste Management Plan, the Ministry's strategic objectives are to:

- Maximise the resource value in waste through different management options
- Innovate by designing waste prevention initiatives to lower Malta's per capita generation rate
- Reform the collection system to increase economies of scale, harmonise collection practices and modernise the collection fleet

- Build the necessary waste management facilities to treat recyclable, organic and residual waste to achieve Malta's targets
- Study the feasibility of an enhanced producer responsibility framework to complement Malta's transition to a circular economy and reflect further on the true cost of waste management
- Promote further the involvement of the private sector in waste management

The Waste Management Plan sets out a number of key priority areas that are aligned with the strategic objectives in order to ensure a robust and effective waste governance framework. An overview of Malta's obligations under the European Union waste directives is provided, as well as an update on where we stand today. In bridging the gap between Malta's current performance and the 2030 waste targets, a suite of ambitious measures is outlined in the Plan, structured as follows:

- Waste Prevention as a Priority
- Waste Collection Reform
- Waste Management and Resource Optimisation

The vision of the Ministry for the Environment is to maximise the inherent resource value in waste through holistic waste management solutions and by fostering societal change towards waste prevention and aspire to progressively move towards a zero-waste scenario.

Waste Prevention Policy

- The Waste Prevention Programme for the Maltese Islands 2014-2020
- Don't Waste Waste Campaign
- Saving Our Blue Campaign
- Unsolicited Mail Project
- Waste Prevention

Measures for the Prevention of Waste

- Economic incentives
- Legislative measures
- Voluntary measures
- Capacity building
- Digitalisation
- Research and Development
- Education and awareness-raising

Measures for improving waste infrastructure

The following measures with respect to waste treatment infrastructure will be implemented over the coming decade to ensure we divert resources away from landfill, with the key initiative being investment in treatment plants at the EcoHive Complex.

- Ensuring recovery of materials

- Improving treatment of organic wastes
- Upgrading Thermal Treatment
- Improving efficiencies of waste management
- Ensuring that we have the best possible infrastructure in place to support deployment of ECOHIVE
- Diversion from landfill and investing in Waste to Energy
- To improve understanding of changing terms in waste composition and inform further decision making on waste management initiatives through waste characterisation exercises.
- A process of review and renewal to maximise operational efficiencies.
- To assess the feasibility of introducing a hierarchy of fees for facility gate fees to ensure full cost recovery for operational and environmental costs.

Waste-to-Energy plant

ECOHIVE is the largest ever investment in the waste management sector that will drive Malta towards a circular economy. This project will process waste in the most sustainable and resource-efficient way possible while also turning it into precious resources into energy and agricultural compost (Ecohive, 2020). The name ECOHIVE refers to as the following: "ECO" ties to the environment and sustainability, while "HIVE" reminds us of a beehive which is constantly active. Four new waste management plants will form part of the ECOHIVE project: energy, recycling, organic and hygienics.

A 5,000 square meter Waste-to-Energy (WtE) plant will be built in Malta to reduce the amount of municipal solid waste disposed into the landfill. The plant will manage around 40% of the overall waste generated in the Maltese Islands, equivalent to 114,000 tonnes and recover a substantial amount of energy of about 69000 MWh per year. The WtE plant will use a robust technology known as Moving Grate Incineration and the waste fed in the plant will be non-recyclable waste.