

Cyprus

**Eighth National Communication
& Fifth Biennial Report**

- under the United Nations Framework Convention on Climate Change

Department of Environment

**Ministry of Agriculture,
Rural Development and Environment**

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Executive Summary

National Circumstances

Geographical profile

Cyprus is an island country, located in the eastern end of the Mediterranean Sea, and the third largest island in the Mediterranean Sea, after the Italian islands of Sicily and Sardinia (both in terms of area and population). The total area of the island is 9,251 km². It measures 240 km long and 100 km wide at its widest point. It lies between latitudes 34° and 36° N, and longitudes 32° and 35° E. The physical relief of the island is dominated by two mountain ranges, the Troodos Mountains and the smaller Kyrenia Range.

Government structure

Cyprus is an independent sovereign Republic with a presidential system of government. The constitution provides for separate executive, legislative and judicial branches of government with independent powers. The President is both Head of State and Government. The Council of Ministers exercises executive power in all matters. Each Minister is the head of his or her Ministry and exercises executive power on all matters within that Ministry's domain. The Government Spokesman and the Deputy Minister to the President are also present at the meetings of the Council of Ministers. The Ministers are appointed by the President. The ministries mainly prepare and implement national laws. Furthermore, there are two types of local authorities: Municipalities and Communities, which are governed by separate laws.

Population

In general, aggregate increases in population are drivers for increasing consumption, energy use and greenhouse gas emissions. The population of the Government controlled area is estimated at 918.000 at the end of 2021, compared to 875.900 at the end of 2018, recording an increase of 0,5%.

Economic profile

The economic profile of a country has a strong link to greenhouse gas emissions, with the overall level and types of economic activity, strongly correlated to energy use. However, this is also dependent on factors such as energy efficiency and the structure of the economy.

The economy of Cyprus can generally be characterised as small, open and dynamic, with services constituting its engine power. The tertiary sector (services) is the biggest contributor to GVA, accounting for about for about 83,2% in 2021. The secondary sector (industry) accounted for around 14,9% of GVA in 2021. The primary sector (agriculture and fishing) is continuously shrinking and only reached 1,9% of GVA in 2021.

Climate profile

Cyprus has an intense Mediterranean climate with the typical seasonal rhythm strongly marked in respect of temperature, rainfall and weather generally. Hot and dry summers from mid-May to mid-October and mild, rainy, rather changeable, winters from November to mid-March are separated by short autumn and spring seasons of rapid change in weather conditions.

The central Troodos massif, rising to 1951 metres and, to a less extent, the long narrow Kyrenia mountain range, with peaks of about 1,000 metres, play an important part in the climate of Cyprus. The predominantly clear skies and high sunshine amounts give large seasonal and daily differences between temperatures of the sea and the interior of the island which also cause considerable local effects especially near the coasts.

During the summer, the island is mainly under the influence of a trough of low pressure extending from the great continental thermal low centred over southwest Asia. It is a season of high temperatures with almost cloudless skies. Rainfall is almost negligible, but isolated thunderstorms sometimes occur which give rainfall amounting to less than 5% of the total in the average year.

In winter Cyprus is near the track of fairly frequent depressions which mainly cross the Mediterranean Sea from west to east. These depressions give periods of unsaddle weather conditions usually lasting from two to five days and produce most of the annual precipitation. Snow occurs rarely in the lowlands and on the Kyrenia range, but falls frequently every winter on ground above 1,000 metres usually occurring by the first week in December and ending by the middle of April and March.

Energy

A key challenge for Cyprus is its high dependency on fossil fuels for energy – the biggest share within the EU in fact, which makes it crucial for the country to develop both its hydrocarbon and renewable energy sources. Cyprus is reliant on fossil fuel imports for its electricity needs, and spends over 8% of its GDP to cover the costs. The island also saw the biggest increase in energy demand among the EU28, growing 39% since 1990 from 1.6 million tonnes of oil equivalent (Mtoe) to 2.2 Mtoe in 2020.

The Renewable Energy Sources (RES) share in gross final consumption of energy was 16.88%, exceeding the national mandatory target of 13% RES in 2020, as set in the Directive 2009/28/EC. Additionally, the country's national grid system has certain intrinsic and technical limitations affecting RES penetration and reliability of the energy system – such as the lack of interconnections to the trans-European electricity networks. It is also highlighted that the island is already one of the highest users per capita in the world of solar water heaters in households, with over 90% of households equipped with solar water heaters and over 50% of hotels using large systems of this kind.

Transportation

Both freight and passenger transport, have continued to grow strongly since 1990 with continued growth in GHG emissions. According to the available information, there is no clear relation between freight or passenger transport with GDP. The transport sector is now the largest consumer of energy in Cyprus after electricity production and the issue of growing greenhouse gas emissions from this sector needs to be addressed.

Road transport emissions include all combustion and evaporative emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on paved roads. Civil aviation emissions include emissions from international and domestic civil aviation, including take-offs and landings.

Industry

Cyprus, after its independence in 1960, demonstrated a successful economic performance in terms of full employment and economic stability, apart from some isolated events. The underdeveloped rural economy inherited from colonialism was transformed into a modern economy with dynamic services, light industry, a very good agricultural sector and advanced physical and social infrastructure. From being traditionally agricultural, Cyprus embraced industrial development in the 1960s and today specializes in the manufacture of medium and high-technology products and semi-customized small-batch products.

Waste

Cyprus' national municipal waste Management Plan of 2015-2021 (MWMP) contained quantitative and qualitative targets and enumerates specific measures and actions to be taken in order for the EU targets to be reached. One of the quantitative targets is that no more than 95,000 tonnes of biodegradable waste to be disposed in landfills (represents the 35% target of the 1999/31/EC directive). Also, the Legal Measures focus on (1) the development of local waste prevention and management schemes, (2) mandatory obligation for establishing separate collection systems by local authorities, (3) establishment of extended producer responsibility (EPR) in streams other than packaging waste, (4)

establishment of a landfill tax/levy and (5) banning the disposal of certain waste streams from entering into landfills.

Agriculture

The agriculture sector has shrunk considerably over the past decades, as well as its contribution to the GDP, combined with the fisheries and forestry sectors. Nevertheless, the importance of agriculture socially and environmentally is great.

The competitiveness of the agricultural sector and productivity depend to a large extent on their structural characteristics. The total utilized agricultural land decreased by 24% between 2003 and 2010. In addition to the above, the agricultural sector in Cyprus is already experiencing the impact of climate change, which has caused, among other things, the degradation of agricultural land, the reduction of agricultural production, the increase in damage caused by extreme weather events

Forest

Wild vegetation in Cyprus is classified in two major categories: a) forest and b) Other Wooded Land (OWL, which includes maquis and garrigue), which are either of state or private ownership. The total area of high forests is about 172,700 ha and occupies the 18.68 % of the total area of Cyprus, including the occupied areas in the northern part of the island. An area of about 139,053 ha or 80, 46 % of the total State- forest area is situated in the area under the control of the Government whilst the remaining 19,54 % is found in the area of Cyprus beyond the control of the Government. According to the last survey, private forests and other forested State land cover 24,74 % of the total area of Cyprus

Greenhouse gas inventory information

The GHG data presented in this report is consistent with the 2023 submission of Cyprus to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), under the Convention and the Kyoto Protocol.

The legal basis for the compilation of the Cyprus' inventory is the Council of Ministers' Decision adopted 15/11/2017 entitled "Structure and operation of the National Greenhouse Gases Inventory System- Roles and Responsibilities".

Summary tables of GHG emissions for Cyprus in the common reporting format are presented in the report for the whole of the reporting period of the NIR2023 (1990-2021) as this was submitted to the UNFCCC secretariat.

National System for the GHG emissions/removals inventory

The Department of Environment of the Ministry of Agriculture, Rural Development and Environment (DoE), is the governmental body responsible for the development and implementation of environmental policy in Cyprus. Moreover, the DoE is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol, according to the Law 29(III)/2009 with which Cyprus ratified the Kyoto Protocol. In this context, the DoE has the overall responsibility for the national GHG inventory, and the official preparation and approval of the inventory prior to its submission. The entities participating are:

- The DoE, designated as the national entity responsible for the national inventory, holds the overall responsibility and maintains an active role in the inventory planning, preparation and management, including technical and scientific responsibility for the compilation of the annual inventory.¹

¹ For 2017, there is a contract with an external expert for scientific and technical support to the inventory team of the DoE and the QA of the GHG inventory. As of 2018, according to the Council of Ministers' Decision of 15/11/2017, the technical and scientific responsibility for the compilation of the

- Governmental ministries and agencies, and non-governmental organisations through their appointed focal persons, ensure the data provision.

The legal framework defining the roles-responsibilities and the co-operation between the Inventory team at the Department of Environment and the designated contact points of the competent Ministries was formalized by Council of Ministers' Decision adopted 15/11/2017 entitled "Structure and operation of the National Greenhouse Gases Inventory System- Roles and Responsibilities". The above-mentioned Decision includes a description of each entity's responsibilities, concerning the inventory preparation, data providing or other relative information. This formal framework has improved the collaboration between the entities involved, assuring the timely collection and quality of the activity data required and solving data access restriction problems raised due to confidentiality issues.

National registry

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8. According to the latest update that was received from the ITL, the national registry of Cyprus is fully connected to the ITL.

Policies and Measures

Under the Kyoto Protocol, for its second commitment period, the EU, its Member States and Iceland have agreed to fulfil their quantified emission limitation and reduction commitments jointly. The Union, its Member States and Iceland agreed to a quantified emission reduction commitment that limits their average annual emissions of greenhouse gases during the second commitment period to 80 % of the sum of their base year emissions, which is reflected in the Doha Amendment.

The EU's current NDC goal submitted in December 2020 within the framework of the Paris Agreement, is to reduce emissions by at least 55% below 1990 levels by 2030 (including LULUCF). Moreover, the European Council (heads of state or government of the EU Member States, the European Council President and the President of the European Commission) endorsed the objective of achieving a climate-neutral EU by 2050, in line with the Paris Agreement.

Policy-making process

The Department of Environment (DoE), of the Ministry of Agriculture, Rural Development and Environment is the main governmental body entrusted with the development and implementation of environmental and climate policy in Cyprus. DoE is responsible, among others, for the formulation of policies concerning environmental protection and climate change, for the coordination of implementation efforts and to ensure compliance with the current EU and national legislative framework. Other entities responsible for integrating climate policy within their respective fields are the following:

- Energy Service, Ministry of Energy, Commerce and Industry (fuels, RES, Energy efficiency)
- Department of Public Works, Ministry of Transport, Communication and Works (sustainable mobility)
- Department of Electromechanical Services, Ministry of Transport, Communication and Works (electro-mobility (alternative fuels) infrastructure)
- Department of Agriculture, Ministry of Agriculture, Rural Development and Environment (agricultural policy)

annual inventory for all sectors will be assigned, on a contract basis, to an independent consultant by the DoE.

- Department of Forests, Ministry of Agriculture, Rural Development and Environment (forests policy)
- Department of Environment, Ministry of Agriculture, Rural Development and Environment (waste management, animal waste management)
- Local authorities

Policies and measures, as well as all other issues and actions regarding mitigation were discussed within the framework of an inter-ministerial committee, comprising representatives from all competent Ministries. Final approval of policies and measures related to climate change mitigation rested with the Council of Ministers.

In January 2020, MARDE and the Ministry of Energy, Commerce and Industry published Cyprus' National Energy and Climate Plan pursuant to article 3 of Regulation (EU) 2018/1999. The National Energy and Climate Plan (NECP) is Cyprus' government's strategic plan for climate and energy issues, setting out a detailed roadmap regarding the attainment of specific energy and climate objectives by 2030. The NECP stresses Cyprus' priorities and development potential in terms of energy and climate change issues, and aims to serve as the key tool for drawing up the national energy and climate policy in the next decade, taking into account the Commission's recommendations.

The effect of Cyprus' policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases than would otherwise occur, were evaluated in Cyprus' NECP 2021-2030. More specifically an impact assessment was undertaken to produce the projected impacts of WEM and WAM scenarios on the energy mix and emissions. The outputs of the cost optimisation model were employed for the two scenarios until 2030 and are subject to technical constraints, development plans and policy options conveyed to the project team by the authorities. The measures that were included in the impact assessment for WEM scenario and separately for the WAM scenario are presented in the report.

Results of policies and measures

The most important overarching and cross-cutting supporting policies and tools which are related with the implementation of measures for the restriction of GHG emissions in Cyprus are presented. Emphasis is given to the National Energy and Climate Plan, the establishment of emissions trading system, the financing mechanisms and fiscal measures that have been developed to support the implementation of projects which inter alia also contribute to the restriction of GHG emissions.

The total realistic quantifiable GHG emissions reduction potential from the implemented and adopted policies and measures (without LULUCF) in the WEM scenario was estimated to be 305 Gg CO₂eq for both 2025 and 2030.

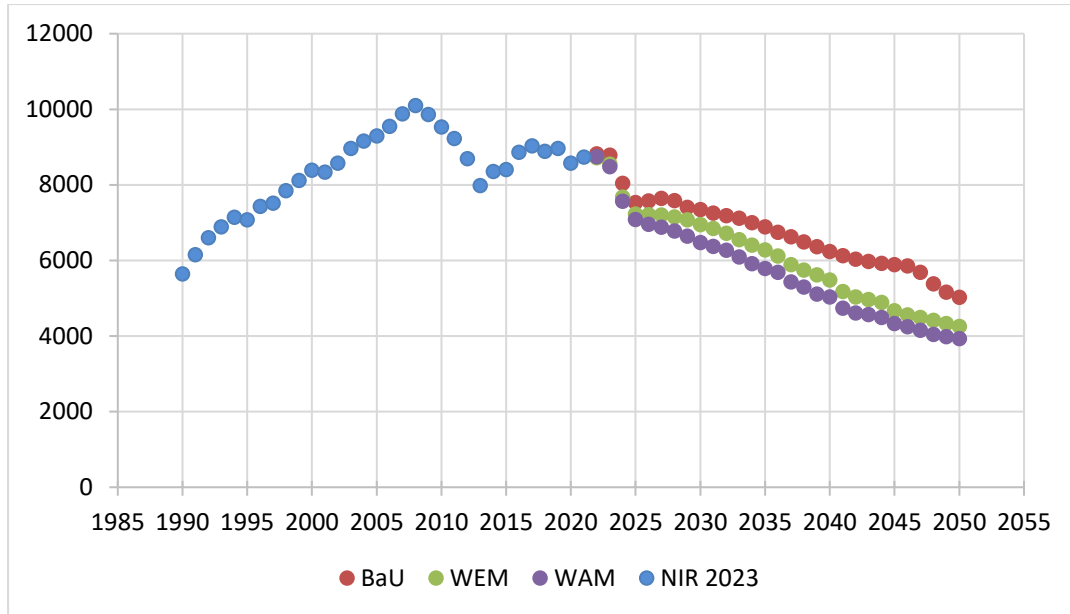
The total realistic quantifiable GHG emissions reduction potential from the implemented and adopted policies and measures (without LULUCF) in the WAM scenario was estimated to be 362 Gg CO₂eq for 2025 and 604 Gg CO₂eq in 2030.

Projections and the Total Effect of Policies and Measures

The NECP highlights our country's energy and climate priorities and development opportunities and aims to be the key tool for shaping/mainstreaming the national energy and climate policy over the next decade. The GHG emission projections presented in this report are based on the latest energy projection scenarios that are developed for the Ministry of Agriculture, Rural Development and Environment by the Cyprus Institute and the October 2020 GDP projections provided by the Ministry of Finance.

Projections

The resulting impact is of the policies and measures for each scenario are presented in this report and summarized in the Figure below. The sudden drop in 2024 across all scenarios is due to the introduction of natural gas.



BaU, WEM and WAM Projections of total national GHG emissions (excluding LULUCF)

The projections presented above take into account the latest microeconomic forecasts, encompassing impacts from the COVID-19 pandemic and the war in Ukraine. It is also noted that the emissions from the possible exploitation of natural gas in the Exclusive Economic Zone are not taken into account due to the high uncertainty associated to any prediction of such changes. Finally, the organic fraction of solid waste not going to the landfill is treated by composting, anaerobic digestion and incinerated for energy. The additional organics for incineration at the cement installation have not been accounted for.

Methodology used for the presented GHG emission projections

The methodology applied for the estimation of the projected GHG emissions has taken into consideration the following:

- (a) At the time the projections were estimated, the 2022 GHG emissions inventory was available. Therefore, all data presented for 2020 and prior is based on the 2022 GHG inventory submitted to the UNFCCC in April 2022 for the purposes of compliance with Regulation (EU) 525/2013. The projection calculations reflect the inventory data for the historical years 1990–2020, revised to reflect the feedback from the latest UNFCCC review of this data.
- (b) For the energy sector two models have been utilised by the Cyprus Institute for the preparation energy projections: OSeMOSYS-Cyprus and Final energy demand projection model.
- (c) For the activities that are included in the EU-ETS data for 2021 was available from the annual reports of the installations. This concerns the sectors of electricity generation (1A1a(i)) and cement and ceramics production (1A2f, 2A1 and 2A4a).
- (d) GDP and population projections from the energy models were used where GDP and population data was needed.
- (e) The projections of activity data were converted to GHG emissions through the application of the 2006 IPCC Guidelines and by applying global warming potential values from the fourth IPCC assessment report, in line with the latest national GHG inventory submission (2022). Emission factors are derived from expert assessments based on the 2006 IPCC guidelines and country specific information.

The main steps of the methodology applied for all sectors were the following: (a) Scenario definition, (b) Activity data projection, (c) Estimation of GHG emissions. Further details on each sector and the specific assumptions applied are given in the report.

Vulnerability Assessment, Climate Change Impacts and Adaptation

Vulnerability assessment, climate change impacts

Cyprus lies at the south-eastern end of the Mediterranean Sea and Europe, which is one of the most sensitive hot-spots and most vulnerable regions in the world regarding climate change. Climate in Cyprus is generally characterized by mild rainy winters, occasional droughts, and long, hot and dry summers.

Recent studies on present and future climate have shown that this semi-arid island has been affected and is expected to be relatively strongly affected by the projected warming and related changes. Therefore, Cyprus, where diverse and extreme climate conditions are already common, is likely to face increases in the frequency and intensity of droughts and hot weather conditions in the near future, with probably disproportional impacts.

The predictions of future climate change presented in detail in this report, were examined in two future periods i.e. the near future period 2021-2050 and the distant future period 2071-2100. The derived values of various climatic parameters in Cyprus for both future stages were compared to the reference values during the period 1960-1990 (control period). The future period 2021-2050 has been chosen specifically and examined in detail for the needs of stakeholders and policy makers, in order to assist their planning in relation to adaptation measures, impacts and vulnerability assessment.

In general, regional climate models consistently predict an overall warming and drying of Cyprus with significant impacts in human health, energy use, water resources and other socio-economic sectors. Pronounced warming and precipitation reductions are also detected from time series of temperature and precipitation parameters, regarding representative locations of Cyprus during the period 1951-2100.

Adaptation

Cyprus prepared a combined National Adaptation Strategy and Action Plan in 2014, which was updated and formally adopted in May 2017. The Ministry of Agriculture, Rural Development and Environment is the central body coordinating the adaptation policy-making process and has led the preparation and adoption of the National Adaptation Strategy and Action Plan. The responsibility for the implementation of specific sectoral actions lies with the responsible authorities for each specific action (e.g. Department of Agriculture for agricultural issues). Meetings with all the stakeholders have taken place to assess the status of implementation of the activities included in the Action Plan. The sectoral breakdown of the actions included in the strategy is presented in the report and summarised in the Table below.

Sectoral breakdown of the actions included in the strategy

	Sector	Number of actions
1	Water	7
2	Soil	4
3	Biodiversity	6
4	Agriculture	6
5	Forests	4
6	Fisheries	2
7	Health	9
8	Energy	7
9	Tourism	1
10	Coastal areas	4
11	Infrastructure	6
12	Horizontal (all sectors)	4
	TOTAL	60

The implementation of several adaptation measures has started taking place. Some autonomous adaptation actions are being undertaken at sectoral level. For example, the Institute of Agricultural Research and the Department of Forests are undertaking projects which facilitate adaptation.

A Monitoring Strategy was developed to complement the National Adaptation Strategy. In the Monitoring Strategy, and a Monitoring Team was suggested. The results of the Monitoring Strategy are expected to provide the basis for the preparation of the 2nd National Adaptation Plan. Monitoring reports are scheduled every year from 2018 to 2022. All the stakeholders have been included throughout the process and particularly monitoring of progress of implementation of adaptation measures. The latest report was completed in 2022 for the progress of implementation of the NAS until 2021.

Financial Resources and Transfer of Technology

Cyprus was a non-Annex I party to the UNFCCC until 1/1/2013 and a non-Annex B party to the Kyoto Protocol. Consequently, Cyprus had no obligations to allocate financial resources for assistance to developing country parties that are particularly vulnerable to climate change. Nevertheless, in 2009, along with the rest of the member states of the EU, Cyprus committed to provide finance for climate change to developing countries.

Research and Systematic Observation

The R&I system in Cyprus is relatively young and is evolving with the aim to increase its efficiency and foster cooperation between the research community and the productive sector (business and industry). The current governance system was established in 2007. The main barriers of the system relate to the inflexible governance structure, the weak coordination between the various actors involved and the absence of an explicit long-term strategy for R&I. In addition, the development of the R&I system is hindered by the weak cooperation between the research and academic community with the business world, the low involvement and investments of the private sector in R&I activities and the limited extroversion of the Cyprus R&I system.

Taking into consideration the above, the government of Cyprus promoted various initiatives and studies in order to develop a concrete proposal for restructuring and upgrading the R&I governance structure in Cyprus.

Research

Research is among the key priority measures of the Action Plan for Growth, a main strategy document that aims at accelerating the economic recovery, creating jobs, improving the competitiveness of the business environment and promoting investments.

The main policy document for Research and Innovations currently in force is the Smart Specialisation Strategy for Cyprus (S3CY), which was approved by the Council of Ministers in March 2015. It includes an Action Plan, to be implemented over the period 2015 – 2022, with measures amounting to €144 mln, with co-financing from the European Structural and Investment Funds (ESIF). The Action Plan of S3CY is expected to also address the main issues of the R&I system in Cyprus such as the inclusion of SMEs in R&I activities and the attraction of private sector in R&I investments, the establishment of synergies between the research and academic community with the business world and the enhancement of extroversion of the Cyprus R&I system.

Systematic Observation

The Cyprus Department of Meteorology handles the measurements of meteorological parameters. The Department of Labour Inspection is responsible for Air Quality and Emissions Inventory. The Oceanic observation is performed by programs of the Cyprus Oceanography Centre while the Water Development Department (WDD) is responsible for the observation system on quantity/quality of

surface water and finally the forest ecosystem health observation belongs to the responsibility of the Department of Forests.

Additionally, since the previous UNFCCC communication, the Climate and Atmosphere Research Center (CARE-C) of the Cyprus Institute has further developed a comprehensive atmospheric network over Cyprus that fully complements those currently operating by 1) the Cyprus Department of Meteorology) for the monitoring of meteorological parameters, and 2) the Department of Labour Inspection for the monitoring of air quality (see previous UNFCCC report). This atmospheric network aims to establish the first ever (open access) long-term observations of key climate forcers in the Eastern Mediterranean and Middle East region, in order to better constrain emissions of greenhouse gases and air pollutants and therefore better support the development of accurate regional (air quality) models for better prediction, mitigation, and adaptation.

Education, Public Awareness

As part of the programme for the implementation of the Convention and the New Delhi Programme, and the relevant provisions of the Kyoto Protocol, Cyprus has carried out a series of actions, which are presented in the report, aiming at the integration of climate change issues at all educational levels and disciplines, the dissemination of information and promotion of participation of youth, stakeholders, and public, as well as the enhancement of cooperation and co-ordination at regional and international level to promote capacity building.

General policy toward education and training

Climate change in the context of formal and non - formal education is an issue of interdisciplinary investigation and interconnected with all the issues of environment and sustainable development as a matter of national, regional and international interest. The consideration of climate change in this context relies on the fact that climate change is not a mono-dimensional problem, cut off from the rest of the Sustainable Development issues, but could be the apparent cause and consequence of a chain of direct and indirect human effects on all environmental and Sustainable issues. Within this context the issue of climate change is considered an intrinsic part of the National Action Plan for Environmental Education with focus on Education for Sustainable Development (NAPEESD) (CPI 2007) which is considered the most important policy document on EE/ESD in Cyprus. It was approved and enacted by the Ministerial Board (2007).

It is noted that the National Strategy on Education for Sustainable Development is under revision aiming to cover the period 2022-2030 and aims to give emphasis on green transition and Sustainable Development Goals in Education in formal, non-formal and in-formal education. In the revised National Action Plan on ESD special emphasis is given to climate change is “captured” holistically in the school process and not just an issue for teaching through curricula. More specifically through the revised action plan on ESD special emphasis given to youth empowerment on climate action, to transforming schools as learning communities for SDGs, including climate change, by promoting programs for greening school infrastructures (school yards, using of renewable resources of energy, supporting local products, strengthening sustainable mobility etc). Access of environmental information to the public is provided through the websites of the relevant Ministries and other governmental agencies.

The Ministry of Education Sports and Youth, through the responsible Unit of Education for Environment and Sustainable Development (Unit of ESSD-Pedagogical Institute), emphasizes the importance of teacher’s professional development on climate change education. A series of Professional Development Courses are offered on Climate Change Education and are obligatory and optional. These courses vary on type and content, covering various aspects and elements of Climate Change Education.

Environmental information and public awareness

One of the missions of the Department of the Environment is to inform and raise public awareness on environmental issues. There are a number of established campaigns that the Department of Environment organises and/or co-organises and are presented in more detail in the report.

Furthermore, a large portion of the information included in the NC8/BR5 was provided from other strategic plans including the National Adaptation Strategy and the NECP 2021-2030 for Cyprus. These plans had extensive public consultations before completed and therefore the information included in the NC8/BR5 have been communicated to all different types of stakeholders. The consultations included public presentations that were covered by social media, a series of meetings where all affected stakeholders per sector were invited to provide their feedback.

International cooperation

Ministry of Education Sport and Youth (MoESY), through the Unit of EESD, is actively involved in various international activities for climate change in education. Indicatively it is mentioned that Cyprus is chairing the UNECE ESD SC and had an intrinsic role on the preparation of the Framework for the implementation of the United Nations Economic Commission for Europe Strategy for Education for Sustainable Development from 2021 to 2030, where climate change and youth empowerment on climate action is considered as one of the key horizontal priority areas

Additionally, Cyprus with the Ministry of Education, Sports and Youth (MoESY) is leading the Mediterranean Committee on Education for Sustainable Development (ESD) and recently, during the UNECE 9th Ministerial Meeting for Environment for Europe that hosted in Cyprus, 5-7 of October 2022, the revised Mediterranean ESD Action Plan 2030, which adopted by the Ministers of Education and Environment, addressed the emergencies for a regional cooperation on climate action

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CYPRUS' EIGHTH NATIONAL COMMUNICATION

1. Introduction

This document represents the Cyprus' eighth National Communication (NC8) required under the United Nations Framework Convention on Climate Change (UNFCCC), as reaffirmed by UNFCCC decision 2/CP.17. It provides a comprehensive overview of climate change-related activity in Cyprus.

As defined in the UNFCCC reporting guidelines for National Communications², the information is structured into:

- National circumstances relevant to greenhouse gas emissions and removals (Chapter 2);
- Greenhouse gas inventory information (Chapter 3);
- Policies and measures (Chapter 4);
- Projections and the total effects of policies and measures (Chapter 5);
- Vulnerability assessment, climate change impacts and adaptation measures (Chapter 6);
- Financial resources and transfer of technology (Chapter 7);
- Research and systemic observation (Chapter 8) and
- Education, training and public awareness (Chapter 9).

UNFCCC decision 2/CP.17 also requires the Cyprus to submit its fifth Biennial Report (BR) by 1st January 2023. The UNFCCC reporting guidelines for National Communications content-wise overlap with the UNFCCC biennial reporting guidelines for developed country Parties (Annex I of decision 2/CP.17).

As endorsed in UNFCCC decision 2/CP.17, Cyprus has opted to submit its 5th Biennial Report as Annex I to this 8th National Communication. The tables as defined in the common tabular format (CTF) for the UNFCCC biennial reporting guidelines for developed country Parties (UNFCCC decision 19/CP.18) are enclosed as Appendix to Annex I. For the CTF submission to the UNFCCC, the electronic reporting facility provided by the UNFCCC secretariat has been used as required by UNFCCC decision 19/CP.18.

To avoid unnecessary duplication of information, overlapping contents were concentrated in the eighth National Communication: Those sections of the fourth Biennial report's main body which content-wise would be identical to sections of the eighth National Communication, do thus solely contain a reference to the corresponding section of eighth National Communication.

This communication focuses to the years up to which data is available; i.e. until 2021.

² FCCC/CP/1999/7 part II, in combination with UNFCCC decision 15/CMP.1

2. National circumstances

2.1. Introduction

This chapter reports the national circumstances of the Republic of Cyprus. It illustrates a number of key characteristics that relate directly or indirectly to the greenhouse gas emissions and include energy, transport, land use, climatic conditions and trade patterns. The chapter analyses how these various factors have influenced greenhouse gas emissions to-date and how the historic trends observed might influence emissions going forward.

The Ministry of Agriculture, Rural Development and Environment is the governmental body with the overall responsibility for the preparation, approval and submission of national communications (Contact persons: Dr Theodoulos Mesimeris and Dr Nicoletta Kythreotou, UNFCCC National Focal Points). Experts from governmental and non-governmental institutions participated in the preparation of the present national communication as information providers.

2.2. Geographic profile

Cyprus is an island country, located in the eastern end of the Mediterranean Sea, and the third largest island in the Mediterranean Sea, after the Italian islands of Sicily and Sardinia (both in terms of area and population). The total area of the island is 9,251 km². It measures 240 km long and 100 km wide at its widest point. It lies between latitudes 34° and 36° N, and longitudes 32° and 35° E.

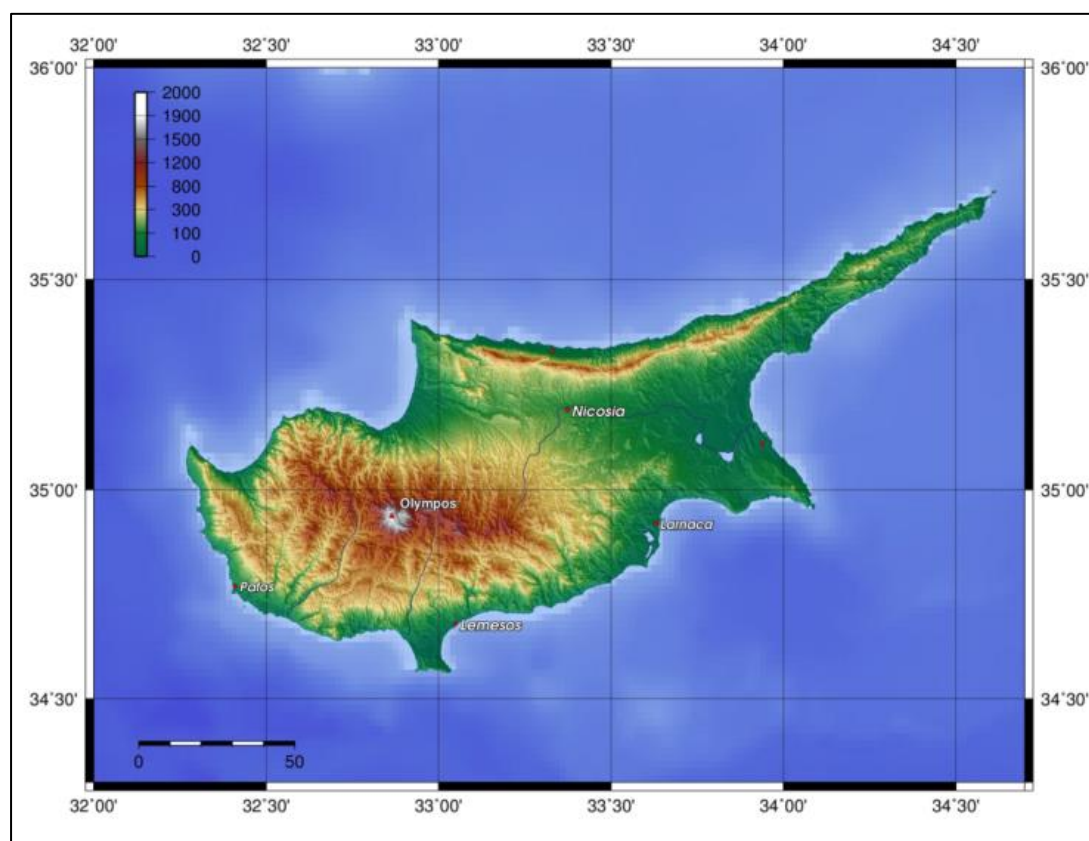


Figure 2.1. Topographic map of Cyprus

The physical relief of the island is dominated by two mountain ranges, the Troodos Mountains and the smaller Kyrenia Range, and the central plain they encompass, the Mesaoria. The Mesaoria plain is drained by the Pedieos River, the longest on the island. The Troodos Mountains cover most of the

southern and western portions of the island and account for roughly half its area. The highest point on Cyprus is Mount Olympus at 1,952 m, located in the centre of the Troodos range. The narrow Kyrenia Range, extending along the northern coastline, occupies substantially less area, and elevations are lower, reaching a maximum of 1,024 m.

2.3. Government Structure

Cyprus is an independent sovereign Republic with a presidential system of government. The constitution provides for separate executive, legislative and judicial branches of government with independent powers. The President is both Head of State and Government.

Presidency

According to the 1960 Constitution, the President is to be Greek Cypriot elected directly by the Greek Cypriot community and the Vice-President is to be Turkish Cypriot elected directly by the Turkish Cypriot community, for a five-year term of office. The Constitution provides that executive power is exercised jointly by the President and the Vice-President, through a Council of Ministers appointed by them (seven and three ministers respectively).

Both the President and the Vice-President have the right of final veto on decisions of the Council of Ministers and laws or decisions of the House of Representatives concerning foreign affairs, defence and security. In 1964, however, the Turkish Cypriot Vice-President and the three Turkish Cypriot ministers withdrew from the government and since then the government has been functioning by necessity only with Greek Cypriots in all ministries, which have been subsequently increased to eleven. The post of Vice-President remains vacant.

The ministries and deputy ministries are the following: Ministry of Defence, Ministry of Agriculture, Rural Development and Environment, Ministry of Justice and Public Order, Ministry of Energy, Commerce, Industry, Ministry of Foreign Affairs, Ministry of Labour Welfare and Social Insurance, Ministry of the Interior, Ministry of Finance, Ministry of Education, Sport and Youth, Ministry of Transport, Communications and Works, Ministry of Health, Deputy Ministry Of Research, Innovation And Digital Strategy, Deputy Ministry of Tourism, Deputy Ministry of Social Welfare, Deputy of Shipping, Deputy Ministry of Culture.

Council of Ministers

The Council of Ministers exercises executive power in all matters. Each Minister is the head of his or her Ministry and exercises executive power on all matters within that Ministry's domain. The Government Spokesman and the Deputy Minister to the President are also present at the meetings of the Council of Ministers. The Ministers are appointed by the President. The ministries mainly prepare and implement national laws.

Local Authorities

Cyprus is separated into 6 districts: Nicosia (Lefkosa), Limassol (Lemesos), Pafos, Larnaca, Ammochostos and Keryneia (Figure 2.2). Each district has a District Officer, who reports to the Minister for the Interior. Keryneia are not under the effective control of the Republic of Cyprus, whereas Ammochostos is partially under the effective control of the Republic of Cyprus.

There are two types of local authorities: Municipalities and Communities, which are governed by separate laws. In principle, Municipalities constitute the form of local government in urban and tourist centres, while Communities constitute the local structure in rural areas. Mayors and Community Presidents are elected directly by the residents for a five-year term.

Any Community may become a Municipality by local referendum subject to the approval of the Council of Ministers, provided it has either a population of more than 5,000, or has the economic resources to function as a Municipality. The main responsibilities of Municipalities are the construction, maintenance and lighting of streets, the collection, disposal and treatment of waste and environmental

protection and improvement. The functions of Communities are generally similar to those of Municipalities, although structurally different. The government provides to most Communities essential administrative and technical assistance through its District Offices.

Currently, there are 39 municipalities and 485 communities, of which 9 and 132 respectively are not under the effective control of the Republic of Cyprus.

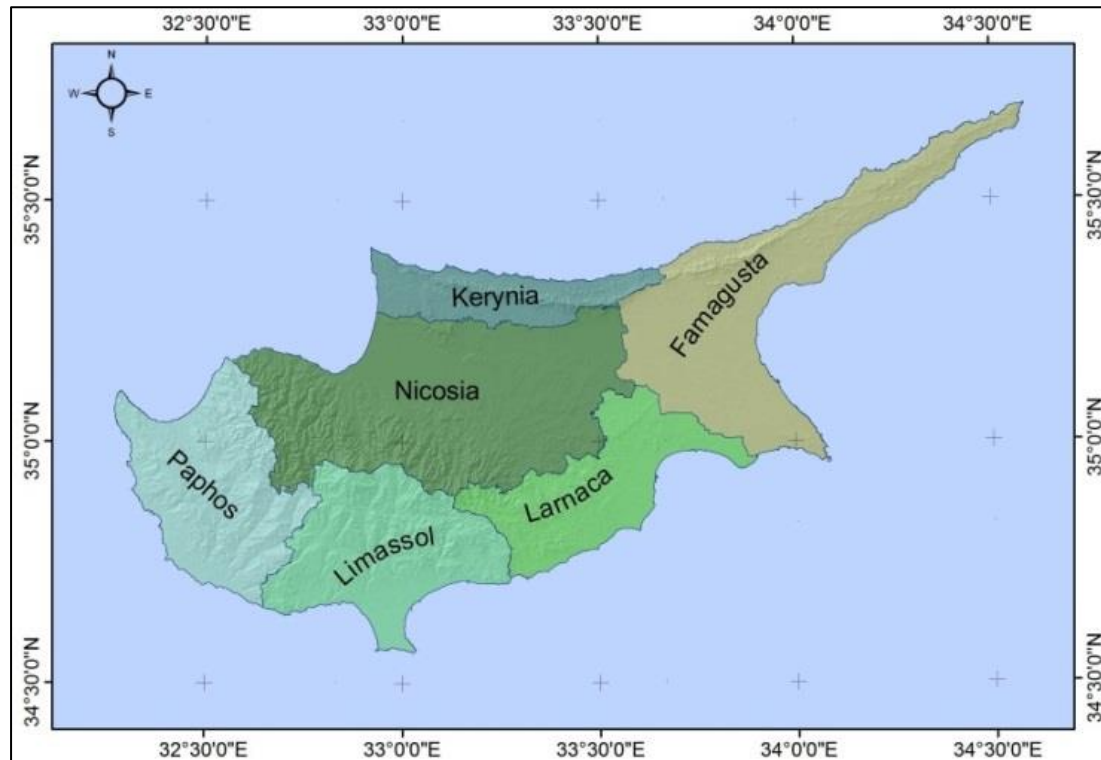


Figure 2.2. The six administrative districts of Cyprus

Legislature

House of Representatives

Legislative authority is exercised by a unicameral House of Representatives. Its members are elected for a five-year term. At the time of its establishment the House consisted of 50 members, 35 of whom were to be Greek Cypriots and 15 Turkish Cypriots. In 1985 the number of seats was increased to 80, 56 allocated to Greek Cypriot members and 24 reserved for Turkish Cypriot deputies. Following the withdrawal of the Turkish Cypriot members in 1964, the House has been functioning only with the Greek Cypriot members.

The Maronite, Armenian and Latin religious groups, which vote as part of the Greek Cypriot community, elect one additional representative each from their ranks. These non-voting representatives attend meetings, but do not participate in the House deliberations. They are consulted on issues of particular interest to their respective group.

Given the vacancy in the Vice- President's office, the House President serves as Acting President of the Republic in the case of temporary absence or temporary incapacity of the President of the Republic.

Judiciary

The administration of justice is exercised by the Republic's separate and independent judiciary. Under the 1960 Constitution and other legislation in force, the following judicial institutions have been established: The Supreme Court, The Assize Courts and District Courts.

Independent Officers and Bodies

There are also independent officers and bodies which do not come under any ministry, including the: Attorney-General and Auditor-General who head the Law Office and Audit Office respectively; Governor of the Central Bank; Ombudsman (Commissioner for Administration); Public Service Commission; Education Service Commission; Planning Bureau; Treasury; Commission for the Protection of Competition; Commissioner of Electronic Communications and Postal Regulation; Commissioner for Personal Data Protection; Commissioner for the Protection of Children's Rights; Law Commissioner; Commissioner for the Environment; Commissioner for the Reform of the Civil Service; Commissioner for Humanitarian Affairs; Commissioner for Volunteering and Nongovernmental Organisations; Tenders Review Authority; Internal Audit Service; Cyprus Radio Television Authority; Cyprus Securities and Exchange Commission.

Member of the European Union

On 1 May 2004 the Republic of Cyprus became a full member of the EU. Accession to the EU was a natural choice for Cyprus, dictated by its culture, civilisation, history, its European outlook and adherence to the ideals of democracy, freedom and justice.

The application of the EU laws and regulations (the *acquis communautaire*) is suspended in the area under military occupation by Turkey, pending a solution to the occupation and forcible division of the country. Meanwhile, the government, in cooperation with the EU Commission, has been promoting arrangements to facilitate increased economic transactions between the two communities and improve the standard of living of Turkish Cypriots, who are also victims of Turkey's military aggression against Cyprus.

While Cyprus has a lot to benefit from EU membership, it also has a lot to offer as a member state. Strategically situated at the crossroads of Europe, the Middle East, North Africa and Asia, Cyprus is becoming an even more important regional business centre, as well as an international communications and transport hub. It is also a prospective energy (natural gas) provider for Europe.

Given its modern infrastructure, sound legal system, tax incentives, low crime rate and well-educated labour force, Cyprus is a favourite regional operations platform for European and other international companies.

Since its accession to the EU, Cyprus has undergone significant structural reforms that have transformed its economic landscape. Trade and interest rates have been liberalised, while price controls and investment restrictions have been lifted. Private financing has been introduced for the construction and operation of major infrastructure projects and monopolies have been abolished.

Cyprus held the Presidency of the Council of the European Union for the first time from July – December 2012.

2.4. Population³

In general, aggregate increases in population are drivers for increasing consumption, energy use and greenhouse gas emissions. The population of the Government controlled area is estimated at 918.000 at the end of 2021, compared to 875.900 at the end of 2018, recording an increase of 0,5%.

2.5. Climate⁴

Cyprus has an intense Mediterranean climate with the typical seasonal rhythm strongly marked in respect of temperature, rainfall and weather generally. Hot and dry summers from mid-May to mid-

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October and mild, rainy, rather changeable, winters from November to mid-March are separated by short autumn and spring seasons of rapid change in weather conditions.

The central Troodos massif, rising to 1951 metres and, to a less extent, the long narrow Kyrenia mountain range, with peaks of about 1,000 metres, play an important part in the climate of Cyprus. The predominantly clear skies and high sunshine amounts give large seasonal and daily differences between temperatures of the sea and the interior of the island which also cause considerable local effects especially near the coasts.

During the summer, the island is mainly under the influence of a trough of low pressure extending from the great continental thermal low centred over southwest Asia. It is a season of high temperatures with almost cloudless skies. Rainfall is almost negligible, but isolated thunderstorms sometimes occur which give rainfall amounting to less than 5% of the total in the average year.

In winter Cyprus is near the track of fairly frequent depressions which mainly cross the Mediterranean Sea from west to east. These depressions give periods of unsaddle weather conditions usually lasting from two to five days and produce most of the annual precipitation. Snow occurs rarely in the lowlands and on the Kyrenia range, but falls frequently every winter on ground above 1,000 metres usually occurring by the first week in December and ending by the middle of April.

Precipitation

The mean annual precipitation varies from year to year and from place to place. The lowest mean annual precipitation for Cyprus was 213mm in 1972-73 and the highest was 800mm in 1968-69. The mean annual precipitation for the period 1961-90 is 503mm. The wettest months are normally December, January and February and the driest are July, August and September.

Statistical analysis of rainfall in Cyprus reveals a decreasing trend of rainfall amounts in the last 116 years. Annual precipitation in Cyprus has on average decreased by about 100mm in the last 85 years (see Figure 2.3).

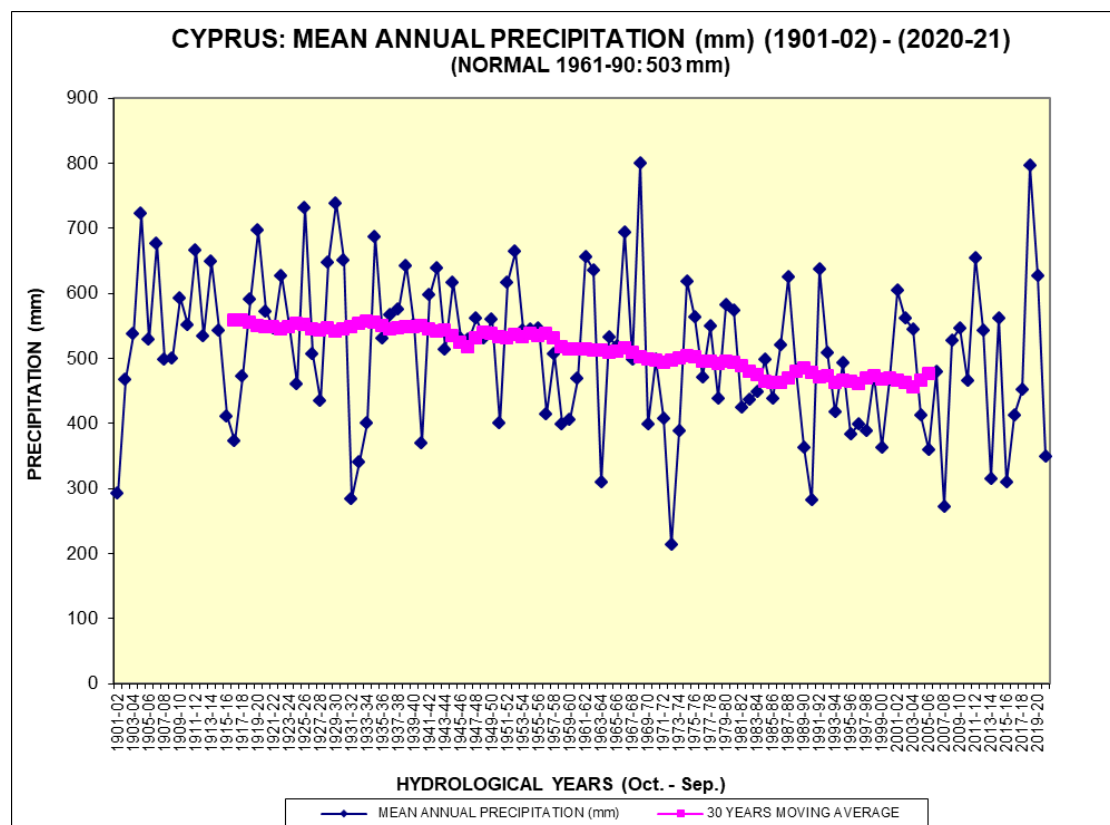


Figure 2.3. Mean annual precipitation in Cyprus 1901-02 – 2020-21 (normal 1961-90: 503 mm)

During the recent years, it has been observed that even though the total annual amount of rainfall does not change significantly, the annual distribution of rainfall has changed considerably, showing extreme rainfall years large amounts of rain alternating with periods of drought (Michaelides et al. 2009).

Temperature

Cyprus has a hot summer and mild winter, but this generalization must be modified by consideration of altitude, which lowers temperatures by about 5°C per 1,000 metres and of marine influences which give cooler summers and warmer winters near most of the coastline and especially on the west coast.

The annual mean temperature for Cyprus varies from year to year, from 16.1°C to 19.7°C, with an average of 17.5°C. The year 2010 was the warmest ever recorded in Cyprus. The years 1961, 1965 and 1967 were the coldest in the last 73 years.

The seasonal difference between mid-summer and mid-winter temperatures is quite large at 18°C inland and about 14°C on the coasts. Differences between day maximum and night minimum temperatures are also quite large especially inland in summer. These differences are in winter 8 to 10°C on the lowlands and 5 to 6°C on the mountains increasing in summer to 16°C on the central plain and 9 to 12°C elsewhere.

The average annual temperature in Cyprus, both in urban and in rural areas, presents an increasing trend. The greater increase in temperature in the towns is due to the urbanization effect, however, the fact that an increase is also observed in rural areas, it is indicative of the general increase in temperature in our area as well as globally. In Nicosia the average annual temperature increased from 18.9°C in the first 30-year period of the century to 20.9°C in the last 30-year period, an increase of 2.0 °C (see figure below).

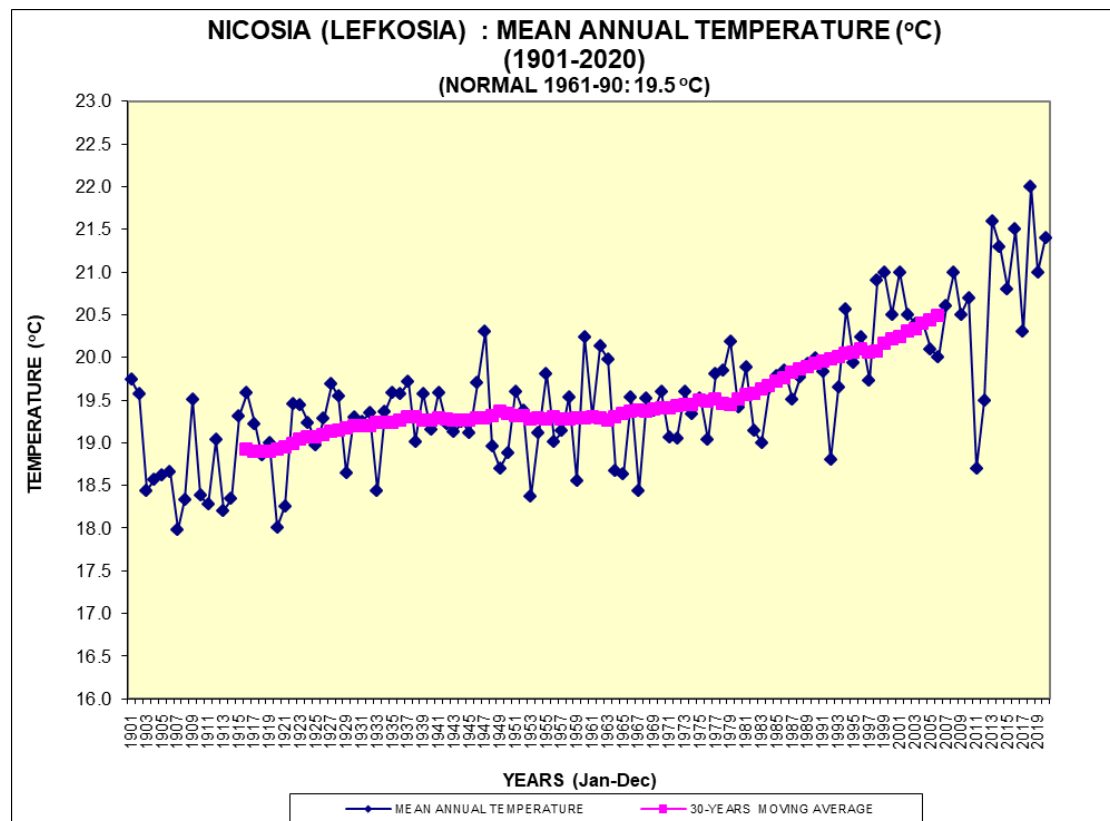


Figure 2.4. Mean annual temperature for Nicosia 1901-2020 (normal 1961-90: 19.5 °C)

Wind

Over the eastern Mediterranean generally surface winds are mostly westerly or south-westerly in winter and north-westerly or northerly in summer. Usually of light or moderate strength, they rarely reach gale force.

Over the island of Cyprus however winds are quite variable in direction with orography and local heating effects playing a large part in determination of local wind direction and strength. Temperature differences between sea and land which are built up daily in predominant periods of clear skies (mainly in summer), cause considerable sea and land breezes. Whilst these are most marked near the coasts they regularly penetrate far inland.

Gales are infrequent over Cyprus but may occur especially on exposed coasts with winter depressions. Small whirlwinds are common in summer appearing mostly near midday as "dust devils" on the hot dry central plain. Very rarely vortices, approaching a diameter of 100 metres or so and with the characteristics of water spouts at sea and of small tornadoes on land occur in a thundery type of weather. Localized damage caused by these has been reported on a few occasions but in general Cyprus suffers relatively little wind damage.

Sunshine

All parts of Cyprus enjoy a very sunny climate compared with most European countries. In the central plain and eastern lowlands the average number of hours of bright sunshine for the whole year is 75% of the time that the sun is above the horizon. Over the whole summer six months there is an average of 11,5 hours of bright sunshine per day whilst in winter this is reduced only to 5,5 hours in the cloudiest months, December and January.

Even on the high mountains the cloudiest winter months have an average of nearly 4 hours bright sunshine per day which goes up to 11 hours during June and July.

2.6. Economy⁵

The economic profile of a country has a strong link to greenhouse gas emissions, with the overall level and types of economic activity, strongly correlated to energy use. However, this is also dependent on factors such as energy efficiency and the structure of the economy.

The economy of Cyprus can generally be characterised as small, open and dynamic, with services constituting its engine power. Since the accession of the country to the European Union on 1 May 2004 the subsequent participation to the ERMII in 29 April 2005 and finally membership to the EURO area as of January 1st 2008, its economy has undergone significant economic and structural reforms that have transformed the economic landscape. Interest rates have been liberalised exchange rates and monetary policy was undertaken by the ECB, while other wide-ranging structural reforms have been promoted, covering the areas of competition, the financial sector and the business sector.

The tertiary sector (services) is the biggest contributor to GVA, accounting for about for about 83,2% in 2021. This development reflects the gradual restructuring of the Cypriot economy from an exporter of minerals and agricultural products in the period 1961-73 and an exporter of manufactured goods in the latter part of the 1970s and the early part of the 80s, to an international tourist, business and services centre during the 1980s, 1990s and the 2000s. The secondary sector (industry) accounted for around 14,9% of GVA in 2021. The primary sector (agriculture and fishing) is continuously shrinking and only reached 1,9% of GVA in 2021. However, the impact of these restructuring has not been evaluated, since this time period is prior to the GHG emission calculations.

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Table 2.1. Main economic indicators

	2018	2019	2020	2021
GDP (in € mln)	21675	23176	21894	24018
Real GDP growth rate	5,6%	5,5%	-4,4%	6,6%
Per capita GDP in PPS, (EU-27 = 100)	91	93	90	91
Rate of Inflation HICP	0,8%	0,5%	-1,1%	2,3%
Unemployment Rate	8,4%	7,1%	7,6%	7,5%
Employment Growth	5,3%	3,8%	-1,2%	1,3%

The private sector, which is dominated by small and medium-sized enterprises, has a leading role in the production process. On the other hand, the government's role is mainly to support the private sector and regulate the markets in order to maintain conditions of macroeconomic stability and a favourable business climate, via the creation of the necessary legal and institutional framework and secure conditions of fair competition.

Before the emergence of the global economic crisis Cyprus had enjoyed a track record of satisfactory economic growth, low unemployment and relatively stable macroeconomic conditions. Over the years 2003 to 2008, real GDP rose at an annual average rate of 4,3 per cent propelled by buoyant investment and growth of private consumption and exports. Consumption was supported by annual employment growth averaging nearly 3,5 per cent over this period, attributable mainly to large inflows of migrant labour, particularly from other EU countries. During this period, per capita income in Cyprus converged rapidly with the EU-27, with GDP in euro per capita terms reaching €21.196 in 2004, or 100 per cent of the EU average in purchasing power parity terms.

The average annual growth in the five years (2008–2012) was 0.1 per cent, while inflation stood at 2,7 per cent and unemployment (as a percentage of the economically active population) at 7 per cent over that period. During that period the international economic crisis affected Cyprus indirectly mainly through lower external demand in tourism, whilst investment was also affected by lower external demand for housing by foreigners.

However, the crisis highlighted large existing imbalances in the economy stemming from the banking sector's large exposure in the Greek economy, domestic overexpansion in the property market and its overall size relative to the economy. At the same time persistent "twin deficits" in the fiscal and current account elevated the economy's vulnerability. Following the loss of market access in May 2011, the government of Cyprus requested financial assistance from its Eurozone partners and the IMF in June 2012. After a period of negotiations, a decision was taken by the Eurogroup and the Executive Board of the IMF in March and April 2013 for a 3-year Macroeconomic Adjustment Programme (the "MAP") to March 2016 of €10 billion financing via the European Stability Mechanism and the IMF.

The MAP agreed with Programme Partners addressed short- and medium-term challenges in the financial, fiscal and structural areas. The programme aimed at bringing back macroeconomic stability through the restoration of market confidence in the financial system, continuing with the ongoing fiscal consolidation process and implementing structural reforms to support competitiveness and sustainable and balanced growth, allowing for the unwinding of macroeconomic imbalances. The MAP was ambitious and addressed fundamental challenges of the Cyprus economy by promoting major reforms in the banking and fiscal areas as well in structural matters. The key programme objectives were:

- to restore the soundness of the Cypriot banking sector and rebuild depositors' and market confidence by thoroughly restructuring and downsizing financial institutions and strengthening supervision;
- to continue the on-going process of fiscal consolidation in order to correct the excessive general government deficit by 2016, in particular through measures to reduce current primary expenditure, and maintain fiscal consolidation in the medium-term, in particular through measures to increase the efficiency of public spending within a medium-term budgetary framework, enhance revenue collection and improve the functioning of the public sector; and
- to implement structural reforms to support competitiveness and sustainable and balanced growth, allowing for the unwinding of macroeconomic imbalances, in particular by reforming the wage indexation system and removing obstacles to the smooth functioning of services markets.

Cyprus authorities successfully completed the three-year macro-economic adjustment program leading to an overall transformation of the production sectors of the economy

The resilience of the Cyprus economy has been shown by the fact that economic activity contracted by 6,6% in 2013 compared to a forecast contraction of 8,7%, while in 2014, the recession was contained to approximately 1,8% compared with a projected contraction of 3,9%. The resilience of the business sector, as well as, the better than anticipated performance in the tourist sector, contributed to the containment of the severity of the contraction of the economy.

In 2015, positive growth was achieved for the first time since 2011 to about 3,4% and further accelerated in 2016 (growth of 6,6%). Growth has been broad-based, driven by very strong performance in the tourism sector, improved labour market conditions and gradual recovery in investment. The positive growth continued until 2019, when the pandemic occurred in 2020 and Cyprus economy shrank by 4,4%. In 2021 positive growth returned to 6,6%.

Unemployment also fared better than expected as it peaked to around 16,1% in 2014, despite projections of more than 20% of the labour force. Since then, unemployment has gradually decreased, with the year 2021 reaching 7,5%.

As regards public finances, targets have been met with considerable margins. In 2015, the budget deficit fell below the reference value of 3% of GDP at around 0,9%, one year ahead of the deadline set by the ECOFIN Council, allowing for the abrogation of the Excessive Deficit Procedure to commence. The nominal budget balance turned in surplus reaching 0,3% of GDP in 2016. This robust fiscal performance has supported debt sustainability, with public debt expected to drop below 100% of GDP by 2017. The reduction of public debt continued until 2020 when the pandemic took place and public debt rose to 113,5%. In 2021, debt fell again to around 101% of GDP.

In the context of the MOU, the Cypriot Banking Sector has been recapitalised and also went through significant restructuring. The supervisory framework has also been strengthened and enhanced while specific measures have been adopted in order to tackle the main challenge in this sector, that is the high level of Non-Performing Loans. These measures include, the new Foreclosure and Insolvency Laws, which introduce the right incentives for all stakeholders, including creditors and debtors, to negotiate a settlement of liabilities. They also create a safety net for vulnerable groups directly affected by the crisis.

Overall, the better than expected performance of the Cyprus economy is also reflected in the upgrades by credit rating agencies, which emphasise the successful transformation of the economy and the rapid correction of macroeconomic imbalances, as well as the impressive performance and resilience of the Cyprus economy.

In the longer term, the recent explorations for hydrocarbon reserves that have taken place in the Exclusive Economic Zone of Cyprus have revealed positive prospects for the development of the industry, which will have significant implications for the Cyprus economy. The Government has submitted a holistic legal framework regarding economic policy surrounding the exploration, discovery and exploitation of natural gas in Cyprus to the House of Representatives for their considerations and approval.

2.6.1. Trade patterns⁶

Due to the island's small domestic market and the open nature of its economy, trade and access to international markets is of utmost importance for Cyprus' well-being. The country's trade balance is traditionally in deficit because the island has to import extensively in order to satisfy domestic demand,

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while the island also depends on imports for its energy supplies. In 2016 Cyprus exported €3,286B and imported €8,531B, resulting in a negative trade balance of €5,245B.

During the last five years the total imports of Cyprus have increased by 3.6%, from €8.21B in 2017 to €8,53B in 2021. 'Agriculture, Constriction and Communication' lead the list with €2,81B followed by 'Consumer Goods' with €2,33B, 'Transport equipment and parts' with €1,73B, and 'Fuels and Lubricants' with €0,75B.

The European Union is the main source of supply of goods to Cyprus in 2021, with a share of €5,47B of total imports. Major suppliers within the Union were Greece with €2,04B, Germany with €10,53B, and Italy with €0,87B.

During the last five years the exports of Cyprus have increased by 9.6%, from €2.96B in 2017 to €3.28B in 2021. 'Industrial products of manufacturing origin' lead the list with €1,33B followed by 'Industrial products of mineral origin' with €0,95B, 'Industrial products of agricultural origin' with €0.77B and 'Agricultural products (raw)' with €0,19B.

Dispatches to the European Union accounted for €0,79B (44%) in 2021 of the total exports. The top export destination is Lebanon (€0,285B – 8%). Exports to Greece and Marshall Islands occupied the second place in importance with €0,251B (7%) and €0,250B (7%) in 2021, respectively.

2.7. Energy⁷

The energy sector in Cyprus⁸

A key challenge for Cyprus is its high dependency on fossil fuels for energy – the biggest share within the EU in fact, which makes it crucial for the country to develop both its hydrocarbon and renewable energy sources. Cyprus is reliant on fossil fuel imports for its electricity needs, and spends over 8% of its GDP to cover the costs.

The island also saw the biggest increase in energy demand among the EU28, growing 39% since 1990 from 1.6 million tonnes of oil equivalent (Mtoe) to 2.2 Mtoe in 2020. The increase in energy demand means an increase in consumption that increased the national GHG emissions. These figures may be low when compared with its larger EU partners, but a more accurate comparison would be Malta where consumption was about 0.93 Mtoe in 2020. However, there is a considerable increase in the use of RES and energy efficiency during the recent years, but this is not reflected in the emissions. Also, Cyprus is determined to enhance cleaner solutions until it can exploit its own reserves.

The Renewable Energy Sources (RES) share in gross final consumption of energy was 16.88%, exceeding the national mandatory target of 13% RES in 2020, as set in the Directive 2009/28/EC. This share comes from the use of solar water heaters, the installation of PV systems, wind parks, biomass/ biogas units and biofuels for transport sector, in combination with the use of heat pumps and biomass use for heating.

Since 2013, electricity from renewable sources is no more promoted through Feed in Tariffs. In 2013 a self-consumption scheme, utilizing net-metering and net-billing methods, was initiated and is in operation until today.

Access of electricity from renewable energy sources to the grid shall be granted according to the principle of non-discrimination. With regard to the use of the grid renewable energy shall be given priority. Grid development is included in the 10-year Transmission Grid Development Plans. In addition,

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⁸ Strategic Energy Hub, 2021, Energy: Oil and Gas, available at <http://www.cyprusprofile.com/en/sectors/energy-and-environment> (accessed 20/12/2021)

renewable heating and cooling (RES H&C) is promoted by support schemes offering subsidies to households.

The country's national grid system has certain intrinsic and technical limitations affecting RES penetration and reliability of the energy system – such as the lack of interconnections to the trans-European electricity networks, a limitation to the amount of intermittent renewable energy that can be connected to the electricity system, and a lack of centralised storage capability.

To tackle these problems the country is planning to introduce smart grids in the national network and energy storage systems. Also, the EuroAsia Interconnector could bring more solutions in its wake.

The island is already one of the highest users per capita in the world of solar water heaters in households, with over 90% of households equipped with solar water heaters and over 50% of hotels using large systems of this kind. With almost year-round sunshine, Cyprus certainly has plenty of energy to harness, but competitive energy storing capabilities are crucial in order to fully tap into its solar potential and facilitate better RES penetration.

There continues to be much ground to cover in terms of renewable energy production, but international interest in developing the sector in Cyprus has been on the rise. In this respect, the production of renewable energy is expected to experience considerable growth in coming years, and significant investment is required in order for Cyprus to achieve its targets – opening the field for companies with expertise in renewables.

The Cyprus Energy Regulatory Authority (CERA) has worked towards the full opening up of the electricity market and granting consumers the right to choose their own supplier – with full liberalisation expected in the first half of 2023.

With respect to the development of the natural gas market in Cyprus, on 13 of December 2019, the tender for the engineering, construction, operation and maintenance of the “LNG Import Terminal” was awarded by ETYFA (DEFA subsidiary) to the joint venture (consortium) China Petroleum Pipeline Engineering, Metron, Hudong-Zhonghua Shipbuilding and Wilhelmsen Ship Management. On 28th September 2020 ETYFA approved the revised work program which is also considered the official start date of the construction works. Due to the Covid-19 restrictions, which had several effects on the project due to an overall global impact on logistics and availability of materials and equipment, as well as the price spike of certain goods, such as steel, the consortium submitted a revised work program which indicates that project works will be completed by end H2 2023.

With respect to the supply of natural gas, on 4 June 2019, through a pre-qualification - Request for Expressions of Interest (RfEoI) process, DEFA invited prospective LNG suppliers to express an interest in supplying LNG to the LNG Import Terminal in order to be added to DEFA's list of pre-qualified LNG suppliers. DEFA intends to procure its LNG requirements through a combination of: (a) medium/ long-term supply via one or more LNG Sales and Purchase Agreements (SPAs); and (b) supplemental cargos via multiple Master Sales Agreements (MSAs) and a bidding process. The deadline for submission of EoI was the 6 September 2019, and 25 companies submitted their interest. This first stage of the above tender procedure was completed successfully in 21 December 2020. DEFA is expected to proceed to the next stage of the process within 2023 with the negotiation and execution of MSAs and with an RfP for the selection of the medium-term contract supplier of LNG.

Also, the first Open Season process for the determination of the allocation of the demand (timely, spatially and quantitatively) of natural gas/LNG by potential buyers within Cyprus (distance of 5km radius from the LNG Import Terminal as per the guidelines set by CERA) was initiated in H1 2022 and is currently ongoing.

The electrical interconnection with Israel and Greece will be the next major challenge in the country energy sector. Cyprus is promoting the «EuroAsia Interconnector» project, aiming at commissioning in 2028. The project will effectively contribute to the security of energy supply and reduction in CO2 emissions by allowing the countries in the region renewable energy sources for electricity generation.

Energy use is the largest source of GHG emissions. The following sections provide a high-level overview of the most relevant factors. Climate policy drivers have had some impact on changes in the national energy system to-date (for-example leading to improvements in energy efficiency or increases in the share of renewables), although to a large extent these have been driven by other factors. Historic trends in GHG emissions from energy-related activities are shown in later sections. However, the impacts of future climate policy in the energy sector are likely to be far more significant, particularly as a result of the new EU Climate and Energy package. These will lead to more sizeable shifts in energy use towards renewables as well as an overall impact on primary and final energy consumption due to improvements in energy efficiency; these effects should become more noticeable within these indicators in coming years.

Total primary energy consumption in Cyprus rose over the period from 1990 despite continued efforts to improve energy efficiency. Trends in the consumption of different energy types within the total have changed significantly since 1990.

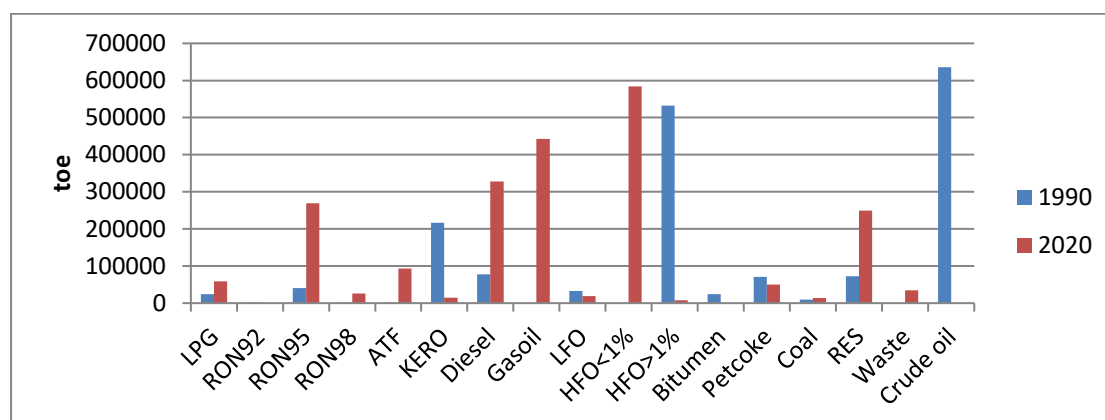


Figure 2.5. Primary energy consumption by fuel for Cyprus, 1990 and 2020

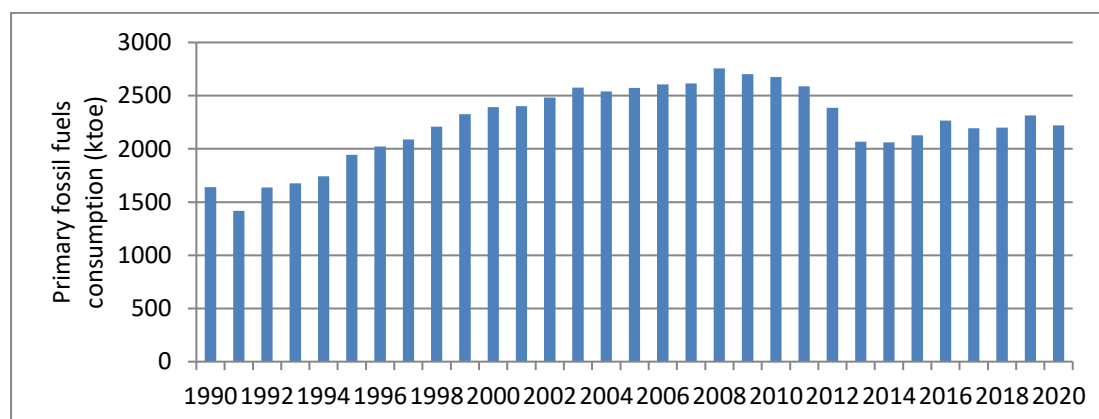


Figure 2.6. Primary consumption of fossil fuels in ktOE, 1990-2020

Renewables have the most marked increase with consumption increased approximately by 10 times from 1990 levels. Fossil fuels continue to dominate total energy consumption and the share of renewable energy sources remains small despite the increase in use. The overall increase in total primary energy consumption has also acted to counteract some of the environmental benefits from fuel switching.

The final energy needs of the economy of Cyprus for 2020 represent 73% of the country’s primary energy consumption. There are very significant energy losses linked to the transformation and distribution of useful energy (e.g. as electricity) to the end users. Energy losses broadly depend on the average efficiency of conventional thermal power stations and CHP plants and the penetration of non-thermal renewables.

2.7.1. Energy Supply

All the oil consumed is from imports and the trend, although cyclical since 1990, has been upwards of 31% in 2020 since 1990. In the case of solid fuels, overall consumption has increased by 85% between 1990 and 2004, due to the thrive of the constructing industry. From 2004 until 2008 the consumption of solid fuel was stable, while after 2008, it decreases substantially to reach 1990s levels, as renewables and alternative fuels are consumed from cement industry.

Although the absolute amount of electricity production from renewables has increased by more than 500 times since 2006 (Figure 2.7), renewable electricity still makes only a 12,6% contribution to total electricity generation in 2020. Overall, the generation mix of electricity in Cyprus has become less carbon intensive since 2008, when the first combined cycle unit for the production of electricity entered in operation and the contribution of renewable sources started to be significant. The increase in total electricity production was 270% from 1990 to 2020.

The share of primary energy met by renewables has increased steadily over time to around 12,4% of total primary energy consumption in 2020. The bulk of renewable energy consumed, about 54 %, comes from solar thermal and biomass. Energy from heat pumps is the next biggest contributor, providing 17% of total renewable energy). Biofuels has seen the biggest increase - from zero 0 in 1990 to contributing around 10% of total renewable energy in 2020.

Based on 2020 figures Cyprus, as all EU countries, has a significant challenge ahead to reach the new Renewable Energy Sources (RES) targets for 2020. The RES targets include all sources of electricity, heat and transport fuel. The RES share in gross final consumption of energy in Cyprus was 16,88% in 2020, exceeding the national mandatory target of 13%.

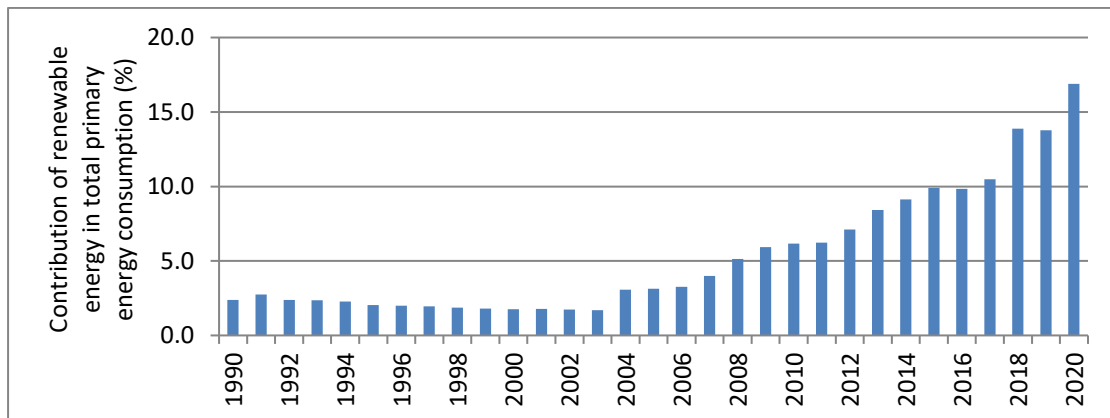


Figure 2.7. Share of renewable energy in total primary energy consumption in per cent, 1990-2020

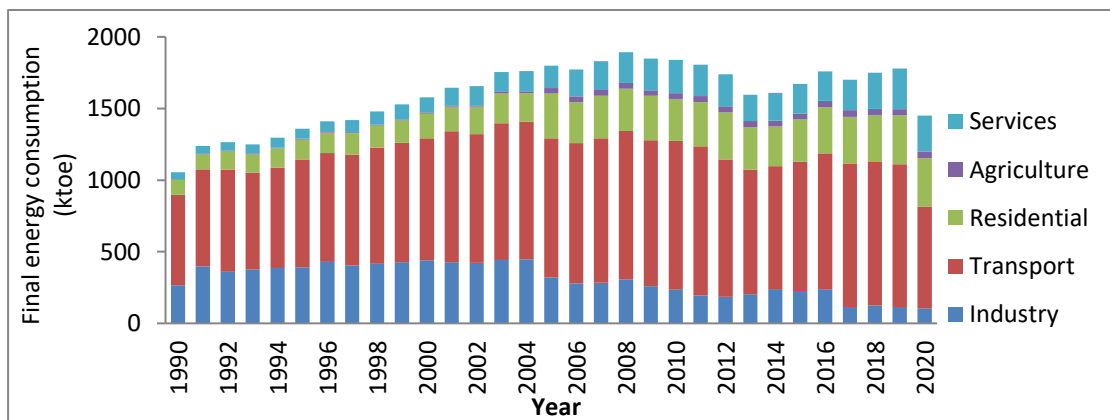


Figure 2.8. Final energy consumption by sector in ktoe, 1990-2020

2.7.2. Energy consumption in different sectors

Final energy consumption in Cyprus increased by about 38% between 1990 and 2020. The electricity sector has seen the biggest increase in overall energy consumption, increasing its consumption by over 300% since 1990. The final consumption of electricity produced from conventional fuels increased by 170% between 1990 and 2020. This is having a significant impact on GHG emissions. The Services sector has also increased its energy consumption markedly, by 358% since 1990, which correlates with an increasing share of GVA coming from this sector. Households are also one of the largest consumers of final energy in the EU. Space heating and cooling are the most significant components of household energy demand, and can vary substantially from year to year depending on climatic conditions. In very recent years, household energy consumption has declined partly as a result of higher fuel prices. Final energy consumption in industry has fallen since 1990, largely as a result of a shift towards less energy-intensive manufacturing industries, as well as the continuing transition to a more service-oriented economy.

2.7.3. Liberalisation of energy markets

As far as the electricity domestic market is concerned the new regulatory regime has been established since 2004 by liberalising 35% of the market. Cyprus has fully transposed Directive (EU) 2019/944 on common rules for the internal market for electricity into its national legislation. The Market Operator is in the process of testing the Market Management System which will allow the full implementation of a three-tiered market, i.e., an over-the-counter forward, a day-ahead and balancing tiered electricity market. At a later stage, an intra-day market will also be introduced. Until then, a transitional arrangement is in effect, which allows the bilateral trading (energy only) between independent producers (45 generation projects) and suppliers (2). At the present, 81.57% of electricity generation and 97.28% of electricity supply belongs to the incumbent.

2.7.4. Energy prices

The graph below shows how the average end-user prices of electricity have varied since 1990 for industry, commerce, households and agriculture in Cyprus.

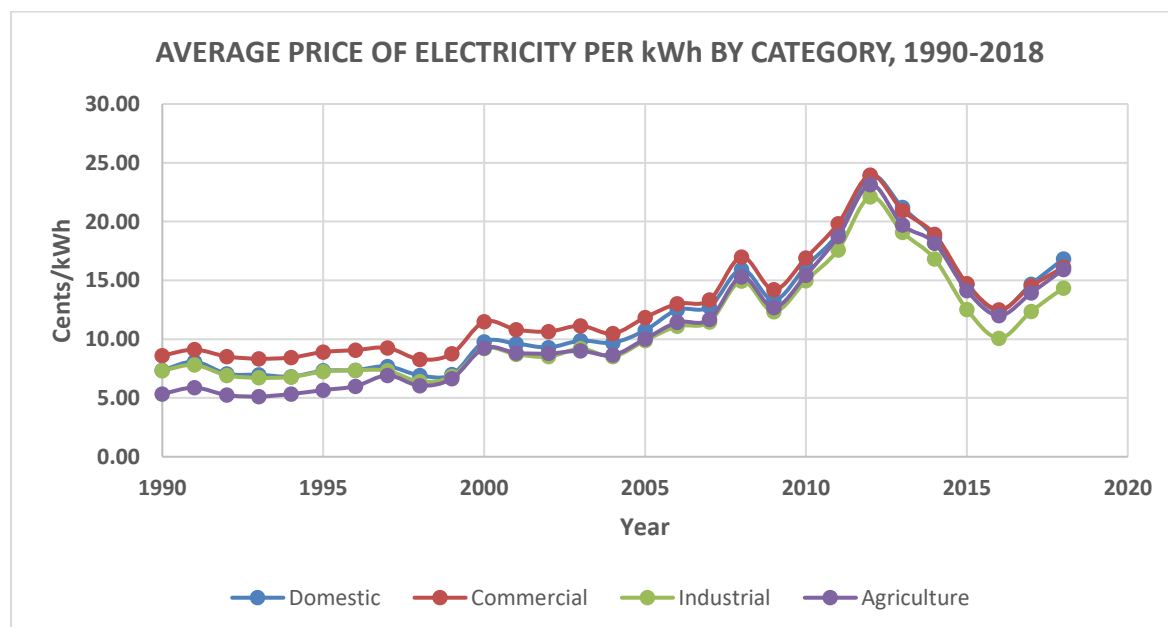


Figure 2.9. Change in average end-user energy prices in Cyprus compared to the gross disposable income for households, commerce, industry and agriculture, 1990-2018

2.8. Transport

Both freight and passenger transport, have continued to grow strongly since 1990 with continued growth in GHG emissions. According to the available information, there is no clear relation between freight or passenger transport with GDP. The transport sector is now the largest consumer of energy in Cyprus after electricity production and the issue of growing greenhouse gas emissions from this sector needs to be addressed.

2.8.1. Transport fleet, Aviation and Shipping

This information for road transport is available in section 4.2.2, and Table 5.1. Emissions for shipping can be found in Annex II, Summary 2 tables. There was an increase of 57.9% of GHG emissions from transport from 1990 to 2020. Please find below more information regarding road transport, aviation and shipping for the historical years, after the NIR.

Aviation

Civil aviation emissions include emissions from international and domestic civil aviation, including take-offs and landings. Civil aviation comprises civil commercial use of airplanes, including scheduled and charter traffic for passengers and freight, air taxiing, and general aviation. To estimate the emissions from aviation, the available information on fuel consumption from EUROCONTROL was used (Table 3.14) for 2005-2021. For the previous years, fuel consumption was obtained from national statistics and the share of domestic vs international was used. Table 2.2 presents an example of fuel consumption for years 2005-2021.

Table 2.2. International and domestic flights' fuel consumptions, EUROCONTROL data (2005-2021)

Fuel consumption (kt)	2005	2006	2007	2008	2009	2010	2011	2012
Domestic	3.958	3.344	2.967	2.823	2.282	2.429	0.739	0.471
International	264.2	266.4	262.4	272.3	257.4	262.6	272.5	263.4
	2013	2014	2015	2016	2017	2018	2019	2020
Domestic	0.305	0.191	0.286	0.179	0.260	0.282	0.119	0.030
International	245.7	246.0	238.1	278.2	316.6	328.9	325.7	103.6
	2021							
Domestic	0.119							
International	176.1							

Road transport

Road transport emissions include all combustion and evaporative emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on paved roads. GHG emissions from road transport for the historical years were estimated using the COPERT 5 software. The COPERT 5 methodology is part of the EMEP/CORINAIR Emission Inventory Guidebook 2016. The Guidebook, developed by the UNECE Task Force on Emissions Inventories and Projections, is intended to support reporting under the UNECE Convention on Long-Range Transboundary Air Pollution and the EU directive on national emission ceilings. Fuel consumption is obtained from national statistics.

The COPERT 5 run estimates the fuel consumption (diesel and gasoline). These values are then compared to statistical fuel sold and the annual mileage values are corrected on the basis of the differences between calculated and statistical fuel consumption. A new COPERT run is performed with the adjusted data and all emissions are calculated.

Biofuels have been first introduced to the national energy mix in late 2007. Biofuel is mixed with diesel to a contribution ranging from 3-6.5%. During the first years (2007-2012), biofuels were solely from oil seeds. Since 2013 however, biodiesel used in Cyprus has an increasing contribution of used cooking oils (8.5% in 2013, 61.3% in 2014, 63.2% in 2015 and 97.1% in 2016). According to the certificates of sustainability criteria which accompanied imported biofuels, all biofuels consumed in Cyprus were from

biomass. The raw material used was cooking oil or oil crops. The emissions from vehicles consuming Biofuels have not been calculated using COPERT 5. They have been calculated with a Tier 1 method after the IPCC guidelines. In the table below there is more information **regarding the fleet**.

Table 2.3. Number of vehicles by type

	1990	2000	2005	2010	2015	2019	2020	2021
Buses	2308	2949	3217	3403	2712	3151	2646	2770
Heavy Duty Trucks	9633	11174	13605	16265	13142	20258	13372	11473
Mopeds & Motorcycles	50953	43315	40381	40272	39282	39375	41676	41189
Light Commercial Vehicles	64644	103436	104711	104437	90673	101481	104576	104119
Passenger Cars	178602	267589	342146	462562	487692	572182	575907	595771

Shipping

Fuel consumption from national statistics is used to calculate the emissions from shipping, without having more precise information on fleet.

2.8.2. Freight transport

Since 2002 (the year for which the first data is available) the demand for freight transport in Cyprus has decreased gradually until 2015, mainly to the changes in the economy of the country after 2008. For the period 2016-2021 the demand for freight transport has increased at a low rate. All the freight transport in Cyprus takes place via road.

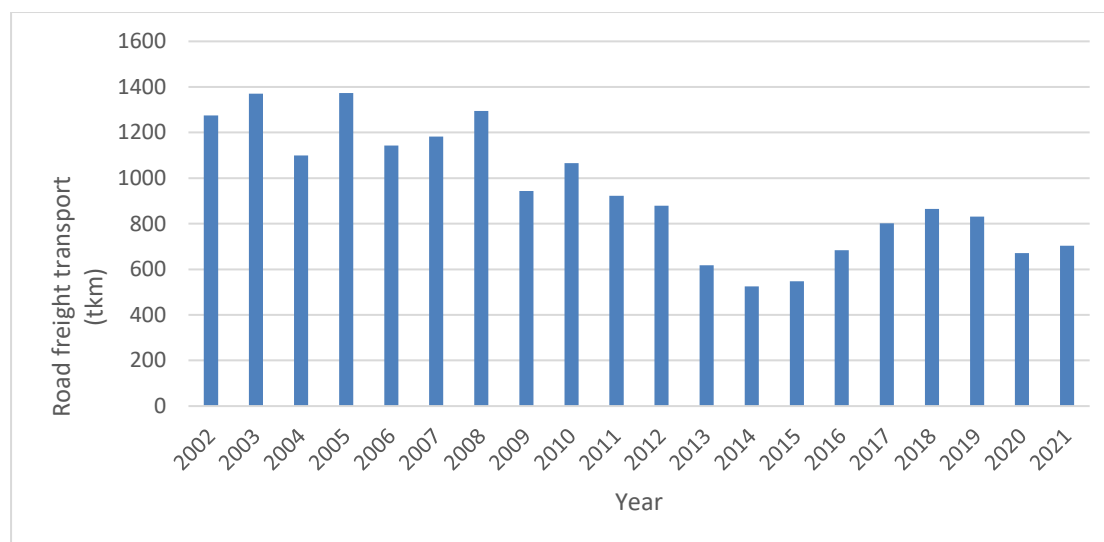


Figure 2.10. Growth in road freight transport 2002- 2021

2.8.3. Passenger transport

Since 1990 the demand for passenger transport in Cyprus has been increasing. It appears that the desired outcome, of a gradual decoupling in passenger transport from GDP, has not yet been observed. Given the continuing upward trend in demand, a reduction in absolute carbon emissions in this sector will need to come primarily via improved vehicle efficiency, modal shift to less energy intensive transport modes, and the shift to less carbon intensive transport fuels (e.g. sustainably produced biofuels or low carbon electricity).

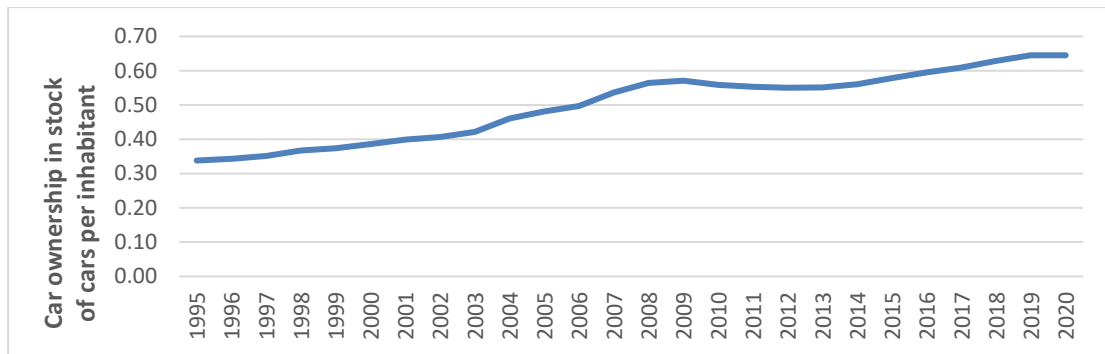


Figure 2.11. Level of car ownership in stock of cars per inhabitant, 1995 -2020

2.8.4. Prices of transport fuels⁹

Overall, the prices for both road transport fuels have increased between 1990 and 2014 due to substantial increases in oil prices and taxes. The tax on petrol increased by 274% (in 1990 €128/1000 litres and 2014 €479/1000 litres) and the tax on diesel increased from zero to €450/1000 litres over the same period. Furthermore, the VAT tax was zero in 1990 and gradually increased to 19% in 2014. Also, comparison of the oil prices of transport fuels occurred between 1990 and 2014 is not possible due to the different quality of the fuels, ex. in 1990 the petrol was Leaded with high sulphur content and today the petrol is unleaded and sulphur free (10 ppm). Rising prices will also help stimulate demand for more efficient vehicles. Road fuels have declined sharply from their peak in 2008 as the price of oil has declined, with (nominal) prices again similar to those in the early 2000s.

GHG emissions are directly affected by price changes. As indicated in Table 3.2, the energy GHG emissions declined considerably from 2011 to 2012 (about 480 ktons CO₂ eq), coinciding with a sharp increase in electricity prices. On the other hand, the lower electricity prices observed in 2016 contributed to an increase by about 395 ktons CO₂ eq between 2015 and 2016. Some more detail is available in CERA's website on a monthly basis¹⁰

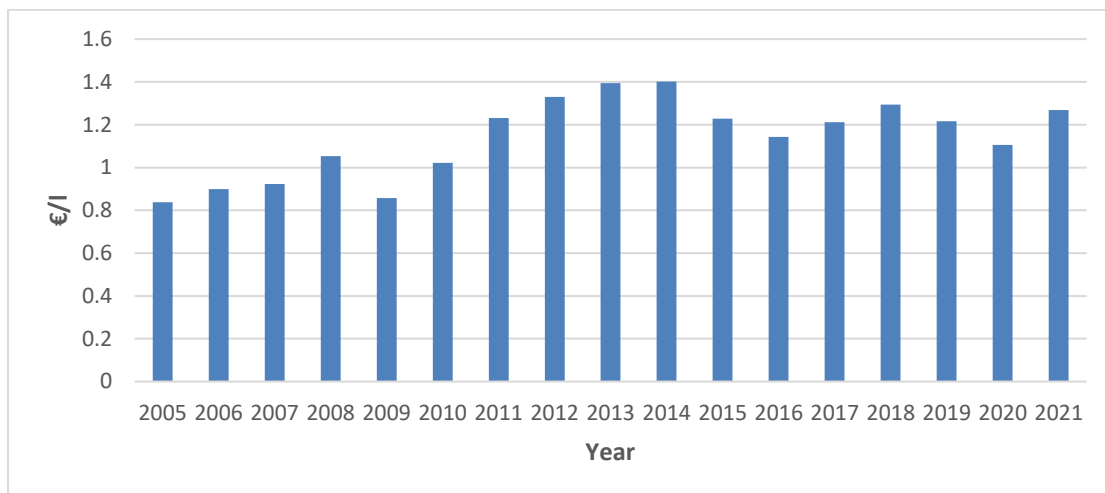


Figure 2.12. Average road transport fuel prices including taxes in €/litre, 2005-2021

⁹ Energy Service, Ministry of Energy, Commerce, Industry and Tourism; 1421 Nicosia; Tel.+357 22 409303; email: energyservice@mcit.gov.cy

¹⁰https://www.cera.org.cy/Templates/00001/data/katanalotes/ilektrismos/Times%20Ilektrismou/ekt_hesi_2023-07.pdf

2.9. Industry

Cyprus, after its independence in 1960, demonstrated a successful economic performance in terms of full employment and economic stability, apart from some isolated events. The underdeveloped rural economy inherited from colonialism was transformed into a modern economy with dynamic services, light industry, a very good agricultural sector and advanced physical and social infrastructure. From being traditionally agricultural, Cyprus embraced industrial development in the 1960s and today specializes in the manufacture of medium and high-technology products and semi-customized small-batch products. Industry grew in a sheltered environment with tariffs and quotas which have been introduced to protect local production.

Major events, that have affected the growth and structure of the economy and specifically of the industrial sector were, the Turkish invasion in 1974, accession to the World Trade Organization (WTO), the Customs Union Agreement with the EU in 1988 and eventual membership to the EU in 2004.

The Protocol for the Customs Union and Accession to the EU provided for the elimination of all restrictions to trade and increased competition in the local market. This had a major impact on the industrial sector which had to face fierce competition both from EU markets and third countries.

1990-2002

In 2002, distribution of Value Added in Manufacturing by Industry, showed Food, beverages and tobacco, as the largest group contributing 38,8% to the manufacturing value added, registered a 1,0% increase in volume of production. This was mainly due to the increase of domestic demand. Following were the subsectors of: Basic Metals and Metal Products, Machinery and Electrical and Optical Equipment and Manufacture of Transport Equipment, Other Non – Metallic Mineral Products, Refined Petroleum Products, Chemicals and Chemical Products and Rubber and Plastic Products, Manufacturing n.e.c, Pulp Paper and Paper Products; Publishing and Printing, Wood and Wood Products, Textiles and Textile Products and Manufacture of Leather and Leather Products. Large increases were recorded in the exports of pharmaceutical products, plastic products, dairy products and perfumes and toilet preparations. Decreases were recorded in the exports of cigarettes, wearing apparel, footwear, electricity distribution and control apparatus, kitchen furniture and jewellery and related articles.

2004-2009

On May 1st 2004, Cyprus, together with nine other countries, formally takes its place alongside the 15 member-states of the European Union. During 2004, the Cyprus economy exhibited an accelerated rate of growth, in contrast to the conditions of subdued growth observed during the previous two years. The gradual improvement of the overall confidence climate, following the accession of Cyprus to the EU, and the improved external environment of Cyprus, which positively affected the external demand for goods and services, constituted the main contributing factors towards this development. The significant increase of the oil price in international markets constituted a restraining factor towards further growth of the Cyprus economy. In summary, the Cyprus economy exhibited conditions of acceleration of economic activity in 2004, mainly due to the strengthening of domestic demand and in particular private consumption demand and investment demand in machinery and transport equipment as well as construction works.

2009-2021

In 2009, the Cypriot economy began to shrink as the economic crisis in Europe and elsewhere began to bite. The industrial sector has been hit the hardest. Local investment was negatively affected by the financial crisis in 2013 where industry found it difficult to secure funding from the local banks.

Cyprus has no heavy industry and the expansion of its light industry is limited by the lack of raw materials and the size of the domestic market. Cyprus is radically restructuring its manufacturing base and actively seeking to attract new high-tech and knowledge-based industries. Main growth industries have been in ICT sector manufacturing parts, instruments and electronics, as well as consumer products such as food and cosmetics. Cyprus' key industrial products are pharmaceuticals, food, beverages, chemicals, mineral products, machinery and equipment. Of these, only pharmaceuticals and non-

metallic minerals have experienced growth in recent years. Today, manufacturing contributes approximately 5% of GDP and accounts for 9% of people in employment.

The majority of manufacturers are small and medium-sized enterprises (SMEs), which employ less than 10 workers. This makes the sector flexible and open to innovation. The government is seeking to improve SMEs' access to finance and overseas markets, and to maximize the commercial potential of local research and development in order to open up untapped areas of productivity.

Within the sphere of competencies and duties of the Ministry of Energy, Commerce and Industry (MECI) in regards to enterprises and manufacturing industry many actions are being implemented, which align with the European Union (EU), United Nations (UN) and United Nations Industrial Development Organization (UNIDO) policies, strategies and goals such as the New Industrial Policy of Cyprus 2019 and grant schemes and financial incentives/aid in different industrial areas.

2.10. Waste

Municipal and Solid Waste Management

The national municipal waste Management Plan of 2015-2021 (MWMP) contained quantitative and qualitative targets and enumerates specific measures and actions to be taken in order for the EU targets to be reached. One of the quantitative targets is that no more than 95,000 tonnes of biodegradable waste to be disposed in landfills (represents the 35% target of the 1999/31/EC directive). Also, the Legal Measures will be focused on the:

- Development of local waste prevention and management schemes
- Mandatory obligation for establishing separate collection systems by local authorities,
- Establishment of extended producer responsibility (EPR) in streams other than packaging waste,
- Establishment of a landfill tax/levy,
- Banning the disposal of certain waste streams from entering into landfills (e.g. green waste, high calorific value waste, etc)

The adaptations of the strategy that are envisaged:

- a) One Sanitary Landfill and one Residual Sanitary Landfill (supplementing MBT unit at Koshi) were constructed and operated (both meet the requirements of directive 99/31/EC). The MBT unit was constructed and operated from 01/04/2010 servicing Larnaca - Ammochostos districts. The Plant was designed in a way that a high separation of recycled and biodegradable material is achieved. Another I.W.M.P (Integrated Waste Management Plant) servicing Limassol district is expected to be operated by the year 2018.
- b) The construction of the Green Point Network (22 collection points for the depositing of various waste streams out of households – bulky waste, green, textile, furniture, weee, etc.) is completed. The 4 Green Points, servicing Paphos district are operated.
- c) Separate collection at source was promoted at households, from the existing collective system for the packing waste servicing also and all types of paper, created under the packaging directive while the competent authority promotes the separate collection from other household streams such as other organic waste eg. food and green waste.
- d) The construction works for the rehabilitation/restoration of the old non approved landfills, which are closed at Paphos and Larnaca - Ammochostos districts, were completed. The preparation of studies/documents regarding the rehabilitation/restoration of the 20 non sanitary landfills of Nicosia district and the 44 sanitary landfills of Limassol district, will be completed within 2018 and after that the construction works will begin.

A comprehensive study was undertaken in 2005 for the elaboration of a Strategic Plan, an Environmental study and a Feasibility study for the restoration and management of landfills. The purpose of the study was to record all landfills, assess their status and level of risk, create a restoration priority list based on pollution risk assessments, undertake the appropriate environmental studies as well as feasibility studies for the restoration of the prioritized landfills. These studies were a necessary step for the restoration of all landfills recorded.

Two (2) landfills are still active in Cyprus but arrangements are made in order to be closed and restored. According to recent data, these two landfills are feeded with approximately 155.000 ton and 200.000 ton of municipality waste each year respectively (reference year 2012).

Sixty-two (62) non sanitary landfills are planned to be restored appropriately within the following years. According to the preliminary study conducted in 2005, these landfills contain approximately 597.269 m³ of solid waste excluding 2 major landfills that have not been closed yet.

Fifty-three (53) landfills have been restored the last five years and are being monitored. During their restoration a total of 4.902.000 m³ of solid waste were reallocated and properly buried using composite liners and leakage collection systems.

The EU landfill directive is fully harmonized in the national legislation but not fully implemented. Cyprus didn't manage to seize of the operation of non-compliant landfills by 2009. Moreover, Cyprus has rehabilitated only 46% of its closed landfills.

In Cyprus, household waste is collected by local authorities or individuals and disposed of in sites of different characteristics. In 2005, five disposal sites were in operation, of which none met the standards for landfills in accordance with the requirements of the relevant EU Directives. The landfills in Nicosia (Kotsiatis) and Limassol (Vati) operated with controlled drop while the other three sites operate under semi-controlled deposition conditions. These sites have been categorised as deep unmanaged for the purposes of inventory preparation. Up until 2010, also in operation were 113 sites of uncontrolled disposal of household and other solid waste. These sites have been categorised as shallow unmanaged.

The situation started changing in 2006 when the first managed waste disposal site started its operation in Pafos. Then the second Integrated Waste Management Plant (IWMP Koshi) started its operation in 2010, serving the districts of Larnaca and Ammochostos. The landfills of Kotsiatis and Vati were closed in February 2019. The IWMP Koshi is serving the district of Nicosia too from 2019. Another IWMP (Pentakomo) started its operation in 2018, serving the district of Limassol.

2.11. Building stock and urban structure

Energy consumption for space heating or cooling within buildings forms a significant component of the country's energy consumption. The level of energy consumption within buildings is primarily affected by: the thermal properties of the building (in terms of insulation, building type – e.g. flat/house); the efficiency of the heating or cooling system; and the stock/efficiency of the appliances used. In general, newer dwellings are likely to be more energy efficient than older buildings. The building sector has one of the highest potentials for improved energy efficiency and measures to reduce the space heating/cooling demand in buildings represent a significant part of this potential. Many of these measures (such as improved insulation) are highly cost-effective, but a number of other barriers to their implementation exist. These are being addressed by a number of the policies related to end-use energy efficiency.

2.11.1. Building Permissions

From the data for the period 1995-2021 (as shown in Figure 2.13), it is noticeable that the maximum number of building permissions issued was in 2006 (9.794) and the minimum in 2014 (4.933). A steep upward trend is recorded during the period 2000-2006, from then on the number of building permissions issued started to decrease, reaching the minimum number recorded in 2014. From 2015, the number of building permissions issued increased slightly.

Looking at the latest data concerning the period January-July 2022, 4521 building permissions were issued, representing an increase of 4% over the corresponding period of the previous year (January - July 2021), where the number of building permissions issued was 4717. Regarding the 4521 building permissions issued, 3089 (68.3%) concerned residential buildings, 712 (15.7%) non-residential buildings, 302 (6.7%) Civil Engineering projects, 314 (6.9%) concerned the division of plots and 104 building permissions (2.3%) were issued for road construction projects.

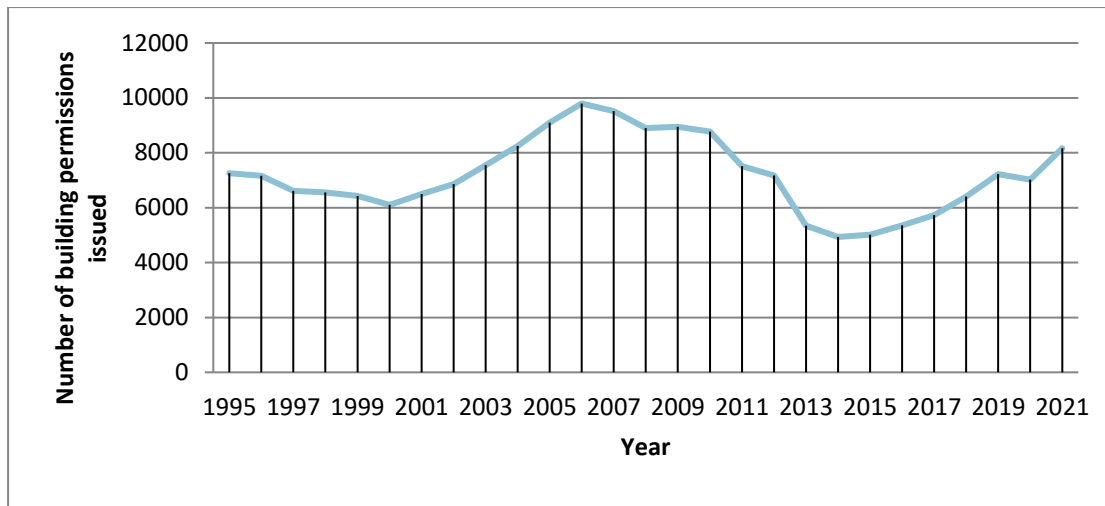


Figure 2.13. Building Permissions Authorised, 1995-2021 (Source: Construction and Housing Statistics 2022, Cyprus Statistical Service)

2.11.2. Dwelling Stock

According to the Cyprus Statistical Service (Source: Construction and Housing Statistics 2022), the dwelling stock at the end of 2020 increased by 1.2% and reached 466000 units as against 460000 in 2019. The following Figure presents the total dwelling stock during the period 1995-2020.

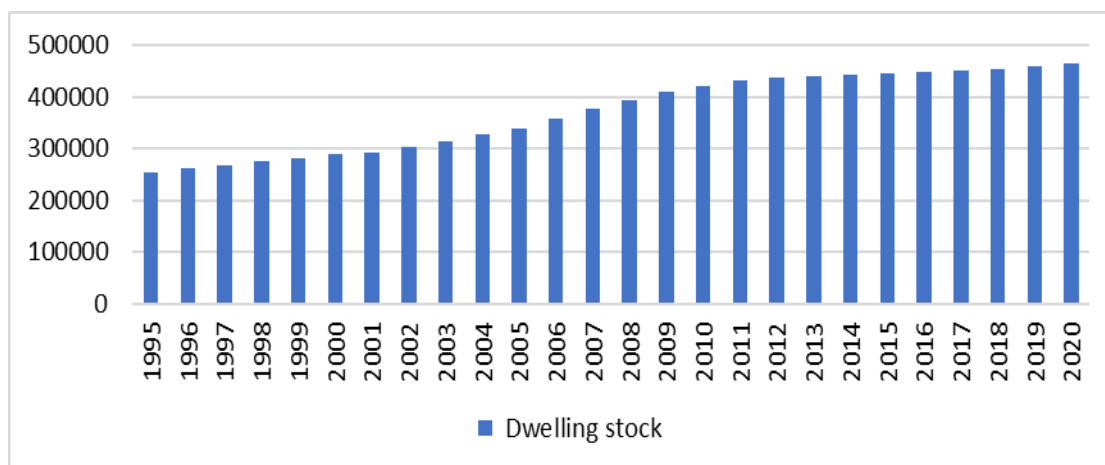


Figure 2.14. Total dwelling stock and occupied living quarters, 1995-2020 (Source: Construction and Housing Statistics 2022, Cyprus Statistical Service)

2.12. Agriculture¹¹

Until 1974, the agricultural sector was considered to be one of the most important sectors of Cyprus' economy. Over the period 1960-1974 the agricultural sector had the largest contribution to Gross Domestic Product, ranging from 16% to 21%, and provided employment to more than 30% of the economically active population. Agricultural production almost doubled in the period 1960-1974 and the added value of the agricultural sector showed an average annual growth rate of about 8%.

¹¹ Mr. George Theophanous, Agriculture Officer, Department of Agriculture, Ministry of Agriculture, Rural Development and Environment; Loukis Akritas Avenue, 1412 Nicosia; Tel: +357 22464028; Fax: +357 22305494; email: gtheophanous@da.moa.gov.cy

Following the Turkish invasion (1974), the agricultural sector suffered severely since the Turkish occupying forces occupied an area that accounted for 46% of total agricultural production and 47% of livestock production. At the same time, the population that was concentrated in the less productive areas of Cyprus was displaced from the occupied areas.

Cyprus' economy, mainly from 2000 until today, is characterised by the growth of the tertiary sector (services) and the shrinking of the other two sectors of the economy (primary and secondary). Indicatively, agriculture accounts for 1.8% of GDP and employs 2.8% of the labor force.

Agricultural income, although it showed increasing trends in the period 2000-2002, with the accession of Cyprus to the EU in 2004 and the implementation of the Common Agricultural Policy (CFP) is decreasing, with the decrease being particularly pronounced in recent years, especially in small which highlights the need to redesign Cyprus' agriculture with emphasis on improving its competitiveness and exploiting its comparative advantages (high quality, early products, etc.).

The competitiveness of the agricultural sector and productivity depend to a large extent on their structural characteristics. The total utilized agricultural land decreased by 24% between 2003 and 2010. In addition, 81% had a size of less than 3 hectares and cultivated 22% of the agricultural land used, while the remaining 19% had a size of more than 3 hectares and cultivated 78% of the agricultural land used. This structural development is mainly the result of a change in the operating environment of the agricultural sector after EU accession, in particular the reduction of protectionism, the abolition of price support, the decoupling of production aid, the simultaneous reduction of prices and subsidies, rising input costs, opening markets and the functioning of the agricultural sector in a highly competitive environment. However, the impact of climate change, and more specifically drought, should not be overlooked.

The agriculture sector has shrunk considerably over the past decades, as well as its contribution to the GDP, combined with the fisheries and forestry sectors. Nevertheless, the importance of agriculture socially and environmentally is great, as can be seen from the amounts allocated annually by the state to support this sector. Indicatively, between 2014 and 2020, the Agricultural Payments Agency made payments of € 243,000,000 (53% from Community funds) whereas all payments made by the Agency to farmers since 2004 amounted over a€ 1 billion.

In addition to the above, the agricultural sector in Cyprus is already experiencing the impact of climate change, which has caused, among other things, the degradation of agricultural land, the reduction of agricultural production, the increase in damage caused by extreme weather events (prolonged droughts, the lack and degradation of water resources).

2.13. Forest

Wild vegetation in Cyprus is classified in two major categories: a) forest and b) Other Wooded Land (OWL, which includes maquis and garrigue), which are either of state or private ownership. These two categories account for 41.7 % (386,190 hectares) of the total land area. The change of forest cover is almost invariable the last 16 years. Analytical data are shown on Table 2.4. (Data taken from FRA 2020-Cyprus Country Report).

The total area of high forests is about 172,700 ha and occupies the 18.68 % of the total area of Cyprus, including the occupied areas in the northern part of the island. An area of about 139,053 ha or 80,46 % of the total State Forest area is situated in the area under the control of the Government whilst the remaining 19,54 % is found in the area of Cyprus beyond the control of the Government. According to the last survey, private forests and other forested State land cover 24,74 % of the total area of Cyprus.

Private forests are small holdings scattered all over Cyprus and are mainly located in distant mountainous and rural areas. However, the practice of private forestry as such, is not existed in Cyprus. The existence of these forests is due to the emigration of people from the mountainous or semi-mountainous to urban areas, the abandonment of agricultural land adjacent to the State forests and the natural expansion of the forest vegetation. The emigration of people resulted in the declination of

grazing, in the reduction of the needs for fuel wood, in the reduction of forest fires on the lands outside State forests and in the transformation of parts of them into forest.

Table 2.4. Wild vegetation in Cyprus

Category of Vegetation	Forests	Other Wooded Land (OWL)	Total
1999			
Area (ha)	171610	213860	385470
%	18.5	23.1	41.7
2005			
Area (ha)	172851	213865	386716
%	18.5	23.1	41.8
2010			
Area (ha)	172841	213285	386126
%	18.7	23.1	41.7
2012			
Area (ha)	172778	213389	386167
%	18.7	23.1	41.7
2015			
Area (ha)	172700	213490	386190
%	18.7	23.1	41.7
2020			
Area (ha)	172530	213570	386100
%	18.7	23.1	41.8

Some of the most typical Annex I habitat types that occur in Cyprus are (* denotes priority habitats):

- A) Mediterranean pine forests with endemic species of Mediterranean pine (habitat type 9540), represented in Cyprus by the Calabrian pine (*Pinus brutia*).
- B) Black pine forest (*Pinus nigra* subsp. *palassiana*) (habitat type 9530 *).
- C) Oriental plane forests (*Platanion orientalis*) (habitat type 92C0)
- D) Olive and carob tree forests (habitat type 9320)
- E) Arboresecent matorral with *Juniperus* spp. (*Juniperus phoenicea*) (habitat type 5210)
- F) *Sarcopoterium spinosum* (Cisto-Micromerietea) (habitat type 5420).

The changes in the land use in the public forests are prohibited by the Forest Laws of 1967, 1987, 1991 and 2012. Changes in the use of the private forests or of the other wooded land may occur. Private forested land which formerly was agricultural land, may reclaim its former use. Another reason of private forest land use change is the building of country houses or ecotourism development.

- State Forest: The Forest Law of 2012, provides for the designation (through Article 10) of any forest or forest land to State Forest for the benefit of the residents of the area or for the protection and management of biodiversity and / or the natural environment in general or covers an area larger of 100 ha. The State Forests are managed under sustainable forest management practices and in the concept of multiple use forests, unless there is a different provision in the Forest Law.

- Private Forest: Any private land covered by forest vegetation in accordance with the definition of forest or forest land in line with the Forest Law of 2012.

The main Management Practices applied in main state Exploitable forests and reforestation strata, are targeted thinning. These are applied following the principles of sustainable forest management providing wood harvested products. As for the stratum of non – exploitable forests a “close to nature” silviculture is applied which mainly aims to a sustainable conservation of the forest stands. The main management practice applied is a conservative single selection system.

The main disturbances of Cyprus forests are forest fires which occur annually. The burnt area varies on an annual basis according to different parameters.

3. Greenhouse gas inventory information

3.1. Introduction

This chapter provides the key points about the Cyprus' GHG inventory.

Under the Kyoto Protocol, for its second commitment period, the EU, its Member States and Iceland have agreed to fulfil their quantified emission limitation and reduction commitments jointly. The Union, its Member States and Iceland agreed to a quantified emission reduction commitment that limits their average annual emissions of greenhouse gases during the second commitment period to 80 % of the sum of their base year emissions, which is reflected in the Doha Amendment¹².

The EU's current NDC goal submitted in December 2020 within the framework of the Paris Agreement, is to reduce emissions by at least 55% below 1990 levels by 2030 (including LULUCF). Moreover, the European Council (heads of state or government of the EU Member States, the European Council President and the President of the European Commission) endorsed the objective of achieving a climate-neutral EU by 2050, in line with the Paris Agreement.

The GHG data presented in this chapter are consistent with the 2023 submission of Cyprus under Art. 26 of Regulation (EU) No 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action and to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), under the Convention and the Kyoto Protocol (April 2023 submission)¹³.

The legal basis for the compilation of the Cyprus' inventory is the Council of Ministers' Decision adopted 15/11/2017 entitled "Structure and operation of the National Greenhouse Gases Inventory System-Roles and Responsibilities".

Summary tables of GHG emissions for Cyprus in the common reporting format are presented in [Annex II](#) for the whole of the reporting period of the NIR2022 (1990-2020) as this was submitted to the UNFCCC secretariat after the review¹⁴.

Information related to the geographical scope

On July 20 1974, the Turkish armed forces staged a full-scale invasion against Cyprus. Turkey proceeded to occupy the northern part of the island and empty it from its Greek inhabitants. By the end of the following year, the majority of the Turkish Cypriots living in the areas left under the control of the Republic of Cyprus had also made their way to the part of Cyprus occupied by the Turkish army.

On November 15 1983 the Turkish Cypriot leadership unilaterally declared that area an independent state, by the name of "Turkish Republic of Northern Cyprus". Despite the fact that this act has been condemned by the UN and that no country other than Turkey has recognised this illegal secessionist entity, the situation continues.

For further information please refer to the website of the Ministry of Foreign Affairs of the Republic of Cyprus¹⁵.

¹² See https://ec.europa.eu/clima/policies/strategies/progress/kyoto_2_en

¹³ Available at

<http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/21395032E3B9BB6CC2257FF003813DD?OpenDocument>

¹⁴ NIR 5 April 2022, CRF 9 Sep 2022, available at <https://unfccc.int/ghg-inventories-annex-i-parties/2022>

¹⁵ http://www.mfa.gov.cy/mfa/mfa2016.nsf/mfa08_en/mfa08_en?OpenDocument

That area is not under the effective control of the Republic of Cyprus. Therefore, no data from official sources are available for the activities taking place in the particular areas, thus no emissions can be estimated for any activities.

This inventory estimates emissions only for areas under the effective control of the Republic of Cyprus.

3.2. Descriptive Summary of GHG Emissions Trends

GHG emissions in 2021 were 8504 Gg CO₂ eq. including LULUCF. Total national emissions including LULUCF increased by 54.8% between 1990 and 2021 and increased by 1.88% between 2020 and 2021. The total GHG emissions trends for the period 1990–2021 are presented in Table 3.1 and Figure 3.1 in kt CO₂ eq.

Table 3.1. Total GHG emissions trend for the period 1990–2021

Total emissions (Gg CO ₂ eq.)	1990	2000	2005	2010	2015	2020	2021
With LULUCF	5494.38	8244.14	9075.21	9268.28	8111.60	8276.15	8503.64
Without LULUCF	5647.45	8386.64	9296.03	9533.32	8407.71	8574.70	8738.96

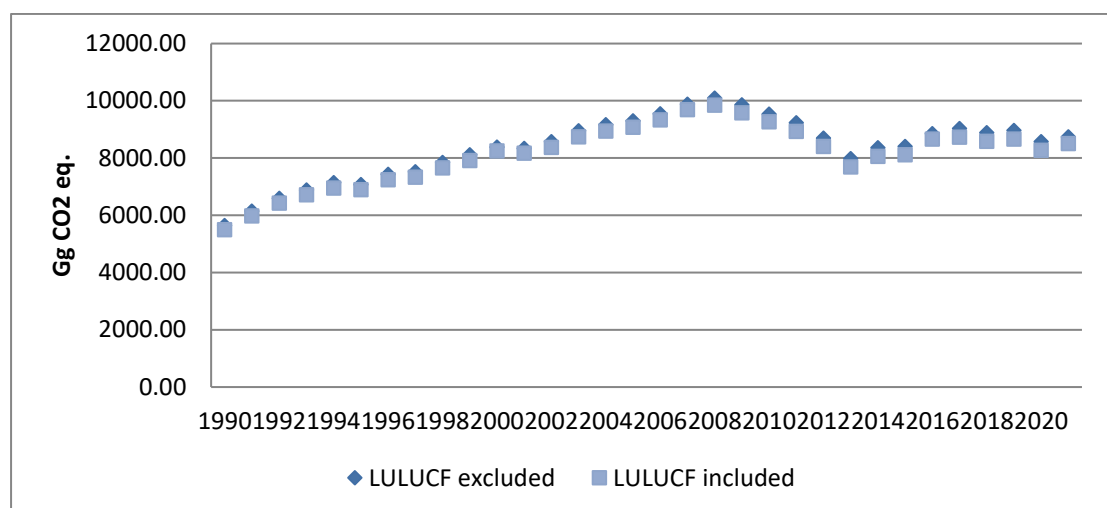


Figure 3.1. Total GHG emissions trend for the period 1990–2021

3.2.2. Emission trends by gas

Table 3.2 provides an overview on the main trends in Cyprus GHG emissions and removals for 1990–2021 by gas. The most important GHG is CO₂, accounting for 80.4 % of total emissions in 2021. In 2021, CO₂ emissions including LULUCF were 6 785 Gg, which was 51.05 % above 1990 levels. CH₄ and N₂O emissions account for 12.56 % and 2.773 % of total GHG emissions respectively in 2021; both gases show increasing trends. As a group of gases, fluorinated gases (HFCs and SF₆) are increasing and account for the remaining 4.2 % of total GHG emissions.

Table 3.2. Cyprus' GHG emissions 1990 to 2021.

	1990	1991	1992	1993	1994
CO ₂ emissions without LULUCF	4644.86	5133.21	5505.66	5749.30	5991.49
CO ₂ emissions with LULUCF	4491.73	4966.05	5332.92	5574.06	5807.09
CH ₄ emissions without LULUCF	775.92	790.92	815.74	846.59	860.86
CH ₄ emissions with LULUCF	775.95	791.02	815.77	846.84	861.52
N ₂ O emissions without LULUCF	223.94	224.27	248.79	264.38	256.49
N ₂ O emissions with LULUCF	223.97	224.35	248.84	264.56	256.89
HFCs	NO,NE	NO,NE	23.04	24.62	26.27
PFCs	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	2.73	3.37	4.01	4.65	5.29
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	5647.45	6151.77	6597.23	6889.54	7140.40
Total (with LULUCF)	5494.38	5984.78	6424.58	6714.73	6957.05
Total (without LULUCF, with indirect)	5652.66	6156.29	6601.97	6894.26	7145.56
Total (with LULUCF, with indirect)	5499.59	5989.31	6429.32	6719.46	6962.21
	1995	1996	1997	1998	1999
CO ₂ emissions without LULUCF	5861.93	6211.89	6298.29	6592.49	6858.75
CO ₂ emissions with LULUCF	5681.44	6025.80	6113.05	6398.72	6660.23
CH ₄ emissions without LULUCF	887.08	908.94	914.49	917.06	919.20
CH ₄ emissions with LULUCF	887.33	909.37	915.10	919.14	919.21
N ₂ O emissions without LULUCF	291.14	268.11	259.59	279.65	272.46
N ₂ O emissions with LULUCF	291.34	268.42	260.00	280.84	272.58
HFCs	28.49	33.60	38.65	47.38	54.29
PFCs	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	5.93	6.57	7.21	7.85	8.49
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	7074.57	7429.10	7518.22	7844.42	8113.19
Total (with LULUCF)	6894.54	7243.74	7334.01	7653.93	7914.81
Total (without LULUCF, with indirect)	7080.44	7435.08	7524.14	7850.22	8120.83
Total (with LULUCF, with indirect)	6900.41	7249.72	7339.92	7659.73	7922.45
	2000	2001	2002	2003	2004
CO ₂ emissions without LULUCF	7104.60	6978.50	7169.43	7559.65	7788.73
CO ₂ emissions with LULUCF	6955.15	6807.34	6967.01	7344.78	7572.91
CH ₄ emissions without LULUCF	938.03	975.60	1003.35	993.17	984.63
CH ₄ emissions with LULUCF	942.50	977.11	1003.39	993.36	985.00
N ₂ O emissions without LULUCF	272.45	304.11	307.46	303.60	268.83
N ₂ O emissions with LULUCF	274.92	305.17	307.90	304.25	269.73
HFCs	62.44	70.91	80.28	92.00	107.15
PFCs	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	9.13	9.80	10.45	11.11	11.76
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	8386.64	8338.92	8570.97	8959.52	9161.11

Total (with LULUCF)	8244.14	8170.32	8369.04	8745.50	8946.56
Total (without LULUCF, with indirect)	8394.25	8346.07	8580.19	8970.59	9174.75
Total (with LULUCF, with indirect)	8251.74	8177.47	8378.25	8756.58	8960.20
	2005	2006	2007	2008	2009
CO ₂ emissions without LULUCF	7957.32	8185.01	8503.49	8715.73	8470.19
CO ₂ emissions with LULUCF	7735.46	7961.05	8314.89	8464.66	8191.16
CH ₄ emissions without LULUCF	959.77	962.36	964.48	962.22	964.50
CH ₄ emissions with LULUCF	959.90	962.68	967.56	962.33	964.69
N ₂ O emissions without LULUCF	244.73	255.60	246.03	232.95	230.11
N ₂ O emissions with LULUCF	245.63	256.75	248.67	234.07	231.30
HFCs	121.80	137.79	153.17	172.12	182.72
PFCs	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	12.42	11.47	11.78	12.09	12.39
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	9296.03	9552.22	9878.95	10095.11	9859.92
Total (with LULUCF)	9075.21	9329.74	9696.06	9845.27	9582.27
Total (without LULUCF, with indirect)	9312.15	9569.91	9897.11	10110.73	9873.55
Total (with LULUCF, with indirect)	9091.32	9347.42	9714.22	9860.89	9595.89
	2010	2011	2012	2013	2014
CO ₂ emissions without LULUCF	8101.12	7787.64	7262.77	6582.61	6950.80
CO ₂ emissions with LULUCF	7833.85	7484.77	6966.92	6283.78	6650.10
CH ₄ emissions without LULUCF	973.63	973.15	963.02	948.31	949.30
CH ₄ emissions with LULUCF	974.35	973.76	963.71	948.55	949.56
N ₂ O emissions without LULUCF	246.88	237.90	234.63	212.25	207.64
N ₂ O emissions with LULUCF	248.39	239.37	236.17	213.56	208.96
HFCs	198.99	216.37	221.17	225.67	233.18
PFCs	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	12.70	14.36	14.97	15.58	16.18
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	9533.32	9229.42	8696.56	7984.42	8357.10
Total (with LULUCF)	9268.28	8928.64	8402.94	7687.13	8057.99
Total (without LULUCF, with indirect)	9546.45	9234.30	8701.22	7988.10	8360.45
Total (with LULUCF, with indirect)	9281.42	8933.52	8407.60	7690.81	8061.34
	2015	2016	2017	2018	2019
CO ₂ emissions without LULUCF	6971.58	7373.67	7503.81	7321.72	7342.34
CO ₂ emissions with LULUCF	6674.14	7169.50	7195.21	7017.47	7043.58
CH ₄ emissions without LULUCF	956.93	980.32	999.01	1013.20	1034.01
CH ₄ emissions with LULUCF	957.02	988.27	999.26	1013.69	1034.36
N ₂ O emissions without LULUCF	215.76	221.28	228.39	230.16	237.57
N ₂ O emissions with LULUCF	216.99	226.62	229.71	231.60	238.93
HFCs	246.65	267.02	287.91	308.05	332.27
PFCs	NO	NO	NO	NO	NO

Unspecified mix of HFCs and PFCs	NO	NO	NO	NO	NO
SF ₆	16.79	15.61	15.80	16.89	15.44
NF ₃	NO	NO	NO	NO	NO
Total (without LULUCF)	8407.71	8857.90	9034.93	8890.02	8961.62
Total (with LULUCF)	8111.60	8667.01	8727.90	8587.71	8664.58
Total (without LULUCF, with indirect)	8411.51	8861.83	9040.19	8895.07	8966.59
Total (with LULUCF, with indirect)	8115.41	8670.94	8733.16	8592.76	8669.55
			Change from 1990 to 2021 (%)		
	2020	2021			
CO ₂ emissions without LULUCF	6910.91	7029.36	51.34		
CO ₂ emissions with LULUCF	6610.54	6784.63	51.05		
CH ₄ emissions without LULUCF	1064.76	1097.41	41.43		
CH ₄ emissions with LULUCF	1065.19	1102.89	42.13		
N ₂ O emissions without LULUCF	244.60	242.47	8.27		
N ₂ O emissions with LULUCF	246.01	246.39	10.01		
HFCs	335.68	353.49	100.00		
PFCs	NO	NO	0.00		
Unspecified mix of HFCs and PFCs	NO	NO	0.00		
SF ₆	18.74	16.24	494.70		
NF ₃	NO	NO	0.00		
Total (without LULUCF)	8574.70	8738.96	54.74		
Total (with LULUCF)	8276.15	8503.64	54.77		
Total (without LULUCF, with indirect)	8579.86	8744.18	54.69		
Total (with LULUCF, with indirect)	8281.31	8508.85	54.72		

3.2.3. Trends in emissions by main source and sink categories

Table 3.3 provides an overview of Cyprus' GHG emissions in the main source categories for 1990 to 2021. Emissions from international aviation and shipping are excluded from national totals and are presented in the table as memo items. Energy, with 6172.4 Gg CO₂ eq., continues to be the largest contributor to the total national GHG emissions (70.6% compared to the total without LULUCF). 3088 Gg CO₂ eq. of these emissions is from the production of electricity, while another 2051 Gg CO₂ eq. is from transport.

Table 3.3. Cyprus' GHG emissions 1990 to 2021 by sector excluding indirect emissions.

	Energy	IPPU	Agriculture	LULUCF	Waste	Total (excl. LULUCF)	Total (incl. LULUCF)
1990	3954.35	727.93	529.99	-153.07	435.18	5494.38	5647.45
1991	4486.96	687.86	536.24	-166.98	440.71	5984.78	6151.77
1992	4811.43	762.12	574.61	-172.65	449.08	6424.58	6597.23
1993	4988.10	833.50	608.14	-174.80	459.80	6714.73	6889.54
1994	5200.67	870.23	596.77	-183.35	472.74	6957.05	7140.40
1995	5107.25	839.73	646.20	-180.03	481.39	6894.54	7074.57
1996	5402.12	904.15	635.20	-185.36	487.64	7243.74	7429.10
1997	5525.00	876.09	620.06	-184.22	497.08	7334.01	7518.22
1998	5866.52	840.75	632.64	-190.49	504.51	7653.93	7844.42
1999	6130.96	853.74	615.42	-198.38	513.07	7914.81	8113.19

	Energy	IPPU	Agriculture	LULUCF	Waste	Total (excl. LULUCF)	Total (incl. LULUCF)
2000	6357.63	883.08	622.69	-142.51	523.24	8244.14	8386.64
2001	6252.10	876.25	676.97	-168.60	533.60	8170.32	8338.92
2002	6412.02	919.23	698.19	-201.94	541.54	8369.04	8570.97
2003	6803.06	934.15	677.63	-214.02	544.68	8745.50	8959.52
2004	6942.20	1014.67	655.71	-214.55	548.53	8946.56	9161.11
2005	7136.65	1003.14	598.68	-220.83	557.57	9075.21	9296.03
2006	7321.74	1060.19	612.44	-222.49	557.86	9329.74	9552.22
2007	7642.68	1071.98	604.37	-182.89	559.92	9696.06	9878.95
2008	7853.41	1094.04	577.40	-249.84	570.25	9845.27	10095.11
2009	7781.63	930.88	570.03	-277.65	577.38	9582.27	9859.92
2010	7546.70	810.82	591.88	-265.04	583.92	9268.28	9533.32
2011	7250.42	811.86	577.44	-300.78	589.71	8928.64	9229.42
2012	6769.05	772.54	555.21	-293.62	599.76	8402.94	8696.56
2013	5847.05	1014.55	513.01	-297.29	609.81	7687.13	7984.42
2014	5994.43	1243.21	499.08	-299.11	620.38	8057.99	8357.10
2015	6117.23	1159.72	505.95	-296.11	624.81	8111.60	8407.71
2016	6512.90	1187.42	529.82	-190.89	627.76	8667.01	8857.90
2017	6604.17	1250.85	544.67	-307.03	635.25	8727.90	9034.93
2018	6493.46	1201.49	550.14	-302.31	644.93	8587.71	8890.02
2019	6566.71	1173.02	565.46	-297.04	656.42	8664.58	8961.62
2020	6047.95	1267.49	603.16	-298.54	656.09	8276.15	8574.70
2021	6172.40	1277.81	626.20	-235.33	662.56	8503.64	8738.96
Change 1990–2021	56.09	75.54	18.15	53.74	52.25	54.77	54.74

3.2.3.1 Energy sector

The energy sector in Cyprus relies on fossil fuel combustion to meet the bulk of energy requirements. Final consumption in 2021 amounted to approximately 81 PJ, with 95.8% of the consumption coming from liquid fuels, 1.3% from solid fuels and 5.2% from biomass. In comparison with 1990, total fuel consumption in 2021 (including biomass) increased by 48%.

The emissions from the energy sector in Cyprus increased by 56.09% during the period 1990–2021. The greatest increase in emissions was between 1990 and 2008 (97%), when the emissions reached their peak (7853 Gg CO₂ eq.). All the emissions in 2021 are from fuel combustion. The contribution of the emissions from the energy sector to the total without LULUCF in 2021 was 70.6% compared to 74.0% in 1990. The main reasons for the increasing emissions since 1990 are increase of electricity demand due to improvement of living conditions, to increase of population (by 34.6%) and increase of number of privately owned vehicles.

While energy is mainly responsible for carbon dioxide emissions, it also contributes to methane and nitrous oxide emissions. The contribution of each source and gas to the total emissions of the energy sector over the period 1990 to 2021 are presented in Table 3.4 and Figure 3.2.

Table 3.4. Emissions from the energy sector 1990–2021

Gg CO ₂ eq.	1990	2000	2005	2010	2015	2020	2021
1. Energy	3954	6358	7137	7547	6117	6060	6172
A. Fuel combustion (sectoral approach)	3954	6357	7137	7547	6117	6060	6172
1. Energy industries	1767	2964	3483	3880	3033	3033	3088
2. Manufacturing industries and construction	505	802	912	700	604	574	531
3. Transport	1237	1838	2112	2375	1923	1916	2051
4. Other sectors	434	731	610	571	532	511	480
5. Other	11	22	19	21	25	27	23
B. Fugitive emissions from fuels	0	1	NO	NO	NO	NO	NO
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO
2. Oil and natural gas and other emissions from energy production	0	1	NO	NO	NO	NO	NO
C. CO ₂ transport and storage	NO	NO	NO	NO	NO	NO	NO
CO ₂	3921	6297	7092	7507	6081	6016	6127
CH ₄	0.5	0.6	0.6	0.6	0.6	0.7	0.7
N ₂ O	0.1	0.2	0.1	0.1	0.1	0.1	0.1

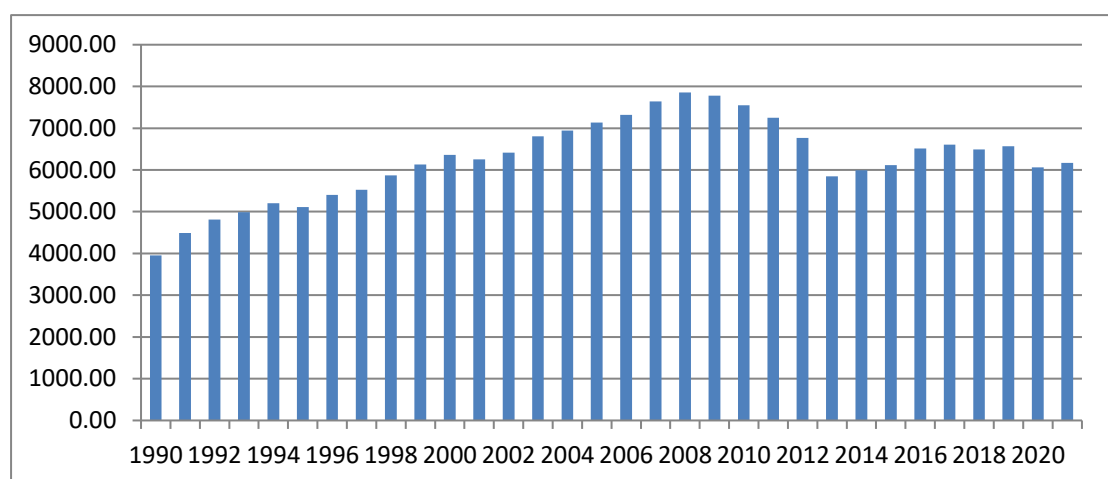


Figure 3.2. Emissions from the energy sector 1990–2021

3.2.3.2 Industrial processes and product use (IPPU) sector

The industrial processes and product use sector is the second largest source of emissions, and contributed 14.6% of total GHG emissions in 2021, compared to 12.9% in 1990. The emissions increased by 75.9% compared to 1990, primarily due to the increase of product uses as ODS substitutes. In 2021, 70% of the IPPU emissions were from mineral production, 27.8% from consumption of Halocarbons, 1.7% from Other Product Manufacture and Use and the remaining 0.4% from non-energy products from fuels and solvent use. The total GHG emissions (in Gg CO₂ eq.) from IPPU sector are presented in Table 3.5 and Figure 3.3 below.

Table 3.5. Total GHG emissions (in Gg CO₂ eq) from Industrial Processes, 1990–2021

	1990	2000	2005	2010	2015	2020	2021
2. Industrial Processes	727.93	883.08	1003.14	810.82	1159.98	1269.41	1277.81
A. Mineral industry	717.07	802.75	860.47	589.98	888.12	902.15	896.99

B. Chemical industry	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.19	4.10	3.46	3.53	2.47	4.92	5.03
E. Electronic industry	NO	NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes	NO,NE	62.44	121.80	198.99	246.92	337.60	353.49
G. Other product manufacture and use	6.66	13.80	17.40	18.32	22.47	24.74	22.30
H. Other	NO	NO	NO	NO	NO	NO	NO

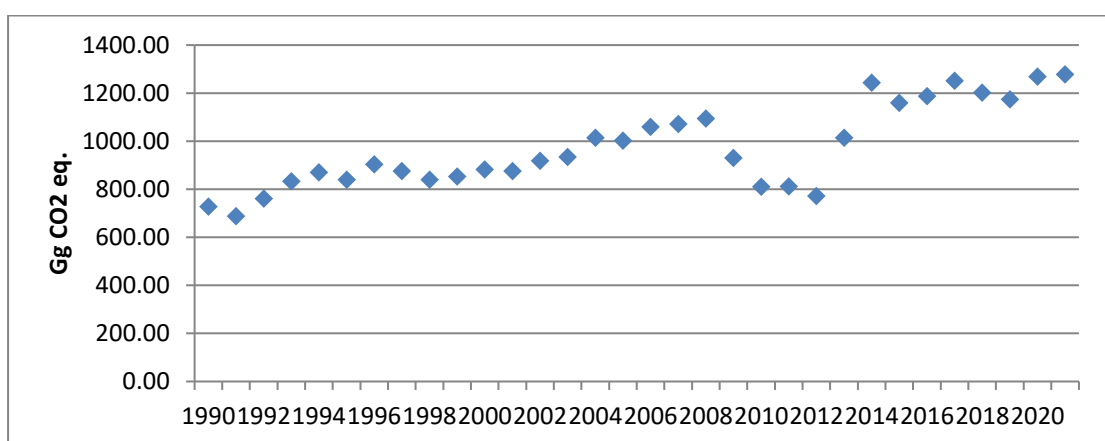


Figure 3.3. Emissions from the IPPU sector 1990–2021

3.2.3.3 Agriculture sector

The agriculture sector is the third largest source of emissions in Cyprus, and contributed 7.4% to total emissions in 2021, compared to 9.6% in 1990. Emissions increased by 18.5% compared to 1990, reflecting increasing animal population, reduction in fertilisers' use and improvement in waste management practices. Agriculture is responsible for mainly methane and nitrous oxide emissions. In 2021 agriculture contributed 39.8% to the total methane emissions and 78% to the total nitrous oxide emissions. The total emissions by gas and source from agricultural activities for the period 1990–2021 in Cyprus are presented in Table 3.6 and Figure 3.4.

Table 3.6. GHG emissions from Agriculture, for the period 1990–2021

Gg CO ₂ eq.	1990	2000	2005	2010	2015	2020	2021
3. Agriculture	529.99	622.69	598.68	591.88	505.95	603.16	626.20
A. Enteric fermentation	220.61	251.11	255.88	263.63	251.32	329.61	352.15
B. Manure management	171.99	230.83	211.78	192.95	139.78	148.55	153.77
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	133.28	138.30	129.27	133.93	113.57	124.16	119.35
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	2.30	0.78	0.78	0.63	0.89	0.62	0.64
G. Liming	NO	NO	NO	NO	NO	NO	NO
H. Urea application	1.82	1.67	0.97	0.74	0.40	0.22	0.30
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO

J. Other	NO	NO	NO	NO	NO	NO	NO
CO ₂ (Gg)	1.82	1.67	0.97	0.74	0.40	0.22	0.30
CH ₄ (Gg)	12.01	14.68	14.23	13.86	11.89	14.64	15.60
N ₂ O (Gg)	0.72	0.79	0.75	0.77	0.65	0.73	0.71
Total (Gg CO₂ eq.)	529.99	622.69	598.68	591.88	505.95	603.16	626.2

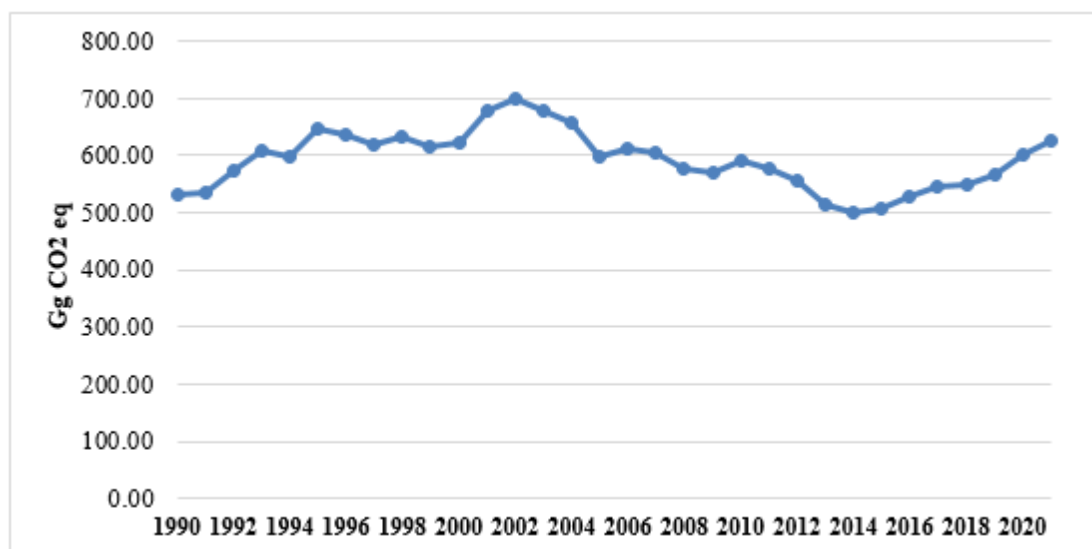


Figure 3.4. Emissions from Agriculture sector, 1990–2021

3.2.3.4 Waste sector

Emissions from the Waste sector in 2021 contributed 7.6% of the total emissions, 58.3% to the total methane emissions of the country and 9.3% to the total N₂O emissions. In 2021, 86.3% of the waste sector emissions are from solid waste disposal, 3.2% from biological treatment of solid waste and 10.4% from waste water treatment and discharge. Total GHG emissions from this sector increased by 52.2 % from 435 Gg CO₂ eq. in 1990 to 663 Gg CO₂ eq. in 2021. Key factors causing this increase is increasing solid waste production per capita which is partly counterbalanced by the improvement of solid waste domestic wastewater management and the increase of population. The total GHG emissions (in Gg CO₂ eq.) from IPPU sector are presented in Table 3.7 and Figure 3.5 below.

Table 3.7. Total GHG emissions (in Gg CO₂ eq) from Waste sector, 1990–2021

Gg CO ₂ eq.	1990	2000	2005	2010	2015	2020	2021
Total waste	435.18	523.24	557.57	583.92	624.81	656.09	662.56
A. Solid waste disposal	295.37	369.73	420.35	482.17	534.39	567.87	572.11
B. Biological treatment of solid waste	NO	NO	NO	4.71	12.65	19.48	21.35
C. Incineration and open burning of waste	NO	NO	NO	NO	NO	NO	NO
D. Wastewater treatment and discharge	139.82	153.51	137.22	97.04	74.05	68.74	69.10
E. Other	NO	NO	NO	NO	NO	NO	NO
CH ₄ (Gg)	15.19	18.25	19.48	20.30	21.66	22.66	22.86
N ₂ O (Gg)	0.04	0.05	0.05	0.06	0.07	0.08	0.08
Total (Gg CO₂ eq.)	435.18	523.24	557.57	583.92	624.81	656.09	662.56

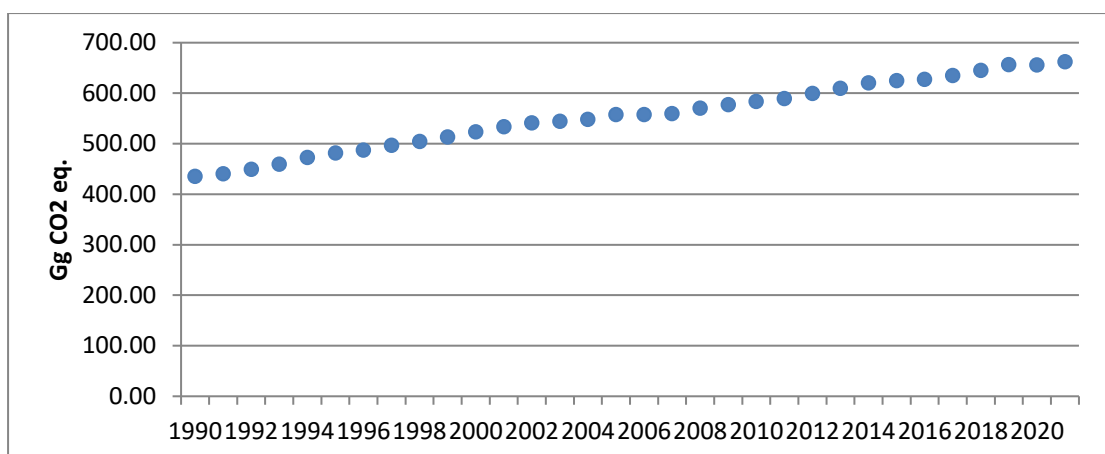


Figure 3.5. GHG emissions from waste for the period 1990–2021

3.2.3.5 LULUCF

The total LULUCF sector represents a GHG sink during the entire period 1990–2021. While the sink generally follows an upward trend, in years of exceptional extent of forest fires (2000, 2007, 2016 and 2021) the trend is visibly broken (see Figure 3.6). Overall, the sink in the total LULUCF increases from -153.1 kt CO₂ eq in 1990 to -235.3 kt CO₂ eq in 2021, representing an increase in net removals of 53.7%. The key driver for the increase in net removals is the prohibition of logging. Environmental policies have also resulted in less intensive agricultural practices and an increase in forest and woodland conservation areas for the purpose of preserving biodiversity and landscapes. The emissions and removals from the LULUCF sector by main land-use category for the whole inventory period are presented in Table 3.8 and Figure 3.6.

Table 3.8. Emissions and removals (+/-) from LULUCF categories (kt CO₂ eq)

Year	Total	FL	CL	GL	WL	SL	OL	HWP
1990	-153.07	1.51	-134.23	-23.05	NO,NE	0.46	0.11	2.14
1991	-166.98	-18.24	-134.77	-23.53	NO,NE	0.45	0.14	8.97
1992	-172.65	-23.54	-135.31	-24.01	NO,NE	0.43	0.17	9.60
1993	-174.80	-11.81	-135.85	-24.49	NO,NE	0.41	0.21	-3.28
1994	-183.35	-23.10	-136.39	-24.96	NO,NE	0.39	0.24	0.46
1995	-180.03	-18.77	-136.93	-25.44	NO,NE	0.37	0.27	0.45
1996	-185.36	-22.26	-137.47	-25.92	NO,NE	0.36	0.30	-0.38
1997	-184.22	-29.88	-138.01	-26.40	NO,NE	0.34	0.33	9.38
1998	-190.49	-27.93	-138.55	-26.87	NO,NE	0.32	0.37	2.15
1999	-198.38	-33.17	-139.08	-27.35	NO,NE	0.30	0.40	0.51
2000	-142.51	9.92	-139.62	-27.83	NO,NE	0.28	0.43	14.30
2001	-168.60	-46.21	-139.61	-28.81	NO,NE	23.09	0.35	22.54
2002	-201.94	-81.47	-139.54	-28.75	NO,NE	23.54	0.35	23.86
2003	-214.02	-94.33	-139.47	-28.69	NO,NE	23.99	0.35	24.02
2004	-214.55	-95.72	-139.40	-28.63	NO,NE	24.44	0.35	24.29
2005	-220.83	-102.58	-139.34	-28.57	NO,NE	24.89	0.35	24.27
2006	-222.49	-103.97	-139.27	-28.52	NO,NE	25.32	0.35	23.42
2007	-182.89	-42.13	-140.99	-28.50	0.44	8.94	0.35	18.81
2008	-249.84	-108.26	-140.81	-28.50	0.45	9.08	0.35	17.64
2009	-277.65	-141.28	-140.62	-28.50	0.47	9.22	0.35	22.51
2010	-265.04	-130.19	-140.04	-28.02	0.48	9.38	0.32	22.82
2011	-300.78	-168.10	-139.46	-27.53	0.50	9.53	0.29	23.79

2012	-293.62	-162.14	-138.88	-27.05	0.52	9.68	0.25	23.78
2013	-297.29	-171.08	-132.03	-23.62	0.45	5.06	0.22	23.50
2014	-299.11	-173.38	-131.42	-23.07	0.46	4.98	0.19	22.91
2015	-296.11	-171.27	-130.81	-22.51	0.47	4.91	0.16	22.73
2016	-190.89	-66.95	-130.25	-21.97	0.47	4.89	0.13	22.57
2017	-307.03	-183.98	-129.69	-21.43	0.47	4.87	0.10	22.41
2018	-302.31	-180.14	-129.12	-20.89	0.47	4.85	0.06	22.24
2019	-297.04	-175.66	-128.51	-20.33	0.49	4.76	0.03	21.96
2020	-298.54	-177.58	-127.92	-19.78	0.50	4.70	NO	21.32
2021	-235.33	-112.90	-127.60	-19.73	0.50	4.29	NO	19.92

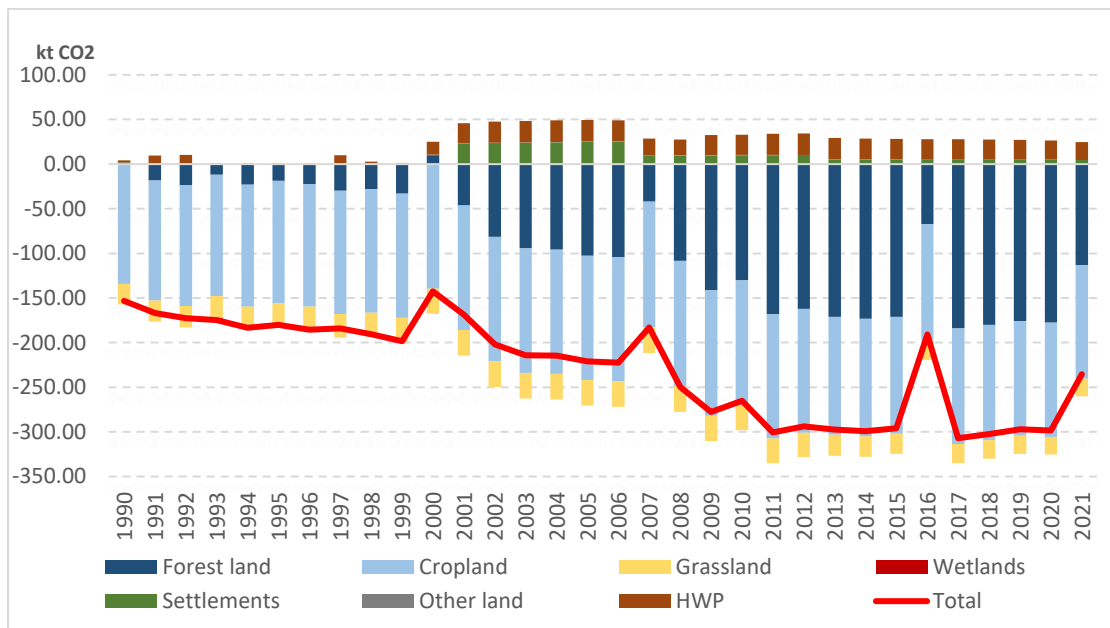


Figure 3.6. Emissions/removals trend in the LULUCF sector in the period 1990–2021

3.2.4. Changes since the 7th National Communication

Since the publication of the 7NC, various updates and revisions to methodologies have been implemented in Cyprus' GHG inventory, which have impacted on the time-series of emissions. The 2017 GHG inventory was used in the 7NC. This means changes to the GHG inventory used in this Communication are a result of four GHG inventory updates.

Cross cutting changes that affect the GHG inventories since 7NC include:

- Implementation of the IPCC 2006 guidelines (moving from the 1996 GLs, the 2000 Good Practice Guidelines and the 2003 LULUCF Good Practice Guidance);
- Changes to the Global Warming Potentials that are used;

Because of these cross-cutting changes, direct comparisons of the changes in the magnitude of emissions between the 7NC and 8NC are not valid.

Key changes on estimating emissions on different sectors that affect the GHG inventories since 7NC include:

- Energy sector
 - Calculation of road transport emissions with the software COPERT5 taking into consideration mean temperatures and humidity as well as precise fleet composition for each year after new registrations data.

- IPPU sector
 - Estimation of emissions from f-gases (2F1) from country specific to Tier 2a methodology
 - Estimation of emissions from electrical equipment (2G1) from country specific to Tier 1 methodology
- Agriculture sector
 - Animal population update with new data regarding mules and asses and horses. Interpolation used for missing years.
 - New animal weight information for non-dairy cattle.
 - Animal weight changes for sheep, horses, mules and asses (default)
 - New information regarding manure management systems. Update of contribution of each system.
 - Indirect N₂O emissions consistent with LULUCF sector
 - Country-specific EF used for Direct N₂O emissions after experiments carried out at the Agricultural Research Institute and publication¹⁶.
- Waste sector
 - Adding non-municipal solid waste to IPCC WasteModel for estimation of emissions from solid waste disposal (5A)
 - Adding a new sub-category (Anaerobic Digestion at Biogas Facilities (5B2)) for estimation of emissions from biological treatment of solid waste (5B)

Because of these cross-cutting changes and changes in methodologies on all sectors, direct comparisons of the changes in the magnitude of emissions between the 7NC and 8NC are not valid.

3.3. National system

3.3.1. Institutional arrangements

The Department of Environment of the Ministry of Agriculture, Rural Development and Environment (DoE), is the governmental body responsible for the development and implementation of environmental policy in Cyprus, as well as for the provision of information concerning the state of the environment in Cyprus in compliance with relevant requirements defined in international conventions, protocols and agreements. Moreover, the DoE is responsible for the co-ordination of all involved ministries, as well as any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol, according to the Law 29(III)/2009 with which Cyprus ratified the Kyoto Protocol.

In this context, the DoE has the overall responsibility for the national GHG inventory, and the official preparation and approval of the inventory prior to its submission. The Figure below provides an overview of the organisational structure of the National Inventory System. The entities participating are:

- The DoE, designated as the national entity responsible for the national inventory, holds the overall responsibility and maintains an active role in the inventory planning, preparation and management, including technical and scientific responsibility for the compilation of the annual inventory.¹⁷
- The 2020 submission was the first submission for which a team of external experts from the Cyprus

¹⁶ Michalis Omirou, Ioannis Anastopoulos, Dionysia A. Fasoula, Ioannis M. Ioannides, The effect of chemical and organic N inputs on N₂O emission from rain-fed crops in Eastern Mediterranean, *Journal of Environmental Management*, Volume 270, 2020, 110755, ISSN 0301-4797, <https://doi.org/10.1016/j.jenvman.2020.110755>

¹⁷ For 2017, there is a contract with an external expert for scientific and technical support to the inventory team of the DoE and the QA of the GHG inventory. As of 2018, according to the Council of Ministers' Decision of 15/11/2017, the technical and scientific responsibility for the compilation of the annual inventory for all sectors will be assigned, on a contract basis, to an independent consultant by the DoE.

Institute¹⁸ worked for the preparation of the emissions and the reporting, under the guidance of the DoE (contractor).

- Governmental ministries and agencies through their appointed focal persons, ensure the data provision.

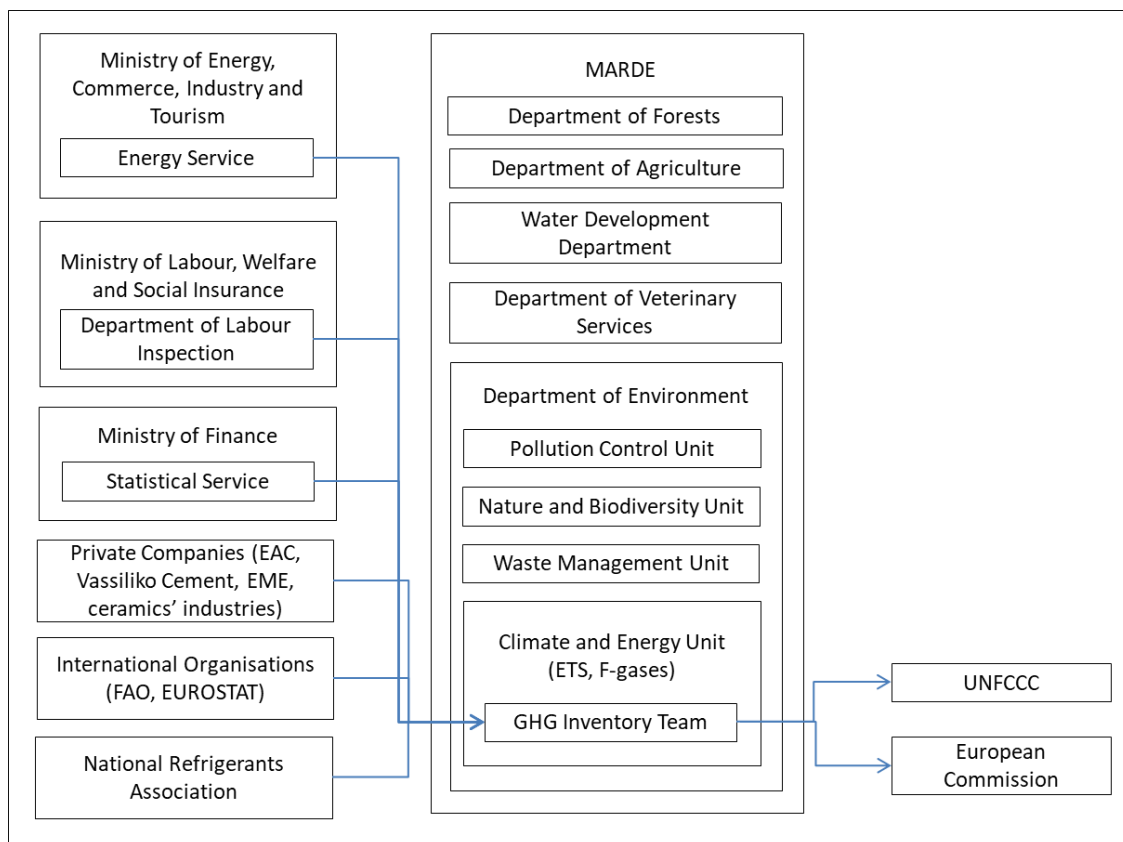


Figure 3.2. Overview of the organisational structure of the National Inventory System

The legal framework defining the roles-responsibilities and the co-operation between the Inventory team at the Department of Environment and the designated contact points of the competent Ministries was formalized by Council of Ministers’ Decision adopted 15/11/2017 entitled “Structure and operation of the National Greenhouse Gases Inventory System- Roles and Responsibilities”. The above-mentioned Decision includes a description of each entity’s responsibilities, concerning the inventory preparation, data providing or other relative information. This formal framework has improved the collaboration between the entities involved, assuring the timely collection and quality of the activity data required and solving data access restriction problems raised due to confidentiality issues.

All the details regarding the roles and responsibilities of each involved institution are clearly presented in the NIR submitted annually to the UNFCCC secretariat. The latest available submission is available at the UNFCCC website. The only change to the national inventory arrangements compared to the NC7 is that the preparation of the LULUCF GHG emissions inventory is outsourced and not prepared by an employee of the department of Environment.

¹⁸ The Cyprus Institute (Cyl) is a non-profit research and educational institution with a strong scientific and technological orientation, addressing issues of regional interest but of global significance, with an emphasis on cross-disciplinary research and international collaborations. The team of experts is working at the Energy, Environment and Water Research Center (EEWRC) of the Cyl, of which the work and collaborations focus on societally relevant issues related to Energy and Renewables, Environment, Atmosphere and Climate, Water and Natural Resources (www.cyi.ac.cy).

3.3.2. Quality Assurance/Quality Control (QA/QC) Procedures

A QA/QC system is being implemented since the May 2007. The Ministry of Agriculture, Rural Development and Environment is responsible for the implementation of the QA/QC system. The system has the following objectives:

- Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals.
- Continuous improvement of GHG emissions/ removals estimates.
- Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements

The accomplishment of the above-mentioned objectives can only be ensured by the implementation, from all the members of the Inventory Team, of the QA/QC procedures included in the plan for the following:

- Data collection and processing.
- Applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals.
- Making quantitative estimates of inventory uncertainty.
- Archiving information and record keeping.
- Compiling national inventory reports.

The QA/QC system developed covers the following processes:

- QA/QC system management: comprises of all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the abovementioned quality objectives.
- Quality control: directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping.
- Archiving inventory information: comprises of activities related to central archiving of inventory information and the compilation of the national inventory report.
- Quality assurance: comprises of activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public
- Estimation of uncertainties: defines procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory.
- Inventory improvement: related to the preparation and the justification of any recalculations made.

This QA/QC system was revised in 2017 after the adoption of the Council of Ministers' Decision (15/11/2017). Details on the QA/QC system implemented for the preparation of the 2017 GHG inventory submission are available in the 2017 inventory report, while information on the current QA/QC system is available in the 2018 submission to the European Commission for compliance with the (EU) 2018/1999¹⁹.

Further details on the QA/QC plan are available in the 2023 submission of the NIR.

3.3.2.1. Cyprus' self-assessment of compliance

Establishment of the National Governance System for Climate and Energy (2017)

The institution responsible for climate change issues in Cyprus is the Ministry of Agriculture, Rural Development and Environment and in particular the Department of Environment. The Department of

¹⁹ Regulation Governance of the Energy Union and Climate Action (Gov. Reg.) and the related Implementing Regulation (EU) 2020/1208; available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0525&from=EN>

Environment has a team of seven officers allocated to climate issues, working both on adaptation and mitigation issues.

For the purposes of implementing the Regulation on the Governance of the Energy Union and Climate Action [(EU) 2018/1999]^[1] and in particular to set out the necessary foundation for a reliable, inclusive, cost-efficient, transparent and predictable Governance that ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (the “Paris Agreement”), through complementary, coherent, and ambitious efforts by the Union and its Member States, while limiting administrative complexity, a new structure for climate and energy governance has been approved by the Council of Ministers (15/11/2017 decision no. 83.709).

The core of this new structure (see Figure 4.1), the “National Governance System for Climate and Energy” is a Ministerial Committee, consisting of the Minister of Agriculture, Rural Development and Environment, the Minister of Energy, Commerce and Industry, the Minister of Finance and the Minister of Transport, Communications and Works. The Ministerial Committee is co-chaired by the Minister of Agriculture, Rural Development and Environment and the Minister of Energy, Commerce and Industry. This committee has to propose policy related to climate and energy to the Council of Ministers which takes the final decision. The proposal of the policy is prepared by the Technical Committee, which consists of the Permanent Secretaries of the same Ministries. The Technical Committee also monitors the implementation of the policies and makes proposals for its revisions when necessary. The Technical Committee is co-chaired by the Permanent Secretary of the Ministry of Agriculture, Rural Development and Environment and the Permanent Secretary of the Ministry of Energy, Commerce and Industry. The Technical Committee is consulted by the following seven Expert Working Groups: Decarbonisation, Energy Efficiency, Energy Security, Internal Energy Market, Research, Innovation and Competitiveness, Renewable Energy and Transport. Each Working Group has a coordinator. All working groups with the exception of decarbonisation are the responsibility of the Ministry of Energy, Commerce and Industry; decarbonisation is the responsibility of the Department of Environment (Ministry of Agriculture, Rural Development and Environment). The secretariat of the National Governance System for Climate and Energy is held by the Department of Environment.

This scheme evolved later, in 2019 to the National Governance System for the implementation of the Green Deal, which was also adopted by the council of Ministers (see Figure 4.2).

This system has the responsibility to propose, adopt, implement and measures related to energy and climate change, and prepare any relevant reports. Moreover, it has the responsibility to take corrective action if any of the measures are not implemented in a timely and efficiency manner.

^[1] 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

3.3.3. The Inventory Methodology and Data

3.3.3.1. Emission factors

The estimation of GHG emissions / removals per source / sink category is predominately based on the methods described in the revised 2006 IPCC Guidelines. The emission factors used were derived from the 2006 IPCC Guidelines and special attention was paid in selecting the emission factors that are most representative of practices and conditions in Cyprus. Furthermore, emission factors were obtained from plant specific information contained in EU ETS reports. Due to data unavailability, for the estimation of the emissions of the sectors Refrigeration and Air Conditioning (2F1), Foam Blowing Agents (2F2), Fire Protection (2F3) and Metered Dose Inhalers (2F4a) the implied emission factors per capita from the average of Greece, Italy, Malta and Spain (NIR2015) have been used. For Use of Electrical Equipment (2G1) and N₂O from Product Uses (2G3), the implied emission factor per capita from Greece was used. Details on the methods applied for the calculation of emissions / removals are given the chapters that follow.

The key categories analysis constitutes the basic tool for methodological choice and for the prioritisation of the necessary improvements. In addition, the results of the various review processes (at national and EU level) represent key input information for the identification of possible improvements. It should be mentioned however, that data availability as well as availability of resources (both human and financial) also have to be considered.

- Data availability could become a significant restrictive parameter when selecting an estimation methodology. The accuracy and the consistency of the emissions estimated depend on the availability of the data needed for the correct application of the selected methodology.
- Availability of resources needs also to be considered as the searching for and the collection of the necessary data in order to apply a detailed methodology for a source category should not affect the completeness and the on-time preparation of an inventory submission.

3.3.3.2. Global warming potential

Emissions from anthropogenic activities affect the concentration and distribution of greenhouse gases in the atmosphere. These changes can potentially produce a radiative forcing of the Earth's surface and lower atmosphere, by changing either the reflection or absorption of solar radiation or the emissions and absorption of long-wave radiation. A simple measure of the relative radiative effects of the emissions of various greenhouse gases is the Global Warming Potential (GWP) index. This index is defined as the cumulative radiative forcing between the present and some chosen time-horizon caused by a unit mass of gas emitted now, expressed relative to that for some reference gas. The values for GWP for the greenhouse gases that are used in this inventory are according to Decision 18/CMA.1²⁰ (Annex II).

Table 3.9. Direct Global Warming Potentials (mass basis) relative to carbon dioxide for the 100-year horizon

Gas	Chemical Compound	100-year Global Warming Potential
Carbon dioxide	CO ₂	1
Methane	CH ₄	25
Nitrous Oxide	N ₂ O	298
HFC-32	CH ₂ F ₂	675
HFC-125	CHF ₂ CF ₂	3500
HFC-134a	CH ₂ FCF ₃	1430
HFC-143a	CF ₃ CH ₃	4470
HFC-227ea	CF ₃ CHF ₂ CF ₃	3220
HFC-245fa	CH ₂ FCF ₂ CHF ₂	1030
HCF-365mfc	CH ₃ CF ₂ CH ₂ CH ₂ CF ₃	794

²⁰ Decision 18/CP.1 Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement

Sulphur hexafluoride	SF ₆	22800
Nitrogen trifluoride	NF ₃	17200

3.3.3.3. Key categories assessment

The 2006 IPCC Guidelines define procedures (in the form of decision trees) for the choice of estimation methods within the context of the IPCC Guidelines. Decision trees formalize the choice of the estimation method most suited to national circumstances considering at the same time the need for accuracy and the available resources (both financial and human). It is considered good practice to identify those source categories (key source categories) that have the greatest contribution to overall inventory uncertainty in order to make the most efficient use of available resources.

In that context, a key source category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions (level assessment) or/and to the trend of emissions (trend assessment). As far as possible, key source categories should receive special consideration in terms of two important inventory aspects:

1. The use of source category-specific good practice methods is preferable, unless resources are unavailable.
2. The key source categories should receive additional attention with respect to quality assurance (QA) and quality control (QC).

As a result of the adoption of the LULUCF Good Practice Guidance (Decision 13/CP.9) the concept of key sources has been expanded in order to cover LULUCF emissions by sources and removals by sinks. Therefore, the term key category is used in order to include both sources and sinks.

The determination of the key categories for the Cyprus' inventory system is based on the application of the Tier 1 methodology (see Annex I for an analytic presentation of calculations) described in the 2006 IPCC Guidelines. Tier 1 methodology for the identification of key categories assesses the impacts of various source categories on the level and the trend of the national emissions inventory. Key categories are those which, when summed together in descending order of magnitude, add up to over 95% of total emissions (level assessment) or the trend of the inventory in absolute terms.

It should be mentioned that source category uncertainty estimates are not taken into consideration and base year estimates were calculated considering 1990 as base year.

The key categories for Cyprus' inventory system (without LULUCF) for the year 2021 are presented in Table 3.10.

Table 3.10. Key categories for Cyprus' inventory system without LULUCF for 2021

IPCC Source category	Direct GHG	Level	Trend
1A1a. Public electricity and heat production	CO ₂	✓	✓
1A2e. Food processing, beverages and tobacco	CO ₂	✓	✓
1A2f. Non-metallic minerals	CO ₂	✓	✓
1A2g. Other (please specify)	CO ₂	✓	
1A3a. Domestic aviation	CO ₂		✓
1A3b. Road transportation	CO ₂	✓	✓
1A4a. Commercial/institutional	CO ₂	✓	✓
1A4b. Residential	CO ₂	✓	✓
1A4c. Agriculture/forestry/fishing	CO ₂	✓	
2A1. Cement production	CO ₂	✓	✓
2A4. Othe process uses of carbonate	CO ₂		✓
2F1. Refrigeration and air conditioning	HFCs	✓	✓

2F3. Fire protection	HFCs		✓
2G1. Electrical equipment	SF ₆		✓
3A1a. Dairy cattle	CH ₄	✓	✓
3A1b. Non-dairy cattle	CH ₄	✓	✓
3A2. Sheep	CH ₄	✓	✓
3B3. Swine	CH ₄		✓
3D. Agricultural soils	N ₂ O	✓	✓
5A1. Managed waste disposal sites	CH ₄	✓	✓
5A2. Unmanaged waste disposal sites	CH ₄	✓	✓
5B1. Composting	CH ₄		✓
5D1. Domestic wastewater	CH ₄		✓
5D2. Industrial wastewater	CH ₄		✓

The methodology applied for the determination of the key categories with LULUCF is similar to the one presented above. The key categories identified for the year 2021 are presented in Table 3.11.

Table 3.11. Key categories for Cyprus' inventory system with LULUCF for 2021

IPCC Source category	Direct GHG	Level	Trend
1A1a. Public electricity and heat production	CO ₂	✓	✓
1A2e. Food processing, beverages and tobacco	CO ₂	✓	✓
1A2f. Non-metallic minerals	CO ₂	✓	✓
1A2g. Other (please specify)	CO ₂	✓	
1A3a. Domestic aviation	CO ₂		✓
1A3b. Road transportation	CO ₂	✓	✓
1A3b. Road transportation	CH ₄		✓
1A4a. Commercial/institutional	CO ₂	✓	✓
1A4b. Residential	CO ₂	✓	✓
1A4c. Agriculture/forestry/fishing	CO ₂	✓	
2A1. Cement production	CO ₂	✓	✓
2A4. Other process uses of carbonates	CO ₂		✓
2F1. Refrigeration and air conditioning	HFCs	✓	✓
2F3. Fire protection	HFCs		✓
2G1. Electrical equipment	SF ₆		✓
3A1a. Dairy cattle	CH ₄	✓	✓
3A1b. Non-dairy cattle	CH ₄	✓	✓
3A2. Sheep	CH ₄	✓	✓
3B3. Swine	CH ₄	✓	✓
3D. Agricultural soils	N ₂ O	✓	✓
4A1. Forest land remaining forest land	CO ₂	✓	✓
4A2. Land converted to forest land	CO ₂		✓
4B1. Cropland remaining cropland	CO ₂	✓	✓
4C1. Grassland remaining grassland	CO ₂		✓
4G. Harvested wood products	CO ₂		✓
5A1. Managed waste disposal sites	CH ₄	✓	✓
5A2. Unmanaged waste disposal sites	CH ₄	✓	✓
5B1. Composting	CH ₄		✓
5D1. Domestic wastewater	CH ₄		✓
5D2. Industrial wastewater	CH ₄		✓

3.4. National registry

This section of the National Communication summarises the national registry of Cyprus. Further details can be found in Chapter 14 of the NIR.

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8.

According to the latest update we received from the ITL, the national registry of Cyprus is fully connected to the ITL. This update will be presented accordingly in the NIR2023.

All mandatory reporting elements related to the national registry according to Decision 15/CMP.1, annex, paragraph 32, are provided below.

As concerns the reporting items of paragraph 32 of the Kyoto Protocol reporting guidelines:

- (a) the Department of Environment, of the Ministry of Agriculture, Rural Development and Environment, operates the Greenhouse Gas Registry of Cyprus. The names and contact information of the registry administrators designated by the Party to maintain the national registry are: Mr. Theodoulos Mesimeris (tmesimeris@environment.moa.gov.cy), Ms. Nicoletta Kythreotou (nkythreotou@environment.moa.gov.cy), located at the Department of Environment (20-22 28is Oktovriou, 2414 Nicosia)
- (b) The EU Member States that are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway have decided to operate their registries in a consolidated manner. The Consolidated System of EU registries was certified on 1 June 2012 and went into production on 20 June 2012. Croatia was migrated and consolidated as of 1 March 2013. A complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of the EU and all consolidating national registries.

Information on changes in national registry in 2020 are presented in Table below. A new central service desk was also set up to support the registry administrators of the consolidated system. The new service desk acts as 2nd level of support to the local support provided by the Parties. It also plays a key communication role with the ITL Service Desk with regards notably to connectivity or reconciliation issues.

Table 3.12. Information on changes in national registry in 2020

Reporting Item	Description
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	No change
15/CMP.1 annex II.E paragraph 32.(b) Change regarding cooperation arrangement	No change
15/CMP.1 annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	There has been 5 new EUCR releases (versions 12.4, 13.0.2, 13.2.1, 13.3.3 and 13.5.1) after version 11.5 (the production version at the time of the latest submission). No changes were applied to the database. No change was required to the application backup plan or to the disaster recovery plan. No

	change to the capacity of the national registry occurred during the reported period.
15/CMP.1 annex II.E paragraph 32.(d) Change regarding conformance to technical standards	The registry was updated with versions 12.4, 13.0.2, 13.2.1, 13.3.3 and 13.5.1. It is to be noted that each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and are carried out prior to the relevant major release of the version to Production. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 annex II.E paragraph 32.(e) Change to discrepancies procedures	No change
15/CMP.1 annex II.E paragraph 32.(f) Change regarding security	No change
15/CMP.1 annex II.E paragraph 32.(g) Change to list of publicly available information	No change
15/CMP.1 annex II.E paragraph 32.(i) Change regarding data integrity measures	No change
15/CMP.1 annex II.E paragraph 32.(j) Change regarding test results	No change

- (c) The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. A diagram of the database structure was provided in the last inventory submission. Iteration 4, introduced in October 2012, added the AUCTION table and added a column to the ACCOUNT table to hold trusted accounts. Iteration 4 did not make any change to the capacity of the registry. The documents were provided in the last inventory submission. In 2012, the EU registry has undergone major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR). During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). All tests were executed successfully and led to successful certification.
- (d) The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The overall change to a Consolidated System of EU Registries triggered changes to the registry software and required new conformance testing. The documents were provided in the last inventory submission. During certification, the consolidated registry was notably subject to connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the DES. All tests were executed successfully and led to successful certification.
- (e) The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all

consolidating national registries. The overall change to a Consolidated System of EU Registries also triggered changes to discrepancies procedures, as reflected in the updated manual intervention document and the operational plan. The documents were provided in the last inventory submission.

- (f) The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. The overall change to a Consolidated System of EU Registries also triggered changes to security, as reflected in the updated security plan. The documents were provided in the last inventory submission.
- (g) Publicly accessible Information is provided through the link of the National Registry in the corresponding Web site of the Department of Environment: <http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/7658BC65743CFD8EC225801F0027349B?OpenDocument>

4. Policies and measures

4.1. National Policies

4.1.1 Introduction

The majority of scholars today agree on the growing influence of the economy and society on the earth's climate through activities such as fossil fuel burning, rainforest deforestation and livestock farming. Recognizing the impact of human activities on the climate, the international community agreed at the Rio Summit in Rio de Janeiro in 1992 with the United Nations Framework Convention on Climate Change. Cyprus ratified the Convention in 1997. The objective of the Convention is to stabilize concentrations of greenhouse gases in the atmosphere at levels that prevent dangerous impacts on the climate from human activities.

In 1997 the Kyoto Protocol was adopted, which set legally binding greenhouse gas emission limit values for the period 2008–2012. Cyprus has ratified the Kyoto Protocol as a state without obligations to reduce or limit emissions. In 2012, at the Climate Change Summit held in Doha, Qatar, the second binding period of the Protocol (2013–2020) was agreed. As part of the EU's commitments (20% reduction in greenhouse gas emissions by 2020 compared to 1990), the Republic of Cyprus also assumed the national targets for a 21% reduction in greenhouse gas emissions by 2020 relative to 2005 with 2005 from electricity, cement and ceramics, and 5% in other sectors such as agriculture, transport, waste, etc., compared to 2005 levels.

Wanting to prepare for the post-2020 international negotiations, EU leaders agreed in October 2014 to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990. This target for Cyprus corresponds to a reduction of greenhouse gas emissions by 42% by 2030 compared to 2005 by electricity, cement and ceramics industries (ETS sectors), and 24% in other sectors such as agriculture, transport, waste, etc. (non-ETS sectors), compared to 2005 levels.

The culmination of the collective efforts that took place in recent years to reduce greenhouse gas emissions and hence to tackle climate change effectively by the global community is the historic agreement reached in Paris in December 2015 at the 21st Session of the Parties to the United Nations Framework Convention on Climate Change. The Paris Agreement entered into force on 4 November 2016. Cyprus completed the ratification process of the Paris Agreement on 4 January 2017. The effects of climate change are becoming increasingly felt both in Europe and globally. These are expected to be particularly serious for Cyprus, as climate change is already evident; over the last 100 years there has been an increase in average temperature and a decrease in average annual rainfall. The effects of climate change will not only continue but will also increase over the next decades.

In view of the above, Cyprus is faced with the challenge of developing its economy in a way that reduces greenhouse gas emissions, while taking appropriate measures and actions to adapt to climate change.

Climate change is a horizontal issue requiring the involvement and activation of almost all Ministries of Cyprus, including the Ministry of Agriculture, Rural Development and Environment, the Ministry of Energy, Trade, Industry and Tourism, the Ministry of Foreign Affairs, the Ministry of Transport, Communications and Works, the Ministry of Labour, Welfare and Social Insurance, the Energy Regulatory Authority and the Local Authorities. As a result, the role of the Environment Department of the Ministry of Agriculture, Rural Development and Environment as a national coordinator is upgraded and strengthened. Additionally, an important factor in the effort is the continuous improvement of the institutional framework.

Climate change mitigation is one of the main targets identified in the Cypriot strategy for sustainable development launched by MARDE in 2007²¹. The objective of the strategy is the development of a set

²¹ http://www.un.org/esa/agenda21/natlinfo/countr/cyprus/nsds_2007en.pdf

of principles for the formulation of an action plan in line with international challenges, and in accordance with EU policy directions and adjusted to the specific national circumstances.

Strategic planning

In February 2014, the House of Parliament voted the Law on Fiscal Responsibility and Budget Systems (FRBSL) no. 20(I)/2014, which covers a wide range of issues related to Management of Public Finance. The goal was to introduce new principles for budgeting that strengthen the flexibility of economic operators and the transparency of the use of state resources, achieving measurable results. In this context, ministries have been asked to implement new procedures for the preparation of a medium-term strategy plan and budgeting on the basis of those activities to achieve their objectives.

The importance of climate change mitigation (and adaptation) for Cyprus is highlighted through its inclusion as the first target of the strategic plan of the Department of Environment and as one of the strategic goals of the Ministry of Agriculture, Rural Development and Environment²².

National Policies and measures

Given that Cyprus was a non-Annex I party to the UNFCCC until 2013, national policies and measures for the reduction of greenhouse gas emissions were developed for the first time in 2007 for the implementation of EU Decision 280/2004²³. Ever since, policies and measures are reviewed, revised and updated every 2 years. The involved ministries are presented in Table 4.1. The sections that follow present the policies and measures by sector.

Table 4.1. Involved ministries to climate change mitigation policies and measures

Ministry	Issues
Ministry of Agriculture, Rural Development and Environment	Agriculture Forestry Land use
Ministry of Energy, Trade, Industry and Tourism	Energy
Ministry of Transport, Communications and Works	Transport
Ministry of Finance	National budgets
Ministry of Interior	Land use

The National Energy and Climate Plan (NECP), which was recently adopted by Cyprus and submitted to the European Commission, constitutes a strategic plan for Cyprus on Climate and Energy issues and comprises a detailed roadmap for achieving concrete Energy and Climate Goals by 2030. The NECP presents and analyzes Policy priorities and Measures in a wide range of economic and development activities and constitutes a reference document for the next decade.

The strategic objective is the energy and climate goals set by the NECP until 2030 to make a decisive contribution to achieve a drastic reduction in greenhouse gas emissions while achieving the necessary energy transition in the most economically competitive way for the national economy.

4.1.2 Overview of Policy-making process

The Department of Environment (DoE), of the Ministry of Agriculture, Rural Development and Environment is the main governmental body entrusted with the development and implementation of environmental and climate policy in Cyprus. DoE is responsible, among others, for the formulation of policies concerning environmental protection and climate change, for the coordination of implementation efforts and to ensure compliance with the current EU and national legislative

²² <http://www.moa.gov.cy/moa/agriculture.nsf/Stratigikos%20Sxediasmos%202016-2018%20EL%20-%20YpOik%20150901.pdf>

²³ 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

framework. Other entities responsible for integrating climate policy within their respective fields are the following:

- Energy Service, Ministry of Energy, Commerce and Industry (fuels, RES, Energy efficiency)
- Department of Public Works, Ministry of Transport, Communication and Works (sustainable mobility)
- Department of Electromechanical Services, Ministry of Transport, Communication and Works (electro-mobility (alternative fuels) infrastructure)
- Department of Agriculture, Ministry of Agriculture, Rural Development and Environment (agricultural policy)
- Department of Forests, Ministry of Agriculture, Rural Development and Environment (forests policy)
- Department of Environment, Ministry of Agriculture, Rural Development and Environment (waste management, animal waste management)
- Local authorities

Policies and measures, as well as all other issues and actions regarding mitigation were discussed within the framework of an inter-ministerial committee, comprising representatives from all competent Ministries. Final approval of policies and measures related to climate change mitigation rested with the Council of Ministers.

In January 2020, MARDE and the Ministry of Energy, Commerce and Industry published Cyprus' National Energy and Climate Plan pursuant to article 3 of Regulation (EU) 2018/1999. The National Energy and Climate Plan (NECP) is Cyprus' government's strategic plan for climate and energy issues, setting out a detailed roadmap regarding the attainment of specific energy and climate objectives by 2030. The NECP stresses Cyprus' priorities and development potential in terms of energy and climate change issues, and aims to serve as the key tool for drawing up the national energy and climate policy in the next decade, taking into account the Commission's recommendations.

4.1.3 Legislative arrangements and administrative procedures for the implementation of climate change policies

In response to the emerging evidence that climate change could have a major global impact, the United Nations Framework Convention on Climate Change (henceforth the Convention) was adopted on 9 May 1992 and was opened for signature in Rio de Janeiro in June 1992.

Cyprus ratified the Convention as a non-Annex I Party in 1997 (Law No. 19(III)/97).

In that framework, the third meeting of the Conference of the Parties (COP) to the Convention, held in Kyoto (1-11 December 1997), finalised the negotiations related to the establishment of a legal instrument; the Kyoto Protocol on Climate Change. The Protocol provides a foundation upon which future action can be intensified and introduced, for the first time, legally binding commitments for developed countries to reduce emissions of greenhouse gases. Detailed rules for the implementation of the Protocol were set out at the 7th Conference of the Parties (in Marrakech) and are described in the Marrakech Accords adopted in 2001.

The Protocol entered into force on 16 February 2005, after its ratification from 141 Parties (with the exception of USA and Australia) including developed countries with a contribution of more than 55% to global CO₂ emissions in 1990. Cyprus ratified the Kyoto Protocol in 2003 (Law 29(III)/2003).

With respect to the EU target under the 1st commitment period of the Kyoto Protocol (i.e. reduction of emissions at 8% for the period 2008–2012), the EU has stated that this will be achieved jointly by EU Member-States under the provisions of Article 4 of the Protocol. The Burden-Sharing agreement between all Member States was finalized during the Environment Council in June 1998 and entered into force with Decision 2002/358/EC concerning the approval, on behalf of the European Community, of the Kyoto Protocol. Cyprus was not a Member State of the EU at the time and therefore did not undertake any commitment at EU level.

In 2011 however, Cyprus requested to change its status under the UNFCCC and join Annex I, which was approved in 2012.

In Doha, Qatar, on 8 December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

Cyprus ratified the Doha Amendment in 2015 (Law 16(III)/2015).

The Paris Agreement which was agreed in 2015, builds upon the Convention and—for the first time—brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort. Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

Cyprus ratified the Paris Agreement in 2016 with Law 30(III)/2016.

The Paris Agreement requires all Parties to put forward their best efforts through “nationally determined contributions” (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts.

The EU and its Member States committed to a binding target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990, to be fulfilled jointly, as set out in the conclusions by the European Council of October 2014.

As stated in chapters 3 and 4, the EU and its Member States committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20 per cent below the 1990 level by 2020, and has substantially overachieved this reduction target, rendering the emission reduction obligations fulfilled.

In December 2020, as part of the European Green Deal EU leaders agreed on a more ambitious goal for cutting greenhouse gases—reducing them by 55% by 2030, rather than 40% and the EU and its member states submitted an updated NDC to the UNFCCC secretariat.

The general framework for monitoring and evaluation of policies and measures till 2020 was based on the Monitoring Mechanism Regulation of the EU (MMR, no. 525/2013). This Regulation aims in the improvement of the quality of the data reported and assist the EU and Member States with the tracking of their progress towards emission targets for 2013 - 2020.

The MMR was replaced by the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action for the period 2021–2030. Regulation (EU) 2018/1999 contains provisions about the tracking of the progress accomplished towards reaching mitigation targets, including specific templates for the monitoring and evaluation of policies and measures, the reporting of GHG projections, projection parameters and indicators, etc. In addition, it contains provisions for progress reports about the status of integrated national energy and climate plans, national adaptation actions, financial and technology support provided to developing countries, energy security, energy market, energy poverty, research, innovation and competitiveness; and about the monitoring and evaluation of policies and respective targets on renewable energy and energy efficiency.

The formulation of climate policy in Cyprus follows EU policy. A key step towards the formulation and implementation of any EU policy is to carry out an Impact Assessment of the proposed policy or key

policy changes. The Impact Assessment outlines a process that prepares evidence for political decision-makers on the advantages and disadvantages of possible policy options. The Impact Assessment is carried out by the Directorate General who takes the lead on a particular policy. The Impact Assessment process is an important element of implementing the EU's commitments under Article 4.2(e) (ii) of the UNFCCC to "identify and periodically review its own policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol than would otherwise occur".

A large proportion of the policies and measures related to GHG mitigation policies are funded from EU programs (RRF, Cohesion funds etc.) and therefore are selected under strict criteria and are monitored very closely during the whole implementation period in order to meet the funding requirements. Furthermore, periodical checks and indicators are used from several national strategic plans including the revision of NECPs in 2023 and 2024, the national adaptation strategy monitoring reports etc.

Information about policies and measures for the reduction of GHG emissions, GHG inventory and projections, legislative arrangements and enforcement and administrative procedures that are in place to meet the national commitments under the Kyoto Protocol are publicly accessible through the following websites:

- www.moa.gov.cy/environment (official website of the Department of Environment, containing information about national GHG inventories, legislation, emission trading system, national allocation plans, etc., available in greek language)
- www.meci.gov.cy (official website of Ministry of Energy, Commerce and Industry, containing information about national strategy and policies about energy, renewable energy sources, biofuels, etc., available in greek language).
- <https://unfccc.int/ghg-inventories-annex-i-parties/2020> (UNFCCC website, containing GHG inventories); <https://unfccc.int/NC7> (UNFCCC website, containing latest national communications)
- Information provided through EU's websites as <http://cdr.eionet.europa.eu/cy/eu> and <http://dataservice.eea.europa.eu/PivotApp/pivot.aspx?pivotid=475>.

4.1.4 A description of the national system for reporting on policies and measures and for reporting on projections pursuant to Article 13(1a) of Regulation (EU) 525/2013

For the purposes of implementing the Regulation on the Governance of the Energy Union and Climate Action (No. 2018/1999) and in particular to set out the necessary foundation for a reliable, inclusive, cost-efficient, transparent and predictable Governance that ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change through complementary, coherent, and ambitious efforts by the Union and its Member States, while limiting administrative complexity, a new structure for national climate and energy governance has been approved by the Council of Ministers (15/11/2017 decision no. 83.709).

The core of this structure (Figure 4.1), the "National Governance System for Climate and Energy", is a Ministerial Committee, consisting of the Minister of Agriculture, Rural Development and Environment, the Minister of Energy, Commerce and Industry, the Minister of Finance and the Minister of Transport, Communications and Works. The Ministerial Committee is co-chaired by the Minister of Agriculture, Rural Development and Environment and the Minister of Energy, Commerce and Industry. This committee has to propose the National Energy and Climate Plan to the Council of Ministers which takes the final decision. The proposal of the NECP is prepared by the Technical Committee, which consists of the Permanent Secretaries of the same Ministries. The Technical Committee also monitors the implementation of the NECP and makes proposals for its revisions when necessary. The Technical Committee is co-chaired by the Permanent Secretary of the Ministry of Agriculture, Rural Development and Environment and the Permanent Secretary of the Ministry of Energy, Commerce and Industry. The Technical Committee is consulted by the following seven Expert Working Groups: Decarbonisation, Energy Efficiency, Energy Security, Internal Energy Market, Research, Innovation and Competitiveness, Renewable Energy and Transport. Transport is an additional working group created due to the significant contribution of the sector to the national emissions. Each Working Group has a coordinator.

All working groups with the exception of decarbonisation are the responsibility of the Ministry of Energy, Commerce and Industry; Decarbonisation is the responsibility of the Department of Environment of the Ministry of Agriculture, Rural Development and Environment. The secretariat of the National Governance System for Climate and Energy is held by the Department of Environment.

This structure evolved after the publication of the Green Deal, to the National Governance System for Development Strategy in relation to the European Green Agreement, with a Council of Ministers' Decision (13/11/2020 no. 90.370) The new governance system incorporated in its structure in addition to the climate and energy issues, all the organisations involved in the implementation of the issues included in the green deal. The new structure is presented in Figure 4.2. All the working groups associated with climate and energy continue the same manner of operation as presented above.

4.1.5 Legal arrangements in place for preparation of reports on policies and measures and of projections

No legal arrangements in place for preparation of reports on policies and measures and of projections other than the Council of Ministers Decisions no. 83.709 of 15/11/2017 and no. 90.370 of 13/11/2020.

4.1.6 Procedural and administrative arrangements and timescales in place for the preparation of reports on policies and measures and of projections, to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the information reported

The Department of Environment of the Ministry of the Agriculture, Rural Development and Environment is responsible for ensuring the timeliness of the Reporting. No later than six months before the deadline of the Reporting, a kick-off meeting between the decarbonisation working group members is organized to launch the work. A date is set by which the decarbonisation working group members provide a list of their respective policies and measures to be included in the Reporting, along with a distinction between the WEM (With Existing Measures) and WAM (With Additional Measures) scenarios. The Department of Environment then checks the lists to ensure completeness and that there are no overlaps.

Two to three months before the deadline of the Reporting, the decarbonisation working group members provide their respective information concerning the policies and measures and projections to the Department of Environment, which compiles all the information into the reporting tools and a single paper report. This schedule leaves enough time to perform the remaining QA/QC activities. The Reporting is prepared in a transparent manner. The Reporting is based on the latest version of National Energy and Climate Plan. Key assumptions and policy measures are described and published in a background report to the projections. Furthermore, the Reporting uses publicly available data to a large extent. Not all data can be published, however, due to being confidentially reported by companies. Out of the assumptions, methods and models used by expert organizations in evaluating policies and measures or used in making the projections, many are publicly available or have been described in public sources.

Accuracy is ensured through several measures. First, all the expert organizations providing information are to as large an extent as possible, and most of the methods and models have been used before in national and international reporting. Third, projections follow the greenhouse gas source and sink categorization recommended by the European Commission on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and revised UNFCCC CRF tables for inventory reporting; Fourth, effect on mitigation of climate change as well as costs and benefits are assessed for such individual or groups of policies and measures that the assessments can be done in an accurate manner giving practical information, taking into account the reasonable amount of work and available data. Furthermore, the QA/QC procedures are strictly followed.

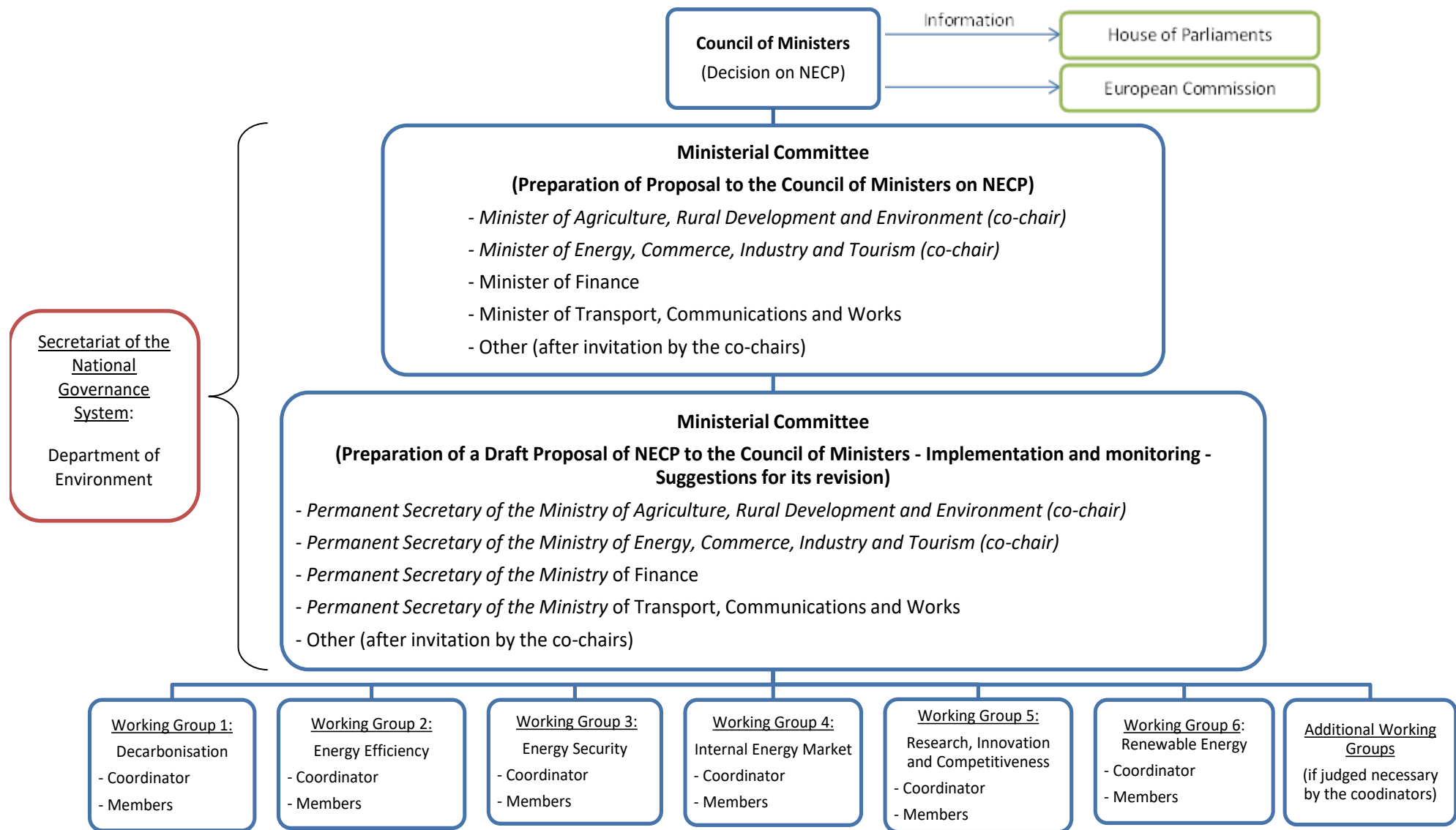


Figure 4.1. Structure of the national governance system for Climate and Energy

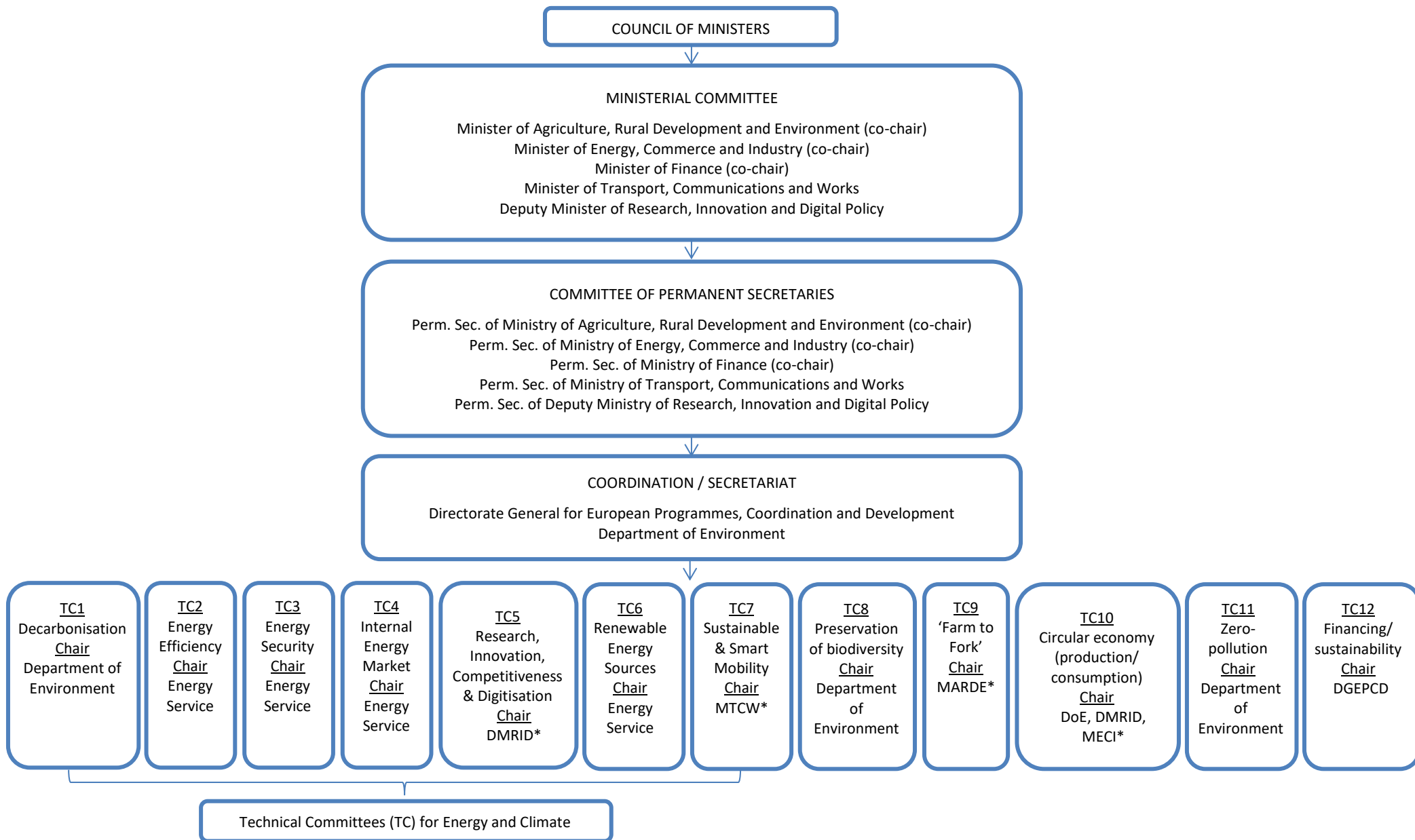


Figure 4.2. Structure of the National Governance System for Development Strategy in relation to the European Green Agreement

Consistency and comparability are ensured through several measures. The Reporting is based on the National Climate and Energy Plan and its scenarios. At an early stage of preparing the PaMs (Policies and Measures), a common framework is determined for the baseline scenario. The framework is determined in a collaborative manner between the ministries mentioned in previous sections and it is approved by the ministerial committee of the national energy and climate governance system. The framework comprises several parameters related to economic growth, population growth, international climate policy, and price of energy. The framework also includes assumptions on the future use of different sources of energy and waste treatment. All ministries use the common framework while contributing to the Plan and its baseline scenario. Furthermore, under the coordination of Department of Environment, interrelated assumptions are discussed and decided between the relevant ministries and government agencies. These procedures ensure the consistency and comparability of the assumptions and results between the different sectors in the Strategy.

Common parameters provided by the European Commission for the Reporting are used whenever applicable. As the Reporting also strongly relies on the latest version of the National Energy and Climate Plan, the above-mentioned PaMs making process improves the consistency and comparability of the information used in the Reporting. In the case that the Reporting requires extending or updating assumptions affecting several sectors, the decarbonisation working group members agree on these together. Sector-specific assumptions that are not available in the above-mentioned sources are selected based on the expertise of the decarbonisation working group members or the expert organizations and rely on other relevant strategies, plans and research reports as much as possible. To classify policies and measures under the WEM and WAM projections, a cut-off date is agreed by the decarbonisation working group. Across the different sectors, the reported policies and measures that are implemented on or before the cut-off date belong to the WEM projection and those implemented after the cut-off date or being in planning phase to the WAM projection.

The decarbonisation working group is made up by the chairs of the other 5 working groups involved in the development of the national energy and climate policy (renewables, energy efficiency, internal energy market, energy security, transport). This group prepares the proposal to the permanent secretaries committee, on which PaMs are included in each scenario. The cut-off date mentioned in the text, mostly relates to the PaMs whose implementation has not started, e.g. tram or natural gas in the NECP.

The Department of Environment then checks the lists to ensure completeness and that there are no overlaps. Furthermore, the projections follow the greenhouse gas source and sink categorization recommended by the European Commission on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and revised UNFCCC CRF tables for inventory reporting).

4.1.7 Description of the links to arrangements on integrated national energy and climate reports pursuant to Art. 17 of Regulation (EU) 2018/1999

To collect data related to policies and measures and projections, the structure prepared for the preparation of the NECP and reporting on progress other dimensions of the Energy Union, e.g. processes to foster consistent use of energy-related data for the development of policies and measures and projections and for integrated progress reporting are applied.

4.1.8 Description of the process for selecting assumptions, methodologies and models for making projections of anthropogenic greenhouse gas emissions

Sectoral experts from the Department of Environment and other key agencies are responsible for selecting the assumptions, methods and models to use for the projections. The Department of Environment experts work closely and interact regularly with other key experts on energy, agriculture, industrial processes, forestry and land use change and waste modelling in order to establish an appropriate set of assumptions and methods. The experts document the data sources, methods and assumptions. Improvement opportunities are regularly identified and documented which includes input from external experts. The Department of Environment manages a list of improvements which is reviewed and prioritised on a regular basis for implementation. Changes to processes are documented in the methodology report.

4.1.9 Description of procedures for the official consideration and approval of the Member States national system for policies and measures and projections

All the involved institutions participating to the decarbonisation technical committee of the national governance system for climate and energy have nominated an expert for every reporting preparation period whose responsibility is to provide the necessary data for the report. Institutional experts take part in the quality assessment process and give the final approval concerning the information in the reporting tools and final report to be submitted.

4.1.10 Information on relevant institutional administrative and procedural arrangements for domestic implementation of the EU's nationally determined contribution, or changes to such arrangements

The domestic implementation of the EU's nationally determined contribution is monitored through regular meetings of the Decarbonisation Working group of the national governance system. Issues, such as budgets, proposals to EU funds are discussed along with different practical issues that may come up during the implementation of the measures.

4.1.11 Description of the stakeholder engagement undertaken in relation to the preparation of policies and measures and projections

All the relevant stakeholders are kept informed through participation in the meetings of the relevant working group of the governance system that will contribute later to the decarbonisation working group.

4.1.12 Information pursuant to article 37(2)(b) of IR (EU) 2020/1208

According to article 37(2)(b) of IR (EU) 2020/1208, Member States shall report information on planned additional national policies and measures, or groups of measures, envisaged with a view to limiting GHG emissions beyond their commitments under Regulation (EU) 2018/842 and Regulation (EU) 2018/841.

At the moment there are no policies and measures that have been adopted or planned that are envisaged with a view to limiting GHG emissions beyond national commitments under Regulation (EU) 2018/842 and Regulation (EU) 2018/841.

4.1.13 Implementation of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

The Nature Protection Law, is the main legal instrument for the protection of biodiversity and ecosystems in Cyprus. It includes provisions on habitat and species conservation and non-deterioration obligations. Additionally, the Department of Environment implements a National Biodiversity Strategy and National Action Plan. Through this legislation, plans and projects are assessed to ensure that biodiversity and ecosystems are protected and do not deteriorate.

The Department of Environment is also responsible for the UNCCD and has a National Desertification Strategy and Action Plan in place.

Additionally, the Department of Water Development, is the competent authority for implementing relevant legislation of the WFD and ensures sustainable use of water."

Finally, the Forest Law (2012 – Article 3) regulates legislatively the conservation, protection, sustainable forest management and the expansion of forests and forested areas along the Republic of Cyprus. The Forest Law (2012) also regulates legislatively the Forest Policy and Forests National Program through the Articles 8 and 9.

Therefore, activities under art. 3.3 and 3.4 of Kyoto Protocol have to comply with the provisions of the above-mentioned laws and thus contribute to the conservation of biodiversity and sustainable use of natural resources.

4.1.14 National Long-Term Low GHG Development Strategy

The Long-Term Low Greenhouse Gas emission (GHG) Development Strategy for 2050 is a Roadmap for the Republic of Cyprus on Climate and Energy, as part of the country's participation in the collective European goal of a successful and sustainable transition to a climate-neutral economy by 2050.

The Long-term strategy for Cyprus is not yet available to the public. The strategic goal is to participate in the commitment towards a climate-neutral economy at EU level and to contribute to the European Green Deal promoted by the European Commission.

With the completion of the elaboration and adoption of the National Energy and Climate Plan (NECP), which analyses the energy and climate goals set by the country as well as the Policy Priorities and the measures for their implementation, the Government is also investigating the optimal policies and measures towards the year 2050 for the achievement of specific climate goals in order to determine the framework for the long-term climate strategy of the country for the year 2050.

Adopting and participating in the European Commission's strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050, the Government aligns itself with the Climate Neutrality Strategy, planning the implementation of innovative but realistic technology applications, funding and research, while ensuring social justice in the context of a fair transition.

It is clear that the long-term strategy is complementary to the NECP, which is the central strategic plan under which specific energy and climate policy measures are implemented. In this context, the long-term strategy presupposes the achievement of the relevant objectives of the NECP.

The 2030–2040 decade should be a decade of choosing the appropriate technological solutions for adoption that are mature at the time, but also of continuing successful policies and measures that will contribute to achieving the goals of 2050, with even greater intensity and rate of implementation. New energy technologies or even fuels that will be available on competitive market terms are, in any case, a technical condition for the period after 2030, which will ultimately determine the relative rates of transition to 2050. The goal is to achieve climate neutrality mainly through further exploitation of existing policies, deployment of new technologies and utilisation of local and international progress on Research & Technology.

4.2. Sectoral Policies and Measures

4.2.1 Sectoral policies and measures: Energy

The emissions of the energy sector excluding transport increased from 2,641 Gg CO₂ eq. in 1990 to 4,143 Gg CO₂ eq. in 2020, corresponding to a 57% increase. As it accounts for the largest portion of emissions, the energy sector must contribute the most to the reduction of greenhouse gases of Cyprus. The import of natural gas, and its initial use for electricity production, is expected to contribute considerable reductions of emissions.

Cyprus is the southernmost region of the European Union at the crossroads of three continents, with a dominant position in the Mediterranean and South East. In general Cyprus presents the energy problems common to most islands:

- (a) Isolated energy system.
- (b) High rates of economic and social development involving high rates of growth in energy demand.
- (c) High cost of energy supply.
- (d) High dependence on petroleum products - small supply security.
- (e) Seasonal variations in energy demand.
- (f) Maximum operation of the system of production and distribution of electricity in peak load demand.
- (g) Strict limitations of protection and promotion of the island environment that act as a disincentive to develop initiatives in energy investments.

Since its independence in 1960, Cyprus has relied on oil for all of its energy related needs: electricity generation, transport, and heating and cooling. In the absence of any domestic oil production, there has been high vulnerability to fluctuating oil prices. There was widespread use of solar water heaters for several decades throughout the island, with additional renewable energy technologies for electricity generation implemented in recent years. By the end of 2020 renewable energy corresponded to roughly 12.9% of supply²⁴.

The traditional system of electricity generation has dominated for over the past 40 years and has been based on monopolised ownership of a few, large, centralised and inflexible generation plants. Even though it has served well historically, recent years have increasingly exposed its vulnerability, be it from the risk of consequences of generation incidents, be it from the emergence of rather high swing load during the day and year due to the lack of base consumption and the high tertiary activity during the day in summer months, or be it simply to volatility to global oil price fluctuations.

A key challenge for Cyprus is therefore its high dependency on fossil fuels for energy. In 2020, Cyprus imported 93% of its gross available energy²⁵, as compared to the EU import average of 57.5%²⁶. Behind Malta, this is the highest imported share in the EU, which makes it crucial for the country to develop both its hydrocarbon and renewable energy sources. Cyprus is reliant on fossil fuel imports for its electricity needs, and spends over 8% of its GDP to cover the costs²⁷. Final consumption in 2020 amounted to approximately 79.9 PJ, with 97.4% of the consumption coming from liquid fuels, 0.7% from solid fuels and 1.8% from biomass. In comparison with 1990, total fuel consumption in 2020 (including biomass) increased by 41%²⁸.

Gross inland consumption in 2020 is also significantly higher as compared to 1990, with an increase from 1618.36 ktoe to 2285.77²⁹. Although this consumption is relatively low compared to other EU-countries, Cyprus had the fourth highest greenhouse gas emissions per capita in 2019 and 2020³⁰. Renewables and other measures to decrease fossil fuel reliance and the resultant high per capita emissions are thus of prominent interest for Cyprus.

In 2020 the Renewable Energy Sources (RES) share in gross final consumption of energy in Cyprus was 16.9%³¹, exceeding the national mandatory target of 13% RES in 2020, as set in the Directive 2009/28/EC³². According to preliminary data the share of RES in 2020 rose to 17.08%. This share comes from the use of solar water heaters, the installation of PV systems, wind parks, biomass/ biogas units and biofuels for transport sector, in combination with the use of heat pumps and biomass use for heating.

²⁴ Cyprus Energy Balance, 2020.

²⁵ Cyprus Energy Balance, 2020.

²⁶ "EU Energy mix and import dependency," Eurostat, 04 March 2022, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_energy_mix_and_import_dependency.

²⁷ "The Green Transition," CyprusProfile, December 2021, <https://www.cyprusprofile.com/sectors/energy-renewables>.

²⁸ "Cyprus 2022 National Inventory Report (NIR)." Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022.

²⁹ Cyprus Energy Balance, 2020.

³⁰ "Greenhouse Gas Emissions per Capita." Compiling Agency: Eurostat, 11 July 2022, <https://ec.europa.eu/eurostat/databrowser/bookmark/a599cac8-3bc9-424c-86e3-8b03366e71fc?lang=en>. Accessed 27 Oct. 2022. Online data code: T2020_RD300. Source of data: European Environment Agency (EEA).

³¹ Cyprus Energy Balance, 2020.

³² 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 (Text with EEA relevance), OJ L 140, 5.6.2009, p. 16–62

Additionally, RES accounted for 10.16% of electricity production in 2019³³. RES power production rose 15.5% in 2019, compared to 2018, mainly due to an increase 23.41 % in the electricity production from photovoltaic systems. However, wind farms generated almost 43.9% of electricity from RES in 2019.

In Cyprus, electricity from renewable sources is no longer promoted through feed-in-tariff schemes since 2015, given that as of 2013 a net metering, net-billing and self-consumption scheme has been put in place. Moreover, in the period 2018–2019, two schemes operated regarding the installation of RES units mainly PV parks that will participate in the competitive electricity market.

Access of electricity from renewable energy sources to the grid shall be granted according to the principle of non-discrimination. Grid development is a matter of central planning (Transmission Grid Development Plan 2021-2030 by the Cyprus TSO). In addition, renewable heating and cooling (RES H&C) is promoted by support schemes offering subsidies to households for the installation of solar thermal systems.

However, the country's national grid system has certain intrinsic and technical limitations affecting RES penetration, and reliability of the energy system. The lack of electricity interconnections to the trans-European electricity networks, limits the amount of intermittent renewable energy that can be connected to the electricity system, and the lack of natural gas interconnections does not allow the supply of Cyprus with electricity produced from natural gas, a fuel that significantly contributes to the reduction of greenhouse gas emissions. In addition, there is a lack of centralised storage capability.

To tackle these problems the country is exploring ways to introduce smart grids in the national network and is on the look-out for projects that could facilitate energy storage, and ventures that have production on a 24-hour basis. Also, the EuroAsia Interconnector could bring more solutions in its wake.

The island is already one of the highest users per capita in the world of solar water heaters in households, with over 90% of households equipped with solar water heaters and over 50% of hotels using large systems of this kind. With almost year-round sunshine, Cyprus certainly has plenty of energy to harness, but competitive energy storing capabilities are crucial in order to fully tap into its solar potential and facilitate better RES penetration.

There continues to be much ground to cover in terms of renewable energy production, but international interest in developing the sector in Cyprus has been on the rise. In this respect, the production of renewable energy is expected to experience considerable growth in coming years, and significant investment is required in order for Cyprus to achieve its targets—opening the field for companies with expertise in renewables.

The Cyprus Energy Regulatory Authority (CERA) has worked towards the full opening of the electricity market and enabling the consumers in exercising their right to choose their own supplier – with expectations of a full liberalisation by Q4 2022. CERA has approved the Trade and Settlement Rules which are based on a 'net pool' model. In addition, CERA has issued Regulatory Decisions with respect to the functional and accounting unbundling of the vertically integrated Electricity Authority of Cyprus.

In respect to the supply of natural gas to Cyprus, on 22/6/2016 the Council of Ministers decided to approve the import of Liquefied Natural Gas (LNG) to Cyprus. For the purpose of implementing the Decision, the Cyprus Natural Gas Company (DEFA) was mandated to carry out a study which concluded that the preferred LNG supply option project is through the use of a floating infrastructure with the development of the necessary mooring facilities and pipeline connection to the natural gas receiving point at Vassilikos.

On the basis of the results of the study the Council of Ministers, on May 18th 2017 decided to mandate DEFA to issue, as soon as possible, an invitation for tenders regarding the long-term supply of LNG to Cyprus to satisfy electricity requirements and an invitation for tenders for the construction and

³³ "Cyprus 2022 National Inventory Report (NIR)." Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022.

operation of the necessary infrastructure. In parallel to the above mentioned, DEFA was also mandated to proceed with the FEED study for the internal natural gas pipeline network.

On 13 of December 2019, the tender for the construction, operation and maintenance of the infrastructure was awarded by ETYFA (DEFA subsidiary) to the joint venture China Petroleum Pipeline Engineering, Metron, Hudong-Zhonghua Shipbuilding and Wilhelmsen Ship Management. On 28th September 2020 ETYFA approved the revised work program for the project. This is also the official start date of the construction works. The project is expected to be completed by H1 2023.

With respect to the supply of natural gas, on 4 June 2019, through a pre-qualification - Request for Expressions of Interest (RfEol) process, DEFA invited prospective LNG suppliers to express an interest in supplying LNG to the LNG Import Terminal in order to be added to DEFA's list of pre-qualified LNG suppliers. DEFA intends to procure its LNG requirements through a combination of: (a) medium and long-term supply via one or more LNG Sales and Purchase Agreements (SPAs); and (b) supplemental cargos via multiple Master Sales Agreements (MSAs) and a bidding process. The deadline for submission of Eol was the 6 September 2019, and 25 companies submitted their interest. This first stage of the above tender procedure was completed successfully in 21 December 2020. DEFA is expected to proceed to the next stage of the process in Q1 2022, with the negotiation and execution of MSAs and with an RfP for the selection of the medium-term contract supplier of LNG.

Cyprus is promoting the project of common interest «EuroAsia Interconnector», an electricity interconnection which is aiming to start commissioning in Q4 2025, and the electricity interconnection between Cyprus, Egypt and Greece, following the trilateral MOU that has been signed in October 2021. In addition, the promotion of the project of common interest «EastMed Pipeline», an offshore/onshore natural gas pipeline connecting East Mediterranean resources to Greece via Cyprus and Crete is aiming to start commissioning in Q4 2025. These projects will effectively contribute to the internal energy market integration, security of energy supply by enhancing diversification of sources and routes and reduction of GHG emissions by allowing the countries in the region to use natural gas deposits and increase the RES electricity production, in the case of EuroAsia Interconnector.

After robust growth rates in the 1980s (average annual growth was 6.1%), economic performance in the 1990s was mixed: real GDP growth was 9.7% in 1992, 1.7% in 1993, 6.0% in 1994, 6.0% in 1995, 1.9% in 1996 and 2.3% in 1997. This pattern underlined the economy's vulnerability to swings in tourist arrivals (i.e., to economic and political conditions in Cyprus, Western Europe, and the Middle East) and the need to diversify the economy. Declining competitiveness in tourism and especially in manufacturing acted as a drag on growth prior to actualization of structural changes. This greatly affected the energy sector.

The emissions from the energy sector in Cyprus increased by 61.3% during the period 1990–2020. The greatest increase in emissions was between 1990 and 2008 (97%), when the emissions reached their peak (7874 Gg CO₂ eq.). All the emissions in 2020 are from fuel combustion. The contribution of the emissions from the energy sector to the total without LULUCF in 2020 was 75.3% compared to 74.0% in 1990.

While energy is mainly responsible for carbon dioxide emissions, it also contributes to methane and nitrous oxide emissions. Fugitive emissions from fuels have not been estimated since 2004 when the refining activities stopped in Cyprus.

The competent authority in relation to energy policies is the Energy Service of the Ministry of Energy, Commerce, Industry and Tourism.

4.2.1.1 Introduction and use of Natural gas in the internal market for electricity production (PaM 5)

The Government of Cyprus, recognizing the positive contribution that the introduction and use of natural gas will have on the economy and the environment of Cyprus, is considering the introduction of natural gas initially for use for electricity generation. It is however expected that after its arrival, natural gas will also be used in other sectors of the economy (commercial, industrial and transport).

In the view of the fact that the interim solution tender process was terminated by DEFA without conclusion with a gas supply agreement, the Ministry of Energy, Commerce, Industry and Tourism, in collaboration with the Cyprus Energy Regulatory Authority (CERA), are examining all available options for the introduction of LNG in Cyprus as soon as possible and complementary to the supply of natural gas from indigenous reserves.

By importing natural gas, apart from the reduction of emissions from the actual use of the natural gas, there would also be a positive contribution to emission reductions through the increased efficiency of the newer technologies used.

The development of natural gas market in Cyprus will be based on the provisions of the relevant EU Directives including the making use of relevant derogations provided in the Directive 2009/73/EC concerning isolated and emergent markets.

Box 4.1. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

- Cyprus Energy Regulatory Authority
- Public Natural Gas Company (DEFA)
- Electricity Authority of Cyprus
- Department of Environment

Type

Political, legislative

National legislation

- K.Δ.Π. 115/2006
- N. 183(I)/2004 as amended

Measures towards attainment

- Introduction and use of natural gas for electricity production
- Installation of combined cycle electricity production units using natural gas as fuel
- Decommissioning or conversion of existing electricity production units

4.2.1.2. Promotion of Renewable energy sources (PaMs 1, 2)

The energy policy of Cyprus is harmonized with the European Union goal of promoting the use of energy from renewable sources, as a major step towards the reduction of global warming and climate change phenomena³⁴.

The EU RES Directive³⁵ sets out specific national targets to be achieved by each individual Member State, regarding the share of RES generated in each Member State by the year 2020. For Cyprus, the national target states that the share of energy produced from RES were to be at least 13% out of the gross national final consumption of energy in 2020. According to preliminary data the share of RES in 2020 rose to 17.08%, an exceedance of the targets.

The main types of RES technologies promoted under these measures for integration in the Cyprus power system are solar energy, wind energy and biomass. Cyprus ranks first in the world in solar energy use for water heating in households, and has achieved significant progress in the production of energy from Renewable Energy Sources (RES).

³⁴ <http://www.investcyprus.org.cy/en/growth-sectors/cyprus-investment-sectors/energy-sector>

³⁵ 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 (Text with EEA relevance), OJ L 140, 5.6.2009, p. 16–62

The most important projects relating to power generation from RES concern wind parks and photovoltaic (PV) parks, concentrated solar thermal plants and biomass and biogas utilisation plants.

Measures are separated into two key categories: Renewable energy sources in electricity production and renewable energy sources for heating and cooling.

4.2.1.2.1. Renewable energy sources in electricity production

The consumption of fossil fuels by energy industries in 2020 (39.4 PJ) increased by 40.1% compared to 1990 (23.3 PJ)³⁶. Since 2005, when the refinery stopped its operations, the emissions from energy industries are entirely caused by the production of electricity (1A1a). Emissions from energy industries accounted for 35.6% of total national emissions without LULUCF for 2020, while in 1990 the contribution was 30.3%. The total GHG emissions from energy industries in 2020 (3.0 Tg CO₂ eq.) increased by 71.6% compared to 1990 (1.8 Tg CO₂ eq). During the period 2009–2013, a decreasing trend of emissions was observed, attributed to the penetration of renewable energy technologies to the energy mix, and to the economic recession that the country is facing since 2010. The trend changes in 2014 to an increasing trend with an annual average of 4%. All units producing electricity in Cyprus for public use running on conventional fuels are operated by the Electricity Authority of Cyprus. The main fuel used for the generation of electricity is HFO, followed gas oil. The renewable energy share in final demand amounted to 14.4% in 2020. Electricity production is regulated by the Emissions Trading System.

Box 4.2. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

- Cyprus Energy Regulatory Authority
- Transmission System Operator
- Ministry of Finance
- Department of Town Planning and Housing, Ministry of Interior
- Department of Environment, Ministry of Agriculture, Natural Resources and Environment

Type

Legislative, voluntary

National legislation

- Law No. 112(I)/2013 on the promotion and encouragement of the use of renewable energy sources which has repealed the old one (N.33(I)/2013)
- Law 110(I)/2011 establishing a European emissions trading system and other relevant issues

Relevant EU legislation

- Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market (Directive 2001/77/EC is repealed by Directive 2009/28/EC from 1 January 2012. Moreover, from 1 April 2010, Article 2, paragraph 2 of Article 3 and Articles 4 to 8 will be deleted)
- 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
- 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

Measures towards attainment

- RES support schemes
- Informational campaigns
- Implementation of relevant legislation

³⁶ "Cyprus 2022 National Inventory Report (NIR)." Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022.

4.2.1.2.2. Renewable energy sources for heating and cooling

According to the latest NECP, the renewable energy share target for heating and cooling was set at 23.5%. RES in heating and cooling in 2020 was 34.2%³⁷. Heating and cooling emissions for industrial, housing and tertiary sectors, contributed 7% to the emissions of the energy sector in 2020, and 5% to the total emissions of the country (excluding LULUCF)³⁸.

The main technologies being traditionally used in Cyprus for heating and cooling are oil-burning central heating and air-conditioning split units. The low operating cost based on cheap oil prices in the past, and clean and effective heating, provided practical advantages, far outweighing the implementation cost in the long-run. A declining trend of wood-burning biomass for home heating was observed in the recent years through 2018³⁹.

The measures promoted are predominately associated with the promotion of solar thermal, biomass and geothermal energy.

Box 4.3. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

- Department of Town Planning and Housing, Ministry of Interior
- Department of Environment, Ministry of Agriculture, Natural Resources and Environment
- Department of Labour Inspection, Ministry of Labour and Social Insurance

Type

Legislative, voluntary

National legislation

- Law No. 112(I)/2013 on the promotion and encouragement of the use of renewable energy sources, which has repealed the old one (N.33(I)/2013)
- Law No. 142(I)/2006 regulating energy efficiency in buildings
- Law No. 30(I)/2009 amending Law No. 142(I)/2006 regulating energy efficiency in buildings
- Law No. 56(I)/2003 on Integrated Pollution Prevention Control (with amending laws no. 15(I)/2006, 12(I)/2008)

Relevant EU legislation

- Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market (Directive 2001/77/EC is repealed by Directive 2009/28/EC from 1 January 2012. Moreover, from 1 April 2010, Article 2, paragraph 2 of Article 3 and Articles 4 to 8 will be deleted)
- 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
- 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
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control and related amendments

Measures towards attainment

- RES support schemes
- Informational campaigns
- Implementation of relevant legislation

³⁷ Cyprus Energy Balance, 2020.

³⁸ "Cyprus 2022 National Inventory Report (NIR)." Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022.

³⁹ Cyprus' Integrated National Energy and Climate Plan, version 1.1. Nicosia January 2020. Pg. 167.

4.2.1.2.3. Promotion of energy efficiency (PaMs 3, 4)

Because of its national peculiarities, which make it a small and isolated system (an island country) without any interconnections to European or other energy networks (electricity, petroleum, natural gas) at present, Cyprus attaches great importance to energy efficiency aiming, inter alia, to improve energy supply security, increase competitiveness and ensure sustainable development/environmental protection.

Measures under the Energy Efficiency Directive (Directive 2012/27/EU) and the Energy Performance of Buildings Directive (Directive 2010/31/EU) are described in the 4th National Communication.

For the EU 2030 energy efficiency targets, Cyprus set a 17% reduction in primary reduction and a 13% reduction in final energy consumption, relative to the 2007 EU PRIMES Reference Scenario⁴⁰. These figures come from the latest NECP, wherein policies and measures for improvement of energy efficiency were created while considering the “Energy Efficiency First Principle.” Please refer to the latest NECP for further details on the impacts of this principle.

4.2.1.2.4. Energy efficiency in industry (existing companies)

A Grant Scheme for encouraging the use of Renewable Energy Sources and Energy Saving for Natural and Legal Persons as well as for Public Sector Bodies engaged in an economic activity, was in place up until the end of 2013. The investments covered by the Grant Scheme fall into two subcategories. NA - Energy Saving (SA) and NB - Renewable Energy Sources (RES).

According to the provisions of the 2013 NEEAP, energy-savings investment means an investment in systems, equipment and materials whose installation achieves at least 10% energy savings in a specific application. Eligible expenses also included the design costs, where necessary, under the restrictions set out in the relevant application documents for the different categories and subcategories of the Scheme.

Category NA1 of the grant scheme applied only to existing undertakings operating in Cyprus for at least four (4) years. Financial aid was granted to energy investments in existing holdings of the undertakings in question, under the condition that the building licence was issued by 28 December 2008. There were five (5) subcategories of investments as follows:

1. Purchase/installation of new equipment for the recovery of waste energy, either directly or indirectly by recovery/recycling of discarded materials, product or employed medium.
2. Purchase/integration of new materials and equipment to reduce idle energy consumption and energy losses.
3. Purchase of new equipment for the production, transmission, distribution and use of energy.
4. Purchase/installation of a new energy management IT system and/or integration of automated direct energy regulation/switch-off devices.
5. Replacement of existing materials and/or equipment connected with the subcategories 1 to 4.

Training seminars on energy management are held on an annual basis, in cooperation with the Human Resources Development Authority of Cyprus (HRDA), the Productivity Centre and the Energy Institute. Four (4) seminars were held in 2013 in Nicosia, Limassol, Larnaca and Paphos, with a duration of 60 hours each. The seminars were addressed to unemployed engineers of all specialties and focused, inter alia, on issues related to energy saving and energy efficiency improvement technologies/systems, ways of operation, selection of an appropriate system and applications in Cyprus (industry, hotels, services, etc.). In addition, examples for drawing up a technical-financial study for the installation of energy-saving systems and other examples of studies under ES Grant Schemes were presented.

Furthermore, information days were held in Nicosia, Limassol and Paphos addressed mainly to engineers who are members of the Cyprus Scientific and Technical Chamber (ETEK), the Cyprus Employers and Industrialists Federation (OEB), the Cyprus Chamber of Commerce and Industry (KEBE), hotel owners, entrepreneurs, credit institutions, municipalities and communities, contractors and the

⁴⁰ Cyprus’ Integrated National Energy and Climate Plan, version 1.1. Nicosia January 2020. pg. 68

general public. Information days focused on energy audits, the energy efficiency of buildings, energy labelling, energy-saving and RES technologies used for heating and cooling purposes.

In recent years, the Cyprus Employers and Industrialists Federation (OEB) holds an annual fair on energy saving, in cooperation with the EAC and the Energy Department. Printed information material on the different energy-saving technologies is distributed at the fairs. In addition, information is provided to the general public with regard to the provisions of the grant schemes. The most efficient energy-saving investments made by natural or legal persons under the grant scheme of the Special Fund ES are rewarded at the 'Save Energy' fair.

In 2013, the Energy Service has approved training institutes to carry out training programmes for candidate Category A and B energy auditors. Category A relates to all buildings regardless of their surface and air conditioning system and includes, inter alia, ports, airports and street lighting. Category B relates to industrial facilities, as well as agricultural activities and installations. The first category B energy auditors have been entered in the relevant registry within 2014. The first energy auditors have been included in the registry of Category A energy auditors in 2013.

In addition, Cyprus' NEEP establishes, as a measure to achieve the target under Article 7, co-financing for conducting energy audits in industries and for the implementation of the energy-saving investments proposed by the energy audit. The measure will concern approximately 10 industries per year.

These measures are expected to be renewed within the following years in view of the new EU obligations for 2030.

A 2017 study noted that there was still a theoretical maximum saving potential of 34% for electricity and 5% for oil and gas for the industry sector⁴¹.

Box 4.4. Important information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

Department of Environment

Type

Legislative, compulsory

National legislation

Law No. 31/2009 on energy end-use efficiency and energy services

Relevant EU legislation

- Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
- Decision 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 emission reduction commitments up to 2020

Measures towards attainment

Grant scheme for energy conservation

4.2.1.2.5. Residential buildings

According to Article 4 of Directive 2012/27/EU on energy efficiency, Member States shall establish a long-term strategy for mobilising investments in the renovation of their national stock of buildings.

In Cyprus, it is estimated that houses account for 19% of final energy consumption, whereas another 13% corresponds to commerce, hotels and services, i.e., mainly office buildings⁴². The different political,

⁴¹ "An energy efficiency strategy for Cyprus up to 2020, 2030 and 2050," GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), July 2017. Pg. 2.

⁴² Energy Service, 2014, Strategy for encouraging investments in the renovation of buildings Under Article 4 of Directive 2012/27/EU on energy efficiency; Annex F of 3rd National Energy Efficiency

economic and social conditions over the years did not allow for the implementation of energy-saving measures during the construction of buildings. The first organised attempt to implement energy-saving measures in buildings was made in 2004 through the grant schemes of the Special Fund for RES and ES, whereas the implementation of compulsory measures in new buildings and large buildings undergoing major renovation started in 2007 with the adoption of the 2007 Decree on the 'Regulation of the Energy Efficiency of Buildings (Minimum Energy Efficiency Requirements)'. Therefore, there is currently an energy-intensive building stock, which has negative consequences for the economy and the environment. In addition, the lack of sufficient thermal insulation measures and the excessive exposure to sunlight observed in many buildings are harmful to the health of citizens, reduce the productivity of workers and diminish the quality of life. Major building renovations offer an opportunity to resolve many of these issues.

Dwellings are the majority of Cyprus' building stock, as 431 059 dwellings have been recorded (2014). However, 78 088 houses are used as weekend or tourist residences, which means that they are used less and, therefore, they consume less energy. In addition, 54 651 homes are empty.

Most dwellings of Cyprus' current building stock have been constructed in the period 2001-2008, followed by the 1980's and the 1990's, which reflect the periods of increased construction activity. In the case of 91% of dwellings, there was no obligation to apply thermal insulation or any other energy-saving measures at the time they were built. Therefore, the energy status of most buildings may be characterised from poor to average, given that, as a rule, building owners did not take any measures during the building's construction, whereas some home owners have taken energy-saving measures at a subsequent stage, mainly under grant schemes of the Special Fund for RES and ES. According to the available statistics, 49% of dwellings have not taken any energy efficiency measures, whereas only 12% have applied some sort of thermal insulation at the building's envelope. The situation is better in the case of window frames, where over 38% have double-glazing.

The main energy product used in the residential sector is electricity coming from the grid, as it is responsible for almost half the final energy consumption, followed by fuel oil and LPG, which are the most important energy products after electricity. In 2020 solar energy accounted for almost 18%, whereas other renewable energy sources, such as PV systems, geothermal heat pumps and biomass have a smaller contribution. The highest primary energy consumption rates are due to air conditioning and heating. Solar thermal systems for domestic hot water production have an increased penetration in the residential sector as they are installed in 91% of dwellings.

The measures implemented in the residential sector taken into consideration are the following:

- Residential new buildings
- Residential buildings energy upgrade
- Residential solar panels replacement

The policies and measures that will stimulate investments in the renovation of existing buildings may be divided into: legislative measures and policies, incentives, training measures and awareness raising measures. Details on the measures implemented are available in Strategy for encouraging investments in the renovation of buildings Under Article 4 of Directive 2012/27/EU on energy efficiency (2014)⁴³.

Action Plan (NEEAP) of Cyprus available at <https://ec.europa.eu/energy/sites/ener/files/documents/CyprusArt42014.pdf>

⁴³ Energy Service, 2014, Strategy for encouraging investments in the renovation of buildings Under Article 4 of Directive 2012/27/EU on energy efficiency; Annex F of 3rd National Energy Efficiency Action Plan (NEEAP) of Cyprus available at <https://ec.europa.eu/energy/sites/ener/files/documents/CyprusArt42014.pdf>

Box 4.5. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

- Ministry of Interior
- Municipalities
- Department of Environment

Type

Legislative, compulsory

National legislation

Law No. 142 (I)/2006 regulating energy efficiency of buildings and amending Laws N. 30(I)2009, N. 210 (I)2012, N. 15 (I)2017

Relevant EU legislation

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

Decision 406/209/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 emission reduction commitments up to 2020

Measures towards attainment

- Implementation of national action plan on energy efficiency
- Implementation of national legislation

4.2.1.2.6. Non-residential buildings

Non-residential buildings include various types of buildings, the most important of which are offices, retail shops, restaurants, hotels and hospitals. There are no statistics on this building category. However, in 2012 the Electricity Authority of Cyprus (EAC) had 85,198 commercial customers, i.e., buildings and building units owned by enterprises and organisations. Table 4.2 provides an analysis of EAC's commercial customers per category of use, which reflects to a great extent the relevant number of buildings and building units per type.

Table 4.2. Electricity consumers per category

Type of consumer	Number of consumers
Wholesale and retail sale, repair of vehicles	24,788
Accommodation premises and establishments serving food	10,097
Public administration and defense	1,671
Education	2,454
Human health and social work activities	2,143
Culture, entertainment and recreation	2,907
Other services	41,138

The vast majority of customers under category 'other services' represent buildings and building units used as offices, which rank first in terms of number followed by retail shops. Despite the fact that there are no statistics on the age of these buildings, it may be assumed that they have a distribution over time which is similar to the one of dwellings, as commercial and other buildings had the same peak period as dwellings. Both in the case of dwellings and other buildings, there was no obligation to apply thermal insulation or any other energy-saving measures at the time they were built. Approaches to envelope construction were the same for all building categories.

The sector of non-residential buildings uses two-thirds of total final consumption of electricity from the grid. The use of RES is reduced as compared to households, with solar energy showing the highest penetration. In some building types, such as hotels, where 50% uses solar energy for hot water production, there is an increased penetration of RES, as compared to the average penetration in buildings of the tertiary sector. One- to five-star hotels in Cyprus number 224, of which 20 are located in mountainous regions.

The measures implemented in the non-residential (tertiary) sector taken into consideration are the following:

- Tertiary new buildings
- Tertiary buildings energy upgrade

The policies and measures that will stimulate investments in the renovation of existing buildings may be divided into: legislative measures and policies, incentives, training measures and awareness raising measures. Details on the measures implemented are available in Strategy for encouraging investments in the renovation of buildings Under Article 4 of Directive 2012/27/EU on energy efficiency (2014)⁴⁴.

Box 4.6. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

- Ministry of Interior
- Municipalities
- Department of Environment

Type

Legislative, compulsory

National legislation

Law No. 142 (I)/2006 regulating energy efficiency of buildings and amending Laws N. 30(I)2009, N. 210 (I)2012, N. 15 (I)2017

Relevant EU legislation

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

Decision 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 emission reduction commitments up to 2020

Measures towards attainment

- Implementation of national action plan on energy efficiency
- Implementation of national legislation

4.2.1.2.7. Public buildings

The term “public buildings”, means buildings used by:

- Central government authorities such as Ministries, the Police and the General Prosecutor's Office;
- Local Administration, such as Municipalities and Communities
- Public schools, public universities and other public educational institutions;
- The military.

Central governmental authorities, means all administrative services whose competence extends to the whole territory of the Republic of Cyprus, which are laid down in Annex IV to the 2006 Coordination of the Public Procurement, Works and Services Contracting Procedures and Relevant Matters Act. These authorities use 1,066 buildings and building units of which only 572 are property of the public sector. As a rule, they use only electricity to cover their energy needs.

In the areas under the effective control of the Republic of Cyprus, Local Administration consists of 30 Municipalities and 350 Communities. Most Municipalities and large communities have only one building, used for administrative purposes and events. However, large Municipalities own more buildings which are being used to serve the public, as well as other building types, such as libraries and sports centres.

⁴⁴ Energy Service, 2014, Strategy for encouraging investments in the renovation of buildings Under Article 4 of Directive 2012/27/EU on energy efficiency; Annex F of 3rd National Energy Efficiency Action Plan (NEEAP) of Cyprus available at <https://ec.europa.eu/energy/sites/ener/files/documents/CyprusArt42014.pdf>

In Cyprus there are 833 public schools of primary and secondary education. The Technical Department of the Ministry of Education and Culture is responsible for the implementation of projects related to the construction of new school units and the maintenance and extension of already existing ones. Regarding public universities, the University of Cyprus, which is the largest public university, owns most of the buildings that have been constructed in recent years within the Campus. The Technological University of Cyprus uses mainly historical buildings and leased buildings in the historical center of Limassol, whereas the Open University of Cyprus uses a building in Nicosia. Public universities have technical departments which are responsible for the maintenance and the smooth operation of their building infrastructures.

The period 2021–2030 will apply the same approach as dictated by Article 5 of Directive 2012/27/EU, namely that Member States should annually renovate 3% of the total area of buildings owned and used by central government authorities, or engage in an alternative approach that achieves equivalent energy savings⁴⁵.

Box 4.6. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

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Type

Legislative, Compulsory

National legislation

Law No. 142 (I)/2006 regulating energy efficiency of buildings and amending Laws N. 30(I)2009, N. 210 (I)2012, N. 15 (I)2017

Relevant EU legislation

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

Measures towards attainment

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4.2.1.3 Promotion of biomass and alternative fuels in industry

Cement is considered one of the most important building materials around the world. Cement production is an energy-intensive process consuming considerable amounts of thermal energy. Globally, historically, the primary fuel used in cement industry is coal⁴⁶. A wide range of other fuels such as gas, oil, liquid waste materials, solid waste materials and petroleum coke have all been successfully used as sources of energy for firing cement-making kilns, either on their own or in various combinations. In Cyprus the predominant fuel used in cement production is pet-coke, while biomass and the non-biomass fraction of waste are also used. Cement production continues to dominate the emissions from mineral products, accounting for 97.8% of this category in 2020⁴⁷.

The new cement producing installation in Cyprus installed in 2011 has the capability of using considerable amounts of alternative fuels and biomass. This advantage should be exploited by encouraging the installation to use non-conventional fuels.

Non-renewable waste is consumed by only one cement-producing installation, which has been submitting an annual emissions report since 2005, in accordance with the requirements of the ETS law

⁴⁵ Cyprus' Integrated National Energy and Climate Plan, version 1.1. Nicosia January 2020. Pg. 78.

⁴⁶ Chinyama, 2011, Alternative Fuels in Cement Manufacturing, available at <https://www.intechopen.com/books/alternative-fuel/alternative-fuels-in-cement-manufacturing>

⁴⁷ "Cyprus 2022 National Inventory Report (NIR)." Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022. <http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/21395032E3B9BB6CC2257FF0003813DD?OpenDocument>

110(I)2011. In the industrial waste category, we report the non-biomass fraction of biomass incinerated; i.e., sewage sludge, tires, ASF, MBM and compost. The waste is incinerated for production of thermal energy in the furnace which burns the raw material to produce the cement. In 2020, 289 TJ of non-renewable industrial waste and 1168 TJ of non-renewable municipal waste were incinerated. Municipal waste incinerated increased from 24 TJ in 2012, which was the first year of use of this source. Industrial waste incineration increased from 18 TJ in 2001⁴⁸.

4.2.1.4 GHG emissions from aviation and shipping

Cyprus recognizes the need to reduce GHG emissions from aviation and shipping and supports EU work on that subject in ICAO and IMO. The EU succeeded to include aviation CO₂ emissions into the EU emissions trading scheme from 2012 onwards, resulting in a limitation of emissions below historic levels in 2004-2006. The EU scheme includes emissions from flights European Economic Area. Agreements with Switzerland, Iceland, Norway and the UK have been signed since 2017 to link the EU ETS with the respective trading scheme. Phase-out of free ETS allowances for airlines could be completed by 2026 if a political agreement on the current legislative proposal will be reached in due time while free permits are foreseen for airlines using sustainable aviation. Furthermore, co-legislators are currently in the process of negotiating a blending mandate for SAF that is expected to require fuel suppliers to blend a certain amount of SAF when supplying fuel in Europe. The EU has also been the driving force behind the ICAO agreement on a global market-based measure to limit GHG emissions from international aviation (Carbon Offsetting Scheme for International Aviation – Corsia), which is in place since 2021. Cyprus, together with all Member States of the EU, was among those countries participating in the voluntary pilot phase. Even though in 2021 no compensation obligations arose due to the crisis induces reduction in emissions, European airlines are expected to actually compensate CO₂ emissions for 2022 and compensation obligations are supposed to significantly increase in 2027 when CORSIA will become legally binding at global level.

For maritime transport, appropriate action has also been implemented at European level (monitoring and reporting on GHG emissions of ships). Especially the proposal for a regulation on the use of renewable and low-carbon fuels in maritime is another important step in the right direction; in this context, Cyprus supports ambitious targets for reducing CO₂ emissions in the maritime sector.

4.2.2 Sectoral policies and measures: Transport

The 2020 road transport emissions contributed 22% of the total national emissions, and 24% of 2019 total national emissions, excluding LULUCF. The emissions of road transport in 2020 increased by 58% compared to 1990, while the 2019 emissions increased by 77% from 1990. The lower number from 2020 is attributed to the lockdowns and movements in restriction brought about by the COVID-19 pandemic, as detailed in Table 3.14 of the 2022 NIR. The substantial increase of GHG emissions from road transport since 1990 is directly linked to the increase of the vehicle fleet and the increase of transportation activity. Cyprus is heavily reliant on passenger car transport, and had the fifth highest number of cars per capita in the EU-27 in 2020⁴⁹.

In addition to the importance for emissions, transport has been an issue of particularly great interest to the society of Cyprus, due to the very large growth of the number of privately owned cars and the associated problems in traffic that are experienced, especially in the capital, Nicosia. Even though many studies have been completed since the 1990s on how to deal with traffic in the urban areas of Cyprus and especially Nicosia, it was not until about a decade ago that action was initiated and measures implemented.

⁴⁸ “Cyprus 2022 National Inventory Report (NIR).” Department of Environment, Ministry of Agriculture, Rural Development and Environment, 06 Apr 2022. <http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/21395032E3B9BB6CC2257FF0003813DD?OpenDocument>

⁴⁹ “Table 2: Passenger cars, 2015-2020”. Passenger Cars in the EU, Eurostat, 05 Aug. 2022, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU.

The energy intensity in the transport sector is among the highest in the EU, mainly due to the large percentage of road transport operations. However, there has been a remarkable improvement in this sector in recent years. The increase in the energy efficiency of private vehicles and the import of smaller and more efficient cars have led to better results although public transport in Cyprus are not adequately developed. The transport sector, along with the electricity generation and building sectors, is one of those sectors that offer a significant potential for energy efficiency improvement.

The Amendment of the Motor Vehicles and Road Traffic Law (Law 100(I)/2013) for revision of the vehicle taxes and annual circulation taxes, a measure that relates to the tax imposed on vehicles with a view to reducing CO₂ emissions, which has been in force since 2014. The latest amendment was decided on 29 March 2019 and has revised the method of calculating the motor vehicle registration fees beyond the CO₂ parameter. More specifically, higher fees are now charged for vehicles emitting more than 120 g/km. Furthermore, an additional fee is included based on the 'Euro' technical specifications of vehicles. This action further promotes the use and purchase of low emission vehicles, including zero emissions vehicles.

Furthermore, incentives for the purchase and use of low/zero emission vehicles including the old vehicle scrapping scheme and financial incentives for the purchase of electric vehicles have been announced.

Regarding public transport, new bus concessions were put in force between 2020 -2022 and will further improve the system. The increase of the use of buses that have low or zero GHG emissions will be implemented for the contract period 2020-2030. Furthermore, the new bus contracts include specific requirements for the use of electric buses.

Additionally, towards the improvement of the efficiency of the public transport system, the Ministry of Transport, Communications and Works, has installed a telematic system that manages the bus services and records data. The related website and mobile application contain a detailed map of the routes and the timetable of buses in order to facilitate passengers in real time. This action was completed in 2018 and its cost was approximately €7 million, including maintenance for 5 years.

Another important measure is the shift of modal share from car trips to sustainable modes of transport, through the policies and measures that are included in the Sustainable Urban Mobility Plans (SUMP) and the National Transport Strategy (NTS). SUMP include costed policies and measures which scientifically prove that a specific modal shift from car trips to sustainable modes of transport can be achieved. This group of measures includes significantly improved bus services (routes, frequencies, hours of operation), upgrading of infrastructure for pedestrians/ cyclists / public transport, development, implementation of a holistic parking policy, implementation of high-quality public transport corridors and essentially a group of targeted measures that promote the use of sustainable modes of transport and discourage the use of car trips.

Furthermore, a Grant Scheme for energy saving in the transport sector (purchase of hybrid vehicles, electric vehicles and low-pollutant vehicles), was in force in the period 2004-2009.

The European Directive 2014/94 / EU on the Development of Rural Renewables Infrastructures establishes a common framework for measures to develop the market for alternative fuels in the transport sector and the implementation of relevant infrastructure within the Union in order to minimize dependence on liquid minerals to reduce the environmental impact in the transport sector. Within the framework of the directive, which sets practical goals, the development of the market and related infrastructure for the use of electricity, liquefied natural gas (LNG), compressed natural gas (CNG) and hydrogen in transport is specifically promoted. Directive 2014/94 / EC is a tool to meet the mandatory 2020 target for road transport, i.e. (a) 10% energy from RES in transport (Directive 2009/28 / EC) and b) 6 % reduction in greenhouse gas emission intensity in the life cycle of road transport fuels (Directive 2009/30/EC) the competent authority is the Ministry of Energy, Trade, Industry and Tourism. A National Policy Framework describing national targets and targets, guidelines, support actions and policies for the development of alternative fuels and developing the necessary infrastructures was prepared by the Ministry of Transport, Communications and Works in cooperation with the Ministry of Energy, Commerce, Industry and Tourism.

Charging points and infrastructures for electric vehicles have been installed in public buildings and in public roads, whereas installation costs in private buildings, single-family houses and undertakings will be subsidised under specific criteria and specifications. There are currently 20 charging stations in Cyprus: 7 charging stations in Nicosia, 6 in Limassol, 2 in Larnaca, 2 in Ammochostos and 3 in Paphos. The Department of Electromechanical Services is undertaking installation of 10 fast charging stations⁵⁰. Although the numbers are still very small, the expectation is that the registration of electric cars will increase considerably, so that they comprise the majority of on-road vehicles by 2030⁵¹.

The installation of LPG systems in vehicles has also started in 2017 and will reduce the emission of pollutants and fuel consumption in old vehicles.

For the reduction of emissions from road transport the competent authorities are considering the implementation in the immediate future of further measures in the fields of Traffic demand management, Improvement of road traffic flow, Reduction in transport demand, Switch in transport modes and alternative fuels and technologies.

The continuation and further development of measures such as the above and additional measures such as improvement of infrastructure for further encouragement of use of public transport, cycling and walking and financial incentives to encourage new vehicles with low to zero emissions and discourage vehicles with high emissions, can reduce the emissions of one of the most important sectors in Cyprus with respect to mitigation.

Biofuels

Biofuels are liquid or gaseous transport fuels such as biodiesel and bioethanol which are made from biomass. They serve as a renewable alternative to fossil fuels in the EU's transport sector, helping to reduce greenhouse gas emissions and improve the EU's security of supply. The EU aimed to have 10% of the transport fuel of every EU country come from renewable sources such as biofuels by 2020. GIZ GmbH conducted a study, 'Penetration of alternative fuels in Cyprus road and maritime sectors,' to analyse this goal for Cyprus⁵². Among the conclusions was that the 10% target was neither cost-effective nor easily feasible for Cyprus, but the overall target was met in a more cost-effective manner with greater contribution from other sectors. While the share of 2nd biofuels was 2.58% for 2020, this is projected to increase over the next two decades.

Box 4.7. Key information

Competent authority

Energy Service, Ministry of Energy, Commerce, Industry and Tourism

Other involved authorities

-

Type

Legislative, Compulsory

National legislation

Law N. 112 (I)/2013 – 2015(transposition of EU Directive 2009/28/EC)

Relevant EU legislation

Directive 2009/28/EC of the European Parliament and 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

Measures towards attainment

-

⁵⁰ Cyprus' Integrated National Energy and Climate Plan, version 1.1. Nicosia January 2020. pg. 116

⁵¹ Cyprus' Integrated National Energy and Climate Plan, version 1.1. Nicosia January 2020. pg. 116

⁵² "Penetration of alternative fuels in Cyprus road and maritime sectors," Deutsche Gesellschaft für Internationale Zusammenarbeit, June 2017.

4.2.3. Sectoral policies and measures: Industry (PaM 6)

The New EU F-gas Regulation adopted in 2014 and applied from 1 January 2015, aims among others in preventing emissions of F-gases from existing equipment by requiring leakage checks, proper serving and recovery of the gases at the end of the equipment's life. For the full implementation of this regulation in Cyprus a proper recovery system needs to be setup and used in Cyprus. Given the high GWP of the F-gases, and their increasing contribution to the national emissions, it is considered crucial for proper recovery to be implemented within the following years.

Under provisions of Art. 9 of Regulation 517/2014/EC, on fluorinated greenhouse gases, without prejudice to existing Union legislation, Member States shall encourage the development of producer responsibility schemes for the recovery of fluorinated greenhouse gases and their recycling, reclamation or destruction. Cyprus has adopted and harmonized the above Regulation into Cypriot Law 62(I)/2016 and 46(I)/2017. The next step is to forward a national Law regarding a producer's responsibility scheme. The main provision of this Law will follow the "polluter pays" principle and each producer will have to participate in an appropriate scheme for management of f-gases that have been recovered for any reason.

At the same time, under the provisions of the same scheme, certified technicians will be encouraged to return to the scheme any fluorinated gases they have recovered, for a pre-decided profit.

Box 4.8. Key information

Competent authority

Department of Environment, Ministry of Agriculture, Rural Development and Environment

Other involved authorities

-

Type

Legislative, compulsory

National legislation

Fluorinated greenhouse gases Law (No. 62(I)/2016 and 46(I)/2017)

Relevant EU legislation

Regulation on fluorinated greenhouse gases 517/2014

Measures towards attainment

- Implementation of "polluter pays" principle; each producer will have to participate in an appropriate scheme for management of f-gases that have been recovered

4.2.4. Sectoral policies and measures: Agriculture (PaMs 7, 8)

Anaerobic digestion technology may help to address two congressional concerns that have some measure of interdependence: development of clean energy sources and reduction of greenhouse gas emissions. Anaerobic digestion, as a way of converting biomass to energy, has been practiced for hundreds of years. It is a technology that helps to reduce waste, generate energy and cut down on carbon emissions. The general performance of anaerobic digesters and the diversity of wastes which they can treat have been increasing steadily as a result of new reactor design, operating conditions, or the use of specialised microbial consortia, during the last decades.

Most small-scale pig farms in Cyprus use mechanical separation for the treatment of their waste. The separated liquid is sent to evaporation lagoons or is used for irrigation, and the solid fraction is used as soil improver. Nine large pig farms have installed a combination of anaerobic/aerobic treatment plants (Anaerobic digestion). The treated liquid fraction is used for irrigation, washing the housing areas or is placed in evaporation lagoons. The produced biogas is combusted onsite by Combined Heat Power generators for the production of heat and electricity. Both heat and electricity are consumed at the farms. Any excess electricity is sold to the electricity provider and directed to the electricity distribution network. Heat is not distributed outside the farm because there is no heat distribution network in Cyprus. The emissions from the electrical energy from the biogas used onsite and offsite has been taken into account in the energy sector according to the national energy balance. In the 2022 NIR, anaerobic digestion was calculated at 60% of waste management for 2020.

Anaerobic digestion is also practiced at cattle farms, calculated at a percentage of 5.0% in the NIR in 2020. The waste from sheep, goats, horses, mules and asses are collected and left to dry before being applied on land for soil improver (Solid storage and dry lot). Poultry waste is characterised by high content of solids (almost dry) and it is collected, left to dry and then used as soil improver (Solid storage and dry lot).

Manure management is responsible for methane and nitrous oxide emissions. Methane is produced during the anaerobic decomposition of manure, while nitrous oxide is produced during the storage and treatment of manure before its use as fertilizer. Emissions from manure management in 2020 accounted for 24.1% of the total agriculture emissions without LULUCF. CH₄ and N₂O from manure management in 2020 accounted for 17.2% and 37.1% of GHG emissions from Agriculture respectively. Total emissions in 2020 decreased by 13% compared to 1990 levels because of the improvement of waste management practices. All available studies show that there is a great potential in Cyprus to further promote anaerobic digestion for the treatment of waste with high organic content.

Even though anaerobic digestion is not clearly stated in the European or national legislation, the technology is preferred by large animal farms to comply with the terms stated on the wastewater and air emissions permits. The technology is strongly promoted by the Department of Environment, especially for the large installations that fall under the Industrial Emissions directive. Relevant national legislation that encourages the promotion of anaerobic digestion is (a) the Control of Water Pollution (Waste Water Disposal) Regulations 2003, Κ.Δ.Π. 772/2003; (b) the Control of Water Pollution (Sensitive Areas for urban waste water discharges) Κ.Δ.Π. 111/2004. It is a voluntary measure which is expected to increase. Therefore, it is considered important to further promote the use of anaerobic digestion for the treatment of animal waste.

4.2.5. Sectoral policies and measures: Waste (PaMs 9, 10)

Emissions from the Waste Sector in 2020 contributed 7% of the total emissions without LULUCF, 61% to the total methane emissions of the country without LULUCF and 7% to the total N₂O emissions without LULUCF. In 2020, 87% of the waste sector emissions are from solid waste disposal, 2% from biological treatment of solid waste and 11% from waste water treatment and discharge. The emissions from waste have changed considerably between 1990 and 2020 due to changes that are taking place in the waste and wastewater management practices of the country. For example, the emissions from Wastewater treatment and discharge between 1990 and 2020 decreased 44%, mainly due to the shift from septic tanks to centralised aerobic treatment systems for the treatment of domestic wastewater. Recycling and composting have been reducing the amount of waste disposal on land since 2010. Due to its dominance, the greatest emphasis of the policies and measures in the waste sector is reduction of emissions from solid waste disposal. A brief description of the situation of Cyprus' landfill follows, with full details on the trends in the waste sectors are available in the 2022 NIR.

A comprehensive study was undertaken in 2005 for the elaboration of a Strategic Plan, an Environmental study and a Feasibility study for the restoration and management of landfills. The purpose of the study was to record all landfills, assess their status and level of risk, create a restoration priority list based on pollution risk assessments, and undertake the appropriate environmental studies as well as feasibility studies for the restoration of the prioritized landfills. These studies were a necessary step for the restoration of all landfills recorded.

Two (2) landfills are still active in Cyprus but arrangements have been made in order for them to be closed and restored. According to recent data, these two landfills are fed with approximately 155,000 tonnes and 200,000 tonnes of municipality waste each year, respectively (reference year 2012).

Sixty-two (62) non sanitary landfills are planned to be restored appropriately within the following years. According to the preliminary study conducted in 2005, these landfills contain approximately 597,269 m³ of solid waste, excluding 2 major landfills that have not been closed yet.

Fifty-three (53) landfills have been restored the last five years and are being monitored. During their restoration a total of 4,902,000 m³ of solid waste were reallocated and properly buried using composite liners and leakage collection systems.

The EU landfill directive is fully harmonized in the national legislation but not fully implemented. Cyprus didn't manage to seize the operation of non-compliant landfills by 2009. Also, Cyprus has rehabilitated only 46% of its closed landfills.

With the EU Landfill Directive being the main guiding force, in combination to the improvement of the infrastructure of the country, Cyprus has developed and implementing during the recent years the revised strategy for municipal solid waste management. The implementation of the strategy is the responsibility of the Department of Environment.

The National Municipal Waste Management Plan of 2015-2021 (MWMP) contained quantitative and qualitative targets and enumerated specific measures and actions to be taken in order for the EU targets to be reached. One of the quantitative targets was that no more than 95,000 tonnes of biodegradable waste to be disposed in landfills (represents the 35% target of the 1999/31/EC directive). Also, the Legal Measures focused on the:

- Development of local waste prevention and management schemes
- Mandatory obligation for establishing separate collection systems by local authorities,
- Establishment of extended producer responsibility (EPR) in streams other than packaging waste,
- Establishment of a landfill tax/levy,
- Banning the disposal of certain waste streams from entering into landfills (e.g., green waste, high calorific value waste, etc.)

The adaptations of the strategy that were envisaged:

- a) One Sanitary Landfill and one Residual Sanitary Landfill (supplementing MBT unit at Koshi) were constructed and operated (both meet the requirements of directive 99/31/EC). The MBT unit was constructed and operated from 01/04/2010 serving Larnaca - Ammochostos districts. The Plant was designed in a way that a high separation of recycled and biodegradable material is achieved. Another I.W.M.P (Integrated Waste Management Plant) serving Limassol district is expected to be operated by the year 2018.
- b) The construction of the Green Point Network (22 collection points for the depositing of various waste streams out of households – bulky waste, green, textile, furniture, WEEE, etc.) is completed. The 4 Green Points, serving Paphos district are operated and the rest expected to be operated by 2018.
- c) Separate collection at source was promoted at households, from the existing collective system for the packing waste serving also and all types of paper, created under the packaging directive while the competent authority promotes the separate collection from other household streams such as other organic waste e.g. food and green waste.
- d) The construction works for the rehabilitation/restoration of the old non approved landfills, which are closed at Paphos and Larnaca - Ammochostos districts, were completed. The preparation of studies/documents regarding the rehabilitation/ restoration of the 20 non sanitary landfills of Nicosia district and the 44 sanitary landfills of Limassol district will be completed within 2018 and after that the construction works will begin.

The National Municipal Waste Management Plan of 2015–2021 (MWMP) has been updated with the new National Municipal Waste Manage Plan of 2022–2028. The latest plan includes further measures, actions and procedures to enable Cyprus' transition to a zero-waste economy. It contains quantitative and qualitative targets and enumerates specific measures and actions to be taken in order for the EU targets to be reached. One of the quantitative targets is that no more than 95,000 tonnes of biodegradable waste to be disposed in landfills (represents the 35% target of the 1999/31/EC directive). The measures accounted for the impacts from tourism, financial projections, separate collection and assumptions, limitations on the capacity of available infrastructure, and utilization/enhancement of existing infrastructure. The responsible authorities for the implementation of the SDDA are listed below, according to how they are detailed in the plan itself⁵³.

⁵³Ministry of Agriculture, Rural Development and Environment. Municipal Waste Management Plan 2022–2028. Pg. 7.

- The Environment Department of the Ministry of Agriculture, Rural Development and Environment acts as the competent authority for waste management.
- The Department of Water Development, of the Ministry of Agriculture, Rural Development and Environment coordinates the construction of the Green Points and the OEDA units and the restoration of the HADA.
- The Provincial Councils for Exploitation of Domestic Waste Disposal or Utilization Sites are the operators of waste disposal or utilization sites and, among other things, are responsible for the receipt, separation and treatment of municipal solid waste, including the management of treatment sites and transshipment stations.
- The Local Government Authorities, as responsible for the implementation of separate collection systems for municipal waste and Pay As You Go (POP). With the relevant clustering of Municipalities and Communities, ATA is expected to have increased responsibilities and powers in a wide range of issues, including municipal waste management, thus providing quality services to the citizen, separate collection and integrated management of their municipal waste.
- Obligated product producers and collective schemes of extended producer responsibility that fulfill the producer's obligations under the relevant legislation.
- Private sector waste treatment facilities and collectors/transporters of waste.

The legal measures, envisaged adaptation strategies, and details on the outcomes of the strategic plan for restoration and management of landfills are outlined in the previous national communication. The Waste Framework Directive, 2008/98/EC, was amended in 2018 to strengthen waste prevention and management, with the main Cyprus legislation for waste management consisting of Waste Law N. 185(I)/2011 and its amendments⁵⁴.

The new municipal waste plan also provides an update of waste sent to landfills, and the general operating status of Cyprus landfills⁵⁵. Out of the total 542,840 tons of municipal waste generated in 2020, 364,140 tons were sent to landfills. Operations for the last two illegal uncontrolled waste disposal sites ended in February 2019. The OEDA Limassol in Pentakomos has been in operation since 2017, while the OEDA Larnaca-Famagusta in Kosi has been in operation since 2010. With the closure of the Kosiatis site, the Kosi site has been accepting the mixed municipal waste from the Nicosia District since November 2018. Municipal waste from Limassol, Larnaca-Ammochostos and Nicosia are transferred to the Integrated Waste Management Facilities in Pentakomos and Kosi, while Paphos mixed waste is transferred to the landfill site in Paphos without pre-treatment. While it was determined that construction of additional mechanical-biological treatment units in Paphos and Nicosia are not necessary, the possibility of transferring the mixed waste of Paphos is under consideration.

Cyprus has no hazardous waste landfill. Some hazardous waste is collected and exported for further processing, while some is used for energy recovery at the Vasilikos Cement Plant. The Cement plant uses some tires and sludge as alternative fuels, along with municipal waste streams.

The key features of the strategy that have been included in the GHG reduction Policies and Measures are the following:

- Reduction of waste to solid waste disposal sites from sorting at production level, with recycling of at least 55%, 60%, and 65% of municipal waste by weight by 2025, 2030, and 2035
- Reduction of organics to landfills
- Increase of amount of organic wastes treated by composting
- Promotion of anaerobic digestion for the treatment of the organic fraction of the municipal solid waste and industrial solid waste

Biogas recovery from old landfills during their restoration is also considered.

⁵⁴ Ministry of Agriculture, Rural Development and Environment. Municipal Waste Management Plan 2022–2028. Pg. 11.

⁵⁵ Ministry of Agriculture, Rural Development and Environment. Municipal Waste Management Plan 2022–2028. Pg. 13.

4.2.6. Sectoral policies and measures: LULUCF mitigation activities

The Department of Forests (Ministry of Agriculture, Rural Development and Environment) is implementing a plan to increase forest tree production from its nurseries for planting in now non-forested lands. The campaign is titled “I plant for Climate” and is directed towards public or private organizations such as municipalities, churches, schools, NGOs and firms who wish to forest public or privately owned lands and who will agree to be responsible to provide the funds and care (i.e. water) of these areas for a minimum of three years. The Department of Forests, after evaluating the applications, will be providing the trees for free, taking into account the area of the plot and the specificities of the location, i.e. elevation. The plants supplied will be selected from a specific list of mostly indigenous, non-invasive species that are suited to the climatic conditions of Cyprus such as: *Pinus brutia*, *Cupressus sempervivines*, *Quercus spp.*, *Juniperus spp.*, *Tamarix spp.*, *Laurus nobilis*, *Ceratonia silique*, *Myrtus nobilis*, *Nerium oleander* and *Rosmarinus officinalis*. The scheme starts from around 70,000 trees in 2020 and is planned to reach 300,000 trees planted per year in 2030.

Moreover, the Ministry of Transport, Communications and Works (MCTW) is examining a project for planting of trees along urban and inter-urban roads of Cyprus. According to MCTW, up to one million trees can be planted next to roads by 2030. MCTW’s proposal estimates a cost of 72 million Euros for creation of the infrastructure for the one million trees (not including watering and maintenance costs).

In addition, the policies included in the national adaptation strategy, such as addressing the increased risk of forest fires and installation of a monitoring system for pest populations with the ultimate aim of identifying a potential outbreak/ monitoring of pest populations in a timely manner are expected to contribute to the maintenance of forested areas and therefore maintain the CO2 absorption rate by the national forests.

4.2.7. Policies and Measures included in the impact assessment

The effect of Cyprus’ policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases than would otherwise occur, were evaluated in Cyprus’ NECP 2021-2030. More specifically an impact assessment was undertaken to produce the projected impacts of WEM and WAM scenarios on the energy mix and emissions. The outputs of the cost optimisation model were employed for the two scenarios until 2030 and are subject to technical constraints, development plans and policy options conveyed to the project team by the authorities.

The measures that were included in the impact assessment for WEM scenario and separately for the WAM scenario are listed in Table 4.3.

Table 4.3 Policies and Measures included in the impact assessment

WITH EXISTING MEASURES SCENARIO			
ADOPTED		IMPLEMENTED	
RES	Support scheme for the production of electricity from renewable energy sources for own use Category A:Net-metering	RES	Support scheme for the production of electricity from RES-Feed-in Tariffs for RES installations
RES	Support scheme for the production of electricity from renewable energy sources for own use Category A:Net-billing	RES	Support scheme for the promotion of renewable energy sources and energy saving
RES	Self-consumption of electricity from renewable energy sources	RES	Thermal Conductivity MAP and Ground Temperatures up to 100m depths using neural networks
RES	Stand alone RES systems	RES	Map for Water Depth around the island for offshore wind parks. Preliminary study contacted for wind speeds around the island
RES	Installation of net-metering PV systems in houses of vulnerable consumers	EE	Support Scheme for promoting energy audits in SMEs
RES	Support scheme for the installation or replacement of solar water heaters in households	EE	Grant Scheme for promoting roof thermal insulation and encouraging the use of RES (end use) in the residential sector

RES	Rural development programme 2014-2020 of the Ministry of Agriculture, Rural Development and Environment.	EE	Minimum energy performance requirements for new and existing buildings, requirements for technical building systems installed in existing buildings, inspections for heating systems and a/c systems
RES	Support scheme for the installation of RES systems that will operate in the competitive electricity market	EE	Support scheme encouraging the use of RES (end use) in the residential, tertiary, industry and agriculture sector (primary consumption energy savings)
RES	Incentives for encouraging the use of RES in different types of developments.	EE	Energy efficiency obligations in public purchases and national green public procurement action plan.
RES	Certification of small-scale RES system installers	EE	Implementation of measures aimed at attaining energy savings in existing public buildings (annual obligation)
RES	Research and innovation programs in the sector of RES	EE	RES& EE fee applied on electricity consumption.
RES	Renewable Energy Communities	EE	Motor vehicle taxes based on CO2 emissions.
RES	25% RES in new Buildings	EE	Integrated Fleet Management System (Central Government vehicles)
RES	Create localised tools for selecting the appropriate PV size and scheme	EE	Technical guidance promotion of NZEB and electronic tool kit for consumers
EE	Energy efficiency Obligation scheme	EE	Energy taxes in road transport fuels
EE	Financing tool providing soft loans for energy efficiency investments	EE	Financing measures for energy efficiency in existing hotels and agricultural sector
EE	Solar water heater replacement scheme	EE	Energy efficiency network with voluntary agreements of businesses to reduce their energy consumption
EE	Increase of energy efficiency in electricity generation due to the increase of efficiency and the switching of the fuel to natural gas (primary consumption energy savings)	EE	Applying a lower VAT rate for the renovation and repair of private dwellings.
EE	Financing tools for energy efficiency investment using European Structural and Investment Funds in the new Programming Period 2021 – 2027	EE	Net billing Scheme for high efficiency cogeneration (HECHP)
EE	Individual energy efficiency interventions and energy efficiency retrofits in selected governmental and municipal buildings	EE	Pilot projects for installing high efficiency cogeneration in public buildings
EE	Energy efficient street lighting	EE	Energy efficiency in electricity infrastructure by upgrading the medium nominal voltage of 11kV to 22kV in selected areas.
EE	Sustainable Urban Mobility Plans (Increasing the share of cycle, pedestrian and PT trips, increase use of busses)	EE	"Park and drive stations" for the use of public busses instead of private cars
EE	Targeted awareness raising actions for energy efficiency	EE	Grant schemes for promoting deep renovation in residential and commercial buildings
EE	Smart meters roll out	EE	Obligatory energy audits in non-SMEs
EE	Use of buses that have low or no GHG emissions	EE	Effective market surveillance for energy labelling of energy related products, tyres and eco design.
EE	Installation of public electric car charging stations	EE	Capacity building, targeted trainings, information workshops and events, promotion of energy managers in public buildings and enterprises
EE	Minimum energy performance requirements for new and existing buildings, requirements for technical building systems installed in existing buildings, inspections for heating systems and a/c systems-revised	EE	Use of telematic system for public busses
SEC	Ministerial Decision 77.286 on 16/11/2014 for the establishment of the Energy and Industrial Area of Vasilikos	EE	Additional floor space "allowance" for new and renovated buildings with higher energy efficiency than minimum energy performance requirements

SEC	Ministerial Decision 77.286 on 16/11/2014 for concession to the KODAP suitable land in the Vasilikos area for the construction of privately owned oil terminal storage	SEC	Tender announcement for the LNG Import Terminal.
EM	Electricity Interconnectivity of Cyprus	SEC	Ministerial Decision ΚΠΑ 212/2014 for holding of emergency oil stocks equivalent to 90 days of net imports of petroleum products.
IEM	Cyprus TSO Ten Year Network Development Plan 2019-2028 according to Article 63 of the Laws for the Regulation of the Electricity Market from 2003 to 2017.	SEC	Ministerial Decision 84.952 on 14/5/2018 for the Signing of a Memorandum of Understanding and Agreement between the Government of the Republic of Cyprus and the Companies Marketing Petroleum Products, namely BP Eastern Mediterranean Ltd, ExxonMobil Cyprus Ltd, Hellenic Petroleum Cyprus Ltd, Intergaz Ltd, Petrolina (Holdings) Public Ltd and Synergaz Ltd for the relocation of petroleum and liquefied petroleum gas installations from the Larnaca coastline to the Vasilikos area
IEM	Regulatory Decision 05/2017 on the Implementation of a Binding Schedule for the Full Implementation and Operation by the DSO of the Meter Data Management System (MDMS).	SEC	1. Single Action Plan for the restoration of the electrical system after power blackout, 2. Setting certain Quality of Electricity Supply Indicators
IEM	Regulatory Decision 02/2018 on the Implementation of a Binding Schedule for the Mass Installation and Operation by the DSO of Advanced Metering Infrastructure (AMI).	IEM	MoU between the countries of Cyprus, Greece, Israel and Italy (05/12/2017, Nicosia).
IEM	Ministerial decision that dedicates MECI as National Competent Authority (NCA). NCA is responsible to implement all the necessary actions in order to achieve real priority status for PCIs in public sector.	IEM	Ministerial Order (no. K.D.P. 289/2015) regarding the energy poverty, the categories of vulnerable customers of electricity and the measures to be taken to protect such customers.
IEM	Ministerial decision that dedicates MECI as NCA. NCA is responsible to ensure the transparency and public participation before and during permit granting process and publish a manual of procedures applicable to projects of common interest.	TRA	Increasing the share of cycle, pedestrian and PT trips
IEM	Ministerial decision that dedicates MECI as NCA. NCA is responsible to develop the NCAs' website "OneStopShopPCIs".	TRA	Motor vehicle taxes based on CO2 emissions.
IEM	Financial assistance for the Preparation of the Natural Gas Market in Cyprus- Cynergy programme	TRA	Revised motor vehicle taxes based on CO2 emissions.
IEM	Financial assistance of PCIs	TRA	Integrated Fleet Management System (Central Government vehicles)
IEM	Regulatory Decision 01/2017 on the Implementation of a Binding Schedule for the Full Commercial Operation of the New Electricity Market Model.	TRA	Replacement of the conventional transport fuels with biofuels
TRA	Installation of public charging stations	R&I	RESTART 2016 - 2020
R&I	Energy efficiency network with voluntary agreements of businesses to reduce their energy consumption	R&I	Grant Scheme to Enhance Business Innovation
		R&I	European Territorial Cooperation Programs - INTERREG
		R&I	Climate-KIC
		R&I	Horizon 2020

		R&I	LIFE
		AGR	Promotion of anaerobic digestion for the treatment of animal waste
		IEM	NCA has accepted the EuroAsia Interconnector application file for the starting of the statutory permit granting procedure
		IEM	Ministerial Decision for the establishment of the trilateral cooperation secretariat, on 21/11/2018 (Cross Border collaboration between Cyprus, other Member States and third countries involved in the PCIs)

WITH ADDITIONAL MEASURES SCENARIO			
PLANNED		PROVISIONAL	
RES	Support scheme for the installation of net-metering photovoltaic systems with capacity up to 20KW, in public schools buildings.	RES	Framework for Repowering of existing RES systems
RES	Support scheme for storage units	RES	Support Scheme for RES in order to promote innovation and reduce CO2
RES	District heating and cooling based on RDF fired cogeneration technologies in tourist areas and rural areas	RES	Statistical Transfer Study and taking advantage of Union Development Platform (Article 8.2)
RES	Subject to Electricity Interconnection open support schemes for other MS	RES	Energy Storage, Further analysis for both behind the meter and central storage for further Penetration of RES (Vehicle to Grid option and smart charging)
RES	Develop a political and technical framework for one stop shop procedure for RES projects	RES	Contact Surveys to measure the existing heat pumps Performance and provide incentives for reporting the replacement of old heat-pumps
RES	Create a financing mechanism in the sense of soft green loans to support further the RES developments in household section	RES	70% RES on all new buildings from on net annual consumption
RES	Renewable Energy Communities, develop framework and incentive mechanisms	RES	Incentive Scheme for process heat RES Systems (CSP) to heavy industrial process
RES	Improve forecasting modelling tool for Weather to Energy production using Real Time Satellite measurements and Real time output measurements from the RES plants. Correlation between PV and Wind on forecasting errors	RES	Conduct studies by Wind Association for offshore floating Wind Parks in Cyprus Exclusive economic zone
RES	Virtual net metering for multiapartment buildings and for Buildings that they do not have enough space for installing on premises the required PV System	RES	Hybrid GAS turbine with CSP and natural GAS or diesel with storage option
RES	Renewable Cooling Measures - Vapour compression cooling systems, Single Split Devices, Multi Split Devices, Reversible heat Pumps, Photovoltaic Cooling, etc based on minimum requirements on efficiency of the cooling system	EE	Efficient district heating and cooling based upon RDF fired cogeneration technologies in tourist areas (primary energy savings)
RES	Create a framework for water to air and ground to air open loop geothermal systems based on technical potential available	EE	Introduction of environmental fees for the use of the road network
EE	Uptake of energy performance procurement in public sector by removing procurement hurdles	R&I	European Structural and Investment Funds in the new Programming Period 2021 – 2027

EE	Removing barriers that impede the uptake of energy performance contracting and the implementation of energy efficiency investments in general	R&I	Increase of the annual spending in research and innovation related to energy and climate in order to reach an average of 15m Euros per year
EE	Energy efficiency in defence and water sector	R&I	Contact surveys and methodology (or simple online software tools) for tracking down the various white appliances that are directly related with the RES technologies
EE	Fiscally neutral green tax reform by increasing environmental taxes while reducing labor taxation	TRA	Increase the use of cars that have low or no GHG emissions
EE	Scheme to subsidize realised CO2 emission reductions for companies that participate to the Energy efficiency network	IEM	Development of natural gas network pipeline infrastructure in Cyprus
EE	Preparation of the corridor and future development of a tram infrastructure		
EE	Additional floor space "allowance" for new and renovated buildings with higher energy efficiency than minimum energy performance requirements -Revision		
IND	Preparation of the proper recovery system for F-gases in equipment		
WST	Reduction of waste to solid waste disposal sites from sorting at production level		
WST	Reduction of organics to landfills		
WST	Promotion of anaerobic digestion for the treatment of the organic fraction of the municipal solid waste		
WST	Biogas recovery from old solid waste disposal sites (deep unmanaged)		
IEM	Regulatory Decision on Storage Systems that are installed before the metering point.		
IEM	Amend the national law to enable operation of the electricity market and make the Market Operator/TSO independent from the vertically integrated electricity company		
IEM	Amend Trade and Settlement Rules and Transmission and Distribution Rules to allow for Demand Response in the market according to Art. 15(8) Directive 2012/27/EU		
TRA	Increase the use of buses that have low or no GHG emissions		
TRA	Increasing the share of cycle, pedestrian and PT trips		
TRA	Enhance planting of trees		
R&I	Financing tool for energy efficiency investment		
R&I	Support schemes to promote energy efficiency investments in agricultural sector		
R&I	Fiscally neutral green tax reform by increasing environmental taxes while reducing labour taxation		
AGR	Further promotion of anaerobic digestion for the treatment of animal waste		
RES/IEM	Citizen Energy Communities		

RES	One-stop Shop for the permitting procedure of RES systems Digital Application		
IEM/ RES	Introduction of Smart Systems/Meters in the Electricity network for grid management and empowering Consumers		
IEM/ RES/ EE	Dynamic Electricity Tariffs (hourly/half hourly		
IEM/ RES	Investigation/Study on Capacity Mechanisms/Regulation		

4.2.8. Activities that lead to higher GHG emission level

Some of activities that lead to higher GHG emission level are:

(a) Composting is considered as a practice that could lead to greater anthropogenic GHG emissions. However, is still under examination how and where and whether is going to be promoted or implemented as a waste management practice for the biodegradable waste.

(b) Due to electricity shortages at the current times, old electricity production units that were going to be disengaged are currently used to meet the electricity demand.

(c) Halloumi cheese is a local cheese that has been recently received the characterisation of "protected designation of origin". This is expected to increase the exports of the particular product the therefore the need for milk production and consequently animal populations to meet this demand.

(d) Cyprus is currently investigating the availability of natural gas within its exclusive economic zone. If natural gas is discovered, the policy that has been decided is to liquify the natural gas into LPG and export it, an activity with high energy demand and consequently high emissions.

Cyprus, to identify and review the activities that lead to higher GHG emission level undergoes public discussions and the opinion of the Department of Environment is requested. Once the proposal is received, an ad-hoc team of experts from all the units at the Department of Environment is setup, to examine the proposal with respect to all the policies managed by the Department of Environment. When the examination of the proposal is completed, the official opinion of the Department of Environment is sent to the responsible authority for proposal, which also includes the opinion with regards to impact of the specific proposal to the GHG emissions of the country.

4.3. EU policy on climate change⁵⁶

This section describes some of the key over-arching strategies and programmes that guide the EU policy-making process on climate change. Further details on these are available in the National Communication of the European Union⁵⁷.

4.3.1. Key developments

The cornerstones of the EU climate change mitigation policies are the following:

- The EU ETS was one of the main instruments that helped reduce GHG emissions in the period from 2013 to 2020. For the period up to 2030, the annual reduction of the emissions cap was strengthened

⁵⁶ C(2022) 6298 REPORT FROM THE COMMISSION Eighth National Communication and Fifth Biennial Report from the European Union under the UN Framework Convention on Climate Change (UNFCCC) (required under the UNFCCC and the Kyoto Protocol); available at <https://unfccc.int/documents/624694>

⁵⁷ C(2022) 6298 REPORT FROM THE COMMISSION Eighth National Communication and Fifth Biennial Report from the European Union under the UN Framework Convention on Climate Change (UNFCCC) (required under the UNFCCC and the Kyoto Protocol); available at <https://unfccc.int/documents/624694>

and the market stability reserve (the mechanism to reduce the surplus of emission allowances in the carbon market) was reinforced. The EU ETS is currently under revision to ensure that it will contribute substantially to the EU's new 2030 target.

- The Effort Sharing Decision provided emission target paths for EU Member States which they had to follow in the period 2013-2020. Most EU Member States overachieved their targets, while some made use of flexibilities provided by the system to achieve their targets. For the period up to 2030, the Effort Sharing Regulation provides new target paths with more ambitious emission reductions. This Regulation is also under revision to ensure that it will be in line with the EU's new 2030 target.

Other cross-sectorial policies are the following:

- The Methane Strategy sets out measures to cut methane emissions, including in Europe. It presents legislative and non-legislative actions in the energy, agriculture and waste sectors, which account for around 95% of methane emissions associated with human activity worldwide.

- Policies for sustainable carbon cycles are being implemented, setting out how to increase removals of carbon from the atmosphere. Short- to medium-term actions are set out to support carbon farming and upscale green business model to better reward land managers for carbon sequestration and biodiversity protection. By 2030, carbon farming initiatives should contribute 42Mt of CO₂ storage to Europe's natural carbon sinks. New industrial value chains for sustainable capture, use, transport and storage of carbon are also promoted, including through the creation of a market for capture, use and storage of CO₂. A robust certification system to reward carbon removals has been announced for 2022.

In the various sectors, the following key developments took place in recent years:

Energy:

- The amended Energy Efficiency Directive is the main legal provision addressing energy efficiency in the EU. The amendment introduced a new headline EU energy efficiency target for 2030 of at least 32.5% (relative to the 2007 consumption projections). The Directive is under revision and, among other things, a higher target for reducing primary and final (energy consumption has been introduced for 2030.

- The EU Energy Performance of Buildings Directive is the main legal provision addressing energy efficiency increases in buildings. A major goal of the amended directive is to accelerate the renovation of the existing building stock through strengthened long-term renovation strategies and the mobilisation of related investments. The European Commission proposed a revision of this Directive which aims at contributing to meeting the target of at least -60 % emission reductions by 2030 in the building sector in comparison to 2015 and sets out how Europe can achieve a zero-emission and fully decarbonised building stock by 2050.

- The recast Renewable Energy Directive is the main legal provision addressing the use of renewable energies in the EU. It includes a binding renewable energy target for the EU for 2030 of at least 32 % for the overall share of energy from renewable sources in the EU's gross final consumption of energy in 2030. To meet the higher climate ambition, the European Commission proposed a revision of the Renewable Energy Directive, which seeks to increase the current target to at least 40 % renewable energy sources in the EU's overall energy mix by 2030.

- The EU Methane Strategy adopted in 2020 outlines a comprehensive policy framework addressing methane emissions in the energy, agriculture and waste sectors. The EU also promotes the mitigation of methane emissions internationally, e.g. under the Global Methane Pledge. To reduce methane emissions in the energy sector, a proposal provides for improved measurement, reporting and verification of energy sector methane emissions and for immediate reduction of emissions through mandatory leak detection and repair and a ban on venting and flaring.

Transport:

- Regarding passenger cars, the most important legal provision is the regulation which sets CO2 emission performance standards for cars and vans. This regulation sets EU fleet-wide CO2 emission targets that apply from 2020, 2025 and 2030 and includes a mechanism to incentivise the uptake of zero- and low-emission vehicles. This regulation is currently under revision with a view to a 100 % CO2 reduction for new cars and vans from 2035 onwards.
- As for freight transport, the regulation setting CO2 emission performance standards for heavy duty vehicles is the most significant legislation. This regulation sets CO2 reduction targets of 15 % in 2025 and 30 % in 2030 compared to the EU average in the reference period (July 2019 to June 2020).
- The Renewable Energy Directive is also relevant for transport. The current Directive aims to accelerate the uptake of renewable energy in the transport sector with the aim of achieving a 14 % share of renewable energy in transport by 2030. A proposal of the European Commission introduced a target for reducing the greenhouse gas intensity of transport fuels by 13 % by 2030. Moreover, the proposal includes additional sub-targets for advanced biofuels and for renewable fuels from non-biological origin.

Industry:

- The Industrial Emissions Directive is the main EU instrument for preventing and reducing pollution from over 30 000 large industrial plants and over 20 000 intensive livestock farms in Europe. The IED is also relevant for greenhouse gas emissions abatement as it regulates industrial emissions to the extent that they are not covered by the EU ETS, methane emissions from livestock installations, and indirect greenhouse gases and short-lived climate forcers. In April 2022, a revised Directive was proposed with several main elements related to decarbonisation: Inclusion of energy efficiency requirements as integral part of permits; inclusion of the largest livestock farms representing 43% of the EU's livestock methane emissions; and more transparent reporting of fluorinated gas emissions. The REPowerEU Plan presented by the European Commission in 2022 in response to the global energy market disruption caused by the Russian Federation's invasion of Ukraine proposes measures to bring down emissions and energy costs for consumers and industry including by accelerating the roll out of renewable energy projects.
- The main legal provision for reducing fluorinated gas (F-gas) emissions in the EU is the Fgas Regulation. This regulation limits the total amount of the most important F-gases that can be sold in the EU from 2015 onwards and phases them down in steps to one-fifth of the baseline in 2030. In April 2022, a proposal was made to update the F-gas Regulation with a view to reducing the amount of hydrofluorocarbons placed on the market by 98 % by 2050 (compared to 2015).

Agriculture:

- Under the previous CAP period which ended in 2020, the EU already promoted several climate relevant actions. However, an evaluation in 2021 showed that the mitigation effects are very difficult to quantify due to limited data availability and the complexity of the implementation architecture.
- The new CAP period will start in 2023 and will increase the emphasis on climate action. 40 % of the total budget will be dedicated to climate-related measures, including improved rules and monitoring requirements.
- In the context of the Green Deal, the EU has put in place several strategies and plans to reduce emissions in the agriculture sector with concrete targets to reduce nutrient losses and fertilizer application and to increase the area of organic farming.
- The Methane Strategy includes measures to improve reporting of emissions from agriculture through better data collection, and to promote opportunities to reduce emissions with support from the Common Agricultural Policy. The main focus is put on best practice sharing for innovative methane-reducing technologies, animal diets, and breeding management.

LULUCF:

- The LULUCF sector has become increasingly important in the context of the EU climate targets and the Green Deal. In recent years, the EU prepared for a robust monitoring and accounting framework of the LULUCF sector which is applied from 2021 onwards. The current legislative proposal foresees an EU-wide mitigation target of -310 million tonnes of carbon dioxide equivalent (Mt CO₂eq) in 2030, the implementation of national LULUCF targets for Member States for 2030 and a better integration better integration of mitigation, adaptation and nature restoration measures in land monitoring systems.
- In addition, the EU has launched several initiatives and strategies to increase carbon removals on the one hand and to improve land management on the other hand in the decades ahead, e.g., through carbon farming practices and new forestry, soil and biodiversity strategies.

Waste:

- The waste policy framework of the EU has been continuously extended and elaborated to address different waste streams. The EU aims to further strengthen the circular economy to reduce material use rate and to significantly reduce waste generation in the EU. To achieve these objectives, new strategies targeting plastic waste and textiles have been published recently; existing waste legislation was or is going to be amended; and, in the context of the Waste Framework Directive, separate waste collection will be enforced (e.g. for biowaste, textiles, hazardous waste and plastic bottles).
- The Methane Strategy includes action to improve the management of landfill gas, harnessing its potential for energy use while reducing emissions, and aims to minimize the disposal of biodegradable waste in landfills to avoid methane formation.

4.3.2. 2020 Climate and Energy Package

The 2020 Climate and Energy Package was formally adopted in 2009 and for the first time provided an integrated and ambitious package of policies and measures to tackle climate change. It includes the 20-20-20 targets, which set the following key objectives:

- To reduce greenhouse gas emissions by at least 20% compared to 1990 by 2020, with a firm commitment to increase this target to 30 % in the event of a satisfactory international agreement being reached;
- To achieve 20% of energy from renewable sources by 2020 (as a share of total EU gross final energy consumption), supplemented by a target to achieve a minimum of 10 % renewable transport fuel;
- To save 20% of total primary energy consumption by 2020 compared to a business-as-usual baseline.

These are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth⁵⁸. In order to meet these key objectives, the Climate and Energy Package comprises four pieces of complementary legislation:

- A Directive revising the EU Emissions Trading System;
- An Effort-Sharing Decision setting binding national targets for emissions from sectors not covered by the EU ETS;
- A Directive setting binding national targets for increasing the share of renewable energy sources in the energy mix;
- A Directive creating a legal framework for the safe and environmentally sound use of carbon capture and storage technologies.

The package was complemented by two further legislative acts that were agreed at the same time: A regulation requiring a reduction in CO₂ emissions from new cars and a revision of the Fuel Quality Directive. The Energy Efficiency Directive was adopted in 2012 to help achieve the energy efficiency target.

4.3.3. 2030 Climate and Energy Framework

The European Union's 2030 Climate and Energy Framework was put in place to ensure that the EU and its Member States achieve their climate change mitigation commitments under the Paris Agreement,

⁵⁸ <http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A52010DC2020>

as communicated in the EU's NDC. The main elements of the 2030 Climate and Energy Framework are the EU ETS, the Effort Sharing Regulation and the LULUCF Regulation.

The 2030 Climate and Energy Framework was first established in line with the EU's original NDC of 2015, which stipulated a 40 % reduction of GHG emissions by 2030 compared to 1990⁵⁹. In 2020, the EU and its Member States updated their NDC and committed to a net GHG emission reduction of at least 55 % by 2030 compared to 1990⁶⁰. While the policies and measures currently in place were developed in line with the target of the first NDC of the EU, they are now in the process of a revision to make them fit for the -55 % target communicated in the updated NDC. A comprehensive set of proposals was presented by the European Commission in July 2021⁶¹.

The key elements of these proposals are:

- more rapid emission reductions in the period up to 2030 under the EU ETS;
- a strengthening of the emission reductions to be achieved by EU Member States by 2030 under the Effort Sharing Regulation;
- strengthened renewable energy and energy efficiency targets;
- various updates to existing legislation, such as stricter CO2 emission standards for cars and
- new proposals, including a carbon border adjustment mechanism and a social climate fund. Based on these proposals, major new legislation is in the process of being finalised by the European Parliament and the Council.

These policies and measures show various interactions. As an example, transport policies such as CO2 emission standards contribute to the reduction of greenhouse gas emissions in the transport sector and hence help Member States achieve their overall emission reduction targets under the Effort Sharing Regulation. As another example, the EU ETS provides an incentive to switch from fossil fuels to renewable electricity generation. Hence, it contributes to the achievement of the renewable energy target. The monitoring and evaluation of progress constitutes an important aspect of the 2030 climate and energy framework. With the Regulation on the Governance of the Energy Union and Climate Action ('Governance Regulation')⁶², the EU has adopted integrated rules to ensure planning, monitoring and reporting of progress towards its 2030 climate and energy targets and its international commitments under the Paris Agreement. The Governance Regulation requires EU Member States to communicate and implement Integrated National Energy and Climate Plans and to regularly report on their progress in implementing them. The Governance Regulation also lays out the detailed reporting obligations on GHG emissions, policies and measures, projections, adaptation and support provided to developing countries.

The impact on costs and non-GHG mitigation have been assessed during the preparation of the National Energy and Climate Plan 2021-2030⁶³, which includes the PaM presented in the NC8/BR5. The NECP is

⁵⁹ Intended Nationally Determined Contribution of the EU and its Member States, <https://unfccc.int/sites/default/files/LV-03-06-EU%20INDC.pdf>

⁶⁰ The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2022-06/EU_NDC_Submission_December%202020.pdf

⁶¹ Delivering the European Green Deal, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-greendeal/delivering-european-green-deal_en

⁶² Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, <http://data.europa.eu/eli/reg/2018/1999/oj>

⁶³ The national Energy and Climate Plan 2021-2030 [http://www.moa.gov.cy/moa/environment/environmentnew.nsf/all/EE3E8BE9D5282E5CC22584F700273BD9/\\$file/submission.zip?openelement](http://www.moa.gov.cy/moa/environment/environmentnew.nsf/all/EE3E8BE9D5282E5CC22584F700273BD9/$file/submission.zip?openelement)

currently under revision to include and additional measures towards achievement of the new national target of -32% compared to 2005 by 2030.

4.3.3. The EU's long-term strategy and the climate law

In addition to the 2030 target, the EU and its Member States committed to the objective of a climate-neutral EU by 2050. This objective was agreed by the European Council in December 2019 and communicated as the EU's long-term low greenhouse gas emission development strategy under the Paris Agreement in March 2020⁶⁴. With the submission of its long-term strategy, the EU became the first large economy that committed to climate neutrality. Besides the EU as a whole, several Member States communicated their own long-term strategies under the Paris Agreement⁶⁴. The binding objective of climate neutrality by 2050 is enshrined in the European Climate Law⁶⁵, which entered into force in July 2021. The European Climate Law also contains the 2030 climate target of reducing domestic emissions by at least 55 % compared to 1990. It constitutes a net target, i.e. removals of CO₂ from the atmosphere are taken into account. However, the total amount of removals which can be counted towards the achievement of the target is limited to a maximum of 225 Mt CO₂eq. The European Climate Law also lays out the process for developing the 2040 climate target, which will take into account an indicative greenhouse gas budget for the period 2030 to 2050. Finally, the European Climate Law establishes a European Scientific Advisory Board on Climate Change, requires the adoption of adaptation strategies and lays out the rules for assessing the progress towards the climate targets.

Cyprus proceeded with the preparation of the Low Emissions Long Term Strategy⁶⁶ which was submitted to the European Commission and to the UNFCCC secretariat in September 2022. This strategy intensifies measures and policies foreseen within the NECP as well as additional measures and policies, which have been impact-assessed. Climate neutrality is achieved through an additional scenario (Ambitious).

4.3.4. The Environment Action Programmes

The overall environmental policy of the European Union is guided by Environment Action Programmes. The 7th Environment Action Programme addressed the period up to 2020. It identified the key objectives to protect, conserve and enhance the EU's natural capital, to turn the EU into a resource-efficient, green and competitive low-carbon economy and to safeguard the Union's citizens from environment-related pressures.

An evaluation of the action programme in 2019 found that it has been an important governance tool and has facilitated a shift in policymaking by recognising that climate and environmental protection is a driver for green growth, a healthy planet and improved wellbeing for individuals.

The 8th Environment Action Programme, which entered into force in May 2022, constitutes the EU's legally agreed common agenda for environment policy up to 2030. It contains six priority objectives, several of which are directly related to climate action:

- to achieve the 2030 GHG emission reduction target and climate neutrality by 2050;
- to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change;
- to advance towards a regenerative growth model, decoupling economic growth from resource use and environmental degradation, and accelerating the transition to a circular economy;

⁶⁴ Communication of long-term strategies, <https://unfccc.int/process/the-paris-agreement/long-term-strategies>

⁶⁵ Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), <http://data.europa.eu/eli/reg/2021/1119/oj>.

⁶⁶ https://ec.europa.eu/clima/sites/lts/lts_cy_en.pdf

- to pursue a zero-pollution ambition, including for air, water and soil and protecting the health and well-being of citizens;
- to protect, preserve and restore biodiversity, and enhance natural capital; and
- to reduce environmental and climate pressures related to production and consumption.

The European Commission, supported by the European Environment Agency and the European Chemicals Agency, monitors, assesses and reports annually on progress on these priority objectives. A mid-term evaluation will be completed by 2024, and a full evaluation by 2029.

4.3.5. Measures promoting sustainable development

4.3.5.1. Progress towards the UN Sustainable Development Goals (SDGs)

Amidst an unprecedented new reality brought about by the pandemic, the high energy prices and the War in Ukraine, we need to embrace the new opportunities that arise, and face the challenges with strength and resilience. With the aim to build forward better, we plan to work together in a spirit of collaboration and solidarity towards the universal implementation of the 2030 Agenda for a sustainable planet for all. All these multiple and interlocking crises facing the World are not conducive to achieving the UN SDGs. On the contrary, the war in Ukraine, the high energy prices with the resulting high inflation and the overall growing economic uncertainty are adding to the obstacles to advance the 2030 Agenda. As 2023 marks the halfway point to 2030, policies and innovative solutions are needed to accelerate SDG progress and cushion the impacts of the crises.

Recognizing the urgent need to accelerate action on all levels and by all stakeholders, in order to fulfil the vision and Goals of the 2030 Agenda, measures are being promoted along the following lines:

- (i) We have secured technical assistance from UNITAR, through EU funding, for the project “Implementation and mainstreaming of the SDGs in the national policy framework in Cyprus”. Recommendations resulted in the adoption of a “whole-of-Government” and a “whole-of-society” approach, acknowledging the potential of a systemic and holistic approach. Thus, we have adopted an **enhanced governance mechanism**, promoting collaboration on policy design and implementation, to reflect critical interactions between different Goals over short-term, medium, and long-term horizons. The project also offered training to the lead Ministries for each SDG, thus enabling them to carry out the required actions in their area of competence.
- (ii) A second component of the work by UNITAR, was the preparation of an SDG Action Plan for 2022-2025, with detailed recommendations and proposed actions for the upcoming years, that will help address the areas of the SDGs where Cyprus is lacking behind. In this context recommendation were also made to improve the social component of the Long-term strategy (LTS) on sustainable growth of the Cyprus economy, that defines the national vision & goals for 2035.
- (iii) Towards realising the “whole-of-society” approach and recognizing the need to involve all stakeholders, in fulfilling the vision and Goals of the 2030 Agenda, we have prepared a platform where Stakeholders will upload each activity they implement, which contributes towards the achievement of the SDGs, serving as best practice to others. It will also provide useful information on the level of progress and existing challenges for SDG implementation in Cyprus and best practices from other countries.
- (iv) An important component of increasing the involvement of stakeholders is awareness raising, so a communication strategy has been designed by UNITAR, in the context of the above project and now, we are in the process of designing implementation actions, with the help of local experts.
- (v) Finally, the European Funds of the 2023-2030 period have been used extensively to promote and finance important reforms and programs, in most areas where gaps and underperformance in the SDGs have been identified. Most importantly the Recovery and Resilience Plan (RRP) and the Cohesion Funds promote reforms and investments that aim to improve:
 - a. the quality of education and training, reach out to young people, not in education, employment or training and improve access to early childhood education and care and to flexible working arrangements, thus providing equal opportunities for all children and making it easier for women to participate in the labour market.

- b. (b) Targeting bottlenecks in digitalisation and the diversification of the economy, investing in R&D to facilitate further progress towards smart growth and decent work (SDG 8)
- c. reforms and investments to address long-standing challenges in the areas of justice and the fight against corruption.

Despite the adverse global environment, overall, Cyprus is performing well and improving on most SDGs, even though progress has been uneven. Cyprus scored below the EU27 average on EU SDG indicators for around 10 goals in 2022. When using Eurostat visualization tool, one can also see that the situation of Cyprus has been good and improving only for SDGs 1, 3 and 15. For SDG 10, Cyprus scored above the EU average but the situation over time has been worsening. For SDGs 4, 8, 11, 16, 7, 2, 9 and 5, the performance is below the EU average but is improving. For SDGs 17 and 12, it is below the average with no improvements. However, the above analysis relies on the overall view while in some indicators Cyprus may be underperforming even in SDFs that overall, it performs well.

Green transition

The transition towards environmental sustainability is the area in which the performance of Cyprus suffers the most relative to the majority of EU countries. In particular, the main challenges that Cyprus faces concern sustainable agriculture, water scarcity and sustainable waste management, energy efficiency, sustainable mobility and the elevated level of greenhouse gas emissions. Nevertheless, Cyprus has overachieved the Renewable Energy Sources (RES) target for 2020, maintains the excellent water quality of its bathing sites, and is currently in the top 5 EU countries in the surface of terrestrial sites which are protected within the framework of Natura 2000. Despite the huge challenges Cyprus faces towards the green transition, it continues to make efforts for the improvement of all its environmental indicators, so as to reach the 2030 climate targets and decarbonisation by 2050.

Major investments have been planned and are scheduled in renewable energy, in the transformation of the network as well as the introduction of smart meters in power distribution. The import and use of natural gas will contribute towards energy efficiency in power generation, in households, businesses as well as in transport infrastructures. Moreover, both electricity storage and interconnections are highly important as they will enable the faster integration of renewables to the electricity system and the export of produced renewable electricity. For storage, the relevant legal framework is under preparation while funding schemes are in the pipeline. The EuroAsia Interconnector project for the electricity interconnection between Cyprus, Israel and Crete is planned to operate by 2025. The works were inaugurated in October 2022. The project received the second largest grant from the Connecting Europe Facility (EUR 657 million in total) and it is also funded by the Recovery and Resilience Facility (EUR 100 million). Moreover, several support schemes started in 2021 to help citizens, public authorities and businesses to save energy, for instance by isolating buildings and producing energy from photovoltaics. By 2022, Cyprus adopted two laws and regulations that increase competition in the electricity market. These reforms will create conditions in the energy market for new investors to participate in the generation, storage and supply of electricity and will promote the participation of electricity storage facilities in the electricity market. In addition, there are efforts to impose green taxation and facilitate the take-up of electric vehicles.

At the same time, agri-environmental measures and eco-schemes will be introduced in order to significantly reduce Cyprus' underperformance in sustainable agriculture by promoting practices that reduce the need for pesticides, increasing the budget for organic farming, together with significant higher target for land under organic, measures that include the substitution of chemical fertilisers.

Regarding water reuse, two major recycled water schemes funded by various European funding sources 97 (including the European Investment and European Development Bank) are currently under way, while, by 2027, Cyprus aims to fully implement all necessary sewerage plans in order to comply with the EU Urban Waste Water Treatment Directive regarding the percentage of wastewater load collected and receiving secondary treatment. Additionally, through the implementation of the Action Plan for the Circular Economy, Cyprus is geared towards creating a sustainable consumption culture among citizens and the industry (manufacturers/entrepreneurs) as well as provide incentives to the industry to invest in the circular economy.

Data for 2021 on Cyprus' greenhouse gas emissions in the effort sharing sectors show that the country far exceeded its annual emission allocations. Current policies in Cyprus are projected to reduce these emissions by 7% relative to 2005 levels in 2030. The additional measures planned in the NCEP would bring the emission reductions to 17%. This is not sufficient to reach the effort sharing target set before it was raised in line with the EU's 55% objective, let alone the new target to reduce by 32%. With the revised recovery and resilience plan and a dedicated chapter on REPowerEU, Cyprus will allocate [41%] of its Recovery and Resilience Facility grants to key reforms and investments to attain climate objectives. Cyprus has set a greenhouse gas emissions reduction target for its effort sharing sectors of 21% to be achieved with domestic measures by 2030, compared to 2005 emissions. The NCEP is currently under revision so as to include measures that will enable the country to reach the new higher "Fit for 55" targets.

Social fairness

Cyprus continues to make progress in reducing poverty in all its forms by decreasing unemployment and income inequality, increasing employment and incomes, and implementing targeted welfare schemes. Cyprus ensures high standards of healthy living and well-being, having recently rolled out its national healthcare system providing equal access to quality healthcare for all. Regarding gender equality, Cyprus ranks among the 10 countries with the smallest gender pay gap but falls behind in the representation of women in politics and women who hold leadership positions in the public and private sector. Focusing on the protection of vulnerable groups, increased efforts have been made to prevent and combat domestic violence and sexual abuse against women and children, and human trafficking. A major challenge that Cyprus faces is the integration of immigrants, due to the high volume of first-time asylum seekers. Measures for the reduction of prices on electricity tariffs have been implemented as well as financial incentives for upgrading the energy efficiency of houses and installation of Photovoltaics with the net metering method for the protection of vulnerable consumers. Contributing to gender equality and to the reduction of the risk of poverty are measures regarding the expansion of affordable childcare centres enabling the entry of care takers in the labour market, particularly women with children. Cyprus' growth of real gross disposable household income (GDHI) per person was one of the slowest in the EU in 2021. Its growth was below the EU average and was flagged as a 'critical situation' on the Social Scoreboard. To tackle this, Cyprus introduced a universal statutory minimum wage, which took effect on 1 January 2023. It is set at EUR 940 and is expected to have 40 000 direct beneficiaries.

Macroeconomic Stability/Digitalization

Cyprus recognises the need for measures and actions that will accelerate performance in industry, innovation, and infrastructure. Thus, various Schemes have already been adopted and are planned for the modernisation and digitalisation of enterprises engaged in manufacturing and trading of agricultural products, the enhancement of Large Enterprises' Competitiveness in the Manufacturing Sector as well as the enhancement of Circular Economy in the Industry. Cyprus aims to boost the digital transformation of the country, covering a wide range of technological, economic and societal innovations. With the adoption of the National Digital Strategy, Cyprus aims to become a fit-for-the-future society and knowledge-based economy enabled by digital and emerging technologies that will drive economic prosperity and competitiveness. Even though Cyprus showcases an increasing employment and decreasing long term unemployment rate, the percentage of young people neither in employment nor in education and training remains a challenge. To this end a scheme is promoted with a budget of a €10 million aiming to increase the employment opportunities of Young People (aged -15-29 years old) Not in Employment or in Education or Training (NEETs) through the economic support of employers, to create new jobs, and to support youth to upgrade their digital competence and efficiency. The Scheme for the Employment and Training of Tertiary Education Graduates also provides opportunities to tertiary education graduates who are under 30 years old to secure a suitable job and acquire work experience and specialised knowledge and skills.

Cyprus also makes considerable efforts towards the objectives of justice and strong institutions that will contribute to a strong business environment. To this end, a comprehensive Anti-corruption Strategy along with the necessary legislation has been prepared. The newly established Independent Authority against Corruption will undertake all necessary initiatives and actions to ensure the coherence and

effectiveness of the actions of the public service, the broader public sector and the private sector in the prevention and fight against corruption. A very ambitious reform is also promoted to enhance the Judicial system with the introduction of an electronic court administration system to digitalise the operations of courts. This includes the creation of an open data platform (e-legislation platform), accessible to citizens and businesses, which will improve legal certainty and transparency and give investors access to complete and credible information on Cyprus' legal and regulatory framework.

Furthermore, reforms towards improving the administrative capacity, and the functioning of public administration for better policy making and implementation will serve towards more just and well-functioning public services, while supporting the sustainable growth of the economy of Cyprus. There are ongoing investments in the digitalisation of various central government services. In 2021-2027 the cohesion policy funds will invest EUR 90 million in the digital transformation.

Building Forward Better— Next Steps

Cyprus' economic model is in the process of changing in order to reflect the ambitions of its society and to become more sustainable, liveable and more resilient to shocks. The adoption of a Long-Term Strategy focuses on introducing a robust new growth model reflecting the country's potential for economically, socially and environmentally sustainable long-term growth and welfare. Although economic performance is important for growth, the broader implications for competitiveness, productivity, innovation, skills and sustainability are equally important. As a result, the new growth model of Cyprus builds on the premises of diversification, resilience, self-sustainability, liveability, the green economy, digitalisation as well as inclusiveness. At the same time, a solid, secured, integrated and modern Government digital architecture is critical towards achieving the transformation to a digital Government and society. Digitalising the Government services will enhance the efficiency and/or enable the provision of online, secure and prompt services to citizens and society, in a user friendly, efficient and effective way which will ultimately facilitate the interaction with public services. Digitalisation is advancing and major RRP and ESIF resources will be allocated to it. In supporting the reduction of existing gender gaps in employment, pay and representation in decision making positions.

Cyprus government envisions towards the SDGs becoming a real policy and action agenda that will enhance the well-being of people everywhere. A preliminary overview of the sustainable development governance in Cyprus pointed to the need for strengthening the country's SDG coordination mechanism and utilize it as an effective tool not only for conducting regular reviews of progress at the national level, but also for informing sectoral policies and programmes with SDGs, improving horizontal coordination and coherence of policies across sectors as well as provide for regular engagement with other stakeholders outside of Government such as civil society organisations or local authorities.

Indicative measures per SDG are available in [Annex III](#).

4.3.5.2. EU Green Deal

The EU has adopted the Green Deal its new growth strategy, with a target of net-zero greenhouse gas emissions by 2050. It is a very ambitious goal that will require significant investment, a change in the way we produce and consume, in taxes and social benefits and in general in the whole economic model.

By decision of the Council of Ministers during its meeting on November 13, 2020 the new National Governance System of the Development Strategy was approved in relation to the European Green Deal, which is an evolution of the National Energy and Climate System, as approved by the Council of Ministers in 2017. Based on the new structure, DG Growth in cooperation with the Department of Environment of the Ministry of Agriculture, Rural Development and Environment jointly perform the role of coordinator / secretariat of the new national system. The structure operates under the guidance of a five-member Ministerial Committee and a corresponding Committee of Directors-General while, at a technical level, the individual initiatives / themes of the green deal will be examined by the 13 competent Technical Committees.

In order to achieve the 2050 target, it was considered necessary to increase the ambition of the intermediate emission reduction target for 2030 from 40% to 55% compared to 1990. To this end, the

European Commission introduced in July 2021 the "Fit for 55" Package, consisting of 14 pieces of legislation, which are expected to cause cumulative effects on the economy as a whole, but also serious impacts on competitiveness, the connectivity of our country and the sustainability of certain sectors. Most legislation is at an advanced stage of negotiations within the EU.

The decision to increase the European target from 40% to 55% was established by law, and therefore compliance is a legal obligation for countries. The way the 40% reduction would be achieved as well as the necessary measures were set out in the National Energy and Climate Plan (NECP) submitted to the EU in January 2020. Now with the new 55% target, Member States (MS) will have to revise the NECP and submit the first draft by the end of June 2023, while the final one will be submitted in June 2024, taking into account the EU comments.

With the help of our academic advisors from the Cyprus Institute and with the use of special energy and economic models, an attempt was made to assess the impact in order to determine our negotiating position during the discussions of the legislation. Also, with the help of consultants, the additional costs that will be required to achieve the new goals will be estimated.

European funds have already been used to promote many green projects. In total, the Recovery and Resilience Plan (RRF), the THALEIA program (Structural Funds), the Just Transition Fund and the Agricultural Fund will provide approximately €1.1 billion. Along with the required national contribution, the contribution of private individuals to Subsidy Schemes (e.g., for building renovations, purchase of vehicles) as well as projects promoted by the national budget, it is estimated that the cost of planned investments until 2030 amounts to approximately €3.1 billion.

Major investments have been planned and are scheduled in renewable energy, in the transformation of the network as well as the introduction of smart meters in power distribution. The import and use of natural gas will contribute towards energy efficiency in power generation, in households, businesses as well as in transport infrastructures. Moreover, both electricity storage and interconnections are highly important as they will enable the faster integration of renewables to the electricity system and the export of produced renewable electricity. For storage, the relevant legal framework is under preparation while funding schemes are in the pipeline. The EuroAsia Interconnector project for the electricity interconnection between Cyprus, Israel and Crete is planned to operate by 2025. The works were inaugurated in October 2022. The project received the second largest grant from the Connecting Europe Facility (EUR 657 million in total) and it is also funded by the Recovery and Resilience Facility (EUR 100 million). Moreover, several support schemes started in 2021 to help citizens, public authorities and businesses to save energy, for instance by isolating buildings and producing energy from photovoltaics. By 2022, Cyprus adopted two laws and regulations that increase competition in the electricity market. These reforms will create conditions in the energy market for new investors to participate in the generation, storage and supply of electricity and will promote the participation of electricity storage facilities in the electricity market. In addition, there are efforts to impose green taxation and facilitate the take-up of electric vehicles.

Regarding water reuse, two major recycled water schemes funded by various European funding sources 97 (including the European Investment and European Development Bank) are currently under way, while, by 2027, Cyprus aims to fully implement all necessary sewerage plans in order to comply with the EU Urban Waste Water Treatment Directive regarding the percentage of wastewater load collected and receiving secondary treatment. Additionally, through the implementation of the Action Plan for the Circular Economy, Cyprus is geared towards creating a sustainable consumption culture among citizens and the industry (manufacturers/entrepreneurs) as well as provide incentives to the industry to invest in the circular economy.

The preliminary assessment of our academic advisors from the Cyprus Institute (CY) is that, if all projects included for funding by European funds are implemented, they will contribute greatly but not fully to the achievement of our goals. While the targets in the renewable energy sector are being met, there is a significant lag in reducing emissions in transport. Investment is lagging behind by more than €1 billion. Euros than required. The lag is greatest in investments in sustainable transport, followed by investments in energy savings. To achieve the new targets set out in the new "Fit for 55" legislative package, additional public investment in the energy and transport sectors needs to increase by around

10-20% in the decade 2021-2030, or by 1-1.5% of GDP per year (around €250-€300 million/year), in order to implement the green transition.

4.5. Summary of National Policies and Measures and Mitigation Impacts

In accordance with the Kyoto Protocol, Cyprus strives to implement policies and measures reported in the NC8 in such a way that adverse effects in other countries are minimised. However, Cyprus is a small island country, economically depended generally on services, therefore there is no main economic activities with serious adverse effects on other Parties. The implemented, adopted and planned PaM s for the mitigation of GHG emissions are capable to minimize any adverse effect.

This chapter concludes with the following three tables, which provide a summary of the policies and measures. Table 4.4 provides a brief description of groups of policies and measures (several PaMs were aggregated in various groups). Table 4.5 provides a quantitative summary of the policies and measures included in all three scenarios, organized by sector and aggregated as necessary. Table 4.6 provides the estimated impact of the policies and measures on the reduction of GHGs for the WEM and WAM scenarios, aggregated as necessary.

Table 4.4. Brief description of policies and measures

PaM No.	Title	Brief description	Sector & Gas affected	Type of policy	Responsible entity
Implemented / adopted policies and measures (included in the “with existing measures” scenario)					
1	Implemented & adopted policies and measures for the promotion of renewable energy sources	This policy concerns the promotion of renewable energy sources through a series of actions such as support schemes and financial assistance for the production of electricity from renewable energy sources, incentives for encouraging the use of RES in different types of developments & RES communities, replacement of the conventional transport fuels with biofuels etc.	Energy; CO2	Economic; Education; Planning; Regulatory	Ministry of Energy, Commerce and Industry
3	Implemented & adopted policies and measures for the promotion of energy efficiency	This policy concerns the promotion of renewable energy sources through a series of actions such as support schemes and financial assistance for energy efficiency investments, implementation of measures aimed at attaining energy savings in existing public buildings, minimum energy performance requirements for new and existing buildings, requirements for technical building systems installed in existing buildings, inspections for heating systems and a/c systems, Implementation of soft measures such as information campaigns, trainings and workshops, energy efficiency in electricity infrastructure, excise tax on road transport fuels, old vehicle scraping scheme and financial incentives for the purchase of electric vehicles, Installation of charging points and infrastructures for electric vehicles, etc.	Energy; CO2	Economic; Education; Information; Planning; Regulatory	Ministry of Energy, Commerce and Industry
5	Introduction of natural gas in the energy market of Cyprus through the implementation of the Project "LNG Import Terminal"	This policy is associated with the design and construction of the LNG import terminal for 20 years operations and maintenance in addition to all necessary infrastructure that will allow the use of natural gas (initially) for electricity production in Cyprus.	Energy; CO2	Fiscal; Planning; Regulatory	Ministry of Energy, Commerce and Industry
6	Implemented & adopted policies and measures for	Preparation of the proper recovery system for F-gases in equipment; This is an obligation according to EU and national legislation. It is however still not properly Implemented. The responsibility for the storage of the recovered f-gases is on the person that had recovered	Industry; HFCs, SF6	Fiscal; Information; Regulatory;	Ministry of Agriculture, Rural

PaM No.	Title	Brief description	Sector & Gas affected	Type of policy	Responsible entity
	proper recovery system for Fluorinated greenhouse gases in equipment	them, but because of the lack of a legal framework that sets an f-gases destruction scheme, the Department of Environment prepares campaigns every few years, collecting all the recovered F-gases and exporting them for destruction. Thus, the status of PaM 6 (“Implementation of “polluter pays” principle; each producer will have to participate in an appropriate scheme for management of f-gases that have been recovered”) is consider as “implemented”. In the WEM scenario, this Pam is included as a percentage increase of recovery through the years.		Voluntary/ negotiated agreements	Development and Environment
7	Implemented & adopted policies and measures for the promotion of anaerobic digestion for the treatment of animal waste	Promotion of anaerobic digestion for the treatment and management of animal waste; Promotion of anaerobic digestion in existing biogas plants; Encouragement of new biogas plants to exploit organic waste from livestock breeding. A financial support scheme is under preparation by the Department of Environment to provide an award for the recovery of the gases. It is anticipated that the first supporting scheme will be in place in 2021.	Agriculture; CH4, N2O	Education; Information; Regulatory; Voluntary/ negotiated agreements	Ministry of Agriculture, Rural Development and Environment
9	Promotion of mitigation actions in the sector of waste	A series of policies and measures are implemented or adopted in the waste sector to reduce greenhouse gas emissions such as reduction of the amount of waste that are sent to solid waste disposal sites, reduction of the amount of organics going to landfills, promotion of alternatives for the treatment of the organic fraction of solid waste (anaerobic digestion) and biogas recovery from old landfills.	Waste; CH4	Education; Fiscal; Information; Planning; Regulatory	Ministry of Agriculture, Rural Development and Environment
11	Reduction of emissions from the businesses	Business4Climate is an innovative idea developed in 2017-2018 by Cyprus Employers and Industrialist Federation, in collaboration with the Cyprus University of Technology (scientific advisor) and the Department of the Environment. Climate4Climate initiative was developed as a pilot project to demonstrate how Cypriot enterprises can voluntarily commit and take action against climate change. Enterprises (other than those involved in the ETS) participating in the project have to sign of a voluntary declaration, to reduce greenhouse gas emissions by more than 8% by 2030. For mobilizing the enterprises, a support scheme is under preparation from the Department of Environment, utilising national funds. It is anticipated that the first supporting scheme will be in place in 2021.	Horizontal; CO2, CH4, N2O, HFCs, SF6	Fiscal; Information; Voluntary/ negotiated agreements	Ministry of Agriculture, Rural Development and Environment

PaM No.	Title	Brief description	Sector & Gas affected	Type of policy	Responsible entity
Planned policies and measures (included in the “with additional measures” scenario)					
2	Planned policies and measures for the promotion of renewable energy sources	Additional measures are considered for the promotion of production of energy from renewable sources such as support schemes for storage units, implementation of an enabling framework to promote and facilitate the development of Renewable Energy Communities, installation of PV Systems in Governmental buildings with the net-billing scheme, etc.	Energy; CO2	Economic; Education; Planning; Regulatory	Ministry of Energy, Commerce and Industry
4	Planned policies and measures for the promotion of energy efficiency	Additional measures are considered for the promotion of energy efficiency, such as promotion of measures in the water sector, Shift of modal share from car trips to sustainable modes of transport – Implementation of Sustainable Urban Mobility Plans, promotion of zero emission vehicles etc.	Energy; CO2	Economic; Education; Information; Planning; Regulatory	Ministry of Energy, Commerce and Industry
8	Further promotion of anaerobic digestion for the treatment of animal waste	Promotion of anaerobic digestion for the treatment and management of animal waste; Promotion of anaerobic digestion in existing biogas plants; Encouragement of new biogas plants to exploit organic waste from livestock breeding. A financial support scheme is under preparation by the Department of Environment to provide an award for the recovery of the gases. It is anticipated that the first supporting scheme will be in place in 2021. This policy assumes further deployment/acceptance of the support scheme.	Agriculture; CH4, N2O	Education; Information; Regulatory; Voluntary/negotiated agreements	Ministry of Agriculture, Rural Development and Environment
10	Promotion of additional mitigation actions in the sector of waste	A series of policies and measures are planned in the waste sector to reduce greenhouse gas emissions such as reduction of the amount of waste that are sent to solid waste disposal sites, reduction of the amount of organics going to landfills, promotion of alternatives for the treatment of the organic fraction of solid waste (anaerobic digestion) and further biogas recovery from old landfills.	Waste; CH4	Education; Fiscal; Information; Planning; Regulatory	Ministry of Agriculture, Rural Development and Environment

Note: Additional information on cost, implementing authorities, non-GHG mitigation benefits, interaction with other policies etc. is available in the NECP⁶⁷. Please note however, that compared to this submission the status of implementation may be different and so is the starting year.

⁶⁷ [http://www.moa.gov.cy/moa/environment/environmentnew.nsf/all/EE3E8BE9D5282E5CC22584F700273BD9/\\$file/submission.zip?openelement](http://www.moa.gov.cy/moa/environment/environmentnew.nsf/all/EE3E8BE9D5282E5CC22584F700273BD9/$file/submission.zip?openelement)

Table 4.5. Summary of Policies and Measures included in each scenario

Name of Policy or Measure	BaU				WEM				WAM			
	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
Energy												
Natural Gas	Start 2024				Start 2024				Start 2024			
RES in electricity	29%	39%	73%	82%	31%	41%	71%	82%	32%	44%	68%	82%
*EE in Other Industries (TJ)					391	909	935	1013	371	1002	1016	1084
EE in Residential (TJ)					929	2226	2563	2312	1772	4534	5407	6065
EE in Services (TJ)					621	1522	1597	1700	1932	4536	4625	4890
EE in Agriculture (TJ)					30	69	72	77	23	80	83	76
RES in Residential					38%	43%	57%	65%	38%	43%	56%	65%
RES in Commercial					34%	42%	63%	73%	33%	43%	62%	74%
Transport												
Biofuels	4.0%	3.7%	2.9%	1.8%	4.0%	3.6%	2.9%	1.8%	4.1%	3.8%	3.0%	2.0%
RES	5%	7%	22%	47%	5%	8%	22%	48%	5%	8%	22%	46%
Electricity Share	2.1%	10.4%	27.9%	58.1%	2.1%	10.8%	28.6%	59.3%	1.8%	9.1%	28.6%	57.3%
Natural Gas Share	0.9%	1.1%	1.5%	1.2%	0.9%	1.1%	1.5%	1.2%	1.0%	1.3%	1.8%	0.1%
IPPU												
Recovery of F-gases from old equipment					1.4%	5%	7.5%	10%	5%	10%	15%	20%
Agriculture												
Promotion of anaerobic digestion for treatment of animal waste												
Cattle	7.5%	10.0%	12.5%	15.0%	7.5%	10.0%	12.5%	15.0%	10.0%	15.0%	22.5%	30.0%
Swine	62.5%	65.0%	67.5%	70.0%	62.5%	65.0%	70.0%	75.0%	65.0%	70.0%	75.0%	80.0%
Poultry	22.5%	25.0%	27.5%	30.0%	22.5%	25.0%	27.5%	30.0%	25.0%	30.0%	35.0%	40.0%
Inorganic N Fertilisers				-5%				-5%				-5%
Urea Application				-5%				-5%				-5%
Waste												
Solid Waste												
Sorting at Source					40% (from 2022); 55% (from 2025); 65% (from 2030)							
Organics to Landfill					24% constant from 2022				24% constant from 2022			
Recovery from Deep Managed and Unmanaged Landfills					20%	20%	20%	20%	30%	30%	30%	30%

Anaerobic Digestion at Biogas Plants					4%	9%	14%	19%	4%	9%	14%	19%
Wastewater												
Percent of Population Connected to Central System	84.5%	84.5%	84.5%	84.5%	84.5%	89.8%	100%	100%	84.5%	89.8%	100%	100%
Industrial Wastewater: Increase Anaerobic Treatment												
Alcohol					3%	5%	5%	5%	3%	5%	5%	5%
Beer					14%	20%	20%	20%	14%	20%	20%	20%
Soft Drinks					3%	5%	5%	5%	3%	5%	5%	5%
Dairy					3%	7%	7%	7%	3%	7%	7%	7%
Meat and Poultry					4%	10%	10%	10%	4%	10%	10%	10%
Vegetables, Fruits, Juices					3%	5%	5%	5%	3%	5%	5%	5%

*Energy Efficiency

Table 4.6. Estimated Mitigation Impact by Policy and Measure (Gg CO₂ Equivalent)

	Gg CO ₂ Equivalent	WEM				WAM			
		2025	2030	2035	2040	2025	2030	2035	2040
Energy									
	Natural Gas, RES in electricity	159	314	65	139	213	545	97	192
	EE in Other Industries (TJ)	11	22	21	11	11	24	22	11
	EE in Households (TJ)	16	34	38	16	48	101	117	48
	EE in Services (TJ)	2	5	4	2	32	66	65	32
	EE in Agriculture (TJ)	-0.03	-0.13	-0.22	-0.31	-0.01	-0.12	-0.26	-0.93
Transport									
	RES, Biofuels, Natural Gas, Electricity	0	14	14	13	107	125	122	34
IPPU									
	Recovery of F-gases from old equipment	6	20	29	39	19	39	59	78
Agriculture									
	Promotion of anaerobic digestion for treatment of animal waste (3B only)	0.12	0.07	2.70	5.27	5.15	9.48	13.18	16.82
	Inorganic Nitrogen Fertilisers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Urea Application	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste									
	Solid Waste: Sorting at Source and Organic	-1.0	-4.1	-4.1	-4.1	-1.0	-4.1	-4.1	-4.1
	Solid Waste: Recovery of Deep Unmanaged and Managed	103	107	107	107	154	160	160	160
	Anaerobic Digestion at Biogas Facilities	-0.01	-0.04	-0.11	-0.32	-0.01	-0.04	-0.11	-0.32
	Wastewater Treatment and Discharge: Population connected to central systems	9	24	24	24	9	24	24	24
	Industrial Wastewater: Increase anaerobic treatment, and 1% recovery from 2025, increasing by 1% a year	0.4	-0.6	1.6	4.4	0.7	2.1	7.0	13.2
Aggregate Impact		305	305	537	304	362	604	1102	695

5. Projections and the total effects of policies and measures

5.1. Introduction

This Chapter describes a “with measures” (WM) or “with existing measures” (WEM) scenario concerning the national projections of greenhouse gas emissions by sources and their removal by sinks for the years 2020, 2025, 2030, 2035 and 2040. The “with measures” scenario assumes that no additional emission reduction policies and measures are adopted than the existing ones (implemented and adopted).

A “with additional measures” (WAM) scenario is also reported, which reflects the effect of all implemented / adopted and planned policies and measures. This scenario includes the additional policies and measures as specified in detail in the National Energy and Climate Plan (NECP), which was adopted by Cyprus in January 2021.

A “Business as usual” (BaU) or “Without measures” (WOM) scenario is also presented in this chapter, which reflects the expected emissions that exclude the effects of all policies and measures which are planned, adopted or implemented after the year chosen as the starting point for the relevant projection.

The NECP constitutes a strategic plan for the Cyprus on Climate and Energy issues and comprises a detailed roadmap for achieving concrete Energy and Climate Goals by 2030. The NECP highlights our country's energy and climate priorities and development opportunities and aims to be the key tool for shaping/mainstreaming the national energy and climate policy over the next decade.

The GHG emission projections presented in this chapter are based on the latest energy projection scenarios that are developed for the Ministry of Agriculture, Rural Development and Environment by the Cyprus Institute⁶⁸ and the October 2020 GDP projections provided by the Ministry of Finance⁶⁹. Further details are provided in the sections that follow.

The projections of total GHG emissions are presented in Figure 5.1, while Table 5.1 presents the sectoral emissions from 1990–2040.

5.2. Projections

The policies and measures included in each scenario are presented in Tables 4.3–4.5 in the previous chapter. The resulting impact is presented below in Figure 5.1 and Table 5.1. The sudden drop in 2024 across all scenarios is due to the introduction of natural gas.

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⁶⁹ Mrs. Maria Matsi; Economic Officer A'; Directorate on Economic Policy, European and International Affairs; Ministry of Finance; mmatsi@mof.gov.cy; Tel. +357 22 601 231; www.mof.gov.cy

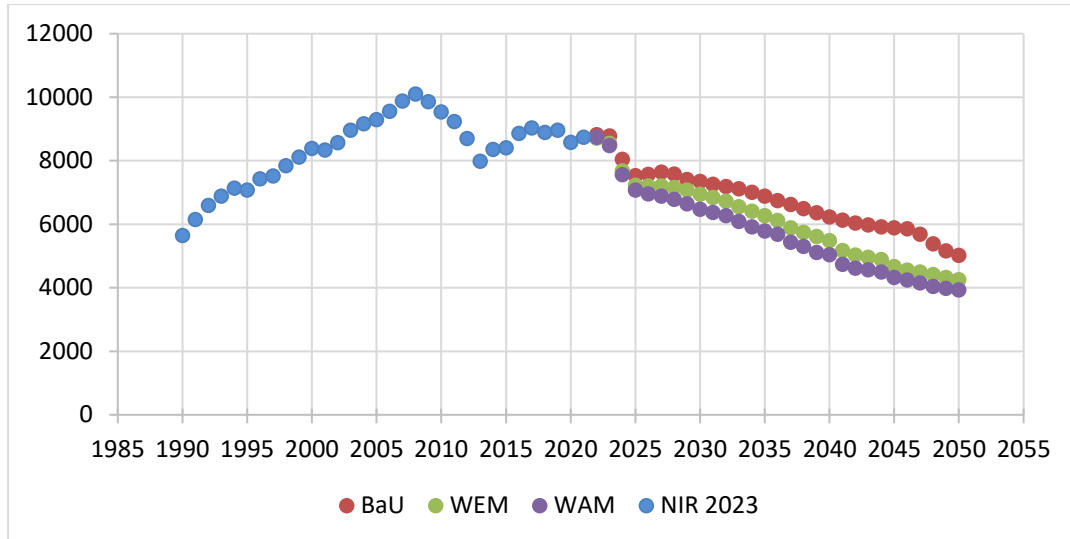


Figure 5.1. BaU, WEM and WAM Projections of total national GHG emissions (excluding LULUCF)

Three important things that should be noted for these projections are the following:

- The emissions from the possible exploitation of natural gas in the Exclusive Economic Zone are not taken into account due to the high uncertainty associated to any prediction of such changes.
- The projections presented here take into account the latest microeconomic forecasts, encompassing impacts from the COVID-19 pandemic and the war in Ukraine.
- The organic fraction of solid waste not going to the landfill is treated by composting, anaerobic digestion and incinerated for energy. The additional organics for incineration at the cement installation have not been accounted for.

Table 5.1. Projections of national GHG emissions disaggregated by sector (excluding LULUCF)

	1990	2005	2020	2025	2030	2035	2040	2045	2050
BaU									
Energy	2717	4517	5172	4194	4132	2872	3057	3107	3047
Transport	1237	1841	2375	1923	1916	2011	1654	1127	523
IPPU	728	883	811	1160	1267	1403	1485	1497	1506
Agriculture	530	623	592	506	603	657	653	650	647
Waste	435	523	584	625	656	592	498	503	510
TOTAL (Excl. LULUCF)	5647	8387	9533	8408	8575	7534	7347	6884	6234
Gas (Excl. LULUCF)									
CO2	4645	7105	8101	6972	6911	5819	5722	5262	4618
CH4	776	938	974	957	1065	986	900	896	893
N2O	224	272	247	216	245	345	327	318	306
HFCs	NO,NE	62	199	247	336	367	380	391	400
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF6	3	9	13	17	19	17	17	18	18
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO
WEM									
Energy	2717	4517	5172	4194	4132	2700	2811	2670	2464
Transport	1237	1841	2375	1923	1916	2011	1654	1122	540
IPPU	728	883	811	1160	1267	1376	1444	1445	1443
Agriculture	530	623	592	506	603	645	639	634	629
Waste	435	523	584	625	656	495	402	404	408
TOTAL (Excl. LULUCF)	5647	8387	9533	8408	8575	7227	6949	6275	5484
Gas (Excl. LULUCF)									
CO2	4645	7105	8101	6972	6911	5648	5478	4821	4050
CH4	776	938	974	957	1065	889	802	793	787

N2O	224	272	247	216	245	333	313	303	291
HFCs	NO,NE	62	199	247	338	339	339	340	338
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF6	3	9	13	17	19	17	17	17	17
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO
WAM									
Energy	2717	4517	5172	4194	4132	2616	2526	2408	2317
Transport	1237	1841	2375	1923	1916	2015	1532	983	338
IPPU	728	883	811	1160	1267	1363	1425	1416	1403
Agriculture	530	623	592	506	603	637	626	620	614
Waste	435	523	584	625	656	450	363	364	364
TOTAL (Excl. LULUCF)	5647	8387	9533	8408	8575	7080	6473	5790	5036
Gas (Excl. LULUCF)									
CO2	4645	7105	8101	6972	6911	5569	5077	4428	3712
CH4	776	938	974	957	1065	839	751	739	726
N2O	224	272	247	216	245	329	307	296	282
HFCs	NO,NE	62	199	247	336	327	321	312	301
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF6	3	9	13	17	19	16	16	15	15
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO

5.2.1 Without measures (BaU)

The BaU emissions by sector for years 1990–2050 are presented above in Table 5.1, and are depicted below in Figure 5.2. The activity data for this scenario is presented in [Annex IV](#). The latest inventory year used as reference is 2021. This scenario assumes a considerable slow improvement in energy intensity across all end-use sectors. It also assumes that the sustainable mobility assumptions of the NECP are not effective and hence there is no modal shift away from private vehicles. These result in very high final energy demand projections, with an equivalent effect in emissions. This scenario resembles the evolution of energy intensity of the EU Reference Scenario 2020. BaU emissions are projected to decrease by 11% in 2050 compared to 1990 and by 46% compared to 2005.

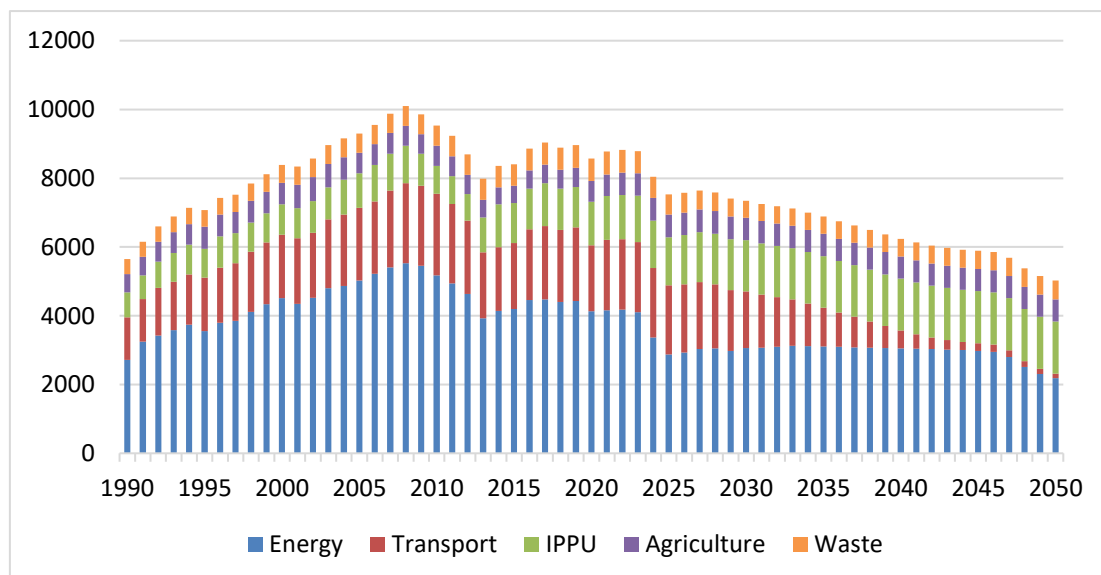


Figure 5.2. Total BaU GHG emissions by sector (Gg CO₂ eq.) 1990–2050

The methodologies applied are the same as those used for the preparation of the 2020 submission of National Greenhouse Gas emissions inventory of Cyprus to the UNFCCC ⁷⁰ and projected activity data.

⁷⁰<https://unfccc.int/documents/461671>

Energy demand projections are largely based on recommended harmonized values from the European Commission as provided under Annex I, Part 2 of Regulation (EU) 2018/1999, and pursuant to Article 18(l) of the Governance Regulation⁷¹. For certain sectors (manufacture of solid fuels, other energy industries, aviation, water-borne navigation, non-specified stationary and mobile), the latest GDP forecast has been used⁷². Other key assumptions for energy are the introduction of natural gas in 2024 and 21% RES in 2025, 29% in 2030, 47% in 2035 and 58% in 2040. Higher fuel prices have increased the competitiveness of renewable energy, especially in the long run. Alongside decreased costs for renewable energy sources, this has resulted in higher renewable energy shares.

5.2.2. With existing measures (WEM)

The WEM emissions by sector for years 1990–2040 are presented above in Table 5.1, and are depicted below in Figure 5.3. The activity data used for the calculations is presented in Annex V. Reduction in the emissions caused by each measure was presented previously in Table 5.4.

The methodologies applied are the same as those used for the preparation of the 2022 submission of National Greenhouse Gas emissions inventory of Cyprus to the UNFCCC⁷³. Similar to the BaU scenario, the energy consumption in end-use sectors resembles that of the EU Reference Scenario 2020. Whereas the BaU scenario resembles the evolution of energy intensity of the EU Reference Scenario 2020, this scenario resembles the evolution of final energy demand of the EU Reference Scenario 2020. The same assumptions regarding transport as the BaU scenario are maintained the same.

The difference in the total emissions between the BaU and the WEM scenario are presented in Figure 5.4. Emissions based on the WEM scenario are projected to decrease by 25% in 2050 compared to 1990 and by 54% compared to 2005. In 2050 the difference between WEM and BaU is -15%.

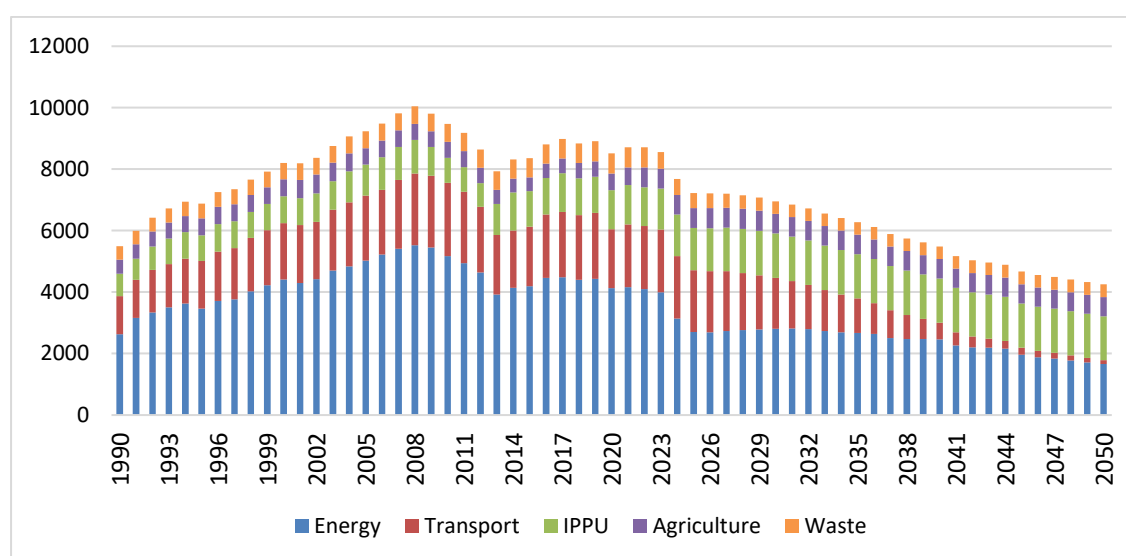


Figure 5.3. Total WEM GHG emissions by sector (Gg CO₂ eq.) 1990–2050

⁷¹ Annex I, Part 2 of the Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action; Article 38(3) of the Implementing Regulation; Article 18(1) of the Governance Regulation.

⁷² GDP forecast as prepared by the Ministry of Finance in October 2022; Maria Matsi, Economic Officer, Directorate of Economic Research and EU Affairs, Ministry of Finance, 1439 Nicosia – Cyprus, Tel. no.: +35722601231, Email: mmatsi@mof.gov.cy

⁷³ <https://unfccc.int/documents/461671>

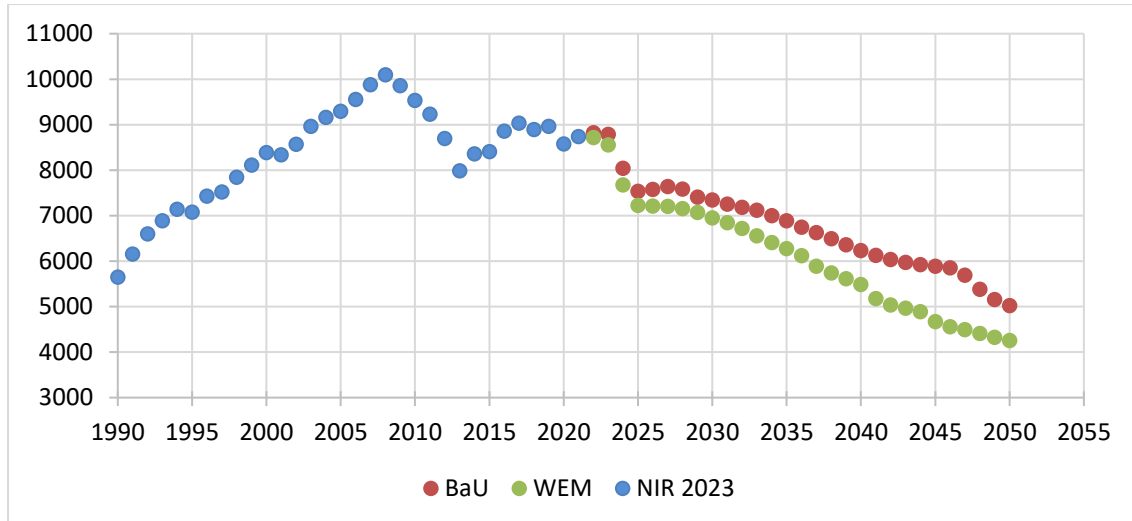


Figure 5.4. Total WEM GHG emissions compared to BaU (Gg CO2 eq.) 1990–2050

The effect of currently implemented and adopted policies and measures (that are incorporated in the WEM projections scenario) are presented in Table 5.2 in terms of GHG emissions avoided on a CO₂ equivalent basis. The aggregate impact is not equal to the sum of the reductions from each measure, as when combined they produce different results.

Table 5.2. Reductions for WEM by Sector and Gas (Gg CO2 eq.)

Gg CO2 eq.	2025	2030	2035	2040	2045	2050
Energy	172	246	437	583	1012	528
Transport	0	0	5	-17	-1	5
IPPU	27	42	53	64	75	86
Agriculture	12	14	16	18	20	22
Waste	97	96	99	102	114	128
Total (Excluding LULUCF)	308	398	609	750	1220	770
Gas (Excluding LULUCF)						
CO2	172	245	440	568	1011	534
CH4	97	98	103	106	121	136
N2O	12	14	14	14	14	14
HFCs	27	41	51	62	72	83
PFCs	NO	NO	NO	NO	NO	NO
SF6	0	1	1	2	2	3
NF3	NO	NO	NO	NO	NO	NO

The total estimated GHG emissions reduction potential from the implemented and adopted policies and measures (without LULUCF) was estimated to be 308 Gg CO₂eq for 2025 (166 Gg under EU-ETS and 142 Gg under ESR sectors); and 398 Gg CO₂eq for 2030 (211 Gg under EU-ETS and 187 Gg under ESR sectors).

5.2.2.1. WEM sensitivity analysis

Sensitivity analysis was not performed because there was no mitigation impact assessment of individual PaMs for the energy sector, due to the type of modelling used for the energy sector. Therefore, if a sensitivity exercise would have been carried out, it would always generate the result that the projections are most sensitive to the changes in the energy sector, since the energy sector produces more than half of the total national emissions.

5.2.3. With additional measures (WAM)

The WAM emissions by sector for years 1990–2050 are presented above in Table 5.1, and are depicted below in Figure 5.6. The activity data used for the calculations is presented in [Annex VI](#).

The methodologies applied are the same as those used for the preparation of the 2023 submission of National Greenhouse Gas emissions inventory of Cyprus to the UNFCCC⁷⁴. The impact in the emissions is presented in Table 5.3 and Figure 5.8. This scenario is based on the official National Energy and Climate Plan (NECP) of January 2020, updated with published technoeconomic data, macroeconomic and fuel price assumptions. In the transport sector, a degree of modal shift is achieved through considerable investments in sustainable modes of transport.

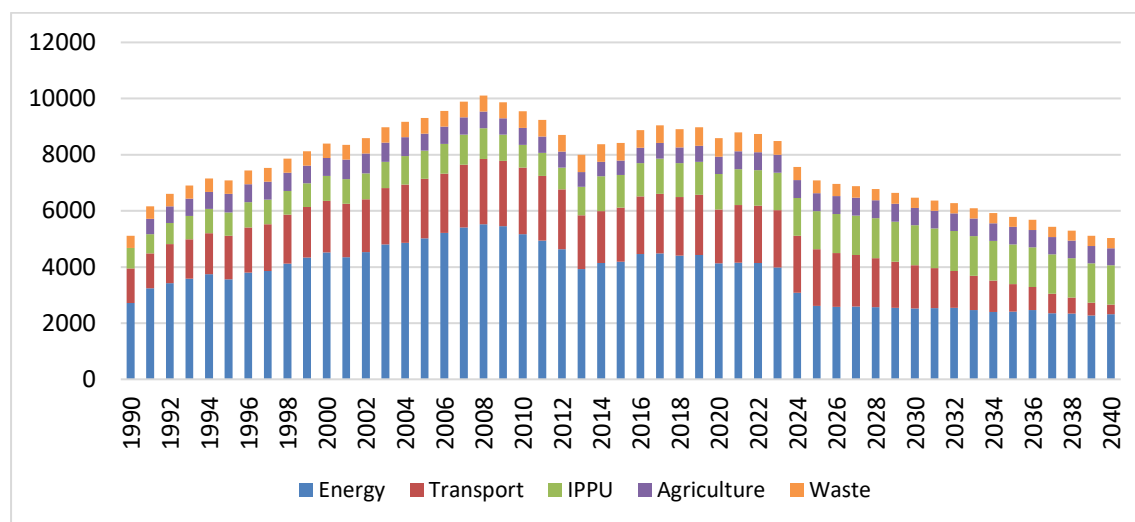


Figure 5.5. Total WAM GHG emissions by sector (Gg CO₂ eq.) 1990–2050

Emissions based on the WAM scenario are projected to decrease by 30% in 2050 compared to 1990 and decrease by 58% compared to 2005. In 2050 the difference between WAM and BaU is -21.8%, while the difference between WAM and WEM is -7.6%. Reductions from the WAM scenario as compared to the BaU scenario are presented below in Figure 5.6 and Table 5.3.

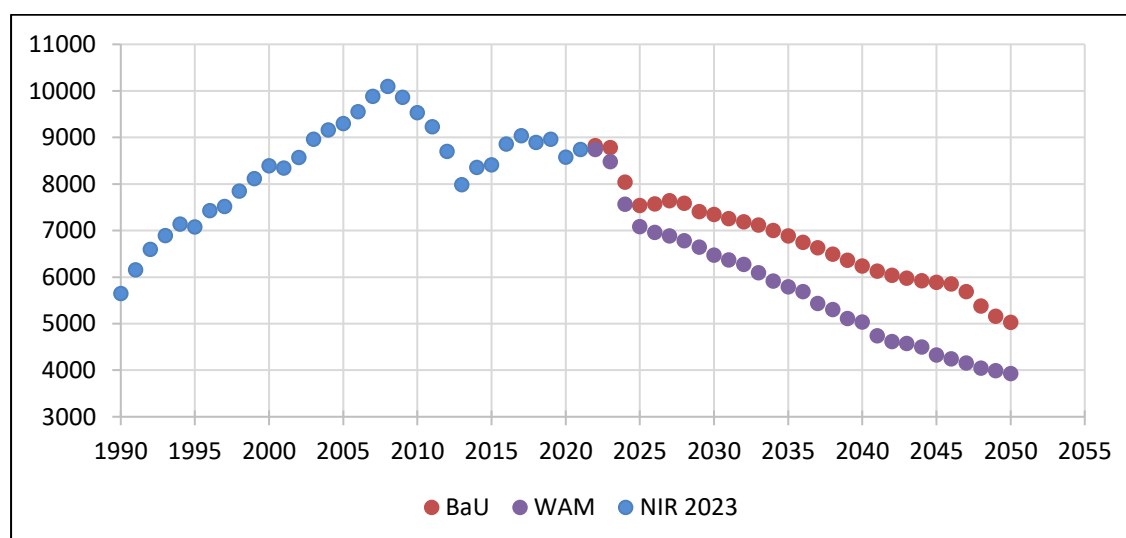


Figure 5.6. Total WAM GHG emissions compared to BaU (Gg CO₂ eq.) 1990–2050

The effect of currently implemented and adopted policies and measures (that are incorporated in the WAM projections scenario) are presented in Table 5.3 in terms of GHG emissions avoided on a CO₂

⁷⁴ <https://unfccc.int/documents/461671>

equivalent basis. The aggregate impact is not equal to the sum of the reductions from each measure, as when combined they produce different results.

Table 5.3. Reductions for WAM by Sector and Gas (Gg CO2 eq.)

Gg CO2 eq.	2025	2030	2035	2040	2045	2050
Energy	256	531	699	730	1120	627
Transport	-4	122	144	185	118	103
IPPU	40	60	81	103	125	147
Agriculture	20	27	30	34	36	37
Waste	142	134	140	146	162	181
Total (Excluding LULUCF)	454	875	1094	1198	1560	1095
Gas (Excluding LULUCF)						
CO2	250	645	834	905	1228	722
CH4	147	149	157	166	184	203
N2O	16	20	22	24	23	23
HFCs	39	59	79	99	120	141
PFCs	NO	NO	NO	NO	NO	NO
SF6	1	2	3	4	5	6
NF3	NO	NO	NO	NO	NO	NO

The total estimated GHG emissions reduction potential from the planned policies and measures (without LULUCF) was estimated to be 454 Gg CO2eq for 2025 (212 Gg under EU-ETS and 242 Gg under ESR sectors); and 875 Gg CO2eq for 2030 (393 Gg under EU-ETS and 482 Gg under ESR sectors).

5.2.3.1. WAM sensitivity analysis

Sensitivity analysis was not performed because there was no mitigation impact assessment of individual PaMs for the energy sector, due to the type of modelling used for the energy sector. Therefore, if a sensitivity exercise would have been carried out, it would always generate the result that the projections are most sensitive to the changes in the energy sector, since the energy sector produces more than half of the total national emissions.

5.2.4 LULUCF projections

The absorptions from the LULUCF sector are expected to increase in the coming years, mainly due to the growth of trees in the forested areas and implementation of the national policies and measures on forestation and reforestation. Table 5.4 and Figure 5.7 present the projected absorptions by the LULUCF sector until 2050 compared to previous years.

Table 5.4. 1990–2050 LULUCF emissions (Gg CO2 eq.)

Gg CO2 eq.	NIR2023	BaU	WEM
1990	-153.07		
1995	-180.03		
2000	-142.51		
2005	-220.83		
2010	-265.04		
2015	-296.11		
2020	-298.54		
2025		-306.96	-306.96
2030		-325.18	-325.18
2035		-343.40	-471.99
2040		-361.62	-526.66
2045		-379.84	-581.33
2050		-398.06	-636.00

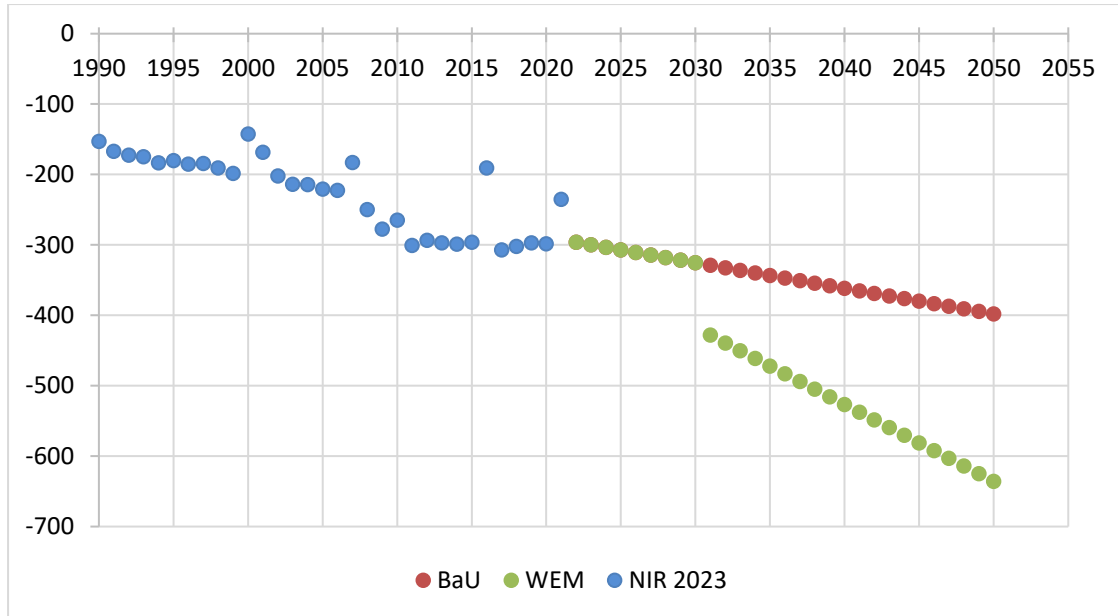


Figure 5.7. Projected LULUCF emissions by 2050, where “NIR2023” are the GHG historical net removals according to the April 2023 GHG inventory submission to the UNFCCC; BaU is the “Business as Usual” scenario; WEM is the “With existing measures” scenario

5.2.5. Air pollutants emissions projection

5.2.5.1. WEM scenario

The aforementioned choices in energy technologies and fuel mix results in the air pollutant emissions projections shown in Table 5.5. Even though the increased renewable energy share across the economy leads to a reduction in NO_x and SO₂ emissions, PM_{2.5} and PM₁₀ emissions initially decline up to 2025, as a result of more stringent regulations in road vehicle transport and a decrease in diesel passenger cars, emissions remain relatively constant during the period 2025-2030 and even increase slightly. This is attributed to an elevated use of biomass in the Heating and Cooling sector. It should be mentioned that the National Emission Ceiling set for SO₂ constrains the use of HFO with high sulphur content from 2020 onward.

Table 5.5. Air pollutant emission projections until 2030 in the WEM Scenario.

Pollutant	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NO _x	kt	6.33	5.98	5.76	5.20	5.06	4.88	4.76	4.72	4.70	4.69
PM ₁₀	kt	1.56	1.38	1.35	1.30	1.33	1.37	1.38	1.40	1.43	1.45
PM _{2.5}	kt	1.37	1.21	1.17	1.13	1.17	1.19	1.20	1.23	1.25	1.27
SO ₂	kt	3.52	1.69	1.71	0.55	0.62	0.63	0.53	0.54	0.56	0.56

When the projections of DLI are taken into account for the remaining sectors of the economy that are not captured by the adopted methodology, a more comprehensive outlook is provided. It should be noted that DLI projects emissions for the major air pollutants only until 2030, and as such the horizon is limited in this case (Table 5.6).

Table 5.6. Economy-wide air pollutant emissions projections in the WEM scenario until 2030.

Pollutant	Unit	2020	2025	2030
NO _x	kt	10.83	8.29	7.91
PM _{2.5}	kt	1.56	1.36	1.45
SO ₂	kt	3.64	0.71	0.66

5.2.5.2. WAM scenario

As compared to the WEM scenario, a reduced projection in air pollutant emissions is observed, as illustrated by Table 5.7. A reduction is noticed for most air pollutants, but PM2.5 and PM10 indicate the highest reduction in the long-term. This is due to a lower use of biomass in the Heating and Cooling sector, as well as to lower fossil fuel consumption in road transport. However, by 2030 a considerable difference is noticed in SO₂ emissions. This is attributed to a slightly increased utilisation of oil-fired generation than in the WEM scenario; a higher deployment of RES in electricity supply in the WAM scenario necessitates an increased use of the flexibility offered by the Dhekelia ICE units. Finally, NO_x emissions are lower in the WAM scenario due to a lower gas-fired generation, as well as a lower dependence on fossil-fired passenger vehicles in the road transport sector.

Table 5.7. Air pollutant emission projections until 2030 in the WAM Scenario.

Pollutant	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NO _x	kt	6.26	5.88	5.64	5.07	4.89	4.79	4.67	4.57	4.46	4.38
Difference from WEM		-1%	-2%	-2%	-3%	-3%	-2%	-2%	-3%	-5%	-7%
PM10	kt	1.54	1.36	1.31	1.26	1.28	1.30	1.31	1.32	1.33	1.35
Difference from WEM		-1%	-2%	-3%	-3%	-4%	-5%	-5%	-5%	-7%	-7%
PM2.5	kt	1.35	1.19	1.14	1.10	1.12	1.14	1.15	1.17	1.18	1.20
Difference from WEM		-1%	-2%	-2%	-2%	-4%	-4%	-4%	-5%	-6%	-6%
SO ₂	kt	3.52	1.67	1.69	0.53	0.59	0.60	0.63	0.66	0.61	0.62
Difference from WEM		0%	-1%	-1%	-4%	-5%	-5%	20%	21%	9%	11%

When the projections of DLI are taken into account for the remaining sectors of the economy that are not captured by the adopted methodology, a more comprehensive outlook is provided. As aforementioned, DLI projects emissions for the major air pollutants only until 2030, and as such the horizon is limited in this case (Table 5.8).

Table 5.8. Economy-wide air pollutant emissions projections in the WAM scenario until 2030.

Pollutant	Unit	2020	2025	2030
NO _x	kt	10.78	8.13	7.60
PM2.5	kt	1.56	1.32	1.38
SO ₂	kt	3.64	0.69	0.72

5.3. Methodology used for the presented GHG emission projections

5.3.1 Description of the information collection process

The methodology applied for the estimation of the projected GHG emissions has taken into consideration the following:

- (f) At the time the projections were estimated, the 2023 GHG emissions inventory was available. Therefore, all data presented for 2021 and prior is based on the 2023 GHG inventory submitted to the EU in March 2023 for the purposes of compliance with Regulation (EU) 525/2013. The projection calculations reflect the inventory data for the historical years 1990–2021.
- (g) For the energy sector two models have been utilised by the Cyprus Institute for the preparation energy projections: OSeMOSYS-Cyprus and Final energy demand projection model.
- (h) For the activities that are included in the EU-ETS data for 2021 was available from the annual reports of the installations. This concerns the sectors of electricity generation (1A1a(i)) and cement and ceramics production (1A2f, 2A1 and 2A4a).
- (i) GDP and population projections from the energy models were used where GDP and population data was needed.
- (j) The projections of activity data were converted to GHG emissions through the application of the 2006 IPCC Guidelines and by applying global warming potential values from the fourth IPCC

assessment report, in line with the latest national GHG inventory submission (2023). Emission factors are derived from expert assessments based on the 2006 IPCC guidelines and country specific information.

The main steps of the methodology applied for all sectors were the following: (a) Scenario definition, (b) Activity data projection, (c) Estimation of GHG emissions. Further details on each sector and the specific assumptions applied are given in the sections that follow.

The base year for projections is the latest year reviewed inventory year of the national GHG emission inventory. Measures which have been introduced before the time of projection preparation are considered as existing measures. Measures expected to be approved later are considered as additional. Predictions of the number of inhabitants are based on information from the Statistical Service. These data are used for the energy models and waste projections. The scenarios of trends in the GDP used in projections are based on predictions provided by Ministry of Finance. These data are used for the energy models and for Waste sector projections. The prices of fuels on the global market and carbon prices are taken from the European Commission harmonised parameter values where national estimates are not available. The prices of domestic energy sources are based on the costs of their acquisition and are also affected by the competitive energy sources. Energy production projection data and energy consumption development are obtained by the relevant bodies (System Operators, Cyprus Energy Regulatory Authority and Energy Service) as well as from projections made by external collaborators. The decision on the projections to be used is taken by the Ministry of Energy. Calculation of GHG emissions from fuel combustion is based on energy balances obtained from the scenarios developed by the model of external collaborators. The projections of GHG emissions in Agriculture are based on trends in the activity data used in the emission inventory calculation. The most important activity data are animal population cattle and swine population, amount of fertilizers applied to agricultural soils, and annual harvest and production. The development of animal numbers is taken from the Department of Agriculture.

The activity data for the base year are taken from the Statistical Service.

The emission estimates in the LULUCF sector are to a large degree determined by development of land areas categorized by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The actual development of six major IPCC land use categories as reported in the latest emission inventory is used. The projections are based on the observed trends and anticipation of gradually less intensive land use changes until 2040. The specific attention is given to forest land, which always represents one of the key absorption categories in the emission inventory.

A waste sector projection contains three source categories - emissions from landfills, emissions from wastewater handling and emissions from biological treatment of waste. The Tier 2 methodology was implemented for the estimation of emissions from land disposal of solid waste using the IPCCWasteModel excel spreadsheet. The parameters are set to Southern Europe region, the Degradable Organic Carbon (DOC) is calculated based on waste by composition and the methane generation rate constant is the default for dry temperate. For biological treatment of solid waste Tier 1 methodology was implemented using the default method given in Equations 4.1 and 4.2 (2006 IPCC guidelines (volume 5, page 4.5)) with activity data based on national statistics. Tier 2 methodology was implemented for the estimation of emissions from wastewater treatment and discharge with incorporation of a country specific emission factor and country specific activity data. Activity data for the projections are various. Main socioeconomic drivers used for quantifications and GDP are obtained from the Ministry of Finance.

Subsequent activity data are estimated in accordance with scenarios description and particular policy.

Different annual reports often provide information regarding costs and energy savings achieved by different programmes and subsidy schemes. Nevertheless, further calculations are needed to evaluate the effect of emission savings in detail.

5.3.2 Description of the alignment with the national inventory system

There are certain parameters that ensure the alignment of projections with the national inventory:

- Data sources: the data sources are the same for both the inventory and the projections
- Methodology: the methodology applied for projections is the latest submitted inventory methodology for 2021
- Experts: the experts involved in the preparation of the inventory are the same as the experts involved in the preparation of the projections

In case discrepancies are identified between the inventory and the projections, QA/QC procedures are applied to achieve the best possible calibration between the two data sets.

5.3.3 Description of the links to arrangements on integrated national energy and climate reports pursuant to Art. 17 of Regulation (EU) 2018/1999

To collect data related to policies and measures and projections, the structure prepared for the preparation of the NECP and reporting on progress other dimensions of the Energy Union, e.g. processes to foster consistent use of energy-related data for the development of policies and measures and projections and for integrated progress reporting are applied.

5.3.4 Description of the quality assurance and quality control activities for reporting of policies and measures and projections

All the expert organizations providing information for the reporting are well-established and have their own QA/QC procedures. Furthermore, the ministries are responsible for the quality of information on their respective policies and measures and projections and perform further checks where applicable, such as comparison to other estimates. The Department of Environment is responsible for collecting and combining all the information and for performing further quality checks. For example, the Department of Environment compares the sectoral projections to the scenarios of the latest Energy and Climate Plan as well as compares the compatibility of the WEM and WAM projections with the effects of policies and measures. The Department of Environment also checks the completeness and that the reporting requirements are met. Sensitivity analyses for projections are carried out for factors being especially significant in terms of greenhouse gas emissions, and they are described in detail in the report accompanying each round of the Reporting. After the reporting tools and paper report have been compiled by the Department of Environment, they are sent to the decarbonisation working group for approval and afterwards to the network of officials for final approval.

5.3.5 Description of the process for selecting assumptions, methodologies and models for making projections of anthropogenic greenhouse gas emissions

Sector experts from the Department of Environment and other key agencies are responsible for selecting the assumptions, methods and models to use for the projections. The Department of Environment experts work closely and interact regularly with other key experts on energy, agriculture, industrial processes, forestry and land use change and waste modelling in order to establish an appropriate set of assumptions and methods. The experts document the data sources, methods and assumptions. Improvement opportunities are regularly identified and documented which includes input from external experts. The Department of Environment manages a list of improvements which is reviewed and prioritised on a regular basis for implementation. Changes to processes are documented in the methodology report.

5.3.6 Description of procedures for the official consideration and approval of the Member States national system for policies and measures and projections

All the involved institutions participating to the decarbonisation technical committee of the national governance system for climate and energy have nominated an expert for every reporting preparation period whose responsibility is to provide the necessary data for the report. Institutional experts take part in the quality assessment process and give the final approval concerning the information in the reporting tools and final report to be submitted.

5.3.7 Information on relevant institutional administrative and procedural arrangements for domestic implementation of the EU's nationally determined contribution, or changes to such arrangements

The domestic implementation of the EU's nationally determined contribution is monitored through regular meetings of the Decarbonisation Working group of the national governance system. Issues, such as budgets, proposals to EU funds are discussed along with different practical issues that may come up during the implementation of the measures.

5.3.8 Description of the stakeholder engagement undertaken in relation to the preparation of policies and measures and projections

All the relevant stakeholders are kept informed through participation in the meetings of the relevant working group of the governance system that will contribute later to the decarbonisation working group.

5.3.9. Energy Sector

5.3.9.1 Information on Models Used

Energy demand and production data for the sectors of energy were obtained mainly from the Cyprus Institute, where OSeMOSYS-Cyprus and Final energy demand projection model. The use of these models leads to the conduction of analytical quantitative targets per technology, such as the demanded power for wind turbines, small-scale biomass or the quantification of energy savings in the industrial and residential sectors, etc.

The existing model of the Cypriot energy system, developed in OSeMOSYS⁷⁵ is updated to support the formulation of the National Energy and Climate Plan of the Republic of Cyprus. The model employed in the second stage of the analysis is developed within the Open-Source Energy Modelling System (OSeMOSYS), which is a long-term cost-optimization energy system model. OSeMOSYS has been used in numerous studies with focus ranging from a global, regional and national scale. It is a bottom-up technoeconomic model that is demand-driven, which means the exogenously defined demand has to be met, no matter the cost. The choice of technologies and energy mix is based on the adopted technoeconomic assumptions (e.g. fuel costs, technology costs, resource availability, emission limits). The model's objective function is the minimization of the total discounted system cost over the entire modelling horizon. An existing model of the Cyprus electricity supply system, using code enhancements that allow consideration of short-term grid constraints, is expanded to include the transport and heating and cooling sectors⁷⁶.

The Final energy demand projection model was initially developed in 2008 in order to suit the planning needs of Cypriot energy and environmental authorities. It has been adopted since 2009 for the preparation of consecutive Renewable Energy and Energy Efficiency Actions Plans that were submitted by the Republic of Cyprus to the European Commission; for the development of a renewable energy roadmap for Cyprus with the aid of the International Renewable Energy Agency; for the national building renovation strategy; for the assessment of the energy efficiency potential in the Cypriot economy; and for various reporting needs to assess the compliance of Cyprus with the Energy Efficiency Directive.

The energy demand forecast model is a macroeconomic model. As an initial step in the analysis, an energy forecast model developed for Cyprus is applied to project final energy consumption across the economy. The energy forecast model has been used to support official energy planning efforts of national authorities in the recent past [4] and is described in detail in a relevant publication by IRENA.

⁷⁵ www.osemosys.org

⁷⁶ Constantinos Taliotis, Elias Giannakis, Marios Karmellos, Nestor Fylaktos, Theodoros Zachariadis, Estimating the economy-wide impacts of energy policies in Cyprus, Energy Strategy Reviews, Volume 29, 2020, 100495, ISSN 2211-467X, <https://doi.org/10.1016/j.esr.2020.100495> (<https://www.sciencedirect.com/science/article/pii/S2211467X20300481>)

Utilizing energy balance statistics for the period 2010–2018 supplied by the Statistics Service of the Republic of Cyprus, an outlook to 2050 is provided. The main energy-consuming sectors of the economy are separately modelled, namely: agriculture, households, cement industry, other industry, services, road passenger transport, road freight transport and aviation. Demand growth for the various energy forms is driven by exogenously defined macroeconomic assumptions obtained from the Ministry of Finance, technology costs and fuel prices, while it is subject to income and short-term and long-term price elasticities; these vary across the different sectors of the economy and are based on national econometric analyses and data from the international literature. In this study, the forecast model provides final energy consumption projections for all sectors except road transport. These are used as input in the cost-optimization model⁷⁷.

Since 2018 it has been used in combination with the OSeMOSYs model in the preparation of diverse national plans, such as the impact assessment of the National Energy and Climate Plan, the greenhouse gas and air pollutant emission projections used by climate change and air quality authorities, the economic impact assessment of the National Recovery and Resilience Plan, the long-term low GHG development strategy, and the preparation of a proposal for a green tax reform including a carbon tax in non-ETS sectors of the economy. The models run for the energy projections were updated with the harmonised key parameters provided by the European Commission in May 2022, in order to reflect the impact of the COVID-19 pandemic and the war on Ukraine.

5.3.10. Non-Energy sectors

GHG emissions in the non-energy sectors are calculated using spreadsheet models that calculate emissions based on projected activity data, emission factors and sector specific assumptions. Activity data is projected on the basis of expert judgement of sectoral experts and where necessary involvement of the private sector.

5.3.11 Scenario Definition

The tables that follow summarise the main assumptions of each scenario applied for the estimation of the GHG emissions up to 2050 for the IPPU, Agriculture and Waste sectors, based on the policies and measures presented in previous sections. Tables 5.9 and 5.10 summarise the main assumptions for the Energy sectors, while Table 5.11 summarises the main assumptions for the non-energy sectors. Assumptions for changes in animal population are presented in Table 5.12. For the complete 2021 data, please refer to the 2023 National Greenhouse Gas Inventory Report. Details on the activity data by sector for energy and non-energy sectors are provided in section 5.5.4.

Table 5.9. Main assumptions and parameters used for the three projections' scenarios (BaU, WEM and WAM)

Energy sub-sector	BaU	WEM	WAM
1A1a i Electricity Generation	Table 4.4/ Table 4.5	Table 4.4/ Table 4.5	Table 4.4/ Table 4.5
1A1c Manufacture of solid fuels and other energy industries	GDP*	Same as BaU	Same as BaU
1A1cii Other Energy Industries			
1A3a ii Domestic Aviation			
1A3d i International water-borne navigation			
1A5 Non-Specified			
1A2 Manufacturing Industries and Construction excluding 1A2f	Energy models	Energy models	Energy models
1A4 Other Sectors			

⁷⁷ Theodoros Zachariadis, Emanuele Taibi, Exploring drivers of energy demand in Cyprus – Scenarios and policy options, Energy Policy, Volume 86, 2015, Pages 166-175, ISSN 0301-4215, <https://doi.org/10.1016/j.enpol.2015.07.003>
<https://www.sciencedirect.com/science/article/pii/S0301421515300148>

1A2f Non-Metallic Minerals 2A1 Cement production	Full capacity from 2021; 80% alternative fuel by 2024 of which 30% biomass	Same as BaU	Same as BaU
1A3a i International Aviation	2021: percent change compared to 2020 based on tourists' arrivals; 2022 onward: GDP	Same as BaU	Same as BaU
1A3b Road Transport	Energy models	Energy models	Energy models
1A3d ii Domestic water-borne navigation	2021: 2019 value; 2022 onward: GDP	Same as BaU	Same as BaU
1A5 Other	GDP	Same as BaU	Same as BaU

Table 5.10. Assumptions for the energy mix to cover the electricity demand for each scenario (BaU, WEM and WAM)

	BaU	WEM	WAM
RES (in final energy demand)	23.6% (2022), 25.4% (2023), 27.2% (2024), 27.9% (2025), 29.1% (2026), 29.7% (2027), 31.6% (2028), 34.6% (2029), 35.3% (2030), 41.2% (2035), 49.3% (2040), 54.5% (2045) and 66.1% (2050)	28.4% (2025), 34.3% (2030), 45.3% (2035), 55.8% (2040), 70.6% (2045), 78.1% (2050)	28.3% (2025), 35.8% (2030), 47.7% (2035), 58.2% (2040), 73.7% (2045), 81.7% (2050)
Biomass	5.28% (2025), 5.8% (2030), 6.0% (2035), 6.2% (2040), 6.6% (2045), 7.1% (2050)	5.4% (2025), 6.1% (2030), 6.3% (2035), 6.5% (2040), 6.9% (2045), 7.5% (2050)	5.3% (2025), 6.7% (2030), 6.8% (2035), 7.1% (2040), 7.9% (2045), 8.7% (2050)
HFO	50% (2020), 56% (2021), 52% (2022), 50% (2023), 1% (2024), 0% rest of the horizon	50% (2020), 56% (2021), 53% (2022), 52% (2023), 1% (2024), 0% rest of the horizon	50% (2020), 56% (2021), 52% (2022), 51% (2023), 1% (2024), 0% rest of the horizon
Diesel	37% (2020), 30% (2021), 33% (2022), 30% (2023), 0% rest of the horizon	37% (2020), 30% (2021), 32% (2022), 28% (2023), 0% rest of the horizon	37% (2020), 30% (2021), 32% (2022), 29% (2023), 0% rest of the horizon
Natural gas	Starts from 2024 75% (2024), 72% (2025), 70% (2026), 64% (2027), 62% (2028), 63% (2029), 63% (2030), 31% (2035), 23% (2040)	Starts from 2024 74% (2024), 71% (2025), 68% (2026), 61% (2027), 62% (2028), 61% (2029), 61% (2030), 33% (2035), 22% (2040)	Starts from 2024 74% (2024), 70% (2025), 66% (2026), 61% (2027), 60% (2028), 59% (2029), 58% (2030), 35% (2035), 23% (2040)

Table 5.11. Main assumptions and parameters used for the three projections' scenarios (BaU, WEM and WAM)

Energy sub-sector	BaU	WEM	WAM
2A2 Lime Production	Reach 8000 t in 2030 linearly; then constant	Same as BaU	Same as BaU
2A4 Other Process Uses of Carbonates 2D1: Lubricant Use 2D2: Paraffin Wax Use	Maintain 2021 constant	Same as BaU	Same as BaU
2D3 Other - Solvent Use	Use 2021 per capita emissions with population projections	Same as BaU	Same as BaU
2F Product Uses as Substitutes for Ozone Depleting Substances	Use 2021 per capita emissions with population projections	Start recovery from 2024, increase linearly to reach 5% recovery in 2030; 10% recovery in 2040; 12.5%	Start recovery from 2024, increase linearly to reach

2G Other Product Manufacture and Use		recovery in 2045; 15% recovery in 2050	5% recovery in 2025; 10% recovery in 2030; 20% recovery in 2040; 25% recovery in 2045 and 30% recovery in 2050
2D3 Other - Urea-based catalysts	Use diesel projection from road transport	Use WEM diesel projection from road transport	Use WAM diesel projection from road transport
3A1a Dairy cattle	Lactation/ GE (gross energy intake): extrapolate 1990-2021 linear trend Pregnancy (NEp): assume constant 2021	Same as BaU	Same as BaU
3B Dairy cattle 3B Other cattle	Anaerobic digestion: linear increase from 2021 to reach 15% in 2040 and extend the trend to 2050 (20%)	Anaerobic digestion: linear increase from 2021 to reach 10% in 2030; 15% in 2040 and extend the trend to 2050 (20%)	Anaerobic digestion: linear increase from 2021 to reach 15% in 2030; 30% in 2040 and extend the trend to 2050 (45%)
3B Swine	Anaerobic digestion: linear increase from 2021 to reach 70% in 2040 and extend the trend to 2050 (75.3%)	Anaerobic digestion: linear increase from 2021 to reach 65% in 2030; 75% in 2040 and extend the trend to 2050 (85%)	Anaerobic digestion: linear increase from 2021 to reach 70% in 2030; 80% in 2040 and extend the trend to 2050 (90%)
3B Poultry	Anaerobic digestion: linear increase from 2021 to reach 30% in 2040 and extend the trend to 2050 (35.3%)	Anaerobic digestion: linear increase from 2021 to reach 25% in 2030; 30% in 2040 and extend the trend to 2050 (35%)	Anaerobic digestion: linear increase from 2021 to reach 30% in 2030; 40% in 2040 and extend the trend to 2050 (50%)
3D1.1 Inorganic N fertilisers	Linear decrease from 2021 to reach -5% in 2040 and extend the trend to 2050	Same as BaU	Same as BaU
3H Urea application	Linear decrease from 2021 to reach -5% in 2040 and extend the trend to 2050	Same as BaU	Same as BaU
5A Solid Waste	<u>per capita production</u> 2021: change with GDP - no tourists - > lower waste production 2021-2050: same as 2021 <u>composition of waste to disposal sites</u> : same as 2021	40% sorting at source from 2022; 55% 2025; 60% 2030; 65% 2035 ³ , constant until 2050 24% of organics to landfill from 2022; 24% in 2030; 24% in 2035 ³ , 24% until 2050 20% recovery of deep unmanaged and managed from 2023	1. 40% sorting at source from 2022; 55% 2025; 60% 2030; 65% 2035, constant until 2050 2. 24% of organics to landfill from 2022; 24% in 2030; 24% in 2035 ³ , 24% until 2050 30% recovery of deep unmanaged and managed from 2023

5B1. Composting	Waste composted: Assume same portion of waste going to compost as 2021	Same as BaU	Same as BaU
5B2. Anaerobic Digestion at Biogas Facilities	Waste digested: Assume constant as 2021	Annual increase of 1% from 2022	Same as WEM
5D Wastewater Treatment and Discharge	Population connected to central systems: assumed constant as 2021	84.5% (2020-2022), 84.8%(2023), 89.8%(2024-2026), 92.9%(2027), 94.0%(2028), 94.7%(2029), 100.0%(2030-2050)	Same as WEM
5D2 Industrial Wastewater Treatment and Discharge	Industrial production: assuming growth proportional to GDP	Increase anaerobic from 2025 (5% alcohol, 20% beer, 5% soft drinks, 7% dairy products, 10% meat and poultry, 5% vegetables, fruits and juices); constant after 2030	Same as WEM

Table 5.12. Assumptions for change in animal population

Animal Specie	2019-2030	2030-2040
Dairy & Other cattle	Linear reduction to reach -3.5% of 2019	Linear reduction to reach -2.5% of 2019
Sheep and goats	Linear increase to reach +10% of 2019	Stable from 2020
Swine	Linear reduction to reach -3% of 2019	Linear reduction to reach -2% of 2019
Horses	Stable from 2020	Stable from 2020
Mules & asses	Extrapolate 2011-2020 linear trend, continue	Continue trend
Poultry	Stable from 2020	Linear increase to reach +10% of 2019

5.3.12. LULUCF sector

For the LULUCF sector, the WEM scenario includes the “I plan for climate” mitigation measure that was introduced in 2018 in addition to the fire prevention measures as presented above. The implementation of the “I plant for climate” campaign is directed towards afforestation of non-forest land areas. The assumption for the WEM scenario is that this measure will lead to the conversion of annual cropland areas to coniferous forest. For the rest of the land-use categories (cropland, grassland, wetlands, settlements, other land) it was assumed that the same trend of land-use changes from 2013 onward until 2050 occur, given that the latest available Corine Land Cover data sets that provide the information on land-use changes are those of 2012 and 2018. For forest land remaining forest land, the average harvesting rate for the period 2012-2021 was assumed, while regarding forest fires, the area affected was assumed to be equal to the average of the total available time series (1990-2021) for the projection. In the case of the HWP pool, the projection was based on the linear extrapolation of the net contribution of sawnwood and wood panels categories based on the 2012-2021 period. The starting point for the projections was 2021, being the latest inventory year of the most updated national GHG inventory which was submitted to the EU. All categories and subcategories as well as all three gases (CO₂, CH₄, N₂O) which have been covered by the GHG inventory were considered in both WOM, WEM scenarios.

The BaU assumes that the policies and measures are not implemented.

Mitigation potential & projections for LULUCF mitigation measure “I plant for Climate”

For the projections it was assumed that 200 trees will be planted per hectare. As the starting year 2018 was utilized and the number of trees produced was estimated as presented below (estimated numbers

were provided by the Department of Forests). It is assumed that the area planted was previously utilized as Annual Cropland and that the reforestation is all coniferous forest. The transition period is 20 years.

Table 5.13. Main assumptions and parameters used for the LULUCF WEM

Year	No of trees produced	Hectares planted (200 trees/ ha) per year	Additional Annual Cropland to Coniferous Forest in ha (total area)	Additional Coniferous Forest to Coniferous Forest (20-year transition period) in ha
2019	9000	45	45	0
2020	70000	350	395	0
2021	150000	750	1145	0
2022	150000	750	1895	0
2023	150000	750	2645	0
2024	150000	750	3395	0
2025	150000	750	4145	0
2026	300000	1500	5645	0
2027	300000	1500	7145	0
2028	300000	1500	8645	0
2029	300000	1500	10145	0
2030	300000	1500	11645	0
2031	300000	1500	13145	0
2032	300000	1500	14645	0
2033	300000	1500	16145	0
2034	300000	1500	17645	0
2035	300000	1500	19145	0
2036	300000	1500	20645	0
2037	300000	1500	22145	0
2038	300000	1500	23645	0
2039	300000	1500	25100	45
2040	300000	1500	26250	395

There were two projections calculated, one for Annual Cropland to Coniferous Forest and the other for Coniferous Forest remaining Coniferous Forest for the period 2019–2050 for the specific mitigation measure.

Table 5.14. Total increase in removals between land categories for LULUCF WEM

Year	No of trees produced	Hectares planted per year, assuming 200 trees per hectare (ha)	Additional annual cropland converted to coniferous forest land (ha)	Additional coniferous forest land remaining coniferous forest land (ha)
2019	9000	45	45	0
2020	70000	350	395	0
2021	150000	750	1145	0
2022	150000	750	1895	0
2023	150000	750	2645	0
2024	150000	750	3395	0
2025	150000	750	4145	0
2026	300000	1500	5645	0
2027	300000	1500	7145	0
2028	300000	1500	8645	0
2029	300000	1500	10145	0
2030	300000	1500	11645	0
2031	300000	1500	13145	0
2032	300000	1500	14645	0
2033	300000	1500	16145	0
2034	300000	1500	17645	0

Year	No of trees produced	Hectares planted per year, assuming 200 trees per hectare (ha)	Additional annual cropland converted to coniferous forest land (ha)	Additional coniferous forest land remaining coniferous forest land (ha)
2035	300000	1500	19145	0
2036	300000	1500	20645	0
2037	300000	1500	22145	0
2038	300000	1500	23645	0
2039	300000	1500	25100	45
2040	300000	1500	26250	395

In the table below the projected net CO₂ removals for the two subcategories directly affected by the “1 plant for Climate” measure, namely the cropland converted to forest land and forest land remaining forest land for the period 2021-2050 are presented.

Table 5.15. Projected net removals in cropland converted to forest land, forest land remaining forest land and in the total LULUCF sector under the WEM scenario

Year	Net removals in cropland converted to forest land	Net removals in forest land remaining forest land	Net removals in LULUCF
	Gg CO ₂ eq.		
2021	-15.50	-95.63	-244.60
2025	-79.30	-155.58	-369.26
2030	-220.72	-155.54	-513.64
2035	-373.28	-155.73	-668.28
2040	-516.16	-156.55	-813.01
2045	-468.25	-161.37	-770.94
2050	-317.42	-170.65	-630.43

5.3.13. Main Differences in Assumptions, Methods Employed, and Results Between Current and Previous National Communication Submissions

As detailed in Chapter 4, the policy and measures for projections are aligned with the National Energy and Climate Plan for the period 2021–2030 (NECP) which is the overarching mitigation action plan of Cyprus for the particular period, along with the National Long-term Strategy pursuant to Article 15 of the Regulation 2018/1999. However, major events have transpired between the adoption of the initial NECP and the current submission, including the COVID-19 pandemic, the war in Ukraine, and the EU’s commitment to Fit-for-55 package. The impacts from COVID-19 and the war in Ukraine result in lower economic growth that impacts the final energy demand. In addition, the projection for fuel prices is also very different. Higher fuel prices means that renewable energy is more competitive, especially in the long run, resulting in higher renewable energy shares.

Also impacting transport projections are updated technoeconomic assumptions of vehicles, namely cost assumptions and fuel efficiencies of vehicles. The NECP policies and measures will be updated in 2023. While projection parameters in previous projection reports to the EU were based in these NECP policies and measures, policies and measures for energy and transport sectors in this national communication were more closely aligned with the recommended harmonised values provided by the European Commission in May 2022. This ensures that projections presented in this report better reflect current economics and technology.

Essentially, the WAM scenario for energy follows the NECP PaMs with revised inputs. The WEM scenario is the replicate of the final reference projection scenario of EU 2020. The BaU scenario is similar to WEM, but replicates intensity by sector, and also reflects that the microeconomic parameters from Cyprus are higher than those from the EU Commission. For the non-energy sector, the BaU, WEM and

WAM scenarios are based on assumptions from the appropriate ministries, as summarised previously in Tables 5.5–5.8.

Two models were used in the NC-8, (i.e. a top-down and a bottom-up model) are soft-linked to provide the projections. In the first step, a long-term energy demand forecast model projects final energy consumption in the electricity and heating and cooling sectors, which is inserted in a cost-optimisation model. The energy forecast model uses projections of national GDP and international oil prices, along with assumptions on income and price elasticities of energy consumption. In the second phase of the analysis, a technoeconomic cost-optimisation model is used to project the technology and energy mix in the electricity supply and transport sectors, while it also facilitates the estimation of necessary investments in the heating and cooling sector to satisfy the demand projected in the first step. These models were not used in the submission of the NC-7.

For the year 2030, the NC-7 submission projected 10221, 9404, and 7906 t CO₂ eq. under the BaU, WEM and WAM scenarios, respectively. The NC-8 submission projected 6967, 6431, and 5875 t CO₂ eq., respectively.

The updated NECP parameters will serve as the guide for future projection reporting. Quantitative targets as they stood in the previous NECP submission are shown below in Table 5.16, while the key policy priorities deemed necessary for obtaining these targets are outlined below in Table 5.17. These will be adjusted as necessary and reflected in subsequent submissions.

Table 5.16. National energy and environmental objectives for the period 2021-2030 in the context of EU policies

Reducing greenhouse gas emissions and environmental objectives	
<ul style="list-style-type: none"> • Emissions in the non-ETS sectors to be reduced by 20.9% compared to 2005. The non-ETS national target is going to be achieved by the use of flexible mechanisms provided by the ESR. • Emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO₂ from the atmosphere • Emissions in ETS sectors to be reduced by 24.9% compared to 2005 • Attaining quantitative targets for reducing national emissions of specific air pollutants 	
Increasing the share of RES in energy consumption	
<ul style="list-style-type: none"> • Share of RES in gross final energy consumption to reach 23% • Share of RES in gross final electricity consumption can reach at least 26% • Share of RES in heating and cooling to reach 39% • Share of RES in the transport sector to reach 14% 	
Improving Energy Efficiency	
<ul style="list-style-type: none"> • Final Energy Consumption of 2.0 Mtoe in 2030, representing 13% reduction in final energy consumption compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario • Primary Energy Consumption of 2.4 Mtoe in 2030, representing 17% reduction in primary energy consumption compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario • Achieving cumulative energy saving of 243.04 ktoe during 2021-2030 	

Table 5.17. Key policy measures planning priorities

PILAR	Key policy planning priorities
GHG emissions and removals	<ul style="list-style-type: none"> • Promotion of natural gas as intermediate fuels for the decarbonisation of the energy system • Promotion of renewable energy sources • Improvement of energy efficiency in buildings, industry and infrastructure • Reduction of emissions in the transport sector • Reduction of fluorinated gas emissions • Reduction of emissions from agricultural sector • Reduction of emissions from waste sector

PILAR	Key policy planning priorities
	<ul style="list-style-type: none"> • Increase carbon sinks
Renewable energy sources	<ul style="list-style-type: none"> • Various RES Support schemes for Self-Consumption • Synergies with other sectors (Energy Efficiency, Waste, Security of supply and Internal Energy Market) to promote RES in all energy sectors • Support schemes for RES to participate in the Electricity Market • Replacement of old Solar Collectors for households • Replacement of Solar Collectors for Commercial purposes and use of Solar Technologies for High process heat and/or Solar Cooling • Old vehicle scrapping scheme and financial incentives for the purchase of electric vehicles (both new and used) • Promotion of the open loop Geothermal Energy • Installation of RES and Energy Efficiency technologies in Public Buildings. • Electricity Storage Installations, Framework development and possible financial incentives. • Various other measures for RES in Transport (New bus contracts (using alternative fuels, electricity, gas, and biofuels B100), Use of Biofuels (and biogas) in Transport Sector • Other indirect measures that will help to increase energy efficiency and thus the RES Share in transport. • Statistical Transfer of Energy to be examined (exporting Energy in case of Electricity Interconnector)
Energy efficiency	<ul style="list-style-type: none"> • Energy efficiency obligation scheme for energy distributors • Energy Fund of Funds providing soft loans for energy efficiency • Individual energy efficiency interventions and energy efficiency retrofits in governmental buildings • Implementation of information and education measures • Support schemes/incentives for promoting energy efficiency in households, enterprises and wider public • Energy efficient street lighting. • Additional floor space “allowance” for buildings exceeded the minimum energy efficiency requirements set by national law • Advanced Metering Infrastructure Plan. • Promotion of energy efficiency in enterprises, through voluntary agreements • Action plan for increasing energy efficiency the road transport. • Energy efficiency in water sector • Vehicle excise duty based on CO2 emissions • Energy consumption fee for Res and energy efficiency applied on electricity bills. • Excise tax on road transport fuels exceeding the minimum levels by EU legislation
Security of supply	<ul style="list-style-type: none"> • Introduction of natural gas via LNG imports and the development of the necessary infrastructure • Increasing the flexibility of the national energy system
Internal Energy market	<ul style="list-style-type: none"> • Promotion of electricity interconnectivity of Cyprus via the project of common interest EuroAsia Interconnector • Development of internal natural gas network pipeline infrastructure • Investments for development and secure operation of the transmission electricity system • Promotion of the necessary regulatory framework and projects for the operation of the competitive electricity market • Promotion of the EastMed pipeline project
Research, innovation and competitiveness	<ul style="list-style-type: none"> • Fund of funds • New Industrial Policy • Establishment of the Deputy Ministry of Innovation and Digital Transformation

PILAR	Key policy planning priorities
	<ul style="list-style-type: none"> • European Structural and Investment Funds in the new Programming Period 2021 – 2027 • Revision of national funds regarding research and innovation with the aim to boost climate and energy priorities

5.3.14. Non-Sectoral Key Underlying Parameters

The GHG emission projections presented in this chapter are based on the October 2022 GDP projections provided by the Ministry of Finance⁷⁸, and are shown below in Table 5.18.

Table 5.18. Summary of Population and GDP Parameters

	2020	2021	2022	2023	2024	2025	2026
Population	896000	913954	916899	919844	922789	925734	928679
GDP (%)	-5.23	5.51	2.71	3.78	3.39	2.99	2.50
	2027	2028	2029	2030	2031	2032	2033
Population	930073	931466	932860	934254	935647	935635	935622
GDP (%)	2.30	2.00	1.69	1.70	1.74	1.76	1.83
	2034	2035	2036	2037	2038	2039	2040
Population	935610	935598	935586	934272	932959	931646	930333
GDP (%)	1.93	2.09	2.23	2.39	2.39	2.39	2.39
	2041	2042	2043	2044	2045	2046	2047
Population	929000	926800	924600	922400	920200	918000	915000
GDP (%)	2.4	2.4	2.4	2.4	2.3	2.3	2.3
	2048	2049	2050				
Population	912000	909000	906000				
GDP (%)	2.2	2.2	2.1				

5.4. Factors and Activities Per Sector

The tables in Annexes III-V show the trends for activity data from 1990–2040. For WEM and WAM scenarios, activity data is only presented for the projected years 2021–2040, as the historical activity data is the same with BaU. Biomass and biofuels are included, but in line with UNFCCC reporting procedures, CO₂ emissions from biomass are not included in sectoral and inventory totals, but rather reported as a memo item in the 2022 National Inventory. Emissions from solvent use are likewise excluded, and reported as indirect emissions in the 2022 National Inventory.

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6. Vulnerability assessment, climate change impacts and adaptation measures

6.1. Introduction

The information presented in this Chapter has been initially collected through the project “Development of a national strategy for adaptation to climate change adverse impacts in Cyprus” or CYPADAPT and has been further enhanced with new research work and analysis published after the end of the project.

6.2. Observed patterns of climate change across and projections for the future

Cyprus lies at the south-eastern end of the Mediterranean Sea and Europe, which is one of the most sensitive hot-spots and most vulnerable regions in the world regarding climate change.

Climate in Cyprus is generally characterized by mild rainy winters, occasional droughts, and long, hot and dry summers. In winter, the average daytime temperature ranges from 12–15°C while the wet season extends from November to March, with most (approx. 60%) of the rain falling between December and February (Pashiardis, 2002). Precipitation is generally associated with the movement of moist maritime flows to the North, occurring particularly over areas of high elevation (Kostopoulou and Jones, 2007a). Winter precipitation is closely related to cyclogenesis in the region (Maheras et al., 2001). In summer, the average maximum temperature in coastal regions is 32°C and often reaches 40°C in lowland continental areas. This is attributed to the extension of the summer Asian Thermal Low which is evident throughout the eastern Mediterranean in all seasonal circulation patterns (Kostopoulou and Jones, 2007a,b) and associated high temperatures and abundant sunshine. The characteristic summer aridity of the region has significant implications in several socio-economic sectors (Giannakopoulos et al., 2010).

Recent studies on present and future climate have shown that this semi-arid island has been affected and is expected to be relatively strongly affected by the projected warming and related changes (Christensen et al. 2007, Michaelides et al., 2009). The already observed shift of the mean synoptic weather patterns in Europe (Michaelides et al., 2010) and in the close area (Tyrllis et al., 2015) has been connected with increase in appearance of heavy rainfall events (Hatzaki et al., 2008; Tymvios et al., 2010), rainfall (Lingis and Michaelides, 2009), heat events (Tymvios et al., 2013) and severe dust events (Michaelides et al., 2013). Therefore, Cyprus, where diverse and extreme climate conditions are already common, is likely to face increases in the frequency and intensity of droughts and hot weather conditions in the near future, with probably disproportional impacts.

Some of the future climate changes were projected by using PRECIS as the main Regional Climate Model and the A1B scenario of the Special Report on Emissions Scenarios (SRES) of the Intergovernmental Panel on Climate Change (Nakićenović and Swart 2000) which provides a good mid-line scenario for carbon dioxide emissions and economic growth.

The predictions of future climate change were examined in two future periods i.e. the near future period 2021-2050 and the distant future period 2071-2100. The derived values of various climatic parameters in Cyprus for both future stages were compared to the reference values during the period 1960-1990 (control period). The projected climate changes for the 2021- 2050 period were made by using six additional simulation models of the ENSEMBLES prediction system beside PRECIS, whereas for the 2071-2100 period the emissions scenarios A2 and B2 were used in addition to the A1B.

The future period 2021-2050 has been chosen specifically and examined in detail for the needs of stakeholders and policy makers, in order to assist their planning in relation to adaptation measures, impacts and vulnerability assessment.

In general, regional climate models consistently predict an overall warming and drying of Cyprus with significant impacts in human health, energy use, water resources and other socio-economic sectors. Pronounced warming and precipitation reductions are also detected from time series of temperature and precipitation parameters, regarding representative locations of Cyprus during the period 1951-2100.

6.2.1. Observed changes

6.2.1.1. Observed changes in temperature

Temperature records and long-term changes in diurnal temperature range have been studied by Collins Price (Price et al., 1999) and more recently, for the period 1892 – 2010 from the Department of Meteorology (Papachristodoulou, 2022) and the Cyprus Institute (Hadjinicolaou et al. 2011). These studies show an increase in the annual mean air temperature of the atmosphere of the order of 1.8°C in Nicosia (Figure 6.1) and 2.9°C in Lemesos (Figure 6.2). This increase is higher than the rise in the global mean surface temperature, which was ranging between $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$ over the last 100 years (1906 – 2005), according to the Intergovernmental Panel on Climate Change (IPCC, 2007).

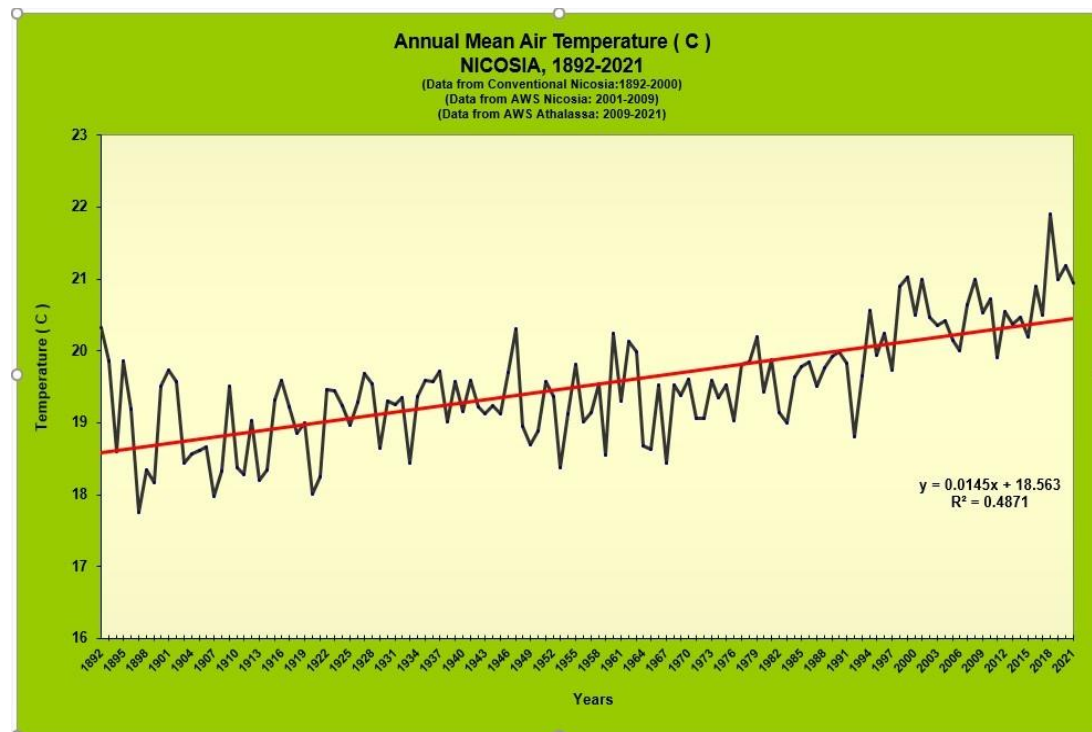


Figure 6.1. Observed changes in the annual mean air temperature (°C) from 1892 till 2021 in Nicosia

Moreover, as regards the annual mean air maximum and minimum temperature, the former varies depending on the location, while the latter show an increase for the whole area. However, a less rapid warming in T_{min} over the mountains compared to inland and coastal areas.

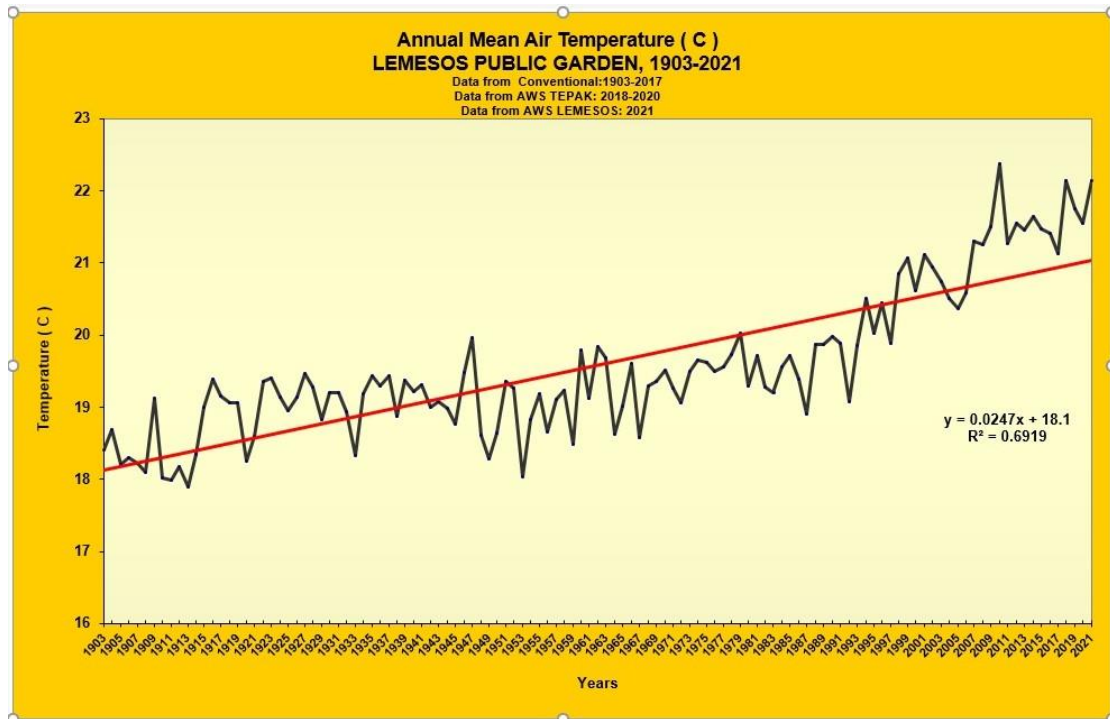


Figure 6.2. Observed changes in the annual mean air temperature (°C) from 1903 till 2021 in Lemesos

The 1961-1990 reference temperature patterns generally illustrate the different climatic zones within Cyprus, from the cool higher elevation regions to the hot and dry lowlands and the warm and humid coasts. Regarding this reference period, the average maximum temperature range is 10-16°C in winter and 25-35°C in summer. The summertime maximum TX in coastal regions is about 33°C, while further inland it often exceeds 40°C.

The average minimum temperature (TN) during winter (DJF) ranges between 2-14°C and in summer ranges between 15-25°C, showing the contrast between the coastal and the continental areas. Winter average TN does not fall below 2°C, even in continental parts of the country, whereas minimum temperatures above 7°C are typical of the Cyprus milder coastal climate.

6.2.1.2. Observed changes in precipitation

From the data of the Department of Meteorology (S. Papachristodoulou, 2022), in Figure 6.3 it can be seen that the annual average of the total precipitation has decreased from 559 mm (climate period 1901 - 1930) to 463 mm (climate period 1971 - 2000) which amounts to a decrease of 18%. The difference of the average precipitation of the climatic period 1941-1970 (pink line) with the average precipitation of the climatic period 1951-1980 (brown line) as well as with the average annual precipitation values of the following climatic periods of the line (1961-1990 and 1971- 2000, red line) depicts the decline in precipitation. The average precipitation of the climate period 1981-2010 (black line) is 464 mm, so it remains at the same level as the previous climate period 1971-2000, while the average precipitation of the climate period 1991-2020 (blue line) is 475 mm, which means that there is also a small increase compared to the 2 previous climate periods. According to Lange (2009) the decrease in precipitation for the period 1905 to 2005 was about 170 mm, while in 2008 precipitation was 45% below the 2000-2007 average, leading to severe drought.

The problem of the rainfall reduction in Cyprus till 2010 is also depicted in Figure 6.4 which shows the water stress index in other words the availability of water. Cyprus ranks first among the European countries in terms of water stress index (Wintgens and Hochstrat, 2006).

The total annual precipitation is presented in Figure 6.5. The large east-west contrast is evident in both annual and seasonal precipitation patterns. The maximum annual total precipitation occurs at the

western coasts and most precipitation occurs in winter and autumn, in similar patterns. The winter total precipitation ranges from about 75mm in the lowlands of central Cyprus to 270mm in the western higher elevation areas, woodlands and wetlands.

The frequency distribution of the annual precipitation per climatic period (30 years) was investigated by Michaelides et al. (2009). The analysis revealed that although the mean precipitation value of each climatic period had minor variation, the statistical distribution characteristics of the annual precipitation between climatological periods diversified significantly with an increase of years with high and low precipitation at the expense of years with average precipitation during consequent climatological periods. These findings are in agreement with the findings of Alpert Pinhas (Pinhas et al., 2002) who studied the paradoxical increase of Mediterranean extreme daily rainfall in spite of decrease in total annual values.

Another important parameter for Cyprus is the increase in evapotranspiration. As shown in Figure 6.6, evapotranspiration has increased by 60-80 mm in the period 1976 - 2006. This, combined with temperature rise and rainfall decrease, intensifies the drying of soils and leads gradually to their desertification.

The 1961-1990 precipitation patterns in Cyprus do not depend only upon the synoptic weather conditions but also on the pronounced topography. The dominance of local topography is also evident from the seasonal total precipitations. For example, winter total precipitation ranges from about 75mm in the lowlands of central Cyprus to 270mm in the western higher elevation areas, woodlands and wetlands.

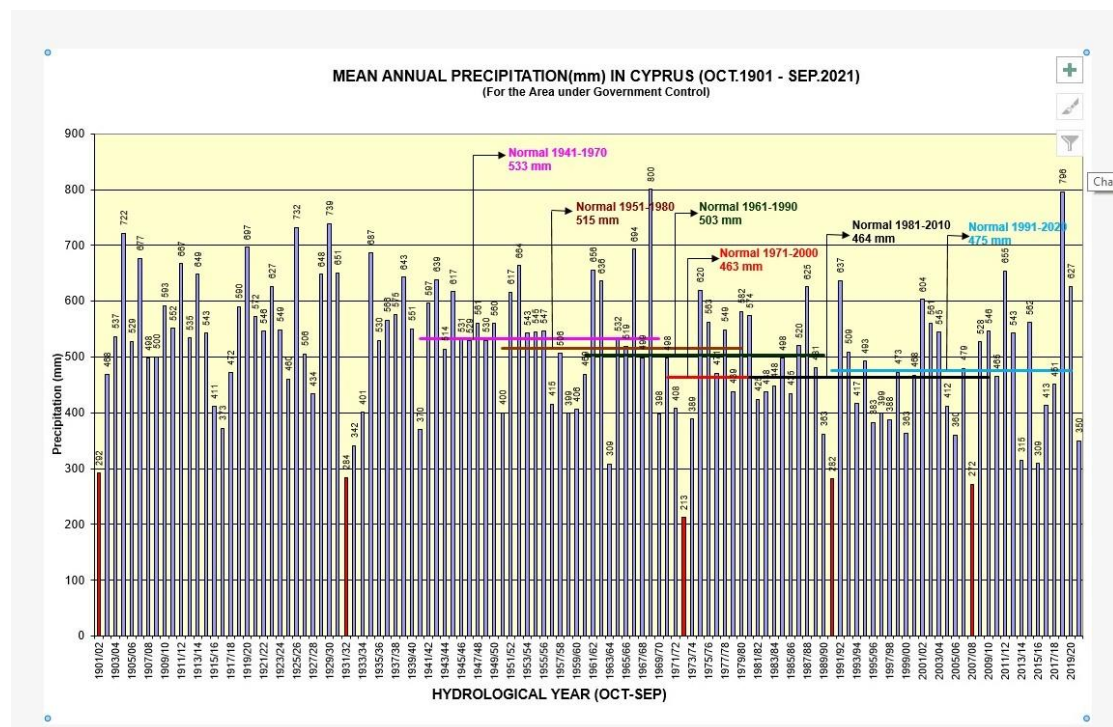


Figure 6.3. Annual average precipitation (mm) in Cyprus from hydrological year 1901-02 till 2020-21
Mean 1901-1930 559mm, mean 1971-2000 463mm, decrease 559-463 = 96mm (17%)

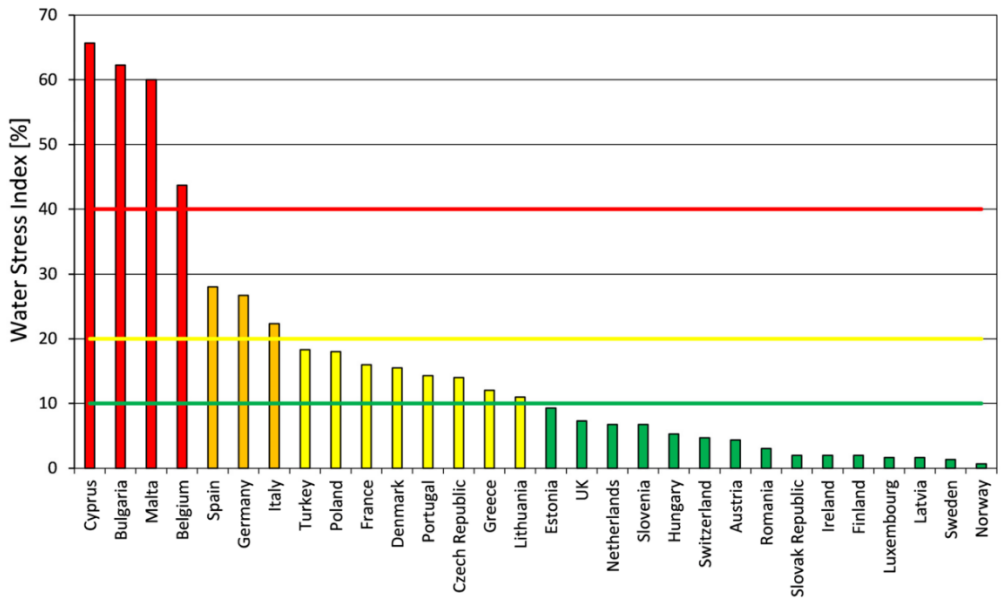


Figure 6.4. Water Stress Index among European countries. Cyprus ranks first (Sofroniou and Bishop, 2014)

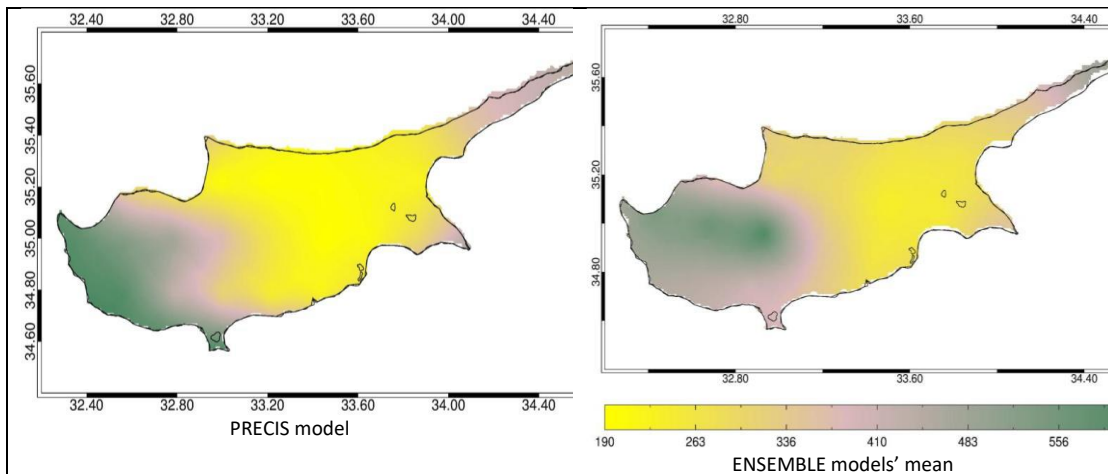


Figure 6.5. Annual total precipitation for the years 1961-1990 (control period)

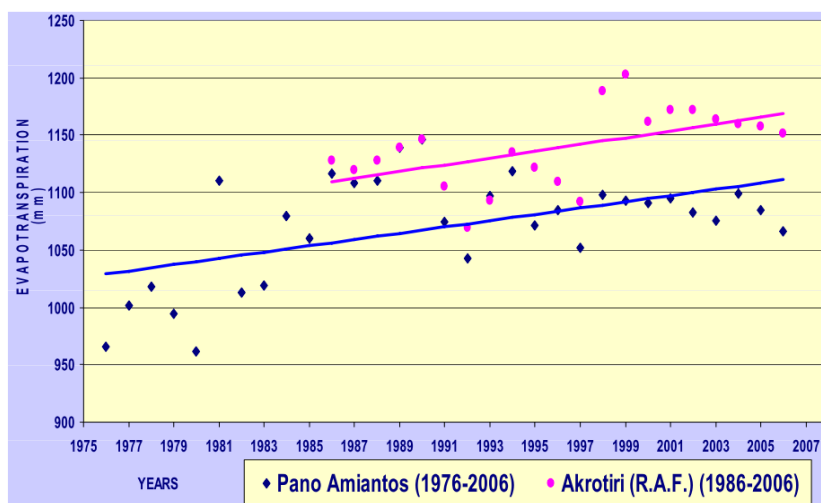


Figure 6.6. Increasing trend in annual evapotranspiration as it testified by records at Pano Amiantos station (1976 – 2006) and Akrotiri station (1986 – 2006) of the Penman-Monteith evapotranspiration

6.2.1.3. Observed changes in Extreme weather events: heat wave, drought, flood, dust

Since 1950 an increasing number of heat wave events have been observed in many regions around the world. An increase in the number of hot nights has also been recorded (IPCC, 2007, IPCC 2013). In addition, larger parts of the world have been affected by droughts as a combined effect of rainfall decline and evapotranspiration increase. Still, heavy rainfall events which lead to flooding have been intensified but this does not characterize a global trend. Finally, the number of tropical storms affecting the Eastern Mediterranean (although varying from year to year) has generally increased in terms of their intensity and duration since the 70s (IPCC 2007, IPCC 2013). However, studies for the Eastern Mediterranean and the Middle East have presented mixed results (Kostopoulou et al., 2005; Tanarhte et al., 2015).

The connection of specific atmospheric circulation patterns with heat events (Tymvios et al., 2013) and the differentiation of the frequency of occurrences of the patterns in the recent climatological periods (Michaelides et al., 2010) confirm the shift of the general climate mean of the area towards drier and warmer conditions with prolonged summertime periods with increasingly frequent occurrence of extreme and lengthier heat events.

In Cyprus, during the last decades the number of hot days and warm nights has increased, whereas the number of days with temperatures less than or equal to 0°C has greatly declined. There has been reported an increasing trend in the minimum temperatures in the island, as indicated from the increase in the number of days with temperature 40°C or higher (Figure 6.7) and the great reduction the number of days with temperatures less than or equal to 0°C (Figure 6.8).

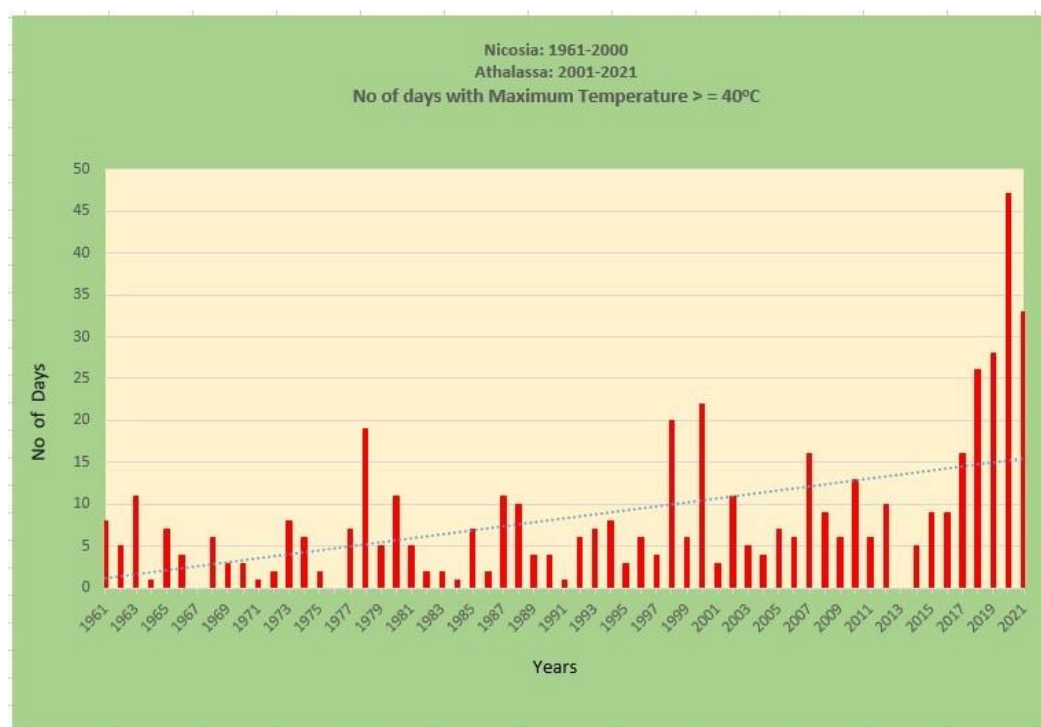


Figure 6.7. Number of days with temperature 40°C or higher from Nicosia station for the period 1961 - 2021

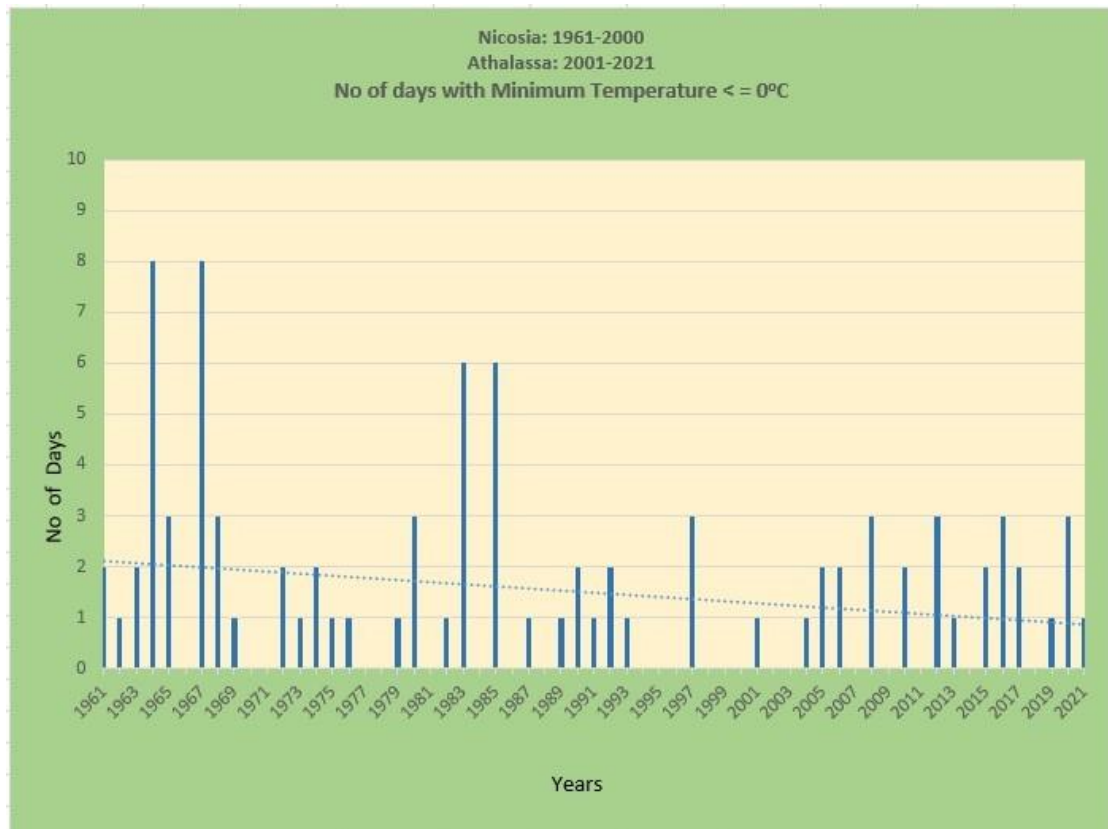
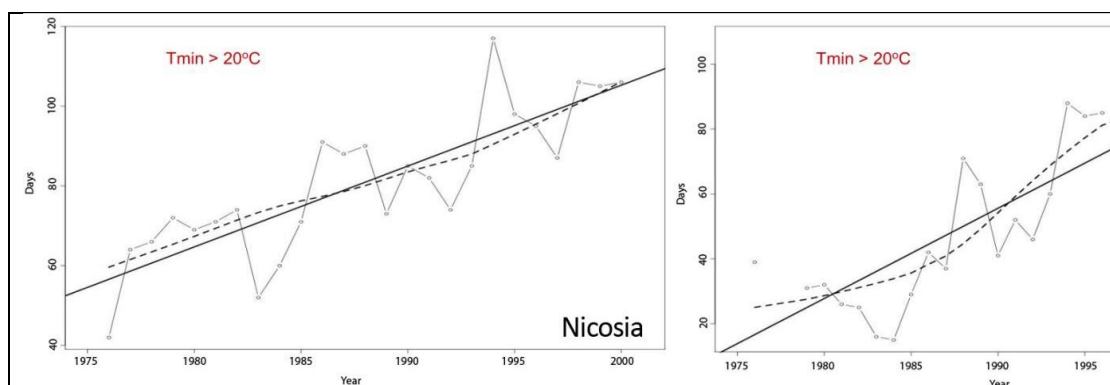


Figure 6.8. Number of days with temperatures less than or equal to 0°C from Nicosia station for the period 1961 - 2021

Furthermore, very important is the increase in the number of warm nights in almost all of Cyprus as evidenced in Figure 6.9 (Hadjinicolaou et al., 2011) and the annual mean temperature distributions present the temperature changes between the periods 1981-1990 and 2001-2008 (Figure 6.10). Over the last decade the greatest part of Cyprus has suffered from high temperatures and the largest part of the population residing in the three major cities, suffered high discomfort and serious socioeconomic problems such as increase in energy for cooling, water consumption and forest fire risk.



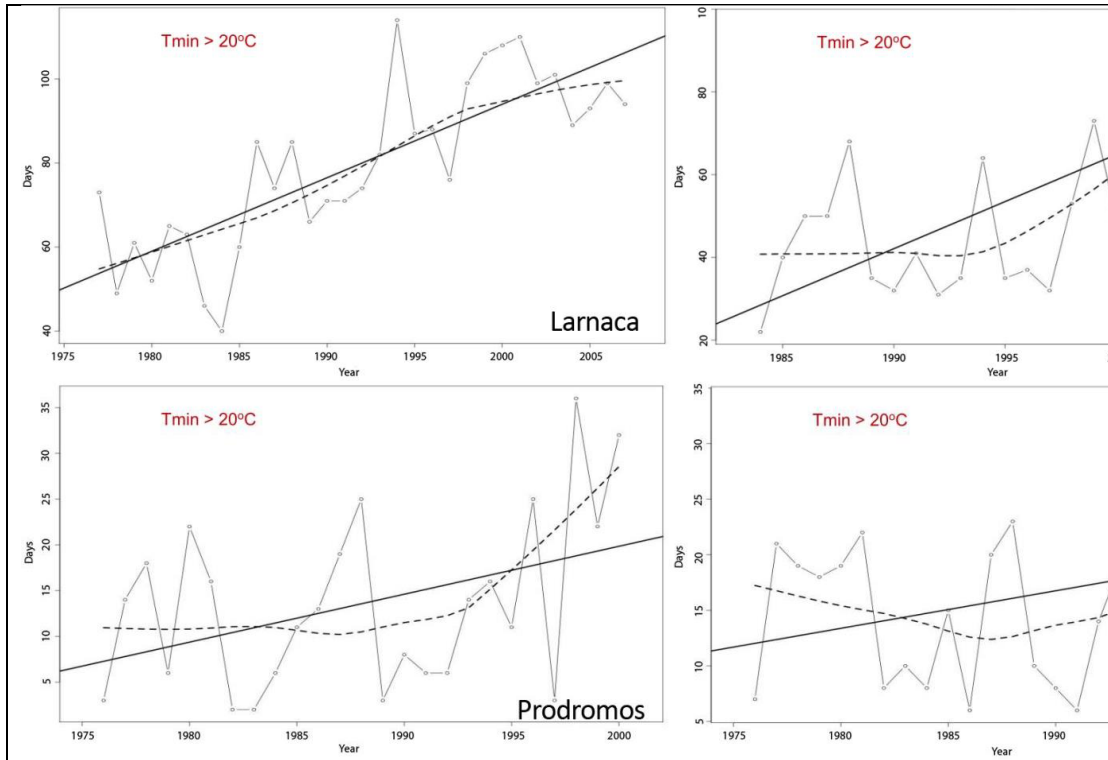


Figure 6.9. Increase in the number of warm nights in Cyprus as it testified by stations' records at Nicosia (1976 – 2000), Lemesos (1976 – 2006), Larnaca (1977 – 2007), Pafos (1983 – 2007), Prodromos (1976 –2000) and Saittas (1976 – 2000)

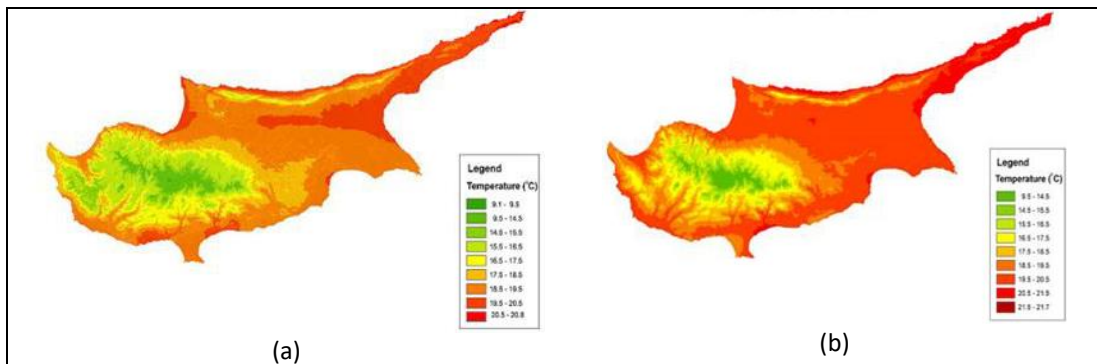


Figure 6.10. Spatial mean annual temperature distribution for period 1981 – 1990 (a) in contrast with the respective for period 2001 – 2008 (b)

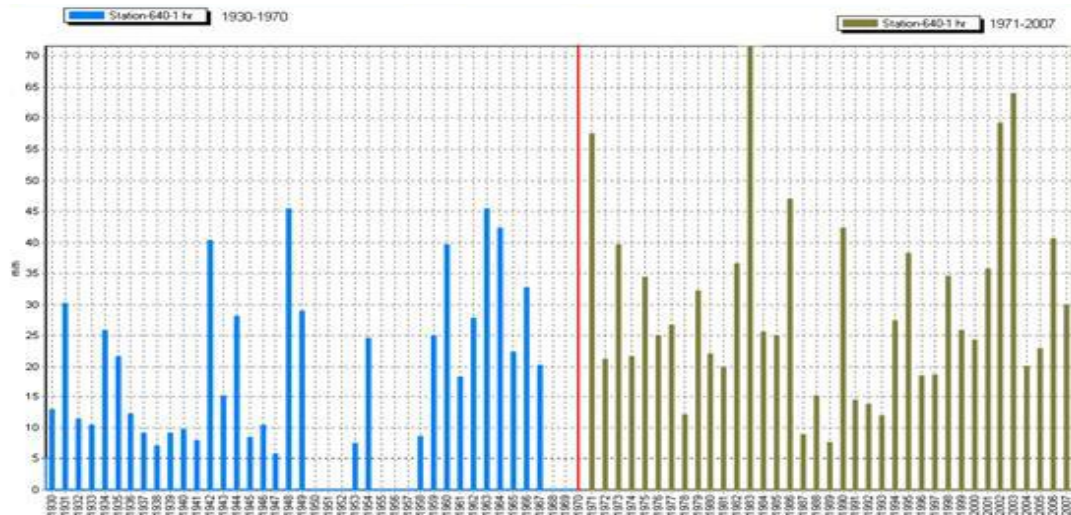


Figure 6.11. Increase in the highest amounts of rainfall in 1 hour for the period 1971 – 2007 in contrast with the respective for the period 1930 – 1970

As mentioned above, Cyprus experienced periodically severe droughts due to the declining precipitation, the worst of which was in 2008. During that event the water reservoirs were filled in only 3% of their capacity, prompting the Cyprus government to spend millions of Euros for water import from Greece (Davenport, 2008). Figure 6.11 shows the observed increase in heavy rainfall which falls in 1 hour for the period 1930-2007 despite the decrease in the mean precipitation. These extreme rainfall events may potentially cause localized flooding phenomena with devastating impacts. Nevertheless, it is not uncommon for isolated summer thunderstorms to occur, which however contribute to less than 5% to the total annual precipitation amount (Pashiardis, 2002).

6.2.2 Projected changes

6.2.2.1 Projected changes in temperature

Since the previous UNFCCC communication, the Climate and Atmosphere Research Center (CARE-C) of the Cyprus Institute has developed updated climate projections for the region and Cyprus (Zittis et al., 2019; Zittis et al., 2020; Zittis et al., 2022). These regional projections are based on in-house projections and analysis of publicly available multi-model ensembles (e.g., Diez-Sierra et al., 2022). In terms of scenarios, they are based on the Representative Concentration Pathways (RCPs), while downscaling using the Shared Socioeconomic Pathways (SSPs) is currently being developed. A scenario close to meeting the Paris Agreement's main targets (e.g., RCP2.6) implies that regional warming will continue at current rates in this decade and then will be stabilized to near 1 °C with respect to the end of the previous century or at about 2 °C since the preindustrial (Figure 6.12). On the contrary, under a business-as-usual pathway (e.g., RCP8.5), the observed warming will continue almost linearly for the rest of the century and will likely reach 4.5 °C. This warming is projected to be more pronounced in the inland parts of the island, including the capital city of Nicosia (Figure 6.13). In addition, it is expected to be stronger during the summer months (e.g., Figure 6.15 – right panel).

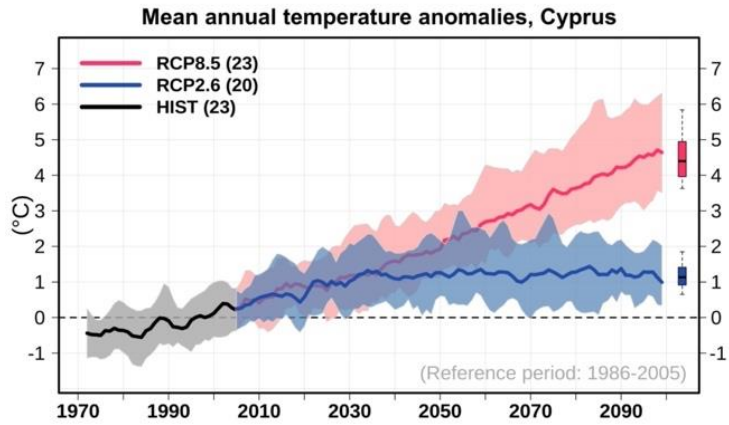


Figure 6.12. Projections of mean annual temperature anomalies for Cyprus based on the CORDEX-CORE ensemble (see Zittis et al., 2022).

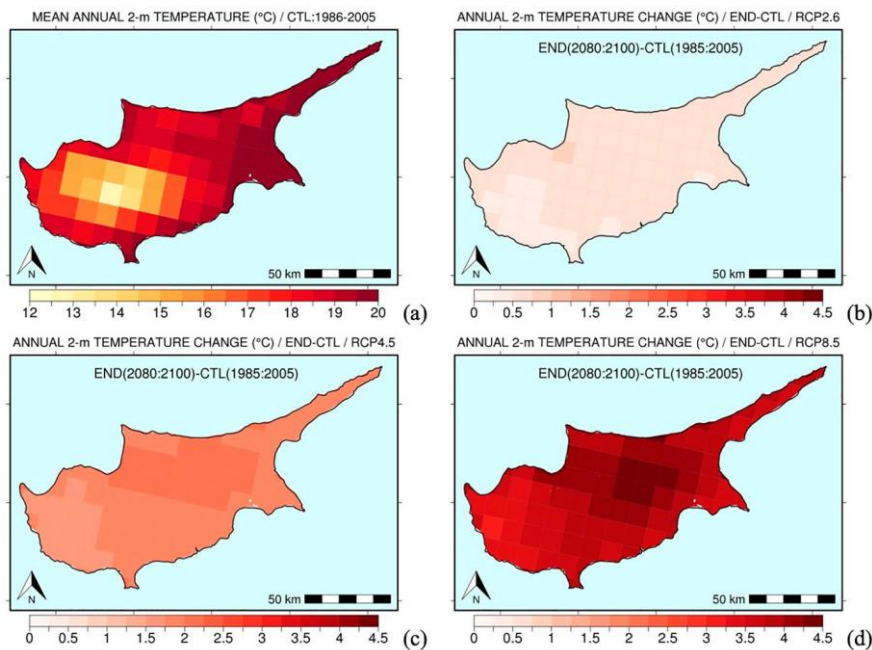


Figure 6.13. Mean annual 2-m temperature over Cyprus for the reference period 1986–2005 (a), and projected changes for the end of the twenty-first century (2080–2100) for three future pathways (b, c, d). (Source: Giannakis et al., 2020)

6.2.2.2. Projected changes in precipitation

The projected precipitation changes for Cyprus are quite variable among models and scenarios. Therefore, Cyprus precipitation patterns must be interpreted with caution, owing to the large temporal variability of rainfall and the inherent limitations of climate models to simulate accurately the hydrological cycle and the large variations of future projected changes among models. Changes in annual precipitation provide important information about occurrences of droughts and subsequent water shortages in Cyprus, expected in the near future.

Regarding precipitation (Figure 6.14), the interannual variability and model spread are significantly higher. Nevertheless, under pathway RCP8.5, the annual rainfall will be decreased by 20-30% of the reference values. This is expected to be most significant during the wet part of the year, which is also more critical for replenishing the water resources of the island (Zittis et al., 2019).

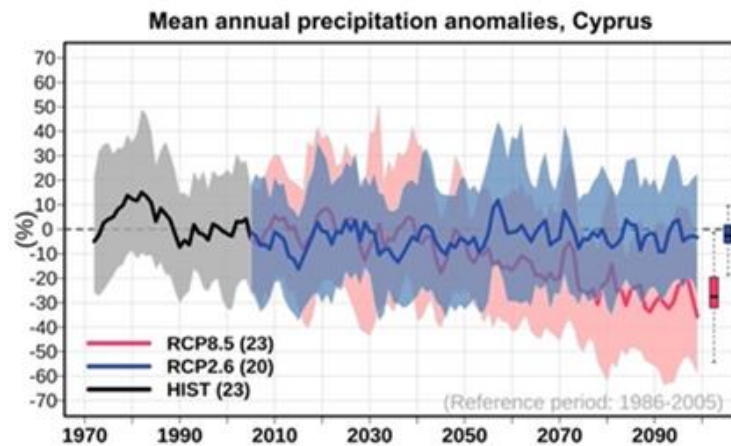


Figure 6.14. Projections of mean annual precipitation anomalies for Cyprus based on the CORDEX-CORE ensemble (see Zittis et al., 2022).

Under RCP2.6, the expected precipitation changes are less pronounced and comparable to the natural climate variability. Moreover, a high-emission scenario suggests a significant expansion of the dry season (red-shaded area in Figure 6.15). According to this scenario, because of the combination of increased temperature and precipitation declines, the wet part of the year will be mostly limited to the winter months of December and January. A comparison between the left and middle panels of Figure 6.15 highlights the benefits of adopting efficient and timely mitigation measures. In such a pathway, the climate characteristics of Cyprus will remain similar to the present-day conditions.

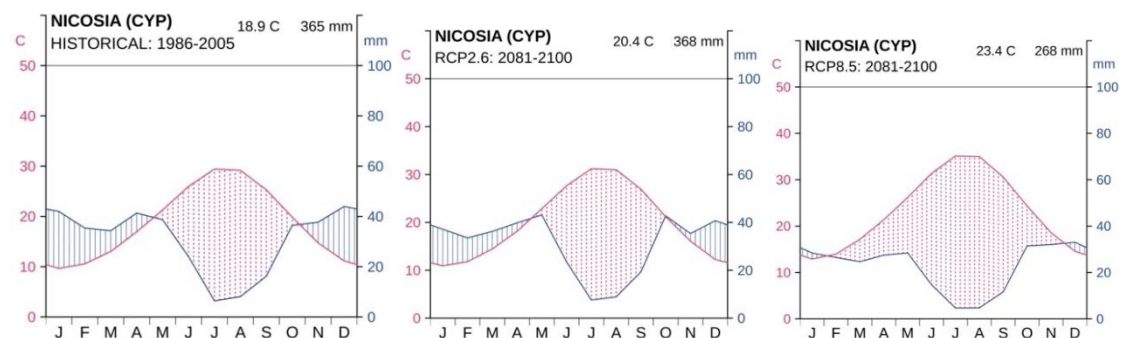


Figure 6.15 Walter-Lieth (ombrothermic) climate diagrams for Nicosia, Cyprus for historical conditions (left panel), and end-of-century projections under RCP2.6 (middle panel) and RCP8.5 (right panel). (Data source: CORDEX-CORE, Zittis et al., 2022).

6.2.2.3. Projected changes in Extreme weather events: heat wave, drought, flood, dust

Extreme weather events in the broader region are expected to intensify in terms of frequency and duration (Hochman et al., 2022). Such events relevant for Cyprus include heatwaves, droughts and, more rarely, extreme precipitation events that can lead to flooding. Heatwaves in the region are expected to occur more often, last longer, and have higher peak temperatures (Zittis et al., 2021a). This is consistent for all scenarios and time horizons; however, particularly for business-as-usual pathways, so far, unprecedented events are expected to become commonplace within the next couple of decades. Such events will persist for several weeks, while their peak temperatures will likely exceed 50 °C, even in moderate climate scenarios (Zittis et al., 2021a). The discomfort during future heatwaves will be exacerbated in the cities due to the urban heat island phenomenon and increased air pollution levels (Pyrgou et al., 2020; Zittis et al., 2022). Observed and projected temperature climate extremes at regional to urban scales have been assessed also in the framework of the CELSIUS research project, coordinated by the Cyprus Institute (<https://celsius.cyi.ac.cy/>). An example of projected temperature changes in simulations that resolve urban scales is presented in Figure 6.16).

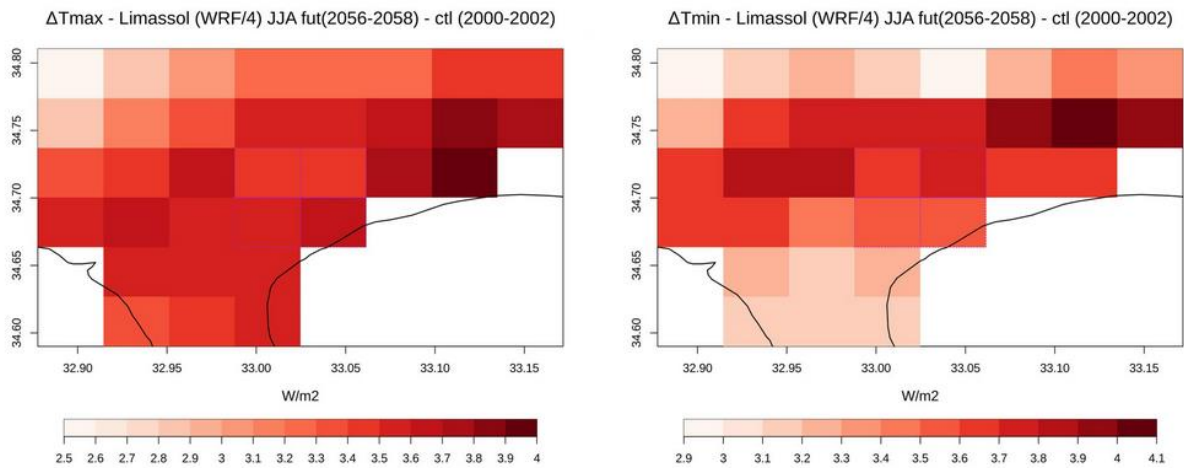


Figure 6.16. Projected change in summer maximum (ΔT_{max}) and minimum temperature (ΔT_{min}) in Limassol, Cyprus, calculated as the difference between a period (2056-2058) under the 3°C global warming level and the reference period (2000-2002), simulated by the WRF model over 4 km horizontal resolution (source: <https://celsius.cyi.ac.cy/>).

Future droughts constitute a significant challenge in the Mediterranean region which is projected to be a global drought hot spot (Spinoni et al., 2020; 2021). This results from the combined effect of temperature increase, precipitation decline and changes in precipitation characteristics (e.g., seasonality). For example, the number of rainy days in Cyprus is expected to decrease significantly (Figure 6.17 – left panel). Particularly in the west of the island and the Troodos mountains peaks, this decline is projected to reach or exceed 20 days per year on average. In addition, the maximum length of dry spells is projected to increase throughout the island (Figure 6.17a – right panel). Drought events will be prolonged by 30 to 40 days, particularly in the southeast territories.

Besides the overall decrease in precipitation, in a warmer world, individual precipitation events could be of unprecedented intensity, posing additional risks for flooding (Zittis et al., 2021b). This is also expected for Cyprus (Zittis et al., 2020). Nevertheless, due to their local nature and the short time scales involved, the predictability skill for such events in the current state-of-the-art climate models is relatively low.

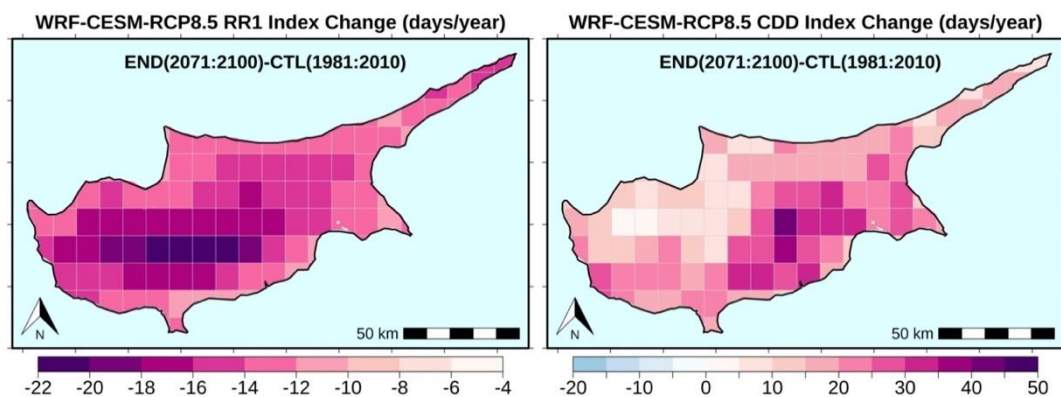


Figure 6.17a. Projected changes in the average number of rainy days (left panel) and consecutive dry days (left panel) under a business-as-usual pathway for the end of the 21st century (Source: Zittis et al., 2020).

Sea-level rise

Sea-level rise (SLR) mainly leads to beach erosion, loss of wetlands, damage to coastal infrastructure and saltwater intrusion into coastal aquifers. These are negatively affecting ecosystems and a range of socio-economic activities such as agriculture, tourism, water and energy management, urban planning

and more. Low-elevation regions, flat sandy beaches and deltaic sediments, commonly found in the eastern Mediterranean coastal zones (incl. Cyprus), are less resistant to SLR than elevated, hard and cliffy shores (Kumar et al., 2010). Most of the critical infrastructure of the island is located near the coast (e.g., airports, ports, power and desalination plants, tourist resorts, etc.); therefore, the coastal parts of the island are highly vulnerable to mean sea-level rise and extreme storm surges. For example, under mean conditions, at the end of the century, the total beach surface loss ranges from ~30% under scenario RCP2.6 to ~54% under the business-as-usual RCP8.5 (León et al., 2021). In addition, the rising of sea levels will affect the operation and maintenance costs of critical infrastructure (e.g., ports), as new investments will be needed to keep their operability. For example, a 58 cm mean sea-level rise projected by the end of the century (RCP8.5) implies an additional cost of more than 4.3 million Euro per year (Figure 6.17b).

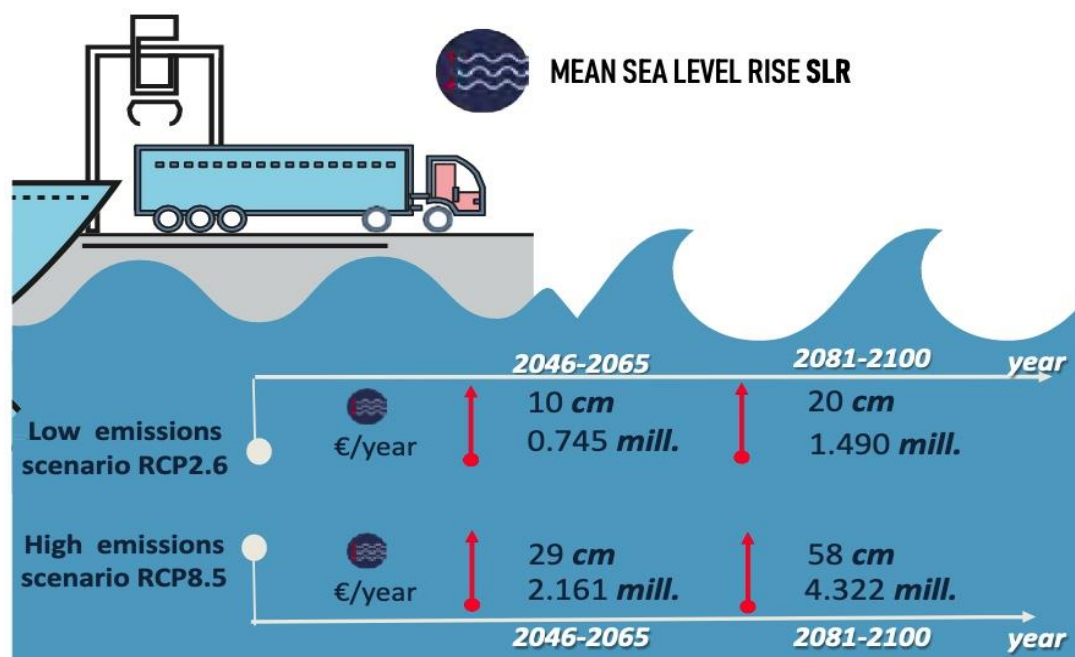


Figure 6.17b. Increased costs for maintaining ports' operability in Cyprus under different scenarios of SLR caused by climate change until 2100 (Adopted from León et al., 2021, <https://soclimpact.net/>).

6.3. Expected impacts and vulnerabilities of climate change in Cyprus

The following sections present the expected impacts and vulnerabilities of climate change in Cyprus for biodiversity, infrastructure, energy, health, forestry, agriculture and water. The latest information related to this section is available via the current National Adaptation Strategy and the preparation of the NC7. Nevertheless, an agreement with the European Commission was recently achieved, to receive technical support for the preparation of a revised NAS including a new Vulnerability Assessment. This work the European Commission is expected to start within 2023.

Furthermore, collaboration with research institutes (i.e. Cyprus Institute - CARE-C) will be enhanced, in order to provide a continuous communication regarding local climate change impacts and support the decisions taken on the adaptation policies and measures.

6.3.1. Biodiversity

Climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century, as already evidenced from the very rapid increase over the last century, especially in dry lands, mountains and Polar Regions (Millennium Ecosystem Assessment- MA, 2005)

Projected changes in climate, combined with land use change and the spread of exotic or alien species are likely to limit the capability of some species to migrate and therefore will accelerate species loss (CBD, 2007).

Cyprus due to its geographical position in the eastern part of the Mediterranean Sea bears all the characteristics of a semi-arid climate and some of the deficits of the global climate change. The rich biodiversity of Cyprus is the result of the combination of the geographical structure, landscape isolation due to its insular character, surrounding sea, topographic relief, geological structure and of course climatic conditions. The flora and fauna of the island are adapted to the various natural biotopes and climatic conditions, resulting in a large number of endemic and rare species (DoE, 2000).

Direct impacts of climate change on Cyprus biodiversity arise mainly from decreased rainfall and increased temperature, droughts, fluctuations in intensified precipitation, sea level rise and increased atmospheric CO₂. These impacts are expected to worsen in future period (2021–2050) as already projected PRECIS and ENSEMBLES prediction system.

Biodiversity is affected by numerous factors concerning the climate, ecology, society, culture, economy and technology (United Nations University, 2005). In terms of climate, the main factors affecting the biodiversity of Cyprus are among others the following: Variability (uneven geographic distribution and temporality of precipitation) - Reduction of frequency of precipitation -Increase of frequency of rainfall's intensity -Increase of temperature (and certain variables of temperature) -Heat-wave - Reduction of snow cover in Troodos -Increase of evapotranspiration (contributes to the intensification of soil drying).

The above-mentioned pressures in combination with other factors such as the island's landscape fragmentations, the intrusion of harmful invasive alien species and the deteriorated freshwater quality, are expected to threaten further and in more complicated way, mainly the terrestrial, marine and freshwater biodiversity of Cyprus.

6.3.1.1. Future Impact assessment

The climatic factors that may have an impact on the biodiversity of Cyprus include the decreased rainfall and increased temperature, droughts, fluctuations in intense precipitation events, sea level rise, increased atmospheric CO₂ and changes in fire regimes. According to PRECIS projections for the future period 2021-2050, the average annual temperature in Cyprus is expected to increase by 1-2°C, precipitation to decrease in seasonal level and in minor degree in annual level, the maximum length of dry spells (precipitation<0.5mm) is expected to increase 10 to 12 days on average, heat wave days (temperature >35°C) will be increased averagely about 10-30 days on annual basis, depending on the region. Concerning future changes of annual max total rainfall over 1 day, PRECIS projections show that a slight increase of about 1-4 mm is anticipated. Finally, regarding the highest annual total precipitation, falling in 3 consecutive days, a negligible increase of about 1-2 mm of rainfall is expected. For the purpose of this report, the future impacts of climate change are grouped in categories and assessed in the sections that follow.

- Terrestrial ecosystems
 - Distribution of plant species in terrestrial ecosystems
 - Plant phenology of terrestrial ecosystems
 - Distribution of animal species in terrestrial ecosystems
 - Animal phenology of terrestrial ecosystems
- Aquatic ecosystems
 - Marine biodiversity
 - Freshwater biodiversity
 - Phenology of aquatic ecosystems

Impacts on terrestrial ecosystems

The distribution of plant species in terrestrial ecosystems, in terms of number of species, services of plants and plant communities, is expected to be affected even more with the projected milder winters in future. So far northward and uphill movements of plants and extinctions of species have been

observed, emerging the concern about the resilience of wild plants to the rate of climate change. Another impact that is expected to be exacerbated is the invasion of alien species, having caused ecological changes throughout the world in the past few hundred years (Clout and Lowie, 1997; Unit of Environmental Studies), such as diseases of local species and alterations of keystone species. The invasive alien species alter or even extinct populations and native species in the natural ecosystems. In Cyprus the already low plants species richness will be worsening in the future period (2021-2050) where droughts are anticipated to be increased.

Changes in phenological responses of plants have been noticed in several places of Europe, including Cyprus, as mentioned in the survey “Growing Season Temperatures in Europe and Climate Forcing over the Past 1400 Years”.

In the future period (2021-2050) the expected temperature increases of about 1-2°C on average, as well as the milder winters, can affect biodiversity negatively, especially in Akamas area, Troodos Mountain and Akrotiri peninsula, were the threatened plants located in a significant level. Both the winter minimum and summer maximum temperature is anticipated to have an increase of 0.8 - 1°C and 1-2°C, respectively, mainly in southern, inland and, western and mountain regions. Since there is no data available for on plant phenology, the extent of future climate impacts cannot be estimated at present.

The population and distribution of animal species in terrestrial ecosystems will be also changed with the temperature rise in the future; as a result of the decreased food availability and the expansion of invasive species and their associated diseases. The most typical example is the establishment of new pest species -such as migratory moths, butterflies, ticks and mosquitoes- due to warmer winters.

Furthermore, projections about the mammals of the Mediterranean regions- especially the threatened in terrestrial environments- suggest up to 9% risk of extinction (assuming no migration) during the 21st century (Andreou et al.).

As regard as the animal phenology of terrestrial ecosystems in Cyprus, there is no information available in relation with the increasing temperature, apart from the noticed increased populations of insects in the forests of Cyprus (DoF). However, the projected increase in temperature can affect animal phenology, due to the induced changes in the metabolic limits of animals, in the reduction of the thermoregulation capacity of warm-blooded animal species, in the length of breeding seasons and the higher reproduction of temperature-sensitive insects and others.

Impacts on aquatic ecosystems

The marine flora and fauna of Cyprus with the great diversity and low biomass are more vulnerable to climate change. Furthermore, the surrounding environment, the Levantine basin (Eastern Mediterranean Sea) is characterized by high temperature and salinity, as well as low nutrient levels, making it a challenging biological niche which constantly tests species' tolerance limits to physical components (Parari, 2009).

The temperature in Cyprus is expected to increase about 1.0 – 2.0°C in winter and about 2.0 – 2.7°C in summer, (according to PRECIS projections, for the future period 2021-2050), resulting in lower nutrient levels (phytobenthos and phytoplankton), higher salinity and acidification and, displacement of the endemic species by the invasive species, that entering the Mediterranean Sea through the Gibraltar straits and the Suez Canal.

For example, marine habitats of neuralgic importance -such as *Posidonia oceanica* meadows- are very sensitive to salinity, temperature and sedimentation alterations. The meadows produced by this marine plant function as nursery grounds for juvenile fish, reproductive fields and fisheries stock replenishment areas are exceptionally important. A potential loss of these meadows would bring catastrophic consequences for the marine biodiversity of Cyprus and its commercial fisheries (Parari, 2009). Since there is no data available further research is required to assess the future impact on marine biodiversity due to changes in nutrient levels.

The inland aquatic biodiversity will be affected by future climate change, as they can cause enhanced phytoplankton bloom, favouring and stabilizing the dominance of harmful cyanobacteria in phytoplankton communities, resulting in increased threats to the ecological status of lakes and enhanced health risks, particularly in water bodies used for public water supply and bathing (EEA et al., 2008). The plants, fish and aquatic organisms of rivers and water storage reservoirs (dams) of Cyprus are threatened by the eutrophication, which can be deteriorated by temperature rise. One of the most important effects in aquatic phenology is the change in the size and growth of phytoplankton and the consequent influence on the light levels, surface temperature and magnitude of nutrient recycling. However, information about phytoplankton growth and bloom response to temperature rise is not available and further research is required.

6.3.1.2. Future vulnerability assessment

The future vulnerability of biodiversity to climate change impacts in terms of their sensitivity, exposure and adaptive capacity based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021- 2050 is assessed for the impact categories as follows:

1. Distribution of plant species in terrestrial ecosystems
2. Distribution of animal species in terrestrial ecosystems
3. Marine biodiversity
4. Freshwater biodiversity

Terrestrial ecosystems

It is noted that, the future vulnerability of “Plant phenology of terrestrial ecosystems”, “Animal phenology of terrestrial ecosystems” and “Phenology of marine ecosystems” was not assessed due to lack of relevant research findings.

The future vulnerability of biodiversity varies substantially as it is related to the different rate and magnitude of climate change in different parts of Cyprus due to the variability of the air pollution levels, altitude, temperature and rainfall variations, meteorological conditions (e.g. wind, moisture), local geomorphology and soil characteristics.

The general characteristics of the plant distribution in Cyprus which indicate a sensitive environment to climate change plant species are the following: (i) low species richness, (ii) sensitive endemic plant species and (iii) several invasive plant species. The number of plant species in Cyprus is generally considered low in comparison with the levels in Europe, perhaps due to the semi-arid climate of the island and the more frequent presence of consecutive years of droughts according to Biosoil project (Hiederer and Durrant, 2010). Nevertheless, studies undertaken in Cyprus indicate that the percentage of endemism is 7.39% which is one of the highest in Europe (Hadjichambis and Della, 2007).

The more sensitive plant species are considered those that belong to relic populations and those that are less capable to adapt in the new environmental conditions. More specifically, according to the Red Book of Flora of Cyprus (Tsintides et al., 2007), 7% of the plant taxa in Cyprus is Regionally Extinct (RE), 14% of endemic plants of Cyprus is characterized as Critically Endangered (CR), 19.5% as Endangered (EN), 39% as Vulnerable (VU), 4,6% as Close Threatened (NT) and 2.2% as Low Danger (LC).

According to the studies of Hadjikyriakou and Hadjisterkotis (2002), 152 adventive species have been recorded. More specifically *Acacia saligna* (Labill.) (H.Wendl.) is described as the most dangerous invasive species in Cyprus, threatening many natural habitats, invading maquis, garigue, phrygana, marshy areas and agricultural land. It has been recorded as a serious threat to the habitat of the Salt Lake of Larnaca and it was considered necessary to remove a number of its population from the area (Atlantis Consulting Cyprus Ltd). Likewise, the *Robinia pseudoacacia* L. has spread in forests, maquis, garigue and phrygana vegetation. In addition, the observed for the first time *Ailantus altissima* (Mill.) Swingle and *Casuarina cunninghamiana* Miq. is also spreading, threatening natural habitats such as forests and maquis.

Considering the above, the sensitivity of the distribution of plant species (including Invasive Alien plant Species) in Cyprus for the future period (2021-2050) can be characterized high.

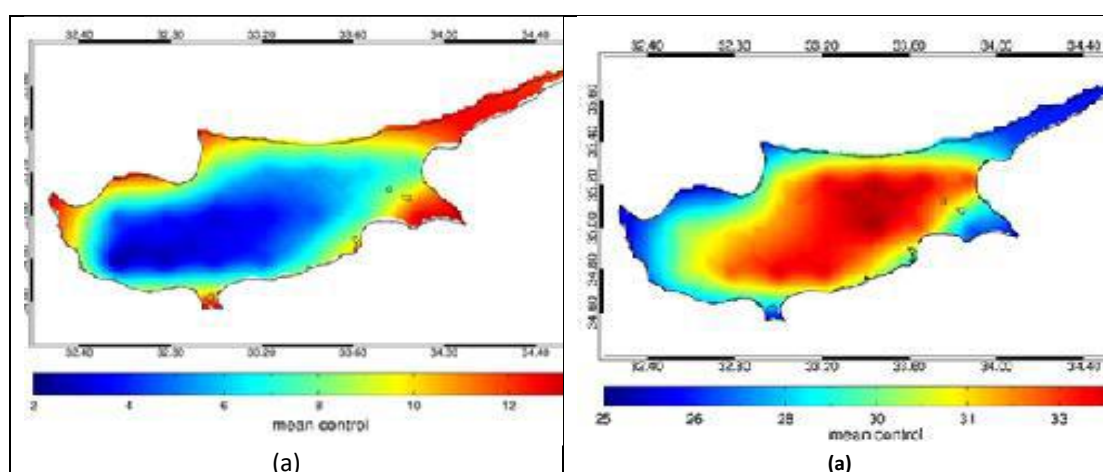
Table 6.1. List with the Critically Endangered (CR) plants of Cyprus

Species	Description
<i>Arabis kennedyae</i>	Troodos, Triptilos (in altitude 9001350m)
<i>Astragalus macrocarpus</i> <i>subsp. lefkarensis</i>	Only in Cyprus in Leykara, Asgata, Alaminos and Kelokedara
<i>Centaurea akamantis</i>	Only in Akamas of Cyprus
<i>Delphinium caseyi</i>	Only in Cyprus, in Pentadaktylos (tops of Saint Ilarionas and Kyparrissovouno
<i>Scilla morrisii</i>	Exclusively at southwest of Cyprus (Monastiri, Agia Moni, Saint Neofytos)
<i>Salvia veneris</i>	West of Kithreas villages
<i>Erysimum kykkoticum</i>	One the rarest endemic species. It is located in the valley of Xeros (Argakin of Pissokremmou

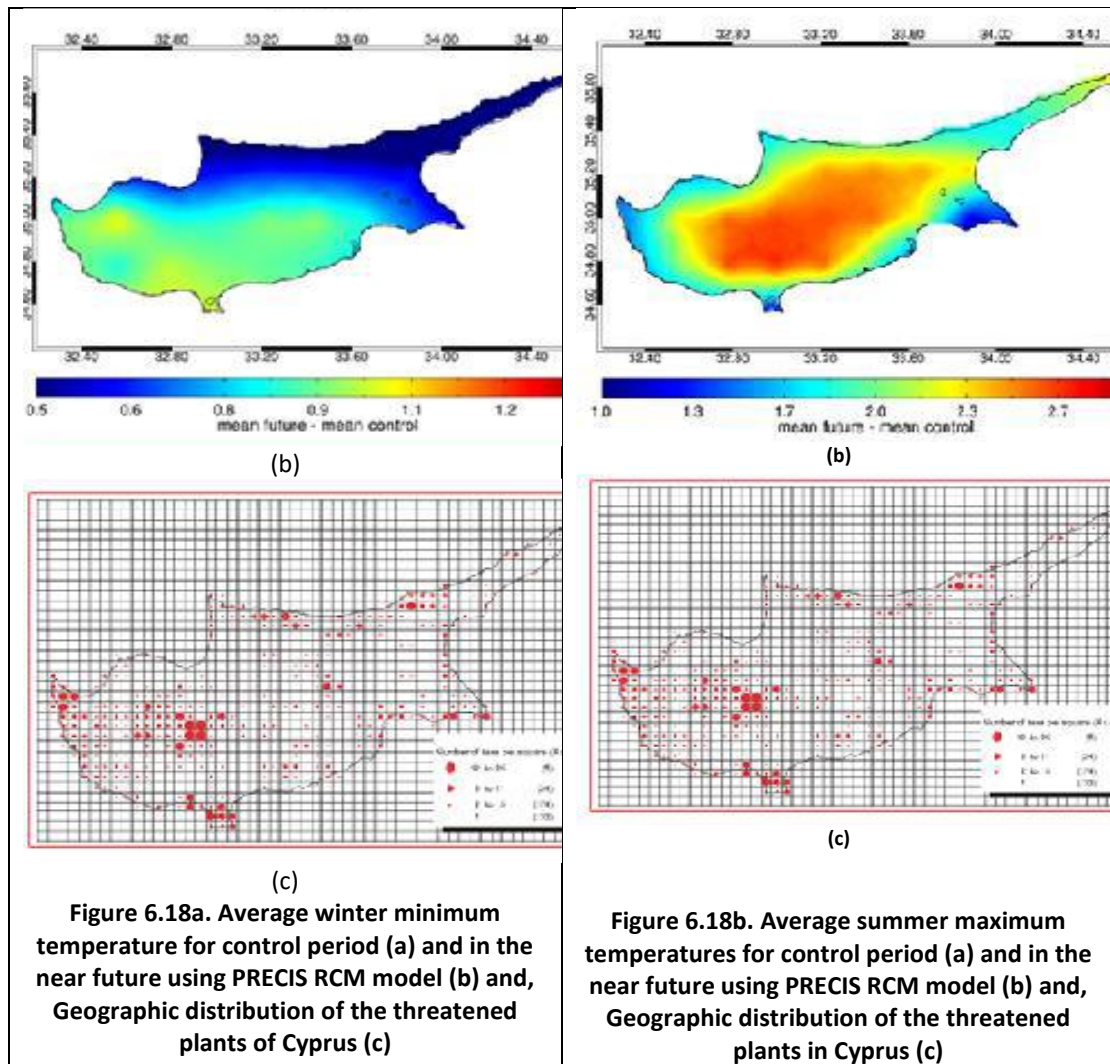
The distribution of the critically endangered plant species (Table 6.1), seems to be in many and scattered areas on the island. Though is no scientific data available concerning phenological responses of plants, these will be affected. In general, the area that the majority of threatened plants are situated will face temperature increase of about 1-2 °C in future (2021-2050), increase in maximum length of dry spell and variations in precipitation and so will threaten even more these species. Combination of density, width and dry spell increase in these areas will determine the degree of its final exposure. Taking into consideration the above findings the distribution of plant terrestrial ecosystems for the future period (2021-2050) is preliminary assessed as high.

The resilience of plants towards climate change refers to their ability to genetically adjust to changing environmental conditions as well as to their ability for uphill migration. However, more research in this field is necessary to be done.

The existing national legislative framework among which the Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (with the Law 153(I)/2003), the ratification of the Bern Convention on the conservation of European wildlife and natural habitats (with the Law 24/1988), the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the CITES (with the Law 20/1974) and the Convention on Biological Diversity (with the Law 4(III)/1996), aim mainly to reduce human pressures posed on biodiversity, while little can be done to reduce the effects from adverse climate conditions. As for example the Action Plan for the planting control and eradication of the Invasive Alien Species of *Acacia* in NATURA 2000 areas⁷⁹, was completed with great success, regarding the spreading of harmful invasive species.



⁷⁹ An ecological network of protected areas in the territory of the European Union, regulated by Directive 92/43/EEC and Directive 2009/147/EC



Consequently, the exposure for the future period (2021-2050) can be considered as high.

The resilience of animals towards climate changes refers to their ability to genetically adjust to changing environmental conditions as well as to their ability for uphill migration. There are no data available for the animal population movements in Cyprus. In addition, the extensive existing national legislative framework is protective for many animal species as shown in Table 6.2.

Nevertheless, the genetic adjustment of animals and the measures taken are not enough for combating the increasing risk of terrestrial animals towards climate change and additional adaptation measures are needed.

Aquatic ecosystems

The high Sea Surface Salinity (SSS) and Sea Surface Temperature (SST) of Cyprus, in comparison with the rest of the Mediterranean region, results in a relatively high species diversity and very low biomass. Temperature rise is the main reason for the northward movement of marine species, changing the composition of local and regional marine ecosystems. Thus, both distribution of fish and the socioeconomic situation of local fishermen are affected heavily.

The increasing intrusion of exotic fish in the Mediterranean Sea has not yet been determined whether it constitutes a serious threat for the extinction of the endemic species. The number of invasive species introduced in the coastal and offshore waters of Cyprus has grown over the last 50 years (Katsanevakis et al., 2009). Studies have shown that the rate of new biological invasions in the Mediterranean Sea is

as high as 1 new species every 9 days (Zenetos et al., 2008). Considering the above, the sensitivity for the future period (2021-2050) can be characterized moderate.

The number of alien biota in the Mediterranean Sea appears to be underestimated, especially the coasts of the Levantine basin, which is one of the hot spot areas for possible species introductions (Zenetos et al., 2005).

Cyprus is located near the manmade nautical channel of Suez which favours the migration and relocation of the Lessepsian species. However, there is no data available for the anticipated effect of temperature increase on the displacement of marine biodiversity. Further research is required.

Anticipated changes in temperature, as already presented, may cause fluctuations in sea water temperatures which are responsible for changes in physiology and sex ratios of fished species, alteration in timing of spawning, migrations, and/or peak abundance and also, for the increasing of invasive species, diseases and algal blooms. These impacts are leading to reduced production of target species in marine systems. Considering the above, the exposure of marine species, for the future period (2021-2050) can be characterized high to very high.

Table 6.2. Protection status of the endangered animal species of the terrestrial ecosystems in Cyprus

Protected fauna species	Measures
Reptiles	
<i>Mauremys caspica</i>	Protected under Annex IV of Directive 92/43/EEC, Annex II of Bern Convention
<i>Coluber cypriensis</i> - EN	Protected under Annex II and IV of Directive 92/43/EEC, Annex II of Bern Convention
<i>Emys orbicularis</i>	Annex II of Bern Convention
10 other species	Protected under Annex II of Directive 92/43/EEC
Birds	
<i>Numenius tenuirostris</i>	Protected under Annex II of SPA ⁸⁰ protocol, Annex II of Bern Convention
<i>Pelecanus crispus</i> - VU	Protected under Annex II of SPA protocol
<i>Oxyura leucocephala</i> - EN	Protected under Annex II of Bern Convention
<i>Branta ruficollis</i> - VU	Protected under Annex II of Bern Convention
<i>Crex crex</i> - LR	Protected under Annex II of Bern Convention
<i>Emberiza aureola</i>	Protected under Annex II of Bern Convention
<i>Gallinago media</i>	Protected under Annex II of Bern Convention
<i>Larus audouinii</i> - LR	Protected under Annex II of Bern Convention
<i>Emberiza cineracea</i>	Protected under Annex II of Bern Convention
Mammals	
<i>Ovis orientalis ophion</i> (Cyprus muflon) – VU	Protected under Annex II and IV of Directive 92/43/EEC
<i>Rhinolophus Euryale</i> - VU	Protected under Annex II and IV of Directive 92/43/EEC
<i>Capra aegagrus</i> (Cyprus goat) - VU	Protected under Annex II and IV of Directive 92/43/EEC, Annex II of Bern Convention
<i>Rousettus aegyptiacus</i>	Protected under Annex II and IV of Directive 92/43/EEC

Scientific recording of the populations of marine species reveals some of the extent of the threat for the marine host species. The genetic adjustments of the host organisms to new conditions need many reproductive cycles, and as a result the most common way of survival is the migration to other latitudes.

In addition, there are numerous institutional measures for the protection of marine ecosystems in Cyprus, including the coastal protected area of Lara-Toxeftra, which encompasses the most important

⁸⁰ Specially Protected Areas

breeding biotope for the sea turtles (*Chelonia mydas* and *Caretta caretta*) (Fisheries Law and related regulations, NATURA 2000 network (DoE, 2010).

The protection of aquatic species of inland and marine waters, is implemented through the provisions of national law since 1971 and its related regulations, as well as through the Law 153(I)/2003 which harmonizes Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora. In addition, Cyprus has ratified the Barcelona Convention for the Protection of the Mediterranean Sea against Pollution and in particular the SPA Protocol concerning Specially Protected Areas and Biodiversity in the Mediterranean. Complementary to these are the Convention on Conservation of European Wildlife and Natural Habitats (Bern Convention), the Convention on the International Trade in Wild Fauna and Flora (CITES) and the Convention on Biological Diversity (CBD). In particular, protected marine species and habitats are those listed in the aforementioned Directives and Conventions, as well as those in the Fisheries Law and Regulations, including all species of sea turtles, dolphins, seals and a species of sand crab (DoE, 2010).

Though the important habitats along the coastal waters of Cyprus are well-preserved, could be threaten by the increased number of successful intrusions of marine species in the area (Ben Rais Lasram and Mouillot, 2009) due to climate change. Considering the above, the adaptive capacity in the future period (2021-2050) can be characterised as moderate.

The indigenous fish species richness in Cyprus is exceptionally poor and susceptible to numerous threats such as the landscape fragmentations, the environmental alterations (caused with the introduction of freshwater fish and crayfish in the artificial dams for recreation purposes) and the pollution caused by human activities. Additional stress on water quality and aquatic populations is expected as a result of further oxygen depletion and eutrophication, induced by the projected temperature increase. Based on the above facts the sensitivity for the future period (2021-2050) can be considered as moderate.

In Cyprus, the plants, fish and aquatic organisms of rivers and lake dams of Cyprus are generally in good condition, whereas the organisms of groundwater are more strained. Climatic changes will have an impact mainly on the quality of the surface waters in Cyprus and consequently on the biodiversity. The nitrogen pollution from untreated sewage effluent and agricultural run-off carrying fertilisers is responsible for the phenomenon of eutrophication, which can possibly be deteriorated by climate change.

There is no data available to correlate the effect of water quality with the change of biodiversity in freshwater bodies. Nevertheless, significant reduction in precipitation which is anticipated for the autumn period, may affect ecosystems of perennial rivers due to delayed flow and the intense reduction in recharge rates. Another factor influencing the water quality and thus the biodiversity in freshwater bodies is the number of heavy rain events due to drifting of fertilizers, sediments and other pollutants. Considering the above, the exposure of freshwater biodiversity and quality in Cyprus is considered as moderate

The resilience of the organisms of these habitats to climate change refers to their ability to genetically adjust to changing environmental conditions. Nevertheless, most of the times, due to landscape deterioration of this kind of habitats, the phenomena of extinction are inevitable.

Further to the needed adaptation measures, a limitation of the extinction phenomena is also achieved by means of several measures implemented for the protecting water resources and inland aquatic species, such as the Laws:13(I)/2004 on the protection and management of water, 34/2002 on the nitrogen pollution of waters (based on the European Directive 91/676/EEC), 42/2004 on the control of nitrogen polluted waters, 41/2004 on the control of water pollution, 517/2002 on the control of water pollution, 56(I)/2003 on waste management,1/1971 on sewerage systems, 108(I)/2004 about sewerage systems,772/2003 about urban wastewater, 254/2003 about the nitrogen pollution of water bodies, 106(I)/2002 about the control of the water and soil pollution,45/1996 about the control of the water and soil pollution.

Consequently, the adaptive capacity of Cyprus' freshwater biodiversity and quality to climate changes is considered to be moderate.

Assessment of overall future vulnerability

The overall future vulnerability of biodiversity against a climatic change impact, in terms of sensitivity, exposure, adaptive capacity on the based on the available data for the above-mentioned indicators are quantified as shown in Table 6.3.

The main indicator for assessing the vulnerability of the terrestrial biodiversity towards climate changes appears to be the landscape fragmentations of the island, as species cannot move neither northern nor higher after a certain point. Instead, the main advantage of the marine biodiversity is the ability of migration, which can also be counted as a disadvantage due to the intrusion of harmful invasive alien species. On the other hand, freshwater biodiversity is not threatened. Considering the above, it is assumed that the first vulnerability priority of the biodiversity in Cyprus to climate changes is the distribution of species in terrestrial ecosystems while the second priority is the biodiversity of aquatic ecosystems.

Table 6.3. Overall vulnerability assessment of biodiversity in Cyprus to climate changes

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Distribution of plant species in terrestrial ecosystems	High (5)	High (5)	Limited to Moderate (2)	Moderate (3)
Distribution of animal species in terrestrial ecosystems	High (5)	High (5)	Limited to Moderate (2)	Moderate (3)
Marine biodiversity	Moderate (3)	High to Very high (6)	Moderate (3)	Limited to Moderate (1.2)
Freshwater biodiversity	Moderate (3)	Moderate (3)	Moderate (3)	None (0)

6.3.2. Infrastructure

The island of Cyprus is situated in the south-eastern part of the Mediterranean Sea. Administratively, Cyprus is divided into the following six districts: (a) Lefkosia (capital), (b) Limassol, (c) Larnaca, (d) Paphos, (e) Famagusta and (f) Kyrenia. It has a total of 772 km of shoreline, of which: (a) 404 km in the occupied zone after the Turkish invasion in 1974; (b) 72 km within the British Military Bases; and (c) 296 km under Government control. The critical infrastructure of Cyprus has been developed near the coastal area, except for Lefkosia which is located near the centre of the island.

In general, the infrastructures in Cyprus are not considered very vulnerable to climate changes, which arise mainly from decreased rainfall and increased temperature, droughts, fluctuations in intense precipitation events, sea level rise, increased atmospheric CO₂ and changes in fire regimes.

The future impact, vulnerability and adaptation measures for the infrastructure sector in Cyprus regarding climatic changes were also assessed as part of the Life+ CYPADAPT project, by using PRECIS and six other regional of the ENSEMBLES prediction system and, the future period (2021–2050) against the control period (1961–1990).

The main vulnerability priority of the sector to climate changes observed until now has been related to the damages caused by urban floods and sea floods. It has to be noted that specific measures have been undertaken the last decades to reduce the severity of this impact (drainage works, town plans, SUDS etc.) and that Cyprus has not experienced any severe floods from the sea in the past. The point of this consideration is the great number of tourist units and other infrastructures, important to Cyprus economy are located in the coastal areas.

According to the Intergovernmental Panel on Climate Change (IPCC), the infrastructure is defined as ‘the basic equipment, utilities, productive enterprises, installations and services essential for the development, operation and growth of a city or nation’. Thus:

- Utility services; (Water supply; Energy supply (power plant and electricity networks); Wastewater and waste collection, treatment and disposal)
- Transport;
- Information and Communications Technology (ICT) infrastructure;
- Industry; and
- Buildings (residential and tourist accommodation units).

Focusing on a local scale, natural hazards such as a rise in sea levels, dry spells, heatwaves and floods are expected to occur more frequently and with greater intensity, endangering cities in vulnerable geographic locations (Romero and Gnatz 2011). Natural hazards and extreme events can destroy livelihoods, dwellings and businesses, as well as public infrastructure such as roads and bridges. Many of the world’s largest urban centres are faced with harsh repercussions from such events because of their proximity to low-elevation coastal zones, where more frequent and more intense events would augment the destruction of public and private property. For instance, flood events in urban centres, which are expected to increase in frequency and severity, can be extremely destructive and costly, both in terms of material and human health damages. Of all urban centres, coastal ones are at high risk due to their exposure to the elements of nature. Historically, coastal sites developed as trading by sea led to the creation of economic hubs and cities. Their increasing industrial activity, local economic growth and wealth attracted rural and immigrant labour populations, ultimately fuelling uncontrolled development. The main climate change impacts on the infrastructure sector include: (i) material damages to infrastructure, possibly linked with extreme events and flooding, (ii) disturbances in normal community function such as interruption and obstruction of passenger or freight transport, (iii) human safety.

6.3.2.1. Future Impact assessment

The climatic factors that are likely to induce impact on Cyprus infrastructure system in the future are the extreme events, mainly the heavy rain, sea level rise, flooding and wind speed. Heavy rain may affect all types of infrastructure due to the risk of flooding, land sliding and collapsing. The relationship between potential climate changes and impacts on infrastructure is shown in Table 6.4.

Heavy rain is anticipated to have an impact on infrastructure. PRECIS predictions show that future changes of annual max total rainfall over 1 day, have a minor increase of about 2-4 mm in western and higher-level regions. The heavy rain events have been monitored since 1917 by the Department of Meteorology and as shown in Figure 6.19 they follow a rising trend. There is evidence that this rising trend is related with climate change.

Flooding which is associated with heavy rain also follows the same pattern, thus an increase, both in terms of frequency and magnitude.

As mentioned above, the infrastructure system is expected to be affected mainly by the following two main categories of impacts: material damages; and disruptive operation.

Table 6.4. Relationship between potential climate changes and impacts on the infrastructure sector

Potential climate change in Cyprus	Type of Infrastructure	Future impacts on infrastructure	Selected Indicators
Heavy rain	All types	- Flood - Landslides	Severity of material damages to infrastructure
	Water infrastructure (water treatment, wastewater collection and treatment)	- Risk for flooding of Sewerage Treatment Plants - Risk for sewer flooding	
	Transport infrastructure	- Increased demand for car use - Flooding of underground networks - Flood damage - Bridge collapse and associated implications	
	Communications	- Reliability of the signal - Disturbances to overhead networks	- Disruption frequency - Duration of disruption
Storm surge	(located at coast)	- Flood - Periodic flooding of coastal infrastructure	- Percentage of critical infrastructure located in or near coastal areas - Disruption frequency in daily operations (social activity and trade) - Duration of disruption
Sea Level Rise	All types (located at coast)	Permanent asset loss at coastal sites	Percentage of critical infrastructure located in or near coastal areas
	Transport infrastructure (ports)	- Limited access to ports - Threat to port operation	Coastal infrastructure asset losses due to Sea Level Rise
High winds	Transport	- Transport disruption (caused by blown down trees etc.) - Impede aircraft operation	- Disruption frequency in daily operations (social activity and trade) - Duration of disruption
Temperature increase	Transport	- Deformation of road and airport asphalt surfaces - Passenger discomfort	
	Communications	Decreased wireless transmission signal	
Extreme events	All types	Risks for human safety	- Number of accidents related to extreme weather events - Population living in disaster prone areas (areas prone to flooding and landslides) - Changes in the proportion of built-over land in disaster prone areas

Potential climate change in Cyprus	Type of Infrastructure	Future impacts on infrastructure	Selected Indicators
	Transport infrastructure	<ul style="list-style-type: none"> - Asset failure due to long, hot, dry periods followed by intense rain causing flash floods. - Stability of foundations of transmission masts and towers, mostly attributable to increased risk of subsidence (more susceptible during drier summers and wetter winters) - Damage to underground cables(more susceptible during drier summers and wetter winters) 	

For the case of Cyprus, the above-mentioned impacts are related with flooding events induced by heavy rain (flash floods). However, there is no evidence that these events are directly connected with climate change and as a result the impacts due to climate change on the infrastructure sector are limited to uncertain. The available data were not conclusive and could not be used as a basis for measuring the future impact of climate change on infrastructure. It is worth saying, however, that there is an increasing trend in the appearance of flooding events, the intensity of which, both in terms of frequency and severity, is likely to exacerbate due to climate change. In general, it must be noticed that sensitivity of the sector is increasing in flood and landslide prone areas (MoE, 2011).

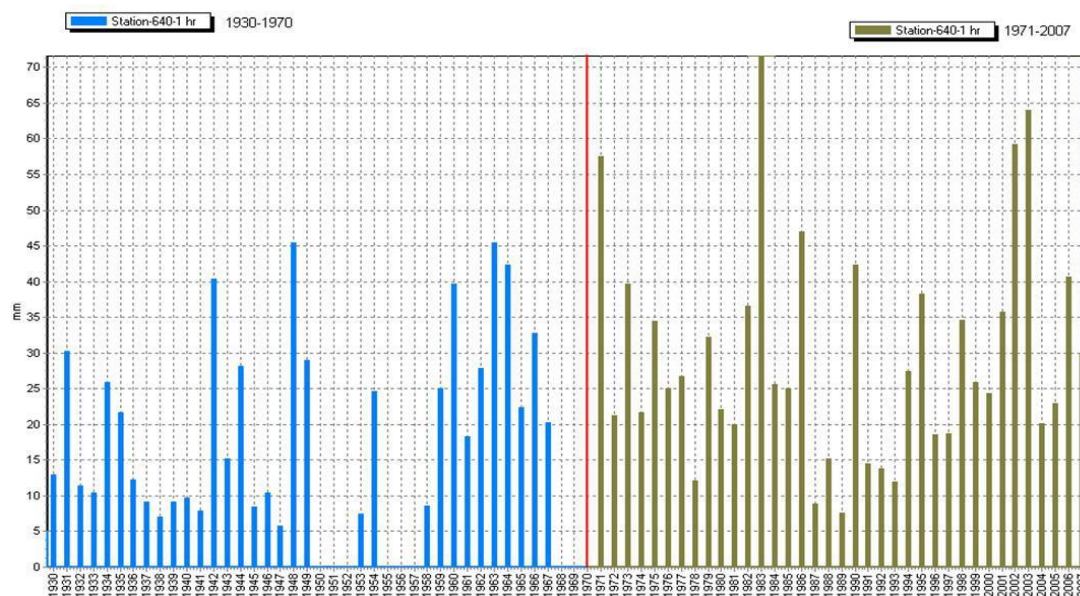


Figure 6.19. Highest amounts of rainfall in 1 hour, in Cyprus (Pashiardis, 2011)

6.3.2.2. Future vulnerability assessment

The future vulnerability of the infrastructure sector is assessed in terms of its sensitivity, exposure and adaptive capacity based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021-2050, presented in the CYPADAPT project.

It must be noted that, there are no sufficient scientific evidence and data to evaluate or correlate all impacts and indicators to future climate changes. Consequently, further research is required in order to provide concrete information for a more detailed and descriptive assessment of the future vulnerability of the sector. Nevertheless, an attempt was made to provide a preliminary assessment of the vulnerability for the following impacts: Infrastructure damage due to floods (urban and sea floods); and Infrastructure damage due to landslides.

Damages of infrastructure due to floods

The vulnerability of the Cypriot infrastructure was assessed regarding the sea floods and urban floods. The former type is caused by storm surge or sea-level and affects mainly the highly developed coastal infrastructure of the island. However, no significant sea flood events have been recorded while for future projections further research is required. The urban floods are directly connected with heavy rain and the consequent damages. According to the records of the flood events observed in Cyprus between 1859 and 2011, over 200 floods caused implications in multiple levels such as damages to road infrastructure, disruption of economic, social and cultural activities and in turn financial losses (WDD, 2011). To sum up, taking into account the current situation as well as the relative future climate changes the sensitivity of infrastructure due to floods was ranked as moderate to high.

The exposure to future sea floods depends on the importance of infrastructure which is located on or near the coastline. In Cyprus this infrastructure includes:

- Electricity supply (three power stations and the Energy centre)
- Water supply (Water treatment plants, Wastewater treatment plants, Desalination plants)
- The international airports of Larnaca and Pafos.
- Seaports;
- Marinas and fishing shelters;
- Industries (two cement plants)
- Buildings (hotels, tourist and residential accommodation units)

Sea-level rise, generally, may affect infrastructure located in or near coastal areas. For the case of Cyprus, however, sea level rise is expected to be moderate. Furthermore, it must be added that, based on archaeological data, Cyprus appears to be experiencing long-term uplift of between 0 and 1 mm per year. This uplift is expected to counteract sea-level rise and given a global rise in sea level of 0.5m by 2100, relative sea-level rise in Cyprus will be in the range 0.4-0.5m (Nicholls and Hoozemans, 1996)

The general assessment of the effects of storminess changes on storm surge is not possible due to the limited geographical coverage of studies and the associated uncertainties (IPCC, 2012). However, according to the projections of the PRECIS climate model, the mean wind speed greater than 5 m/s in Cyprus during the future period 2021-2050 is not expected to present substantial changes, on the contrary, it presents minor decreases in general of the order of about 5-12 days for the number of days with mean wind speed greater than 5 m/s.

The urban centres of Larnaca, Limassol and Lefkosia are sensitive to flood risks mainly due to their dense structuring and the restriction of green space, the elimination of natural waterways for the construction of roads, the deficient or even absent storm-water drainage system and, the covering of waterways and drain entrances with garbage. On the other hand, mountain areas are less sensitive to floods, given that the inclination of terrain together with the infiltration capacity of forested areas do not allow for flooding events to take place.

The climate projection model used for the case of Cyprus does not provide estimates for the frequency and intensity of floods in the future. Nevertheless, there is an indicator referring to the annual maximum total precipitation over one day indicating heavy rainfall, which could also be associated with flood risk.

In compliance with the Floods Directive 2007/60/EC, the Water Development Department of Ministry of Agriculture, Rural Development and Environment (MARDE) through its report "Preliminary Flood Risk Assessment" identified 19 areas around the island as "Areas with Potential Significant Flood Risk" which are monitored.

In relation to the exposure of the infrastructure to flood events, future changes in land use and their implications should be considered. Land use changes can induce significant flood risk through changes in the runoff coefficient, (influenced by the percentage of precipitation, the ground cover of an area, ground slope).

To sum up, the exposure of the infrastructure sector to urban floods as the relative future climate changes the future exposure is ranked as high.

In order to reduce the impact of floods, the Cyprus Government has undertaken a series of flood protective measures including but not limited to the following:

- (a) Hard coastal defence works (for sea flood protection),
- (b) Fishing shelters and artificial reefs (for sea flood protection),
- (c) Dams (for urban flood protection)
- (d) Sustainable Urban Drainage systems (for urban flood protection).

Due to lack of sufficient data on the future impacts of climate change on the infrastructures of Cyprus, the analysis on the effectiveness of the already applied measures as well on the necessity for additional measures for the protection of infrastructure could not be conducted. Further research is suggested to take place on the subject. Taking everything into account, the adaptive capacity for urban floods was considered to be moderate.

Damages of infrastructure due to landslide damage

Cyprus is well-known for its interesting and often complex geology, particularly in the south-west part of the island. The reason for the increased susceptibility of this area to landslides is the remains of former sea-floor deposits and massive submarine slides, which tend to be heavily deformed and are rich in the types of clay minerals that are prone to land sliding. This tendency is exacerbated by the steep terrain and the long history of powerful earthquakes in the region. In addition, climate change increases the likelihood for land displacements. More specifically changes in temperature and precipitation could be relevant for more landslides. In this regard the sensitivity was ranked as limited. However further research is required in order to provide concrete information for the future.

Variations in precipitation, temperature, heavy rain and heat wave days changes, can have an impact on landslide occurrence (Crozier, 2009) and therefore pose risk of infrastructure. However, due to the lack of data landslides in Cyprus and the issue should be investigated further.

A research project entitled ‘Study of landslides in areas of Pafos District’, has being undertaken aiming to minimize the landslide risk and, to promote a more efficient and secure urban development. It must be emphasized that it is appropriate such studies to be elaborated in order to allow the adaptive capacity to increase.

As few landslide protection measures have been undertaken such as road protection measures, retention walls and terraces and further research is suggested to take place on the subject. Considering the above, both the exposure and adaptive capacity of infrastructure to landslide damages for the future period (2021-2050) can be characterized as limited.

6.3.2.3. Assessment of overall vulnerability

The overall future vulnerability of the infrastructure system against climatic change impacts, in terms of sensitivity, exposure, adaptive capacity, based on the available data is presented in Table 6.5.

In general, the infrastructures in Cyprus are not considered very vulnerable to future climate changes. In specific, the first vulnerability priority of the sector to climate changes is related to the damages caused by urban floods. However, it must be noticed that specific measures have been undertaken in order to reduce the severity of this impact (drainage works, SUDS etc.). The second vulnerability priority is related to the damages to infrastructure caused by sea floods. Considering that a great number of infrastructures important for Cyprus is located in the coastal areas of the island and that Cyprus has not experienced any severe floods from the sea in the past, the vulnerability towards this impact is considered limited. The vulnerability of infrastructure systems to landslide cannot be evaluated due to limited availability of data.

Table 6.5. Overall vulnerability assessment of the infrastructure sector in Cyprus to climate changes

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Damage from urban floods	Moderate to High (4)	High (5)	Moderate (3)	Limited to Moderate (1.5)
Damage from sea floods	Limited (1)	Very High (7)	Limited to Moderate (2)	Limited (0.6)
Damage from landslides	Limited (1)	Limited (1)	Limited (1)	None (0)

6.3.3. Energy

Cyprus, as an island situated in the south-eastern part of the Mediterranean Sea, constitutes an isolated energy system. The energy requirements are covered mostly by oil imports, making Cyprus a highly energy dependent island (Koroneos et al., 2005; Zachariadis 2010). Until recently, renewable energy was considered as the sole indigenous form of energy, before the discovery of natural gas resources in its Exclusive Economic Zone (EEZ) – which is expected to change the energy mix and consequently improve the energy sufficiency of the island. As indicated, the energy sector of Cyprus is not considered very vulnerable to climate changes. In particular, the main vulnerability priority identified for the sector is related to increased energy demand for cooling and desalination. However, given that there is

potential for increasing energy supply in Cyprus to meet the increasing energy demand, the vulnerability towards this impact is characterized as limited to moderate. The impact of climate changes on the efficiency of thermal power plants is not expected to be significant, while very limited vulnerability was identified on the potential for RES generation.

On a global basis, it is expected that the energy sector will experience different impacts due to climate change, including change of the heating/cooling degree days over year, reduction of the overall efficiency of the power stations associated with the increase in temperature of the cooling medium used in the energy production process, reduction in hydropower production etc.

According to EEA the Mediterranean basin has already been subjected to decrease precipitation something that is going to exacerbate as the climate change continues to persist and intensify. The decreased precipitation and stream flows will lead apart from low water availability, to decreased energy yield (regarding hydroelectricity). However, hydropower is not used in Cyprus and is not projected to be introduced to the energy mix of the island in the coming years, due to limited water resources and intermittent river flows.

The main vulnerability priorities identified for the sector are related to the energy demand for cooling and heating, which is directly affected by climate changes and, to the efficiency of thermal power plants, which is not expected to be significantly affected by climate changes. With regard to the impact of climate changes on the various types of RES generation -except hydropower which is not exploited in Cyprus - this is minor.

The impacts of future climate change on the energy sector based on the climate projections output produced by the PRECIS and six other ENSEMBLES regional climate models, as well as on other socioeconomic projections for the period 2021-2050. The future period 2021-2050 has been chosen, instead of the end of the twenty-first century as frequently used in other climate impact studies, in order to assist investors and policy makers to develop near future plans.

The main pressure on the sector is the energy production cost. Cyprus shows particular vulnerability on the energy sector stemming from oil prices as the total amount of oil used is imported. Additional pressures -especially during the summer- are the energy demand for drinking water production from seawater desalination plants (to reduce the dependence of drinking water on rainfall) and for irrigation (for longer periods through pressurized irrigation systems and long conveyance pipe works) due to decreasing precipitation.

Climate change will affect both the supply and demand of energy profile in different ways.

Table 6.6. Relationship between climate changes and impacts on the energy sector

Potential climate changes	Impacts
Increase in temperature and relative humidity	- Increased cooling demand and decreased heating demand
	- Decreased thermal efficiency in thermal power plants
Precipitation	Change in Bio-power generation
Wind speed	Change in Wind power generation
Cloud cover	Change in Solar power generation

6.3.3.1. Future impact assessment

On a worldwide basis, it is expected that the energy sector will experience different impacts due to climate change, including alterations of the heating/cooling demand, reduction of the overall efficiency of thermal power stations, reduction in hydropower production etc. According to the PESETA IV study (European Commission, 2020), the Mediterranean basin has already been subjected to decreased precipitation, which is going to deteriorate as climate change grows. The reduced precipitation and stream flows will lead, apart from low water availability, to decreased energy yield (regarding hydroelectricity). However, hydropower is not used in Cyprus and is not projected to be introduced to the energy mix of the island in the coming years due to limited water resources and intermittent river

flows. Therefore, the main impacts identified for the sector are related to the increased energy demand for cooling, increasing needs for desalination and the efficiency of thermal power plants. Regarding the impact of climate change on the various types of RES generation -except hydropower which is not exploited in Cyprus- this is expected to be minor.

Climate change impacts on the energy sector as these have been identified and assessed in light of the climate projections for the future (2021-2050) are mainly associated with the change in the heating and cooling loads. The climatic factors that are likely to induce impacts on the energy sector are temperature and relative humidity, precipitation, wind, and cloud cover. The future impacts of climate change on the energy sector are summarized below.

1. Renewable energy yield

In the case of Cyprus, the renewable energy sources most likely to be affected by climate change are wind and solar power. Wind power, introduced to the Cypriot energy system in 2010, is affected by wind speed and changes in wind variability. There are limited assessments for estimating the impact of climate change on wind power production in Cyprus. However, the mean wind speeds are projected to decrease slightly (0.20 m/s) in the western, south-eastern and inland regions where the majority of wind turbines are installed. The projected decrease in the potential for wind energy production ranges from 3 to 10% according to the scenario and period. Solar energy is influenced by cloudiness and atmospheric aerosols, but the magnitude of the potential impact is unknown due to complex relationships between these climate factors (Kirkinen, 2005). The energy production efficiency of photovoltaics or solar panels varies with the temperature and level of solar irradiation. According to projections for the period 2021-2050, the solar energy potential of Cyprus will increase due to the increase in annual sunshine duration (additional 60-160 hours) but will be hindered to some extent by the potential increased number of hot days per year (additional 17 to 24 days per year).

2. Efficiency of thermal power plants

Regarding the efficiency of thermal power plants, future changes in temperature may be used as an indicator. According to regional climate projections for the future period 2021-2050, the average annual temperature in Cyprus is expected to increase by 1-2°C compared to the reference period 1960-1990. However, it is not known whether a change in temperature of this magnitude will have an impact on the efficiency of thermal power plants.

3. Energy demand

Energy consumption is particularly sensitive to weather (mainly air temperature). In the Mediterranean basin, the expected change in energy demand is expected to change by 2050 as follows: 2 to 3 fewer weeks per year will require heating; and additional 2 to 5 weeks will require cooling (Alcamo, 2007). According to PRECIS a further increase in the maximum and minimum temperature (by 1.3-1.9 °C and 1.3- 1.8 °C, respectively) is expected in Cyprus during the period 2021- 2050. Consequently, an increase in cooling demand and a decrease in heating demand are expected. This is expected to result in annual welfare losses in Cyprus of more than 100 million Euros (at constant prices of year 2010) (Zachariadis and Hadjinicolaou, 2014). According to more recent estimations (León et al., 2021), by the end of the century, under a business-as-usual pathway, the cooling demand for Cyprus will be nearly three times higher than the 1986-2005 reference. A pathway close to meeting the Paris Accord main targets, still implies a nearly 50% increase in the cooling demand. The increasing energy demand for seawater desalination due to the combined warming and drying in the future is also relevant for Cyprus. This demand is expected to increase by 159% by the end of the century in a high-emission scenario (León et al., 2021). On the contrary, a more optimistic scenario (RCP2.6) will limit this increase to 32% (Figure 6.20).

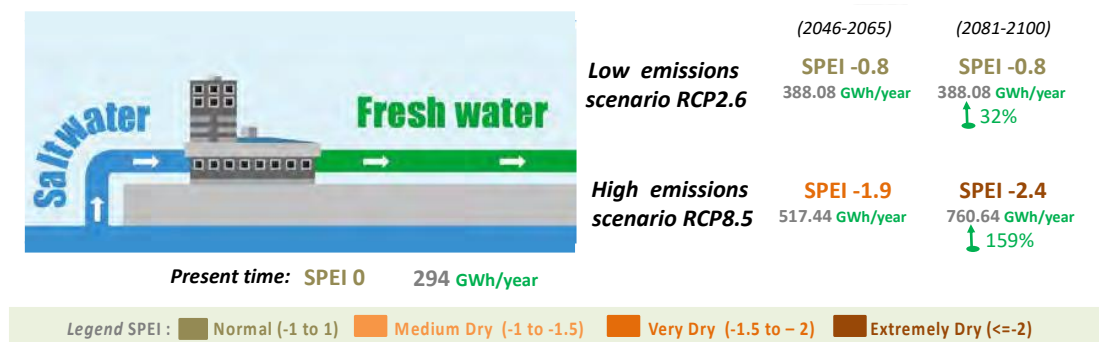


Figure 6.20. Estimations of increased energy demand for desalination in Cyprus under different scenarios of climate change (Adopted from León et al., 2021, <https://soclimpact.net/>).

6.3.3.2. Future Impact assessment

The future vulnerability of the energy sector to climate change impacts is assessed in terms of its sensitivity, exposure and adaptive capacity based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021- 2050, presented in the CYPADAPT project.

Due to the lack of sufficient scientific evidence and data, a preliminary assessment of the vulnerability of the following impacts on the energy sector, is attempted: 1. Renewable energy yield; 2. Efficiency of thermal power plants; 3. Energy demand.

1. Renewable energy yield

Renewable power production is considered sensitive to climate changes due to the reduction in renewable energy potential such as wind, solar and biomass. Given that the wind power is considered particularly sensitive to changes in wind speed and that solar energy potential is sensitive to changes in sunshine duration and higher temperatures and, that the use of biomass is limited, the sensitivity of RES energy production to climate changes can be characterised as limited to moderate.

The future exposure of RES energy potential and production to projected climate changes, rely mainly on the variations of wind and solar power potential. The annual mean wind speed changes will be slightly decreased of about 0.20 m/s in western, south-eastern and inland regions, where the majority of wind parks are installed. Therefore, the wind production is also expected to decrease in the near future. The solar energy yields are expected to be slightly increased in the future due to the projected increase in annual total sunshine duration (ranging between 60-75 hours for most of the domains and between 100-140 hours for the mountain areas).

The high temperatures, which are considered to be associated with reduced solar power potential in photovoltaics, or solar panels, will increase throughout Cyprus. According to PRECIS projections the hot day index (number of days with maximum temperature >30°C) seems to increase by 5–12 days over the northwestern and south-western coasts, by 20–24 days in continental lowlands, and by 26-28 days over Troodos mountains. Considering that the renewable energy potential in Cyprus is not significant, the future exposure of RES yield is ranked as limited.

The main policy action related to renewable energy deployment in Cyprus is the Directive 2009/28/EC on the promotion of the use of energy from renewable sources. The variety of measures taken for fostering renewable power penetration to the energy production sector, make the adaptive capacity to be considered as moderate.

2. Efficiency of thermal power plants

Though the required condensing power is sensitive to temperature increase (air and water) and is expected to reduce the thermal efficiency of power plants, no such evidence is found (Electricity Authority of Cyprus).

Considering that the energy produced and delivered to balance the energy demand would slightly be affected, the sensitivity was ranked as limited, while the exposure of power plants to future increases in temperature is moderate. On the other hand, the modernization and replacement of old equipment and the implementation of the necessary maintenance activities are expected to increase or stabilize thermal efficiency of the plants and ranked its adaptive capacity as limited to moderate.

3. Energy demand

The energy consumption is sensitive to climatic conditions and it is expected to decrease in warmer winter, and to increase in summer. Moreover, peak energy demand will be considerably greater than net consumption due higher temperatures in summer, imposing the installation of additional generating capacity over and above that needed to cater for underlying economic growth.

Energy consumption shows a clearer upward trend compared to air temperature. The energy load variations are seasonal and yearly, as it reflects both the economic growth and the greater usage of air conditioners in residential and commercial situations. The former is mainly influenced by the prevailing weather conditions and the latter by economic, social and demographic factors. Conclusively, the sensitivity of power demand towards temperature changes is considered very high.

The exposure of energy demand to future climate changes, as indicated by the overall energy consumption variation, as well as the changes in the heating and cooling demand, due to temperature changes, is ranked as very high.

According to a study combining econometric models of electricity demand with climate projections of the regionally focused PRECIS model (Zachariadis and Hadjinicolaou, 2012), by the mid-21st century annual electricity demand is projected to rise by 5.6% due to climate change, causing annual welfare losses in Cyprus of more than 100 million Euros (at constant prices of year 2010). Although additional power requirements are not very remarkable on an annual basis, climate change is expected to exacerbate the already existing imbalance between winter and summer electricity demand in the country. This outlook indicates that a reasonable and cost-effective future energy path in regions with Mediterranean climate would involve substantial deployment of solar-powered electricity generation, a zero-carbon energy source that can meet peak load requirements without increasing the country's dependency on imported fossil fuels. Moreover, this forecast highlights the need for adaptation to climate change through substantial investments in the improvement of the energy performance of the Mediterranean building stock.

The adaptive capacity of the sector to changing demand for electricity and heat is built up by means of the following:

- Installation of new power plants to satisfy future energy demand: The EAC's plan includes the installation of new power plants and the replacement of the old ones.
- Energy efficiency measures undertaken or underway: The established National Energy Efficiency Action Plan involves the implementation of measures for improving energy efficiency until 2020.
- Use of solar energy for heating and cooling. In Cyprus, solar thermal systems are widely used for the needs for hot water, while photovoltaic systems are increasingly used at household level reducing therefore the pressure on the energy supply sector; and
- Introduction of natural gas in the energy supply portfolio. The upcoming introduction of natural gas is a policy measure aiming to diversify the energy supply mix.

Based on the measures taken so far and those under way, the adaptive capacity of the cooling/heating energy demand was ranked as high.

6.3.3.3. Future vulnerability assessment

The overall vulnerability of the energy sector to climate changes, in terms of sensitivity, exposure and adaptive capacity is presented in Table 6.7.

As indicated, the energy sector of Cyprus is not considered very vulnerable to climate changes. In particular, the main vulnerability priority identified for the sector is related to the energy demand for cooling and heating, since it is directly affected by climate changes. However, given that there is

potential for increasing energy supply in Cyprus to meet the increasing energy demand, the vulnerability towards this impact is characterized as limited to moderate. The impact of climate changes on the efficiency of thermal power plants is not expected to be significant, while no vulnerability was identified on RES generation. The reason for this is that hydropower, which is the only type of RES being significantly affected by climate changes, is not exploited in Cyprus due to the already limited water resources, while the impact of climate changes on the other types of RES is minor.

Table 6.7. Overall vulnerability assessment of the energy sector in Cyprus to climate changes

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Renewable energy yield	Limited (1) to Moderate (2)	Limited (1)	Moderate (3)	None (-1.6)
Efficiency of thermal power plants	Limited (1)	Moderate (3)	Limited (1) to Moderate (2)	None (-0.3)
Energy demand	Very High (7)	Very High (7)	High (5)	Limited (1) to Moderate (2)

6.3.4. Health

6.3.4.1. Climate change and public health

In case of a continuous increase of current emissions, the next generations will face more diseases, deaths related to heat waves and natural disasters, higher rates of climate-related infections and morbidity /mortality associated with allergic and air pollution diseases. There is high possibility according to the IPCC (80% confidence) that in the future the increase in cardio-respiratory morbidity and mortality will be attributed to ground-level ozone. There is significant evidence that the Mediterranean Basin is already experiencing some of the impacts of climate change including those on public health. The main climate change related phenomena that have been recorded in Cyprus are temperature increase (especially during the summer months), an enhance in the frequency and intensity of heat waves, a reduction in the total precipitation amounts in parallel with increasing rainfall intensity and enhanced drought.

Vulnerable populations that include the elderly, children, pregnant women, and people with chronic or pre-existing medical conditions are expected to be the most affected by extreme heat (Zittis et al., 2022). The extreme environmental conditions are also expected to augment differences and inequalities between the more affluent and impoverished populations of the country. The increasing temperatures may affect cities more than other locations, with different adaptive capacities to cope with hot weather. Outdoor labour activities, such as construction and agriculture, will be challenged, particularly during the warm part of the year. In a recent review of the effects of climate change on human health in the EMME, Neira et al (2022) have proposed a set of policy suggestions which, if implemented, could improve the resilience of health systems against climate change for all countries in the region, including Cyprus. These policy suggestions, include a decisive region-wide decarbonisation, the integration of environmentally driven morbidity and mortality data throughout the region, advancing the development and widespread use of affordable technologies for the production and management of drinking water by non-traditional means, the development of comprehensive strategies to improve the health status of displaced populations, and fostering regional networks for monitoring and controlling the spread of infectious diseases and disease vectors. This review, as well as the reports of other Task Forces working in the context of the Cyprus-led 'Eastern Mediterranean and Middle East Climate Change Initiative' (EMME-CCI) can be found at: <https://emme-cci.org/>. Research on the climate change effects upon public health in Cyprus is performed by institutions and government departments in Cyprus concerning the study of climatological data and their possible health effects (CDC, 2009). Cyprus also participates in MedCLIVAR, which is an international network, aiming to study the climate change impacts and challenges pose to public health, as well as the occurrence of extreme events -closely related to climate variability in the Mediterranean and other regions around the world.

6.3.4.2. Future impact assessment

Human beings are exposed to climate change both directly through changing weather patterns and indirectly through changes in the ecological and social systems (Confalonieri et al., 2007)

Changes in the frequency and severity of extreme events, particularly heatwaves, floods, droughts and intense rainfall, result in local air pollution and more aeroallergens affecting health directly. Other indirect health impacts may result from the effects of climate change on ecological and social systems, such as changes in the occurrence of infectious diseases, local food production and under-nutrition, and various health consequences of population displacement and economic disruption.

A summary of the potential impacts of climate change on human health in Cyprus per climate change factor is presented in Table 6.8.

Table 6.8. Relationship between climate changes and impacts on the public health sector

Potential climate changes	Direct Impacts	Indirect Impacts
High temperatures and heat waves	<ul style="list-style-type: none"> - Heat related stresses - Deaths due to heat strokes - Cardiovascular diseases - Respiratory and metabolic disorders 	<ul style="list-style-type: none"> - Water-borne diseases due to increased algal blooms - Food-borne diseases due to food contamination - Vector-borne diseases due to the higher risk of transmission, geographical and seasonal distribution
Increase in the intensity and frequency of extreme events (floods, storms)	<ul style="list-style-type: none"> - Deaths and injuries from floods, storms, landslides and fires - Psychological morbidity (mental disorders) from floods, storms, landslides and fires 	<ul style="list-style-type: none"> - Water-borne diseases caused by water contamination and poor sanitation - Vector-borne diseases (malaria, Leishmaniasis, Mosquitos) due to stagnant waters - Diarrhoea diseases (including cholera) - Reduced nutritional status
Droughts	<ul style="list-style-type: none"> - Deaths and injuries from fires caused by high temperatures combined by strong winds and drought 	<ul style="list-style-type: none"> - Vector-borne diseases due to contamination of small rivers and drainage canals - Water-borne diseases - Respiratory diseases due to increased air-borne particulate matter - Child malnutrition and under-nutrition, due to loss of agricultural production
Air pollution		<ul style="list-style-type: none"> - Eye irritation - Respiratory tract irritation - Exacerbation of respiratory diseases - Exacerbation of asthma and irritation of bronchi - Exacerbation of allergic rhinitis, asthma and other atopic diseases

There is increasing evidence of the importance of mental disorders as an impact of disasters (Ahern et al., 2005). A systematic review of post-traumatic stress disorder in high income countries found a small but significant effect following disasters, such as medium to long-term impactson behavioural disorders in young children (Durkin et al., 1993; Becht et al., 1998; Bokszczanin, 2000).

However, the effects of climate change on existing environmental and public health problems are difficult to discern. The challenge is to identify their ‘additional’ effect, i.e., the increase in health problems that can be attributed to climate change as an additional risk factor.

The climate change impacts on the public health sector in Cyprus were assessed on the base of PRESIS projections for the future (2021-2050) within the CYPADAPT project, under the following categories:

I. Direct impacts

1. Deaths and health problems related to heat waves and high temperatures,
2. Deaths /injuries from floods,

3. Deaths /injuries from landslides,
4. Deaths /injuries from fires.

II. Indirect impacts

1. Vector-borne and rodent-borne diseases
2. Water- borne and food-borne diseases,
3. Climate-related effects upon nutrition,
4. Air pollution related diseases.

I. Direct impacts

Deaths and health problems related to heat waves and high temperatures are of primary concern in Cyprus, although these issues are also influenced by socio-economic changes such as population growth, the increased average age and migration. General predictions and observations in Mediterranean cities have shown that heat waves can have very strong effects on mortality, reporting an increase of 1-4% for each 1°C rise (IPCC 2007). In addition, mortality is associated to the timing of heat waves as indicated by the higher mortality found early in the summer than the mortality in late season.

Exposure to extreme and prolonged heat is associated with heat cramps, heat syncope, heat exhaustion and heat stroke (Faunt et al., 1995) and occupational health implications.

According to PRECIS projections, the annual number of hot days (Tmax exceeds 30°C) and the annual number of tropical nights (TNmax exceeds 20°C) are expected to increase all over Cyprus in the future, by 17 -24 days and by 20-45 days per year, respectively. While the number of heat wave days per year (days with Tmax over 35°C), is expected to present a wider range of changes from 2 to 34 days. In addition, humidity during summer in the coastal cities of Cyprus could reach high levels which in conjunction with high temperatures, cause great discomfort to people. However, there are no sufficient data for estimating heat related deaths and health problems which could be associated with climate changes in Cyprus.

Flood-related deaths and injuries are expected to increase with the anticipated increase in the frequency and intensity of extreme weather events such as heavy rainfall, storms and floods. Generally, the exposure to high-frequency flooding events can result in long-term problems such as increased rates of anxiety and depression stemming from the experience itself, troubles brought about by geographic displacement, damage to the home or loss of family possessions. Moreover, the persistence of flood-related health effects is directly related to flood intensity. The number of floods with recorded victims in Cyprus between 1970-2011 shows an increasing trend (WDD, 2011), but the data were not sufficient to assess the deaths and injuries from floods.

Landslide-related deaths and injuries are expected to increase with increasing extreme rainfall events (Confalonieri et al., 2007) and may also result in the displacement of communities and migration. However, there is no official record in Cyprus of victims affected.

The impacts of future climate changes on both the frequency and intensity of floods and the occurrence of landslides in Cyprus, could not be assessed as the only related indicator provided by PRECIS was the annual maximum total precipitation over one day, which is expected to have minor changes in the future period (2021-2050) ranging from 2 to 5 mm.

Fire- related deaths and injuries are expected to increase with increasing the risk of forest and rural fires due to climate change. Forest and bush fires may cause deaths of people trapped in them, burns and other injuries. Large fires are also accompanied by an increased number of patients seeking emergency services. In particular, forest fires in Cyprus are considered a major and permanent threat, causing enormous damage to forest ecosystems and in some cases threaten residential regions (Alker, 2009), taking into account, the high temperatures, prolonged and severe drought periods, strong winds and the configuration of the ground and extremely flammable vegetation.

The future risk of fires in Cyprus, as assessed by means of the Fire Weather Index (FWI) and, the PRECIS climate model is high. In specific, there will be an increase in the number of days with high fire risk of 5-15 days/year, as well as an increase in the number of days with extreme fire risk of 1-10 days/year in the future period (2021-2050) compared to control period (1960-1990).

However, there are no sufficient data for estimating whether there is an increasing trend on the incidents of fire-related deaths and injuries which could be associated with the trend in fires in Cyprus.

II. Indirect impacts

Vector-borne and rodent-borne diseases are among the well-studied diseases associated with climate change, due to their widespread occurrence and sensitivity to climatic factors. The former are transmitted by infected mosquitoes and other arthropod species, mainly during droughts, whereas the other are transmitted directly to humans by contact with rodent urine or other body fluids, mainly during floods or high rainfall events, droughts and introduction of exotic plant species

According to PRECIS climate projections in Cyprus for the period 2021-2050, the length of drought periods which is associated with the occurrence of both vector- and rodent- borne diseases is projected to increase up to 13 days/year on average. As for the heavy rainfall events, the most relative indicator provided by PRECIS refers to the annual maximum total precipitation over one day, which is expected to have minor increase.

In general, water-borne diseases are likely to increase with climate changes such as reduced rainfall, increased temperature, increase in the frequency of extreme weather events (droughts, heavy rainfall, floods), due to the possible risk of water deterioration and lack of good hygiene. Higher water temperatures and flooding may also lead to contamination of water with harmful algal blooms or runoff pollutants. Contamination of food may be induced by higher temperatures (surface and ocean) due to enhance the survival and proliferation of viruses, bacteria and pathogens in foodstuffs.

However, in Cyprus there many measures in place such as effective water and food legislation, high quality of health services, sanitation standards and drainage systems, to safeguard public health.

The future climate changes projected for Cyprus include minor changes in the annual average precipitation while the length of drought periods is projected to present an increase up to 13 days/year on average. It must be noted that although Cyprus is considered a dry region, the water availability is satisfactory, with the substantial contribution of desalinated water to drinking water supply and the extensive waste water drainage system.

The causal chains through which climate variability and extreme weather influence human nutrition are complex and involve different pathways such as water scarcity, salinisation of agricultural lands, destruction of crops through flood events, wind storms, frosts and hail, disruption of food logistics through disasters, and increased burden of plant infectious diseases or pests (Confalonieri et al., 2007). Reduced food production may lead in diminished dietary diversity, reduction in overall food consumption and in malnutrition, especially in low-income countries.

In Cyprus the greatest climatic threats for the agricultural production (especially seasonal) and food availability, are droughts (through cuts in irrigation water) and frosts. Other extreme weather events such, heat waves, wind storms, hail and floods are, also related to damaged crop yields and have impacts upon nutrition.

According to PRECIS climate projections in Cyprus for the period 2021-2050, the length of drought periods (precipitation<0,5mm) is projected to increase up to 13 days per year on average. However, as drinking water supply will be satisfied by desalinated water in a great extent (except for the areas not connected to government water works), the irrigation water availability will increase compared to the control period. Furthermore, the mean number of heat wave days per year (temperature >35°C) is expected to increase from +2 to +34 days per year and the number of heavy rainfall events, as indicated by the annual maximum total precipitation over one day, is expected to have minor changes, ranging from 2 to 5 mm on average. Finally, the frequency of damages to crops due to frosts and wind storms

will decrease while as regards the damages due to heat waves it is expected that they will increase. Concerning the frequency of damages by droughts and floods, it is not clear whether the effect will be negative, positive or none.

The diseases related to air pollution include exacerbation of respiratory diseases, tract irritation, exacerbation of asthma, irritation of bronchi, atopic diseases, exacerbation of allergic rhinitis, eye irritation. The air pollution health risks related to climate change are caused primarily from the increased concentrations in the atmosphere of particulate matter and ozone, related to forest fires, heat-waves, Sahara dust events, re-suspension from soils and other surfaces, as well as from traffic and other anthropogenic activities.

The future climate changes in Cyprus that are considered to be associated with the impact of air pollution-related diseases are according to PRECIS climate projections in Cyprus for the period 2021-2050: the mean number of heat wave days per year (temperature >35°C) which is associated with increases of tropospheric ozone and particulates, is expected to increase from +2 to +34 days per year. In addition, it is expected that the already dry climate in Cyprus which contributes to the suspension of PM10 will be further intensified with the prolongation of drought periods (precipitation <0,5mm) up to 13 days/year on average. However, wind speed which also associated with this effect is expected to decrease. As for the changes in the mean annual maximum temperature in Cyprus which is related to increased pathogen prevalence in air, this is expected to increase by 1 - 2°C with respect to the control period. 1960-1990. In general, it can be said that climate changes will have a negative impact on the air pollution related diseases in Cyprus.

6.3.4.3. Future vulnerability assessment

The future vulnerability of public health to climate change impacts is assessed in terms of its sensitivity, exposure and adaptive capacity, based on selected indicators and on the available quantitative and qualitative data for Cyprus as well as on the climate projections for the period 2021-2050 and presented in the CYPADAPT project.

The vulnerability of public health is assessed for each of the following impacts:

- Deaths and health problems related to heat waves and high temperatures
- Deaths and injuries from floods/storms
- Landslide-related deaths and injuries
- Fire- related deaths and injuries
- Vector-borne and Rodent-borne diseases
- Water-borne and food-borne diseases
- Climate-related effects upon nutrition
- Air pollution-related diseases

It must be noted that, there are no sufficient scientific evidence and data to evaluate or correlate all impacts and indicators to future climate changes. Consequently, further research is required in order to provide concrete information for a more detailed and descriptive assessment of the future vulnerability of the sector.

1. Deaths and health problems related to heat waves and high temperatures

Excessive heat is a well-known cause of heat stress, exacerbated illness and mortality. Heat waves have readily discernible health outcomes because they result in a large number of deaths and affect relatively large, heterogeneous areas simultaneously. However, not all heat waves have a similar impact on mortality. In addition to the intensity of a heat wave, the duration and the timing of the event are particularly important. Illnesses recognisable as the direct results of exposure to prolonged periods of high environmental temperature are heatstroke, heat exhaustion, and heat cramps.

Empirical-statistical models for heat stress are constructed for Cyprus during summer (June-August) for the period 2004-2011, in order to investigate the relationship between hot weather conditions and mortality for Cyprus since excessive heat is a well-known cause of heat stress, exacerbated illness and mortality. The calculated summer excess deaths (or the heat related mortality) per day for each

maximum air temperature interval, as well as the frequency of occurrence of the temperature intervals during this period are presented in Figure 6.21.

A fairly linear increase of mortality with increasing temperature and thus high sensitivity is observed - with hotter days associated with greater mortality risk. Heat-related deaths start to be discernible when the maximum temperature is 38°C or above.

In addition, local factors, apart from climate, such as topography, urban heat-island magnitude, income, and the proportion of elderly people, are also important in determining the underlying temperature–mortality relationship in a population (Curriero et al., 2002). The population groups that are most vulnerable to heat waves are the elderly, persons with pre-existing chronic diseases, people confined to bed, children, population groups with low socio-economic status, workers in outdoor environments. Moreover, heat waves have a much bigger health impact in cities than in surrounding suburban and rural areas.

Generally, the risk period for heat waves in Cyprus is identified during the whole summer, that is, from June to August (three months). According to the WHO (2010), the 98.8% of Cyprus population is exposed to moderate heat wave hazard (32- 41°C). The heat-related mortality, as projected to the future climate of 2021-2050 using temperature output from the PRECIS and ENSEMBLES climate model simulations under the A1B emissions scenario, is expected to increase up to 10 excess deaths per day under very hot weather conditions (Figure 6.22).

To investigate the potential negative impacts of climate warming on human life, the humidity index or “Humidex” (Masterton and Richardson, 1979) was employed to express the temperature perceived by people (Figure 6.23).

The public health response of Cyprus in heat waves is based at forecasting heat waves, issuing warnings and providing advices for self-protection from heat waves, through the mass media (television, radio, newspapers, and public websites). Furthermore, to the sufficient ability of the health care system of Cyprus to respond to heat related incidents, there are working regulations prohibiting outdoor labour work when temperature exceeds 40°C and, though the majority of houses and buildings are fully air-conditioned, communal centres have been established to accommodate people with no access to an air-conditioned environment. Considering the above-mentioned indicators, the adaptive capacity of Cyprus’ public health to heat waves is characterized as limited to moderate.

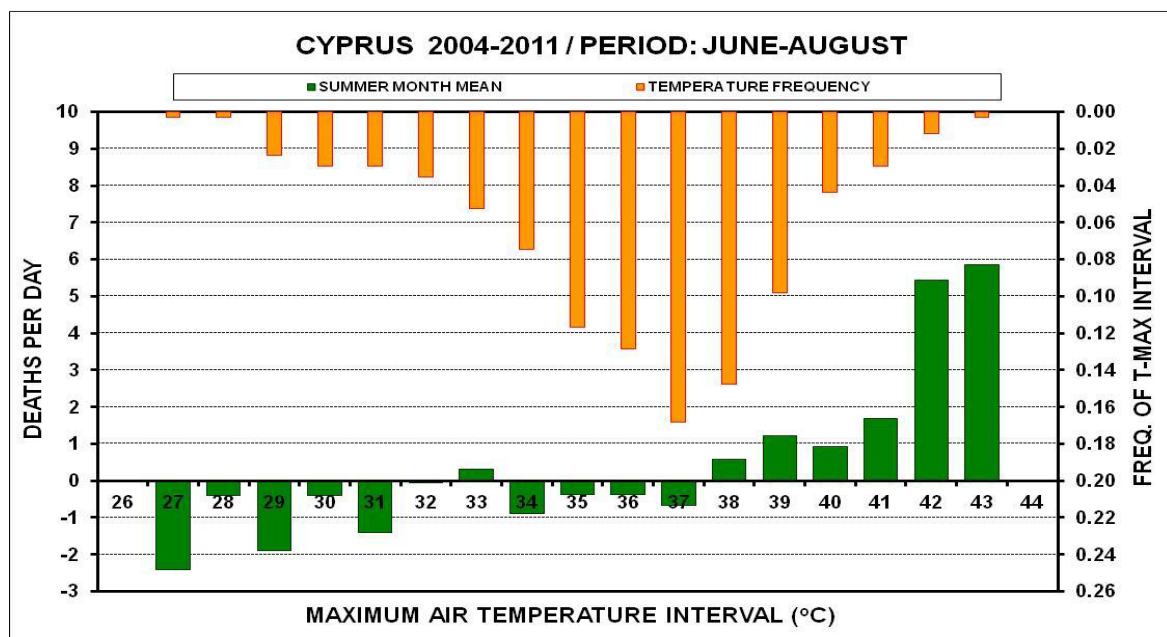


Figure 6.21. Daily excess summer deaths (green bars, left-hand axis) in Cyprus by maximum air temperature interval for the years 2004-2011. The frequency of occurrence of each temperature interval (right-hand axis) is shown using orange bars

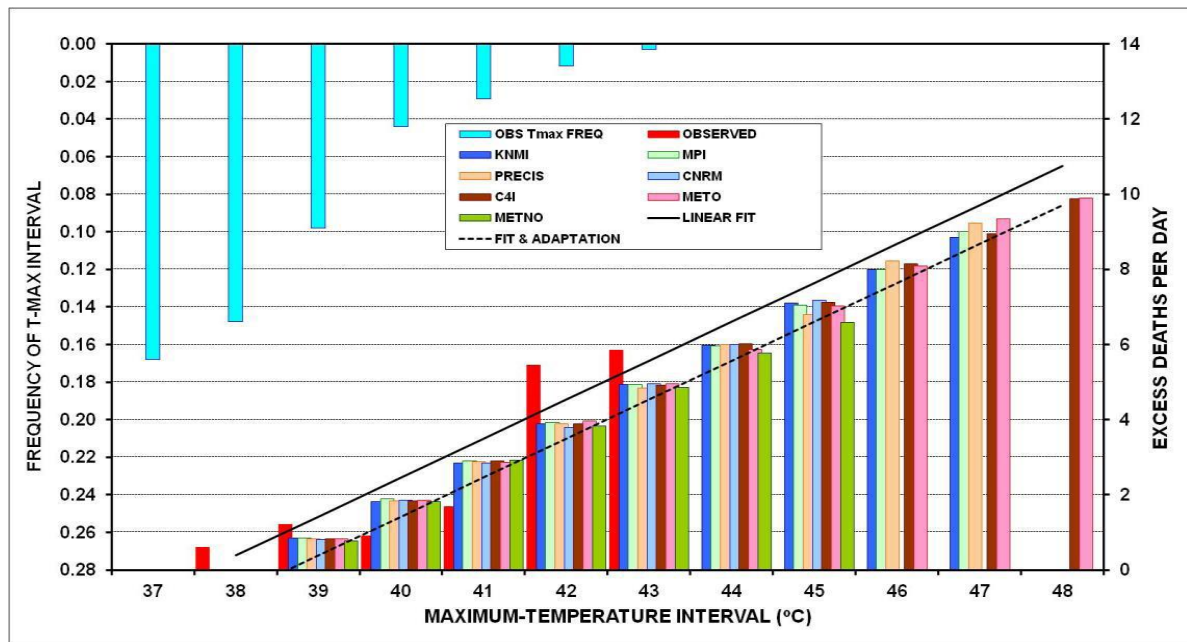


Figure 6.22. Excess deaths (right axis; model and observation bars for present and future climate with adaptation) and daily temperature frequencies (left axis; light blue bars) in Cyprus for the future period 2021-2050

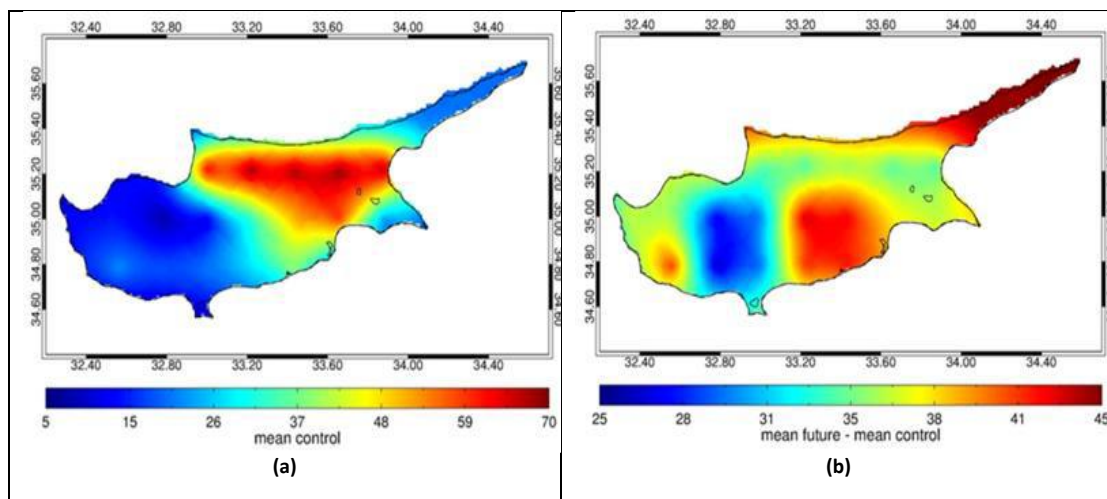


Figure 6.23. Maximum length of Humidex > 38°C (a) for the control period (1960-1990) and (b) the near future (Future – Control period), PRECIS RCM model

i. Heat-related health effects

Studies in Cyprus have found an increase in mortality risk due to cardiovascular disease associated with increased average daily temperatures (Lubczyńska et al., 2015). In this study, the evidence suggests that the increments in relative risk observed immediately after spikes in ambient temperature are the highest for ischaemic heart disease, followed by cerebrovascular disease. Furthermore, the authors suggest that the frequent presence of air conditioning (AC) units in homes in Cyprus (with up to 80% of households reportedly having at least one AC unit) might help reducing some of the negative health effects associated with heat waves (Lubczyńska et al., 2015; Zachariades and Hadjinicolaou, 2015). A 1°C increase above baseline in daily maximum temperature in Cyprus would result in doubling heat-related mortality, whereas a temperature increment of 5°C would increase mortality by almost 8-fold (Heaviside et al., 2015). Because of the urban heat island effect, this risk is reportedly higher in Cyprus's capital, Nicosia (Heaviside et al., 2015; Pyrgou and Santamouris, 2018). Increased temperatures have also been associated with increased morbidity in Cyprus (Pantavou et al., 2021). Data for the period 2009 – 2018, highlight that hospital admissions are likely to start increasing when mean daily

temperatures rise above 26.1°C. Furthermore, for each 1 °C increase in mean daily temperature, hospital admissions in Cyprus increase by 0.6%. For the future, heat discomfort is expected to increase significantly due to the combined effect of strong summer warming and increased atmospheric humidity levels. In a business-as-usual scenario (RCP8.5) this discomfort conditions are expected to last more than 160 days per year and expand beyond the summer season (Figure 6.24). Besides daytime extremes, night-time temperatures are also expected to significantly increase in the region (Ntoumos et al., 2022).

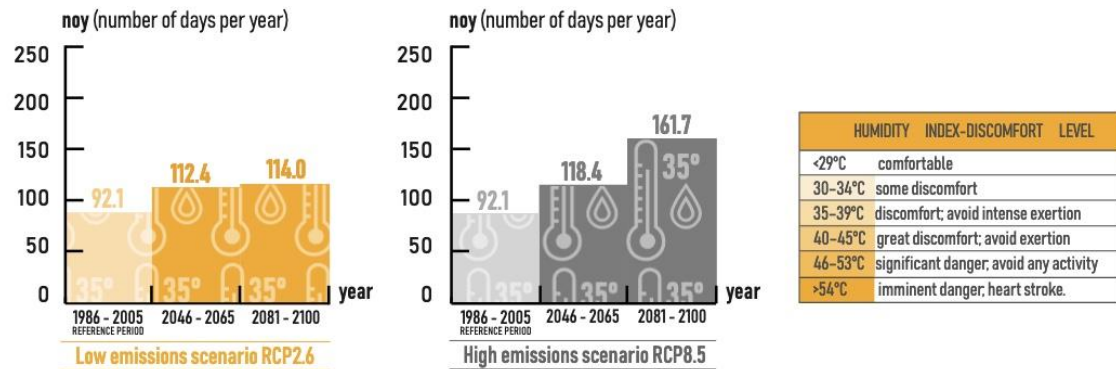


Figure 6.24. The number of days per year with Humidex greater than 35°C. A day with Humidex above 35°C describes conditions from discomfort to imminent danger for humans (Adopted from León et al., 2021, <https://soclimpact.net/>).

2. Deaths and injuries from floods/storms

The main population groups that are considered sensitive to deaths and injuries from floods and storms are (i) the elderly over 65 (13.3%) which cannot move easily and fast in case of a flooding event and (ii) infants and young children (16.1%) especially if they are not under the protection of an adult. The following figures illustrate the level of severity for public health of recorded flooding events in Cyprus during the period 1859-2011.

The flood hazard distribution map of Cyprus (Figure 6.26) indicates that the risk ranges from very high levels (Lefkosia) to very low (Troodos) depending on the regions.

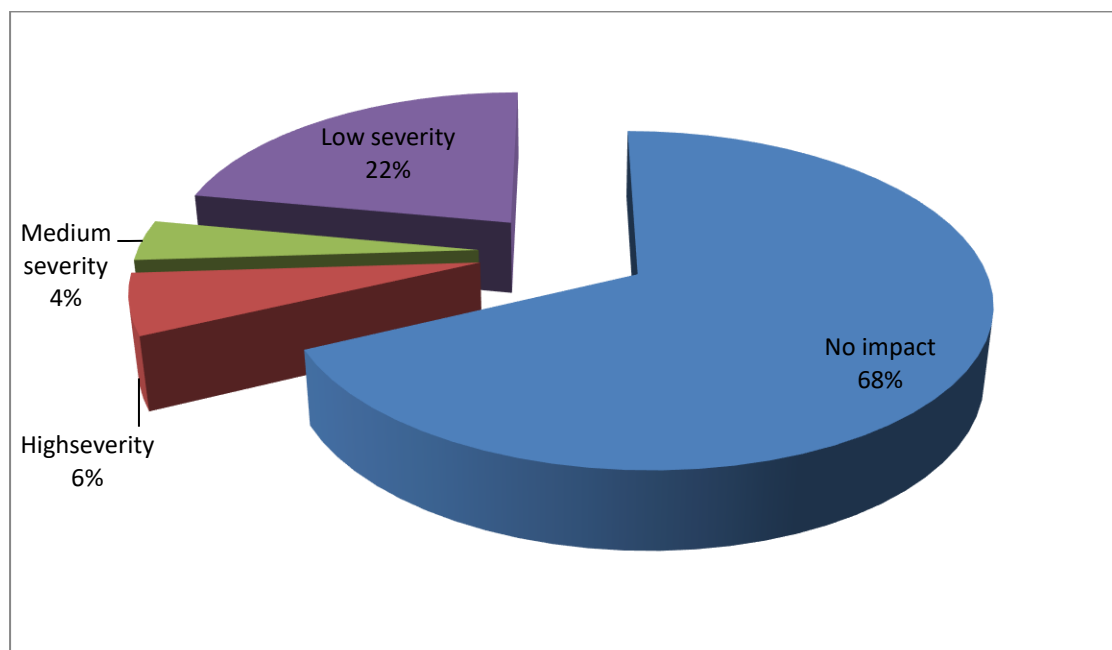


Figure 6.25. Impact of flooding events on public health (1859-2011) (WDD, 2011)

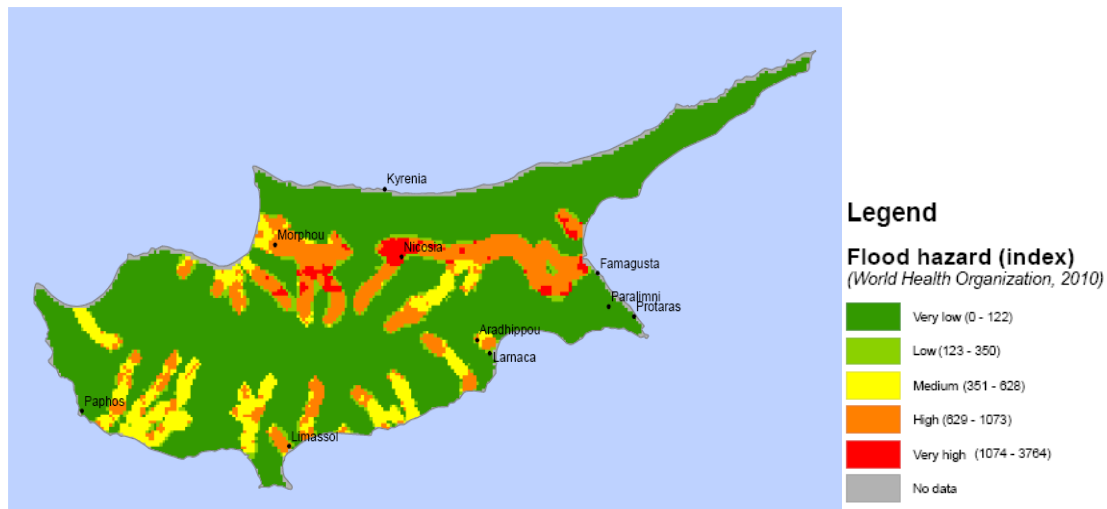


Figure 6.26. Flood hazard distribution map of Cyprus (WHO, 2010)

For the protection of people during a severe flooding event, the civil preparedness and defence service of Cyprus is in place and the health care system of Cyprus cherishes injured people. To prevent the occurrence of flooding events in Cyprus, a separate drainage system is being developed and expanded the last two decades in order to collect stormwater. Furthermore, it is expected that through the implementation of the Flood Risk Management Plans by the end of 2015 and the associated flood protection works, public health will be substantially safeguarded by the adverse effects of floods.

Taking into account the above, the sensitivity, exposure and the adaptive capacity of public health in Cyprus to floods and storms is considered limited to moderate, for the former and moderate for the rest aspects.

3. Landslide-related deaths and injuries

The main population groups that are considered sensitive to deaths and injuries from landslides are the elderly people and the young children, same as mentioned above. According to the landslide hazard map produced by the World Health Organization (2010) (Figure 6.27), Cyprus population is not at risk from landslides. Similarly, is the risk regarding future climate changes as the related indicator, the annual maximum total precipitation over one day, show a slight increase.



Figure 6.27. Landslide hazard distribution map of Cyprus (WHO, 2010)

4. Fire-related deaths and injuries

Given that there are no data on the number of people killed or injured during fire events in Cyprus, the vulnerability of public health to fires is based on the fire risk areas in conjunction with the population density in these areas

According to PRECIS near future (2021-2050) the Fire Weather Index (FWI) projections rich the highest values during summer and is higher at the elevated forested areas, mainly at Troodos Mountain which are not densely populated (Figures 6.30 and 6.31).

Considering that the total share of population, which is sensitive to fires is 29% (the elderly over 65 and infants and young children), the geographic distribution of high fire risk and the low population density of these areas, the sensitivity and exposure of the population in Cyprus to fire-related deaths and injuries, are characterized as moderate and, as limited to moderate, respectively.

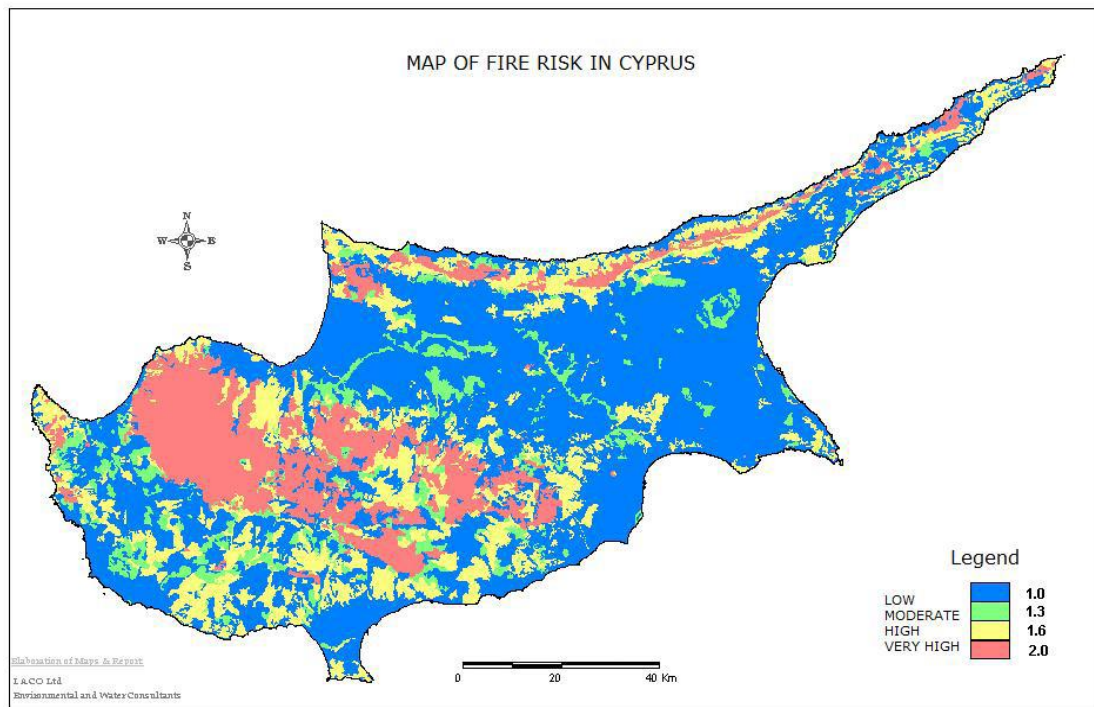


Figure 6.28. Map of fire risk in Cyprus (Department of Environment), 2007

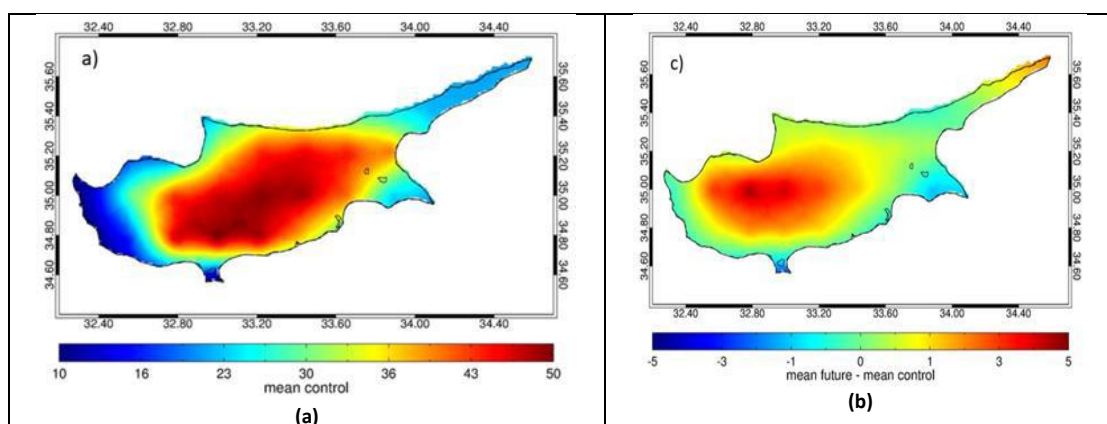


Figure 6.29. July average FWI in (a) the control period (1960-1990) and (b) the near future (Future – Control period)

5. Vector-borne and Rodent-borne diseases

All citizens in Cyprus, living either in urban or rural areas, have direct access to clean and safe water and are served with an efficient sanitation system (public wastewater network, septic tanks, waste

disposal system). According to data provided by the United Nations Environment Programme (UNEP), Cyprus presents the lowest rate for vector-borne diseases among other countries (Cosmatos, 2009).

6. Water-borne and food-borne diseases

Provided that many waterborne diseases are associated either directly or indirectly, to the quantity and quality of the water supply, it is noted that all people leaving in Cyprus have direct access to clean and safe water and to adequate sanitation facilities.

The following facts are indicative of the exposure status of public health in Cyprus to water-borne and food-borne diseases:

- The estimated number of “healthy” life years lost (DALYs) attributable to water, sanitation and hygiene for 16 Member States of the EU27, shows that Cyprus is in the first place (reference year 2002)
- The recorded incidents of salmonellosis in Cyprus for the period 1984-2007 present a general increasing trend, although they remain quite below the average respective values in the EU
- The incidents of Hepatitis A in Cyprus are quite low (less than 1 incident/100,000 capita per year) for the period 1980-2007 while the respective value for the EU was significantly higher until recently when it declined the current exposure level of population to water and food-borne diseases can be characterized as limited to moderate.

The expected changes of the climate factors influencing the exposure of public health in water-borne and food –borne diseases through drinking water contamination, according to the PRESIS model for the future period 2021-2050 are: the decreased rainfall, the increased temperature, the increase in the frequency and intensity of droughts.

Thus, the future sensitivity and exposure of population to water and food-borne diseases e can be characterized as limited and, as limited to moderate respectively.

7. Climate-related effects upon nutrition

Incidents of malnutrition are more likely to be detected in population groups with lower socio-economic status as well as to infants and young children. The population groups characterized by high risk of poverty in Cyprus amounted to 16% of the total population in the period 2005-2008 and the percentage of infants and young children amounts to 16.2% of the total population.

The agricultural sector is the first to suffer from the consequences of extreme climatic phenomena and their impact in farmers’ seasonal yields as well as the availability of food. In Cyprus, nutrition is based on both agriculture and livestock national production but also on a great extent on imports.

Consequently, the sensitivity and exposure of public health in Cyprus to climate-related effects upon nutrition are considered as limited to moderate and, limited respectively.

8. Air pollution-related diseases

Certain groups are potentially more vulnerable than others to air pollution, such as the children, pregnant women, people over 65 years of age, and persons suffering from cardiovascular and respiratory diseases (e.g. asthma). The data available on these groups in Cyprus show that comprise the 30% of the total population. Therefore, the sensitivity of Cyprus public health to air pollution is considered moderate.

6.3.4.4. Assessment of overall vulnerability

The overall future vulnerability of public health to future climate changes, in terms of sensitivity, exposure, adaptive capacity based on the available data is as presented in Table 6.9. As it can be seen from the table, the public health of Cyprus is not considered vulnerable to climate changes mainly due to the fact that it is characterized by a good adaptive capacity. The only vulnerability that was identified through the CYPADAPT project is related to the deaths and health problems from heat waves and high temperatures. Thus, the adaptive capacity should be enhanced with urgent and satisfactory measures for the effective protection of the population from heat waves.

Table 6.9. Overall vulnerability assessment of public health in Cyprus to climate changes

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Deaths and health problems related to heat waves and high temperatures	High (5)	Moderate to High (4)	Limited to moderate (2)	Moderate (2.5)
Flood-related deaths and injuries	Limited to moderate (2)	Moderate(3)	Moderate(3)	None (- 0.6)
Landslide-related deaths and injuries	Limited to moderate (2)	Limited (1)	Moderate(3)	None (-1.6)
Fire-related deaths and injuries	Moderate(3)	Limited to moderate (2)	Moderate(3)	None (-0.6)
Vector-borne and rodent-borne diseases	Limited (1)	Limited to moderate (2)	Moderate(3)	None (-1.6)
Water-borne and food-borne diseases	Limited (1)	Limited to moderate (2)	Moderate to High (4)	None (-2.6)
Climate-related effects upon nutrition	Limited to moderate (2)	Limited (1)	High (5)	None (-3.6)
Air pollution-related diseases	Moderate(3)	Moderate(3)	Moderate(3)	None (0)

6.3.5. Forestry

The total forest area in Cyprus, covering 390,944 ha, which is the 42.3% of the island, consists of forests (44.2%) and other wooded land (55.8%). The Cypriot forests are natural with the main forest species of pine (*Pinus brutia*, *Pinus nigra*), many endemic species such as the Golden oak (*Quercus alnifolia*) and Cyprus cedar (*Cedrus brevifolia*) species (DoF, 2011a).

The forest sector is highly dependent on climate. Direct impacts of climate change on Cyprus forests arise mainly from decreased rainfall and increased temperature, droughts, fluctuations in intensified precipitation and changes in fire regimes. Indirect impacts come from the interactions between changes in climatic variables and several abiotic and biotic factors (Lindner et al., 2008). Non climate related pressures are mainly associated with (i) unsustainable timber harvesting, (ii) overgrazing which causes degradation not only on the vegetation but also on the soil and water regime of the island and (iii) land development especially for tourism development and construction of holiday dwellings.

The future impact, vulnerability and adaptation measures for the forestry sector in Cyprus regarding climatic changes were also assessed as part of the Life+ CYPADAPT project, by using PRECIS and six other regional of the ENSEMBLES models and, the future period (2021–2050) against the control period (1961–1990).

The main vulnerability priorities for the forests of Cyprus as observed in the recent past, has been related to the damages caused by fires as well as insect attacks and diseases on the dieback of tree species. These impacts are expected to worsen in future.

Cyprus has formulated a forest policy and a National Forest Programme, while starting a process of updating its forest legislation, laying the stress on environmental services and recreation rather than wood production.

6.3.5.1. Future impact assessment

The magnitude of the direct impacts on Cyprus' forests is expected to increase, as the relevant climate change factors are expected to intensify.

According to PRECIS projections for the future period 2021-2050, the average annual temperature in Cyprus is expected to increase by 1-2°C with respect to the control period 1960-1990, while precipitation is expected to decrease in seasonal level and in minor degree in annual level. In addition, the maximum length of dry spells (precipitation<0.5mm) is expected to increase by 10 to 13 days on

average, while heat wave days (temperature >35°C) will be increased averagely about 10-30 days on annual basis. Concerning future changes of annual max total rainfall over 1 day, projections show that a slight increase of about 1-4 mm is anticipated. Finally, regarding the highest annual total precipitation, falling in 3 consecutive days, a negligible increase of about 1-2 mm of rainfall is expected.

In the context of the future impact assessment the indicators presented in Table 6.10 summarize the potential impacts of climate change on Cyprus' forests. The main direct and indirect impacts presented in the table were grouped in the following impact categories: 1. Dieback of tree species, insect attacks and diseases leading to desertification, 2. Fires, 3. Floods, wind throws and storm damages, and 4. Forest growth.

Table 6.10. Relationship between potential climate changes and impacts on the forest sector

Potential climate change in Cyprus	Potential Forest impacts	
	Direct Impacts	Indirect Impacts
Drought	Insect attacks Dieback of trees Pressure on fauna species Biodiversity loss Desertification	Reduction of forestry regeneration and growth Degradation of forest, impacts on forests' health and vitality Increase in number and severity of forest fires Soil erosion Increase of dust in the atmosphere Negative effect on reforestations and natural stands
Higher mean annual temperatures – Hot spells	Insect attacks Dieback of trees Pressure on fauna species Biodiversity loss Desertification	Increase in number and severity of forest fires Photosynthesis decrease Decrease of biomass growth and yield Decrease of forests' productivity Decrease of wood production Effect on carbon sequestration rates and net carbon balance
Decreased rainfall	Change in competition among - plant species Nutrient availability in soils Deficiency in water for fauna	
Increase of extreme events (floods, wind throws and storm damages)	Injuries Inhibition of seed germination Changes in plant anatomy Promotion of early senescence and mortality Nutrient availability in soils	
Atmospheric CO₂ increase	Increase in photosynthesis rates (varying with plant nitrogen status and species) Effects on forest growth, tree physiology Insect attacks	

1. Dieback of tree species, insect attacks and diseases leading to desertification

Climate change has an effect on insect development and diseases, which are the main harmful forest organisms in Cyprus forests. Faster development of insects due to rising temperature and low levels of soil moisture due to drought can lead to further necrosis of trees. The typical Mediterranean climate with mild winters and hot, dry summers favours the breeding of harmful forest organisms in large populations (DoF).

The anticipated increase in temperature in the island and decrease in rainfall, as well as their related changes in heat wave days and maximum length of dry spell, will have a negative impact on forest organisms in Cyprus forests. This climatic change except from dieback of the tree species due to thermal stress has secondary results such as increase in the severity of future insect attacks.

The warm and dry climate conditions make pine stands in the forests of Cyprus vulnerable to pests such as the pine processionary caterpillar and bark beetle.

Projections of PRECIS regional climate model make evident that all forested areas of Cyprus will experience, in the near future, a warming of about 0.8 – 1.1°C. In specific, winter minimum temperature is expected to reach 6°C in mountains and, 7-9°C in forested area in coastal regions. Furthermore forested regions of Troodos Mountain will experience a significant warming of about 2.0 – 2.7°C reaching summer maximum temperatures of about 32 – 35.7°C in comparison with the control period.

As a conclusion rising temperature may enable some insect species to develop faster and endanger thus the forest growth. In this frame the predicted increase in winter minimum and summer maximum temperature in the future period can worsen current situation of dieback of tree species.

Increases in maximum length of dry spell can affect negatively forest species sensitive to soil moisture content causing the drying of trees, further stress on forest ecosystems, particularly those found in lowland and hilly areas, and possible necrosis of trees due to enhanced the activity of insects. In Cyprus, the necrosis of a significant number of pines and cypress in Stavrovouni forest during the dry period 2005 – 2008 was attributed to the impact of insects (DoF, 2011b; Cyprus Institute, 2011).

Number of heatwaves days is also a very important factor since in combination with the length of dry period can cause “thermal stress” to trees leading to extended necrosis mainly during the long hot summer period.

An increase of about 20-30 days (temperature over 35°C) is expected for mountain regions and conversely 10 days for other areas. Concerning annual rainfall no increase is anticipated in the future period (2021-2050), but seasonal precipitation will decrease, inducing thermal stress on trees and increase in the severity of future insect attacks. Changes in the hydrological regime may also have serious implications for the forests’ sustainability.

2. Fires

Eastern Mediterranean countries, with relatively temperate climates that favor forest and shrubland biomes, including Cyprus are among those most affected by forest fires (Zittis et al., 2022). Severe drought events can create the pre-conditions for forest fires, predominantly during the warm and dry part of the year. Summer fires frequently rage across the Mediterranean landscapes, while their impact is augmented by extraordinary high temperatures, as well as droughts that are found to regulate the fuel moisture (Turco et al., 2017). Across most forests in the Mediterranean, days of critical fire risk, the length of the fire season and the extent of burnt areas have increased significantly in the past decades and are expected to continue doing so in the 21st century, especially under business-as-usual pathways (Karali et al., 2014). Considering the prevailing dry and hot conditions during the summer month, there are areas that already belong to very high fire risk class (e.g., in the northern slopes of the Troodos Mountains) (Figure 6.30 – left panel). It seems that under RCP2.6, the Fire Weather Index (FWI) slightly increases by 5 %. On the other hand, under RCP8.5 the increase in fire danger exceeds 20 % by the end of the century. In such a scenario, the majority of the island will be under high and very high fire danger.

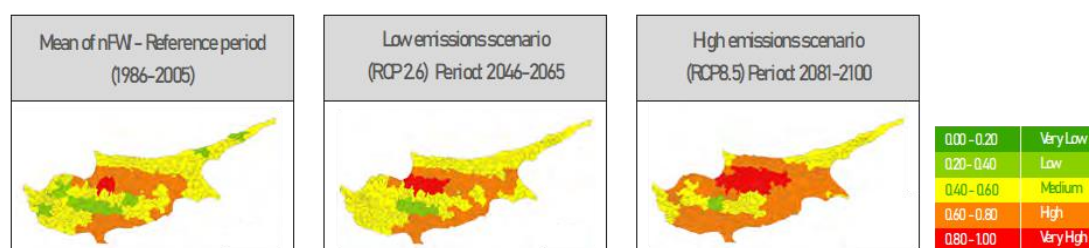


Figure 6.30. Fire Weather Index values for historical condition and two future periods based on the EURO-CORDEX with the colour associated to the level of risk. (Adopted from: León et al., 2021).

Forests of Cyprus are vulnerable to fire, primarily due to the long, hot and dry summers, mild winters, strong winds, intense relief and flammable xerophytic vegetation. These natural factors are further exacerbated by changing climatic conditions, which favour prolonged periods of drought and extreme weather events. Also, the accumulation of biomass due to the abandonment of rural areas and the increasing tourism and exodus of city residents to forested areas, are also important factors which contribute to an increased fire risk, especially during summer months.

In addition, as already mentioned above, forest fires are highly sensitive to climate change because fire behaviour responds immediately to fuel moisture, which is affected by precipitation, relative humidity, air temperature and wind speed. Thus, the projected increase in temperature will increase fuel dryness and reduce relative humidity and this effect will worsen in those regions where rainfall decreases. Accordingly, increases in climate extreme events are expected to have a great impact on forest fire vulnerability.

Mediterranean Europe, in general, has been identified as likely to suffer potentially increased fire risk. Among the climatic parameters with implication on fire risk, is the maximum length of dry spell (amount of rainfall less than 0.5 mm) because it is a parameter which not only increases fire risk but also highly influence forest species due to their sensitivity to soil moisture content. As mentioned, this parameter is expected to increase by 8 to 12 days, in comparison to the control period.

The Canadian Fire Weather Index system (FWI) is one of the most widely used indices of fire risk. Regarding PRECIS results, FWI reaches extremely high values in forested areas of about 50 (extreme high risk) in the control period, especially in summer, while a slight increase is projected for the future.

3. Floods, wind throws and storm damages

Forest damage by wind and snow are a continuing cause of economic loss in forestry throughout Europe and Cyprus (Lindner et al., 2008) because of reduction in the yield of recoverable timber, increased costs of unscheduled thinning and clear-cutting, and resulting problems in forestry planning. Despite the great severity of the particular climate change impact on forests, there are no available data for future estimation of wind throws and storm damages in Cyprus.

Flooding is harmful especially if it occurs during the growing season (Lindner et al., 2008). Extreme flooding events are expected to occur more frequently as a consequence of climate change. While the number of rain days is projected to decrease the number of days with heavy rain events is projected to increase (annual max total rainfall over 1 day show a slight increase of about 5mm is anticipated for forested areas and 2-4 mm is anticipated in western and inland regions).

4. Forest growth

Forest growth and productivity may be affected by projected climate change aspects such as increases in temperature, changes in precipitation and increases in air pollution. More specifically all forested areas of Cyprus will experience, in the near future, a warming of about 0.8 – 1.1°C and minor decreases in the annual total precipitation. Higher mean annual temperatures, decreases photosynthesis affecting thus the biomass growth and yield (Linder et al., 2010). Future changes in precipitation, in terms of frequency and availability, will have a significant effect on plant and forests' growth, as well on forestry species.

It is recognized that, rising concentrations of CO₂ in the atmosphere is believed to act as a fertilizer and increase photosynthesis rate, while higher ozone and nitrogen deposition affect tree physiology, carbon allocation and plant interactions, resulting in complex interactions with other climatic impact factors such as drought (Lindner et al., 2008).

In general, Cyprus, a region with already warm and dry conditions especially during summer, is likely to experience decrease in forest growth while the projected climate conditions will magnify the already intense water stress circumstances provoking forest growth failure.

6.3.5.2. Future vulnerability assessment

The future vulnerability of forestry sector to climate change impacts in terms of their sensitivity, exposure and adaptive capacity based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021- 2050 is assessed for the impact categories as follows: (1) Dieback of tree species, insect attacks and diseases, (2) Fires, (3) Floods, wind throws and storm damages, and (4) Forest growth.

1. Dieback of tree species, insect attacks and diseases

Increase in temperature is significant for the health of the forest ecosystem, enabling some insect species to develop faster and endanger thus the forest growth. Studies showed that the increased incidents of dieback of forest species in Cyprus are attributed to the adverse environmental conditions that prevailed and particularly the decrease in rainfall and increase in air temperature (Christou et al., 2001). A large number of tree species are affected by indigenous insects.

The summer maximum temperature is anticipated to increase about 2-2.7 °C in forested regions reaching 30-32 °C which may also lead to extinction of certain species in their current geographical range. Furthermore, PRECIS predicts duplication of heat wave days in forested areas for the future period reaching 40-60 days. Increases in maximum length of dry spell can affect negatively forest species sensitive to soil moisture content.

The number of heatwaves days is a very important factor since in combination with the length of dry period can cause “thermal stress” to trees leading to extended necrosis mainly during the long hot summer period. As PRECIS predictions show, an increase of about 20-30 days is expected for Troodos mountain regions and conversely 10 days for western areas, in comparison to the control period.

Precipitation is being geographically and seasonally, unevenly distributed, with maximum precipitation falling on the island’s two mountainous masses during November and March. The overall decrease in precipitation for the future period is not significant, but it is most evident for winter and autumn seasons. The projected decrease of about 20mm in winter precipitation in combination with higher predicted temperatures in all forested areas may enhance the dieback of forest species.

Thus, both the sensitivity and exposure of Cyprus’ forests to increased diebacks and insect outbreaks is expected to be very high.

The Department of Forests in Cyprus has taken action considering the implications of droughts and high temperatures and prepared a “Short-term Action Plan for the Confrontation of the Implications of Drought in Cyprus state forests (2009-2010)”. The measures and actions of the Plan address the dieback of tree species, insect attacks, biodiversity loss as well as fires (DoF, 2009b). Despite the numerous measures that are implemented in Cyprus for combating dieback of forests and insect attacks as well as for the protection of biodiversity, the effect can only be alleviated but not eliminated. Additional adaptation measures are needed to further enhance adaptive capacity towards this impact.

Thus, the adaptive capacity of Cyprus’ forests to increased diebacks is characterized as moderate.

2. Fires

Forests in Cyprus are sensitive to fires because of their composition which is dominated by flammable vegetation and the topography of the forested areas, which is mostly mountainous (DoF).

In Cyprus for the future period, it is expected to have increase in temperature, decrease in total rainfall and increase in dry spell days. Nevertheless, the overall Fire Weather Index is expected to have a small increase.

The Fire Weather Index for the control period has an extremely high value (about 50: extreme high risk), especially during July and August and will be higher in future of about 2-3 in all the forestry areas of Cyprus. The overall findings of the analysis (FWI) suggest that number of days with fire risk (FWI>15) will be increased from 5 to 15 days and number of days with extreme fire risk (FWI>30) will have an

increase of 1 to 5day for the future period. It was also found, that future exposure of almost all forested areas in Cyprus to fire risk is expected to be medium to high in spring period, whereas in autumn period is expected to be high.

Wind speed in summer, which is also a dominant factor of fire behaviour, is expected have a slight decrease of about 0.018-0.23 m/sec in the future period (2021-2050).

Considering the above, both the sensitivity and exposure of Cyprus' forests to fires are characterized as very high.

As far as concern the adaptive capacity of Cyprus forests to fires can be characterized as moderate, due to the several measures which are taken by the Forestry Department of Cyprus aiming to eliminate forest fires. Particularly, these are (a) prevention, (b) pre-suppression, (c) detection and suppression measures.

In addition, under the framework of the Rural Development Programme 2007-2013 of Cyprus, various economic incentives were provided to individuals to apply measures in order to improve the existing protection system of forests from fire as well as the restoration of burned areas. Despite the great efforts and the good results of recent years, the problem of fires still exists and will always constitute a permanent threat for the forests of Cyprus. However further measures can increase the adaptive capacity.

3. Floods, wind throws and storm damages

The factors affecting the sensitivity of forests to floods are the slope of the area, the age of the plant species, their anatomy, the type of soils and others. In Cyprus slopes in excess of 18% and 12% cover 10% and 22% of the island (Geological Survey Department; I.A.CO Ltd, 2007). Maquis and garique vegetation, which consist 56% of the total forest and OWL area in Cyprus, are more generally sensitive to floods due to their lower height. However, are located in areas with inclination, thus they are not considered sensitive to flooding.

The Water Development Department of MARDE through its report "Preliminary Flood Risk Assessment" identified 19 areas around the island as "Areas with Potential Significant Flood Risk", which are mainly the urban centres. In the future period (2021-2050), annual max total rainfall over 1 day is anticipated to have a slight increase of about 2-4 mm in western, inland and mountain regions and the risk of floods will not be increased significantly. Consequently, both the sensitivity and exposure of Cyprus' forests to floods are considered to be limited.

The fact that there are limited flooding events in Cyprus forests without any human intervention for their protection, indicates that the forests themselves due to their topography (mountain areas) have the capacity to be self-protected from floods (autonomous adaptive capacity), as water run-off finds its way to the plains.

Therefore, the adaptive capacity of Cyprus can be characterized as high.

4. Forest growth

Forest growth and productivity may be affected by projected climate change aspects such as increases in temperature, decrease in precipitation and increases in air pollution.

According to PRECIS forested regions of Troodos Mountain (Troodos and Paphos forest) will experience a significant warming of about 2.0 – 2.7°C in comparison with the current situation (control period). Future increase in winter temperature will affect the biggest part of Cyprus and forested areas. However, the impact on forest growth and productivity cannot be evaluated. Considering the fact that summer temperatures are already high, a further increase may result in increasing the risk of halting of forest growth in forested areas in the future. The most significant increase in number of heat wave days, of about 20-30 days, appears in the central part of Cyprus affecting significantly Troodos forest and increasing the risk of forest growth.

Decrease in precipitation for the future period are not significant however they are most evident for winter and autumn seasons. PRECIS results indicate that all forested areas in Cyprus will experience a decrease in rainfall during autumn season. The decrease in autumn rainfall may have an effect on forest growth since it follows a prolonged dry summer period which may put forested areas under stress.

6.3.5.3. Assessment of overall vulnerability

The overall future vulnerability of forests to climate changes, in terms of sensitivity, exposure, adaptive capacity on the based on the available data for the above mentioned indicators are quantified as shown in Table 6.11. As it can be seen from the table, the main future vulnerability priorities for the forests of Cyprus are the impact of climate changes on the dieback of tree species, insect attacks and diseases as a significant part of Cyprus' forests has already been affected and the effect of increased frequency and intensity of forest fires as the latter cause severe and extended damages on forests.

Table 6.11. Overall vulnerability assessment of forests in Cyprus to climate changes Impact

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Dieback of tree species, insect attacks and diseases	Very high (7)	Very high (7)	Moderate (3)	Moderate to high (4)
Fires	Very high (7)	Very high (7)	Moderate (3)	Moderate to high (4)
Floods	Limited (1)	Limited (1)	High (5)	None (-5)
Forest growth	Not evaluated	Very high (7)	Moderate (3)	Not evaluated

6.3.6. Agriculture

Agriculture has always been an economic activity of great importance in the Mediterranean basin and a major source of employment and income for the countries of the region, including Cyprus. Agriculture serves for the direct supply of safe, nutritious and affordable food to society and plays an important role in landscape preservation and prevention of desertification (Demetriou, 2005).

According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2014), climatic condition patterns have brought and will bring about numerous changes concerning agricultural activities on a global scale and consequently will influence the world's food supply.

The agricultural sector is highly dependent on climate since temperature, sunlight and water sources are the key factors for plant growth. Although certain impacts of climate change may be beneficial, as for instance prolonged growing seasons and rise of temperatures, there will be also severe consequences that can put agricultural activities at significant risk, as well. Shifting weather conditions can cause variations in the sowing and harvest time of various crops. Moreover, extreme weather phenomena, such as heatwaves, droughts or hail can damage arable cultivations and reduce crop yields (IPCC, 2014).

At present, agriculture is still considered to be one of the major economic sectors of Cyprus due to the island's favourable climate and location near by its leading market, Europe. Additionally, it contributes to the social cohesion, the employment, the protection of the environment, as well as the general welfare of the society (Bruggeman et al., 2011a).

The main components of the agricultural sector, is agriculture and livestock. The most important crops in terms of production value are wheat, potatoes, grapes, citrus, vegetables and olives (Figure 6.31). The subsectors of the animal husbandry industry are mainly cattle, sheep and goats, pigs and poultry, while ostrich farming has been also recently established for commercial uses (Figure 6.32).

The water consumption in agriculture and livestock represents the 60% and 3% of the total water demand in Cyprus respectively (Figure 6.33). As it can be seen in Figure 6.34 the most water-intensive crops are citrus and open-field vegetables.

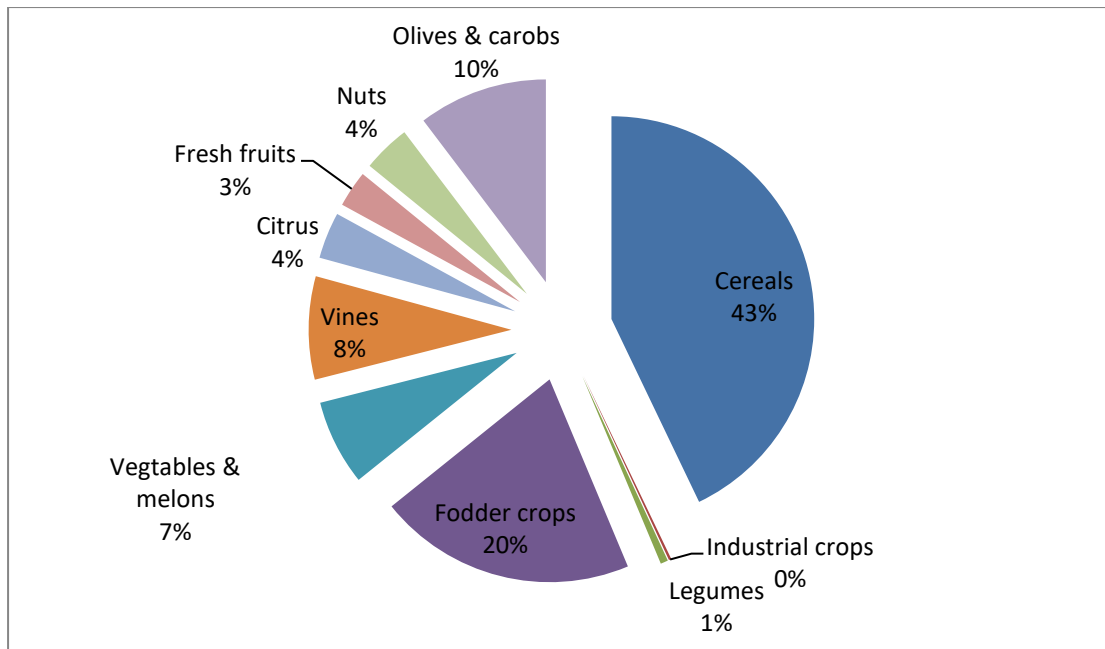


Figure 6.31. Area covered by type of crop as a per cent of total crop area, 2002-2008 (CYSTAT, 2010)

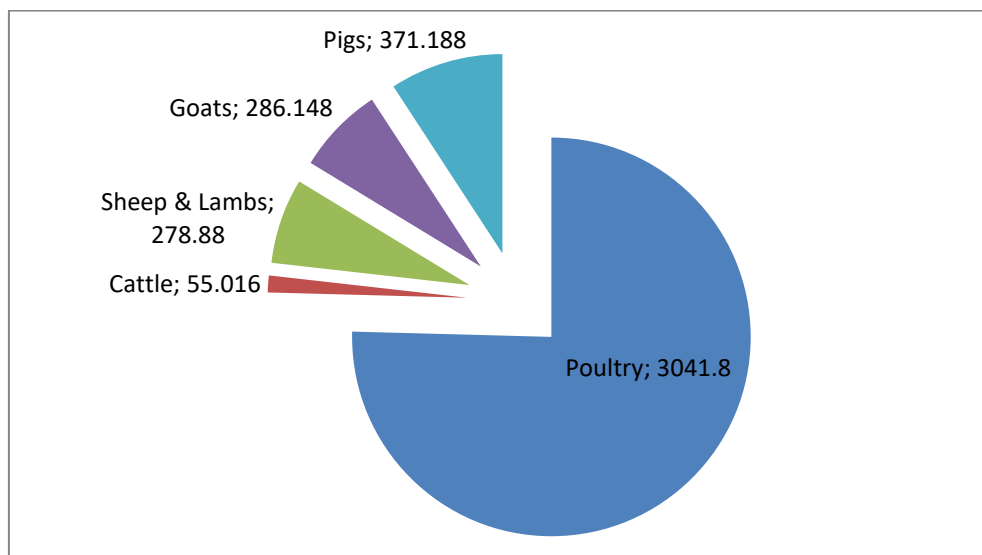


Figure 6.32. Animal population in husbandry (in thousands), average 1984-2008 (CYSTAT, 2010)

In general, 24% of the total crop area is irrigated (mainly for vegetables, citrus, potatoes, melons, table grapes, deciduous fruit, bananas), while the remaining 76% is non-irrigated (rain fed for cereals, fodders, olives, carobs, wine grapes, almonds) (CYSTAT, 2010). The irrigation water supply is provided by 73% of the demand, from non-Governmental Water Works (GWW), mainly private boreholes, and the remaining 27% from GWW, mainly surface water (WDD, 2009).

The water demand for livestock varies significantly among animal species (e.g. animal's size and growth) and is being influenced by environmental and other factors, such as air temperature, relative humidity and the level of animal exertion or production, the water content of the animal's feed or dietary needs etc. (OMAFRA, 2007).

The main vulnerability priorities for the agricultural sector of Cyprus as observed in the recent past, that have been related to impact of climate changes are the reduced crop yield/ productivity due to the limited water resources, the damages caused to crops due to extreme weather events, and the declining soil fertility.

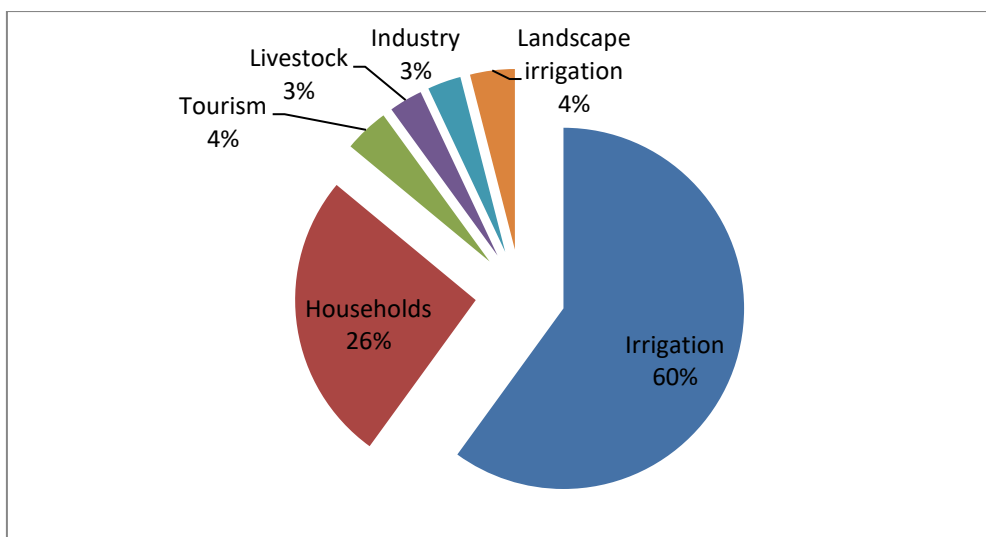


Figure 6.33. Allocation of total water consumption per sector for 2011 (WDD, 2011a)

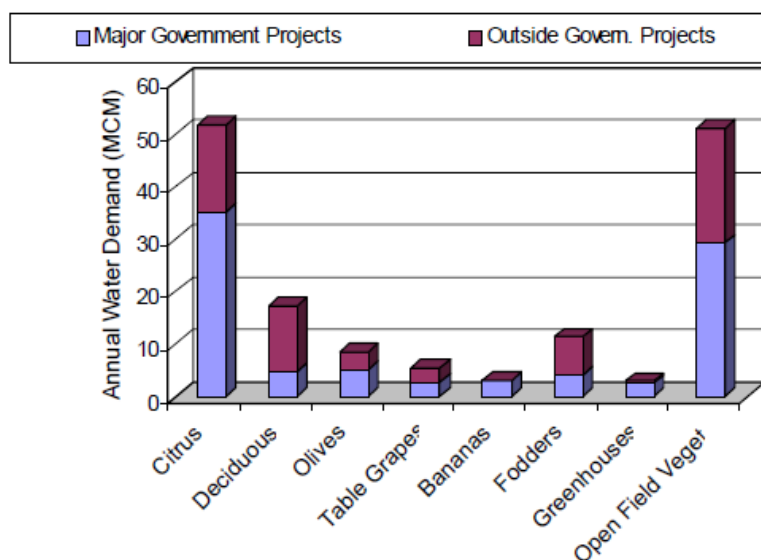


Figure 6.34. Annual water demand data for various crops (WDD – FAO, 2001)

The future impact, vulnerability and adaptation measures for the agricultural sector in Cyprus regarding climatic changes were also assessed as part of the Life+ CYPADAPT project, by using PRECIS and six other regional of the ENSEMBLES models and, the future period (2021–2050) against the control period (1961–1990).

6.3.6.1. Future impact assessment

The magnitude of the impacts on Cyprus' agricultural sector is expected to increase, as the relevant climate change factors are expected to intensify.

According to PRECIS projections for the future period 2021-2050, with respect to the control period 1960-1990: the average annual temperature in Cyprus is expected to increase by 1-2°C, while precipitation is expected to decrease in seasonal level and in minor degree in annual level. In addition, the maximum length of dry spells (precipitation<0.5mm) is expected to increase by 10 to 13 days on average, while heat wave days (temperature >35°C) will be increased averagely about 10-30 days on annual basis. Concerning future changes of annual max total rainfall over 1 day, projections show that a slight increase of about 1-4 mm is anticipated. Finally, regarding the highest annual total precipitation, falling in 3 consecutive days, a negligible increase of about 1-2 mm of rainfall is expected.

Even though the effects of climate change on the primary sector are generally difficult to be distinguished from non-climatic impacts associated with the management of natural resources, there are some basic impacts identified which are related to global change (IPCC, 2007).

According to FAO (2007), the principal climate change impacts on agriculture can be roughly divided into two categories, namely the biophysical impacts and the socio-economic impacts, as shown in Table 6.12. The potential changes in climate and their respective impacts on the agricultural sector for the case of Cyprus are presented in Table 6.13.

Table 6.12. Climate change impacts on the agricultural sector

Biophysical impacts	Socio-economic impacts
Physiological effects on crops, pasture, forests and livestock (quantity, quality)	Decline in yields and production
Changes in land, soil, water resources (quantity, quality)	Reduced marginal GDP from agriculture
Increased weed and pest challenges	Fluctuations in world market prices
Shifts in spatial and temporal distribution of impacts	Changes in geographical distribution of trade regimes
Sea level rise, changes to ocean salinity	Increased number of people at risk of hunger and food insecurity; Migration and civil unrest

Table 6.13. Potential changes in climate and their respective impacts on the agricultural sector in Cyprus

Potential climate changes	Impacts
Increased Temperature	<ul style="list-style-type: none"> - Reduction of crop suitability and productivity - Changes in crop quality - Increased challenges of weeds, crop pests and diseases - Increased water requirements for irrigation - Water scarcity intensification - Water quality deterioration - Intensification of desertification
Decreased Precipitation	<ul style="list-style-type: none"> - Decreased crop productivity - Intensification of desertification - Decreased soil fertility
Increase of atmospheric CO₂	<ul style="list-style-type: none"> - Increased biomass production and increased potential efficiency of physiological water use in crops and weeds - Modified hydrologic balance of soils due to C/N ratio modification - Changed weed ecology with potential for increased weed competitive crops - Increased water use efficiency of some plants and as a result altered competitive interactions of species - Changes in the distribution of animal species
Increase of atmospheric O₃	<ul style="list-style-type: none"> - Crop yield decrease
Sea level rise	<ul style="list-style-type: none"> - Loss of arable land in coastal agricultural areas - Soil salinization in coastal agricultural areas - Salinization of groundwater aquifers resulting in low water quality for irrigation
Increased frequency of extreme weather events (heat waves, droughts, hail, floods)	<ul style="list-style-type: none"> - Crop failure - Damages to crops - Decrease in crop yield - Competition for water between different sectors (irrigation, tourism, domestic etc.) due to extended drought periods - Damage to grain formation - Increase in pests - Heat stress for animals

The extent of climate change impacts varies upon different ecosystems, regions and countries. In warmer regions like the Mediterranean basin, the majority of impacts are likely to have a negative influence, resulting in economic losses, especially significant in areas which are already under pressure due to socio-economic and other environmental problems, for instance water scarcity (EEA, 2008b).

The main direct and indirect impacts presented in the table above were grouped in the following impact categories and analysed in brief below: 1. Crop yield alterations, 2. Soil fertility alteration, 3. Increase in pests and diseases, 4. Damages to crops from extreme weather events, 5. Alterations in livestock productivity, 6. Increase in costs for livestock catering.

1. Crop yield alterations

The increases in ambient CO₂ seem to have positive impacts on plant growth and lengthening of the growing season, through the enhancement of photosynthesis and plant respiration (EAA, 2008a). However, these potential positive impacts, in southern and warmer latitudes are less significant than the potential negative impacts, which include reduced crop yields due to high temperatures, increased water demand for irrigation and reduced water availability due to periods of prolonged droughts, water scarcity, rainfall decrease and increased competition for water between sectors, which will in turn be much more intense (Behrens et al., 2010).

In Cyprus, the anticipated increase in temperature and evapotranspiration, and the decrease in rainfall, as well as their related changes in heat wave days and maximum length of dry spell, will decrease the crop yield.

Furthermore, the projected climate conditions will magnify the already intense water stress circumstances (drought, water shortage problems) on the agricultural sector, provoking crop failure (Bruggeman et al, 2011c). The combination of decreased rainfall and increased drought periods are expected to decrease water availability for irrigation and to increase crop moisture stress and thus further decrease crop yields. In particular, the traditional irrigated farming is the first to receive water cuts during drought years, leading to a significant decrease of the lands covered with annual crops such as vegetables and potatoes.

Bruggeman et al. (2015) used a daily water balance model to estimate agricultural water demand, water productivity and economic returns for all agricultural crop fields in Cyprus, under different policy, economic and climate scenarios. High-resolution gridded meteorological observational data sets (Camera et al., 2014) were used for the 1980-2010 reference period. Statistically downscaled projections of three Regional Climate Models for the medium emission A1B scenario indicated a 1.5–12% decrease in the mean annual rainfall over Cyprus for 2020–2050, relative to 1980-2010 (Camera et al., 2017). Crop plot data for the year 2010 were derived from applications for the Single Area Payment Scheme (Cyprus Agricultural Payment Organization), which is estimated to represent 95% of the crop area in Cyprus. The data set (excluding fallow) had 333,216 plots, covering 124,568 ha. Average annual irrigation water demand for this area increased from 154.9 Mm³ in 1980-2010 to between 160.1 and 163.6 Mm³ for the three models in 2020-2050 (3 - 6% increase). Total rainfed crop production decreased for 2020-2050, as a result of increased water stress, by 1% by 5%, relative to 1980-2010. Index prices were developed for three policy and economic scenarios (optimistic, medium, pessimistic) for crop prices (0.93 – 1.56), fuel (1.2 -1.6) and fertilizer (1.02-1.28), based on 10 global economic models, trends in global crude oil prices and the 2012 World Energy Outlook of the International Energy Agency. Net profits for the medium and optimistic policy and economic scenario for the future were higher than for 1980-2010 for all three climate models. However, the pessimistic scenario showed a 40% reduction in net profits of crop production for all three climate projections. The losses in profit were most severe for the rainfed crops, most of which would become non-profitable.

2. Soil fertility alteration

The principal soil aspects that affect soil fertility and are susceptible to climate change are soil biodiversity, organic carbon content, available soil moisture, erosion, salinization and desertification.

Soil fertility in Cyprus experiences a declining trend in recent years, mainly due to the erosion which has affected specifically the arable land and the land used for permanent crops (MANRE, 2007).

The expected higher temperature and lower precipitation may intensify the loss in soil organic carbon and soil moisture, the reduced water availability and the increase and variations in fires and desertification. It has been shown that the occurred desertification and loss of productive land in Cyprus are being exacerbated in recent past, because of the deterioration of soil quality with the expansion of droughts (IACO Ltd, 2007).

Regarding the fire risk in Cyprus, it is expected to be higher in forested areas, increasing so the risk for extended land erosion and the loss of cultivated areas (Behrens et al., 2010).

A further reduction in surface water availability may lead to the overexploitation and depletion of aquifers, which will result in sea intrusion to coastal aquifers, extended soil salinization and erosion, reducing so the fertility of agricultural land in particular the irrigated farms.

The effects of the degradation and abandonment of agricultural mountain terraces were investigated by Camera et al. (2018) and Djuma et al. (2020). Camera et al. (2018) monitored soil erosion using seven 1-m wide sediment traps, three on standing sections of a drystone terrace wall and four on collapsed sections, in a vineyard in the Troodos Mountains, from December 2015 to November 2017. Nearly half of the soil erosion (43%) occurred during two very intense rainfall events (maximum 30-min intensity exceeding 35 mm/hr), out of the 34 monitored events. Erosion from standing terrace sections was 3.8 less than the erosion from the collapsed sections. The average soil erosion rate was computed to range between 2.4 to 3.2 Mg/ha per year. The results indicate that the projected changes in rainfall extremes can have important implications for soil erosion in the Troodos Mountains.

Djuma et al. (2020) sampled and analysed soil organic carbon (SOC) up to 80-cm depth in 24 paired sites, representing a productive and a neighbouring abandoned terraced vineyard in the Troodos Mountains. The time period of abandonment was derived from aerial imagery of 1963 and 1993. In the top soil (0–10-cm, SOC concentrations were higher in abandoned (1.4% SOC) than in productive sites (0.9% SOC), with a statistical significance level < 0.05. Concentrations were highest (1.6% SOC) in fields abandoned before 1963. However, mean SOC stocks, with coarse fragment correction, were slightly higher for the productive sites (22 Mg/ha) than for the abandoned sites (21 Mg/ha) and were not affected by the time of abandonment (p-value: 0.85). The study indicated that soil erosion processes are likely to reduce SOC stocks in the early stages after terrace abandonment, while recolonization of terraces by natural vegetation can improve SOC concentrations over time.

3. Increase in pests and diseases

Additional risk for crop production, as secondary effects induced by higher temperatures and prolonged growing season, will be posed by pest outbreaks, emergence of new pests and pathogens, weeds cycle acceleration and an increase in the frequency of diseases. There are no sufficient data to asset this issue and further research is needed.

4. Damages to crops from extreme weather events

The increasing trend in the occurrence of extreme weather phenomena will be more frequent and intense in the future, causing more damages to crops yields. In addition, the magnitude of damage caused to crops depends highly on the timing of the cycle of crops when the extreme weather events take place. More frequent, occurrence of dry spells, heat waves, and frost and hail incidents will potentially damage agriculture more than changes in the annual average temperature (Behrens et al., 2010).

Considering the above, damages to crops due to extreme weather events in Cyprus are expected to be further intensified in the future, mainly due to the increase in the number of heat wave days and to a lesser extent due to the increase in drought periods, while the damages to crops due to frosts, are expected to be reduced.

As mentioned earlier, the PRECIS climate projections in Cyprus for the period 2021-2050, indicate increases in the mean number of heat wave days per year (temperature>35°C) up to 34 days, and up to 12 days per year on average in the length of drought periods (precipitation<0,5mm). On the other hand, the mean number of frost nights per year (temperature<0°C) is expected to decrease up to 8 days on average, while the heavy rainfall and flooding events, will slightly decrease as the annual maximum total precipitation over one day shows minor changes in the future.

5. Alterations in livestock productivity

The projected increase in temperatures and heat waves are expected to reduce livestock productivity due to diseases outbreaks and heat stress suffered by animals, causing among others reduction in the feed intake, conception, growth and productivity rates.

In addition, warmer and drier climate conditions may reduce forage production resulting in shortage of animal feed which could modify animal diets and reduce growth and reproduction rates.

Changes in precipitation patterns and in particular the increase in flooding events may also cause the spreading of animal diseases, thus putting additional constraints to livestock productivity (IFAD, 2009).

The most important constraints of the livestock sector in Cyprus encompass the insufficient production of animal feed, as the reduced rainfall and increased drought periods in Cyprus will have also a negative effect on livestock feed productivity.

6. Increase in costs for livestock catering

The livestock sector in Cyprus depends mainly on imports due to the insufficient production of animal feed.

Rising temperatures and decreasing rainfall, resulting in reduced yields of forage crops and increased costs for farmers for providing other sources of feeding.

Increased risk for heat stress and unproductive grazing land during the summer months, as well as, the increase in extreme weather events may lead to increased housing requirements. Increased mechanical ventilation of both housing and transportation for livestock in order to reduce the risk of thermal discomfort in animals and, the risk of spreading of diseases is also expected to increase the cost for livestock catering. Additional research is needed to gather information and data regarding the climate change impact in the sector.

6.3.6.2. Future vulnerability assessment

The future vulnerability of the agricultural sector to climate change impacts is assessed in terms of its sensitivity, exposure and adaptive capacity, based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021- 2050, as follows: 1. Crop yield alterations, 2. Soil fertility alteration, 3. Increase in pests and diseases, 4. Damages to crops from extreme weather events, 5. Alterations in livestock productivity, 6. Increase in costs for livestock catering

1. Crop yield

In general, crop yield is favoured by the positive effect of increased CO₂ concentrations for the majority plants. However, this is counterbalanced by the negative effects, such as the decreased photosynthetic and water use efficiency, induced by the hot and dry conditions as in Cyprus. Crop production, both rainfed and irrigated, is highly sensitive to precipitation as crops, as shown in Figure 6.35.

During the studied period 1988-2008, the lack of water caused an extensive reduction of crop production, with rainfed crops such as cereals, straw and green fodder being mostly affected, with a reduction of 90%, 85% and 87.6% respectively (CYSTAT, 2010).

Considering the percentage of rainfed crops in the total crop production, the exposure of crop yields regarding this indicator, is characterized as moderate.

In addition, the sensitivity of crop production to water availability especially for irrigated crops depends on the water allocation policy of Cyprus under drought conditions (water rationing) and the prioritization of water uses, as their water requirements are the last to be satisfied (WDD, 2011b). In addition, which the loss in irrigated production is mainly due to the reduction in irrigation water supply, whereas the loss in rainfed production is both due to climate change and an overall decrease in agricultural land use (Bruggeman et al, 2011c).

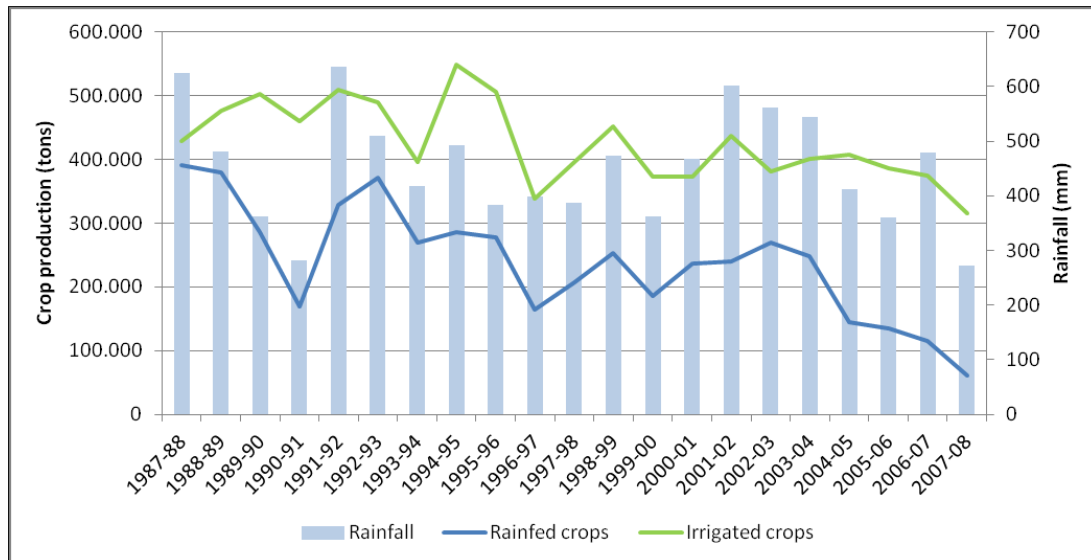


Figure 6.35. Rainfed and irrigated crop production and precipitation during the period 1987/88-2007/8 (CYSTAT, 2010; MSC, 2012)

Consequently, irrigated temporary crops are more exposed to the reduced water availability under drought conditions, and considering their percentage in the total crop production, the exposure of crops to reduced water availability, is characterized as high to very high. The geographical distribution of crops is also linked with reduced water availability and crop yields under climate changes (Figure 6.36).

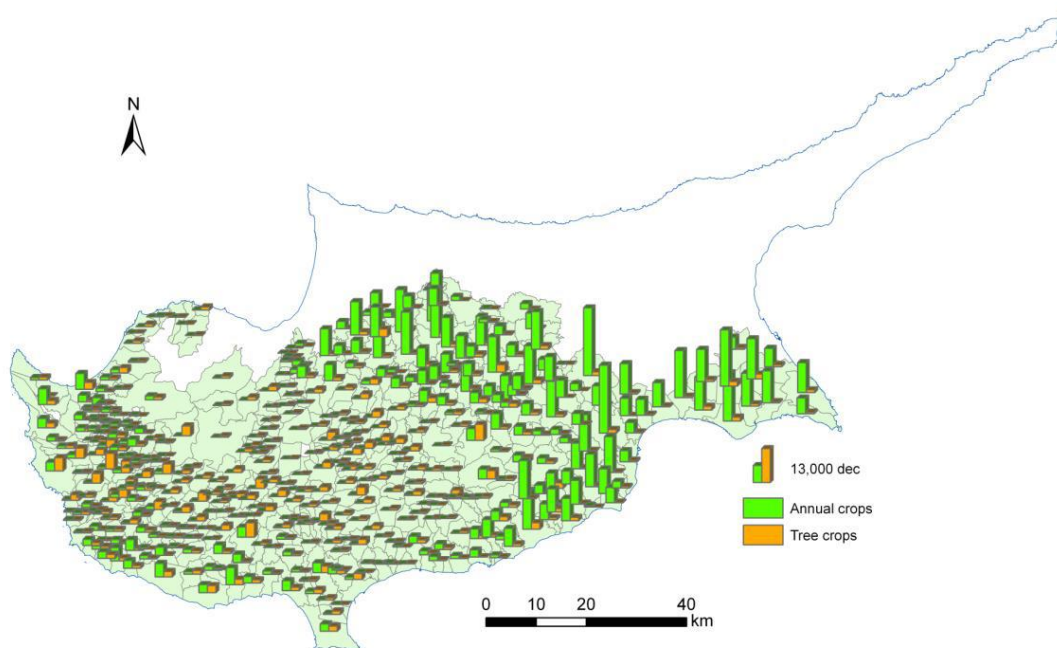


Figure 6.36. Distribution of the annual and tree crops (Bruggeman et al., 2011d)

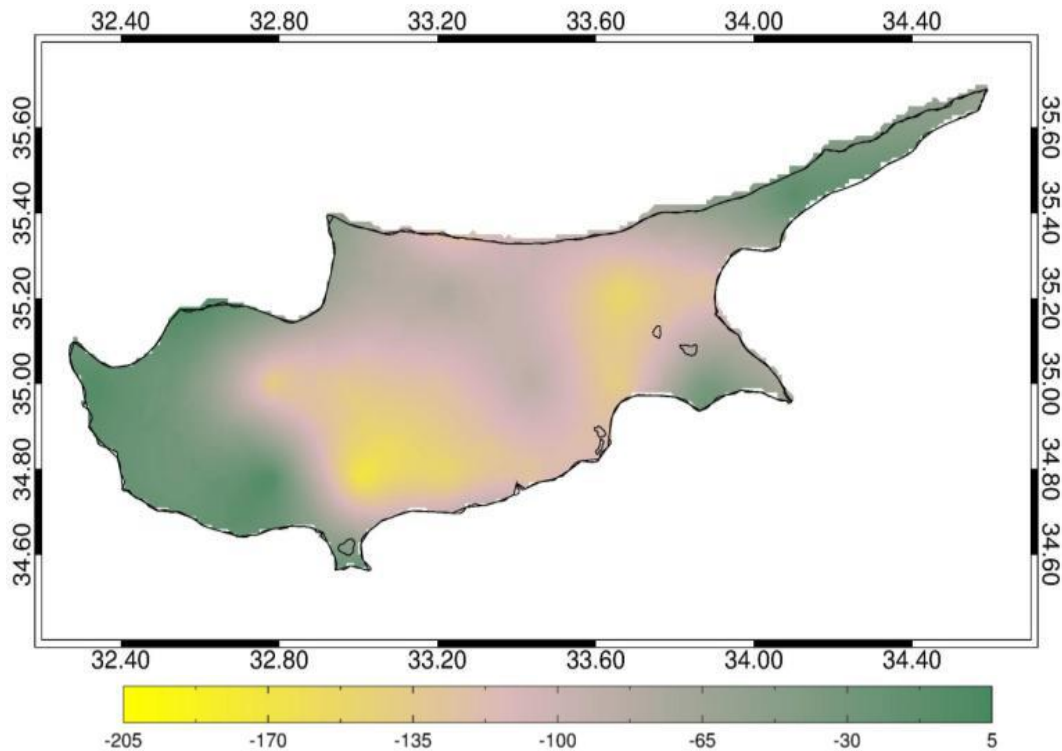


Figure 6.37. Changes in maximum length of dry spell (RR<0.5mm) between the future (2021-2050) and the control period (1961-1990)

The crops located in the mountain areas, although at limited extent, are irrigated only from groundwater resources. Thus, apart from the risk of their overexploitation, they depend on climate parameters such as precipitation and evapotranspiration, as well as on climate-related parameters such as soil moisture and run-off. Therefore, the crops located in the mountain areas very sensitive to climate changes, especially during prolonged drought periods (>1year).

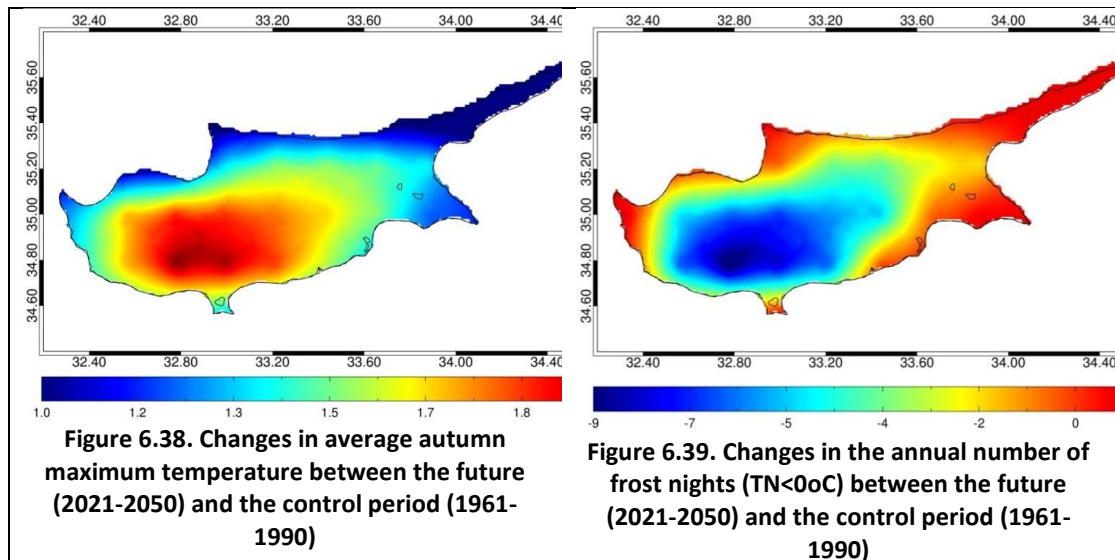
On the other hand, although flat plain areas and coastal regions have less precipitation than mountainous regions, they are irrigated mainly by the Government Water Works, which are also connected to desalination plants. It must be noted that some coastal areas are irrigated with low quality (saline) water from private boreholes.

With climate changes, the aforementioned effects on the crops located at the mountain and coastal areas are expected to be exacerbated, thus making them highly sensitive to climate changes.

Another factor associated with crop yields is the water availability. Although a minor reduction in precipitation of 5% is estimated based on the PRECIS model, the future total dam inflow will be decreased by 23% while the available groundwater resources are estimated to be reduced by approximately 29%.

As far as the length of drought periods in the future (2021-2050) is concerned, the central part of Cyprus will face an increase in the maximum length of dry spell, between 15 -20 days/year in the continental agricultural areas in the eastern part of Troodos Mountain, respectively (Figure 6.37).

The length of the growing season will be influenced mainly by the increase in temperatures in autumn and spring (Ainsworth and Long, 2005) and the decrease in the number of frost days. According to the PRECIS projections in the future period 2021-2050 (Figure 6.38), the expected increase in the average autumn maximum temperature (TX) ranges between 1.0-2.0°C in the northern coasts and south-eastern area, and the in the area around southern Troodos, respectively. A similar pattern is also projected for the spring season, where TX increase is between 1.0-1.8°C. Furthermore, the number of frost nights (temperature<0°C), is expected to decrease up to the maximum 6-9 days in the greater area around central and southern Troodos.



Considering the above, it is highly likely that the length of the growing season will be extended and crops yield on mountains is expected to increase. Therefore, the sensitivity of crop yields to climate change is characterized as very high and the exposure as high.

Assessment of adaptive capacity

The practices applied in Cyprus in order to reduce the impact of reduced crop yields are:

- (a) increasing water availability for irrigation. This is achieved by increasing water availability from Government Water Works, and by applying on-farm practices.
- (b) reducing water demand for irrigation This is achieved through (i) increasing water use efficiency in irrigation (Redistribution of irrigated land, Use of advanced irrigation system, Irrigation scheduling, (ii) reducing run-off (Minimum soil cover, Minimum land management reflecting site-specific conditions, Terracing) and (iii) using less water intensive crops
- (c) increasing crop productivity. The increase in crop productivity is achieved through (i) the application of crop rotation, (ii) fertilization and (iii) using crops more resistant to hot and dry climates.

2. Soil fertility

Soil fertility is sensitive to increasing temperatures as they intensify the loss of soil organic carbon and soil moisture and increase wildfires and desertification. According to the PRECIS model, the change in the average annual maximum temperature (TX) for the period 2021-2050 will increase by 1.0–2.0°C at the eastern and western coastal agricultural area, and in higher elevation areas, respectively.

To sum up, all agricultural areas are expected to be exposed to increased temperatures and especially the mountain areas, followed by the continental lowland agricultural areas and the coastal agricultural areas.

Soils are sensitive to long dry periods along with regular strong seasonal winds as they causes wind erosion. In addition, soil erosion by rain is caused by intense precipitation and river flooding. However, the agricultural land in Cyprus and especially arable land and land used for permanent crops which constitutes approximately 70% of the total agricultural land, is sensitive to erosion mainly due to the intensive cultivation and overexploitation of land resources, which overburden the soil and reduce its productivity.

As for the future changes in droughts and strong winds, affecting the exposure of soils to wind erosion it is mentioned that the maximum increase in the length of dry spell, will be between 15 -20 days/year in the central part of Cyprus (Figure 6.39), while the number of days with mean wind speed greater than 5 m/s will decrease up to 12 days/year. In general, all agricultural areas are characterized by

decreases in strong winds and the exposure to soil erosion by wind in the future due to climate changes will not further intensify.

As regards the future exposure of agricultural land to erosion by rain, since the future changes in the maximum amount of rainwater that falls in a short period of time (1 day in this case) within the year is insignificant, it is expected that the exposure to soil erosion by rain in the future due to climate changes will not be further intensified. The agricultural land located at the coasts, which represents the higher percentage of cultivated land, is mainly irrigated with good water quality from Government Water Works and in lesser degree from private boreholes, becoming so more sensitive to soil salinization due to overexploitation and sea intrusion.

The future changes in precipitation and in the periods of drought, which are associated with the salinization of coastal agricultural land, are expected to be minor and thus the future exposure of crops to the risk of soil salinization is moderate.

Desertification is a result of erosion by wind and rain, reduced soil moisture and chemical degradation of land (e.g. salinization) (IACO, 2007). The combined evaluation of Figure 6.40 and Figure 6.36, showed that the majority of crops cultivated in Cyprus are located in areas which

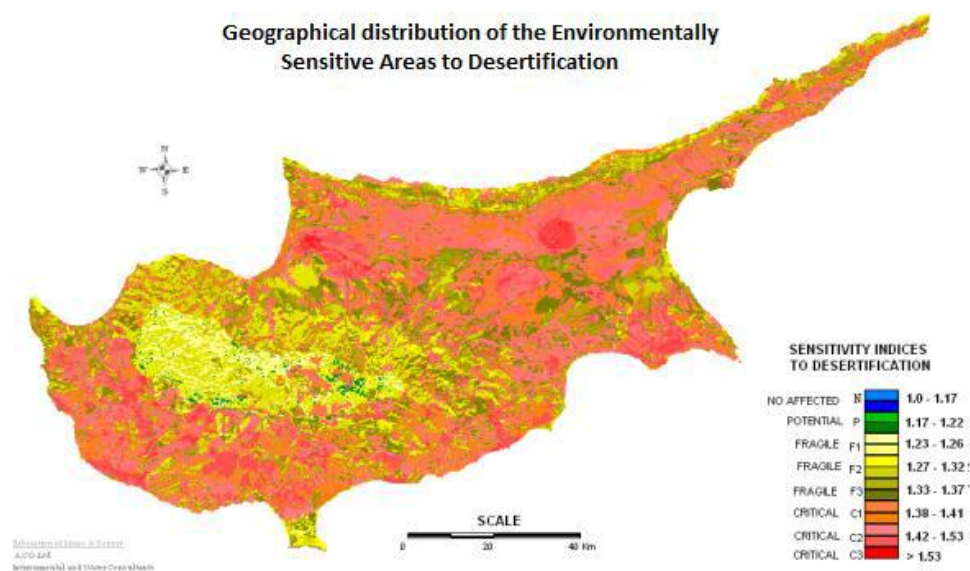


Figure 6.40. Geographical distribution of the Environmentally Sensitive Areas to Desertification (IACO, 2007)

are considered as fragile or critical to desertification, and therefore their current exposure to desertification is characterized as high.

Considering the abovementioned climate change impact indicators on soil fertility, it is concluded that the agricultural sector of Cyprus has moderate sensitivity and high exposure to climate changes.

Assessment of adaptive capacity

Measures to minimize the degradation of arable land are provided, including economic incentives under the Rural Development Programme of Cyprus (2007-2013) such as for the use (i) mechanical instead of chemical destruction of weeds, (ii) integrated production management and (iii) organic production.

Additionally, guidance and technical support is provided to farmers regarding salinity and infiltration problems, irrigation management methods for overcoming them, as well as a plethora of measures and different approaches which could be employed by farmers for mitigating risk of reduced soil fertility. Thus, the current adaptive capacity of Cyprus' agriculture towards this impact is considered as limited to moderate.

3. Pests and diseases

The assessment of the sensitivity and exposure of the agriculture in Cyprus to pests and diseases due to climate changes is not yet possible, because of the lack of data. Further research is needed regarding the number of pest outbreaks, the areas covered by weeds, the recorded incidents of plant diseases as well as the exposure of crops to climate changes and other aspects.

Assessment of adaptive capacity

The measures that have been undertaken in Cyprus to support farmers in order to reduce the proliferation of new pests and diseases are categorized into four groups: (a) promotion of indigenous and locally adapted plants and animals, (b) development of an Integrated Pest Management Strategy, (c) application of crop rotation and (d) resistance enhancement of existing plants and animals against pests and diseases.

However, in absence of data on the magnitude of the impact of climate changes on pests and diseases on crops, the adaptive capacity towards this impact cannot be evaluated.

4. Damages to crops from extreme weather events

The sensitivity of crops to extreme weather events is evaluated based on the extent of the damage caused in the recent past, in terms of crop species and type of extreme event, while the exposure is assessed based on the current and future frequency of the extreme climatic events causing damages to crops in Cyprus. The major losses to crops, because of these damages, for the period 1978-2009 is possessed by cereal and dry fodder crops, followed by potato crops deciduous crops, vines with 9.2% and citrus as illustrated in Figure 6.41. The common damaging extreme climatic event is hail, since when it occurs almost all crops are affected with extensive damages (Ioannou, 2010).

Therefore, it is estimated that the sensitivity of crops cultivated in Cyprus to extreme climatic events is high.

With regard to exposure it was observed that compensations for damages by hail events were paid every year from the establishment of the Agriculture Insurance Organisation in 1978 until 2007 with a frequency of occurrence 100%, followed by compensations for frosts with a frequency of occurrence 83%, droughts with 70%, heatwaves and windstorms with 53% each and floods with 47%.

Considering the above and their related future climate changes was mentioned earlier, the exposure of the agricultural sector of Cyprus to extreme climatic events is characterized as moderate to high.

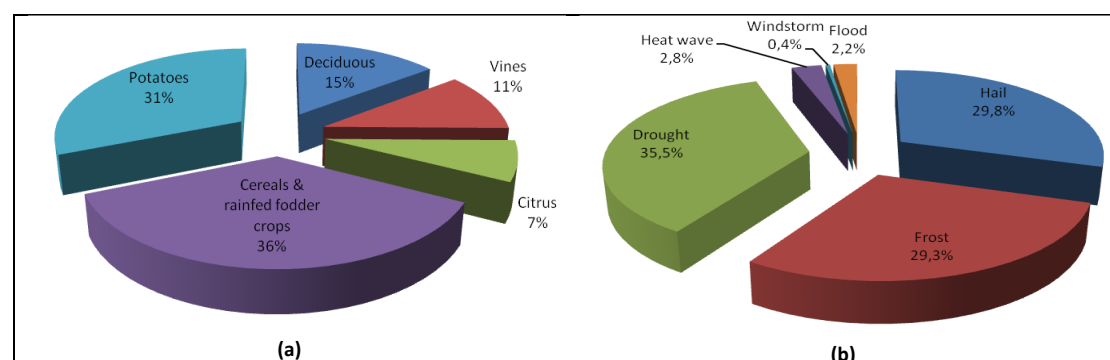


Figure 6.41. Contribution of the compensations (a) paid to main crops affected and (b) paid for the main extreme weather events to the total compensations provided in Cyprus during the period 1987-2007 (AIO, 2008a)

Assessment of adaptive capacity

For the protection of crops against droughts, a plethora of measures have been undertaken or promoted, in order to increase water availability for irrigation and reduce run-off. However, in spite of

the measures, water demand for irrigation during drought events is not fully met in most cases, and thus the adaptive capacity of crops to droughts is considered limited to moderate.

In general, the abovementioned measures for the protection of crops from extreme events are applied on farm level and hence their implementation depends on the private initiative of farmers. Considering the above the adaptive capacity to this impact is characterized as limited to moderate.

5. Livestock productivity

There are no available data for the determination of the sensitivity and exposure of livestock productivity in Cyprus to climate changes. Further research is needed concerning for example, the animal species which are more resilient to increased temperatures and heat waves, production of animal feed, the reduction of incidents of diseases outbreaks etc.

Assessment of adaptive capacity

Catering for animal welfare under adverse weather conditions can be enhanced by increasing the amount of shade and shelter or by keeping livestock indoors, such as shelterbelts, planting tall, fast-growing, trees on the southern edge of pastures. The implementation of this measure is promoted through the Rural Development Programme with the provision of economic incentives for the plantation of hedgerows of forest trees.

Another measure adopted, which also contributes to the increase of the sector's adaptive capacity, is the establishment of a gene bank for animal species in order to protect genetic diversity. Guidance and advice is also provided by the Ministry of Agriculture, Natural Resources and Environment of Cyprus to farmers, in increasing of animal productivity by promoting improved breeding and management methods, improving veterinary services for animal disease control and treatment, local production of animal feed, and upgrading of farm units through mechanization and enhancing their management skills.

However, in absence of data on the magnitude of the impact of climate changes on livestock productivity, the adaptive capacity towards this impact cannot be evaluated.

6. Costs for livestock catering

There are no available data for the determination of the sensitivity and exposure of costs for livestock catering in Cyprus to climate change. Further research is needed concerning the increase in costs for livestock catering during extended warm periods in Cyprus, the deficit in local animal feed production and the excess costs for importing animal feed, for providing housing, ventilation, etc.

Assessment of adaptive capacity

The measures for enhancing adaptive capacity to increased costs for livestock catering are related mainly to the financial support provided by the Rural Development Programme of Cyprus for improving outdoor and indoor conditions for livestock.

In absence of data on the magnitude of the impact of climate changes on the costs for livestock catering, the adaptive capacity towards this impact cannot be evaluated.

6.3.6.3. Assessment of overall vulnerability

The overall future vulnerability of the agricultural sector of Cyprus to future to climate changes, in terms of sensitivity, exposure, adaptive capacity on the based on the available data for the above-mentioned indicators are quantified as shown in Table 6.14. The first vulnerability priority of the sector is the impact of climate changes on crop yield, which is expected to be significantly reduced. The second priority of the sector regarding its vulnerability to climate changes is related to the damages caused to crops due to extreme weather events, taking into account the magnitude, frequency and intensity of these effects on crops, especially of droughts and heat waves. The last priority refers to the impact of

climate changes on soil fertility, is expected to magnify the existing deterioration. For the rest of the identified impacts, no evaluation took place due to lack of sufficient data.

Table 6.14. Overall vulnerability assessment of the agricultural sector in Cyprus to climate changes

Impact	Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Crop yield alterations	Very high (7)	High (5)	Limited to Moderate (2)	Moderate to high (3.9)
Soil fertility alterations	Moderate (3)	High (5)	Limited to Moderate (2)	Limited to Moderate (1.9)
Increase in pests and diseases	Not evaluated	Not evaluated	Not evaluated	---
Damages to crops from extreme weather events	High (5)	Moderate to high (4)	Limited to Moderate (2)	Moderate (2.5)
Alterations in livestock productivity	Not evaluated	Not evaluated	Not evaluated	---
Increase in costs for livestock catering	Not evaluated	Not evaluated	Not evaluated	---

6.3.7. Water resources

Freshwater resources, their systems and management are strongly depended on climate changes such as increases in temperature, sea level and precipitation variability (Kundzewicz et al., 2007), with a potential of high vulnerability not only for water resources but also to human societies and ecosystems as a consequence (Bates et al., 2008).

Water resources are closely interrelated with climate as the physical processes, through which the water cycle takes place, strongly depends on climate factors. Thus, the processes of evaporation, condensation, precipitation, infiltration, runoff, and subsurface flow strongly dependant on climatic factors such as temperature, radiation, sea level rise, vapour pressure and wind. In addition, climate affects the soil moisture and consequently the infiltration of water to groundwater bodies. Extreme climatic events such as droughts, heavy rainfall and flooding hamper water storage, resulting in significant water losses and deterioration of water quality. Increased temperatures and decreased precipitation lead to increased evapotranspiration, condensation and eutrophication, while sea level rise threatens coastal groundwater bodies with salinization.

Cyprus is already below the water scarcity threshold of 1,000 m³/year per capita (Bruggeman et al., 2022). The combined effect of precipitation declines and higher temperatures will further challenge the already limited water resources of Cyprus. The increasing population, changes in the standards of living, and tourist flows, especially during summer, will have a strong impact on the demand for water and food. Therefore, the water resources and agriculture sectors are considered to be highly vulnerable to the impacts of climate change. This is the case for both surface and groundwater resources in most of the region that are projected to be further limited under climate change conditions and particularly when considering pathways of strong radiative forcing (Chenoweth et al., 2011). Climate change and heat extremes will mainly affect mainly tomato, grapevine, and olive tree, whose growing cycle takes place during summer (Papadaskalopoulou et al., 2020). By contrast, crops covering autumn-winter season, such as potato, barley, and wheat, are expected to partially avoid the harsh summer conditions, but still be impacted significantly by rainfall deficits.

The water resources of Cyprus are considered vulnerable to climate changes, since they are limited due to the semi-arid climate that characterizes this Mediterranean island. Freshwater availability depends almost entirely on rainfall which is highly variable with frequent prolonged periods of drought. The Republic of Cyprus in order to satisfy drinking water and irrigation demand, continue deliver a number of water works for the exploitation of the available freshwater resources (both surface and groundwater) and no- freshwater resources (sea water, recycled water). According to the standards of the International Commission of Large Dams (ICOLD), Cyprus is the first in Europe regarding the number of dams per square kilometre, having 108 dams and reservoirs with a combined storage capacity of 332 Mm³ (WDD, 2011a).

The water sector currently experiences both quantitative and qualitative pressures from several environmental and socio-economic activities and practices. In specific, the impact, vulnerability and adaptation assessment for water resources in Cyprus, regarding the observed climate changes in recent past, showed the following key vulnerabilities: i) Water availability for irrigation, ii) Frequent occurrence of droughts, iii) Groundwater quality, and iv) Water availability for domestic water supply.

These impacts are expected to worsen in future period 2021–2050 as already projected by the PRECIS and ENSEMBLES regional climate models with respect to the control period 1960-1990.

6.3.7.1. Future impact assessment

The climatic factors that may have an impact on the water resources of Cyprus include the decreased rainfall and increased temperature, droughts, fluctuations in intense precipitation events. According to PRECIS projections for the future period 2021-2050, the average annual temperature in Cyprus is expected to increase by 1-2°C, while the average annual total precipitation will be slightly decreased with seasonal variations. The maximum length of dry spells (precipitation < 0.5mm) is expected to increase by 10 to 12 days on average, while the heat wave days (temperature > 35°C) will be increased averagely by 10-30 days on annual basis, depending on the region. Concerning future changes of annual max total rainfall over 1 day, PRECIS projections show that a slight increase of about 1-4 mm is anticipated. Finally, regarding the highest annual total precipitation, falling in 3 consecutive days, a negligible increase of about 1-2 mm of rainfall is expected.

The potential changes in climate and their respective impacts on water resources for the case of Cyprus are presented in Table 6.15.

Table 6.15. Relationship between climate changes and impacts on the water sector

Potential climate changes	Impact
Increased temperature	<ul style="list-style-type: none"> - Increased water temperatures - Increase in evaporation
Increased evapotranspiration	<ul style="list-style-type: none"> - Water availability reduction - Lower replenishments rates (lower groundwater levels) - Salinisation of water resources
Decreased precipitation, including increased droughts	<ul style="list-style-type: none"> - Decrease in runoff - More widespread water stress - Increased water pollution and deterioration of water quality due to lower dissolution of sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt - Decreased rates of groundwater recharge - Salinisation of coastal aquifers due to overpumping motivated by insufficient water supply
Increase in interannual precipitation variability	<ul style="list-style-type: none"> - Increase in the difficulty of flood control and reservoir utilization during the flooding season
Increase in heavy precipitation events	<ul style="list-style-type: none"> - Flooding - Adverse effects in quality of surface water and groundwater - Contamination of water supply - Lower replenishment rates in the aquifers of the mountain areas due to steep slopes
Increase in surface water temperature	<ul style="list-style-type: none"> - Increased algae growth and reduced dissolved oxygen levels in water bodies which may lead to eutrophication and loss of fish - Prolonged lake stratification with decreases in surface layer nutrient concentration and prolonged depletion of oxygen in deeper layers - Changes in mixing patterns and self-purification capacity - Salinisation of water resources
Sea level rise	<ul style="list-style-type: none"> - Salinisation of coastal aquifers (minor effect)

The future impacts of climate change on water resources are analysed in brief under the following categories: 1. Decrease in water availability, 2. Deterioration of water quality, 3. Increase in flood frequency and intensity, and 4. Increase in drought frequency and severity.

1. Decrease in water availability

Climate changes such as changes in temperature, precipitation patterns and snowmelt is projected to lead to major changes in yearly and seasonal water availability across Europe. More specifically, southern and south-eastern regions, which already suffer most from water stress, will be particularly exposed to reductions in water resources. Decreased summer precipitation results to a reduction of water stored in reservoirs fed with seasonal rivers. There is very high probability (80% confidence) that many regions in the Mediterranean basin will suffer a decrease in surface and groundwater resources due to climate change (Kundzewicz et al., 2007).

According to PRECIS projections for the future period 2021-2050, the average annual temperature in Cyprus is expected to increase by 1 - 2°C, while annual precipitation will have minor changes and discerned seasonal changes in precipitation. The total winter and autumn precipitation present decrease of 10-20mm per year and, a minor increase in summer precipitation reaching 5 mm on average. Considering this, increased temperatures play a more significant role in potential future changes in water availability.

The main natural source of water in Cyprus is rainfall. The rainfall is unevenly distributed geographically with the highest in the two mountain ranges and the lowest in the eastern lowlands and coastal areas.

The climate changes are anticipated to have also an effect on evapotranspiration as well as on soil moisture, infiltration and runoff, together with the increase in water demand will in turn have a significant effect on water availability.

In general, evapotranspiration tends to decrease with reduced precipitation, but it increases with higher temperatures. It is estimated that during the period 1971-2000, 86% of rainfall returned to the atmosphere as evapotranspiration. The KNMI model predicted a general decrease in annual evapotranspiration ranging from -3% to -7% for the period 2021-2050 compared to the period 1970-2000 (CYPADAPT project).

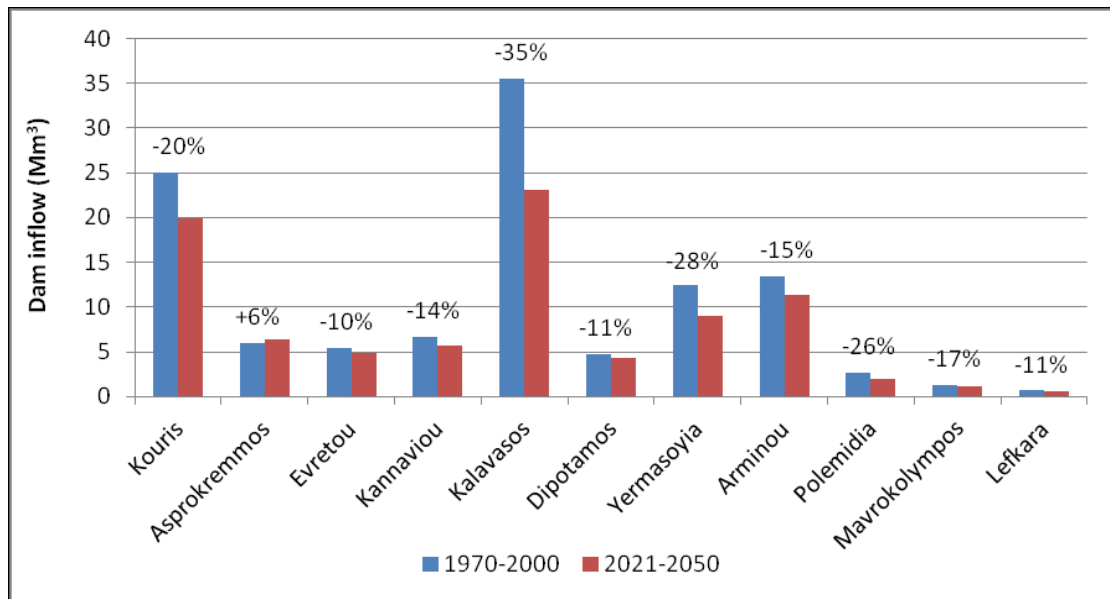
As mentioned above, the changes in evapotranspiration and in the heavy rain events are expected to have an additional impact on river flows and thus the quantity and quality of surface water, inbounded in dams and reservoirs.

The average annual inflow to the dams during the period 1971-2000 was approximately 130Mm³, while the respective future total dam inflow in the period 2021-2050 is expected to decrease by 23%, while the total average precipitation, according to PRECIS, is estimated to decrease only by 5%. In Figure 6.42 the change in the inflow to the main dams of Cyprus for the period 1970-2050 is presented.

The reduction in precipitation and the increase in evaporative demand will also lead to a reduction in groundwater levels. Also a change in the amount of effective rainfall and in the duration of the recharge season will alter recharge rates (Kundzewicz et al., 2007). In addition, high intensity precipitation favours runoff against groundwater recharge. Regarding future changes in high intensity precipitation, minor increases ranging from 2 to 5 mm in the annual maximum total precipitation over one day are expected in the future period (2021-2050) according to PRECIS.

The available groundwater resources in the future, as mentioned above, are estimated to be reduced by 23% on average. Again, it must be mentioned that this method does not account for future changes in runoff which could increase runoff and water losses and decrease water storage.

At this point, it has to be noted that, the water availability to rainfall continues, beside the substantial contribution of the desalination plants to domestic water demand, and of the recycled water to the agricultural demand. However, the existing and planned investments for the supply of non-freshwater resources are expected to minimize the future marginal difference between water supply and demand.



* 1970-2000: Actual dam inflow (WDD, 2011a), 2021-2050: Projection

Figure 6.42. Change in inflow to the main dams of Cyprus for the period 1970-2050

2. Deterioration of water quality

According to the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), it is believed that higher water temperatures, increased precipitation intensity, and longer periods of low flows exacerbate many forms of water pollution. However, there is no evidence for climate related trend in water quality (Parry et al., 2007).

Surface water bodies in Cyprus are mainly the storage reservoirs with no inflows during the summer months. As a result, there is no dilution and in combination with the high evapotranspiration rates, their quality will be deteriorated. In addition, the increasing temperatures enhance eutrophication rates, stratification and low levels of dissolved oxygen.

A trend in water quality deterioration is mainly observed in groundwater resources, due to the low recharge rate in combination with the low permeability of some sedimentary aquifers in Cyprus, which results in the dissolution of soluble salts and the increase in salinity (WDD, 2008). The rapid urbanization in various parts of Cyprus during the last 30 years, the uncontrolled waste discharge, the excessive use of fertilizers and pesticides, the overexploitation of many coastal aquifers gradually deteriorated the quality of Cyprus' groundwater.

The future climate changes that are anticipated to intensify the impact of water quality deterioration are the changes in water temperature, (related to the changes in air temperature), low flows or dry spells. According to PRECIS projections, for the future period 2021-2050 with respect to the control period 1960-1990, the annual maximum total precipitation over one day show minor increases ranging from 2 to 5 mm on average, while the average annual temperature in Cyprus is expected to increase by 1-2°C. As far as the periods of low flows or dry spells in the future (2021-2050), it is projected that there will be a range of changes from slight decreases to an increase of up to 12 days/year on average.

3. Increase in flood frequency and intensity

According to the IPCC, increases in the intensity of precipitation, may result in more frequent and hazardous flooding events. In particular, flash and urban floods, triggered by local intense precipitation events, are likely to be more frequent throughout Europe (Christensen and Christensen, 2007; Kundzewicz et al., 2006)

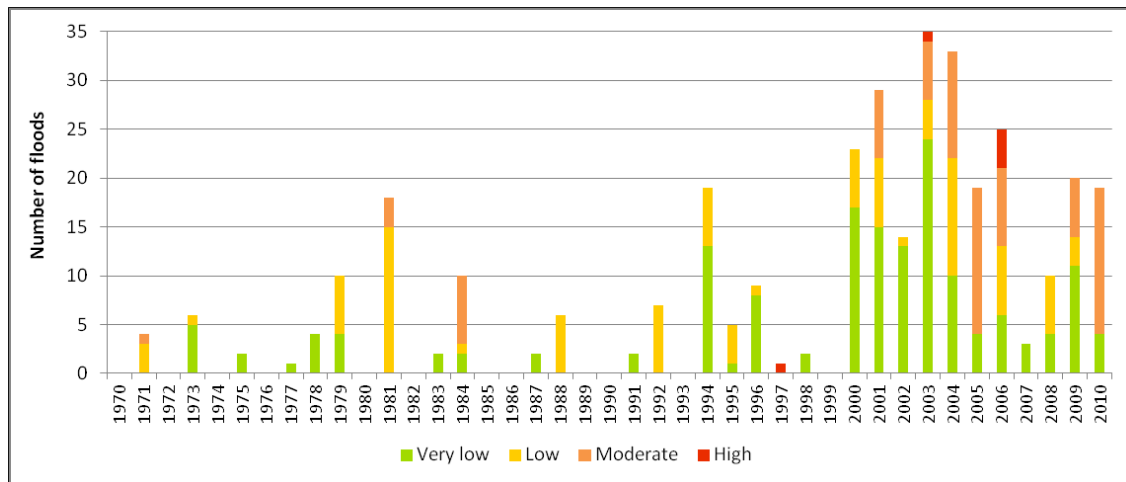


Figure 6.43. Number of flooding events per year in Cyprus (1971-2010) (WDD, 2011d)

Cyprus in spite of the fact that is characterized by long and frequent dry periods, also suffers from flooding events. As illustrated in Figure 6.43, the frequency of flooding events has increased considerably during the period 2000-2010 with respect to the period 1970-2000, as 61% of the total flooding events refer to that period.

In addition, the related hazard for each flooding event (ranked very low, low, moderate, high) in terms of adverse consequences for human health, the environment, cultural heritage and economic activity are presented.

Although a minor increase in the precipitation intensity is projected in the future, it is expected that it will further intensify the phenomenon.

4. Increase in drought frequency and severity

Droughts affect significantly both the water availability and water quality. In the future period 2021-2050, the impact of droughts will be intensified, since according to the PRECIS results the length of the drought periods is projected to increase up to 12 days/year on average.

In a study of the European Commission (2008) Cyprus is registered among the areas with highest frequencies of droughts in Europe during the period 1976 to 2006, with a large part of its territory being affected whenever droughts occurred. In Cyprus, droughts may last one or several years, the most critical of which was in the summer of 2008, with four consecutive years of low rainfall (EEA, 2010a). As can be seen in Figure 6.44, the years with precipitation above normal appear to decline, while many years with precipitation below normal were observed during the last decade with the year 2007-08 being characterized as a year of severe drought (<70% normal) and 2005-06 as a year of drought (71-80% normal).

4. Baseflow

Baseflow, which is the contribution of groundwater systems to streamflow, plays an important role in maintaining aquatic ecosystems and stream water quality. Bruggeman et al. (2022b) analysed the effects of decreasing rainfall on streamflow and baseflow for 21 watersheds in Cyprus. The streams originate from the Troodos Mountain massif, which forms a complex, fractured aquifer system, consisting of mantle, plutonic, intrusive and extrusive ophiolite rocks. Daily streamflow and rainfall over the watershed areas was analysed for 35 hydrologic years, from 1980/1981 to 2014/2015. The 21 gauged watersheds, which are monitored by the Water Development Department, range in area between 5 and 110 km². Baseflow was estimated using the USGS code PART. Baseflow indices for the past 35-years averaged 0.74 and ranged between 0.50 and 0.96, indicating that the majority of the streamflow water resources originate from baseflow. Linear and power relations between annual rainfall and streamflow and between annual rainfall and baseflow for the 21 watersheds were statistically significant, based on the F-test ($p < 0.05$). Power relations showed generally a better fit than

the linear relations, but the differences in the F-statistic and the coefficient of determination (R2) were small. A 10% reduction in average annual rain resulted in an average streamflow reduction for the 21 watersheds of 27% with the use of linear relations and 44% with the use of power relations. Similarly, baseflow was, on average, reduced by 26% (linear) and by 43% (power). Under a 30% reduction in rainfall, streamflow was, on average, reduced by 80% (linear) and by 74% (power), whereas baseflow reductions averaged 78% (linear) and 72% (power). The empirical analysis showed that under our changing climate, relative reductions in streamflow and baseflow can be expected to be more than double the relative reductions in rainfall. Process-based hydrologic modelling research is ongoing to improve our understanding of these substantial decreases in our water resources under climate change.

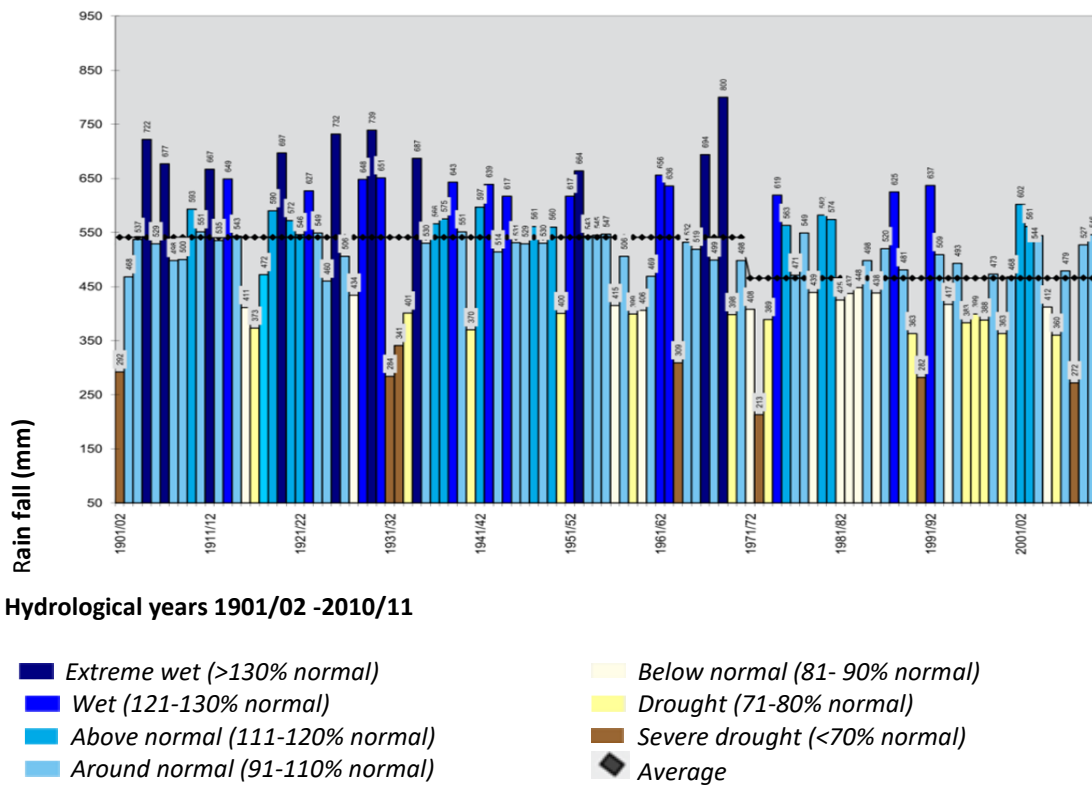


Figure 6.44. Mean annual precipitation in Cyprus (area under Government control) (WDD)

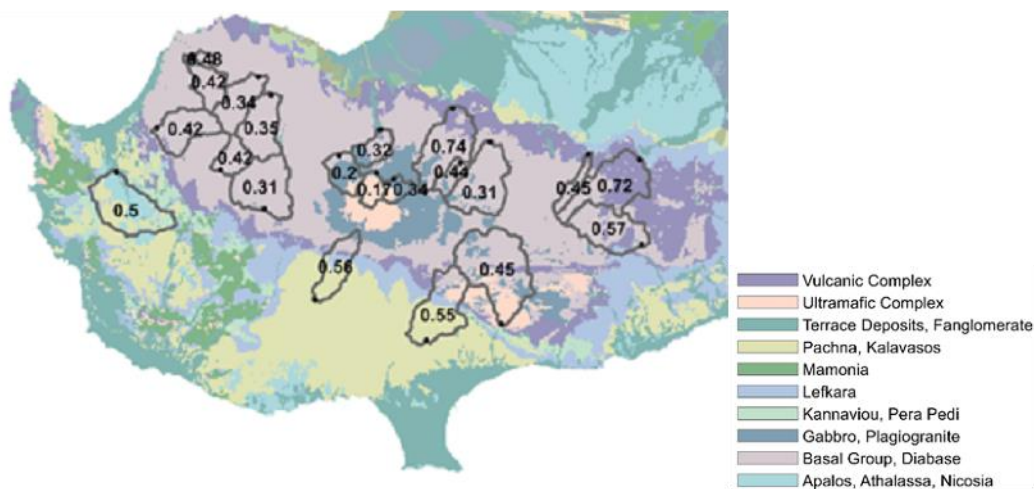


Figure 6.45 Reduction in average annual baseflow (fraction) under a 10% reduction in rainfall, derived from power relations, for 21 watersheds in Cyprus (Bruggeman et al., 2022b).

6.3.7.2. Future vulnerability assessment

The future vulnerability of water resources to climate change impacts is assessed in terms of their sensitivity, exposure and adaptive capacity, based on the available quantitative and qualitative data for Cyprus and the climate projections for the period 2021- 2050. The vulnerability is assessed for each of the follow impact categories: 1. Water availability, 2. Water quality, 3. Floods, 4. Droughts.

1. Water availability

The sensitivity and exposure of water availability to future climate changes in Cyprus is assessed by the sensitivity of runoff/ dam inflow to changes towards the rainfall and the consequent flow variability, and by the degree of exposure to limited water supply. Additional exposure to pressures, imposed on freshwater resources by non-climatic factors, such as water demand and groundwater overexploitation also increase the vulnerability of the sector.

The relationship between rainfall and dam inflow for the future period 2021-2050, based on PRECIS projections was compared to the respective data for the period 1971-2000. The results showed: i) A decrease of 23% in the future average total dam inflow, although the average precipitation decrease is only 5%. As an example, the above relation for the catchment of the Kouris dam is given in Figure 6.46, and ii) A high variability of dam inflow, indicating so a high sensitivity of Cyprus surface water resources to climate changes. The magnitude of exposure for all the 15 main dams in Cyprus ranges from -35% to +6% in the future period 2021-2050in comparison with the period 1970-2000.

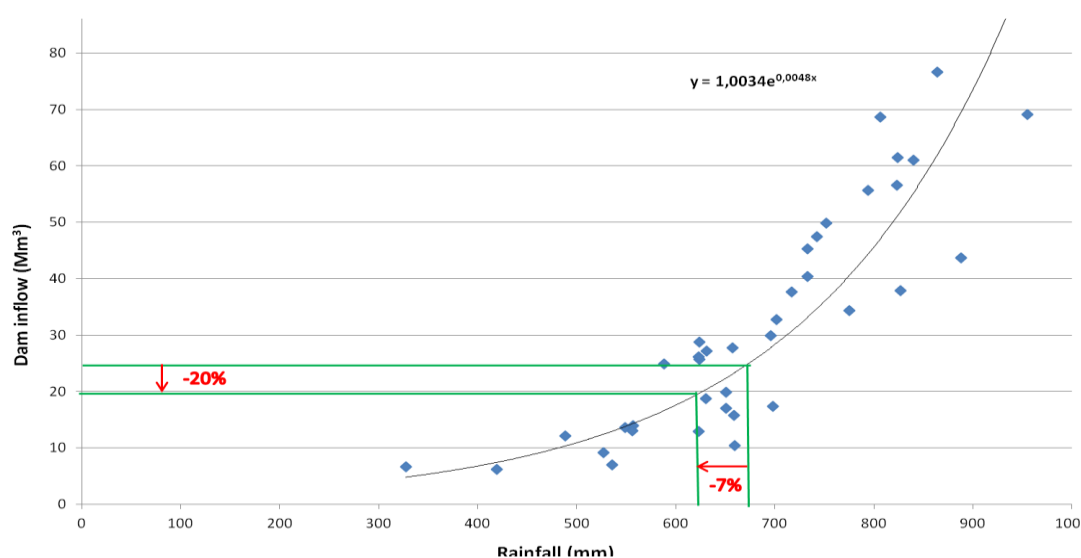


Figure 6.46. Relation between annual precipitation and annual inflow to the catchment area of the Kouris dam for the period (2021-2050)-(1970-2000)

In the recent past, the direct climate change effects observed include the diminishing precipitation and increased evapotranspiration with consecutive years of drought, which led to the depletion of surface water stored in reservoirs and the overexploitation of many aquifers especially for the irrigation of the agricultural land. The decreasing trend in ground water levels is expected to continue in future, and given that a large percent of groundwater bodies already being exposed directly or indirectly to climates changes (WDD, 2008, WDD 2011a) the Cyprus' groundwater resources exposure to climate change characterized high.

Freshwater stress, in terms of both quantity and quality, due to the decreased quantity of available freshwater resources will be worst in the future period 2021-2050 in comparison to the period 200-2010 as indicated from the following estimated indicators:

- The estimated current and future Water Stress Indicator per capita (WSI) was 284 m³/c/y and 195 m³/c/y respectively, both of which are considered very low, indicating that it is not possible for the case of Cyprus to rely exclusively on freshwater resources in the current situation and even more in the future

- The Water Availability Index, WAI is estimated to be approximately -0.26 and -0.1 respectively, indicating that the demand is higher than the availability of freshwater sources and that this inadequacy will be magnified in the future.
- The Water Exploitation Index (WEI) of Cyprus for the year 2007 was 64%, which is by far the highest WEI value among the European countries (EEA, 2010c). A WEI above 20 % implies that a water resource is under stress and values above 40 % indicate severe water stress and clearly unsustainable use of the water resource (Raskin et al. 1997).

Water stress is often related to the deterioration of fresh water resources in terms of both quantity and quality (Hochstrat and Kazner, 2009). Already stressed water resources are considered more vulnerable to climate changes. The difficulty facing Cyprus in order to meet water demand either for satisfying drinking water supply or for other purposes such as agriculture, tourism and industry, due to water stress, indicates the sensitivity of the sector to climate changes.

Following, the indicators used for the quantification of future water stress caused by the decreased quantity of available freshwater resources in Cyprus are presented. It is noted that, these indicators refer exclusively to the exploitation of freshwater resources, while non-freshwater resources (desalinated water, recycled water) are not taken into account

Already stressed water resources are considered more vulnerable to climate changes. The projected decreased precipitation and increased evapotranspiration due to future temperature increase will affect negatively the water availability, while the increase in demand due to population increase and the rising of living standards added an extra pressure in the already limited freshwater resources.

Taking into consideration the above, water availability is considered to have very high sensitivity and very high exposure to current and future climate changes.

Assessment of adaptive capacity

In order to combat this gap, between the increasing demands for water and the reducing water supply, due to the impacts of climate change, several adaptation measures, plans and water works have been implemented or planed by the Government. The Programme of Measures defined in the Cyprus River Basin Management Plan includes inter alia measures which are expected to reinforce Cyprus' adaptive capacity to the decreasing availability of freshwater resources and thus to climate change, are presented in Table 6.16.

Table 6.16. List of measures to adapt Cyprus' water management to climate change impacts

Adaptation measures	Implemented	Planned
Measures to increase Fresh water supply		
Reservoirs	X	
Inter-basin water transfer	X	
Artificial recharge of aquifers	X	X
Water import	X	
Diversification of water resources utilisation		
Water reuse	X	X
Desalination	X	X
Stormwater harvesting		X
Measures to decrease water consumption		
Replacement of networks	X	X
Water allocation/cuts	X	X
Use of water meters	X	X
Land consolidation	X	X
Increasing efficiency of irrigation	X	X
Control groundwater abstractions	X	
Changes in crop patterns		X
Awareness raising campaigns	X	

Economic/legal instruments		
Subsidies	X	X
Water pricing	X	X
Over consumption penalties	X	X
Other instruments		
Improving forecasting, monitoring, information -alert system	X	X

Many of the measures adopted have already alleviated the problem of water scarcity. Thus, the domestic water supply is continuous with the supplement of desalinated water. As for the future situation is concerned, the sum of the average estimated freshwater and non-freshwater resources for the period 2021-2050 (341Mm³) is expected to fully satisfy future water demand from all sectors. However desalinated water is distributed mainly in the urban centers of Cyprus through Government Water Works (GWW), while other areas, such as the mountain communities, depend solely on freshwater resources (mainly groundwater) for meeting their drinking water needs (WDD, 2009a).

As shown in Figure 6.47a, total water use efficiency in Cyprus rose from 65% in 1995 to 82% in 2005-2010, placing the island among the first two countries as regards water use efficiency (Plan Bleu, 2011).

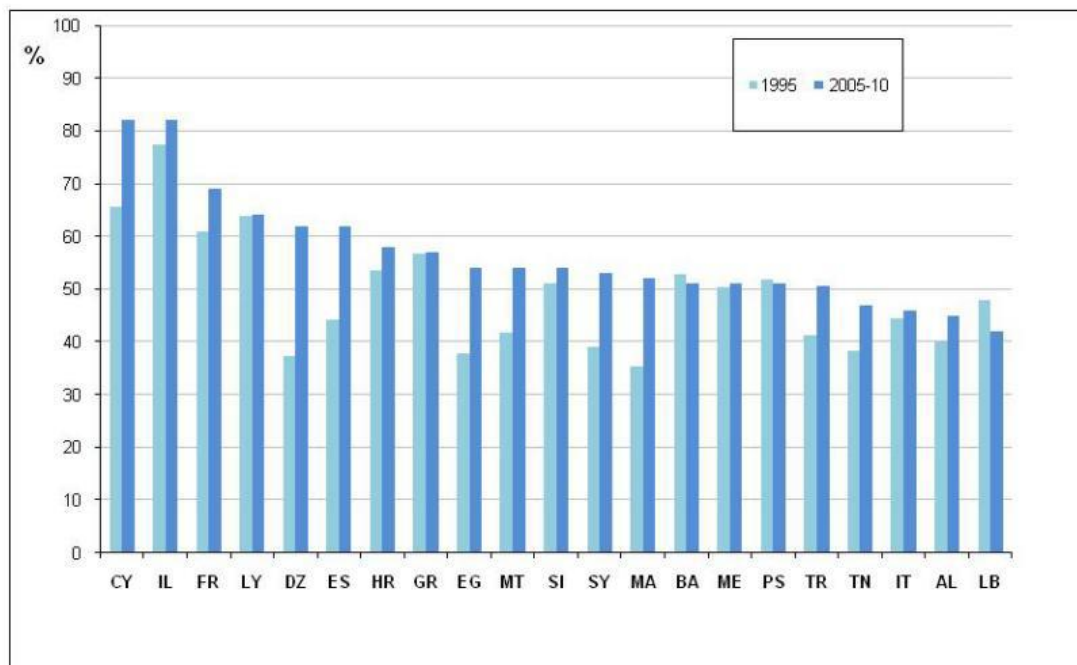


Figure 6.47a. Total water use efficiency in Mediterranean countries (1995, 2005-2010) (Plan Bleu, 2011)

The future adaptive capacity to water availability for domestic water supply in the plain and coastal areas, and in the mountain areas, is considered to be high to very high, and limited to moderate, respectively.

On the other hand, the measures applied have not yet managed to fully satisfy water demand for irrigation as agriculture constitutes the main water consumer in Cyprus. In addition, water is not evenly distributed whether it is freshwater or recycled water. In particular, recycled water for irrigation is distributed only in the plain and coastal areas. While the irrigation in mountain areas depends on the water available in the storage reservoirs which are of limited capacity and during drought periods their reserves are depleted, and on private boreholes, thus resulting in the overexploitation of aquifers.

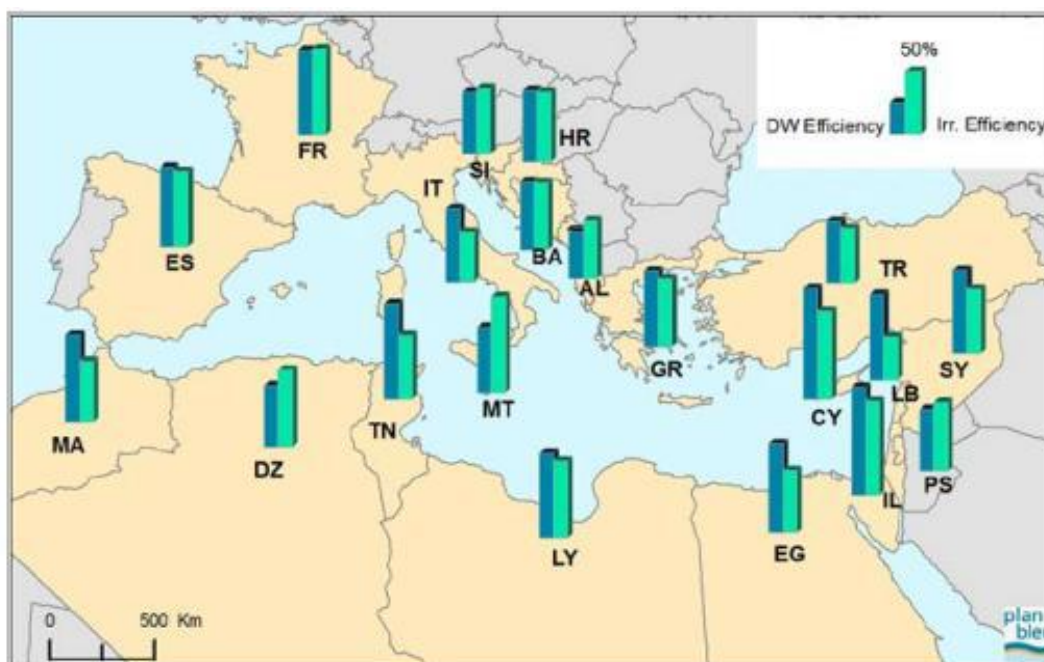


Figure 6.47b. Water use efficiency in drinking water and irrigation sectors in 2010 (Plan Bleu, 2011)

Therefore, the future adaptive capacity of Cyprus to water availability for irrigation in the plain coastal areas and in the mountain areas is considered as moderate and as limited to moderate, respectively.

Additional recommended adaptation measures (Shoukri and Zachariadis, 2012) that are considered to further enhance adaptive capacity towards this impact, include: Maintenance and repair of the water distribution systems and related infrastructure (adoption of technologies for leakage detection and control), Collection and use of rainwater, Review of the Water Policy etc.

2. Water quality

Water bodies in Cyprus are sensitive to eutrophication, stratification and low levels of dissolved oxygen as a result of increased water temperatures and decreased water flows due to reduced precipitation. In addition, heavy precipitation events and flooding adversely affect water quality. The reduction in the recharge rates due to reduced precipitation is more intense in the case of groundwater bodies, thus being more sensitive to climate changes. In addition, coastal aquifers are highly sensitive to salinization due to sea intrusion caused by their over-exploitation.

Considering the above, it was estimated that surface water bodies have moderate to high sensitivity to pollution due to climate changes while groundwater bodies have high to very high sensitivity.

The degree of water quality deterioration is mainly defined by the future climate changes, such as decreased precipitation and increased droughts, the increase in heavy precipitation events, the increase in surface water temperature and the sea level rise in Cyprus as projected in the future (2021-2050).

According to PRECIS the projections in the future period 2021-2050 (Figure 6.49), in brief are: The total annual precipitation will decrease with regional and seasonal variations. The maximum length of drought periods (consecutive days with precipitation < 0.5mm) it is anticipated the central part of Cyprus by 15 days/year in the continental areas and approximately 20 days/year in the eastern part of Troodos mountain. The heavy precipitation events in the future will be without significant changes, as the annual maximum total precipitation over one day (heavy rainfall index) is expected to have a slight increase of about 2-4 mm in western, inland and mountain regions. As for changes in water temperature, these were related to the changes in air temperature. The average change in annual maximum temperature (TX) will range from +1.0°C at the eastern and northern coasts to +2.0°C in higher elevation areas and especially at the southwestern side of Troodos. Sea level changes in Cyprus are not expected to be significant.

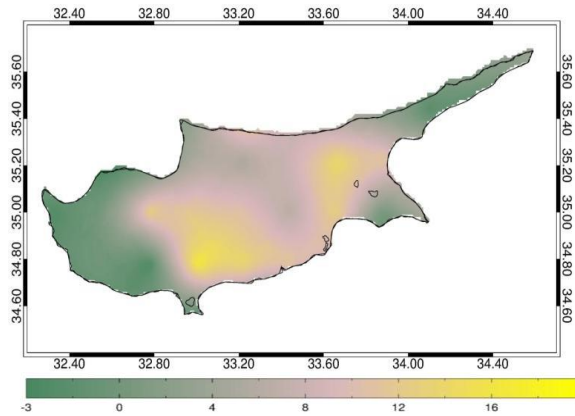


Figure 6.48. Changes in maximum length of dry spell (RR<0.5mm) between the future (2021-2050) and the control period (1961-1990)

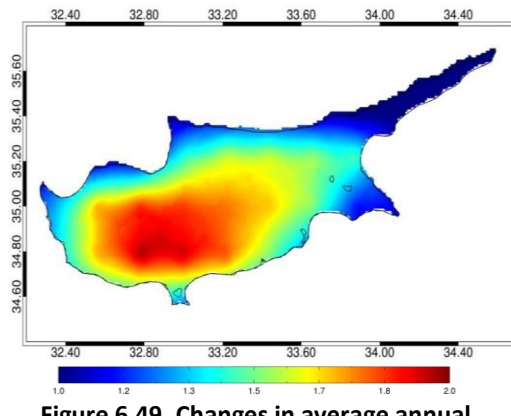


Figure 6.49. Changes in average annual maximum TX between the future (2021-2050) and the control period (1961-1990)

The exposure of the quality of water bodies in Cyprus (which, are already in bad qualitative condition) are considered more vulnerable to climate change impacts

Based on the results of the monitoring program of Cyprus' water bodies, within the implementation of the Water Frame Directive the qualitative status of the water bodies is as follows:

- a) Surface water bodies: The majority of river and lake bodies of Cyprus were classified in a good or moderate ecological and chemical status (Source: WDD (7) and (8)) and all the 25 coastal water bodies were found in good or high ecological status or good ecological potential (Fisheries Department), and in good chemical status (WDD, 2011a). Furthermore, two surface water areas, in which direct or indirect disposal of urban waste water takes place, have been identified as sensitive and the surface waters with the greater relative pollution potential and thus most vulnerable are located in the central and north-western part of Cyprus (WDD, 2011a; PigWasteMan, 2007). Considering the above, it is estimated that the exposure of surface water bodies to pollution is limited to moderate.
- b) Groundwater bodies: The main causes of groundwater bodies' pollution in Cyprus are agriculture, seawater intrusion, wastewater disposal and certain geological formations. From the monitoring of the 19 groundwater bodies during the period 2000-2008, 8 groundwater bodies (42%) were characterized according to the Water Framework Directive as in bad qualitative condition, based on the results of chemical analysis in the salinity levels and/or the levels of pollutants present in the groundwater bodies. In other words, the quality of groundwater bodies can be characterized as moderate to bad. Taking into account the above, the exposure of the groundwater bodies in Cyprus to deterioration of their quality is characterized as high to very high.

Assessment of adaptive capacity

To protect freshwater from pollution, a wide range of legislation which has been established in Europe, most notably the Water Framework Directive (WFD), is implemented in Cyprus.

The Programme of Measures defined in the annual report of the Cyprus River Basin Management Plan (WDD, 2011a – Annex III) includes the establishment of regulations or basic measures that should be implemented in order to achieve the objectives set out for 2015. Protected areas, Protection from point source discharges likely to cause pollution to water, Protection of groundwater bodies from salinization.

The legislation of the Cypriot Government referred as "Water Pollution Control Laws 2002- 2009" is the main tool with which all issues related to water pollution control from industrial and other activities are regulated.

Furthermore, aiming for compliance with the Urban Wastewater Treatment Directive (91/271/EEC) requirements, the wastewater collection and treatment infrastructure is being significantly expanded and upgraded.

The water policy of Cyprus on the salinization of groundwater bodies is based mainly on the prevention of seawater intrusion with the achievement of a positive balance between the abstractions and recharge, by setting proposed volumes of abstraction for each of its aquifers according to their quantitative condition. Furthermore, the measures foreseen for the achievement of a good chemical status of Cyprus groundwater bodies until 2015, in compliance with the Water Framework Directive, also contribute to this direction.

Consequently, it was estimated that the future adaptive capacity of water quality to climate changes is moderate for the case of surface water and limited to moderate for groundwater.

3. Floods

The climate projection model used for the case of Cyprus does not provide estimates for the frequency and intensity of floods in the future. Nevertheless, the annual maximum total precipitation over one day indicating heavy rainfall, which could also be associated with flood risk, will be not significantly changed, as projected the PRECIS model for the future period (2021-2050).

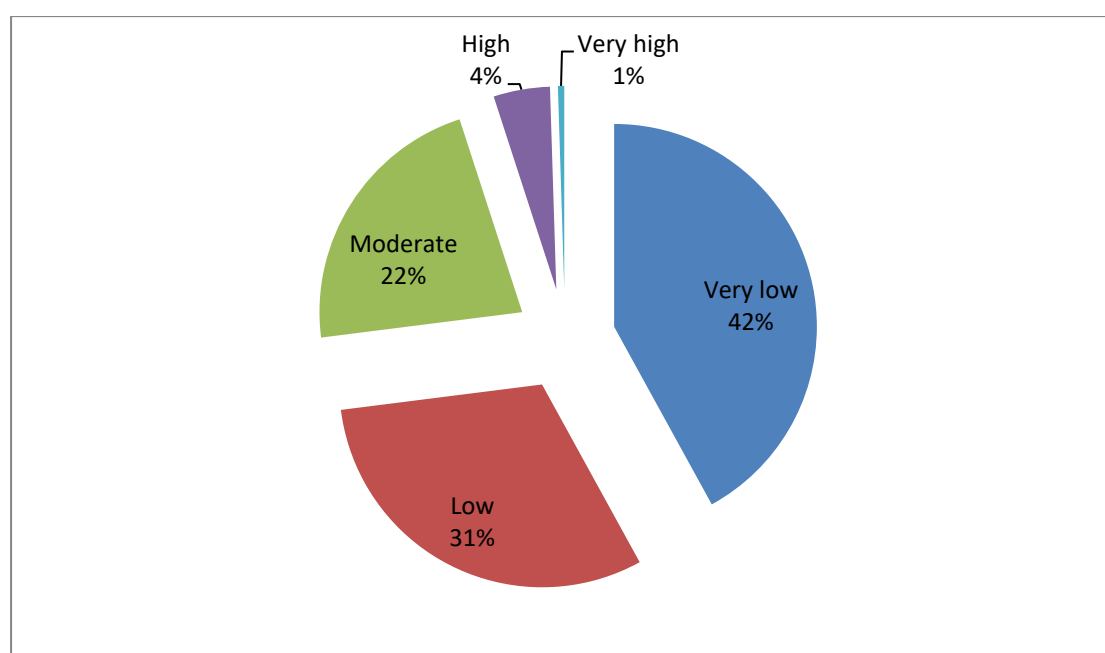


Figure 6.50. Hazard ranking of flooding events during the period 1859-2011

According to the Water Development Department (WDD), the recorded floods in Cyprus for the period 1859-2011 are characterized as urban floods (37%), flash floods (20%), river or fluvial floods (16%), pluvial floods (13%), or a combination of the above (WDD, 2011d). The distribution of floods according to their flood hazard in Cyprus in terms of adverse consequences for human health, environment, cultural heritage and economic activity for this period is presented in Figure 6.50.

The current vulnerability of Cyprus regarding flooding events will worsen with climate changes (WDD, 2011d).

The urban centers are sensitive to flood risks mainly due to their dense structuring and the restriction of green space, the elimination of natural waterways for the construction of roads, the deficient or even absent stormwater drainage system and the covering of waterways and drain entrances with garbage. On the other hand, mountain areas are less sensitive to floods, given that the inclination of terrain together with the infiltration capacity of forested areas do not allow for flooding events to take place.

This is also indicated in the “Preliminary Flood Risk Assessment” report (prepared by WDD for the compliance with the Floods Directive 2007/60/EC), where 19 areas around the island identified as “Areas with Potential Significant Flood Risk”. They mainly refer to river parts that pass through built-up areas and are characterized by frequent and significant flash floods.

To sum up, it is considered that the exposure to floods of the mountain areas of Cyprus is expected to be moderate while the exposure of urban areas is considered to be limited.

Assessment of adaptive capacity

Cyprus’ adaptive capacity to the increasing frequency and intensity of flooding events can be estimated by the existing flood protection works and the river protection zones as well as by the projected plans for the management of future flood risks. The last two decades, a separate drainage system is being developed in Cyprus in order to collect storm water.

In addition, it must be mentioned storage reservoirs act as a flood control measure as the water is impounded in the dam and its downstream release is regulated even in the case of an overflow.

The Law 70(I)2010 on the Flood Risk Assessment, Management and Preparedness, which harmonizes the Floods Directive 2007/60/EC with the Cypriot legislative framework states that Flood Hazard maps and Flood Risk maps must be prepared by the end of 2013, while Flood Risk Management Plans must be prepared by the end of 2015.

Considering the above, the adaptive capacity of Cyprus to urban floods is estimated as moderate.



Figure 6.51. Areas with potential significant flood risk in Cyprus Source: WDD (10)

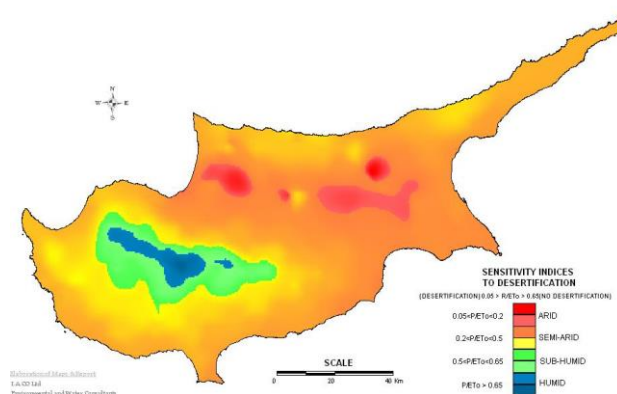


Figure 6.52. Environmentally Sensitive Areas to Desertification (IACO Ltd, 2007)

In addition, the adaptive capacity of mountain areas to floods is estimated by their inherent ability to absorb water due to the high infiltration capacity of vegetated areas and thus to prevent flooding. Thus the adaptive capacity of mountain areas to floods in mountain areas is considered high.

The maintenance and restoration of wetlands and riverbeds as natural defense against floods constitute an additional recommended adaptation measure that is considered to further enhance adaptive capacity towards this impact.

4. Droughts

Cyprus with very limited water resources is vulnerable to droughts as it has exploited most of all its natural water resources, with most of its aquifers depleted, and no perennial rivers. In order to estimate the sensitivity to droughts in Cyprus, the Department of Environment in 2007 has assigned to I.A.C.O. Ltd to define the areas threatened by desertification, by analyzing factors and processes leading to desertification and propose corrective measures. As shown in Figure 6.52 the 91% of the total area of Cyprus was characterized as critical or sensitive.

With the use of PRECIS regional climate model, the future changes (2021-2050) in the maximum length of the period with consecutive dry days (precipitation<0.5mm) per year will be increased by 10-12 days in comparison to the control period 1961-1990.

Consequently, the future exposure of Cyprus to droughts mainly is expected to be very high.

Assessment of adaptive capacity

Drought management is an essential element of water resources policy and strategies in EU but especially in drought prone areas, such as Cyprus. The Cyprus Drought Management Plan (DMP) has been prepared according to the guidelines of the European Commission (EC, 2008) Drought Management Plans (DMP), aiming to minimize the adverse impacts on the economy, social life and environment when drought appears.

Furthermore, it focuses on developing comprehensive, long-term drought preparedness policies and plans of actions that place emphasis on monitoring and managing emerging stress conditions and other hazards associated with climate variability in order to significantly reduce the risks and vulnerabilities to extreme weather events (WDD, 2011a).

Cyprus has considerably increased its adaptive capacity in coping with drought by adopting the EU guidelines on water and drought management. However, the Cyprus DMP and its Water Policy have recently implemented and have yet to be tested to prove their efficiency in achieving the abovementioned goals. For these reasons, Cyprus future adaptive capacity to droughts is considered moderate.

6.3.7.3. Assessment of overall future vulnerability

The overall future vulnerability of forests to climate changes, in terms of sensitivity, exposure, adaptive capacity is presented in Table 6.17.

As it can be seen from the table above, the main vulnerability for the water sector in Cyprus is related to the water availability for domestic water supply and irrigation in mountain areas. Water supply in mountain areas characterized by very high sensitivity and exposure to climate changes, while they have low adaptive capacity to cope with these changes mainly due to the insufficiency of government water works attributed to techno-economic reasons.

The other important vulnerabilities of the sector are related to the water availability for irrigation in plain and coastal areas, the groundwater quality and droughts. Additional adaptation measures are requested in order to eliminate all adverse consequences.

Table 6.17. Overall future vulnerability assessment of the water resources in Cyprus to climate changes

Impact		Sensitivity	Exposure	Adaptive Capacity	Vulnerability
Water availability for domestic water supply	in urban areas	Very high (7)	Very high (7)	High to Very high (6)	Limited (1)
	in mountain areas	Very high (7)	Very high (7)	Limited to Moderate (2)	High (5)
Water availability for irrigation	in plain & coastal areas	Very high (7)	Very high (7)	Moderate (3)	Moderate to High (4)
	in mountain areas	Very high (7)	Very high (7)	Limited to Moderate (2)	High (5)
Water quality	of surface water bodies	Moderate to High (4)	Limited to Moderate (2)	Moderate (3)	None (-0.2)
	of groundwater bodies	High to Very high (6)	High to Very high (6)	Limited to Moderate (2)	Moderate to High (4)
Floods	in urban areas	Moderate to High (4)	Limited (1)	Moderate (3)	None (-1)
	in mountain areas	Limited (1)	Moderate (3)	High (5)	None (-3.3)
Droughts		Very high (7)	Very high (7)	Moderate (3)	Moderate to High (4)

6.3.8. Tourism

6.3.8.1. Climate change and public health

The tourism sector is recognized as being highly vulnerable to climate change, and research is still considered scarce to support destinations to enhance resilience capacities. For example, higher temperatures could lead to a gradual decrease in tourism attractiveness during summer, caused by a higher frequency and intensity of heat waves and the decrease of thermal comfort of tourists. Other expected consequences of climate change impacting coastal destinations in Europe are sea-level rise, ocean acidification, precipitation patterns, thus leading to increased risks of beach surface loss, marine and terrestrial biodiversity degradation, forest fire events, among others (Arabadzhyan et al., 2020). In southern Europe, and particularly in Cyprus, the potential loss in overnight stay demand due to changes in climate conditions will likely reach 20% in a 2°C world (Jacob et al., 2018). This is particularly the case during the summer season, while climate conditions in higher latitudes will become milder and northern destinations will likely become more attractive.

6.3.8.2. Future impact assessment

The island of Cyprus is likely to experience several adverse climate change risks that could directly or indirectly impact the tourism industry. These include increased heat discomfort, increased risk of forest fires, the spread of vector-borne diseases, coastal erosion and more (Figure 6.53). As evaluated by tourists (León et al., 2021b), these risks will likely affect their decisions in terms of destination selection, the season of visit and the duration of stay. The reduction in tourism revenues due to changes in human comfort as captured by the hum-index, the degradation of the marine environment, the increased risk of forest fires and beach reduction will result in a decrease in tourism revenues (León et al., 2021a). According to the different scenarios and time horizons, this decrease is expected to range between -11 and -50%. Compared to other EU countries, a robust reduction in the number of overnight stays is expected in both winter and some seasons (Jacob et al., 2018). Besides the tourist flows, hotel prices and revenues will also be affected, for example, by the increasing cost of cooling and water supply.

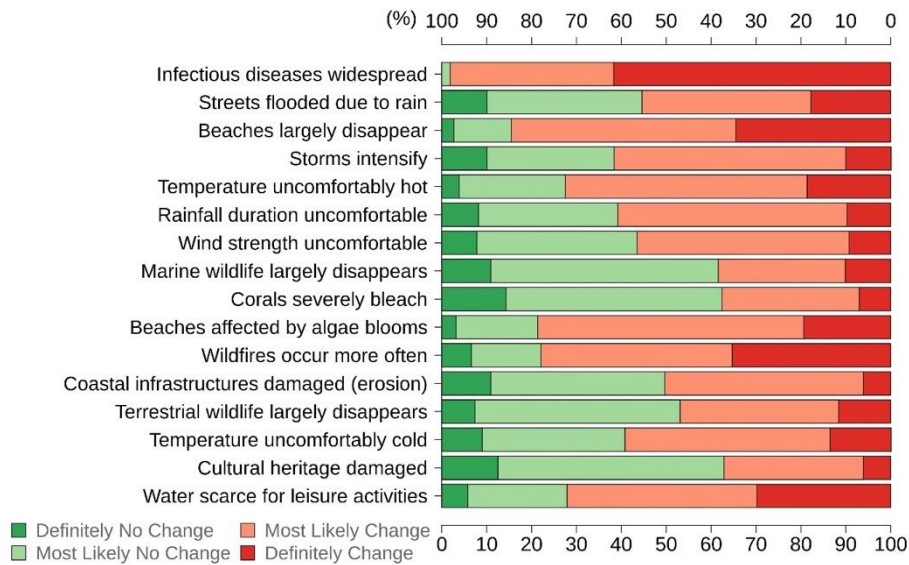


Figure 6.53. Change of travelling decisions under climate change impacts in Cyprus (Adopted from León et al., 2021b)

6.4. Actions for adaptation to climate change

6.4.1. National adaptation policy

Cyprus has adopted a National Adaptation Strategy and Action Plan in May 2017.

The adaptation policy process has been aided by the CYPADAPT⁸¹ project, which was co-financed by the EU through the LIFE+ instrument. This project started in September 2011 and was completed in March 2014. The coordinator was the Department of Environment of the Ministry of Agriculture, Rural Development and Environment, the authority responsible for climate change in Cyprus. Cyprus prepared a combined National Adaptation Strategy and Action Plan in 2014⁸², which was updated and formally adopted in May 2017⁸³.

The Ministry of Agriculture, Rural Development and Environment is the central body coordinating the adaptation policy-making process and has led the preparation and adoption of the National Adaptation Strategy and Action Plan. The responsibility for the implementation of specific sectoral actions lies with the responsible authorities for each specific action (e.g. Department of Agriculture for agricultural issues). In November 2017, meetings with all the stakeholders have taken place to assess the status of implementation of the activities included in the Action Plan. The sectoral breakdown of the actions included in the strategy is presented in Table 6.18.

The contents of the National Adaptation Plan of Cyprus to climate change are the following:

- Brief presentation of the expected changes in climate worldwide and especially in Cyprus
- Brief presentation of the results of the vulnerability assessment of Cyprus to climate change for each of the eleven policy areas
- Presentation of the proposed climate change adaptation measures for each of the eleven policy areas of Cyprus

⁸¹ <http://cypadapt.uest.gr/>

⁸² http://cypadapt.uest.gr/wp-content/uploads/20141219/deliverable_5.1_greek.pdf

⁸³ [Cyprus National Adaptation Strategy 2017](#)

Table 6.18: Sectoral breakdown of the actions included in the strategy

	Sector	Number of actions
1	Water	7
2	Soil	4
3	Biodiversity	6
4	Agriculture	6
5	Forests	4
6	Fisheries	2
7	Health	9
8	Energy	7
9	Tourism	1
10	Coastal areas	4
11	Infrastructure	6
12	Horizontal (all sectors)	1
	TOTAL	57

Stakeholders' involvement

Stakeholders are involved in a dedicated process. The active engagement of stakeholders and experts (relative ministerial departments, associations, non-governmental organizations, universities, research institutes, etc.) was recognised from the beginning of the National Adaptation Strategy development as a key element for the assessment of vulnerability, the identification and evaluation of adaptation measures and most importantly, for the development of the National Adaptation Strategy. Stakeholders were involved in several phases of the project and in particular during the following: assessment of current and future impacts, adaptation and vulnerability assessment, identification and assessment of the adaptation measures the development of the National Adaptation Strategy. The Adaptation Strategy has gone through two different consultation phases before it was finalised.

Vulnerability assessment

A first vulnerability assessment on the most important economic sectors was made within the CYPADAPT project. Key climate change risks and priority policy areas were identified. Past research had already indicated that the sectors that would require priority attention on the design and application of adaptation actions for Cyprus would be water resources, coasts, biodiversity and tourism. Cyprus's first detailed Climate Change Risk Assessment (CCRA) was published in 2016⁸⁴. It provides an overview of potential risks and opportunities of climate change for Cyprus until 2100 and its findings will inform the development of adaptation plans by the Government and the competent authorities. The vulnerability assessment has focused on 11 priority sectors. These include water resources, land use, seaside areas, biodiversity, forestry, agriculture, fisheries, tourism, energy, infrastructure and public health.

Status of implementation

The implementation of several adaptation measures has started taking place. Some autonomous adaptation actions are being undertaken at sectoral level. For example, the Institute of Agricultural Research and the Department of Forests are undertaking projects which facilitate adaptation.

Some additional examples of the main measures for dealing with the effects and adaptation of Cyprus to climate change, by sector, and their implementing stakeholder include:

Public health

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[http://www.moa.gov.cy/moa/environment/environmentnew.nsf/276491E82F8428E1C22580C30034ABF2/\\$file/Evidence-Report-v1_final.pdf](http://www.moa.gov.cy/moa/environment/environmentnew.nsf/276491E82F8428E1C22580C30034ABF2/$file/Evidence-Report-v1_final.pdf)

- Create and maintain urban parks and other green practices to reduce the urban heat island effect. (Implementation stakeholder (IS): Department of Town Planning)
- Prepare an emergency plan to determine the responsibilities of the various health centers, social welfare services and municipal health centers. (IS: Public Health Services of the Ministry of Health)
- Development and strengthening of early heat warning systems. (IS: Meteorological Service)
- Operation of community centers in each municipality/community (eg town halls, schools, Open Elderly Protection Centers - KAPI) to provide protection (air conditioning, shade, liquids) to the population at risk. (IS: Municipalities)

Energy

- Greening of cities to avoid / reduce the urban heat island phenomenon, with the aim of reducing energy consumption for cooling and external shading, with specific measures, such as the creation of parks and the adoption of "green" policies (IS: Department of Town Planning / Municipalities)

Tourism

- Investments in infrastructures/technologies to deal with increased temperatures (IS: Energy Agency)

Infrastructure

- Development of flood relief projects in cities. (IS: Department of Water Development and Local Government)
- Effective rainwater management in existing and new buildings. (IS: Municipalities)
- Review of building regulations to prohibit building in flood plains and coastal zones. (IS FY: Department of Water Development)
- Improvement of the design and construction materials of buildings and transport infrastructure (IS: Department of Town Planning / Department of Public Works)

Water resources

- Control and avoidance of water-bearing demands (eg golf courses, tourist facilities, water-bearing crops) in all areas with insufficient water resources (IS: Department of Water Development)
- Strengthening the efficient use of water in buildings, agriculture and industry (IS: Department of Water Development and Department of Agriculture)
- Expanding the use of water supply meters (IS: Department of Water Development and Department of Agriculture)
- Implementation and regular reviews of the Drought Management Plan, indicators and thresholds assigned to them. (IS: Department of Water Development and Department of Agriculture)

Soil

- Development and implementation of a Plan of Measures to Combat Desertification in Cyprus (IS: Department of the Environment)
- Development and implementation of a plan for sustainable land use (IS: Department of Agriculture)

Coastal Zones

- Actions to protect and improve coastal zones from coastal erosion, including the construction of breakwaters as well as measures to mitigate the effects of dams on coastal ecosystems (e.g. actions

to transport sediments from the dams to the beach, actions to protect river ecosystems etc).(IS : Department of Public Works)

Biodiversity

- Protection, preservation and proper management of the important natural wetlands of Cyprus. (IS: Department of Environment, Department of Water Development)

Agriculture

- Measure: Improving the efficiency of water use for irrigation by adopting more advanced irrigation systems and maintaining existing irrigation systems. (IS: Department of Water Development and Department of Agriculture)

Forests

- Development and implementation of a Strategic Plan for the adaptation of the forests of Cyprus to climate change (IS: Department of Forestry)
- Selection and use of suitable forest species with high resistance to adverse climatic conditions (eg drought). (FY: Department of Forestry)
- Reinforcement of fire prevention measures. (IS: Department of Forestry)

There are also a number of instances of cooperation with wider regional authorities⁸⁵, municipalities, community groups and private local enterprises, including:

- CAMP-Cyprus covers a local spatial dimension at the southern peri-urban coastal area of Larnaca town by implementing activities in four fields i) biodiversity, (ii) carrying capacity assessment, (iii) strategic environmental assessment and (iv) environmental economics and economic instruments. It involves the co-operation of Larnaca municipality and the communities of Pervolia, Meneou and Kiti.
- The COASTANCE project for coastal zone adaptation includes an assessment of the coastal risks and management measures for the pilot case of Mazotos area in Larnaca District.
- The MAREMED project on adaptation in coastal areas, with the Larnaca District Development Agency partnering with 14 regions from five countries⁸⁶.

Finally, an important action relevant to the implementation Article 4 paragraph 1 (e) of the Convention, is the Cyprus Climate Change Initiative

More specifically, Cyprus, aware of the need to take immediate actions to address and mitigate the effects of Climate Change, especially in the Eastern Mediterranean region, which is particularly vulnerable to the effects of climate change, has decided to undertake a specific Initiative and coordinating role to address of the wider area. Its purpose is, in cooperation with the other countries of the region, to draw up a Regional Action Plan to achieve their obligations towards the Paris Agreement and to deal with and/or adapt to the effects of Climate Change. A detailed work program was developed for the development of the Regional Action Plan, which consists of two distinct components: a scientific and an intergovernmental one.

The scientific part of the Initiative has been assigned to the Cyprus Institute, which coordinates a group of more than 240 scientists who provide their opinions and suggestions in a number of thematic areas related to climate change in our wider region. The regional Action Plan includes targeted initiatives in 13 thematic areas covering areas such as health, education, research, tourism, water resources, forest wealth, marine environment, migration, cultural heritage, energy and technology, aiming to:

⁸⁵ Each wider region (District) comprise of a number of Municipalities

⁸⁶ <http://www.maremed.eu/index.php?act=1,2,3>

- The reduction of greenhouse gas and carbon emissions.
- The transition to renewable and cleaner forms of energy.
- Providing incentives to businesses and industries to invest in green technologies.
- The creation of new employment opportunities in green jobs.

The Action Plan has been discussed and finalized at a Ministerial Summit hosted in Cyprus on June 7, 2022, and has been approved by the heads of state at a Regional Summit held in November 2023 on the sidelines of the United Nations World Summit on Climate Change COP27. Based on the Regional Action Plan, the countries of the region they will be able to develop their own national climate action plans. Any future steps are still under discussion.

Monitoring & revision of the strategy

A Monitoring Strategy⁸⁷ was developed to complement the National Adaptation Strategy. In the Monitoring Strategy, and a Monitoring Team was suggested. The results of the Monitoring Strategy are expected to provide the basis for the preparation of the 2nd National Adaptation Plan. Monitoring reports are scheduled every year from 2018 to 2022. All the stakeholders have been included throughout the process and particularly monitoring of progress of implementation of adaptation measures.

The monitoring reports are available publicly at the Department of Environment website.⁸⁸

Reviews involve all stakeholders coordinated by the Department of Environment, as stated in the Council of Ministers' decision that adopted the National Adaptation Strategy and the Action Plan in May 2017.

6.4.2. EU level actions

In recognition of the shared challenges and cross-border nature of climate change, the European Union has led the development of an EU-wide framework for adaptation. The European Commission started in 2007 by adopting a Green Paper "Adapting to climate change in Europe – options for EU action"¹⁰⁶. It was followed by the White Paper "Adapting to climate change: Towards a European framework for action"⁸⁹ in 2009. These documents led to the adoption of the 'EU strategy on adaptation to climate change'¹⁰⁸ on 16 April 2013.

The strategy predates but does not conflict with some key objectives and commitments made by the EU at the international level, including most recently the UNFCCC Paris Agreement (Article 7), the Sustainable Development Goals and the Sendai Framework on Disaster Risk Reduction¹⁰⁹ and also the Aichi biodiversity (CBD) targets. It is also in line with the ten priorities of the Juncker Commission.

6.4.2.1. The EU Strategy on Adaptation to Climate Change

The 'EU Strategy on adaptation to climate change' was adopted by the European Commission on 16 April 2013. The overall aim is to contribute to a more climate-resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, developing a coherent approach and improving coordination.

The revised EU Strategy on Adaptation to Climate Change, which was adopted in 2021, targets a smarter, swifter and more systematic adaptation that will:

- Improve knowledge of climate impacts and adaptation solutions
- Step-up adaptation planning and climate risk assessments

⁸⁷ http://cypadapt.uest.gr/wp-content/uploads/20141219/deliverable_5.2_english.pdf

⁸⁸ <http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/C15CD89954708638C2257FF1003494BD?OpenDocument>

⁸⁹ COM(2009) 147 final WHITE PAPER Adapting to climate change: Towards a European framework for action <http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF>

- Accelerate adaptation action
- Help to strengthen climate resilience on global scale

6.4.2.2. Progress and outcomes of adaptation action

Since the publication of the 6th NC in 2014, the EU and its Member States have significantly increased the number of actions for coping with the impacts of climate change at international, national and local levels as well as across sectors. These have been presented in detail in the 7th National Communication & 4th Biennial Report from the European Union under the UN Framework Convention on Climate Change (UNFCCC).

As mentioned in the previous section, a Monitoring Strategy was developed to complement the National Adaptation Strategy. Based on this strategy, monitoring reports are produced every year from 2018, and within these reports there is specific chapter on the progress of implementation (Chapter 4: Actions completed during relevant to the implementation of the NAS). More specifically Chapter 4, includes a description of the Actions that were completed during the previous year of submission and are relevant to the implementation of the NAS.

Additionally, in 'Chapter 5: Measures and actions to adapt Cyprus to climate change, the monitoring report presents the progress in the implementation of the measures and actions which are included in the NAS and the Cyprus Action Plan for Adaptation. More specifically, Chapter 5, Includes changes and additions suggested by the implementing stakeholders and provides progress details for each of the measures/policies, under the label 'observations' as part of the details of each measure/policy.

The monitoring reports for each year are available publicly at the website of the Department of Environment, in the Greek language. The latest report was completed in 2022 for the progress of implementation of the NAS until 2021.

Success Stories

Finally, some of the success stories stemming out of the NAS include:

1. The implementation of measures related with the reduction of the risk of the occurrence and spread of forest fires, by the Department of Forests. Furthermore, the latest actions include technology-driven solutions using drones to parole high risk areas and study for the implementation of electro-optical sensors for fire identification
2. Incentivizing farmers to use recycled water for the irrigation of selected crops. This measure is already being implemented by Water Development Department (WDD) / Department of Agriculture. The volumes of recycled water allocated for irrigation was aprox. 20 million cubic meters in 2020 and 22 million cubic meters in 2021.
3. Expanding the use of water supply meters as well as the parallel installation of modern automatic aggregation systems collection and evaluation of the meter readings for their effective monitoring. This measure is already being implemented in the communities as part of the Water Development Department's strategic planning.

The Water Development Department (WDD) has a number of actions/projects in place that contribute to the adaptation of the water sector to climate change, while significant actions/projects are planned for implementation in the near future that will further contribute towards this direction. Such actions/projects derive from the obligations of Cyprus for implementation of relevant EU Directives, but also from the long-term necessity to cope with the observed effects of climate change to our water resources, which are leading to significant economic, social and environmental challenges.

The Cyprus water policy has been driven by the relevant EU legislation. In that respect, the EU Water Framework Directive is the central and unifying legislative instrument but it also comprises of legislation on aquatic ecology & habitats, drinking water, bathing water and urban waste water, prevention of pollution caused by nitrates, industrial emissions, pesticides and persistent organic pollutants.

The EU Water Framework Directive was adopted in the national legislation with the Water Protection and Management Law 2004. It is complemented by the Integrated Water Management Law of 2010, which is the main national water law.

The Water Framework Directive, which aims at comprehensively implementing water protection and at achieving good water status in terms of both water quality and quantity, is a priority. Its implementation contributes to strengthen the resilience of the aquatic ecosystem and thus helps to adapt to climate change. In this context, the 2nd River Basin Management Plan and Program of Measures were adopted on 7 October 2016 and the 3rd RBMP is currently being elaborated and is expected to be adopted by the Council of Ministers in autumn 2023. A Drought Management Plan has also been adopted. The 1st Flood Risk Management Plan, which has been developed in coordination with the 2nd RBMP has also been concluded and adopted on 12 December 2016 and the 2nd FRMP is expected to be also adopted by the end of 2023.

Actions/projects deriving from the implementation of the EU Water Framework Directive and the Integrated Water Management Law:

- Monitoring of underground water resources, an ongoing action applied all over the country.
- Monitoring of surface water allocation for various uses and optimal use of different potable water sources.
- Obligation to report to the European Commission about the River Basin Management Plan (RBMP)
- Obligation to report to the European Commission about the Flood Risk Management Plan (FRMP)
- Monitoring of the quality and quantity of groundwater and surface water.

Actions/projects deriving from the Urban Wastewater Treatment Directive

- Monitoring of the implementation program for Installation of collection systems and wastewater treatment plants.
- Monitoring of the treated wastewater reuse in agriculture aiming to improve water balance and better utilization of water resources and aquifer recharge for ground water recovery and limitation of saline water intrusion.

Control of underground water abstraction

Background

Groundwater plays a key role in irrigation, as it was always considered to be the most obvious and accessible source of water. As a result, private boreholes and wells have been extensively used, not only by the Irrigation Organizations or the farmers outside the Governmental Water Works (GWW), but also by the farmers who typically irrigate their land within the GWP areas, especially when they had to overcome shortages during dry years.

Today, most of the aquifers face severe over abstraction problems, which led to seawater intrusion and deterioration, of both, quantity and quality of groundwater. This was the reason to introduce a system by which the WDD can regulate, to a certain extent, the abstraction from the aquifers. During the last 20 years, a special legislation was applied in certain areas in order to prevent the deterioration of the local coastal aquifers.

Measure

Measures are taken to control overexploitation of underground water resources

- Under the national Integrated Water Management Law of 2010, WDD assumed the responsibility to monitor borehole drilling and abstraction permits, aiming to effectively monitor abstractions according to the aquifer's conditions all over the country.

- Monitoring involves identification of the condition of underground water bodies, by recording the water levels in strategic locations all over the country. Based on the monitoring results each aquifer's status is characterized accordingly.
- Generally, when the aquifer is in "poor status," or it is over pumped, new permits are limited only to the irrigation of existing permanent plantations. Additionally, the procedure involves the reviews of the old boreholes with the objective to apply an abstraction charge, reflecting the environmental and resource cost, to all.
- From the application of the above measures in 2011 there are indications of improved conditions in some underground water bodies. However, there is still a long way to reach the required goals.

Control of available surface water quantities and optimal use of potable water sources

Background

The situation with water scarcity in Cyprus has deteriorated in the recent decades, as a result of climate change, with frequent and gradually increasing droughts, having a negative impact on development, the environment, agriculture, and public health. In view of these challenges, the Government of Cyprus has adopted an integrated approach to water resources management, tackling the water issue in terms of quantity, quality, health, conservation and protection and economics.

Measure

In order to cope with annual drought events, the Government applies a Drought Mitigation and Response Plan in all (GWW) on a yearly basis, depending on prevailing climatic conditions. It includes different restrictions to water use and other water demand and supply management measures.

7. Financial resources and transfer of technology

7.1. Introduction

Cyprus was a non-Annex I party to the UNFCCC until 1/1/2013 and a non-Annex B party to the Kyoto Protocol. Consequently, Cyprus had no obligations to allocate financial resources for assistance to developing country parties that are particularly vulnerable to climate change. Nevertheless, in 2009, along with the rest of the member states of the EU, Cyprus committed to provide finance for climate change to developing countries.

7.2. Provision of new and additional resources

CyprusAid is the Development Cooperation Service of the Republic of Cyprus, established in its current form by the Council of Ministers in 2005. CyprusAid functions within the framework of a policy making mechanism that has been put in place in order to steer Cyprus' Official Development Assistance. This policy mechanism is one that retains a high degree of centralisation in the decision-making process, while at the same time allows for a more decentralized approach in the aid delivery arrangements. The mechanism comprises of a Coordination Body (CB) headed by the Minister of Foreign Affairs and having the Minister of Finance and the Permanent Secretary of the Planning Bureau as members. The CB is responsible for the setting of targets (quantitative, territorial and sectoral) on the basis of international obligations, EU policy recommendations and national priorities. The Planning Bureau is responsible for the preparation of policy preparation, as well as the management and implementation of the decisions of the CB while the MFA is responsible for representing the Republic abroad and also for publicizing the Republic of Cyprus ODA activities. A second body, headed by the Permanent Secretary of the Ministry of Foreign Affairs (MFA) and comprised of representatives of the Ministries of Finance, Commerce, Industry and Tourism, Agriculture, Natural Resources and Environment, Labour and Social Insurance, Education and Culture and the Planning Bureau, as well as representatives of civil society, acts in a consultative capacity to the Coordination Body.

According to the relevant EU ministerial decision and the necessary decision from the national council of ministers, Cyprus was going to provide €1.8 million as fast start finance. The amount was new and additional. The €1.8 million were going to be given in three years 2010-2011-2012, €0.6 million annually.

Funding was provided for the years 2010 and 2012. No additional funding was provided after 2012.

7.3. Assistance to developing country Parties that are particularly vulnerable to climate change

CyprusAid after studying options funds and organizations implementing projects on climate change, and with the consent of the Ministry of Finance promoted cooperation with the "Global Climate Change Alliance-GCCA", a funding mechanism coordinated by the European Commission. This mechanism acts as an intermediary / coordinator for contributions and projects to tackle climate change. The choice of "GCCA" as a means of disposing of contribution of Cyprus based on that provides recognition to donors. Furthermore, the "GCCA" is an initiative of the European Commission and the substantial and political support of Member States in this, strengthens and makes this mechanism valuable in the international arena on climate change. Moreover, GCCA focuses climate support on LDCs and SIDS.

Furthermore, the Cyprus Climate Change Initiative has been discussed and finalized at a Ministerial Summit hosted in Cyprus on June 7, 2022, and has been approved by the heads of state at a Regional Summit held in November 2023 on the sidelines of the United Nations World Summit on Climate Change COP27.

The Initiative aims at the development of a Regional Action Plan to address the specific needs and challenges countries are facing in the EMME region, and advance mitigation actions in accordance with the Paris Agreement.

Based on the Regional Action Plan, the countries of the region they will be able to develop their own national climate action plans. Any future steps are still under discussion.

7.3.1. Funding provided in 2010

Project name: "Building Climate Resilience in Nepal"

The estimated costs of the project amounted to €19,400,000 (European Union: €8,000,000, Development Cooperation Service of the United Kingdom €10,800,000 and Cyprus €600,000). The project is implemented by the method of award of centralized management to the local office of the Office for Development Cooperation of the United Kingdom in Nepal.

The main objectives of the project are: (a) the development of an administrative infrastructure in Nepal, both at national and local level to enable the implementation of the National Adaptation Programme of Nepal to climate change and (b) promote the integration policy on climate change programs and projects of the government at national and local level and develop mechanisms to promote initiatives for climate adaptation.

The institutionalization of cooperation has been the signing of a Credit "Transfer Agreement" between the Cyprus and the European Union represented by the European Commission.

7.3.2. Funding provided in 2012

Project name: "Climate Change Adaptation and Sustainable Land Management in the Eastern Caribbean"

For 2012 the Planning Bureau has negotiated a Credit "Transfer Agreement", for funding the project in the Caribbean (Antigua & Barbuda, Dominica, Grenada, Saint Lucia, St. Christopher (St. Kitts) & Nevis St. Vincent, Grenadines, Montserrat, British Virgin Islands, Anguilla).

This project was funded by the European Commission with a contribution of €10,000,000 and the Republic of Cyprus with a contribution of €600,000.

The overall project objective was to contribute to the implementation of the provisions laid down in Article 24 of the Revised Treaty of Basseterre, which makes reference to implementation by each State Party "St. George Declaration" on the Declaration of Principles for Environmental Sustainability, which aims, among others, to achieve long-term conservation and sustainable productivity of the region's natural resources and the ecosystem.

The immediate goal of the project is to improve the resilience of the natural resources base in the region to the impacts of climate change through: (a) promoting efficient and sustainable practices and frameworks of land management and (b) promoting concrete pilot projects in order to adapt the field (especially in terms of land management) to climate change.

7.4. Activities related to transfer of technology

No activities related to transfer of technology have been implemented.

8. Research and systemic observation⁹⁰

8.1. Introduction

The R&I system in Cyprus is relatively young and is evolving with the aim to increase its efficiency and foster cooperation between the research community and the productive sector (business and industry). The current governance system was established in 2007. The main barriers of the system relate to the inflexible governance structure, the weak coordination between the various actors involved and the absence of an explicit long-term strategy for R&I. In addition, the development of the R&I system is hindered by the weak cooperation between the research and academic community with the business world, the low involvement and investments of the private sector in R&I activities and the limited extroversion of the Cyprus R&I system.

Taking into consideration the above, the government of Cyprus promoted various initiatives and studies in order to develop a concrete proposal for restructuring and upgrading the R&I governance structure in Cyprus. Due to a wider administrative reform effort which is currently under way, decisions on the specific issue are still under preparation. It should be noted however that the gap is currently filled, to some extent, by the Council of Ministers.

Currently, 2 Strategy documents approved by the Council of Ministers are under implementation, namely the Smart Specialisation Strategy and the National European Research Area Roadmap for Cyprus 2016-2020.

8.2. General policy on and funding of research and systematic observation

8.2.1. Institutional mapping, actors and roles and responsibilities

The National Research and Innovation Council (NRIC) is the political, decision-making body of the R&I System. It is composed by a cabinet of six members/ ministers (Finance, Energy-Commerce-Industry and Tourism, Education and Culture, Transport, Communications and Works, Agriculture-Rural Development and Environment and Health) and it is chaired by the President of the Republic. The NRIC is entrusted with the responsibility of formulating long term R&I strategic priorities. Also, the Cyprus Scientific Council (CSC) is an advisory scientific body comprising of 19 reputable high calibre scientists. All three Public Universities as well as Private Universities and Public Research Institutions are represented in the CSC. This Council is responsible for advising NRIC on strategy and policy R&I matters. The existing Governance system has proven however rather inflexible and has been inactive for the past few years. The gap is currently filled, to some extent, by the Council of Ministers.

The responsibility for the design of the national R&I policy, is carried out by the Directorate General Growth (DGG), an independent governmental body which, administratively, is under the Minister of Finance. The major policy initiative undertaken by DGG was the preparation of the Smart Specialisation Strategy of Cyprus (S3Cy). This strategy is implemented through an Action Plan that is a “dynamic” document reflecting the national Framework Programmes for R&I over the period 2016-2020. Also, another policy initiative undertaken by DGG was the preparation of the National European Research Area (ERA) Roadmap for Cyprus 2016-2020. The Roadmap describes the current situation related to the implementation of ERA priorities at national level and indicates the national priorities and relevant current and future actions aiming to address the individual ERA Priorities.

R&I Policy is mainly implemented by the Research Promotion Foundation (RPF), which is the main research funding agency in Cyprus. The RPF was established in 1996 as an autonomous agency under

⁹⁰ Directorate for Research, Innovation and Lifelong Learning, Directorate General for European Programmes, Coordination and Development, Republic of Cyprus, 1409 Nicosia, Cyprus, <http://www.dgepcd.gov.cy>

private law, supervised by a Board of Directors, chaired by the Permanent Secretary of DG EPCD. The RPF is responsible for: (a) the provision of competitive funding for the implementation of research and technological development projects and innovation activities through the development and monitoring of national programmes and grant schemes for the implementation, inter alia, of the Action Plan of the Smart Specialisation Strategy for Cyprus, (b) the management of European research and innovation projects by establishing the network of National Contact Points (NCP) for Cyprus' participation in the EU Framework Programmes, thus providing assistance to applicants for EU research competitive funding and the implementation of international agreements in R&I and (c) the implementation of bilateral and multilateral agreements between Cyprus and other countries in the field of research and technological development.

Also, The Technology Service of MECIT, is responsible for the design and implementation of specific actions/programmes related to business innovation, on the basis of the national policy and in particular the S3Cy.

The major research activity in Cyprus is performed by the Higher Education Institutes (HEIs), Research Promotion Organizations (RPOs) including departments and Institutions of the public sector, enterprises and the private non-profit organisations. The role of public universities (University of Cyprus, Central University of Technology and Open University of Cyprus) is crucial, while the major RPOs, such as the Agricultural Research Organisation, the Cyprus Institute of Neurology and Genetics, the Cyprus Institute, the State General Laboratory, the Department of Fisheries and Marine Research and the Department of Meteorology are important research performers. Research in the Business sector is dominated by a few Enterprises in the pharmaceutical sector as well as small-medium companies and start-ups mainly in the ICT sector.

8.2.2. Main instruments, policies and programmes

Research is among the key priorities of the Action Plan for Growth, a main strategy document that aims at accelerating the economic recovery, creating jobs, improving the competitiveness of the business environment and promoting investments.

The main policy document for Research and Innovations currently in force is the Smart Specialisation Strategy for Cyprus (S3CY), which was approved by the Council of Ministers in March 2015. It includes an Action Plan, to be implemented over the period 2015 – 2022, with measures amounting to €144 mln, with co-financing from the European Structural and Investment Funds (ESIF). The Action Plan of S3CY is expected to also address the main issues of the R&I system in Cyprus such as the inclusion of SMEs in R&I activities and the attraction of private sector in R&I investments, the establishment of synergies between the research and academic community with the business world and the enhancement of extroversion of the Cyprus R&I system.

The main tool for the implementation of the S3CY Action Plan is the National Framework Programme for Research and Innovation RESTART 2016-2020, implemented by the Research Promotion Foundation that offers ample opportunities to all local stakeholders, including universities and research organisations, to establish consortia for the implementation of projects, thus nurturing closer links between them.

The core priority of S3Cy is Sustainable Development, that is, the safeguarding of the physical, human and social resources of the island over time. Sustainability involves both the developmental approach essential to all the initiatives within the Strategy, but also four specific issues: Climate Change, Natural Resources (water – ecosystems), Cultural Heritage, and Blue Growth.

Within the framework of the S3Cy the following priority areas have been identified : Tourism; Energy (renewable forms of energy, solar energy, Solar-thermal technology Solar; Photovoltaic, Technologies for Solar Heating and Cooling, energy storage and transfer); Agriculture–Food Industry; Construction industry (sustainable urban development, sustainable construction, existing building stock, innovative and intelligent materials and reuse of building materials, cultural heritage); Transportation (marine, shipping, intelligent transport systems, road freight) and Health (e-health, prognosis-prevention and

treatment of diseases, health pharmaceutical industry). Environment and ICT were also defined as important sectors of horizontal character.

Also, another policy document, is the National “European Research Area (ERA)” Roadmap for Cyprus 2016-2020m, which was approved by the Council of Ministers in 19th of July 2017. The Roadmap describes the current situation related to the implementation of ERA priorities at national level and indicates the national priorities and relevant current and future actions aiming to address the individual ERA Priorities.

8.2.3. International Cooperation

The preparation and monitoring of bilateral and multilateral transnational agreements on the promotion of Science, Technology and Innovation (STI) Cooperation as well as the participation in International Organizations and initiatives for R&I is carried out by the DGG.

Cyprus has concluded a number of STI Cooperation Agreements and Memoranda of Understanding with third countries (i.e. United States, Israel, Russia, Egypt, China, Cuba). The choice of partner-countries is decided on a case-by-case basis, taking into consideration Cyprus’ external policy priorities and the interest of the Cypriot Research Community for cooperation in R&I with a specific country.

Furthermore, Cyprus is participating in international research organizations such as CERN (the European Organisation for Nuclear Energy), where it is an “associate member in the pre-stage to membership”, providing, inter alia, the opportunity to national research organizations and scientists to participate in consortia for projects of mutual interest. Cyprus is also a founding member of SESAME and in fact, the only EU Member State participating as a full member, together with Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey, providing a link between the EU and the organization, which is highly valued by the European Commission in the context of scientific diplomacy.

The implementation of bilateral and multilateral agreements between Cyprus and other countries in the field of research and technological development and the promotion of the participation of, Cyprus in European and International initiatives and organisations (COST, EUREKA, EUROSTARS, etc.) were carried out mainly by the RPF through relevant Schemes in the National Funding Programme “RESTART 2016-2020”.

Specifically, the National Framework Programme “RESTART 2016-2020”, under the priority “Extroversion – Open Horizons” included 4 programmes (Bilateral Cooperation, International Collaboration-Dual targeting, EUREKA Cyprus and European Initiatives) for the enhancement of the extroversion of the R&I sector.

RPF is also the responsible agency for the promotion and the facilitation of the participation of Cypriot organizations and researchers in EU Framework Programmes by establishing the network of National Contact Points (NCP) for Cyprus’ participation in the EU Framework Programmes, thus providing assistance to applicants for EU research competitive funding and the international agreements programmes in R&I.

The CYI has collaboration with the Israeli Met Service on data exchange, for the development of climate modelling tools and future climate projections. The CYI is also part of the MENA-CORDEX Program, which is a branch of the International Coordinated Regional Climate Downscaling Experiment (CORDEX) Initiative, sponsored by the World Climate Research Program. The CORDEX is providing global coordination of Regional Climate Downscaling for improved regional climate change adaptation and impact assessment.

Examples of projects /activities in climate change developed in the bilateral and multilateral initiatives

- (a) Ensuring an optimum and reliable photovoltaic performance, University of Cyprus, bilateral with Israel.

A cornerstone of the transition from polluted and finite energy to clean and renewable energy systems is the increasing reliability, efficiency and service lifetime of the photovoltaic (PV) solar systems.

However, a major aspect that is lacking along this exponential growth is the ease of asset operations. To date, technicians are still essential to manually examine displayed data on screens with, as expected, a very limited success. The strong market growth of PV requires the equivalent automated tools for asset management.

The main aim of the proposal is the development of a commercial product that will assist in maintaining an optimal level of operation of PV plants. In particular, the proposed project is concerned with advancing the field of the automatic identification of performance loss, degradation and failures in monitored PV plants and their classification into various fault types and degradation mechanisms, which are manifested in the field.

Specifically, innovative methodologies based on machine learning and statistical analysis will be developed for identifying performance losses and failures in PV plants without disrupting their operation. Such methodologies have also the potential to contribute greatly to new standards on PV performance, degradation and reliability.

The algorithms will be integrated in a commercial product, Raycatch, which is an artificial intelligence (AI) diagnostics technology for solar energy, on a mission to revolutionize the PV market by enabling automated management of solar assets. By deciphering existing solar energy data, Raycatch transforms PV O&M tasks from traditional scheduled operations to on-demand management. The result is maximized performance and maintenance of solar assets, leading to increased yield, decreased operational costs and the acceleration of solar energy penetration in the global energy market.

(b) Retrospective modelling and prediction of Ionospheric weather, Frederick Research Center, bilateral with Russia.

The ultimate objective of the REMAP project is to embark on innovative research activities in order to enhance the research potential in Cyprus at the Ionospheric Research Group of Frederick Research Center under a collaboration with established fellow scientists from Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Russian Academy of Sciences. The main scientific aim is to advance scientific excellence in ionospheric modelling and monitoring. One aspect of this effort will be based on the valorization of the Digisondes at Nicosia and Moscow and the unique auto-scaled fof2-hmF2 datasets hosted on various databases all over the globe. A second goal is to advance scientific excellence in the field of global ionospheric modeling to enhance the IRI-Plas model representation by improving the solar representation of the well-known CCIR coefficients and by exploiting past GNSS radio occultation (RO) datasets to validate the topside representation of this model. A unique study will also be undertaken to apply the powerful height-time-reflection intensity (HTI) technique on ionograms from Nicosia and Moscow for visualization and statistical investigation of an array of ionospheric phenomena such spread F and Intermediate Descending Layers that develop into sporadic E layers.

Finally, it is noted that Cyprus currently does not participate in activities of the IPCC, the World Climate Research Programme or the Future Earth and the Global Climate Observing.

8.2.4. Funding of research and systematic observation

The national target for R&D expenditures as a percentage of GDP was set to reach 0.50% by the year 2020. This target was set taking into account the particularities of Cyprus in terms of the size of the research community, the orientation of the economy in low value-added products and services and the very small size and low involvement of Cypriot companies in R&D activities in terms of participation and expenditure in R&D.

Cyprus ranks very low in terms of R&D expenditure, as it counts only for 0.48% of GDP for 2015. The significant fluctuations of GDP determine to a large extent the evolution of Research and Development intensity as actual investments in absolute terms remain relatively stable over the years.

Expenditures (GERD) performed by the Government in 2015 (most recent available data) was accounted to 50.6%, including the expenditures of the Public Universities which were accounted to

23%. The private sector contribution accounted to 26,4% while the contribution from abroad accounted to 23%.

By sector of performance, the higher education institutions accounted in 2015 for €42,6 million or 49,9% of total R&D expenditure, the business enterprises for €19,5 million or 22,8%, the private non-profit institutions for €12,2 million or 14,3% and the government for €11,1 million or 13,0%. In the business enterprise sector, information and communication constituted the principal source of R&D activity, with a total R&D expenditure of €10,1 million, while of importance was also the contribution of the manufacturing industry (and particularly the manufacturers of basic pharmaceutical products and preparations) with €7,3 million.

The private sector contribution to Research and Development activities is low and has been identified as a major limitation factor for the development of the field. Business Enterprise Expenditure on Research and Development (BERD) also stood very low compared to the EU average in 2015. More specifically, the indicator stood at 0.11% of GDP in 2015, far below the EU average (1.3%). Businesses performed 22.8% of GERD in 2015. In terms of R&D financing, the Cypriot private sector funded 26.4% of overall R&D expenditure in 2015 (most recent available data).

The proportions among fields of science have not changed significantly over the years. Most of the research expenditures focused on Natural sciences (€36.3 million), while Engineering sciences absorbed €19.1 million, Social sciences €13.0 million, Humanities €7.0 million, Agricultural sciences €6,7 million and Health sciences €3,1 million.

The Cyprus Government allocates institutional funding to public Higher Education Institutes (HEIs) and the Research Promotion Organisation (RPO) annually, through the state budget. HEIs have introduced mechanisms within the universities for the selection and management of research proposals.

Also, national funding schemes included in the Action Plan of the S3Cy, amounting to €144 ml and co-funded by the European Structural and Investment Funds (ESIF), are implemented mainly through the Research Promotion Foundation (RPF) and the Technology Service of the Ministry of Energy, Commerce, Industry and Tourism (MECIT).

8.3. Systematic observation

8.3.1. Atmospheric observation

Measurements of meteorological parameters⁹¹

The Cyprus Department of Meteorology is a Department of the Ministry of Agriculture, Rural development and Environment and handles issues concerning the weather and climate of Cyprus.

In order for the Sector of Climatology to achieve its goals of measuring all the meteorological parameters, it operates a dense network of Meteorological Stations which includes 144 rainfall stations, 17 climatological stations, 3 synoptic station, 1 upper air station, 52 automatic stations, 2 stations measuring UV radiation and 20 radiation stations.

The Department of Meteorology also was operating a Meteorological Doppler Radar in Troodos mountains (Kykkos area) until 2009. From June 2017, the Department of Meteorology operates two new x-band Weather Radar (one in Rizoelia area in Larnaka and one in Paphos).

For information regarding the network of stations, see Figure 8.1 and Table 8.1.

Table 8.1. Type of meteorological stations in Cyprus

Type of Meteorological Stations	Number of Met. Stations
Rainfall Stations	144

⁹¹ Stalo Papachristodoulou, , Met Officer A', Department of Meteorology, Nikis 28, 1086 Nicosia; Tel.: +35722802911 , e-mail: cpapachristodoulou@dom.moa.gov.cy

Conventional Climatological Stations	9
Automatic Weather Stations	52
Radiation Stations	20
UV- Radiation Stations	2
Synoptic stations	3
Upper Air stations (Radiosonde)	1

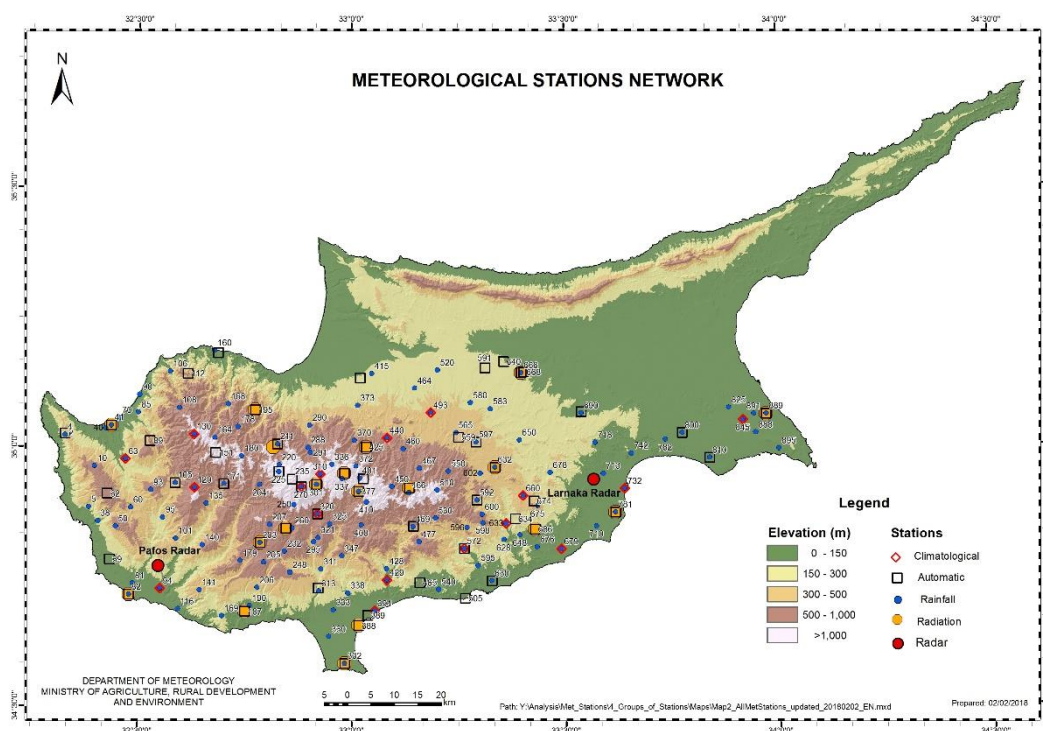


Figure 8.1. Cyprus meteorological stations network

Ground level air pollutants⁹²

The Ministry of Labour & Social Security is responsible for Air Quality and Emissions Inventory in Cyprus. The Air Quality Section of the Department of Labour Inspection operates a network of 13 ambient air monitoring stations all over Cyprus as shown in Figure 8.2. The results, together with other useful information on air quality, are given to the public, on-line, through the website www.airquality.gov.cy and through indoor/outdoor information panels.

Atmospheric climate observing systems (incl. measuring atmospheric constituents)

Since the previous UNFCCC communication, the Climate and Atmosphere Research Center (CARE-C) of the Cyprus Institute has further developed a comprehensive atmospheric network over Cyprus that fully complements those currently operating by 1) the Cyprus Department of Meteorology (DoM) for the monitoring of meteorological parameters (see previous UNFCCC report), and 2) the Department of Labour Inspection (DLI) for the monitoring of air quality (see previous UNFCCC report).

This atmospheric network aims to establish the first ever (open access) long-term observations of key climate forcers in the Eastern Mediterranean and Middle East region, in order to better constrain emissions of greenhouse gases and air pollutants and therefore better support the development of accurate regional (air quality) models for better prediction, mitigation, and adaptation.

⁹² Savvas Kleanthous, Senior Labour Inspection Officer, Head of Air Quality Section, Department of Labour Inspection; 12, Apelli Street, 1080 Nicosia, Cyprus; Tel: +357-22405639; e-mail: skleanthous@dli.mlsi.gov.cy



Figure 8.2. Cyprus air quality monitoring stations

8.3.1.1. Ground-based observations: The Atmospheric Network operated by the CARE-C (Cyprus Atmospheric Observatory, [CAO](#),) consists of 4 ground-based stations which operate continuously with the objective to provide (open access) high quality long-term atmospheric observations relevant climate:

- 1) A **regional background station** - [CAO-AMX](#) (co-operated with DLI for Air quality) to document regional pollution (with minimal influence of Cyprus) and impact of long-range transport from Europe, Africa, and the Middle East
- 2) A **marine background station** – [CAO-IN](#) to document specifically greenhouse gases (CO₂, CH₄) with minimal influence of Cyprus (anthropogenic and biosphere emissions/sinks)
- 3) A **free-troposphere background station** – [CAO-TRO](#) to document atmospheric composition in the free troposphere (to complement the boundary layer observations performed at [CAO-AMX](#) and [CAO-IN](#))
- 4) An **urban background station** – [CAO-NIC](#) to characterize urban pollution of the Nicosia urban area with atmospheric parameters complementary to those provided by the local air quality network,

The list of atmospheric parameters monitored at each station is accessible at the above links. They comprise Air Quality parameters (O₃, CO, SO₂, NO_x, PM_{2.5}/PM₁₀), Greenhouse Gases (CO₂, CH₄), Aerosol properties (Chemical composition, Size-resolved number concentration, light scattering/absorption, dry/wet deposition, etc.), Reactive gases (VOCs), and further information on aerosol formation (nucleation).

For the [CAO-AMX](#) station (National Facility), these observations are part of the European Research Infrastructure [ACTRIS](#) (Aerosol, Clouds and Trace Gases Research Infrastructure) that is currently supported (for Annual Membership) by the Cyprus Deputy Ministry of Research, Innovation, and Digital Policy ([DMRID](#)). This station is also a component of the [WMO-GAW](#) (World Meteorological Organization - Global Atmospheric Watch) network (as Regional Station), and contributes to the [EMEP](#) (European Monitoring and Evaluation Programme) network. Atmospheric observations are provided in Open Access to these different networks (e.g. [EBAS](#) atmospheric database) and follow strict quality control procedures regularly checked with the support of WMO, ACTRIS, EMEP, IAEA, etc. Cyprus Atmospheric data from CAO network (The Cyprus Institute): Real-time (level 0) data display of the major CAO stations are provided in Open Access (<https://emme-care.cyi.ac.cy/data/>).



Figure 8.3.: Pictures of the four (4) ground-based monitoring stations of the Cyprus Atmospheric Observatory (CAO) currently operated by the Climate and Atmosphere Research Center (CARE-C) of the Cyprus Institute. (Right) Logos of the international networks under which the CAO stations are operating

8.3.1.2. Remote sensing observations: As part of the CAO network a comprehensive suite of remote sensing observations are performed continuously over Cyprus and relate to

- + Long-term vertical profiling of aerosol/cloud properties obtained by sunphotometers part of [AERONET](#) (Aerosol Robotic Network) network (CAO-NIC, CAO-AMX, LIMASSOL), and by LIDAR/ceilometers for aerosol vertically-resolved profiling. Real-time (level 0) data of sunphotometers are accessible in real-time at AERONET webpage. Remote sensing observations at Limassol are performed by the [ERASTOTHENES](#) Center of Excellence of the Cyprus University of Technology
- + Long-term Vertical (column integrated) greenhouse gas (CO₂, CH₄, N₂O) observations through passive spectroscopy that are part of the [TCCON](#) (Total Carbon Column Observing Network) and aims (after forthcoming upgrade) to be part of the [NDACC](#) (Network for the Detection of Atmospheric Composition Change).
- + Long-term solar radiation observations that aims to become part of the [WRMC-BSRN](#) (World Radiation Monitoring Center – Baseline Surface Radiation Network)

8.3.1.3. Atmospheric data availability:

Cyprus Air Quality data (DLI): <https://www.airquality.dli.mlsi.gov.cy/>
 Cyprus Weather data (DoM): http://www.moa.gov.cy/moa/dm/dm.nsf/home_en/home_en?openform
 Cyprus Atmospheric composition data (CAO, The Cyprus Institute): see networks above.

8.3.2. Oceanic observation

Oceanic observation is performed by the following programmes of the Cyprus Oceanography Centre⁹³:

Hydrochanges: The CIESM body coordinates and brings together all kinds of marine scientists from the Mediterranean and Black Seas. It has encouraged this initiative to increase the number of sensors in the very deep ocean for detecting climatic changes. Currently, it is an umbrella and networking agent for countries and institutions who wish to develop such long-term observing programs in the deep sea. In situ measurements of temperature and salinity, collected with adequate spatial and temporal resolutions, and with particular attention to sensitive, often long-neglected Mediterranean areas (straits and channels, zones of dense water formation, deeper parts of the basins), constitute a priority,

⁹³ www.oceanography.ucy.ac.cy

particularly in the current context of global climate change. To this effect, our CIESM program is deploying/ monitoring an array of stations that could be viewed in time as the marine counterpart of meteorological stations. A station is composed of a short (~10 m high) subsurface mooring equipped with an autonomous CTD (1 to 2-hr sampling interval) and usually a current-meter. Moorings are set in place close to the seabed at depths ranging from 300 to 2,500 m, for periods of 1-2 years before recovery (for maintenance and calibration) and re-deployment, by scientific teams and/ or hydrographic services of participating countries. More than twenty stations are already in operation, plus those susceptible to be deployed soon, are indicated on the map below. The partner from Cyprus is the Oceanography centre.

MEDship: The CIESM body coordinates and brings together all kinds of marine scientists from the Mediterranean and Black Seas. It has encouraged this initiative to increase the number and quality of ship-based observations of physical, chemical, and biological in the Mediterranean. Special emphasis is given on the deepest layers and longest (climatic) time scales. A link has been made with a similar global initiative called 'GO-SHIP', in which high standards for data collection, analysis, and distribution are set for the global oceans. This program is actively seeking funding to be implemented, but already coordination between partners is taking place. The partner from Cyprus is the Oceanography centre.

8.3.3. Terrestrial observation

Observation System on quantity/quality of surface water⁹⁴

The Water Development Department (WDD) is responsible for implementing the water policy of the Ministry of Agriculture, Natural Resources and Environment, to provide effective protection, rational development and sustainable management of water resources in Cyprus. In this context, the WDD implements the necessary measures to prevent the qualitative and quantitative deterioration of water bodies from contamination, pollution and uncontrolled exploitation. The WDD is also responsible for the feasibility studies, design, implementation, operation and maintenance of infrastructure, such as dams, ponds, irrigation, domestic water supply and sewerage schemes, water and wastewater treatment and recycling systems, as well as desalination plants.

In order to fulfil its mission, the Department systematically collects, classifies, archives, analyses and evaluates hydrological, hydro-geological, geotechnical and other data necessary for the protection and sustainable management of water resources in Cyprus.

In the field of quantitative monitoring of surface waters, continuous stream flow monitoring takes place at 52 hydrometric stations. In addition, the flows of 45 springs are measured on a regular basis.

Qualitative monitoring of surface waters, takes place at 45 river monitoring stations at a frequency of 9 times annually and 13 lake (reservoir) monitoring stations at a frequency of 4 and 6 times annually. Elements for biological monitoring: macroinvertebrates, phytobenthos, macrophytes and chlorophyll a. Parameters for chemical monitoring: Metals, VOCs, Pesticides, PCBs and PAHs. Additional monitoring parameters are nutrients, microbiology, ecotoxicology and physico-chemical parameters (Temp., pH, EC, DO, Turbidity).

⁹⁴ Water development department website, www.moa.gov.cy/wdd

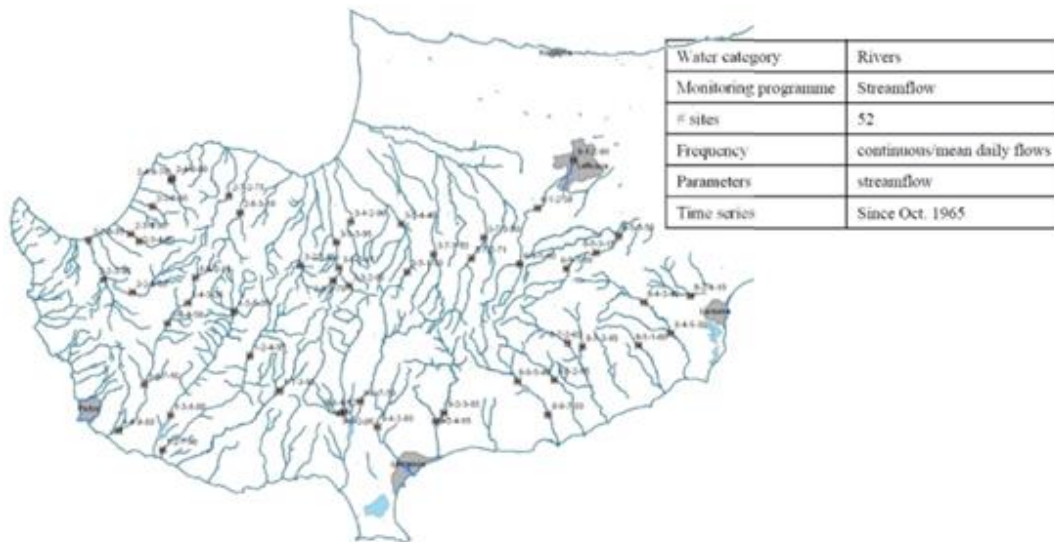


Figure 8.4. Surface waters quantitative monitoring stations⁹⁵

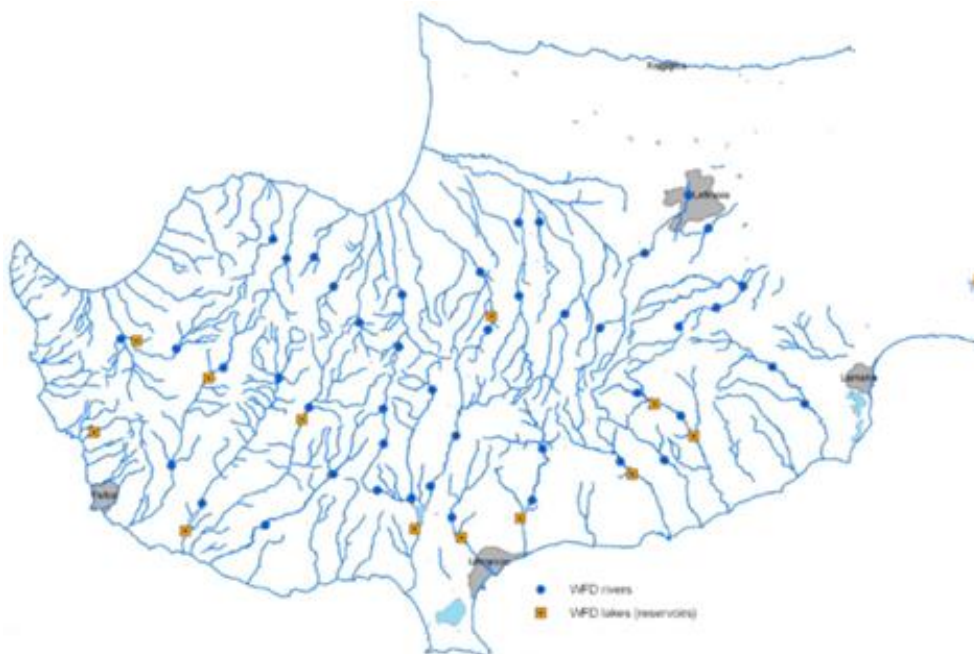


Figure 8.5. Surface waters qualitative monitoring stations

⁹⁵ Gerald Dörflinger, 2011. The Cyprus Water Development Department: Water data collection, data bases, access and utilization of data by third parties; presented at Data Repositories and Computational Infrastructure for Environmental and Climate Studies in the Eastern Mediterranean 2nd DARECLIMED Workshop; available from [http://www.moa.gov.cy/moa/wdd/WDD.nsf/All/24A949CC66A15BF5C22579DB0028205E/\\$file/DARECLIMED_G_Dorflinger_15Dec2011.pdf](http://www.moa.gov.cy/moa/wdd/WDD.nsf/All/24A949CC66A15BF5C22579DB0028205E/$file/DARECLIMED_G_Dorflinger_15Dec2011.pdf)

Forest ecosystem health observation⁹⁶

Forest ecosystem health observation belongs to the responsibility of the Department of Forests. It is accomplished through the monitoring programs implemented in forest ecosystems of Cyprus. These programs are classified into three categories, depending on the agent which threatens the stability of forest ecosystems:

- (a) Annual surveys for quarantine harmful organisms. The survey is carried out for specific harmful organisms which are described under the Council Directive 2000/29/EC. The survey aims to the verification of the absence of pests which their introduction into the Community will cause extensive damages to forest plants and products. Surveys are carried out by plant health inspectors and the results are submitted annually to the EU.
- (b) Monitoring Program for Pine Processionary Caterpillar (*Thaumetopoea wilkinsonii*). Pine processionary caterpillar is a very common harmful insect (defoliator) causing extensive damages to the pine ecosystems of Cyprus. Monitoring program includes the establishment of permanent plots and the annual data are very useful in application control measures.
- (c) ICP Forests-Biomonitoring Program. The Department of Forests participates in the program which is one of the world's largest biomonitoring networks, where more than 40 countries are involved. Its aims are:
 - to provide a periodic overview on the spatial and temporal variation of forest condition in relation to anthropogenic and natural stress factors (in particular air pollution) by means of European-wide and national large-scale representative monitoring on a systematic network;
 - to gain a better understanding of the cause-effect relationships between the condition of forest ecosystems and anthropogenic as well as natural stress factors (in particular air pollution) by means of intensive monitoring on a number of selected permanent observation plots spread over Europe and to study the development of important forest ecosystems in Europe.

The results of the program provide information on forest health, air pollution, climate change and biodiversity.

8.3.4. Satellite Observation

8.3.4.1. GMES

The Republic of Cyprus as a European Union member state participates in the European program Copernicus (ex GMES). The "Regulation (EU) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013)" set the framework of the programme.

The GMES programme is built on the research activities carried out under Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013) and the GMES Space Component Programme of ESA.

The GMES programme is comprised the following:

- (a) a service component ensuring access to information in support of the following areas:
 - atmosphere monitoring,
 - climate change monitoring in support of adaptation and mitigation policies,
 - emergency management,
 - land monitoring,
 - marine environment monitoring,
 - security;

⁹⁶ Dr. Andreas K. Christou, Senior Forest Conservator, Head of Research, Publicity & Silviculture Sector, Department of Forests, 1414, Nicosia, Cyprus, Tel.: 22819490, e-mail: achristou@fd.moa.gov.cy

- (b) a space component ensuring sustainable spaceborne observations for the service areas referred to in point (a);
- (c) an in-situ component ensuring observations through airborne, seaborne and ground-based installations for the service areas referred to in point (a).

8.3.4.2. Copernicus

The Copernicus programme is the continuation program of GMES and is a civil, user driven programme under civil control, building on the existing national and European capacities, as well as ensuring continuity with the activities achieved under the Global Monitoring for Environment and Security (GMES). The maximum amount allocated by the European Union to implement its activities shall be EUR 3.786 million at 2011 prices for the period from 1 January 2014 to 31 December 2020.

8.3.4.3. Copernicus Climate Change Service

The Copernicus Climate Change Service provides information to increase the knowledge base to support adaptation and mitigation policies. It contributes to the provision of Essential Climate Variables (ECVs), climate analyses, projections and indicators at temporal and spatial scales relevant to adaptation and mitigation strategies for the various European Union's sectorial and societal benefit areas.

The Climate Change Service (C3S)⁹⁷ is designed to increase the knowledge base in support of adaptation and mitigation policies. The Climate Change service contributes to the observations, reanalyses and projections of Essential Climate Variables (ECVs) among other quantities. Series of climate impact indicators are generated on the basis of these geophysical field and regularly updated and then feed into various types of products (maps, reports, etc.) tailored to policy applications.

The service is organized around four complementary blocks: A Consistent Climate Data store (CDS), a Sectoral Information System (SIS), an Evaluation and Quality Control (EQC) platform and, finally, an Outreach and Dissemination (OD) platform. It is established and its performance routinely assessed according to common practice for an operational service. The success of the implementation of the proposed service largely relies on the quality of the information flow and the overall coordination between the various blocks. Series of precise, well-defined and operational procedures are defined and established such that the information delivered to the end-user is fully traceable, quality controlled and disseminated within the most appropriate time. The articulation between the different public national and international institutions and the private sector that are involved in the Climate Change service through the entire production and dissemination chain is a critical element of the operations.

National Coordination

The Department of Electronic Communications (DEC) of the Ministry of Communications and Works, as the responsible department for space policy, is the national coordinator of the Copernicus programme, one of the flagship programmes for the European Space Policy sector. The role of the DEC is to coordinate the relevant governmental departments that have the knowledge and the expertise of the various services of the programme. The DEC will also contribute in the area of radiofrequencies that are related to the programme, as it is also the national frequency manager.

The services of the programme relevant to climate change issues have been allocated as follows:

- Atmosphere monitoring service: Department of Meteorology and Department of Labour Inspection
- Climate change monitoring service: Department of Environment
- Land monitoring service: Department of Lands and Surveys
- Marine environment monitoring service: Department of Fisheries and Marine Research, Department of Environment, Department of Meteorology, Cyprus Police and University of Cyprus(Cyprus Oceanography Centre)

⁹⁷<https://climate.copernicus.eu/>

Support for developing countries to establish and maintain observing systems and related data and monitoring systems

Several challenges prevent many neighboring countries to initiate long-term atmospheric observations (weather, air quality, climate forcers) including the lack of scientific/technical knowledge, the absence of national/regional networks to better coordinate efforts and resources, and other issues related to open-access data, in particular in regards to greenhouse gas emissions from the oil and gas industry. With the objective to address all these issues and build national capacities in the EMME region, the Cyprus Institute is aiming at developing a comprehensive regional collaboration network to promote the establishment of atmospheric monitoring optimally connected to international networks (incl. EU Research Infrastructure) and satellite-based observations (ESA, NASA) that still require ground-truth validation. This activity falls under the mission of the Climate & Atmosphere Research Center of the Cyl which has received a total funding of 15M€ from the European Commission (through the Horizon 2020 EMME-CARE project) and 15M€ complementary funding from the Cyprus Government to address issues related to Air Pollution and Climate Change in the Eastern Mediterranean and Middle East (EMME) region.

The scientific network established by the Cyprus Institute on the topic related to air pollution and climate change is illustrated below.



Figure 8.6. Scientific collaboration network established by the Cyprus Institute to further promote atmospheric observations to address regional/global issues related to air pollution and climate change

This regional collaboration network is actively contributing to the exchange of scientific knowledge that takes place annually through the (on-line) “Climate and Atmosphere Research & Innovation in the Eastern Mediterranean & Middle East” workshop that brings altogether over 300 scientific experts from the region. Complementary scientific/technical capacity building and scientific collaboration activities are also implemented such as Joint Scientific Publications in top journals on regional climate change projections (Zittis et al., Review of Geophysics, 2022), the “EMME-CARE Autumn school”, and the EMME Climate Change initiative (EMME-CCI) led by the President of the Republic of Cyprus which has mobilized over 220 scientific experts primarily from the Eastern Mediterranean and Middle East (EMME) region to establish 13 Scientific Tasks to establish the ever regional assessment of climate change.

There are also different mechanisms and strategies that are currently put in place to support regional capacity building in the EMME region, as listed below:

- The EU Horizon 2020 "EMME-CARE" (2019-2026) which aims to establish a regional (EMME) scientific collaboration network in the EMME region (Coord. The Cyprus Institute)
- On-line scientific workshops on Air Pollution & Climate Change in the EMME region (led by the Cyprus Institute and bringing > 250 scientists from the EMME region every year)
- Leading the MENA-CORDEX regional node and helping regional countries with their national climate projections (e.g. Israel Met Service through collab. agreement)
- Bilateral collaboration agreements with Research Performing Organizations and Governmental Environmental Agencies (e.g. in Lebanon, Egypt, Kuwait, U.A.E., Qatar, etc)
- Field campaigns to enhance atmospheric observations (Greenhouse Gases, Air pollutants) in the EMME region (Egypt, Lebanon, U.A.E., etc)
- Other (competitive) funding opportunities such as World Bank to support national capacity building on air pollutants and short-lived climate pollutants (e.g. Egypt)

8.3.4.4. European Space Agency

In October 2008 the Council of Ministers (Decision of No. 67.802) gave the political responsibility of the space policy sector to the Minister of the Communication and Works and tasked the DEC to be the Executive Body to formulate and implement the national policies. DEC was also appointed as ESA counterpart for the implementation of the ESA – Cyprus cooperation.

The ESA – Cyprus Cooperation Agreement was signed by Mr Peter Hulsroj, ESA Director of Legal Affairs and External Relations and, Mr Michael Constantinides, Permanent Secretary of the Ministry of Communications and Works of Cyprus on 27 August 2009. The said agreement was ratified by Law N. 1(III)/2010 and was published in the Official Gazette of the Republic on 5/3/2010.

In 2011 technical experts from ESA visited Cyprus in order:

- to support the creation of a database of companies/institutes/universities that are interested in participating in space activities;
- to map the existing capabilities of the country;
- to facilitate the identification of areas where a specific intervention will lead to an effective participation of the industry and academia through the European Cooperating State Agreement with the European Space Agency if so requested by Cyprus.

In their analysis report the ESA experts stated that the overall assessment following the exercise is that Cyprus is a country with intellectual infrastructure and technical capabilities pertinent to space.

Existing capabilities could be used as leverage for space related activities in the areas of Earth observation, navigation and telecommunication downstream added services, possibly in ground-based long-term testing and characterization of solar generators and niche material research and turbulent flow modelling.

The mechanism for implementing the findings of the assessment will be discussed with Cyprus in order to appropriately support the conclusion of an ECS Agreement. It is recognized by both sides that the conclusion of an ECS Agreement should take place as soon as possible. However, a smooth transition between the Cooperation Agreement and the ECS Agreement should be ensured.

8.3.5 Opportunities for and barriers to free and open international exchange of data and information

Information on the identification of opportunities and barriers to free and open international exchange of data and information on action taken to overcome barriers is provided below.

Opportunities

- Satellite-based observations allowed Cyl, to write peer-review, open access scientific publications to assess National Emissions of NO₂ from Egypt⁹⁸ and for Qatar (currently under review)

⁹⁸ Rey-Pommier et al., 2022; available at <https://acp.copernicus.org/articles/22/11505/2022/>

- Ship-borne observations in international waters (Mediterranean, Red Sea, Gulf), allowed Cyl us to write peer-review open scientific publications to assess Air Pollution and GHG concentrations in the EMME region and highlight for instance the major influence of the Oil & Gas industry.
- Cyl is developing with EU partners several scientific tools to assess GHG emissions in the EMME region from satellite-based observations, activity data, etc.

Obstacles/barriers

- Some countries of the region have stopped Cyl's initiatives to measure Air Pollutants / Greenhouse Gases in their country (although we have established strong local scientific partnerships with signed collaboration agreements with national research performing organizations). E.g. Scientific instruments blocked at the custom
- Some other countries are requesting to be consulted before any scientific publications of atmospheric observations performed in their country - Cyl have tried (with no success yet) to obtain funds from competitive EU calls to build a comprehensive regional network to monitor GHG concentrations (Cyprus, Lebanon, Egypt, Jordan).

8.4. Research⁹⁹

The Research Promotion Foundation (RPF) announced in September 2016 the RESTART 2016-2020 Work Programme for Research, Technological Development and Innovation for the 2016-2020 period, which will hereinafter be referred to as "RESTART 2016-2020 Programmes". It referred to three (3) Strategy Pillars, which reflected the strategic objectives of the RESTART 2016-2020 Programmes and to 22 specific Programmes, each having its individual specialised objectives. Moreover, it is co-funded by the Republic of Cyprus (through the RPF budget) and the European Regional Development Fund for the 2016-2020 period.

The main objectives of the RESTART 2016-2020 Programmes, which reflect on the three (3) main Strategy Pillars, were the following:

1. Smart development, with focus on selected priority sectors, through supporting the effectiveness of the RTDI System in Cyprus, its association with the productive base of the Economy, the enhancement of its extroversion and the reinforcement of its links and interoperability between its components.
2. Ensuring the sustainability and dynamics of the Research, Technological Development and Innovation (RTDI) system and to reinforce its future perspectives, focusing on excellence and on the support of human resources, especially those of the younger generation.
3. Support the operational framework of the RTDI system and production of added value resulting from research and innovation activities, through the development of supportive instruments and pilot measures, the encouragement for dissemination and exploitation of research results, and the cultivation and promotion of appropriate culture.

8.4.1. Priority Sectors of the Smart Specialisation Strategy

The Priority Sectors that have been selected through the study for Smart Specialisation Strategy for Cyprus (S3Cy) are the following:

- The Sectors of "Tourism" and "Energy" as the dominant priority sectors.
- The Sectors of "Agriculture- Food Industry¹⁰⁰", "Built Environment- Construction Industry", "Transport- Shipping" and "Health", as secondary priority sectors, and

⁹⁹Maria Andreou – Ieridou, Scientific Officer, Research Promotion Foundation, PO Box 23422, 1683 Nicosia; tel. +357-22205063; e-mail. mandreou@research.org.cy

¹⁰⁰ In the framework of "Agriculture- Food Industry" Sector only activities relating to research and development in this sector, will be funded by the Research Promotion Foundation through the European Regional Development Fund. Activities relating to the active involvement of farmers in the cultivation of cooperation culture and the adoption of innovative methods and practices in order to solve problems in the field of Agriculture, will be financed by the relevant Programmes of the Ministry of Agriculture, Rural Development and Environment, via the European Agricultural Fund for Rural Development.

- The Sectors of “Information and Communication Technologies”, “Sustainable Growth-Environment” and “Key Enabling Technologies (KET)” as important Horizontal Sectors which, beyond their intrinsic importance, deeply affect the qualitative development of the Priority Sectors.

Horizontal Priority Sectors

The emphasis of horizontal sector “Sustainable Growth- Environment” is placed upon the following areas, which present important prospects and challenges:

- Adaptation to Climate Change- Prevention and Management of Risks: Monitoring and Management Systems, Protection of Critical Infrastructures and Mitigation of Desertification
- Rational Management of Nature Resources with Emphasis on Water Resources and the Protection of Ecosystem and Biodiversity
- Conservation, Promotion and Exploitation of Cultural Heritage
- Sustainable Blue Growth

In the “Information and Communication Technologies (ICT)” horizontal priority sector, the emphasis is placed, but not limited to, on the following areas:

- Information Technologies
 - Software: innovative software, multimedia and graphics applications, knowledge and content management technologies- bigdata, language technologies, new internet applications- cloud services
 - Hardware: smart systems, optimisations of hardware and processing power, high efficiency computational systems, system interoperability, Artificial Intelligence, robotics, sensors
- Communication Technologies
 - Networks: security, high capacity, flexibility network management
 - Wireless and Satellite Communication: new generation wireless and mobile networks, mobile broadband networks, 4th generation network applications, remote sensing
 - High Speed Transmission Media: optical fibres, light wave networks
- Horizontal ICT Applications
 - Digital Tourism and Culture: tele-service, web observatories, product management and promotion, digitalisation of cultural heritage, 3D representation
 - Digital Education: e-learning, computer assisted and interactive learning
 - Digital Health and Quality of Life: health management, systems, tele-medicine, tele-examination, digital integration and assistance, ICT assisted independent living, innovative diagnostic imaging approaches
 - Promotion of Ecological Technologies: smart distribution systems, water management, environmental monitoring, smart energy applications
 - Digital Governance, Labour and Entrepreneurship: tele-working, e-commerce, citizen service systems, integrated public service management systems.

The horizontal priorities include the field of Key Enabling Technologies (KET). KETs are the technological building blocks which provide important prospects for innovation and contribute to the development and manufacturing of advanced products and the application of reforms and improvements in productivity and performance, thereby being of vital importance for the evolvement of the industry sector and for addressing significant societal challenges.

8.4.2. Association between Programmes and Priority Sectors

The relation between the Programmes of Pillar I with the Priority Sectors with Thematic Focus and the Horizontal Priority Sectors is shown in the Table 8.2. This is further specified in Programme descriptions.

Cyprus, through the RPF and in particular the Programme “European Initiatives – National Development”, participates in the following European initiatives, which aim at coordinating the funding of research activity and the establishment of research priorities at a pan-European level, through the formulation and implementation of Joint Research Programmes:

- M.ERA-NET: Materials-Energy,
- SOLAR ERA-NET: Solar Energy
- Water Challenges for a Changing World: Environment- Tourism,
- URBAN EUROPE: Global Challenges – Local Solutions: Urban development- Construction Industry- Environment,
- Agriculture, Food Security and Climate Change (FACCE): Agriculture- Food Industry- Environment, and
- Cultural Heritage and Global Change: A New Challenge for Europe: Cultural Heritage- Tourism- ICT- Environment.

Table 8.2. Requirements for targeting of projects of pillar in priority sectors with thematic focus and/or horizontal priority sectors

SECTION	PROGRAMME	SECTORS WITH THEMATIC FOCUS						HORIZONTAL SECTORS		
		TOURISM	ENERGY	AGRICULTURE - FOOD INDUSTRY	BUILT ENVIRONMENT- CONSTRUCTION INDUSTRY	TRANSPORT- SHIPPING	HEALTH	SUSTAINABLE GROWTH- ENVIRONMENT	ICT	KET
R&I Partnerships	Integrated Projects	X	X	X	X	X	X			
Infrastructures	New Strategic Infrastructure Units- Young Scientists	*	*	*	*	*	*	*	X	X
Participation of Enterprises	Research in Enterprises	X	X	X	X	X	X	X	X	
	Research in Start- Ups	X	X	X	X	X	X	X	X	
	Proof of Concept for Technology/ Knowhow Applications	X	X	X	X	X	X	X	X	
Extroversion- Open Horizons	Bilateral Collaborations	X	X	X	X	X	X	X	X	
	International Collaboration- Dual Targeting	X	X	X	X	X	X	X	X	
	EUREKA Cyprus	X	X	X	X	X	X	X	X	
	European Initiatives- National Development	X	X	X	X	X	X	X	X	

** The New Strategic Infrastructure Units- Young Scientists Programme anticipates the implementation of Projects in the field of ICT and KETs, with applications in the six Thematic Priority Sectors as well as the Horizontal Sector "Sustainable Growth- Environment".*

8.4.3. Success stories: CARE-C

CARE-C¹⁰¹ is a regional European Centre of Excellence for Climate and Atmosphere Research, based in Cyprus, for the Eastern Mediterranean and Middle East (EMME) region. CARE-C is focused on addressing urgent climate change and air pollution challenges and impacts in the EMME, which has been recognized as a global climate change “hotspot”. The EMME is already facing adverse effects such as heat waves, droughts and atmospheric dust storms which are only due to intensify in the coming decades. Without proper mitigation and adaptation actions, these harmful effects could soon lead to intolerable environmental conditions, ultimately forcing mass migration for the 400 million people living in the area, with widespread health and socio-economic implications for the region and the planet.

The EMME is also a region with a complex geopolitical landscape, that historically has had limited dedicated scientific resources for climate research. CARE-C has set to address these challenges through a combination of research, innovation and education actions with a regional focus.

CARE-C was founded at the Cyprus Institute in January 2020 through competitive funding secured from the European Commission and the Cyprus Government, in the framework of the European Commission Horizon-2020-TEAMING project “EMME-CARE” (Eastern Mediterranean and Middle East Climate and Atmosphere Research Centre; Grant no. 856612).

The Centre was established in cooperation with EU Advanced Partners: the Max Planck Institute for Chemistry in Mainz in Germany, the Alternative Energies and Atomic Energy Commission (CEA) in France, and the University of Helsinki (UHEL) in Finland.

Activities are organized within four dedicated Research Departments:

- Environmental Observations, conducting continuous long-term measurements of atmospheric composition, related environmental parameters and trends, and analysis of atmospheric loads and interactions of gaseous and aerosol pollutants in urban and remote regions of the EMME to further our understanding of the changing regional environment
- Environmental Predictions, dedicated to the study of the role of anthropogenic emissions in biogeochemical cycles, air quality and climate change with a focus on the EMME region
- Impact and Policy, dedicated to pursuing multi- and cross-disciplinary research on societal challenges needing regional and local solutions
- Innovation, identifying attractive commercial research applications that contribute to sustainable economic growth for Cyprus and the region and ensure the Centre’s financial longevity

Some examples of the work CARE-C is undertaken for different research filed is presented below:

- a. Climate process and climate system studies including, paleoclimatic studies: Research on the drivers of accelerated warming in Mediterranean climate-type regions.
- b. Research on the impacts of climate change: RIF Integrated Research Project (2019-2023), coordinated by The Cyprus Institute. The project aims to improve agricultural production and food processing in the Troodos Mountains of Cyprus, through social innovation, sustainable natural resource management and climate change adaptation
- c. Socioeconomic analysis, including analysis of both the impacts of climate change and response options: Estimations of increased energy demand for desalination in Cyprus under different scenarios of climate change
- d. Research and development of mitigation and adaptation approaches, including technologies: The Cyprus Government Initiative aims to bring the EMME region together to coordinate a concerted regional response to address the climate crisis, in line with the goals of the Paris Agreement. A Regional Climate Action Plan for climate change mitigation and adaptation is developed (first report presented in COP27).

¹⁰¹ emme-care.cyi.ac.cy

9. Education, training and public awareness

9.1. Introduction

It is generally acknowledged that combating climate change will be a success only if the danger is widely known and understood by the public and especially by those who have to undertake mitigation and adaptation measures. This can be accomplished with intensive education, awareness and training efforts at all levels.

For this purpose, as part of the programme for the implementation of the Convention and the New Delhi Programme, and the relevant provisions of the Kyoto Protocol, Cyprus has carried out a series of actions, which are presented below, aiming at the integration of climate change issues at all educational levels and disciplines, the dissemination of information and promotion of participation of youth, stakeholders, and public, as well as the enhancement of cooperation and co-ordination at regional and international level to promote capacity building.

9.2. General policy toward education, training and public awareness

Climate change in the context of formal and non - formal education is an issue of interdisciplinary investigation and interconnected with all the issues of environment and sustainable development as a matter of national, regional and international interest. The consideration of climate change in this context relies on the fact that climate change is not a mono-dimensional problem, cut off from the rest of the Sustainable Development issues, but could be the apparent cause and consequence of a chain of direct and indirect human effects on all environmental and Sustainable issues. Within this context the issue of climate change is considered an intrinsic part of the National Action Plan for Environmental Education with focus on Education for Sustainable Development (NAPEESD) (CPI 2007) which is considered the most important policy document on EE/ESD in Cyprus. It was approved and enacted by the Ministerial Board (2007). It is noted that the National Strategy on Education for Sustainable Development is under revision aiming to cover the period 2022-2030 and aims to give emphasis on green transition and Sustainable Development Goals in Education in formal, non-formal and in-formal education. In the revised National Action Plan on ESD special emphasis is given to climate change is “captured” holistically in the school process and not just an issue for teaching through curricula. More specifically through the revised action plan on ESD special emphasis given to youth empowerment on climate action, to transforming schools as learning communities for SDGs, including climate change, by promoting programs for greening school infrastructures (school yards, using of renewable resources of energy, supporting local products, strengthening sustainable mobility etc). Access of environmental information to the public is provided through the websites of the relevant Ministries and other governmental agencies. With the ratification of the Aarhus Convention, Cyprus has posed legal obligations for the access of information regarding the state of the Environment. In addition, law no. 119(I)/2004 by which Cyprus incorporated the Directive 2003/4/EC on “public access to environmental information” into national legislation, seeks to increase public access and dissemination of information, contributing to a greater public awareness in decision making and environmental protection. According to this law, “environmental information” includes information related to climate change such as: state of elements (among others air, atmosphere, water, coastal areas, biological diversity, and the interactions among them), factors (e.g., emissions, energy), policies and measures, reports, cost-benefit analyses.

The Cypriot Government gives high priority to public consultation and awareness. Draft legislation related to climate change, energy and environmental issues are open to public consultation before their adoption.

9.3. Primary, secondary and higher education

9.3.1. Curriculum on Environmental Education (EE) and Education for Sustainable Development (ESD)

Through the Curriculum of EE/ESD which is an important innovation in the educational system of Cyprus and is formatted in a uniform and systematic way in pre-primary and primary education, the issue of climate change examined through all the other related thematic units such as energy, production and consumption, urbanization, waste, water, transportation, as well as the Sustainable Development Goals. Specifically, it is aimed that students understand in a systematic and holistic way that the problem of climate change is complex, has multiple causes and effects both locally and globally. For this purpose within the education process the issue is viewed through the social, political and cultural aspects, along with the environmental. Climate change is first examined in the immediate local environment of students and then extends through various teaching techniques, applications and examples globally.

For this purpose in the learning process a variety of methodological and pedagogical approaches (experiential learning, simulations, investigations etc) applied in order to help students understand the impact of climate change on a local and global level. Also, the pedagogical principles of Environmental Education and Education for Sustainable Development as intergenerational communication, interaction with place, holistic investigation and action community are applied for studying climate changes.

Examples of issues that are approached through the curriculum of EE/ESD on climate change are:

- Study of the effects of water scarcity at local and global level and awareness of the extent and complexity of the problem across the globe.
- Correlation of water shortage with other issues such as climate change and desertification.
- A study of the factors that contributed to the intensity of the problem of climate change.
- Reflection upon our responsibility on addressing the phenomenon of climate change and suggestion of measures to alleviate the problem.
- Investigation of the measures and actions taken at national and global level to address climate change.
- Interconnection of climate change around the world with the decline of biodiversity.
- Interconnection of the greenhouse effect and global climate change through energy consumption.
- Study of the impact of the increasing use of motorized vehicles on the environment at local and global levels (air pollution, climate change, etc.).
- Awareness of the impact of climate change on social, economic and political level.
- Cooperation of students with agencies and organizations to promote information measures, information and participation in intervention programs on climate change.

It is noted that the above issues are indicative regarding the investigation of environmental issues, since as mentioned above, the twelve thematic units of the curriculum concerning all educational levels approach systematically the issue of climate change.

Additionally, in primary education, climate changes are part of the curriculum of all the distinct subjects. Indicatively through the subject of Science includes specific unit for the atmosphere pollution and the climate changes, aiming students be able to explain the green-house effects, the causes and its role to the climate change, as well as the actions and behaviours that eliminated it. According to the subject of Greek-language the oral and writing skills, as well as the development of students literacy is pursued through texts, activities, exercises as well as other educational means that consider the climate changes.

Special emphasis in the curriculum is given to Sustainable Development Issues and Climate Change through the STEM (Science, Technology, Engineering, Mathematics) pedagogical approach. Real life issues such as reducing energy from fossil fuels, creating a smart energy building, water management and school water supply are examined through STEM approach. The aim is students to investigate and analysis real life problems and through problem solving and systemic thinking to promote feasible solutions that can be applied in their context.

9.3.2. Educational tools for the study of climate change

The effective investigation of climate change in schools, prerequisite the development of the appropriate educational tools, that support the teaching of climate change in formal (school education) and non-formal education. Climate Change as a systemic issue is an intrinsic part of all the educational and pedagogical tools that produced by the Ministry of Education, Sport and Youth (Unit of Education for Environment and Sustainable Development), for Sustainable Development Issues. These tools based on synchronous and asynchronous learning. Indicatively are the educational tools "Issues in Education for Sustainable Development " and "Rational waste management". These, are supporting tools for the teacher and the student to study the issues of production and consumption, transportation, desertification, tourism, poverty, waste, where there is special emphasis on the study of climate change. Also, an education tool for energy efficiency developed aiming to introduce and support students and the school community to smart ways for reducing energy and also for using renewable resources of energy. It is noted that the study of the issue of climate change is through the application of pedagogical techniques of Environmental Education and Education for Sustainable Development such as debate, simulations, use of new technologies, moral dilemma, concept maps, experimental investigations, bibliographic research, field study, etc. The above tools concern Primary and Secondary Education as a means to support the curriculum of EE/ESD. During Covid-19 where schools closed and teaching switch on to the on-line learning a series of on-line tools developed related with the climate change. An indicative example is the series of 12 teaching lessons on food waste. The lessons raising awareness and especially educating students on issues related to food sustainable consumption and production, food safety, food waste management and reduction, composting, the adoption of sustainable practices to reduce food waste. All these lessons are closely related with the causes and impacts of climate change. The courses designed to provide unique pedagogical learning experiences through simulations, games, quizzes, learning scenarios and are used by both teachers and students. The design of the courses provides opportunities for immediate feedback in relation to the topics that each course examines and through interactive applications contributes to reflective learning.¹⁰²

Climate Change is also addressed through a series of education broadcasts on the TV web education channel. Educational broadcasts such as desertification and climate change, sustainable cities, climate change and food security, bioclimatic design are some of the issues that presented. All the broadcasts are used in teaching process in synchronous and asynchronous learning and it's an important tool for teachers, students and parents for being aware on climate change emergencies taking action now.¹⁰³

Finally, is in process for finalizing the educational tool The "SDGs and Global Citizenship are travelling" is an educational material with the aim of conveying to the educational community and to the civic society the message that " each and everyone of us, leading by personal and collective example, can contribute to the accomplishment of the sustainable development goals". Seventeen books, one for each SDG, "travel in a suitcase", to schools, to neighborhoods, to businesses, to communities and to organizations. The "travelling SDGs Suitcase" pursues to inform, raise awareness, awaken and mobilize each one of us, to make the necessary changes and interventions that will gradually and in the long term improve the quality of life and create the conditions for healthy, prosperous and sustainable societies. Climate Change is examined through the book "SDG13: Learning and Action for Climate Change", as well as a horizontal issue that permeates the rest of the books that planned to be published in 2023.

In Secondary Education, where the curriculum on EE/ESD has not yet been introduced, the issue of climate change is examined and studied through various subjects. Students though Biology, Physics, Geography and technology describe the greenhouse effect in terms of the interaction of radiation with matter. Students learn about the urbanisation and evaluate the evidence for additional anthropogenic causes of climate change, including the correlation between change in atmospheric carbon dioxide concentration and the consumption of fossil fuels. Students describe the potential effects of increased levels of carbon dioxide and methane on the Earth's climate and how these effects may be mitigated. Students discuss why is climate change important? The impacts of climate change on different sectors of society are interrelated. Drought can harm food production and human health. Flooding can lead to

¹⁰² <https://mepaa.moec.gov.cy/index.php/el/epimorfosi/imerides-seminaria-sinedria>

¹⁰³ <https://elearning.schools.ac.cy/index.php/el/monada-perivallontikis-ekpaidefsis>

disease spread and damages to ecosystems and infrastructure. Human health issues can increase mortality, impact food availability, and limit worker productivity.

Indicatively on how climate change is integrated through various subjects in secondary education are the examples below:

In Biology and Geography.

1st Grade Biology: Activity Book

Examination of Greenhouse effect

- The importance of plants to maintain stable amounts of carbon dioxide in the atmosphere
- Relationship of photosynthesis and greenhouse
- How the increase the amount of carbon dioxide in the atmosphere causes a rise in the average temperature of the Earth
- How humans can cope with the increase in the average temperature of the Earth
- Activity which refers to changing the behaviour of mouflon in times of scarcity

2nd Grade Biology Gymnasium: Activity Book

Topics included:

- Examination of the problem of climate change
- Investigation of the increase in average temperature in Cyprus from 1893 until today
- Investigation of the reduction of average rainfall in Cyprus from 1893 until today
- Investigation the impact of climate change on species' populations, ecosystems and ecological balance
- Human's role on the environmental of the problem of climate change
- Possible solutions, actions and behaviour changes on climate change that we can take individually or collectively
- Other environmental problems caused secondarily by climate change

1st Grade Geography: Book and workbook

- "The Earth and Man "
- Emphasis in anthropogenic systems.
- The global problems and challenges to be faced by humankind as expressed by the UN.
- Understanding and interpretation of human interactions with the environment and managing the challenges facing humanity, as is climate change.

Geography, Grade B Gymnasium: Book and workbook

The curriculum of Gymnasium Grade B Geography explores locally and internationally issues related to climate change as natural, urban and rural environments, natural hazards, natural resources management energy, management waste etc. The main issues which concern the curriculum of Grade B Geography are the ways in which they relate the above influencing factors, the patterns and the changes that occur and what will be the impact on the present and future generations.

Beyond the above subjects, climate changes are part of the curriculum of all the other subjects of secondary education (Physics, Chemistry, household economy, foreign languages etc) as a horizontal issue.

9.3.3. Higher Education

Several undergraduate and postgraduate programmes in Cypriot Universities deal with diverse aspects of climate change. Undergraduate programmes in Civil & Environmental Engineering and Environmental Science & Technology as well as postgraduate and doctoral programmes in Environmental Engineering, Energy Resource Management, Environmental Science, Environmental

Management, and Education for Sustainable Development, contain numerous courses on climate change impacts, economics, mitigation and climate change education.

9.4. Public information campaigns

One of the missions of the Department of the Environment is to inform and raise public awareness on environmental issues. Among the established campaigns that the Department of Environment organises and/or co-organises are the following:

- The Department of Environment participates every year with the established cycling tour of Nicosia in the European Mobility Week campaign which provides the opportunity to present sustainable mobility alternatives to local residents;
- Since 2014 the Department of Environment organizes along with other authorities and organizations the Cyprus Green Public Procurement Awards (CY GPP AWARDS) – EU Ecolabel. The CY GPP Awards is an institution that appears to have a strong response from Contracting Authorities, (State Authorities - Public Sector) and the Public Law Entities and the Local Authorities.
- In addition to the Green Public Procurement Awards, the European Ecolabel is awarded to Cypriot products. The Department of Environment which is also the EMAS Competent Authority, has implemented EU EMAS in its headquarters in Nicosia with the aim of protecting the environment and its own activities and staff, limiting and reducing its impact on the environment, through the day-to-day operation of the Department, hoping to follow its example other Public Authorities.
- The Department of Environment participates annually as a co-organizer at the Earth Hour celebration held at the Presidential Palace. Households, public buildings and businesses have been involved in turning off the lights for an hour, demonstrating the need to protect the environment and take action on climate change.
- Each year the Department of Environment participates in 'Let's Do it Cyprus' campaign which is part of the 'Let's Do it World' campaign that aims to clean the natural areas of the world from rubbish. The project is implemented in 94 countries all over the world. It is based on volunteer work and the goal is to clean up the waste recorded in the island in a single day. Public and local authorities, private companies, community service companies, recycling companies, non-governmental organizations, associations and schools participate in this effort in order to protect the environment and develop environmental awareness to ensure a cleaner tomorrow.
- The Department of Environment promotes and informs actions regarding climate change through radio and tv broadcasts, newspaper articles and promotional videos in social media.

Public participation for the preparation or domestic review of the national communication

Information for the preparation of the report was requested and provided from all relevant authorities. Furthermore, a large portion of the information included in the NC8/BR5 was provided from other strategic plans including the National Adaptation Strategy and the NECP 2021-2030 for Cyprus. These plans had extensive public consultations before completed and therefore the information included in the NC8/BR5 have been communicated to all different types of stakeholders. The consultations included public presentations that were covered by social media, a series of meetings where all affected stakeholders per sector were invited to provide their feedback.

More specifically for the NECP, the following actions were completed in terms of public consultation:

- Several meetings were held for energy and transport issues
- A presentation was given for the party of Movement of Ecologists — Citizens' Cooperation on 20 June 2018, on the obligations in the field of energy and climate, the mechanism for drawing up the plan and the description of the measures and policies envisaged achieving the relevant energy and climate objectives.

- Similar presentations were given on from July 2018 to March 2019 to research and academic institutions of Cyprus, trade associations and the scientific and technological chamber of Cyprus.
- A Workshop on ‘Research, Innovation and Competitiveness in the field of climate and energy’ was held on 10 September 2019. The aim of the workshop was to submit proposals within the framework of the consultation on national priorities and policies for a decade in the areas of Research, Innovation and Competitiveness in the field of Energy in order to keep pace with the cutting-edge technologies and at the same time to combine financial opportunities and capacities, and also to update the institutional requirements.
- A series of bilateral meeting were held in October 2019 with several environmental and ecological organisations and movements, including youth, trade associations and the scientific and technological chamber of Cyprus. During these meetings more details were provided on the contents of the NECP.
- The “official” presentation of the NECP was made during a whole day event on the 1st of November 2019, during which the proposed policies and measures were presented in detail, along with the impact assessment. A second event with the same content was organized in collaboration with the University of Cyprus on the 8th of November 2019 during which live streaming and live radio link was provided.
- The NECP was posted on for consultation on the website of the Department of Environment for a period of 26 days, from 21 October 2019 to 15 November 2019. 108 comments were received, including comments from associations of stakeholders, civil society organisations, companies active in the energy sector, universities / research centres and natural persons. The high participation of the youth is noticeable and should be emphasised.

9.5. Training programmes

9.5.1. Education and training of teachers on climate change

The Ministry of Education Sports and Youth, through the responsible Unit of Education for Environment and Sustainable Development (Unit of ESSD-Pedagogical Institute), emphasizes the importance of teacher’s professional development on climate change education. A series of Professional Development Courses are offered on Climate Change Education and are obligatory and optional. These courses varies on type and content, covering various aspects and elements of Climate Change Education.

- A. Obligatory Professional Development Courses** seek to strengthen teachers in the planning of actions against climate change, using the school and the community as the main field of action. The seminars are developed in four experiential workshops and promote the use of ESD teaching technics (role play, concept map, brainstorming etc). Seminars focuses on clarifying key concepts related to action, activity, and active citizenship, using examples from real life. Their aim is to help teachers in a practical way to understand the importance of planning actions against climate change, in a collective and participatory way. At the same time through the ESD Curricula, professional development courses offered to highlight the systemic relationship that exists between climate change and other global challenges (migration, poverty, environmental justice), as well as to reveal the emergency for taking action against climate change. During the obligatory seminars special emphasis is given to the investigation of issues related to Cyprus and Climate Change and the designing of several action plans related to those issues, as part of the Schools Sustainable Environmental Education Policy (SEEEP) in pre-primary and primary education and as part of the School Unit Improvement Plan in secondary education.

At the beginning of the academic year 2022-2023, a series of new professional development courses offered for climate change education for teachers in all educational levels. A three days courses: “Empowering students against climate change: Ideas, examples, and implementation of

climate change actions at school” and “Empower students against Climate Change” offered. At the end of each course, each trainee became a trainer and provided obligatory training related to Climate Change Education to his/her school aiming to support further the school community to deal with different aspects of Climate Change in school¹⁰⁴.

- **Optional Professional Development Courses** seek, through experiential workshops and interactive activities in schools, outdoor learning Environment, such as the Governmental Network of Environmental Education Centers, to strengthen the school community in teaching about climate change and planning actions against climate change related to their local community. Seminars include: a) the theoretical part, which is an introduction to the global issue of the Climate Crisis and b) the planning of actions against climate change. Indicative workshops that are offered are: Consumerism and climate change, Human Stories and Climate Change, Role play: Legislation to reduce greenhouse gas emissions, Young Leaders Against Climate Change, Climate Action: Supporting the 13th Sustainable Development Goal, Causes of Climate Change: Testimonies of Consumerism in the past and the present, Climate Change: Social, Economic and Environmental Implications, Mitigation and Adaptation: Target the Heart of the Problem, Climate Change in Cyprus. Some of the workshops are utilizing digital environments to promote ESD digital skills and aim to educate and train teachers on ways to leverage Climate Change-related digital lessons in the classroom (<https://view.genial.ly/616dbd3c2f11290dd53d84a5/presentation-spatalh-trofimwn-historia-mias-fraoylas-klimatikh-allagh>). More than 100 schools participated in this form of workshops.

Another course optional professional development course offered by the Unit of EESD, is on how to develop and implement STEAM projects in schools in order to tackle authentic word real problems including Climate Change. Through this 30-hour professional development course, three projects on various issues of climate change, designed and developed, aiming to operate as an example of good practice that can facilitate teachers to work with climate change issues more effectively in their school practice.

The Unit of EESD for supporting more effectively the teachers on climate change education created on Viber a community called "Educating about Climate Change" for providing promptly educational material and tools on the topic to teachers.

9.5.2. Environmental Education Programs

All environmental education programs applied in all educational levels (Pre-primary, Primary, Secondary, Vocational and Technical Education) coordinated (Gold- Leaf, Eco Schools, Young Reporters for the Environment, Globe, Semep, Litter less, Learning about Forests) approach climate change according to the theme processed by each participating school. Climate change is approached as a separate, independent study topic or incorporated dimensions of climate change on other related issues such as for example in the study of biodiversity.

Each program has its own objectives, but the ultimate purpose of all is the development of positive attitudes and behaviours concerning the environment and sustainable development, as well as their awareness on climate change. For example **The [South Eastern Mediterranean Sea Project \(SEMEP\)](#) is an interdisciplinary environmental education project under the auspices of UNESCO** which focuses primarily on the South Eastern Mediterranean sea region. Twenty secondary schools are involved in the project and teachers and students are involved in activities which are designed for an inductive or ‘inquiry’ field work approach that incorporates the processes of field research. In this program **Climate change issues** are introduced, key questions are raised, and students select methods to investigate and develop possible solutions to these. The teachers and researchers act as supervisors and advisors, providing equipment, advice and ensuring safe working. The field experiments **enable students to:** learn about organisms and environments, environmental and sustainability issues, explain everyday and technological applications of science, evaluate associated personal, social, economic and environmental implications, make decisions based on the evaluation of evidence and arguments, use

¹⁰⁴ <https://mepaa.moec.gov.cy/index.php/el/epimorfosi/imerides-seminaria-sinedria>

peer-reviewed literature as a foundation for communicating about climate change and living systems and use scientific vocabulary, terminology and definitions.

Additionally, the Unit of EESD developed the program “The Climate calls “S.O.S.”. This program developed in collaboration with the German Embassy, the Cyprus Institute, the office of the Commissioner of the Environment, the Cyprus Cartoons Association, The Animafest Cyprus. The program pursued to support the participants to understand the complexity of the climate change, to be aware of the systemic nature and the chain effects of Climate Change at the environmental, social, economic and political level, to be informed on actions promoted in the fight against climate change at the scientific and technological level, to get familiar with policies that promoted in EU against climate change, to be aware of the role and responsibility that each of us has in the deterioration, but also in addressing the issue of Climate Change, to acquaintance with actions and campaigns to enlighten and inform the public on the issue of Climate Change at local and global level, to introduce to information and awareness techniques, such as TV spots, cartoons, caricatures, informative posters, to be aware of the role and power that everyone has as a catalyst for change in the issue of Climate Change.

More than 2000 participated and the deliverables of this action were the development of children animated films and cartoons against climate change, which is used as information, awareness and education tool for the school community and the civil society¹⁰⁵.

9.6. Resource or information centres

The issue of climate change in terms of non-formal education is approached systematically through the Governmental Network of Environmental Education Centers of the Cyprus Ministry of Education Sports and Youth, which operates as a complementary structure of schools, with the aim of bringing environmental issues into fields of environmental interest and of transferring the learning process in terms of the environmental issues beyond and outside the context of the classroom. Specifically the issue of climate change is studied through all the Environmental Education Centers’ of the Governmental Network (Pedoulas, Akrotiri, Athalassa, Salamiou, Kavo-Greko, Koilani, Panagia) under specific environmental educational programs implemented at each center. For example, at Pedoulas Environmental Education Center climate change is discussed through environmental education programs concerning the biodiversity of the forests of the Troodos, the Amiantos mine field and desertification in the region, the degradation of soils. At the Athalassa Environmental Education Center, climate change is examined in relation to urbanization, transport and Athalassa National Forest Park. At the Akrotiri Community Environmental Education Center, climatic change is discussed in relation to the wetland and flora and fauna of the region. At the Salamiou Environmental Education Center, the issue of climate change is discussed in relation to local cultivations, at the Environmental Education Centre Kavo-Greko climate change is examined in conjunction with the environmental degradation of the area because of the non-sustainable tourism development. At Koilani Environmental Education Center climate change is investigated through its’ impacts on local cultivations and at Panagia Environmental Education Center Climate Change is examined through the programs of loss of biodiversity and the forest degradation. An important element in the study of climate change at the non - formal level is the fact that the issue is approached through field studies, where special attention is given to experimental investigation, the interaction of students with space and with local populations. Emphasis is given to the intergenerational communication and interaction aiming the students to have first-hand experiences on how the climate change, through the years, impacted on landscape and local communities’ life. Specifically, all the programs through which the issue of climate change is examined are presented in the website of [Unit](https://mepaa.moec.gov.cy/index.php/el/#) of EESD. <https://mepaa.moec.gov.cy/index.php/el/#>

9.7. Participation in International Activities

Ministry of Education Sport and Youth (MoESY), through the Unit of EESD, is actively involved in various international activities for climate change in education. Indicatively it is mentioned that Cyprus is chairing the UNECE ESD SC and had an intrinsic role on the preparation of the Framework for the implementation of the United Nations Economic Commission for Europe Strategy for Education for

¹⁰⁵ <https://elearning.schools.ac.cy/index.php/el/monada-perivallontikis-ekpaidefsis>

Sustainable Development from 2021 to 2030, where climate change and youth empowerment on climate action is considered as one of the key horizontal priority areas¹⁰⁶

Additionally, Cyprus with the Ministry of Education, Sports and Youth (MoESY) is leading the Mediterranean Committee on Education for Sustainable Development (ESD) and recently, during the UNECE 9th Ministerial Meeting for Environment for Europe that hosted in Cyprus, 5-7 of October 2022, the revised Mediterranean ESD Action Plan 2030, which adopted by the Ministers of Education and Environment, addressed the emergencies for a regional cooperation on climate action. Furthermore MoESY participated actively to the EC Working Group of Environmental Sustainability where specific policy recommendations to the Member States are given including climate action¹⁰⁷. Also, internationally MoESY is participating actively on the UNESCO Countries ESD2030 initiatives, where youth and climate action is a key issue. During the UNECE 9th Ministerial Meeting for EfE, Cyprus facilitated the organization of 40 side-events where Climate Change discussed in the framework of the sustainable Infrastructure, sustainable tourism and Education for Sustainable Development.

Furthermore, MoESY through bilateral and trilateral collaborations is developing with countries of Middle East and Eastern Mediterranean joint programs for empowering teachers, students and education institutions to work more actively against climate change initiatives. Indicatively, are mentioned the bilateral collaboration between Cyprus and Egypt, where Cyprus provides expertise and support at the Egyptian Schools on how to become sustainable and green schools. Also is provide a series of professional development courses to the teachers, for familiarizing them with pedagogical approaches and techniques that can use in their schools for climate change. In the framework of the regional collaboration the Unit of EESD lead the task force for Climate Change Education (CCE) and Outreach in the Eastern Mediterranean and Middle East and prepared the scientific report of the task force on climate change and outreach of the climate change initiative in the EMME Region. This report is a very useful tool for CCE in the EMME Region since it identifies the trends, commonalities and gaps of CCE in the EMME region and aims to help the countries of the region to develop synergies and collaborate to accelerate and integrate CCE into their educational policies and systems https://emme-cci.org/wp-content/uploads/CC_edu_in_EMME_report.pdf

Also, MoESY is participating at various international and regional frameworks where Climate Change is considered as a key strand such as Global Education Network in Europe, Mediterranean Information Office for Environment, Culture and Sustainable Development, Union of the Mediterranean.

It is noted that MoESY participated actively in the Pre-Cop26 Conference in Milan 30 of September till 2 of October 2021 for 'Youth4Climate: Driving Ambition'. Also, in Cop27 in Egypt MoESY will participate at the side-event for Climate Change in Education, that will take place at 10th of November 2022.

9.8. Monitoring, Review and Evaluation of the implementation of the Article 6 of the Convention

At national level the Unit of EESD operates as a permanent mechanism for the monitoring, review, implementing and evaluating the SDGs and Climate Change in formal, non-formal and informal education. The establishment of the Permanent Structure for EESD is a reference point for Cyprus because, as a permanent structure, it brings together all the actions related to ESD at the level of formal, non-formal and non-formal education for all education and civil society, which enables the interconnection of ESD policies and their complementarity. Secondly, the establishment of the Permanent Structure for EESD functions as a permanent structure for the design, monitoring, updating and evaluation of ESD at all levels of education and between Ministries, ensuring a) the institutional memory for the actions on ESD and climate change, b) its long-term and systematic implementation, c) its uniform application at all levels of education, d) the taking of immediate and corrective measures in cases where there are gaps in its implementation. Also, the fact that the staff of the EESD Unit comes from various scientific fields, such as the natural sciences, education, humanities, the social sciences,

¹⁰⁶ <https://unece.org/environment/documents/2022/05/working-documents/framework-implementation-united-nations-economic>

¹⁰⁷ <https://data.consilium.europa.eu/doc/document/ST-9242-2022-INIT/en/pdf>

enhances the peer learning and the enhancement of interdisciplinary learning experiences within the staff, a factor that contributes significantly to the promotion of actions and programs for climate change through which all dimensions of sustainability are highlighted.

At school level a self-assessment mechanism has been established for the school as a result of the introduction of the Education for Sustainable Development curriculum officially in pre-primary and primary education, where climate change is part. The ESD curriculum is connected with the development of the Sustainable Environmental Education Policy of each school (SEEP), which is based on the whole school approach, aiming for each school to become sustainable in the long term and systematically. The Ministry of Education, Sport and Youth, through the Unit of Education for Environment and Sustainable Development, in cooperation with the Departments of Education and the Universities, has designed a quality assessment system for ESD implementation in schools and for SEEP integration. It is a school self-assessment report based on qualitative criteria. It is completed by schools at the end of each year, aiming to help schools to identify the degree of achievement of their SEEP, its gaps and weaknesses and to take remedial measures the following year to make progress on ESD (climate change). The education assessment tool on ESD is for school self-improvement on integrating ESD and not for ranking schools. The self-assessment tool covers the administrative, technical, pedagogical, organizational and social level of the school and examines the achievement of: a) The learning objectives on SD issues that identified as the key issue of the SEEP, b) The school subjects used, c) The activities organized, d) The pedagogic approaches and teaching techniques applied, e) The type of collaboration with the local community, the local populations, the governmental services and the non-governmental organizations, f) The utilization of the external environments and the ways in which they were utilized, g) The participation of students and the way in which they participated.

References

- Ahern M.J., R.S. Kovats, P. Wilkinson, R. Fewand F. Matthies, 2005. Global health impacts of floods: epidemiological evidence. *Epidemiol. Rev.*, 27, 36-45
- Ainsworth E.A. and S.P. Long, 2005. What have we learned from 15 years of freeair CO₂ enrichment (FACE)? A metaanalytic review of the responses of photosynthesis, canopy properties and plant production to rising CO₂. *New Phytol* 165: 351-371
- Alcamo J., J.M. Moreno, B. Nováky, M. Bindi, R. Corobov, R.J.N. Devoy, C. Giannakopoulos, E. Martin, J.E. Olesen, A. Shvidenko, 2007. Europe. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, page 543, Cambridge University Press, UK. Available at: <http://www.ipcc.ch/pdf/assessmentreport/ar4/wg2/ar4-wg2-chapter12.pdf>
- Alker A., 2009. Impact of Global Warming on Infectious Disease in Cyprus. *Cyprus Climate Change Assessment Papers – 2009 Compiled by the Master's Degree Candidates of the Cyprus International Institute in the "Cyprus Climate Workshop"*, as part of the Institute's "Global Climate Update" course, June 2009
- Alpert, P., Ben-Gai, T., Baharad, A., Benjamini, Y., Yekutieli, D., Colacino, M., Diodato, L., Ramis, C., Homar, V., Romero, R., Michaelides, S. and Manes, A. (2002): The paradoxical increase of Mediterranean extreme daily rainfall in spite of decrease in total values. *Geophys. Res. Lett.*, Vol 29, No.11, 31-1 - 31-4
- Andreou E., I. Constantinou, D. Ierodiakonou, C. Stefanou, n.d. *Impacts of Climate Change on Cyprus Water Supply, Agriculture, and Biodiversity Adaptation and Mitigation Measures.*
- Atlantis Consulting Cyprus Ltd., n.d. *Study for the Assessment of the Environmental Impacts from the Operations for the Management and restoration of the Larnaca Salt Lakes CY 6000002, Action C12.* DG Environment, European Commission, Ministry of Agriculture Natural Resources and Environment of the Republic of Cyprus.
- Bates B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008. *Climate Change and Water*. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.
- Becht M.C., M.A.L. van Tilburg, A.J.J.M. Vingerhoets, I. Nyklicek, J. deVries, C. Kirschbaum, M.H. Antoni and G.L. vanHeck, 1998. *Watersnood: een verkennend onderzoek naar de gevolgen voor het welbevinden en de gezondheid van volwassenen en kinderen [Flood: a pilot study on the consequences for well-being and health of adults and children]. Tijdsch. Psychiat.*, 40, 277-289."
- Behrens A., Georgiev A., Carraro M., 2010. *Future Impacts of Climate Change across Europe.* Center for European Policy Studies (CEPS). Working Document No. 324
- Ben Rais Lasram F., D. Mouillot, 2009. Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. *Biol Inv* 11(3): 697–711
- Bokszczanin A., 2000. *Psychologiczne konsekwencje powodzi u dzieci i mlodziezy [Psychological consequences of floods in children and youth]. Psychol. Wychowawcza*, 43, 172-181
- Bruggeman A., C. Zoumides, S. Pashiardis, P. Hadjinicolaou, M.A. Lange, T. Zachariadis, 2011c. *Effect of climate variability and climate change on crop production and water resources in Cyprus.* Study for the Ministry of Agriculture, Natural Resources and Environment, led by the Agricultural Research Institute of Cyprus, June 2011

- Bruggeman A., C. Zoumides, S. Pashiardis, P. Hadjinicolaou, M.A. Lange, T. Zachariadis, 2011d. Blue and green water use in crop production in Cyprus; exploring pathways towards climate change adaptation, CYPADAPT presentation, workshop November 2-3, 2011
- Bruggeman A., C. Zoumides, S. Pashiardis, P. Hadjinicolaou, M.A. Lange, T. Zachariadis, M. Markou, A. Stylianou, A. Michaelides, 2011a. Working Paper: Economic Impact of Climate Change on the Cypriot Agricultural Sector. Nicosia: The Cyprus Institute
- CDC Centers for Disease Control and Prevention, 2009. Water- and Food-borne Diseases. D.o.H.a.H.S. Internet article available at: <http://www.cdc.gov/climatechange/effects/waterborne.htm>
- Chmielewski F.M. and T. Rotzer, 2001. Response of tree phenology to climate change across Europe, *Agricultural and Forest Meteorology*, 108, 101-112
- Christensen J. H. and O.B. Christensen, 2007. A summary of the PRUDENCE model projections of changes in European climate by the end of this century. *Climatic Change* 81: 7–30
- Christensen J.H. and O.B. Christensen, 2007. A summary of the PRUDENCE model projections of changes in European climate by the end of this century. *Climatic Change* 81: 7–30
- Christou K. A., X. Hatzikyriakou, C. Nikolaou, 2001. Die-back of Cyprus cedar (*Cedrus brevifolia*) at Pafos forest. *Proceedings International Conference Forest Research: a challenge for an integrated European approach*, Thessaloniki, Greece, 27 August-1 September 2001, Volume I 2001 pp. 269-274. Available at: <http://www.cabdirect.org/abstracts/20023189817.html>
- Clout M. and S. Lowie, 1997. Biodiversity loss due to biological invasion: Prevention and cure. *World Conservation Congress Workshop on Alien Species* (pp. 29-40). IUCN Species Survival Commission, North American Wetlands Conservation Council (Canada)."
- Confalonieri U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauge, R.S. Kovats, B. Revich, A. Woodward, 2007. Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 391-431
- Cosmatos A., 2009. Global Climate Change. The Effects of Climate Change on Vector Born Diseases (Malaria) in Cyprus. *Cyprus Climate Change Assessment Papers –2009* Compiled by the Master's Degree Candidates of the Cyprus International Institute in the "Cyprus Climate Workshop" as part of the Institute's "Global Climate Update" course, June 2009
- Crozier M.J., 2009. Deciphering the effect of climatechange on landslide activity: Areview. Elsevier
- Curriero F., K.S. Heiner, J. Samet, S. Zeger, L. Strug and J.A. Patz, 2002. Temperature and mortality in 11 cities of the Eastern United States. *Am. J. Epidemiol.*, 155, 80-87
- Cyprus Institute, 2011. Climate change and water scarcity in Cyprus, impacts and adaptation. *Clico Climate Change, Hydro-conflicts and Human Security. Seventh Framework Programme.*
- Cyprus International Institute, Harvard School of Public Health. Retrieved from http://cyprusinstitute.us/2009/lerodiakonou_et_al_4-Climate_Change_Papers.pdf
- CYSTAT, 2010. *Agricultural statistics 2008, Series II*, Nicosia. Statistical Service Republic of Cyprus Printing Office.
- Davenport S., 2008. Drought in Cyprus, *Weather News*. *Weather – November 2008*, Vol. 63, No. 11. Available at: <http://onlinelibrary.wiley.com/doi/10.1002/wea.345/pdf>
- Demetriou C., 2005. Implementation of Articles 5 & 6 of the EU Water Framework Directive 2000/60/EC The perspective from a semi-arid Mediterranean island, *Coping with drought and water*

deficiency from research to policy making, Water Development Department of Cyprus. Proceedings of the Arid Cluster Conference, Limassol, 12-13 May 2005, pp. 11-22

Department of Environment (DoE), 2000. Fourth National Report to the United Nations Convention on Biological Diversity. Nicosia: Ministry of Agriculture, Natural Resources & Environment.

Department of Environment (DoE), 2010. Fourth National Report to the United Nations Convention on Biological Diversity. Republic of Cyprus: Ministry of Agriculture, Natural Resources and Environment.

Department of Forests (DoF), 2009b. Short-term Action Plan for the Confrontation of the Implications of Drought in Cyprus state forests – Period 2009-2010. Ministry of Agriculture, Natural Resources and Environment of Cyprus. June 2009, Nicosia.

Department of Forests (DoF), 2011a. Cyprus report: The State of the World's Forest Genetic Resources. Ministry of Agriculture, Natural Resources and Environment of Cyprus. Nicosia.

Department of Forests (DoF), 2011b. Preparation of Management Plans for "Natura 2000" Areas: Management Plan for the Rizoelia National Forest Park (CY6000006) and Alonas, Melission Forests. Ministry of Agriculture, Natural Resources and Environment of Cyprus. Available at: <http://www.moa.gov.cy/moa/fd/fd.nsf/a5e0199a400ea5d8c2257060003da28b/caa9c428f48acf25c2257921003aba66?OpenDocument>

Department of Forests (DoF), n.d. Department of Forests. Retrieved from http://www.moa.gov.cy/moa/fd/fd.nsf/DMLflora_en/485EE01E2C170171C2256F1C00385AF8?OpenDocument

Durkin M.S., N. Khan, L.L. Davidson, S.S. Zaman and Z.A. Stein, 1993. The effects of a natural disaster on child behaviour: evidence for posttraumatic stress. *Am. J. Public Health*, 83, 1549-1553

EEA, JRC, WHO, 2008. Impacts of Europe's changing climate, An indicator based assessment.

European Commission (EC), 2008. Drought Management Plan Report Including Agricultural, Drought Indicators and Climate Change Aspects. Water Scarcity and Droughts Expert Network, Technical Report - 2008 – 023. Available at: http://ec.europa.eu/environment/water/quantity/pdf/dmp_report.pdf

European Environment Agency (EEA), 2008a. Impacts of Europe's changing climate – 2008 indicator-based assessment. Copenhagen: European Commission Directorate

European Environment Agency (EEA), 2008b. EU agriculture – taking on the climate change challenge. Brussels: European Commission Directorate

European Environment Agency (EEA), 2010a. Main drought events in Europe, 2000–2009. Available at: <http://www.eea.europa.eu/data-andmaps/figures/main-drought-events-ineurope-200020132009>

European Environment Agency (EEA), 2010c. Water exploitation index (WEI) in Europe (1990-2007). Available at: <http://www.eea.europa.eu/data-andmaps/figures/water-exploitation-index-wei-3>

FAO, 2007. Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities. Food and Agriculture Organization, Geneva. Available at: <ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf>

Faunt J.D., T.J. Wilkinson, P. Aplin, P. Henschke, M. Webb, R.K. Penhall, 1995. The effete in the heat: heat related hospital presentations during a ten-day heat wave. *Australia and New Zealand Journal of Medicine*, 25:117–120

Giannakopoulos C., P. Hadjinicolaou, C. Zerefos, G. Demosthenous, 2009. Changing Energy Requirements in the Mediterranean Under Changing Climatic Conditions, *Energies* 2, pp.805-815

- Giannakopoulos C., P. Hadjinicolaou, E. Kostopoulou, K. V. Varotsos, and C. Zerefos, 2010. Precipitation and temperature regime over Cyprus as a result of global climate change. *Adv. Geosci.*, 23, 17–24, 2010
- Hadjichambis A. and A. Della, 2007. Manuscript. Lefkosia: Agricultural Research Institute.
- Hadjikyriakou G. and E. Hadjisterkotis, 2002. The adventive plants of Cyprus with new records of invasive species. XXVth International Congress of the International Union of Game biologists and IXth International Symposium Perdix. *Z. Jagdwiss*
- Hadjinicolaou P., C. Giannakopoulos, C. Zerefos, A.M. Lange, S. Pashiardis, J. Lelieveld, 2011. Mid-21st century climate and weather extremes in Cyprus as projected by six regional climate models. *Reg Environ Change*, Vol. 11, pp441–457
- Hatzaki, M., Lingis, P., Flocas, H.A., Michaelides, S., Oikonomou, C. (2008): The impact of an upper tropospheric teleconnection pattern on precipitation extremes over Cyprus. *Advances in Geosciences*, 16, 131-136
- Hiederer R. and T. Durrant, 2010. Evaluation of BioSoil Demonstration Project Preliminary Data Analysis. Italy: JRC, ies.
- Hochstrat R., Kazner C., 2009. Case study report Cyprus. Flexibility in coping with water stress and integration of different measures. TECHNEAU
- IACO Ltd., 2007. National Action Plan to Combat Desertification in Cyprus, Volume I: Environmentally Sensitive Areas to Desertification Map - Executive Summary, Final Report. Nicosia: Environment Service
- IFAD, 2009. Livestock and climate change factsheet. International Fund for Agricultural Development. Available at: <http://www.ifad.org/lrkm/factsheet/cc.pdf>
- Intergovernmental Panel on Climate Change (IPCC), 2007. Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Parry, Martin L., Canziani, Osvaldo F., Palutikof, Jean P., van der Linden, Paul J., and Hanson, Clair E. (eds.)]. Cambridge University Press, Cambridge, United Kingdom, 1000 pp.
- Intergovernmental Panel on Climate Change (IPCC), 2012. Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. [Field C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, Plattner G.K., S.K. Allen, M. Tignor, P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19
- Ioannou A., 2010. The social role of the Agricultural Insurance Organization with data and numbers. Recordings of the radio programme "The time of the Countryside". Available at: www.oga.org.cy/images/.../koinwnikos_rolas.doc
- Katsanevakis S., K. Tsiamis, G. Ioannou, N. Michailidis, A. Zenetos, 2009. Inventory of alien marine species of Cyprus. *Mediterranean Marine Science* 10(2): 109–133
- Kirkinen J., A. Martikainen, H. Holttinen, I. Savolainen, O. Auvinen and S. Syri, 2005. 'Impacts on the energy sector and adaptation of the electricity network business under a changing climate in Finland', FINADAPT Working Paper 10, Finnish Environment Institute, Helsinki, pp. 12-15
- Koroneos C., P. Fokaidis, N. Moussiopoulos, 2005. Cyprus energy system and the use of renewable energy sources, *Energy*, Volume 30, Issue 10, pages 1889-1901. Available at: <http://www.sciencedirect.com/science/article/pii/S0360544204004931>

- Kostopoulou E, Jones PD (2005) Assessment of climate extremes in the Eastern Mediterranean. *Meteorol Atmos Phys* 89: 69–85
- Kostopoulou E. and P.D. Jones, 2007a. Comprehensive analysis of the climate variability in the eastern Mediterranean, Part I: Map pattern classification, *Int. J. Climatol.*, 27, 1189–1214
- Kostopoulou E. and P.D. Jones, 2007b. Comprehensive analysis of the climate variability in the eastern Mediterranean, Part II: relationships between atmospheric circulation patterns and surface climatic elements, *Int. J. Climatol.* , 27 (10), 1351-1371
- Kostopoulou, E., C. Giannakopoulos, M. Hatzaki, A. Karali, P. Hadjinicolaou, J. Lelieveld and M.A. Lange (2014) Spatial and temporal patterns of recent and future climate extremes in the Eastern Mediterranean and Middle East region. *Nat. Hazards Earth Syst. Sci.* 14, 1565-1577
- Kundzewicz Z.W., M. Radziejewski and I. Pińskwar, 2006. Precipitation extremes in the changing climate of Europe. *Climate Research* 31: 51–58
- Kundzewicz, Z.W., L.J. Mata, N.W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I.A. Shiklomanov, 2007, 'Freshwater resources and their management. Climate Change 2007: Impacts, Adaptation and Vulnerability'. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 173-210
- Available at: <http://www.ipcc.ch/pdf/assessmentreport/ar4/wg2/ar4-wg2-chapter3.pdf>
- Lingis, P., Michaelides, S.C. (2009): Teleconnection patterns of the Siberian Anticyclone and precipitation over Cyprus. *Atmospheric Research*, 94, 663- 674.
- Lange A.M., 2009. Climate Change and Water Scarcity on Cyprus. Cyprus Climate Conference. Climate Change: A Challenge for Europe and Cyprus, 27th - 29th November 2009. Nicosia, Cyprus. Available at: http://www.cyprus-climate-conference.info/index.php?option=com_content&view=article&id=20&Itemid=25
- Lelieveld, J., P. Hadjinicolaou, E. Kostopoulou, C. Giannakopoulos, A. Pozzer, M. Tanarhte and E. Tyrllis (2014) Model projected heat extremes and air pollution in the eastern Mediterranean and Middle East in the 21st century. *Reg. Env. Change*, 14, 1937-1949
- Lemoine N., H.C. Schaefer, K. Böhning-Gaese, 2007. Species richness of migratory birds is influenced by global climate change. In *Global Ecology and Biogeography*.
- Levinsky I., F. Skov, J. Svenning, C. Rahbek, 2007. Potential impacts of climate change on the distributions and diversity patterns of European mammals. In *Biodiversity and Conservation*
- Lindner M., J. Carcia-Gonzalo, M. Kolström, T. Green, R. Reguera, 2008. Impacts of Climate Change on European Forests and Options for Adaptation. Report to the European Commission Directorate-General for Agriculture and Rural Development
- Lindner M., M. Maroschek, S. Netherer, A. Kremer, A. Barbati, J. Carcia-Gonzalo, R. Seidl, S. Delzon, P. Corona, M. Kolström, J.M. Lexer, M. Marchetti, 2010. Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. *Forest Ecology and Management* 259, 698–709
- Lybczynska M, Christophi C and Lelieveld J. 2015, Heat-related cardiovascular mortality risk in Cyprus: a case-crossover study using a distributed lag non-linear model. *Environmental Health* (2015) 14:39 DOI 10.1186/s12940-015-0025-8
- Maheras P., H.A. Flocas, I. Patrikas, C. Anagnostopoulou, 2001. A 40 year objective climatology of surface cyclones in the Mediterranean region: spatial and temporal distribution. *Int J Climatol* 21(1):109–130

Maritime Affairs, European Commission (EC), May 2009, The economics of climate change adaptation in EU coastal areas. Available at:
http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/cyprus_climate_change_en.pdf

Masterton J.M. and Richardson F.A. 1979. Humidex: a method of quantifying human discomfort due to excessive heat and humidity, report no. CLI 1-79. Downsview, Ontario: Atmospheric Environmental Service

Michaelides S.C., F.S. Tymvios, T. Michaelidou. Spatial and temporal characteristics of the annual rainfall frequency distribution in Cyprus. *Atmospheric Research* 94 (2009) 606–615

Michaelides, S., Tymvios, F., Charalambous, D: Investigation of trends in synoptic patterns over Europe with artificial neural networks. *Advances in Geosciences*, 23, 107-112, 2010

Michaelides S., F. Tymvios, S. Athanasatos. Trends of dust transport episodes in Cyprus using a classification of synoptic types established with artificial neural networks. *Journal of Climatology* Volume 2013, Article ID 280248, <http://dx.doi.org/10.1155/2013/280248>

Ministry of Agriculture, Natural Resources and Environment (MANRE), 2007. National Report on Combating Desertification – Cyprus, Environment Service, February 2007. Available at:
<http://archive.unccd.int/cop/reports/northmed/national/2006/cyprus-eng.pdf>

Ministry of Environment of Lebanon (MoE), (2011), Vulnerability, adaptation and mitigation chapters of Lebanon’s second national communication: Vulnerability and adaptation of human settlements and infrastructure.

Nakićenović N., R. Swart (Eds), 2000. IPCC Special Report on Emissions Scenarios. A Special Report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK

Nicholls R.J., F.M.J. Hoozemans, 1996. The Mediterranean: vulnerability to coastal implications of climate change, *Ocean and Coastal Management*, Volume 31, Issues 2–3, pp. 105-132

Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), 2007. Factsheet Water Requirements of Livestock. Available at: <http://www.omafra.gov.on.ca/english/engineer/facts/07-023.htm>

Parari M., 2009. Climate Change impacts on coastal and marine habitats of Cyprus. Cyprus International Institute for the Environment and Public Health in Association with Harvard School of Public Health

Parry M.L., O.F. Canziani, J.P. Palutikof et al., 2007. Technical Summary - Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 23-78. Available at: <http://www.ipcc.ch/pdf/assessmentreport/ar4/wg2/ar4-wg2-ts.pdf>

Pashiardis S., 2002. Trends of precipitation in Cyprus rainfall analysis for agricultural planning, UN Food and Agriculture Organization (FAO), Climagri Workshop, on Development of a regional network on climate change and agriculture for the countries in the Mediterranean region, FAO’s headquarters, Rome, Italy.

Pashiardis S., 2011. Κλιματικές αλλαγές στην Κύπρο – στατιστικά στοιχεία και πορίσματα των τελευταίων 100 χρόνων [Climate change in Cyprus – statistical data and conclusions from the last 100 years]

PigWasteMan, 2007. Report on Task 5: Impact on water resources. LIFE Third Countries 2003 Project Deliverable

- Plan Bleu, 2011. Mediterranean Strategy for Sustainable Development Follow-Up: Main indicators, 2011 Update. Regional Activity Centre, UNEP. Available at: http://www.planbleu.org/publications/Indicateurs_SMDD_2011_EN.pdf
- Price, C., Michaelides, S.C., Pashiardis, S. and Alpert, P. (1999): Long term changes in diurnal temperature range in Cyprus. *Atmospheric Research*, 51, 85- 98
- Proestos Y, Christophides GK, Erguler K, Tanarhte M, Waldock J, Lelieveld J. 2015 Present and future projections of habitat suitability of the Asian tiger mosquito, a vector of viral pathogens, from global climate simulation. *Phil. Trans. R. Soc. B* 370 : 20130554. <http://dx.doi.org/10.1098/rstb.2013.0554>
- Raskin P., P.H. Gleick, P. Kirshen, R.G. Jr. Pontius and K. Strzepek, 1997. Comprehensive assessment of the freshwater resources of the world. Stockholm Environmental Institute, Sweden. Document prepared for the fifth session of the United Nations Commission on Sustainable Development, 1997
- Secretariat of the Convention on Biological Diversity (CBD), 2007. Biodiversity and Climate Change, International Day for Biological Diversity
- Shoukri E., T. Zachariadis, 2012. Climate Change in Cyprus: Impacts and Adaptation Policies. Environmental Policy Research Group Report 01-12, Cyprus University of Technology, Limassol
- Sofroniou A., Bishop S. 2014. Water Scarcity in Cyprus: A Review and Call for Integrated Policy. *Water* 2014, 6(10), 2898-2928; doi:10.3390/w6102898
- Tanarhte M, Hadjinicolaou P, Lelieveld J (2015) Heat wave characteristics in the eastern Mediterranean and Middle East using extreme value theory. *Clim Res Vol. 63*: 99–113, 2015
- Tsintides C.T., C.S. Christodoulou, P. Delipetrou, K. Georghiou, 2007. The red data book of the Flora of Cyprus. Lefkosia: Cyprus Forestry Association.
- Tymvios, F., Savvidou, K., and Michaelides, S. C.: Association of geopotential height patterns with heavy rainfall events in Cyprus, *Advances in Geosciences*, 23, 73-78, doi:10.5194/adgeo-23-73-2010, 2010.
- Tymvios, F., S. Michaelides, D. Charalambous, A. Retalis, D. Paronis, D. G. Hadjimitsis, A. Agapiou, K. Themistokleous, and C. Skouteli. "Connection of Heat Events in Cyprus with Synoptic Upper Air Patterns." In *Advances in Meteorology, Climatology and Atmospheric Physics*, pp. 787-792. Springer Berlin Heidelberg, 2013
- Tyrlis E., F. S. Tymvios, C. Giannakopoulos and J. Lelieveld. The role of blocking in the Summer 2014 collapse of the Etesians over the eastern Mediterranean. *Journal of Geophysical Research*, DOI: 10.1002/2015JD023543
- Unit of Environmental Studies (n.d.). Review of biodiversity research results from Cyprus that directly contribute to the sustainable use of biodiversity in Europe. Lefkosia, Cyprus. Retrieved from: <http://www.biostrat.org/Sustainable%20use%20of%20biodiversity%20-%20CY.pdf>
- United Nations University, 2005. Synthesis Report Baseline Survey on Sustainable Land Management in the Pamir – Alai Mountains. Retrieved from <http://www.ehs.unu.edu/file/get/3480>
- Water Development Department (WDD), 2008. Significant Cyprus Water Management Issues Review, Tell us your opinion. Updated report after public consultation. Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia
- Water Development Department (WDD), 2009. Economic analysis of water use, estimation of the total cost of water services, determination of current levels of cost recovery. Special report 2.1. Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia. Available at: [http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/11E4F13527A4185BC22578BD002FAB66/\\$file/AnalysisofWaterUses_gr.pdf?openelement](http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/11E4F13527A4185BC22578BD002FAB66/$file/AnalysisofWaterUses_gr.pdf?openelement)

Water Development Department (WDD), 2009a. Economic analysis of water use, estimation of the total cost of water services, determination of current levels of cost recovery. Special report 2.1. Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia. Available at: [http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/11E4F13527A4185BC22578BD002FAB66/\\$file/Analysi ofWaterUses_gr.pdf?openelement](http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/11E4F13527A4185BC22578BD002FAB66/$file/Analysi%20of%20Water%20Uses_gr.pdf?openelement)

Water Development Department (WDD), 2011. Implementation of Articles 11, 13 and 15 of the Water Framework Directive (2000/60/EC) in Cyprus. Annex VIII - Final Report on Water Policy, Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia.

Water Development Department (WDD), 2011a. Cyprus River Basin Management Plan. Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia. Available at: http://www.moa.gov.cy/moa/wdd/wdd.nsf/guide_en/guide_en?OpenDocument

Water Development Department (WDD), 2011a. Cyprus River Basin Management Plan. Ministry of Agriculture, Natural Resources and Environment, Republic of Cyprus, Nicosia. Available at: http://www.moa.gov.cy/moa/wdd/wdd.nsf/guide_en/guide_en?OpenDocument

Wintgens T., R. Hochstrat, 2006. Report on integrated water reuse concepts. AQUAREC – EVK1-CT-2002-00130. Available at: http://www.amk.rwth-aachen.de/fileadmin/files/Forschung/Aquarec/D19_final_2.pdf

World Health Organisation (WHO), 2010. The WHO e-Atlas of disaster risk for the European Region - Volume 1. Exposure to natural hazards (version 2.0) World Health Organization

World Resources Institute. (n.d.). Biodiversity and Protected Areas - Cyprus. Retrieved from <http://earthtrends.wri.org>: Biodiversity and Protected Areas-Cyprus, World Resources Institute.

Zachariadis T. and P. Hadjinicolaou, 2012. The Economic Effect of Climate Change on Electricity Use – A Case Study from Cyprus. Economic Policy Paper 08-12, Economics Research Centre, University of Cyprus. http://www.ucy.ac.cy/erc/documents/DOP_8-12.pdf

Zachariadis T., 2010. Forecast of electricity consumption in Cyprus up to the year 2030: The potential impact of climate change, Energy Policy, Volume 38, Issue 2, pages 744-750. Available at: <http://www.sciencedirect.com/science/article/pii/S0301421509007460>

Zenetos A., E. Meric, M. Verlaque, P. Galli, C.F. Boudouresque, A. Giangrande, M. Bilecenoglu, 2008. Additions to the annotated list of marine alien biota in the Mediterranean with special emphasis on Foraminifera and Parasites. Mediterranean Marine Science.

Zenetos A., M.E. Cinar, M.A. Pancucci-Papadopoulou, J.G. Harmelin, G. Furnari, F. Andaloro, H. Zibrowius, 2005. Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. In Mediterranean Marine Science

Zittis, G., P. Hadjinicolaou, M. Fnais and J. Lelieveld (2015) Projected changes of heat wave characteristics in the eastern Mediterranean and the Middle East. Reg. Environ. Change, doi: 10.1007/s10113-014-0753-2

Cyprus' Integrated national energy and climate plan for the period 2021-2030

Annex I: BIENNIAL REPORT

A1. Introduction

This report constitutes the second Biennial Report of Cyprus, as required by Decision 2/CP.17 of the Conference of the Parties under the United Nations Framework Convention on Climate Change (UNFCCC).

A2. Information on GHG emissions and trends, GHG inventory including information on national inventory system

Please refer to Chapter 2 of the National Communication.

A2.1. Introduction and summary information from the national GHG inventory

Please refer to Chapter 3 of the National Communication.

A2.2. National inventory arrangements

A2.2.1. Summary information on national inventory arrangements

Please refer to Chapter 3.3 of the National Communication.

A2.2.2. Summary information on changes to national inventory arrangements since the last National Communication or Biennial report

The national inventory arrangements and the QA/QC procedures have been restructured in 2017, to meet the requirements of CMP and COP Decisions relevant to national systems and QA/QC. The most important change is that the legal framework defining the roles-responsibilities and the co-operation between the DoE Inventory team and the designated contact points of the competent Ministries was formalized by Council of Ministers' Decision adopted 15/11/2017 entitled "Structure and operation of the National Greenhouse Gases Inventory System- Roles and Responsibilities". The above-mentioned Decision includes a description of each entity's responsibilities, concerning the inventory preparation, data providing or other relative information. This formal framework has improved the collaboration between the entities involved, assuring the timely collection and quality of the activity data required and solving data access restriction problems raised due to confidentiality issues.

No changes were adopted to the arrangements since the initial Ministerial decision.

A3. Quantified economy-wide emission reduction target

This section explains the EU 2030 emission reduction target under the UNFCCC and the target compliance architecture set up within the EU in order to meet that target. It also gives an overview of other EU emission reduction targets that are helping achieve the quantified economy-wide emission reduction target under the UN.

A3.1. 2030 Climate and Energy Framework

The Climate and Energy Framework was agreed by EU leaders in October 2014 and builds on the 2020 climate and energy package. It sets three key targets for the year 2030:

- At least 40% reduction in greenhouse gas emissions (from 1990 levels). To achieve this, EU ETS sectors would have to cut emissions by 43 % (compared to 2005), and the ETS will be reformed and strengthened to achieve this. Non-ETS sectors would need to cut emissions by 30 % (compared to 2005), and this will need to be translated into individual binding targets for Member States;
- At least 32% share of EU energy consumption for renewable energy;

- At least 27% improvement in energy efficiency.

The European Council asked the Commission to review the energy efficiency target by 2020 having in mind an EU level of 30%. With the Clean Energy for All Europeans package from November 2016, the Commission has already proposed to set a binding EU-wide target of 30 % for energy efficiency by 2030.

The framework is in line with the longer-term perspective set out in the Roadmap for moving to a competitive low carbon economy in 2050, the Energy Roadmap 2050 and the Transport White Paper. The framework will be underpinned by a new and transparent governance process that will the targets outlined above to be met in an effective and coherent manner. This governance process will be based on national plans for competitive, secure, and sustainable energy but will follow a common EU approach.

The European Commission has proposed a number of actions to help deliver the framework and the 2030 targets, including a reformed EU ETS (with a proposal for legislation being presented in parallel to the Communication on the 2030 framework), a new Effort Sharing Regulation, a proposal to integrate greenhouse gas emissions and removals from land use, land use-change and forestry (LULUCF) into the 2030 climate and energy framework a proposal for amending the Energy Efficiency Directive and the Energy Performance of Buildings Directive and a new set of indicators for the competitiveness and security of the energy system, such as price differences with major trading partners, diversification of supply, and interconnection capacity between EU countries.

An impact assessment for the framework was published in January 2014 and considers the costs and benefits of the proposed framework for 2030. It found that average annual additional investments are projected to be in the order of € 38 billion for the EU as a whole over the period 2011-2030, with more than half of the investments needed in the residential and tertiary sectors. However, it should also be noted that fuel savings will to a large extent compensate for these investments. Crucially, costs do not differ substantially from the costs of renewing an ageing energy system, which would be necessary in any case.

The European Commission adopted "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy" in February 2015. This strategy is made up of five closely related and mutually reinforcing dimensions—'security, solidarity and trust', 'a fully-integrated internal energy market', 'energy efficiency', 'climate action—decarbonising the economy' and 'research, innovation and competitiveness'. Every year a State of the Energy Union review is conducted to assess progress and consider areas for further strengthening. The second State of the Energy Union report was published in February 2017, noting that 2016 had been a year of delivery, translating the overall vision into "concrete legislative and non-legislative initiatives". It also looked forward to the low emission mobility strategy due to be published in late 2017.

A3.1.1. National Energy and Climate Plan

Cyprus national energy and climate plan (NECP) has been drawn up to perform the requirement laid down in Article 9(1) of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, in accordance with which each Member State must prepare and submit to the Commission their national energy and climate plan.

The National Energy and Climate Plan (NECP), that adopted in 2020 presents the existing structure of the energy sector, the policies implemented so far, the evolution scenario of the energy system for the achievement of the national energy and climate targets for the year 2030, as well as the planned policies and measures for their achievement.

The energy and climate objectives present opportunities, benefits and advantages of the national economy, the energy system and civil society, in general, as well as the challenges that need to be overcome.

The main objective of the development of the National Energy and Climate Plan is to design and plan the cost-effective policies and measures that will help to achieve the medium- and long-term national

energy and climate goals, will contribute to the economic development of the country and will also respond to the challenge of other environmental goals.

In this context, the main goals set out in the preparation of the national energy planning and the preparation of the energy and climate plan are:

- Achievement of national targets for reducing greenhouse gas emissions, to increase the participation of Renewable Energy Sources in domestic energy consumption and to achieve end use energy savings in final energy consumption;
- Enhancement of energy supply security;
- Strengthen the competitiveness of Cyprus' economy;
- Protection of consumers while strengthening their role in the energy system;
- Setup and operation of a competitive internal energy market;

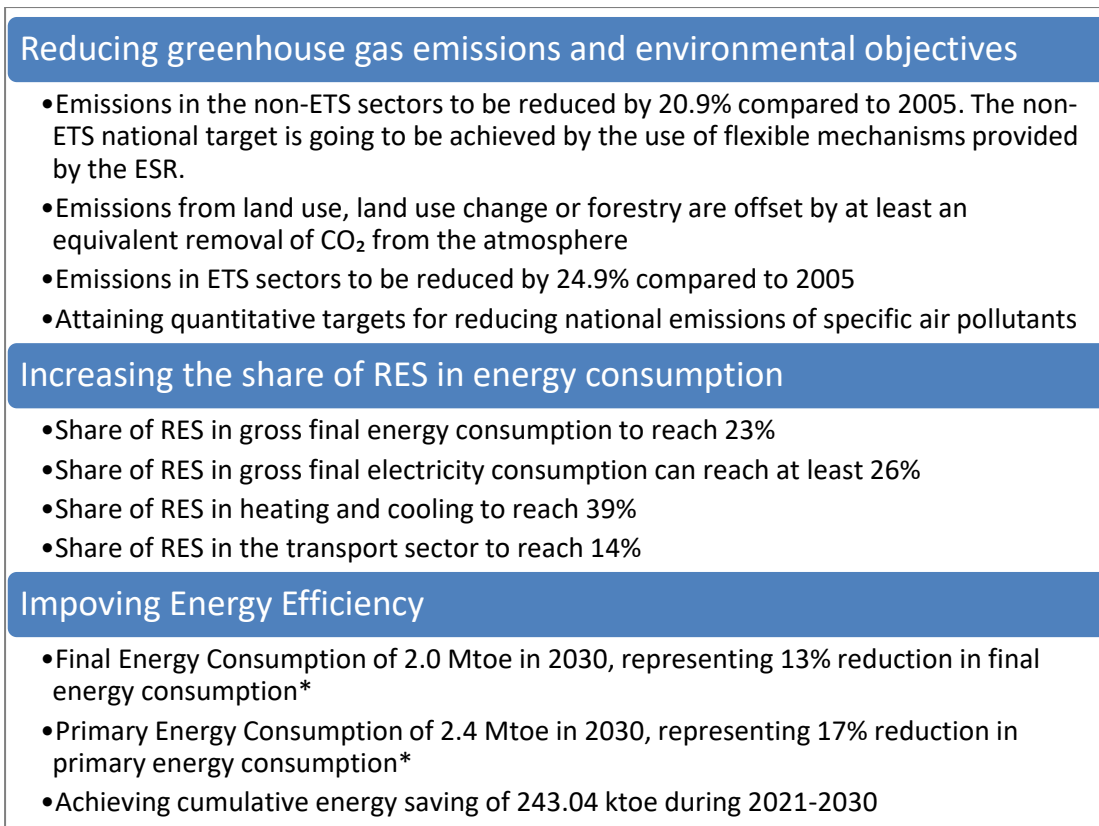
In particular, as part of the energy planning, key quantitative policy targets are set for the period up to the year 2030, stemming from national priorities as well as from the climate and energy objectives developed and agreed at EU level. They also comprise 'intermediate' targets in the framework of key international and European projects and long-term strategies to reduce greenhouse gas emissions by 2050. These national targets for the year 2030 result both from specific quantitative commitments undertaken by Member States (i.e. targets for non-ETS sectors and for the reduction of national emissions of certain air pollutants), and taking into account the characteristics and specificities of the national energy system, the domestic potential for developing technologies and applications, the potential for adaptation as well as the socio-economic characteristics. This process results in the adaptation of national targets to the corresponding central European ones (i.e. the targets for sectors that are part of the Emissions Trading Schemes, RES, energy efficiency), which are finally proposed under this national plan.

It should be noted that this plan is part of the European climate change policy with specific climate targets by 2050 and the need to develop a long-term strategy by 2050. The analysis made with the present/proposed energy and climate plan focuses on measures and policies by the year 2030.

In addition, it should be stressed that improving energy efficiency is a key horizontal priority, as it leads to multiple benefits such as reducing greenhouse gas emissions, reducing energy costs, improving comfort conditions in buildings, increasing added value and employment and improving the competitiveness of businesses. Towards this, the energy efficiency first principle has been taken into account.

Specifically for the year 2030, the following targets are set:

- i. 24% reduction in non-ETS greenhouse gas emissions compared to 2005.
- ii. Ensure that greenhouse gas emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO₂ from the atmosphere
- iii. 23% RES penetration into gross final energy consumption for the year 2030. Regarding the three indicative sub-targets for the promotion of RES in gross electricity consumption, (at least up to 26%, heating and cooling (up to 39%) and transport (up to 14%), by 2030 were set.
- iv. National indicative key targets set for energy efficiency: Final Energy Consumption of 2.0 Mtoe in 2030 and Primary Energy Consumption of 2.4 Mtoe in 2030. National obligatory target for achieving cumulative end use energy savings of 243.04 ktoe during 2021-2030. These targets are expected to be achieved in the context of energy planning.



* compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario

Figure I3.1. National energy and environmental objectives for the period 2021-2030 in the context of EU policies

To achieve all these targets, a necessary horizontal condition is to mobilise significant investment funds from both the private and the public sectors, which will need to maintain and strengthen their role in an increasingly efficient way, especially in energy networks. A key condition is also the combined use of specialised financial mechanisms that will allow for the optimal economic and timely implementation of the planned measures and policies at the level of specific projects and interventions. The implementation of these investments is directly related to the creation of the appropriate framework for the development and implementation of the investment projects and thus to the individual regulatory, licensing and financial framework.

Table I.1. Key policy measures planning priorities

PILAR	Key policy planning priorities
GHG emissions and removals	<ul style="list-style-type: none"> • Promotion of natural gas as intermediate fuels for the decarbonisation of the energy system • Promotion of renewable energy sources • Improvement of energy efficiency in buildings, industry and infrastructure • Reduction of emissions in the transport sector • Reduction of fluorinated gas emissions • Reduction of emissions from agricultural sector • Reduction of emissions from waste sector • Increase carbon sinks
Renewable energy sources	<ul style="list-style-type: none"> • Various RES Support schemes for Self-Consumption

PILAR	Key policy planning priorities
	<ul style="list-style-type: none"> • Synergies with other sectors (Energy Efficiency, Waste, Security of supply and Internal Energy Market) to promote RES in all energy sectors • Support schemes for RES to participate in the Electricity Market • Replacement of old Solar Collectors for households • Replacement of Solar Collectors for Commercial purposes and use of Solar Technologies for High process heat and/or Solar Cooling • Old vehicle scrapping scheme and financial incentives for the purchase of electric vehicles (both new and used) • Promotion of the open loop Geothermal Energy • Installation of RES and Energy Efficiency technologies in Public Buildings. • Electricity Storage Installations, Framework development and possible financial incentives. • Various other measures for RES in Transport (New bus contracts (using alternative fuels, electricity, gas, and biofuels B100), Use of Biofuels (and biogas) in Transport Sector • Other indirect measures that will help to increase energy efficiency and thus the RES Share in transport. • Statistical Transfer of Energy to be examined (exporting Energy in case of Electricity Interconnector)
Energy efficiency	<ul style="list-style-type: none"> • Energy efficiency obligation scheme for energy distributors • Energy Fund of Funds providing soft loans for energy efficiency • Individual energy efficiency interventions and energy efficiency retrofits in governmental buildings • Implementation of information and education measures • Support schemes/incentives for promoting energy efficiency in households, enterprises and wider public • Energy efficient street lighting. • Additional floor space “allowance” for buildings exceeded the minimum energy efficiency requirements set by national law • Advanced Metering Infrastructure Plan. • Promotion of energy efficiency in enterprises, through voluntary agreements • Action plan for increasing energy efficiency the road transport. • Energy efficiency in water sector • Vehicle excise duty based on CO2 emissions • Energy consumption fee for Res and energy efficiency applied on electricity bills. • Excise tax on road transport fuels exceeding the minimum levels by EU legislation
Security of supply	<ul style="list-style-type: none"> • Introduction of natural gas via LNG imports and the development of the necessary infrastructure • Increasing the flexibility of the national energy system
Internal Energy market	<ul style="list-style-type: none"> • Promotion of electricity interconnectivity of Cyprus via the project of common interest EuroAsia Interconnector • Development of internal natural gas network pipeline infrastructure • Investments for development and secure operation of the transmission electricity system

PILAR	Key policy planning priorities
	<ul style="list-style-type: none"> • Promotion of the necessary regulatory framework and projects for the operation of the competitive electricity market • Promotion of the EastMed pipeline project
Research, innovation and competitiveness	<ul style="list-style-type: none"> • Fund of funds • New Industrial Policy • Establishment of the Deputy Ministry of Innovation and Digital Transformation • European Structural and Investment Funds in the new Programming Period 2021 – 2027 • Revision of national funds regarding research and innovation with the aim to boost climate and energy priorities

The goal of the national energy and climate plan is to achieve a reduction in sectors covered under the Effort Sharing Decision (ESD, non-ETS) of greenhouse gas emissions of 24% by 2030 compared to 2005. This will be achieved through a phase approach as presented in figure I3.2.

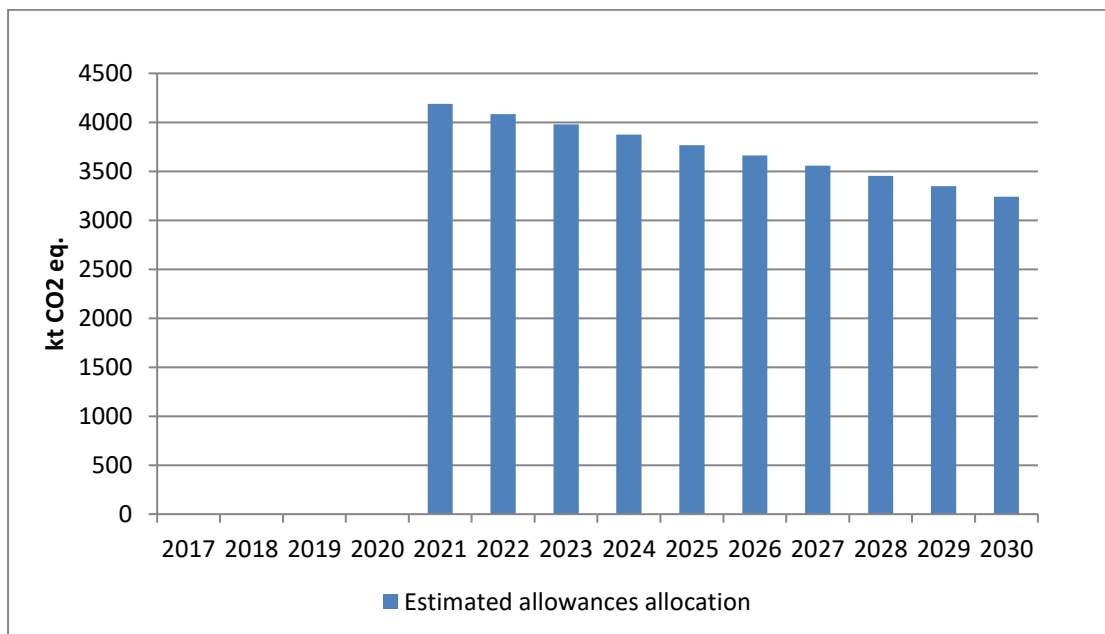


Figure I.3.2. Allowances allocation of GHG emissions of non-ETS sectors

The ETS and Non-ETS emissions are illustrated on Figures I.3.3., I.3.4. and I.3.5. for both historical and projected years.

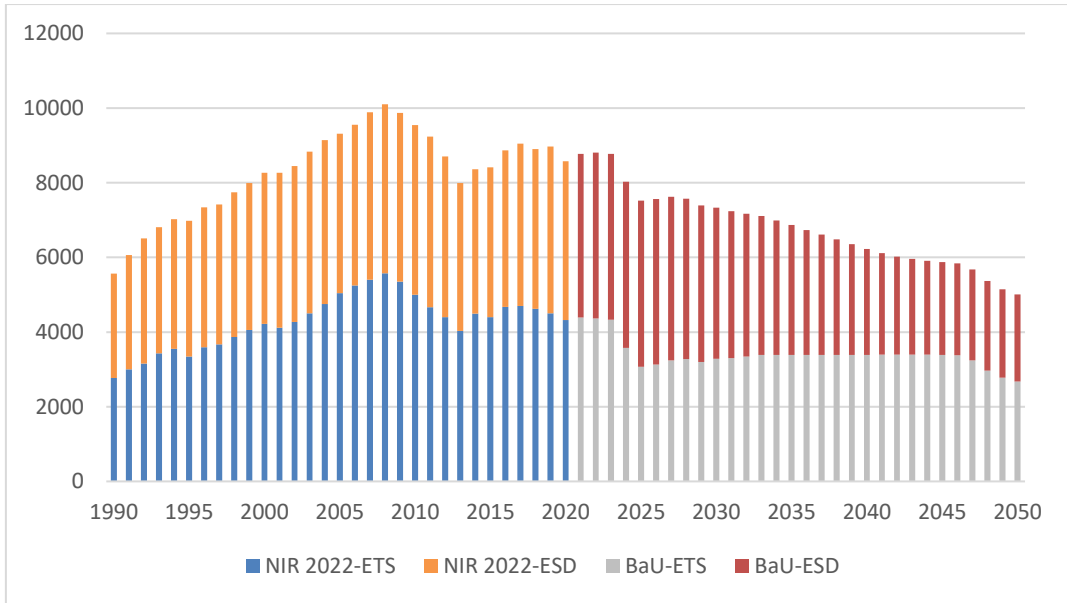


Figure I.3.3. GHG ETS/ESR emissions for both historical and BaU projected years

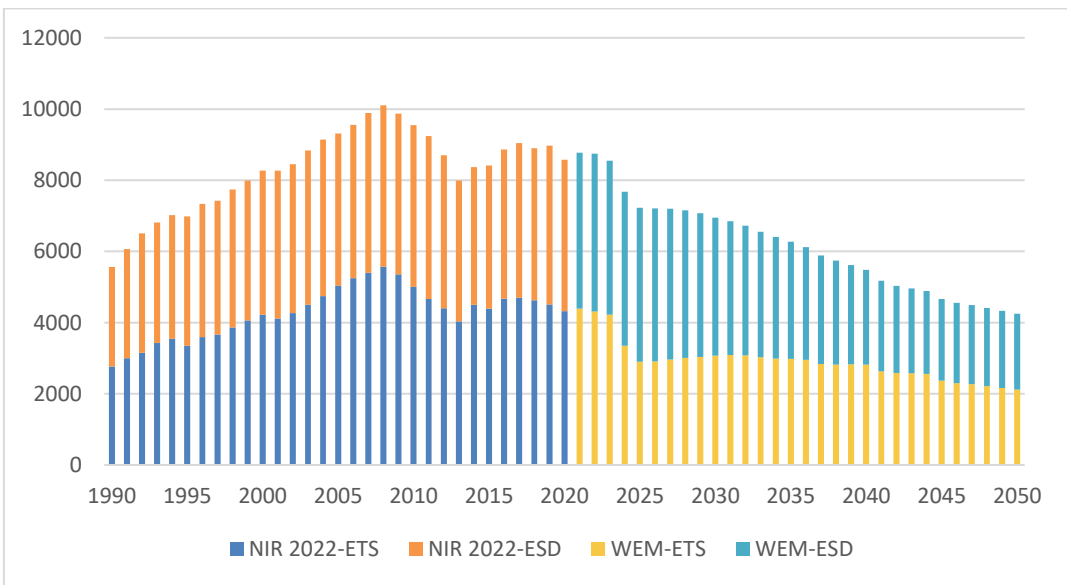


Figure I.3.4. GHG ETS/ESR emissions for both historical and WEM projected years

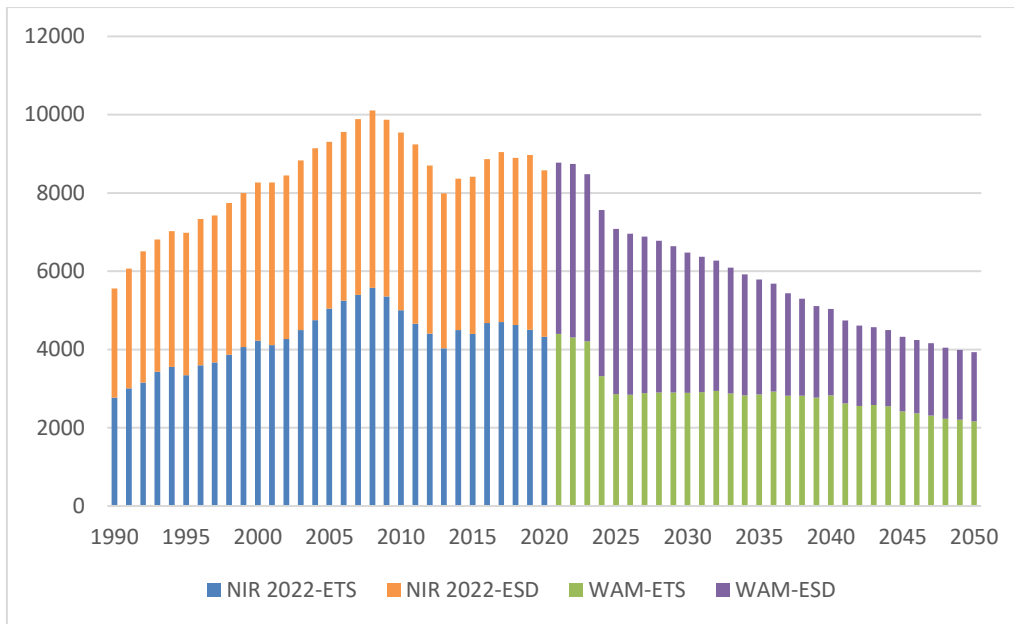


Figure I.3.5. GHG ETS/ESR emissions for both historical and WAM projected years

A3.2.2. Monitoring on progress to 2030 targets

For the monitoring of GHG emissions at the EU and the Member State level, the Monitoring Mechanism Regulation has been adopted, see section 2.2.2.1 of the EU’s fourth Biennial Report. Also, for the effective operation of the EU ETS, robust, transparent, consistent and accurate monitoring and reporting of greenhouse gas emissions are essential, therefore an annual procedure of monitoring, reporting and verification (MRV) at the installation level is implemented. For a description of the requirements contained therein, please refer to section 2.2.2.1 of the EU’s second Biennial Report. Installation and aircraft operators have to monitor, report and verify their annual emissions in accordance with two EU Regulations, the Monitoring and Reporting Regulation (MRR) and the Accreditation and Verification Regulation (AVR). For a description of the requirements contained therein, please refer to in section 2.2.2.2 of the EU’s fourth Biennial Report.

Monitoring, reporting and verification of the Effort Sharing Regulation (ESR) targets mainly takes place through the submission of the national GHG inventories by MS. Chapter III of the Commission Implementing Regulation 749/2014 sets out strict criteria by which MS national GHG inventories GHG emissions are reviewed annually at the EU-level. Based on this review, the European Commission issues an implementing decision on MS ESR emissions in the given year, which might lead to MS inter alia facing penalties as described above.

In addition, under Regulation (EU) 2018/1999 each EU Member State will have to submit every 2 years after the initial submission of the NECP, a Progress Report of policies and measures that were included in the NECP. Cyprus’ first progress report was submitted in March 2023 and is currently under review.

A3.2.3. Accounting for Market-based Mechanisms under the 2030 Climate and Energy Framework

Please refer to [Section 5.4](#) of the 8th National Communication.

A4. Progress in achievement of the quantified economy-wide emission reduction targets

Please refer to [Section 5.3.1](#) of the 8th National Communication.

A5. Projections

Please refer to [Chapter 5](#) of the 8th National Communication.

A6. Provision of financial, technological and capacity building support to developing countries

Please refer to [Chapter 7](#) of the 8th National Communication.

Annex II: Summary tables of GHG emissions for Cyprus in the common reporting format for the whole of the reporting period of the NIR2023 (1990-2021)

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1990
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	4491.73	775.95	223.97	NO,NE	NO	2.73	NO	NO	5494.38
1. Energy	3921.78	14.17	18.40						3954.35
A. Fuel combustion (sectoral approach)	3921.78	13.71	18.40						3953.89
1. Energy industries	1761.49	2.00	3.66						1767.15
2. Manufacturing industries and construction	502.34	0.98	1.51						504.83
3. Transport	1216.56	7.88	12.35						1236.79
4. Other sectors	430.40	2.81	0.86						434.06
5. Other	10.99	0.04	0.02						11.06
B. Fugitive emissions from fuels	NO,NE	0.45	NO,NE						0.45
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.45	NO,NE						0.45
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	721.26	NO,NE,NA	3.93	NO,NE	NO	2.73	NO	NO	727.93
A. Mineral industry	717.07								717.07
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.19	NE,NA	NE,NA						4.19
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				NO,NE	NO	NO	NO	NO	NO,NE
G. Other product manufacture and use	IE	NE	3.93		NO	2.73			6.66
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.82	336.36	191.81						529.99
A. Enteric fermentation		220.61							220.61
B. Manure management		113.91	58.08						171.99
C. Rice cultivation									NO
D. Agricultural soils		NE	133.28						133.28
E. Prescribed burning of savannas			NO						NO
F. Field burning of agricultural residues		1.85	0.45						2.30
G. Liming	NO								NO
H. Urea application	1.82								1.82
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-153.13	0.03	0.03						-153.07
A. Forest land	1.46	0.03	0.02						1.51
B. Cropland	-134.24	NO	0.01						-134.23
C. Grassland	-23.05	NO	NO						-23.05
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.46	NO	0.00						0.46
F. Other land	0.11	NO	0.00						0.11
G. Harvested wood products	2.14								2.14
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	425.39	9.80						435.18
A. Solid waste disposal	NO,NA	295.37							295.37
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		130.02	9.80						139.82
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	900.89	0.52	7.34						908.75
Aviation	718.10	0.14	5.32						723.56
Navigation	182.79	0.38	2.01						185.18
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	30.50								30.50
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.21								
Total CO₂ equivalent emissions without land use, land-use change and forestry									5647.45
Total CO₂ equivalent emissions with land use, land-use change and forestry									5494.38
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									5652.66
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									5499.59

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1991
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	4966.05	791.02	224.35	NO,NE	NO	3.37	NO	NO	5984.78
1. Energy	4451.29	14.48	21.19						4486.96
A. Fuel combustion (sectoral approach)	4451.29	13.94	21.19						4486.42
1. Energy industries	1824.04	2.06	3.93						1830.04
2. Manufacturing industries and construction	927.41	1.43	2.36						931.20
3. Transport	1217.24	7.65	13.96						1238.86
4. Other sectors	470.37	2.75	0.92						474.03
5. Other	12.23	0.05	0.03						12.30
B. Fugitive emissions from fuels	NO,NE	0.54	NO,NE						0.54
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.54	NO,NE						0.54
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	680.45	NO,NE,NA	4.04	NO,NE	NO	3.37	NO	NO	687.86
A. Mineral industry	676.21								676.21
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.23	NE,NA	NE,NA						4.23
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				NO,NE	NO	NO	NO	NO	NO,NE
G. Other product manufacture and use	IE	NE	4.04		NO	3.37			7.41
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.47	345.79	188.99						536.24
A. Enteric fermentation		224.46							224.46
B. Manure management		120.20	58.06						178.26
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	130.65						130.65
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		1.13	0.28						1.41
G. Liming	NO								NO
H. Urea application	1.47								1.47
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-167.16	0.10	0.08						-166.98
A. Forest land	-18.39	0.10	0.05						-18.24
B. Cropland	-134.78	NO	0.01						-134.77
C. Grassland	-23.53	NO	NO						-23.53
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.44	NO	0.00						0.45
F. Other land	0.14	NO	0.01						0.14
G. Harvested wood products	8.97								8.97
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	430.66	10.05						440.71
A. Solid waste disposal	NO,NA	300.72							300.72
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		129.94	10.05						139.99
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1029.51	0.55	7.98						1038.04
Aviation	853.22	0.17	6.33						859.71
Navigation	176.30	0.38	1.66						178.33
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	28.00								28.00
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	4.52								
	Total CO ₂ equivalent emissions without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions with land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry								

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1992
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	5332.92	815.77	248.84	23.04	NO	4.01	NO	NO	6424.58
1. Energy	4772.82	14.52	24.09						4811.43
A. Fuel combustion (sectoral approach)	4772.82	14.00	24.09						4810.91
1. Energy industries	2120.79	2.40	4.46						2127.66
2. Manufacturing industries and construction	713.28	0.87	1.54						715.69
3. Transport	1362.49	7.63	16.97						1387.08
4. Other sectors	561.45	3.05	1.08						565.58
5. Other	14.81	0.06	0.03						14.90
B. Fugitive emissions from fuels	NO,NE	0.52	NO,NE						0.52
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.52	NO,NE						0.52
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	730.92	NO,NE,NA	4.15	23.04	NO	4.01	NO	NO	762.12
A. Mineral industry	726.64								726.64
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.28	NE,NA	NE,NA						4.28
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				23.04	NO	NO	NO	NO	23.04
G. Other product manufacture and use	IE	NE	4.15		NO	4.01			8.16
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.92	362.46	210.23						574.61
A. Enteric fermentation		224.58							224.58
B. Manure management		135.14	60.19						195.33
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	149.36						149.36
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		2.74	0.67						3.41
G. Liming	NO								NO
H. Urea application	1.92								1.92
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-172.73	0.03	0.05						-172.65
A. Forest land	-23.59	0.03	0.02						-23.54
B. Cropland	-135.33	NO	0.02						-135.31
C. Grassland	-24.01	NO	NO						-24.01
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.42	NO	0.00						0.43
F. Other land	0.17	NO	0.01						0.17
G. Harvested wood products	9.60								9.60
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	438.76	10.32						449.08
A. Solid waste disposal	NO,NA	306.42							306.42
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		132.34	10.32						142.66
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1015.78	0.56	7.90						1024.24
Aviation	830.04	0.16	6.15						836.36
Navigation	185.74	0.40	1.75						187.88
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	27.80								27.80
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	4.74								
Total CO₂ equivalent emissions without land use, land-use change and forestry									6597.23
Total CO₂ equivalent emissions with land use, land-use change and forestry									6424.58
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									6601.97
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									6429.32

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1993
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CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	5574.06	846.84	264.56	24.62	NO	4.65	NO	NO	6714.73
1. Energy	4947.71	14.47	25.92						4988.10
A. Fuel combustion (sectoral approach)	4947.71	13.91	25.92						4987.54
1. Energy industries	2242.99	2.54	4.72						2250.25
2. Manufacturing industries and construction	754.63	0.93	1.64						757.20
3. Transport	1376.59	7.35	18.43						1402.36
4. Other sectors	558.13	3.05	1.09						562.27
5. Other	15.37	0.06	0.03						15.46
B. Fugitive emissions from fuels	NO,NE	0.56	NO,NE						0.56
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.56	NO,NE						0.56
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	799.99	NO,NE,NA	4.24	24.62	NO	4.65	NO	NO	833.50
A. Mineral industry	795.18								795.18
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.81	NE,NA	NE,NA						4.81
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				24.62	NO	NO	NO	NO	24.62
G. Other product manufacture and use	IE	NE	4.24		NO	4.65			8.89
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.60	383.09	223.45						608.14
A. Enteric fermentation		234.43							234.43
B. Manure management		145.71	63.67						209.39
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	159.05						159.05
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		2.94	0.72						3.67
G. Liming	NO								NO
H. Urea application	1.60								1.60
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-175.24	0.25	0.18						-174.80
A. Forest land	-12.20	0.25	0.13						-11.81
B. Cropland	-135.87	NO	0.02						-135.85
C. Grassland	-24.49	NO	NO						-24.49
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.40	NO	0.01						0.41
F. Other land	0.20	NO	0.01						0.21
G. Harvested wood products	-3.28								-3.28
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	449.03	10.77						459.80
A. Solid waste disposal	NO,NA	312.91							312.91
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		136.12	10.77						146.89
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	863.12	0.49	6.63						870.24
Aviation	705.94	0.14	5.23						711.32
Navigation	157.18	0.35	1.39						158.92
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	27.70								27.70
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	4.73								
	Total CO ₂ equivalent emissions without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions with land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry								

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
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Inventory 1994
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	5807.09	861.52	256.89	26.27	NO	5.29	NO	NO	6957.05
1. Energy	5155.44	15.01	30.22						5200.67
A. Fuel combustion (sectoral approach)	5155.44	14.36	30.22						5200.02
1. Energy industries	2370.90	2.88	5.32						2379.10
2. Manufacturing industries and construction	767.81	0.92	1.65						770.39
3. Transport	1430.62	7.50	22.11						1460.24
4. Other sectors	570.29	2.99	1.10						574.38
5. Other	15.82	0.06	0.03						15.91
B. Fugitive emissions from fuels	NO,NE	0.65	NO,NE						0.65
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.65	NO,NE						0.65
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	834.35	NO,NE,NA	4.32	26.27	NO	5.29	NO	NO	870.23
A. Mineral industry	827.76								827.76
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	6.58	NE,NA	NE,NA						6.58
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				26.27	NO	NO	NO	NO	26.27
G. Other product manufacture and use	IE	NE	4.32		NO	5.29			9.61
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.70	384.12	210.94						596.77
A. Enteric fermentation		238.15							238.15
B. Manure management		143.73	63.08						206.82
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	147.31						147.31
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		2.24	0.55						2.79
G. Liming	NO								NO
H. Urea application	1.70								1.70
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-184.41	0.66	0.40						-183.35
A. Forest land	-24.09	0.66	0.34						-23.10
B. Cropland	-136.42	NO	0.03						-136.39
C. Grassland	-24.96	NO	NO						-24.96
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.38	NO	0.01						0.39
F. Other land	0.22	NO	0.01						0.24
G. Harvested wood products	0.46								0.46
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	461.73	11.01						472.74
A. Solid waste disposal	NO,NA	319.60							319.60
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		142.13	11.01						153.14
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	919.91	0.59	6.98						927.48
Aviation	725.33	0.14	5.38						730.84
Navigation	194.58	0.45	1.60						196.64
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	60.76								60.76
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.15								
	Total CO ₂ equivalent emissions without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions with land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry								

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1995
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	5681.44	887.33	291.34	28.49	NO	5.93	NO	NO	6894.54
1. Energy	5059.48	15.60	32.18						5107.25
A. Fuel combustion (sectoral approach)	5059.48	15.01	32.18						5106.66
1. Energy industries	2166.14	2.67	4.78						2173.59
2. Manufacturing industries and construction	755.50	0.87	1.58						757.96
3. Transport	1518.13	7.41	24.57						1550.12
4. Other sectors	602.54	3.99	1.21						607.73
5. Other	17.17	0.06	0.04						17.27
B. Fugitive emissions from fuels	NO,NE	0.59	NO,NE						0.59
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.59	NO,NE						0.59
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	800.91	NO,NE,NA	4.39	28.49	NO	5.93	NO	NO	839.73
A. Mineral industry	794.46								794.46
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	6.45	NE,NA	NE,NA						6.45
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				28.49	NO	NO	NO	NO	28.49
G. Other product manufacture and use	IE	NE	4.39		NO	5.93			10.32
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.54	401.50	243.16						646.20
A. Enteric fermentation		248.62							248.62
B. Manure management		150.87	65.10						215.97
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	177.56						177.56
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		2.01	0.49						2.50
G. Liming	NO								NO
H. Urea application	1.54								1.54
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-180.49	0.26	0.20						-180.03
A. Forest land	-19.16	0.26	0.13						-18.77
B. Cropland	-136.96	NO	0.03						-136.93
C. Grassland	-25.44	NO	NO						-25.44
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.37	NO	0.01						0.37
F. Other land	0.25	NO	0.02						0.27
G. Harvested wood products	0.45								0.45
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	469.98	11.41						481.39
A. Solid waste disposal	NO,NA	326.76							326.76
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		143.23	11.41						154.64
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1013.52	0.65	7.73						1021.90
Aviation	796.86	0.16	5.91						802.93
Navigation	216.65	0.50	1.82						218.97
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	76.72								76.72
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.87								
Total CO₂ equivalent emissions without land use, land-use change and forestry									7074.57
Total CO₂ equivalent emissions with land use, land-use change and forestry									6894.54
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									7080.44
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									6900.41

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1996
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6025.80	909.37	268.42	33.60	NO	6.57	NO	NO	7243.74
1. Energy	5350.99	16.09	35.04						5402.12
A. Fuel combustion (sectoral approach)	5350.99	15.54	35.04						5401.58
1. Energy industries	2281.12	2.75	4.97						2288.84
2. Manufacturing industries and construction	856.06	0.97	1.77						858.80
3. Transport	1567.41	7.29	26.96						1601.66
4. Other sectors	628.34	4.46	1.31						634.11
5. Other	18.06	0.07	0.04						18.17
B. Fugitive emissions from fuels	NO,NE	0.54	NO,NE						0.54
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.54	NO,NE						0.54
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	859.52	NO,NE,NA	4.46	33.60	NO	6.57	NO	NO	904.15
A. Mineral industry	852.47								852.47
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	7.05	NE,NA	NE,NA						7.05
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				33.60	NO	NO	NO	NO	33.60
G. Other product manufacture and use	IE	NE	4.46		NO	6.57			11.03
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.38	416.79	217.03						635.20
A. Enteric fermentation		255.85							255.85
B. Manure management		159.06	67.70						226.76
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	148.87						148.87
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		1.88	0.46						2.34
G. Liming	NO								NO
H. Urea application	1.38								1.38
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-186.09	0.43	0.31						-185.36
A. Forest land	-22.91	0.43	0.22						-22.26
B. Cropland	-137.51	NO	0.04						-137.47
C. Grassland	-25.92	NO	NO						-25.92
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.35	NO	0.01						0.36
F. Other land	0.28	NO	0.02						0.30
G. Harvested wood products	-0.38								-0.38
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	476.06	11.58						487.64
A. Solid waste disposal	NO,NA	335.02							335.02
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		141.04	11.58						152.62
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1047.16	0.78	8.17						1056.11
Aviation	764.25	0.15	5.67						770.07
Navigation	282.91	0.63	2.50						286.04
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	74.50								74.50
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.98								
Total CO₂ equivalent emissions without land use, land-use change and forestry									7429.10
Total CO₂ equivalent emissions with land use, land-use change and forestry									7243.74
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									7435.08
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									7249.72

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1997
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6113.05	915.10	260.00	38.65	NO	7.21	NO	NO	7334.01
1. Energy	5471.48	15.76	37.76						5525.00
A. Fuel combustion (sectoral approach)	5471.48	15.02	37.76						5524.26
1. Energy industries	2410.95	2.86	5.19						2418.99
2. Manufacturing industries and construction	755.51	0.86	1.57						757.94
3. Transport	1633.24	7.22	29.68						1670.14
4. Other sectors	652.82	4.00	1.29						658.11
5. Other	18.96	0.07	0.04						19.07
B. Fugitive emissions from fuels	NO,NE	0.74	NO,NE						0.74
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.74	NO,NE						0.74
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	825.71	NO,NE,NA	4.52	38.65	NO	7.21	NO	NO	876.09
A. Mineral industry	819.26								819.26
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	6.45	NE,NA	NE,NA						6.45
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				38.65	NO	NO	NO	NO	38.65
G. Other product manufacture and use	IE	NE	4.52		NO	7.21			11.73
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.10	413.38	205.58						620.06
A. Enteric fermentation		250.10							250.10
B. Manure management		162.55	69.44						231.99
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	135.96						135.96
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.72	0.18						0.90
G. Liming	NO								NO
H. Urea application	1.10								1.10
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-185.24	0.61	0.41						-184.22
A. Forest land	-30.82	0.61	0.32						-29.88
B. Cropland	-138.05	NO	0.04						-138.01
C. Grassland	-26.40	NO	NO						-26.40
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.33	NO	0.01						0.34
F. Other land	0.31	NO	0.02						0.33
G. Harvested wood products	9.38								9.38
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	485.35	11.73						497.08
A. Solid waste disposal	NO,NA	343.46							343.46
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		141.89	11.73						153.61
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1061.10	0.84	8.30						1070.24
Aviation	753.05	0.15	5.58						758.78
Navigation	308.04	0.69	2.72						311.45
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	63.42								63.42
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.91								
Total CO₂ equivalent emissions without land use, land-use change and forestry									7518.22
Total CO₂ equivalent emissions with land use, land-use change and forestry									7334.01
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									7524.14
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									7339.92

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1998
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6398.72	919.14	280.84	47.38	NO	7.85	NO	NO	7653.93
1. Energy	5810.70	16.15	39.67						5866.52
A. Fuel combustion (sectoral approach)	5810.70	15.38	39.67						5865.75
1. Energy industries	2643.21	3.14	5.75						2652.10
2. Manufacturing industries and construction	758.37	0.90	1.61						760.88
3. Transport	1709.99	7.04	30.91						1747.95
4. Other sectors	678.93	4.22	1.36						684.50
5. Other	20.19	0.08	0.04						20.31
B. Fugitive emissions from fuels	NO,NE	0.77	NO,NE						0.77
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.77	NO,NE						0.77
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	780.95	NO,NE,NA	4.57	47.38	NO	7.85	NO	NO	840.75
A. Mineral industry	776.84								776.84
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.11	NE,NA	NE,NA						4.11
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				47.38	NO	NO	NO	NO	47.38
G. Other product manufacture and use	IE	NE	4.57		NO	7.85			12.42
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.84	408.35	223.45						632.64
A. Enteric fermentation		242.20							242.20
B. Manure management		165.25	69.33						234.58
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	153.90						153.90
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.90	0.22						1.12
G. Liming	NO								NO
H. Urea application	0.84								0.84
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-193.77	2.08	1.20						-190.49
A. Forest land	-31.10	2.08	1.09						-27.93
B. Cropland	-138.59	NO	0.05						-138.55
C. Grassland	-26.87	NO	NO						-26.87
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.31	NO	0.01						0.32
F. Other land	0.34	NO	0.02						0.37
G. Harvested wood products	2.15								2.15
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	492.56	11.95						504.51
A. Solid waste disposal	NO,NA	352.16							352.16
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		140.40	11.95						152.35
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1102.67	0.82	9.20						1112.68
Aviation	794.15	0.16	5.89						800.19
Navigation	308.52	0.66	3.31						312.49
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	69.18								69.18
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.80								
	Total CO ₂ equivalent emissions without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions with land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry								

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 1999
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total	
SINK CATEGORIES	CO ₂ equivalent (kt)									
Total (net emissions)⁽¹⁾	6660.23	919.21	272.58	54.29	NO	8.49	NO	NO	7914.81	
1. Energy	6071.50	16.28	43.18						6130.96	
A. Fuel combustion (sectoral approach)	6071.50	15.44	43.18						6130.12	
1. Energy industries	2826.94	3.31	5.99						2836.24	
2. Manufacturing industries and construction	783.44	0.95	1.68						786.07	
3. Transport	1754.28	6.82	34.07						1795.16	
4. Other sectors	686.08	4.29	1.39						691.77	
5. Other	20.76	0.08	0.04						20.88	
B. Fugitive emissions from fuels	NO,NE	0.84	NO,NE						0.84	
1. Solid fuels	NO	NO	NO						NO	
2. Oil and natural gas	NO,NE	0.84	NO,NE						0.84	
C. CO ₂ transport and storage	NO								NO	
2. Industrial processes and product use	786.33	NO,NE,NA	4.62	54.29	NO	8.49	NO	NO	853.74	
A. Mineral industry	782.20								782.20	
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	
D. Non-energy products from fuels and solvent use	4.14	NE,NA	NE,NA						4.14	
E. Electronic industry				NO	NO	NO	NO	NO	NO	
F. Product uses as ODS substitutes				54.29	NO	NO	NO	NO	54.29	
G. Other product manufacture and use	IE	NE	4.62		NO	8.49			13.11	
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Agriculture	0.92	401.93	212.57						615.42	
A. Enteric fermentation		240.50							240.50	
B. Manure management		159.93	69.10						229.03	
C. Rice cultivation		NO							NO	
D. Agricultural soils		NE	143.11						143.11	
E. Prescribed burning of savannas		NO	NO						NO	
F. Field burning of agricultural residues		1.50	0.37						1.87	
G. Liming	NO								NO	
H. Urea application	0.92								0.92	
I. Other carbon-containing fertilizers	NO								NO	
J. Other	NO	NO	NO						NO	
4. Land use, land-use change and forestry⁽¹⁾	-198.51	0.01	0.12						-198.38	
A. Forest land	-33.19	0.01	0.01						-33.17	
B. Cropland	-139.14	NO	0.05						-139.08	
C. Grassland	-27.35	NO	NO						-27.35	
D. Wetlands	NO,NE	NO	NO						NO,NE	
E. Settlements	0.29	NO	0.01						0.30	
F. Other land	0.37	NO	0.03						0.40	
G. Harvested wood products	0.51								0.51	
H. Other	NO	NO	NO						NO	
5. Waste	NO,NA	500.98	12.08						513.07	
A. Solid waste disposal	NO,NA	360.89							360.89	
B. Biological treatment of solid waste		NO	NO						NO	
C. Incineration and open burning of waste	NO	NO	NO						NO	
D. Waste water treatment and discharge		140.10	12.08						152.18	
E. Other	NO	NO	NO						NO	
6. Other (as specified in summary 1.A)										
Memo items:⁽²⁾										
International bunkers	1298.07	1.23	10.39						1309.69	
Aviation	813.79	0.16	6.03						819.98	
Navigation	484.28	1.07	4.36						489.71	
Multilateral operations	NO	NO	NO						NO	
CO ₂ emissions from biomass	64.43								64.43	
CO ₂ captured	NO								NO	
Long-term storage of C in waste disposal sites	NE								NE	
Indirect N ₂ O			NO,NE							
Indirect CO ₂ ⁽³⁾	7.64									
				Total CO ₂ equivalent emissions without land use, land-use change and forestry						8113.19
				Total CO ₂ equivalent emissions with land use, land-use change and forestry						7914.81
				Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry						8120.83
				Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry						7922.45

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2000
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6955.15	942.50	274.92	62.44	NO	9.13	NO	NO	8244.14
1. Energy	6296.08	15.94	45.61						6357.63
A. Fuel combustion (sectoral approach)	6296.08	15.10	45.61						6356.80
1. Energy industries	2954.60	3.42	6.22						2964.25
2. Manufacturing industries and construction	799.51	1.09	1.86						802.46
3. Transport	1795.15	6.51	36.04						1837.70
4. Other sectors	725.39	4.01	1.43						730.83
5. Other	21.43	0.08	0.05						21.56
B. Fugitive emissions from fuels	NO,NE	0.84	NO,NE						0.84
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.84	NO,NE						0.84
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	806.84	NO,NE,NA	4.67	62.44	NO	9.13	NO	NO	883.08
A. Mineral industry	802.75								802.75
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.10	NE,NA	NE,NA						4.10
E. Electronic industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				62.44	NO	NO	NO	NO	62.44
G. Other product manufacture and use	IE	NE	4.67		NO	9.13			13.80
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.67	411.17	209.85						622.69
A. Enteric fermentation		251.11							251.11
B. Manure management		159.43	71.40						230.83
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	138.30						138.30
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.62	0.15						0.78
G. Liming	NO								NO
H. Urea application	1.67								1.67
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-149.44	4.47	2.47						-142.51
A. Forest land	3.11	4.47	2.34						9.92
B. Cropland	-139.68	NO	0.06						-139.62
C. Grassland	-27.83	NO	NO						-27.83
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	0.27	NO	0.01						0.28
F. Other land	0.40	NO	0.03						0.43
G. Harvested wood products	14.30								14.30
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	510.92	12.32						523.24
A. Solid waste disposal	NO,NA	369.73							369.73
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		141.19	12.32						153.51
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1433.77	1.53	11.42						1446.71
Aviation	827.30	0.16	6.13						833.59
Navigation	606.47	1.37	5.28						613.12
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	56.93								56.93
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	7.60								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8386.64
Total CO₂ equivalent emissions with land use, land-use change and forestry									8244.14
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8394.25
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8251.74

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2001
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6807.34	977.11	305.17	70.91	NO	9.80	NO	NO	8170.32
1. Energy	6187.52	15.80	48.78						6252.10
A. Fuel combustion (sectoral approach)	6187.52	14.98	48.78						6251.27
1. Energy industries	2837.28	3.29	6.12						2846.70
2. Manufacturing industries and construction	745.41	1.09	1.82						748.31
3. Transport	1854.66	6.49	39.34						1900.49
4. Other sectors	728.51	4.03	1.44						733.99
5. Other	21.65	0.08	0.05						21.78
B. Fugitive emissions from fuels	NO,NE	0.82	NO,NE						0.82
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.82	NO,NE						0.82
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	790.81	NO,NE,NA	4.72	70.91	NO	9.80	NO	NO	876.25
A. Mineral industry	786.68								786.68
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.14	NE,NA	NE,NA						4.14
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				70.91	NO	NO	NO	NO	70.91
G. Other product manufacture and use	IE	NE	4.72		NO	9.80			14.52
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.17	438.67	238.14						676.97
A. Enteric fermentation		268.70							268.70
B. Manure management		168.64	77.83						246.46
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	159.99						159.99
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		1.33	0.33						1.65
G. Liming	NO								NO
H. Urea application	0.17								0.17
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-171.16	1.51	1.06						-168.60
A. Forest land	-48.51	1.51	0.79						-46.21
B. Cropland	-139.69	NO	0.08						-139.61
C. Grassland	-28.81	NO	NO						-28.81
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	22.98	NO	0.11						23.09
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	22.54								22.54
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	521.13	12.47						533.60
A. Solid waste disposal	NO,NA	378.84							378.84
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		142.29	12.47						154.76
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1573.85	1.56	12.39						1587.80
Aviation	970.68	0.19	7.19						978.07
Navigation	603.17	1.37	5.19						609.73
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	60.59								60.59
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	7.15								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8338.92
Total CO₂ equivalent emissions with land use, land-use change and forestry									8170.32
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8346.07
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8177.47

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2002
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6967.01	1003.39	307.90	80.28	NO	10.45	NO	NO	8369.04
1. Energy	6345.29	15.92	50.81						6412.02
A. Fuel combustion (sectoral approach)	6345.29	15.15	50.81						6411.24
1. Energy industries	2998.47	3.44	6.47						3008.39
2. Manufacturing industries and construction	756.68	1.10	1.85						759.63
3. Transport	1836.81	6.20	40.98						1883.99
4. Other sectors	732.57	4.33	1.46						738.36
5. Other	20.76	0.08	0.04						20.88
B. Fugitive emissions from fuels	NO,NE	0.77	NO,NE						0.77
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.77	NO,NE						0.77
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	823.72	NO,NE,NA	4.78	80.28	NO	10.45	NO	NO	919.23
A. Mineral industry	819.00								819.00
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.72	NE,NA	NE,NA						4.72
E. Electronic industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				80.28	NO	NO	NO	NO	80.28
G. Other product manufacture and use	IE	NE	4.78		NO	10.45			15.23
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.42	458.50	239.27						698.19
A. Enteric fermentation		281.84							281.84
B. Manure management		175.26	81.67						256.93
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	157.25						157.25
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		1.40	0.34						1.75
G. Liming	NO								NO
H. Urea application	0.42								0.42
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-202.42	0.04	0.44						-201.94
A. Forest land	-81.54	0.04	0.02						-81.47
B. Cropland	-139.64	NO	0.10						-139.54
C. Grassland	-28.75	NO	NO						-28.75
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	23.34	NO	0.21						23.54
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	23.86								23.86
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	528.93	12.61						541.54
A. Solid waste disposal	NO,NA	388.75							388.75
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		140.18	12.61						152.79
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1368.40	1.17	11.32						1380.89
Aviation	934.92	0.18	6.93						942.03
Navigation	433.48	0.99	4.39						438.85
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	66.88								66.88
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	9.21								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8570.97
Total CO₂ equivalent emissions with land use, land-use change and forestry									8369.04
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8580.19
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8378.25

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2003
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7344.78	993.36	304.25	92.00	NO	11.11	NO	NO	8745.50
1. Energy	6732.71	16.44	53.91						6803.06
A. Fuel combustion (sectoral approach)	6732.71	15.75	53.91						6802.37
1. Energy industries	3224.91	3.67	6.71						3235.30
2. Manufacturing industries and construction	783.51	1.24	2.04						786.80
3. Transport	1945.64	6.41	43.62						1995.66
4. Other sectors	757.33	4.35	1.49						763.16
5. Other	21.32	0.08	0.05						21.44
B. Fugitive emissions from fuels	NO,NE	0.69	NO,NE						0.69
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.69	NO,NE						0.69
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	826.20	NO,NE,NA	4.84	92.00	NO	11.11	NO	NO	934.15
A. Mineral industry	821.47								821.47
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.74	NE,NA	NE,NA						4.74
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				92.00	NO	NO	NO	NO	92.00
G. Other product manufacture and use	IE	NE	4.84		NO	11.11			15.95
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.73	444.38	232.52						677.63
A. Enteric fermentation		273.94							273.94
B. Manure management		170.02	77.47						247.49
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	154.68						154.68
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.41	0.37						0.78
G. Liming	NO								NO
H. Urea application	0.73								0.73
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-214.87	0.19	0.66						-214.02
A. Forest land	-94.62	0.19	0.10						-94.33
B. Cropland	-139.59	NO	0.12						-139.47
C. Grassland	-28.69	NO	NO						-28.69
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	23.69	NO	0.30						23.99
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	24.02								24.02
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	532.35	12.33						544.68
A. Solid waste disposal	NO,NA	398.82							398.82
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		133.53	12.33						145.86
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1391.24	1.06	10.91						1403.21
Aviation	1001.36	0.20	7.42						1008.98
Navigation	389.88	0.87	3.48						394.23
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	75.37								75.37
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	11.07								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8959.52
Total CO₂ equivalent emissions with land use, land-use change and forestry									8745.50
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8970.59
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8756.58

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2004
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7572.91	985.00	269.73	107.15	NO	11.76	NO	NO	8946.56
1. Energy	6896.94	16.00	29.27						6942.20
A. Fuel combustion (sectoral approach)	6896.94	15.80	29.27						6942.01
1. Energy industries	3283.44	3.75	7.10						3294.29
2. Manufacturing industries and construction	863.24	1.31	2.18						866.74
3. Transport	2048.67	6.38	18.61						2073.67
4. Other sectors	681.20	4.18	1.33						686.71
5. Other	20.39	0.17	0.05						20.61
B. Fugitive emissions from fuels	NO,NE	0.20	NO,NE						0.20
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	0.20	NO,NE						0.20
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	890.85	NO,NE,NA	4.91	107.15	NO	11.76	NO	NO	1014.67
A. Mineral industry	884.95								884.95
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	5.90	NE,NA	NE,NA						5.90
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				107.15	NO	NO	NO	NO	107.15
G. Other product manufacture and use	IE	NE	4.91		NO	11.76			16.67
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.95	432.57	222.20						655.71
A. Enteric fermentation		271.96							271.96
B. Manure management		159.61	74.73						234.33
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	147.39						147.39
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		1.00	0.08						1.07
G. Liming	NO								NO
H. Urea application	0.95								0.95
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-215.82	0.37	0.89						-214.55
A. Forest land	-96.29	0.37	0.20						-95.72
B. Cropland	-139.54	NO	0.14						-139.40
C. Grassland	-28.63	NO	NO						-28.63
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	24.04	NO	0.40						24.44
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	24.29								24.29
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	536.06	12.46						548.53
A. Solid waste disposal	NO,NA	409.36							409.36
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		126.71	12.46						139.17
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1086.31	0.52	8.57						1095.40
Aviation	915.85	0.18	6.79						922.82
Navigation	170.46	0.34	1.78						172.58
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	67.02								67.02
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	13.64								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9161.11
Total CO₂ equivalent emissions with land use, land-use change and forestry									8946.56
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9174.75
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8960.20

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2005
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7735.46	959.90	245.63	121.80	NO	12.42	NO	NO	9075.21
1. Energy	7092.42	15.96	28.27						7136.65
A. Fuel combustion (sectoral approach)	7092.42	15.96	28.27						7136.65
1. Energy industries	3471.84	3.95	7.34						3483.13
2. Manufacturing industries and construction	908.28	1.36	2.26						911.90
3. Transport	2088.67	6.27	17.44						2112.38
4. Other sectors	604.60	4.21	1.19						609.99
5. Other	19.03	0.17	0.04						19.24
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	863.94	NO,NE,NA	4.98	121.80	NO	12.42	NO	NO	1003.14
A. Mineral industry	860.47								860.47
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.46	NE,NA	NE,NA						3.46
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				121.80	NO	NO	NO	NO	121.80
G. Other product manufacture and use	IE	NE	4.98		NO	12.42			17.40
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.97	398.43	199.28						598.68
A. Enteric fermentation		255.88							255.88
B. Manure management		141.92	69.85						211.78
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	129.27						129.27
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.63	0.15						0.78
G. Liming	NO								NO
H. Urea application	0.97								0.97
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-221.86	0.13	0.91						-220.83
A. Forest land	-102.78	0.13	0.07						-102.58
B. Cropland	-139.49	NO	0.16						-139.34
C. Grassland	-28.57	NO	NO						-28.57
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	24.39	NO	0.50						24.89
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	24.27								24.27
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	545.38	12.19						557.57
A. Solid waste disposal	NO,NA	420.35							420.35
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		125.03	12.19						137.22
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1750.15	2.26	13.97						1766.38
Aviation	833.10	0.16	6.17						839.44
Navigation	917.05	2.10	7.80						926.94
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	63.60								63.60
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	16.11								
	Total CO ₂ equivalent emissions without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions with land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry								
	Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry								

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2006
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7961.05	962.68	256.75	137.79	NO	11.47	NO	NO	9329.74
1. Energy	7277.99	16.00	27.75						7321.74
A. Fuel combustion (sectoral approach)	7277.99	16.00	27.75						7321.74
1. Energy industries	3653.38	4.01	7.56						3664.95
2. Manufacturing industries and construction	868.32	1.27	2.11						871.70
3. Transport	2077.45	5.93	16.70						2100.07
4. Other sectors	664.90	4.60	1.34						670.85
5. Other	13.95	0.19	0.04						14.17
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	905.85	NO,NE,NA	5.08	137.79	NO	11.47	NO	NO	1060.19
A. Mineral industry	902.37								902.37
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.48	NE,NA	NE,NA						3.48
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				137.79	NO	NO	NO	NO	137.79
G. Other product manufacture and use	IE	NE	5.08		NO	11.47			16.55
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.17	400.91	210.37						612.44
A. Enteric fermentation		257.52							257.52
B. Manure management		142.84	68.68						211.52
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	141.55						141.55
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.55	0.13						0.68
G. Liming	NO								NO
H. Urea application	1.17								1.17
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-223.96	0.32	1.15						-222.49
A. Forest land	-104.46	0.32	0.17						-103.97
B. Cropland	-139.44	NO	0.18						-139.27
C. Grassland	-28.52	NO	NO						-28.52
D. Wetlands	NO,NE	NO	NO						NO,NE
E. Settlements	24.72	NO	0.59						25.32
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	23.42								23.42
H. Other	NO	NO	NO						NO
5. Waste	NO,NE,NA	545.45	12.40						557.86
A. Solid waste disposal	NO,NE,NA	431.33							431.33
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		114.12	12.40						126.52
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1771.71	2.17	16.22						1790.10
Aviation	839.84	0.16	6.22						846.23
Navigation	931.87	2.00	10.00						943.87
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	64.14								64.14
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	17.68								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9552.22
Total CO₂ equivalent emissions with land use, land-use change and forestry									9329.74
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9569.91
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									9347.42

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2007
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total	
SINK CATEGORIES	CO ₂ equivalent (kt)									
Total (net emissions)⁽¹⁾	8314.89	967.56	248.67	153.17	NO	11.78	NO	NO	9696.06	
1. Energy	7600.55	16.85	25.28						7642.68	
A. Fuel combustion (sectoral approach)	7600.55	16.85	25.28						7642.68	
1. Energy industries	3801.67	4.29	7.98						3813.94	
2. Manufacturing industries and construction	926.03	1.51	2.43						929.97	
3. Transport	2216.51	5.64	13.49						2235.65	
4. Other sectors	636.02	5.24	1.33						642.59	
5. Other	20.32	0.17	0.05						20.54	
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE	
1. Solid fuels	NO	NO	NO						NO	
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE	
C. CO ₂ transport and storage	NO								NO	
2. Industrial processes and product use	901.83	NO,NE,NA	5.20	153.17	NO	11.78	NO	NO	1071.98	
A. Mineral industry	898.32								898.32	
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	
D. Non-energy products from fuels and solvent use	3.51	NE,NA	NE,NA						3.51	
E. Electronic Industry				NO	NO	NO	NO	NO	NO	
F. Product uses as ODS substitutes				153.17	NO	NO	NO	NO	153.17	
G. Other product manufacture and use	IE	NE	5.20		NO	11.78			16.98	
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3. Agriculture	1.11	400.40	202.86						604.37	
A. Enteric fermentation		262.08							262.08	
B. Manure management		137.82	71.28						209.09	
C. Rice cultivation		NO							NO	
D. Agricultural soils		NE	131.46						131.46	
E. Prescribed burning of savannas		NO	NO						NO	
F. Field burning of agricultural residues		0.51	0.12						0.63	
G. Liming	NO								NO	
H. Urea application	1.11								1.11	
I. Other carbon-containing fertilizers	NO								NO	
J. Other	NO	NO	NO						NO	
4. Land use, land-use change and forestry⁽¹⁾	-188.61	3.08	2.64						-182.89	
A. Forest land	-46.83	3.08	1.61						-42.13	
B. Cropland	-141.17	NO	0.18						-140.99	
C. Grassland	-28.50	NO	NO						-28.50	
D. Wetlands	0.44	NO	NO						0.44	
E. Settlements	8.31	NO	0.63						8.94	
F. Other land	0.32	NO	0.03						0.35	
G. Harvested wood products	18.81								18.81	
H. Other	NO	NO	NO						NO	
5. Waste	NO,NA	547.23	12.69						559.92	
A. Solid waste disposal	NO,NA	443.42							443.42	
B. Biological treatment of solid waste		NO	NO						NO	
C. Incineration and open burning of waste	NO	NO	NO						NO	
D. Waste water treatment and discharge		103.81	12.69						116.50	
E. Other	NO	NO	NO						NO	
6. Other (as specified in summary 1.A)										
Memo items:⁽²⁾										
International bunkers	1693.34	2.00	14.42						1709.76	
Aviation	827.25	0.16	6.13						833.54	
Navigation	866.09	1.84	8.28						876.21	
Multilateral operations	NO	NO	NO						NO	
CO ₂ emissions from biomass	103.05								103.05	
CO ₂ captured	NO								NO	
Long-term storage of C in waste disposal sites	NE								NE	
Indirect N ₂ O			NO,NE							
Indirect CO ₂ ⁽³⁾	18.16									
				Total CO ₂ equivalent emissions without land use, land-use change and forestry						9878.95
				Total CO ₂ equivalent emissions with land use, land-use change and forestry						9696.06
				Total CO ₂ equivalent emissions, including indirect CO ₂ , without land use, land-use change and forestry						9897.11
				Total CO ₂ equivalent emissions, including indirect CO ₂ , with land use, land-use change and forestry						9714.22

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2008
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	8464.66	962.33	234.07	172.12	NO	12.09	NO	NO	9845.27
1. Energy	7810.69	16.96	25.77						7853.41
A. Fuel combustion (sectoral approach)	7810.69	16.96	25.77						7853.41
1. Energy industries	3967.29	4.43	8.17						3979.90
2. Manufacturing industries and construction	903.32	1.51	2.43						907.26
3. Transport	2305.76	5.43	13.81						2325.00
4. Other sectors	591.69	5.33	1.27						598.29
5. Other	42.62	0.26	0.09						42.97
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	904.51	NO,NE,NA	5.34	172.12	NO	12.09	NO	NO	1094.04
A. Mineral industry	901.00								901.00
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.50	NE,NA	NE,NA						3.50
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				172.12	NO	NO	NO	NO	172.12
G. Other product manufacture and use	IE	NE	5.34		NO	12.09			17.42
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.54	388.05	188.81						577.40
A. Enteric fermentation		253.33							253.33
B. Manure management		134.23	67.08						201.32
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	121.61						121.61
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.48	0.12						0.60
G. Liming	NO								NO
H. Urea application	0.54								0.54
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-251.07	0.11	1.12						-249.84
A. Forest land	-108.43	0.11	0.06						-108.26
B. Cropland	-140.98	NO	0.18						-140.81
C. Grassland	-28.50	NO	NO						-28.50
D. Wetlands	0.45	NO	NO						0.45
E. Settlements	8.43	NO	0.66						9.08
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	17.64								17.64
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	557.22	13.04						570.25
A. Solid waste disposal	NO,NA	455.95							455.95
B. Biological treatment of solid waste		NO	NO						NO
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		101.27	13.04						114.31
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1654.94	1.89	14.87						1671.70
Aviation	858.60	0.17	6.37						865.13
Navigation	796.34	1.72	8.50						806.57
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	156.43								156.43
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	15.62								
Total CO₂ equivalent emissions without land use, land-use change and forestry									10095.11
Total CO₂ equivalent emissions with land use, land-use change and forestry									9845.27
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									10110.73
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									9860.89

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2009
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	8191.16	964.69	231.30	182.72	NO	12.39	NO	NO	9582.27
1. Energy	7738.77	19.30	23.56						7781.63
A. Fuel combustion (sectoral approach)	7738.77	19.30	23.56						7781.63
1. Energy industries	3992.47	4.35	8.26						4005.09
2. Manufacturing industries and construction	798.90	1.33	2.12						802.35
3. Transport	2310.32	5.17	11.42						2326.91
4. Other sectors	616.79	8.28	1.71						626.78
5. Other	20.29	0.17	0.05						20.50
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	730.28	NO,NE,NA	5.49	182.72	NO	12.39	NO	NO	930.88
A. Mineral industry	726.74								726.74
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.54	NE,NA	NE,NA						3.54
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				182.72	NO	NO	NO	NO	182.72
G. Other product manufacture and use	IE	NE	5.49		NO	12.39			17.88
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1.14	381.20	187.69						570.03
A. Enteric fermentation		252.63							252.63
B. Manure management		128.14	66.13						194.27
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	121.45						121.45
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.43	0.11						0.54
G. Liming	NO								NO
H. Urea application	1.14								1.14
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-279.04	0.19	1.20						-277.65
A. Forest land	-141.57	0.19	0.10						-141.28
B. Cropland	-140.80	NO	0.18						-140.62
C. Grassland	-28.50	NO	NO						-28.50
D. Wetlands	0.47	NO	NO						0.47
E. Settlements	8.53	NO	0.69						9.22
F. Other land	0.32	NO	0.03						0.35
G. Harvested wood products	22.51								22.51
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	564.00	13.38						577.38
A. Solid waste disposal	NO,NA	469.08							469.08
B. Biological treatment of solid waste		0.03	NO,NE						0.03
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		94.88	13.38						108.26
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1500.67	1.66	12.39						1514.71
Aviation	811.53	0.16	6.02						817.70
Navigation	689.14	1.50	6.37						697.01
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	182.35								182.35
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	13.63								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9859.92
Total CO₂ equivalent emissions with land use, land-use change and forestry									9582.27
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9873.55
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									9595.89

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2010
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7833.85	974.35	248.39	198.99	NO	12.70	NO	NO	9268.28
1. Energy	7506.87	16.89	22.93						7546.70
A. Fuel combustion (sectoral approach)	7506.87	16.89	22.93						7546.70
1. Energy industries	3868.00	4.21	8.00						3880.21
2. Manufacturing industries and construction	696.58	1.31	2.03						699.92
3. Transport	2358.79	5.12	11.50						2375.42
4. Other sectors	563.22	6.08	1.35						570.64
5. Other	20.29	0.17	0.05						20.50
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	593.51	NO,NE,NA	5.62	198.99	NO	12.70	NO	NO	810.82
A. Mineral industry	589.98								589.98
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.53	NE,NA	NE,NA						3.53
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				198.99	NO	NO	NO	NO	198.99
G. Other product manufacture and use	IE	NE	5.62		NO	12.70			18.32
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.74	388.21	202.94						591.88
A. Enteric fermentation		263.63							263.63
B. Manure management		124.07	68.88						192.95
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	133.93						133.93
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.51	0.12						0.63
G. Liming	NO								NO
H. Urea application	0.74								0.74
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-267.27	0.73	1.51						-265.04
A. Forest land	-131.30	0.73	0.38						-130.19
B. Cropland	-140.22	NO	0.17						-140.04
C. Grassland	-28.02	NO	NO						-28.02
D. Wetlands	0.48	NO	NO						0.48
E. Settlements	8.66	NO	0.72						9.38
F. Other land	0.29	NO	0.03						0.32
G. Harvested wood products	22.82								22.82
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	568.53	15.39						583.92
A. Solid waste disposal	NO,NA	482.17							482.17
B. Biological treatment of solid waste		3.03	1.67						4.71
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		83.32	13.72						97.04
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1416.02	1.47	12.22						1429.72
Aviation	828.13	0.16	6.14						834.43
Navigation	587.89	1.31	6.09						595.28
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	167.18								167.18
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	13.14								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9533.32
Total CO₂ equivalent emissions with land use, land-use change and forestry									9268.28
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9546.45
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									9281.42

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2011
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7484.77	973.76	239.37	216.37	NO	14.36	NO	NO	8928.64
1. Energy	7211.38	16.98	22.06						7250.42
A. Fuel combustion (sectoral approach)	7211.38	16.98	22.06						7250.42
1. Energy industries	3710.04	4.07	7.73						3721.84
2. Manufacturing industries and construction	572.44	0.88	1.44						574.76
3. Transport	2289.16	4.76	11.31						2305.22
4. Other sectors	613.11	7.08	1.52						621.72
5. Other	26.63	0.20	0.06						26.88
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	575.35	NO,NE,NA	5.77	216.37	NO	14.36	NO	NO	811.86
A. Mineral industry	571.83								571.83
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	3.53	NE,NA	NE,NA						3.53
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				216.37	NO	NO	NO	NO	216.37
G. Other product manufacture and use	IE	NE	5.77		NO	14.36			20.14
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.91	383.61	192.92						577.44
A. Enteric fermentation		270.08							270.08
B. Manure management		112.96	68.55						181.52
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	124.23						124.23
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.56	0.14						0.70
G. Liming	NO								NO
H. Urea application	0.91								0.91
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-302.86	0.61	1.47						-300.78
A. Forest land	-169.03	0.61	0.32						-168.10
B. Cropland	-139.63	NO	0.17						-139.46
C. Grassland	-27.53	NO	NO						-27.53
D. Wetlands	0.50	NO	NO						0.50
E. Settlements	8.78	NO	0.75						9.53
F. Other land	0.26	NO	0.02						0.29
G. Harvested wood products	23.79								23.79
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	572.57	17.14						589.71
A. Solid waste disposal	NO,NA	495.46							495.46
B. Biological treatment of solid waste		5.51	3.05						8.55
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		71.60	14.09						85.70
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1484.81	1.56	11.96						1498.33
Aviation	859.10	0.17	6.37						865.64
Navigation	625.71	1.39	5.60						632.69
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	188.13								188.13
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	4.88								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9229.42
Total CO₂ equivalent emissions with land use, land-use change and forestry									8928.64
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9234.30
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8933.52

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2012
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6966.92	963.71	236.17	221.17	NO	14.97	NO	NO	8402.94
1. Energy	6731.62	16.93	20.50						6769.05
A. Fuel combustion (sectoral approach)	6731.62	16.93	20.50						6769.05
1. Energy industries	3545.93	3.90	7.24						3557.08
2. Manufacturing industries and construction	458.92	0.56	0.98						460.45
3. Transport	2115.64	4.59	10.67						2130.89
4. Other sectors	590.86	7.70	1.57						600.13
5. Other	20.29	0.17	0.05						20.50
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	530.60	NO,NE,NA	5.80	221.17	NO	14.97	NO	NO	772.54
A. Mineral industry	527.64								527.64
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.95	NE,NA	NE,NA						2.95
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				221.17	NO	NO	NO	NO	221.17
G. Other product manufacture and use	IE	NE	5.80		NO	14.97			20.77
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.55	364.14	190.52						555.21
A. Enteric fermentation		263.38							263.38
B. Manure management		100.20	65.11						165.31
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	125.27						125.27
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.56	0.14						0.70
G. Liming	NO								NO
H. Urea application	0.55								0.55
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-295.85	0.68	1.54						-293.62
A. Forest land	-163.18	0.68	0.36						-162.14
B. Cropland	-139.05	NO	0.16						-138.88
C. Grassland	-27.05	NO	NO						-27.05
D. Wetlands	0.52	NO	NO						0.52
E. Settlements	8.90	NO	0.78						9.68
F. Other land	0.23	NO	0.02						0.25
G. Harvested wood products	23.78								23.78
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	581.95	17.80						599.76
A. Solid waste disposal	NO,NA	506.81							506.81
B. Biological treatment of solid waste		6.68	3.67						10.35
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		68.46	14.13						82.60
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1450.80	1.50	11.96						1464.26
Aviation	830.69	0.16	6.16						837.01
Navigation	620.11	1.34	5.81						627.25
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	183.37								183.37
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	4.66								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8696.56
Total CO₂ equivalent emissions with land use, land-use change and forestry									8402.94
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8701.22
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8407.60

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2013
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6283.78	948.55	213.56	225.67	NO	15.58	NO	NO	7687.13
1. Energy	5814.27	14.96	17.82						5847.05
A. Fuel combustion (sectoral approach)	5814.27	14.96	17.82						5847.05
1. Energy industries	2829.73	3.11	5.91						2838.75
2. Manufacturing industries and construction	538.27	0.69	1.18						540.14
3. Transport	1907.25	4.10	9.32						1920.66
4. Other sectors	512.59	6.87	1.36						520.83
5. Other	26.42	0.19	0.05						26.67
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	767.55	NO,NE,NA	5.75	225.67	NO	15.58	NO	NO	1014.55
A. Mineral industry	765.18								765.18
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.37	NE,NA	NE,NA						2.37
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				225.67	NO	NO	NO	NO	225.67
G. Other product manufacture and use	IE	NE	5.75		NO	15.58			21.32
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.79	340.66	171.57						513.01
A. Enteric fermentation		251.14							251.14
B. Manure management		89.10	59.89						149.00
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	111.57						111.57
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.42	0.10						0.52
G. Liming	NO								NO
H. Urea application	0.79								0.79
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-298.83	0.24	1.31						-297.29
A. Forest land	-171.45	0.24	0.13						-171.08
B. Cropland	-132.19	NO	0.16						-132.03
C. Grassland	-23.62	NO	NO						-23.62
D. Wetlands	0.45	NO	NO						0.45
E. Settlements	4.27	NO	0.79						5.06
F. Other land	0.20	NO	0.02						0.22
G. Harvested wood products	23.50								23.50
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	592.69	17.12						609.81
A. Solid waste disposal	NO,NA	519.36							519.36
B. Biological treatment of solid waste		5.73	3.12						8.85
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		67.60	14.00						81.60
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1530.27	1.78	12.79						1544.85
Aviation	774.87	0.15	5.74						780.77
Navigation	755.40	1.63	7.05						764.08
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	178.36								178.36
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	3.68								
Total CO₂ equivalent emissions without land use, land-use change and forestry									7984.42
Total CO₂ equivalent emissions with land use, land-use change and forestry									7687.13
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									7988.10
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									7690.81

(1) For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

(2) See footnote 7 to table Summary 1.A.

(3) In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2014
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6650.10	949.56	208.96	233.18	NO	16.18	NO	NO	8057.99
1. Energy	5962.22	14.25	17.95						5994.43
A. Fuel combustion (sectoral approach)	5962.22	14.25	17.95						5994.43
1. Energy industries	2940.32	3.21	6.16						2949.69
2. Manufacturing industries and construction	693.24	1.19	1.87						696.30
3. Transport	1840.80	3.93	8.71						1853.43
4. Other sectors	449.90	5.78	1.14						456.82
5. Other	37.97	0.14	0.08						38.18
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	988.17	NO,NE,NA	5.67	233.18	NO	16.18	NO	NO	1243.21
A. Mineral industry	985.79								985.79
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.38	NE,NA	NE,NA						2.38
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				233.18	NO	NO	NO	NO	233.18
G. Other product manufacture and use	IE	NE	5.67		NO	16.18			21.86
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.41	332.42	166.26						499.08
A. Enteric fermentation		249.45							249.45
B. Manure management		82.85	60.09						142.94
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	106.13						106.13
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.12	0.03						0.15
G. Liming	NO								NO
H. Urea application	0.41								0.41
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-300.70	0.27	1.32						-299.11
A. Forest land	-173.79	0.27	0.14						-173.38
B. Cropland	-131.58	NO	0.16						-131.42
C. Grassland	-23.07	NO	NO						-23.07
D. Wetlands	0.46	NO	NO						0.46
E. Settlements	4.19	NO	0.79						4.98
F. Other land	0.17	NO	0.02						0.19
G. Harvested wood products	22.91								22.91
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	602.63	17.75						620.38
A. Solid waste disposal	NO,NA	528.51							528.51
B. Biological treatment of solid waste		7.16	3.93						11.09
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		66.95	13.82						80.77
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1509.14	1.74	12.58						1523.46
Aviation	775.81	0.15	5.75						781.71
Navigation	733.33	1.59	6.83						741.75
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	169.18								169.18
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	3.35								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8357.10
Total CO₂ equivalent emissions with land use, land-use change and forestry									8057.99
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8360.45
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8061.34

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2015
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6674.14	957.02	216.99	246.65	NO	16.79	NO	NO	8111.60
1. Energy	6080.59	17.60	19.04						6117.23
A. Fuel combustion (sectoral approach)	6080.59	17.60	19.04						6117.23
1. Energy industries	3023.00	3.35	6.19						3032.55
2. Manufacturing industries and construction	600.16	1.38	2.04						603.58
3. Transport	1910.44	3.89	9.16						1923.49
4. Other sectors	521.73	8.88	1.60						532.22
5. Other	25.26	0.09	0.05						25.40
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	890.59	NO,NE,NA	5.68	246.65	NO	16.79	NO	NO	1159.72
A. Mineral industry	888.12								888.12
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.47	NE,NA	NE,NA						2.47
E. Electronic Industry					NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				246.65	NO	NO	NO	NO	246.65
G. Other product manufacture and use	IE	NE	5.68		NO	16.79			22.47
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.40	332.87	172.68						505.95
A. Enteric fermentation		251.32							251.32
B. Manure management		80.84	58.93						139.78
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	113.57						113.57
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.71	0.17						0.89
G. Liming	NO								NO
H. Urea application	0.40								0.40
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-297.43	0.10	1.23						-296.11
A. Forest land	-171.42	0.10	0.05						-171.27
B. Cropland	-130.97	NO	0.15						-130.81
C. Grassland	-22.51	NO	NO						-22.51
D. Wetlands	0.47	NO	NO						0.47
E. Settlements	4.11	NO	0.80						4.91
F. Other land	0.15	NO	0.01						0.16
G. Harvested wood products	22.73								22.73
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	606.46	18.35						624.81
A. Solid waste disposal	NO,NA	534.39							534.39
B. Biological treatment of solid waste		8.15	4.50						12.65
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		63.91	13.85						77.76
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1518.32	1.84	12.52						1532.67
Aviation	750.89	0.15	5.57						756.60
Navigation	767.43	1.69	6.95						776.07
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	221.70								221.70
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	3.81								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8407.71
Total CO₂ equivalent emissions with land use, land-use change and forestry									8111.60
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8411.51
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8115.41

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2016
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7169.50	988.27	226.62	267.02	NO	15.61	NO	NO	8667.01
1. Energy	6474.20	18.12	20.57						6512.90
A. Fuel combustion (sectoral approach)	6474.20	18.12	20.57						6512.90
1. Energy industries	3300.00	3.69	6.90						3310.59
2. Manufacturing industries and construction	596.03	1.52	2.22						599.76
3. Transport	2037.64	3.96	9.84						2051.44
4. Other sectors	515.28	8.86	1.57						525.72
5. Other	25.26	0.09	0.05						25.40
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	899.07	NO,NE,NA	5.72	267.02	NO	15.61	NO	NO	1187.42
A. Mineral industry	896.42								896.42
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.66	NE,NA	NE,NA						2.66
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				267.02	NO	NO	NO	NO	267.02
G. Other product manufacture and use	IE	NE	5.72		NO	15.61			21.33
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.39	352.89	176.53						529.82
A. Enteric fermentation		273.00							273.00
B. Manure management		79.74	61.26						141.00
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	115.24						115.24
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.15	0.04						0.18
G. Liming	NO								NO
H. Urea application	0.39								0.39
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-204.17	7.94	5.34						-190.89
A. Forest land	-79.05	7.94	4.16						-66.95
B. Cropland	-130.40	NO	0.15						-130.25
C. Grassland	-21.97	NO	NO						-21.97
D. Wetlands	0.47	NO	NO						0.47
E. Settlements	4.09	NO	0.80						4.89
F. Other land	0.12	NO	0.01						0.13
G. Harvested wood products	22.57								22.57
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	609.31	18.45						627.76
A. Solid waste disposal	NO,NA	541.06							541.06
B. Biological treatment of solid waste		8.16	4.49						12.65
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		60.09	13.96						74.05
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1783.35	2.15	14.86						1800.35
Aviation	877.15	0.17	6.50						883.83
Navigation	906.20	1.97	8.35						916.53
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	235.45								235.45
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	3.93								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8857.90
Total CO₂ equivalent emissions with land use, land-use change and forestry									8667.01
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8861.83
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8670.94

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7195.21	999.26	229.71	287.91	NO	15.80	NO	NO	8727.90
1. Energy	6562.05	20.07	22.05						6604.17
A. Fuel combustion (sectoral approach)	6562.05	20.07	22.05						6604.17
1. Energy industries	3287.83	3.71	6.94						3298.48
2. Manufacturing industries and construction	615.71	2.05	2.89						620.65
3. Transport	2109.65	3.85	10.41						2123.91
4. Other sectors	523.44	10.36	1.76						535.57
5. Other	25.41	0.09	0.05						25.55
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	941.35	NO,NE,NA	5.79	287.91	NO	15.80	NO	NO	1250.85
A. Mineral industry	938.91								938.91
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.43	NE,NA	NE,NA						2.43
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				287.91	NO	NO	NO	NO	287.91
G. Other product manufacture and use	IE	NE	5.79		NO	15.80			21.59
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.42	362.49	181.76						544.67
A. Enteric fermentation		286.37							286.37
B. Manure management		75.79	63.46						139.25
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	118.22						118.22
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.33	0.08						0.41
G. Liming	NO								NO
H. Urea application	0.42								0.42
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-308.60	0.25	1.31						-307.03
A. Forest land	-184.37	0.25	0.13						-183.98
B. Cropland	-129.84	NO	0.15						-129.69
C. Grassland	-21.43	NO	NO						-21.43
D. Wetlands	0.47	NO	NO						0.47
E. Settlements	4.06	NO	0.81						4.87
F. Other land	0.09	NO	0.01						0.10
G. Harvested wood products	22.41								22.41
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	616.45	18.80						635.25
A. Solid waste disposal	NO,NA	548.31							548.31
B. Biological treatment of solid waste		8.28	4.67						12.94
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		59.87	14.13						74.00
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1802.99	1.89	15.20						1820.09
Aviation	998.33	0.20	7.40						1005.92
Navigation	804.67	1.70	7.80						814.16
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	288.44								288.44
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.26								
Total CO₂ equivalent emissions without land use, land-use change and forestry									9034.93
Total CO₂ equivalent emissions with land use, land-use change and forestry									8727.90
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									9040.19
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8733.16

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
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GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7017.47	1013.69	231.60	308.05	NO	16.89	NO	NO	8587.71
1. Energy	6450.82	20.05	22.59						6493.46
A. Fuel combustion (sectoral approach)	6450.82	20.05	22.59						6493.46
1. Energy industries	3342.36	3.72	6.97						3353.05
2. Manufacturing industries and construction	549.60	2.47	3.38						555.45
3. Transport	2080.00	3.68	10.54						2094.22
4. Other sectors	452.27	10.09	1.64						464.00
5. Other	26.59	0.10	0.05						26.74
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	870.68	NO,NE,NA	5.87	308.05	NO	16.89	NO	NO	1201.49
A. Mineral industry	868.24								868.24
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	2.44	NE,NA	NE,NA						2.44
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				308.05	NO	NO	NO	NO	308.05
G. Other product manufacture and use	IE	NE	5.87		NO	16.89			22.76
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.22	368.36	181.56						550.14
A. Enteric fermentation		292.99							292.99
B. Manure management		75.13	64.01						139.14
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	117.49						117.49
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.25	0.06						0.31
G. Liming	NO								NO
H. Urea application	0.22								0.22
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-304.25	0.49	1.44						-302.31
A. Forest land	-180.89	0.49	0.26						-180.14
B. Cropland	-129.27	NO	0.15						-129.12
C. Grassland	-20.89	NO	NO						-20.89
D. Wetlands	0.47	NO	NO						0.47
E. Settlements	4.03	NO	0.81						4.85
F. Other land	0.06	NO	0.01						0.06
G. Harvested wood products	22.24								22.24
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	624.79	20.14						644.93
A. Solid waste disposal	NO,NA	555.06							555.06
B. Biological treatment of solid waste		10.33	5.82						16.15
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		59.40	14.32						73.72
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1894.30	1.98	16.22						1912.50
Aviation	1037.11	0.20	7.69						1045.00
Navigation	857.19	1.77	8.53						867.49
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	324.87								324.87
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites	NE								NE
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.05								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8890.02
Total CO₂ equivalent emissions with land use, land-use change and forestry									8587.71
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8895.07
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8592.76

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

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GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	7043.58	1034.36	238.93	332.27	NO	15.44	NO	NO	8664.58
1. Energy	6522.74	20.89	23.08						6566.71
A. Fuel combustion (sectoral approach)	6522.74	20.89	23.08						6566.71
1. Energy industries	3282.06	3.63	6.83						3292.52
2. Manufacturing industries and construction	559.88	2.64	3.57						566.09
3. Transport	2124.79	3.76	10.79						2139.35
4. Other sectors	530.21	10.77	1.84						542.81
5. Other	25.80	0.09	0.05						25.95
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	819.37	NO,NE,NA	5.95	332.27	NO	15.44	NO	NO	1173.02
A. Mineral industry	814.39								814.39
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.98	NE,NA	NE,NA						4.98
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				332.27	NO	NO	NO	NO	332.27
G. Other product manufacture and use	IE	NE	5.95		NO	15.44			21.39
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.23	378.31	186.92						565.46
A. Enteric fermentation		303.12							303.12
B. Manure management		74.68	65.74						140.42
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	121.06						121.06
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.51	0.12						0.63
G. Liming	NO								NO
H. Urea application	0.23								0.23
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-298.76	0.35	1.37						-297.04
A. Forest land	-176.19	0.35	0.18						-175.66
B. Cropland	-128.65	NO	0.14						-128.51
C. Grassland	-20.33	NO	NO						-20.33
D. Wetlands	0.49	NO	NO						0.49
E. Settlements	3.94	NO	0.82						4.76
F. Other land	0.03	NO	0.00						0.03
G. Harvested wood products	21.96								21.96
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	634.80	21.62						656.42
A. Solid waste disposal	NO,NA	561.54							561.54
B. Biological treatment of solid waste		12.57	7.10						19.67
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		60.69	14.52						75.21
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1909.90	2.02	16.46						1928.38
Aviation	1027.07	0.20	7.61						1034.89
Navigation	882.83	1.82	8.84						893.49
Multilateral operations	NO	NO	NO						NO
CO₂ emissions from biomass	320.13								320.13
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites									
Indirect N₂O			NO,NE						
Indirect CO₂⁽³⁾	4.97								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8961.62
Total CO₂ equivalent emissions with land use, land-use change and forestry									8664.58
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8966.59
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8669.55

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
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GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6610.54	1065.19	246.01	335.68	NO	18.74	NO	NO	8276.15
1. Energy	6003.62	20.34	23.99						6047.95
A. Fuel combustion (sectoral approach)	6003.62	20.34	23.99						6047.95
1. Energy industries	3023.11	3.37	6.34						3032.83
2. Manufacturing industries and construction	554.09	3.15	4.25						561.49
3. Transport	1901.92	2.88	11.55						1916.34
4. Other sectors	498.01	10.84	1.80						510.65
5. Other	26.48	0.10	0.06						26.63
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	907.07	NO,NE,NA	6.00	335.68	NO	18.74	NO	NO	1267.49
A. Mineral industry	902.15								902.15
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	4.92	NE,NA	NE,NA						4.92
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				335.68	NO	NO	NO	NO	335.68
G. Other product manufacture and use	IE	NE	6.00		NO	18.74			24.74
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.22	410.00	192.94						603.16
A. Enteric fermentation		329.61							329.61
B. Manure management		79.89	68.66						148.55
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	124.16						124.16
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.50	0.12						0.62
G. Liming	NO								NO
H. Urea application	0.22								0.22
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-300.37	0.42	1.40						-298.54
A. Forest land	-178.22	0.42	0.22						-177.58
B. Cropland	-128.06	NO	0.14						-127.92
C. Grassland	-19.78	NO	NO						-19.78
D. Wetlands	0.50	NO	NO						0.50
E. Settlements	3.88	NO	0.82						4.70
F. Other land	NO	NO	NO						NO
G. Harvested wood products	21.32								21.32
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	634.42	21.67						656.09
A. Solid waste disposal	NO,NA	567.87							567.87
B. Biological treatment of solid waste		12.44	7.05						19.48
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		54.12	14.62						68.74
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1201.10	1.88	11.10						1214.08
Aviation	326.65	0.06	2.42						329.13
Navigation	874.45	1.81	8.68						884.95
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	412.55								412.55
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites									
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.16								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8574.70
Total CO₂ equivalent emissions with land use, land-use change and forestry									8276.15
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8579.86
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8281.31

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

SUMMARY 2 SUMMARY REPORT FOR CO₂ EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2021
Submission 2023 v5
CYPRUS

GREENHOUSE GAS SOURCE AND	CO ₂ ⁽¹⁾	CH ₄	N ₂ O	HFCs	PFCs	SF ₆	Unspecified mix of HFCs and PFCs	NF ₃	Total
SINK CATEGORIES	CO ₂ equivalent (kt)								
Total (net emissions)⁽¹⁾	6784.63	1102.89	246.39	353.49	NO	16.24	NO	NO	8503.64
1. Energy	6127.04	20.65	24.71						6172.40
A. Fuel combustion (sectoral approach)	6127.04	20.65	24.71						6172.40
1. Energy industries	3077.69	3.43	6.44						3087.56
2. Manufacturing industries and construction	522.07	3.67	4.88						530.62
3. Transport	2036.26	3.25	11.65						2051.16
4. Other sectors	468.10	10.22	1.68						479.99
5. Other	22.93	0.08	0.05						23.06
B. Fugitive emissions from fuels	NO,NE	NO,NE	NO						NO,NE
1. Solid fuels	NO	NO	NO						NO
2. Oil and natural gas	NO,NE	NO,NE	NO						NO,NE
C. CO ₂ transport and storage	NO								NO
2. Industrial processes and product use	902.02	NO,NE,NA	6.06	353.49	NO	16.24	NO	NO	1277.81
A. Mineral industry	896.99								896.99
B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-energy products from fuels and solvent use	5.03	NE,NA	NE,NA						5.03
E. Electronic Industry				NO	NO	NO	NO	NO	NO
F. Product uses as ODS substitutes				353.49	NO	NO	NO	NO	353.49
G. Other product manufacture and use	IE	NE	6.06		NO	16.24			22.30
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	0.30	436.67	189.23						626.20
A. Enteric fermentation		352.15							352.15
B. Manure management		84.01	69.76						153.77
C. Rice cultivation		NO							NO
D. Agricultural soils		NE	119.35						119.35
E. Prescribed burning of savannas		NO	NO						NO
F. Field burning of agricultural residues		0.51	0.13						0.64
G. Liming	NO								NO
H. Urea application	0.30								0.30
I. Other carbon-containing fertilizers	NO								NO
J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry⁽¹⁾	-244.72	5.48	3.92						-235.33
A. Forest land	-121.25	5.48	2.87						-112.90
B. Cropland	-127.73	NO	0.12						-127.60
C. Grassland	-19.73	NO	NO						-19.73
D. Wetlands	0.50	NO	NO						0.50
E. Settlements	3.56	NO	0.73						4.29
F. Other land	NO	NO	NO						NO
G. Harvested wood products	19.92								19.92
H. Other	NO	NO	NO						NO
5. Waste	NO,NA	640.08	22.47						662.56
A. Solid waste disposal	NO,NA	572.11							572.11
B. Biological treatment of solid waste		13.63	7.71						21.35
C. Incineration and open burning of waste	NO	NO	NO						NO
D. Waste water treatment and discharge		54.34	14.76						69.10
E. Other	NO	NO	NO						NO
6. Other (as specified in summary 1.A)									
Memo items:⁽²⁾									
International bunkers	1355.36	1.75	12.16						1369.27
Aviation	554.92	0.11	4.11						559.14
Navigation	800.44	1.64	8.04						810.13
Multilateral operations	NO	NO	NO						NO
CO ₂ emissions from biomass	420.62								420.62
CO ₂ captured	NO								NO
Long-term storage of C in waste disposal sites									
Indirect N ₂ O			NO,NE						
Indirect CO ₂ ⁽³⁾	5.22								
Total CO₂ equivalent emissions without land use, land-use change and forestry									8738.96
Total CO₂ equivalent emissions with land use, land-use change and forestry									8503.64
Total CO₂ equivalent emissions, including indirect CO₂, without land use, land-use change and forestry									8744.18
Total CO₂ equivalent emissions, including indirect CO₂, with land use, land-use change and forestry									8508.85

⁽¹⁾ For carbon dioxide (CO₂) from land use, land-use change and forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for

⁽²⁾ See footnote 7 to table Summary 1.A.

⁽³⁾ In accordance with the UNFCCC Annex I inventory reporting guidelines, for Parties that decide to report indirect CO₂ the national totals shall be provided with and without indirect CO₂.

Annex III: Reporting on SDGs - description of main forward-looking measures and their estimated impact

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
1.No poverty	1. Introduction of National Minimum Wage.	As of January 1st 2023, statutory minimum wage has been in effect in Cyprus. It has been set at €885 upon recruitment and it rises to €940 after 6 months of continuous employment at the same employer. However, some parameters still need to be regulated for a smoother and more distinct system. It is expected that the minimum wage introduction will have overall positive effects from a socioeconomic perspective. According to the 2021 Cystat median and average, the starting salary of €885 corresponds to 55% and 43% and €940 to 58% and 45% of median and mean respectively.
	2. Pension System Reform.	Social dialogue on the reform of the pensions system started in July 2021 in the Labour Advisory Body. The government's aim is to modernize the pension system in order to tackle existing problems and provide adequate income replacement for all. In Oct.2022 the Government signed an agreement for technical cooperation with ILO on the pension Reform. The first deliverable - a policy direction report was submitted in January 2023.
	3. Guaranteed Minimum income (basic needs, housing and allowance for disability).	Ongoing action GMI: For 2022 approximately €108,217 mln were provided for 21,846 beneficiaries. GMI-Housing: For 2022 approximately €10,618mln were provided for 3,603 beneficiaries. GMI-disability: For 2022 approximately €44,994 mln were provided for 10,539 beneficiaries.
	4. New Scheme supporting pensioners with low income	Ongoing action The New Scheme was established by a Ministerial decision No.94.078, dated 30.11.2022. The aim is to provide cash benefit addressed to pensioners' households whose total annual income is below the poverty threshold. Households with at least one person who receives: Pension from the Social Insurance Fund (Statutory, Incapacity, Widow etc.), Social

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
		<p>Pension, or Pension from any occupational pension scheme applicable in Cyprus.</p> <p>The entitlement to receive support is decided on a household basis. Only a generic scheme is applicable.</p> <p>The minimum resource is decided based on the annual poverty threshold as estimated in the EU SILC (European Union Statistics on Income and Living Conditions) survey conducted by Eurostat.</p> <p>For 2022 approximately €90.785 mln where provided for 36.305 beneficiaries.</p>
2.Zero hunger	1. Cyprus Common Agricultural Policy Strategic Plan for the period 2023–2027 is currently under preparation. The provisions under the new CAP require an enhanced Green Architecture and the consideration of Farm to Fork Strategy of the EU.	Contribution towards sustainable food production, sustainable farm management and environmentally and climate-friendly practices and methods.
	2. Agri-environmental measures and eco-schemes will be introduced in order to significantly reduce Cyprus' underperformance in sustainable agriculture (e.g. promoting practices that reduce the need for pesticides, increased budget for organic farming, together with significant higher target for land under organic, measures that include the substitution of chemical fertilisers).	
	3. National plan to introduce healthy eating courses for school-aged children.	
3.Good health and well-being	1. Treatment interventions for substance use disorders.	Encourage healthy eating habits. 100% coverage of the interventions that include pharmacological, psychosocial and rehabilitation and aftercare services.
	2. Operation of a National Air Quality Monitoring Network which consists of nine monitoring stations fully equipped with automatic real time instruments measuring the pollutants covered by the relevant EU Air Quality Directive.	Warning the public and especially the vulnerable groups (children, the elderly and patients) and the workers working in open spaces in case of high pollutants concentration in the atmosphere.
	3. National Strategic Plan for HIV/AIDS and the management and control of TB are in place.	Monitoring and control of the diseases
4.Quality education	1. Re-operation of the STEM education programme in nine All-Day Optional schools (Primary Education).	<ul style="list-style-type: none"> •Digital skills development. •Scientific literacy development. •Increase the participation of girls in STEM Education.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
	2. Training programmes for young people aged 15-29 not in education, employment, or training (NEETs) to acquire basic knowledge and skills.	2021-2027: 2.800 beneficiaries, budget €5,0mln.
	3. Literacy Program (running in all Gymnasiums). (Secondary Education).	Support on functional literacy, while also preventing school and social exclusion.
	4. The provision of second chance education and lifelong learning is taking place with the functionality of five Evening Schools, which are addressed to adolescent students (Secondary Education).	The Evening Schools include literacy programs, which support adolescent students develop a basic body of knowledge in the subjects of Greek Language, Mathematics and English.
	5. Training programmes in digital skills for people over the age of 55.	Training of at least 2.550 people by the end of 2025.
	6. A very innovative project the project “PEDIA-Creating almost Zero Energy Schools” aims to improve the quality of life of students and teachers in schools by transforming school buildings to almost zero energy schools. The Ministry of Education (Unit of EESD and Technical Services) in collaboration with the Cyprus Energy Agency, captures, within this project, the Sustainability in schools holistically. It’s the first time that is pursued the school buildings to become an integral part of the learning process. The creation of green roofs, the installation of passive cooling and heating systems as well as the use of automation and smart technologies, apart from improving the quality of life in the school, will contribute qualitatively to the upgrading of the learning process.	Fifty-five schools from all educational levels will become sustainable and almost zero energy school. 20 million invested by the Horizon 2020 and the resilient and recovery fund of the EU. The impact is that the school building itself will be a source of learning and a dynamic field for providing first hand experiences for SDGs to the students and the teachers. Additionally, improving the quality of school buildings we aim to create more healthy, environmental and climate resilient schools.
	7. The Ministry of Education, Sport and has revised the National Strategy on Education for Sustainable Development under the title “Education for Sustainable Development and green transition 2030”. The revised National Strategy is fully aligned with the global agenda 2030 as well as with the other international and regional policies in the field (EU Green Deal, new implementation framework of the UNECE Strategy 2021-2030, EU learning for environmental sustainability, UNESCO ESD2030), and seeks to implement, in an integrated, systemic, concrete and long-term horizontal measures, the 2030 Agenda in formal, non-formal and in-formal education.	The impact of the Strategy is multilayer: To strengthen the structures for supporting, implementing, monitoring and updating the Strategy. To infuse SDGs in curricula of all education levels in an interdisciplinary way. To establish a holistic school approach at all levels of education through the promotion of pedagogical methods, educational tools, [changes in the building infrastructure and equipment of schools (green technologies), which will contribute to their sustainable transformation.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
		<p>To review the professional development programmes for teachers, managers and educational staff and to strengthen their content knowledge, teaching and methodology of of SDGs.</p> <p>To further strengthen non-formal learning and to extend the programs of the Governmental Network of Environmental Education Centers to the civil society.</p> <p>To empower the position of Cyprus in international and regional organizations that working in in the fields of Education for Sustainable Development, strengthen its participation in international networks, transfer expertise and promote its policies at the level of bilateral and multilateral cooperation, and use national and European financial instruments for the implementation of its policies on SDGs.</p>
5.Gender equality	<p>1. STEAM and STEM education projects and also training at the school level and centrally promote the participation of girls in technology related activities.</p> <p>2. Operation of The Women’s House, an interdisciplinary centre, where professionals from various disciplines and state officials including Clinical Psychologists, Social Workers, and specially trained Police Officers work together.</p>	<p>Increase in the number of girls engaging into technology related activities.</p> <p>In the context of the implementation of the obligations arising from the Council of Europe Convention on preventing and combating violence against women and domestic violence, the Council of Ministers by its Decision, No. 88.585 and dated 27/11/2019, approved the implementation of a relevant proposal for the operation of the Women's House which has begun its operation since 01/12/2020 under the supervision of the Social Welfare Services. The Women's House operates as a multidisciplinary center, friendly to victims of violence, where professionals from various specialties and State Officials, such as Social Workers, specially trained members of the Police, and others, work under the same roof / structure in order to provide protection and specialized support to victims of violence. Specifically, the Women's House provides the following services to women as well as to their dependent children, victims of violence, including women immigrants or refugees regardless of their migrant or refugee status. The management of the Women's House was assigned with a state subsidy by the State</p>

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
	3. Re-organisation of the work of the inspectorate mechanism, so that inspections on the implementation of the Equal Pay Legislation are more targeted and clearly linked to sectoral and occupational segregation, including review of the investigation procedures and of compliance means.	<p>Aid Plan of the Deputy Ministry of Social Welfare to the Association for the Prevention and Confrontation of Violence in the Family.</p> <p>-Better performance of the inspection mechanism -Unjustified pay differences will be more easily identified and will reveal the extend and true nature of differences in pay in different sectors and occupations -Investigation results will be more easily translated to the corrective actions needed.</p>
	4. The Interdepartmental Committees for Gender Equality of the Ministry of Education, Sport and Youth has revised the Strategic Plan for Gender Equality (2023-2026). The revised Strategic Plan includes goals, activities and actions that emphasize the inclusion of gender equality in a) educational issues, b) teachers' professional learning and in-service training of Ministry officials and c) the empowerment of the role of families in promoting gender equality	The impact of the strategy to create culture of gender equality and provide equal opportunities in learning.
6.Clean water and sanitation	1. Water Resource Management Reform under RRP.	
	2. Creation of District Organizations for Local Administration under New legal framework for Local Authorities Reform.	Ensure the cooperation and joint effort of all stakeholders in the water sector (Government, Water Supply and Sewerage Boards, Local Authorities).
	3. Approval of the 10-year National Investment Plan in the Water sector of Cyprus.	Economies of scale will be achieved which will lead to the improvement and development of water infrastructures.
7.Affordable and clean energy	1. Installation of thermal insulation on roofs of existing houses and/or installation of photovoltaic system (PV) with the net metering method, of solar water production systems of water use in houses, expansion of PV and the optional installation of smart meters in homes for the plugging-in and charging of electric or hybrid vehicles.	Reduce energy consumption, increase energy efficiency and RES production and promote electromobility.
	2. Reduced prices on electricity tariffs, financial incentives for upgrading the energy efficiency of their houses and/or installation of PV with the net metering method.	Protection of vulnerable consumers.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
		<p>The Government of Cyprus adopted various temporary support measures to cushion the impact of energy price inflation on households and businesses, as follow:</p> <ul style="list-style-type: none"> • Introduced a 10% discount on the electricity bill of all consumer tariffs from November 2021 to February 2022, providing from the Electricity Authority of Cyprus. • Reduced the VAT rates on electricity consumption for households customers, from 19% to 9% (with a higher reduction for vulnerable households customers to 5%), and • Provides subsidy for the increasing cost of electricity consumption (June 2022- Sept. 2022), based on tiered support in order to encourage energy saving at the same time and is applied for invoices of the period Sept 2022-June 2023. For the implementation of this measure, the Government is providing payments to the Electricity Authority of Cyprus.
	3. Electricity interconnection between Cyprus, Crete, and Israel (Euroasia Interconnector).	Energy security, Transition to green economy, increase of RES penetration.
	4. New legislation was put into force to enable the use of LPG as a fuel for cars (Autogas). This legislation is supplemented with legislation for the safety considerations and aspects of LPG fueling stations as well as the premises where LPG fueled cars are inspected, serviced, converted, etc.	<p>Creation of a new economic sector. e.g. technicians, inspectors, etc. who deal with Autogas.</p> <p>Possible reduction of hazardous for the environment emissions due to the conversion of cars by using LPG instead of conventional fuels.</p>
8. Decent Work and Economic Growth	1. New ambitious Long-Term Economic Strategy (LTES) has been recently finalised, aiming for a new growth model.	Transform Cyprus into a productive, green, and digitalized economy, resilient to external shocks, and at the same time encompassing a fair and inclusive society.
	The operation of four mobile units of Public Employment Service (PES) for NEETs (announced 7/2022).	The development and operation of mobile units of PES will promote outreach activities for NEETs in all districts of Cyprus with the purpose to

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
		minimize the risks of social exclusion and increasing the opportunities for their integration in the labour market.
	3. Adoption of legislation regulating telework.	Telework as a flexible working arrangement will be regulated. Legally binding rights for employees will lead to increased use of telework which will lead to increased participation and flexibility in the labour market. The government plans to submit before the House of Representatives a bill regulating telework by the end of June 2023.
9. Industry, Innovation and Infrastructure	1. Adoption of a National Digital Strategy developed through four portfolios, each one addressing the challenges, gaps, and impediments of the sector, namely, the Digital Government, Digital Infrastructure, Digital Economy, and Digital Society Portfolio.	Cyprus aims to become a fit-for-the-future society and knowledge-based economy enabled by digital and emerging technologies that will drive economic prosperity and competitiveness and position the country as a resilient player in the European digital economy and a regional science and high-tech hub. The Digital Strategy 2020-2025 is currently under implementation.
	2. Development and adoption of the national R&I. Strategy 2030.	Support the R&I ecosystem, enhance links between policymaking and implementation, , facilitate the commercialization of research results and address societal challenges, with emphasis to the green and digital transitions.
	3. New Industrial Strategy.	Enhance the Cyprus circular economy model.
10. Reduced Inequalities	1. Set up of an inspection mechanism – Equality Law.	Safeguard the enforcement of the Equality Law. Inspections also investigate issues relating to undeclared and illegal work.
	2. Vocational orientation and training to third country nationals.	Facilitate integration of third country nationals in the labour market.
	3. Integration measures targeting the education sector. The Greek language courses for adults and minors as well as mediation services in schools.	Improve language skills and promote inclusion in society.
	4. The Interdepartmental Committees for the Integration of Students with Migrant Background of the Ministry of Education, Sport and Youth has submitted the new Action Plan 2023-2025 for the integration of students with migrant background. The new action plan includes actions and activities covering the five pillars in focus (mapping migrant student population, reception of new arrivals, teaching Greek as a second language, teachers' professional learning and intercultural dimension in curricula and school life) Special emphasis is given to language learning both through teaching Greek as	The impact of the strategy is to create opportunities and conditions for smooth integration and educational inclusion for student with migrant background.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
	a second language as well as through content-based in other subjects (e.g.CLIL).	
11. Sustainable Cities and Communities	. Enhancement of sustainable modes of transport (public transport, cycling, pedestrians, disable people).	Accessibility and attractiveness of the favorable sustainable modes of transport and reduction of the greenhouse gas emission footmark of the transport sector.
	Smart city strategy coordinated by the newly established Deputy Ministry of Research, Innovation and Digital Policy includes strategic sustainable urban planning and ‘Smart Cyprus’ actions. At the present time, the three priorities, as indicated by the main municipalities of Cyprus are smart parking, smart lighting and smart waste collection management solutions.	Improve quality of life for citizens and special groups of people and encourage modal shift.
	. Three local government reform bills approved in March 2022 aim at creating more efficient local authorities. Changes include reducing the number of municipalities from 30 to 20 and the clustering of local councils. The new administrative system is due to take effect in 2024.	The new laws guarantee the administrative and financial autonomy of municipalities to make them economically viable; empower local councils to pool resources for communal services such as garbage collection, public transport and street cleaning; and allow for the creation of district clusters to run services including water supply and waste management.
12. Responsible Consumption and Production	Municipal Waste Management Plan 2022-2028. According to the above Plan, a Pay-As-You-Throw (PAYT) scheme must be in place by end of June 2024 in all local authorities aiming in the separate collection of municipal waste. To this end, by the end of December 2023 the local authorities must develop Local Action Plans for the prevention and management of municipal waste.	Increase in the separate collection of municipal waste and of preparation for reuse and recycling to 55% by 2025, 60% by 2030 and 65% by 2035, reduction in waste generation as well as reduction in the landfill of waste. The implementation of the PAYT scheme will enhance the separate collection of municipal waste, the increase for reuse and recycling, the reduction in waste generation and the reduction in the landfill of waste.
	Waste Prevention Programme 2023-2029.	
	Action Plan for the Circular Economy 2021-2027 parate collection of municipal waste.	

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
13. Climate Action		
13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	1. Climate Change is integrating within Environment and Sustainable Development curricula and the inclusion in schools' sustainable environmental policy mitigation and adaption measures such as greening the school environment, green technologies, waste management.	The creation of a sustainable school which will provide a healthy, environmental and resilient school environment for all.
	2. Long Term Strategy for Climate Change- The national long-term strategy for low carbon development has been approved by the Council of Ministers in September 2022	Implementing the strategy is expected to boost investment, net exports and have a positive impact on positive finances in the long-run.
	3. Introduction of natural gas via LNG import infrastructure and possibly domestic resources as well as the EuroAsia Interconnector project for the electricity interconnection between Cyprus, Israel and Crete.	Increase of renewable energy penetration, improvement of conditions for demand response via network modernisation and regulatory changes and full implementation of a competitive electricity market and achievement of energy security.
	4. Publication of the Scientific Progress Report for Climate Change Education and Outreach in the Eastern Mediterranean and Middle East Countries (Ministry of Education –Unit of Education for Environment and Sustainable Development)	The report provides a holistic view of Climate Change Education integration in diverse education systems and in all levels and forms of education. It helps countries to learn from each other and take remedial measures for improving the performance of Climate Change Education in teaching and learning in formal, non-formal and in-formal education (pre-primary till lifelong) and in research.
14. Life Below Water	1. Cyprus has designated marine areas under various protection regimes. These include six Natura 2000 areas, one Specially Protected Area of Mediterranean Importance (SPAMI), four Marine Protected Areas with	Sustainable Management and Protection of Marine and Coastal Ecosystems.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
	fisheries restrictions, six Marine Protected Areas, six areas with Artificial Reefs that are strictly fisheries no-take zones, one offshore Fisheries Restriction Area, and one additional offshore area which was proposed as a Natura 2000 area.	
	2. Actions that deal with the increase of scientific knowledge, enhancement of the conservation and sustainable use of oceans and their resources, such as surveys on sensitive benthic habitats (e.g. deep sea) and species (e.g. cetaceans).	Identification of new sensitive habitats to be protected and increase of knowledge on sensitive species.
	3. Revision of the national management plan, in regard to harvesting and overfishing, illegal, unreported, and unregulated fishing and destructive fishing practices.	Monitoring of Harvesting, Overfishing, Illegal, Unreported, and Unregulated Fishing.
15. Life On Land	EU Biodiversity Strategy.	Good Conservation Status of habitats and Species.
	National Biodiversity Strategy. Implementation of Habitats and Birds Directives.	
16. Peace, Justice and Strong Institutions	1. Action Plan for Gender Mainstreaming in Foreign Policy has been drawn up.	Promote the rights of women and girls everywhere.
	2. The newly established Independent Authority against Corruption is considered the dedicated entity for promoting integrity and preventing and combatting corruption.	To undertake all necessary initiatives and actions to ensure the coherence and effectiveness of the actions of the public service, the broader public sector and the private sector in the prevention and fight against corruption, as well as to ensure, in the best and most efficient way, the implementation, progress, monitoring and evaluation of the National Strategy against Corruption.
	3. The law on Prevention and Combating of Trafficking and Exploitation of Persons and the Protection of Victims.	Protection and promotion of the rights of the victims, including support and protection of child victims of trafficking.

SDG	List of main contributing measures	Estimated impact of the measures (qualitative and/or quantitative)
17. Partnerships for the Goals	1. Participation in various European Projects for capacity building activities is providing expertise on how to integrate SDGs in Higher Education curricula in South Africa, Asia and Middle East countries (Unit of Education for Environment and Sustainable Development).	Awareness and information regarding SDGs implementation in various regions. Exchange of experiences, ideas and good practices. Visibility of the Cyprus policies on ESD and contribution on the formation of policies of other countries. Common language of communication, share vision and joint work for common tasks.
	2. Cyprus has doubled its funding for post-graduate scholarships for academically eligible students from developing and other third countries.	From €150,000 in 2022 to €300,000 in 2023.
	3. Cyprus provides development assistance to third countries, including, over the recent past, Jordan, Palestinian Authority, Kenya and Zimbabwe through bilateral programmes.	Impact on gender equality, health and children welfare (current budget approx. €1,000,000).
	4. Cyprus has a leading role in developing partnerships between countries for integrating the SDGs. More particularly Cyprus is chairing the UNECE ESD Steering Committee, which includes 56 Member States and the ESD Mediterranean Committee, which includes 22 Member States. Through the two regional strategies that has been approved at the highest level at the 9th Ministerial Meeting for Environment or Europe, that organized by the Republic of Cyprus and the UNECE the countries in the two regions under the Cyprus leadership and Chairing in the two Committees committed that they will work together for integrating in a most effective way the SDGs in the two regions by implementing: a) The UNECE Countries the new implementation framework for the UNECE ESD Strategy 2021-2030 and b) the Mediterranean Countries the revised ESD Mediterranean Action Plan 2030.	Impact on regional collaboration and partnerships for SDGs in regional level. Development of bilateral and multilateral networks on issues of common interest. Joint vision, exchange of expertise, framing policies on ESD and SDGs through common understanding and consensus.

Annex IV: BaU scenario - activity data

Table III.1 Annual Fuel Consumption by Energy Sector per Scenario 2020–2040: BUSINESS AS USUAL

Fuel consumption (TJ)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Electricity																
Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFO	21856	22669	26073	28100	29380	26743	28413	30046	32799	34627	36421	36149	37648	40460	42149	44622
Diesel	0	0	450	149	84	351	254	246	496	897	799	158	68	217	361	699
Manufacture of Solid Fuels																
Charcoal	112	112	112	112	405	388	328	288	314	281	248	253	235	209	184	174
Other Energy Industries																
Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing Industry (excluding cement)																
Diesel	534	594	719	747	769	834	878	921	981	1008	1041	1052	1008	1036	932	866
LPG	172	172	193	179	175	179	179	182	175	172	186	186	189	203	196	186
gas biomass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other oil products	0.0	201	0.0	0.0	0.0	0.0	0.0	40.2	0.0	0.0	0.0	0.0	0.0	0.0	241	0.0
RFO	1059	3548	3377	2862	3148	2776	3176	2003	1946	1946	2003	1545	1574	1855	2148	1374
Solid biofuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White spirit	0.0	0.0	0.0	40.2	0.0	40.2	40.2	40.2	0.0	40.2	0.0	40.2	0.0	0.0	0.0	40.2
1A2f Non-Metallic Minerals (cement)																
Pet-coke	1300	3023	2763	3705	3640	4063	4778	4940	4875	5005	4583	4323	4518	4453	4745	5005
RFO	374	1252	1192	1010	1111	980	1121	707	687	687	707	545	556	626	687	1495
Diesel	89	99	120	124	128	139	146	154	164	168	174	175	168	173	155	144
LPG	43	43	48	45	44	45	45	46	44	43	46	46	47	51	49	46
Other kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other bituminous coal	2503	2503	671	800	697	516	464	490	671	774	1264	1367	1367	1367	1471	1632
Solid biomass	0	0	0	0	0	0	0	0	0	0	41	70	90	211	127	38
Industrial waste (non-renewable)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18	0	15	71	138
Municipal waste (non-renewable)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1A3a i International Aviation																
Jet kerosene	10043	11933	11609	9873	10144	11145	10689	10532	11107	11382	11571	13576	13076	14005	12809	11652
1A3a ii Domestic Aviation																
Jet kerosene	364	415	386	314	307	321	292	272	271	261	248	271	242	239	200	175
1A3b Road Transport																
Gasoline	7219	7529	7618	7485	7972	8105	8237	8458	8635	8989	9121	9697	10095	11157	12484	13413
Diesel	9000	8657	10543	10928	11185	12214	12771	13456	14313	14564	15024	15243	14635	15071	15192	14842
LPG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biodiesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fuel consumption (TJ)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1A3d i International water-borne navigation																
Diesel	1032	860	903	602	516	645	1075	1161	1505	1978	2150	2021	1419	1548	1161	2881
RFO	1374	1454	1535	1454	2020	2182	2626	2868	2545	4363	5777	5858	4242	3555	1091	9090
1A3d ii Domestic water-borne navigation																
Diesel	30	29	35	36	37	40	42	44	47	53	23	18	24	19	26	31
1A4a Commercial / Institutional																
Diesel	475	528	640	664	683	741	780	819	872	896	925	935	896	921	829	770
RFO	62	209	199	168	185	163	187	118	114	114	118	91	93	104	114	40
LPG	558	558	626	581	569	581	581	592	569	558	604	604	615	660	638	604
Other kerosene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
solid biomass	19	15	15	15	11	12	17	9	8	11	10	10	10	9	8	7
gas biomass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Charcoal	15	15	15	15	30	103	103	103	118	103	74	74	103	103	118	148
1A4b Residential																
Other kerosene	526	526	745	701	745	745	788	876	920	876	1051	1051	1358	1358	1051	701
Diesel	2255	2509	3038	3153	3245	3521	3705	3889	4143	4258	4396	4442	4258	4373	3935	3569
LPG	1502	1502	1686	1564	1533	1564	1564	1594	1533	1502	1625	1625	1656	1778	1717	1625
solid biomass	126	105	103	102	74	79	119	61	56	77	68	70	64	58	53	51
charcoal	15	15	15	15	30	103	103	103	118	103	74	74	103	103	118	148
1A4c Agriculture / Forestry / Fishing / Fish farms - stationary																
Diesel	623	693	839	871	897	973	1024	1075	1145	1176	1215	1227	1176	1208	1087	1029
LPG	43	43	48	45	44	45	45	46	44	43	46	46	47	51	49	46
Gas biomass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mobile																
Diesel	89	99	120	124	128	139	146	154	164	168	174	175	168	173	155	132
1A5a Stationary																
Diesel	148	165	200	207	213	232	244	256	273	280	289	292	280	288	259	241
LPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1A5b Mobile																
Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Fuel consumption (TJ)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electricity															
Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFO	46014	47530	49583	47448	42797	43097	36529	26371	32281	35069	35877	31609	32621	31325	24516
Diesel	294	686	975	3921	6763	4770	9135	10111	5234	3816	6406	10890	10498	11009	14584
Manufacture of Solid Fuels															
Charcoal	135	274	211	47	48	45	82	71	58	94	163	172	112	93	80
Other Energy Industries															
Diesel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	262

Fuel consumption (TJ)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Industry (excluding cement)															
Diesel	885	780	663	663	516	676	860	516	516	688	688	901	795	1025	905
LPG	237	237	189	237	189	237	284	189	237	284	237	326	340	377	346
gas biomass	0	0	0	15	30	67	70	68	67	69	68	68	66	65	66
Kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.6	0.0	0.0	1.6	1.2	4.3	5
Other oil															0
RFO	1050	1818	1616	1212	1212	1535	570	604	768	565	647	712	640	600	592
Solid biofuels	0	0	0	0	0	0	0	0	86	59	57	72	85	117	83
White spirit	40.2	40.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1A2f Non-Metallic Minerals (cement)															
Pet-coke	4745	4648	4940	4680	3770	3250	3055	4388	5265	4153	4007	3533	2420	1806	2038
RFO	1414	1535	1535	1212	1010	606	525	323	283	323	404	497	587	621	541
Diesel	147	123	111	111	86	98	129	43	43	43	86	70	59	78	98
LPG	47	47	47	47	47	47	47	47	47	47	47	18	19	21	34
Other kerosene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.1	0.8	0.9
Other bituminous coal	1620	1403	1157	613	736	313	0	0	96	155	21	130	582	714	579
Solid biomass	61	133	281	304	347	306	29	28	116	95	55	86	78	126	205
Industrial waste (non-renewable)	73	288	239	276	299	4	0	0	279	221	94	90	157	165	289
Municipal waste (non-renewable)	0.0	0.0	0.0	0.0	0.0	0.0	24	45	37	295	569	812	805	1123	1168
1A3a i International Aviation															
Jet kerosene	11746	11570	12008	11350	11582	12015	11618	10837	10850	10502	12268	13963	14505	14365	4568
1A3a ii Domestic Aviation															
Jet kerosene	147	131	125	101	107	32.6	20.8	13.4	8.4	12.6	7.9	11.5	12.4	5.24	1.33
1A3b Road Transport															
Gasoline	7219	7529	7618	7485	7972	8105	8237	8458	8635	8989	9121	9697	10095	11157	12484
Diesel	9000	8657	10543	10928	11185	12214	12771	13456	14313	14564	15024	15243	14635	15071	15192
LPG	0	0	0	0	0	0	0	0	0	0	0	0	21	23	19
Biodiesel	0	37	592	629	629	666	666	629	407	407	370	359	375	450	1037
Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A3d i International water-borne navigation															
Diesel	4558	4472	3784	3139	2279	2494	2967	3569	3440	3225	4085	4356	5064	5322	5121
RFO	7676	6908	6666	5898	5414	5696	5171	6343	6181	6828	7797	6226	6226	6311	6395
1A3d ii Domestic water-borne navigation															
Diesel	24	27	33	64	41	38	27	20	24	27	20	29	28	38	17
1A4a Commercial / Institutional															
Diesel	817	774	860	817	989	860	688	731	559	559	645	782	702	706	505
RFO	81	81	81	81	81	81	162	162	81	121	162	170	129	146	98
LPG	615	615	662	615	615	662	662	568	520	568	520	623	650	735	526
Other kerosene	0	0	0	0	0	0	0	0	0	0	0	2	78	105	107
solid biomass	5	14	15	15	15	13	16	16	16	15	15	17	17	17	132
gas biomass	0	0	0	11	12	11	11	11	12	12	16	17	45	54	20

Fuel consumption (TJ)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Charcoal	148	207	207	177	177	177	177	177	177	207	207	209	176	166	161
1A4b Residential															
Other kerosene	701	701	613	832	613	701	745	526	394	613	613	624	407	550	560
Diesel	4214	3827	3354	3569	3010	3440	3268	2666	2451	2795	2795	2797	2298	2599	2567
LPG	1656	1703	1608	1703	1608	1797	1750	1561	1466	1608	1656	1536	1346	1521	1481
solid biomass	74	95	123	500	260	339	419	353	249	551	531	691.327	709.199	768.568	644
charcoal	148	177	177	148	148	177	177	177	177	207	236	255	256	249	300
1A4c Agriculture / Forestry / Fishing / Fish farms - stationary															
Diesel	1076	1073	989	860	817	946	903	903	817	946	903	957	884	945	1022
LPG	47	47	47	47	47	47	47	47	0	95	95	115	120	135	122
Gas biomass	0	15	78	209	274	448	476	466	464	460	475	419	443	464	471
mobile															
Diesel	128	131	129	172	172	129	129	86	86	86	86	80	77	82	64
1A5a Stationary															
Diesel	172	258	559	215	215	258	215	215	387	258	258	238	261	244	242
LPG	0	0	0	0	0	0	0	47	47	47	47	62	43	59	60
1A5b Mobile															
Diesel	0	0	0	44	44	88	44	88	88	44	44	54	63	56	66

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Electricity																				
Natural gas	0	0	0	30810	30872	31662	30567	30934	32300	33555	25972	25570	18214	18053	17945	17332	17190	17085	17033	15409
HFO	27684	26473	26590	728	68	122	151	241	80	0	0	0	0	0	0	0	0	0	0	0
Diesel	12339	13655	13192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manufacture of Solid Fuels																				
Charcoal	85	87	90	93	96	98	101	103	104	106	108	110	112	114	116	119	122	125	128	131
Other Energy Industries																				
Diesel	276	283	294	304	313	321	328	335	341	346	352	359	365	372	380	389	398	407	417	427
Industry (excluding cement)																				
Diesel	915	901	909	934	956	963	951	950	952	955	940	929	922	918	918	922	929	935	941	946
LPG	362	353	353	359	363	363	357	354	352	351	345	340	336	334	334	335	338	340	342	344
gas biomass	13.3	15.9	19.0	23.3	27.7	31.5	33.9	37.5	41.6	45.8	48.8	52.0	55.4	59.1	63.3	67.9	73.0	78.2	83.7	89.6
Kerosene	5.4	5.3	5.3	5.4	5.4	5.4	5.3	5.3	5.3	5.3	5.2	5.1	5.0	5.0	5.0	5.0	5.0	5.1	5.1	5.1
Other oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RFO	1113	1081	1074	1082	1086	1075	1047	1029	1012	998	969	945	924	909	898	891	887	882	878	874
Solid biofuels	17	20	24	30	35	40	43	47	53	58	62	66	70	75	80	86	92	99	106	113
White spirit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1A2f Non-Metallic Minerals (cement)																				
Pet-coke	430	342	253	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
RFO	46	36	27	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Diesel	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LPG	9	8	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Other kerosene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other bituminous coal	1714	1362	1010	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881
Solid biomass	279	222	165	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144
Industrial waste (non-renewable)	266	212	157	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137
Municipal waste (non-renewable)	1426	1133	840	733	733	733	733	733	733	733	733	733	733	733	733	733	733	733	733	733
1A3a i International Aviation																				
Jet kerosene	14010	14390	14933	15440	15901	16298	16673	17007	17294	17589	17895	18211	18544	18902	19297	19727	20198	20681	21175	21681
1A3a ii Domestic Aviation																				
Jet kerosene	1.40	1.44	1.50	1.55	1.59	1.63	1.67	1.70	1.73	1.76	1.79	1.82	1.86	1.89	1.93	1.98	2.02	2.07	2.12	2.17
1A3b Road Transport																				
Gasoline	13442	13282	12978	13115	12737	12364	11808	11178	10356	9532	8676	7843	7018	6191	5375	4449	3626	2782	1871	1378
Diesel	14924	12566	12304	11792	11074	10375	9707	9050	8408	7794	7226	6678	6161	5613	4859	4100	4076	3797	3293	3005
LPG	3	6	9	12	14	17	19	21	24	25	28	30	32	34	36	36	7	21	36	35
Biodiesel	802	675	1109	1087	1035	985	930	872	810	748	688	630	573	515	447	374	344	300	242	209
Natural Gas	0	0	0	0	237	236	235	234	233	232	232	231	231	230	230	237	237	236	302	140
1A3d i International water-borne navigation																				
Diesel	5403	5550	5759	5955	6133	6286	6431	6559	6670	6784	6902	7024	7152	7290	7442	7608	7790	7976	8167	8362
RFO	6748	6931	7192	7436	7658	7850	8030	8191	8329	8471	8619	8771	8931	9104	9294	9501	9728	9960	10199	10442
1A3d ii Domestic water-borne navigation																				
Diesel	38	39	40	42	43	44	45	46	47	47	48	49	50	51	52	53	54	56	57	58
1A4a Commercial / Institutional																				
Diesel	530	555	584	667	762	835	881	920	945	941	918	897	877	858	841	825	804	782	759	736
RFO	103	108	113	127	142	154	162	169	173	173	170	166	163	159	156	153	149	146	141	137
LPG	552	571	594	657	726	778	812	837	850	840	816	793	771	751	732	715	694	672	651	630
Other kerosene	101	104	108	120	132	142	148	152	155	153	149	144	140	137	133	130	126	122	119	115
solid biomass	141	149	158	188	223	251	271	289	303	306	303	299	296	294	292	291	287	282	277	271
gas biomass	22	23	24	29	34	38	41	44	46	47	46	46	45	45	45	44	44	43	42	41
Charcoal	172	182	194	229	272	307	331	353	370	374	370	366	362	359	357	355	350	345	338	332
1A4b Residential																				
Other kerosene	515	530	565	604	634	644	656	659	655	648	636	623	609	592	574	552	531	512	493	474
Diesel	2345	2412	2574	2750	2887	2932	2987	3002	2984	2951	2897	2839	2772	2696	2614	2515	2420	2330	2244	2158
LPG	1489	1556	1705	1896	2071	2152	2228	2297	2355	2397	2420	2440	2455	2469	2479	2461	2447	2436	2428	2422
solid biomass	641	641	661	678	690	689	693	691	685	678	667	658	649	640	631	617	605	594	586	578
charcoal	302	302	311	319	325	324	326	325	322	319	314	310	305	301	297	290	285	280	276	272
1A4c Agriculture / Forestry / Fishing / Fish farms - stationary																				

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	1029	1019	1024	1035	1040	1032	1013	996	977	958	937	919	902	888	877	868	860	851	841	823
LPG	82	81	81	81	80	79	77	75	73	71	68	66	65	63	61	60	59	58	57	55
Gas biomass	448	443	446	450	453	449	441	434	425	417	408	400	393	387	382	378	374	370	366	358
mobile																				
Diesel	61	60	60	61	61	61	60	59	57	56	55	54	53	52	52	51	51	50	49	48
1A5a Stationary																				
Diesel	256	263	273	282	290	298	304	310	316	321	327	332	339	345	352	360	369	378	387	396
LPG	63	65	68	70	72	74	76	77	78	80	81	83	84	86	87	89	92	94	96	98
1A5b Mobile																				
Diesel	70	71	74	77	79	81	83	84	86	87	89	90	92	94	96	98	100	103	105	108

Table III.2 Activity data for the non-energy sectors per Scenario 2020–2040: BUSINESS AS USUAL

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2. INDUSTRIAL PROCESSES																				
2A1 Cement production																				
Clinker (t)	16508 51	18449 96	18929 64	19409 32	19889 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00	20000 00
2A2 Lime Production																				
Slaked lime (t)	4647	5019	5392	5764	6137	6510	6882	7255	7627	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
2A4a Ceramics																				
Production (t)	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6	17715 6
2A4b Other Uses of Soda Ash																				
Imports (t)	172	172	193	179	175	179	179	182	175	172	186	186	189	203	196					
Imports (t)	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
2D1: Lubricant Use																				
Consumption (kt)	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01
2D2: Paraffin Wax Use																				
Imports (kt)	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
2D3 Other																				
Urea-based catalysts																				
Diesel (Gg)	347	292	286	274	258	241	226	210	196	181	168	155	143	131	113	95	95	88	77	70
3. AGRICULTURE																				
3A1a Dairy cattle																				
kg milk/ day	19.6	19.6	19.6	19.7	19.7	19.7	19.7	19.7	19.8	19.8	19.8	19.8	19.8	19.9	19.9	19.9	19.9	19.9	20.0	20.0
GE MJ/head/day	287.5	288.8	290.1	291.4	292.8	294.1	295.4	296.7	298.1	299.4	300.7	302.0	303.3	304.7	306.0	307.3	308.6	309.9	311.3	312.6
population																				
Dairy cattle	38924	38353	37783	37213	36643	36072	35502	34932	34362	33791	33707	33622	33538	33453	33369	33285	33200	33116	33031	32947
Other cattle	42818	42227	41635	41044	40452	39860	39269	38677	38086	37494	37400	37307	37213	37119	37025	36932	36838	36744	36650	36557

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Sheep	33098 1	33385 5	33672 9	33960 2	34247 6	34535 0	34822 4	35109 8	35397 2	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6	35684 6
Swine	35668 1	35430 7	35193 2	34955 8	34718 3	34480 9	34243 4	34006 0	33768 5	33531 1	33464 0	33396 9	33329 9	33262 8	33195 7	33128 7	33061 6	32994 6	32927 5	32860 4
Horses	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472
Mules and Asses	1332	1393	1450	1504	1554	1601	1644	1684	1720	1753	1782	1808	1831	1850	1865	1877	1886	1891	1893	1893
Goats	26231 7	26385 2	26538 6	26692 1	26845 6	26999 1	27152 5	27306 0	27459 5	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0	27613 0
Poultry	35783 68	35815 89	35848 10	35880 31	35912 51	35944 72	35976 93	36009 14	36041 35	35783 68	36140 63	36497 58	36854 54	37211 49	37568 44	37925 39	38282 34	38639 29	38996 25	39353 20
3D Agricultural Soils																				
FSN (kt N in fertilizer)	7.763	7.744	7.726	7.707	7.689	7.670	7.651	7.633	7.614	7.596	7.577	7.559	7.540	7.521	7.503	7.484	7.466	7.447	7.429	7.410
FAM (kt N)	16.70	16.72	16.74	16.76	16.78	16.80	16.82	16.84	16.85	16.86	16.87	16.87	16.88	16.88	16.89	16.90	16.90	16.91	16.91	16.92
N SEWSLUDGE (kt N)	0.0460	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
N COMP (kt N)	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124
FCR (kt N)	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760
Atmospheric deposition (kt N)	4.151	4.153	4.155	4.157	4.159	4.160	4.162	4.164	4.166	4.165	4.165	4.164	4.164	4.163	4.162	4.161	4.161	4.160	4.159	4.159
3H Urea application																				
M - kt applied	299	299	298	297	296	296	295	294	293	293	292	291	290	290	289	288	287	287	286	285
5. WASTE																				
Population (mln)	0.914	0.917	0.920	0.923	0.926	0.929	0.930	0.931	0.933	0.934	0.936	0.936	0.936	0.936	0.936	0.936	0.936	0.934	0.933	0.932
5A. Solid waste disposal																				
per capita production (kg/cap)	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646
Waste to disposal sites (kt)	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
Managed, anaerobic waste management	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Composition of waste to disposal sites																				
Food	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%	39%
Garden	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Paper	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Wood	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Textile	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Nappies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Plastics, other inert	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%	19%
Other solid to landfills- Deep Unmanaged (Gg)																				

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Industrial effluent sludge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wood wastes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Textile wastes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Animal and vegetal wastes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other solid to landfills- Deep Managed (Gg)																				
Industrial effluent sludge	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Wood wastes	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Textile wastes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Animal and vegetal wastes	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
5B Biological Treatment																				
M composted (kt)	56.1	56.2	56.4	56.6	56.8	57.0	57.0	57.1	57.2	57.3	57.4	57.4	57.4	57.4	57.4	57.4	57.3	57.2	57.1	57.1
M digested (kt)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
5D Wastewater Treatment and Discharge																				
TOW septic (kt)	3.11	3.12	3.13	3.14	3.15	3.16	3.16	3.17	3.17	3.17	3.18	3.18	3.18	3.18	3.18	3.18	3.17	3.17	3.17	3.16
TOW collected (kt)	21.14	21.21	21.27	21.34	21.41	21.48	21.51	21.54	21.57	21.61	21.64	21.64	21.64	21.64	21.64	21.64	21.61	21.58	21.55	21.52
Protein, kg/person	29.81	30.81	31.81	32.81	33.81	34.81	35.81	36.81	37.81	38.81	39.81	40.81	41.81	42.81	43.81	44.81	45.81	46.81	47.81	48.81
NWWT (t)	1.861	1.867	1.873	1.879	1.885	1.891	1.894	1.897	1.900	1.902	1.905	1.905	1.905	1.905	1.905	1.905	1.903	1.900	1.897	1.894
TOW industrial (kt COD/yr)	16.86	17.31	17.97	18.58	19.13	19.61	20.06	20.46	20.81	21.16	21.53	21.91	22.31	22.74	23.22	23.73	24.30	24.88	25.48	26.09
Anaerobic																				
alcohol	3.5%	3.4%	3.3%	3.2%	3.1%	3.0%	2.9%	2.9%	2.8%	2.8%	2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.4%	2.4%	2.3%	2.3%
beer	15.5%	15.1%	14.6%	14.1%	13.7%	13.3%	13.0%	12.8%	12.6%	12.4%	12.1%	11.9%	11.7%	11.5%	11.3%	11.0%	10.8%	10.5%	10.3%	10.0%
soft drinks	3.4%	3.3%	3.1%	3.0%	3.0%	2.9%	2.8%	2.8%	2.7%	2.7%	2.6%	2.6%	2.5%	2.5%	2.4%	2.4%	2.3%	2.3%	2.2%	2.2%
dairy products	3.8%	3.7%	3.6%	3.5%	3.4%	3.3%	3.2%	3.1%	3.1%	3.0%	3.0%	2.9%	2.9%	2.8%	2.8%	2.7%	2.6%	2.6%	2.5%	2.5%
meat & poultry	4.8%	4.7%	4.5%	4.4%	4.2%	4.1%	4.0%	4.0%	3.9%	3.8%	3.8%	3.7%	3.6%	3.6%	3.5%	3.4%	3.3%	3.3%	3.2%	3.1%
soaps & detergents	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
vegetable oils	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
vegetables, fruits & juices	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
wine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Annex V: WEM scenario - activity data

Table IV.1 Annual Fuel Consumption by Energy Sector per Scenario 2020–2040: WITH EXISTING MEASURES

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Electricity																				
Natural gas	0	0	0	28725	28106	28049	26073	27002	27541	27956	18360	17794	17418	17034	16791	16484	16150	16139	14920	12926
HFO	27684	26362	26474	689	17	28	41	56	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	12339	13062	11850	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry (excluding cement)																				
Diesel	915	887	880	890	897	890	865	851	839	828	815	806	799	795	796	799	805	810	816	821
LPG	362	348	342	342	342	336	325	317	311	305	299	295	292	290	290	291	293	295	296	298
gas biomass	13	15	18	22	26	29	30	33	36	39	42	45	48	51	55	59	63	68	73	78
Kerosene	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4
Other oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RFO	1113	1065	1042	1034	1022	996	955	924	895	868	842	820	802	788	779	773	769	765	762	758
Solid biofuels	17	20	23	28	32	36	38	42	46	50	53	57	60	65	69	74	80	86	92	98
White spirit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A3b Road Transport																				
Gasoline	13442	13282	12978	13115	12737	12364	11808	10974	10155	9333	8479	7647	6824	5998	5183	4259	3437	2595	1686	1194
Diesel	14924	12566	12304	11792	11074	10375	9707	9050	8408	7794	7226	6678	6161	5613	4864	4105	4081	3802	3298	3010
LPG	3	6	9	12	14	17	19	21	24	25	28	30	32	34	36	36	7	21	36	35
Biodiesel	802	675	1109	1087	1035	985	930	865	803	741	681	623	567	509	440	368	338	294	235	203
Natural Gas	0	0	0	0	237	236	235	234	233	232	232	231	231	230	230	237	237	236	302	140
1A4a Commercial / Institutional																				
Diesel	530	552	579	657	746	814	855	889	909	907	887	868	849	832	817	803	783	762	741	720
RFO	103	107	112	125	139	150	158	164	167	167	164	161	158	155	152	150	146	142	139	135
LPG	552	569	590	649	713	761	790	811	821	812	790	769	749	730	713	697	677	657	637	617
Other kerosene	101	104	108	118	130	139	144	148	150	148	144	140	136	133	130	127	123	120	116	112
solid biomass	141	148	157	185	218	244	262	278	290	294	291	289	286	284	283	282	278	274	270	265
gas biomass	22	23	24	28	33	37	40	42	44	45	44	44	44	43	43	43	43	42	41	40
Charcoal	172	181	192	225	266	298	320	339	355	360	356	353	350	347	346	345	340	335	330	323
1A4b Residential																				
Other kerosene	515	524	554	586	610	615	621	620	612	601	588	574	559	542	525	507	489	472	456	440
Diesel	2345	2387	2523	2671	2780	2800	2831	2824	2786	2736	2678	2616	2546	2469	2394	2308	2227	2151	2077	2004
LPG	1489	1534	1660	1825	1972	2026	2076	2119	2152	2170	2182	2192	2197	2199	2210	2205	2205	2208	2214	2223
solid biomass	641	637	652	665	671	665	664	656	645	632	620	609	597	585	577	566	557	550	544	540
charcoal	302	300	307	313	316	313	313	309	303	298	292	286	281	275	272	266	262	259	256	254
1A4c Agriculture / Forestry / Fishing / Fish farms - stationary																				
Diesel	1029	1019	1024	1035	1041	1033	1014	997	978	960	939	921	905	890	880	871	863	854	844	827
LPG	82	81	81	81	80	79	77	75	73	71	69	67	65	63	62	60	59	58	57	56

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gas biomass	448	443	446	451	453	450	442	434	426	418	409	401	394	388	383	379	376	372	368	360
<i>mobile</i>																				
Diesel	61	60	60	61	61	61	60	59	57	56	55	54	53	52	52	51	51	50	49	48

Table IV.2 Activity data for the non-energy sectors per Scenario 2020–2040: WITH EXISTING MEASURES

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2.INDUSTRIAL PROCESSES																				
<i>Urea-based catalysts</i>																				
Diesel (Gg)	313	309	302	305	296	288	275	255	236	217	197	178	159	139	121	99	80	60	39	28
2F Product Uses as Substitutes for Ozone Depleting Substances																				
recovery	0%	0%	0%	0.7%	1.4%	2.1%	2.9%	3.6%	4.3%	5%	5.5%	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%	9.0%	9.5%	10%
2G Other Product Manufacture and Use																				
recovery	0%	0%	0%	0.7%	1.4%	2.1%	2.9%	3.6%	4.3%	5%	5.5%	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%	9.0%	9.5%	10%
5. WASTE																				
5A. Solid waste disposal																				
Waste to disposal sites (kt)	37515 4	35539 0	33530 4	31508 1	26911 1	26396 8	25835 6	25272 5	24707 7	24141 1	23572 7	22968 0	22363 2	21758 5	21153 9	21153 6	21123 9	21094 2	21064 5	21034 8
Composition of waste to disposal sites																				
Food	35%	32%	28%	24%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
Garden	6%	5%	5%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Paper	29%	31%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Wood	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Textile	7%	7%	8%	8%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Nappies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Plastics, other inert	20%	22%	23%	25%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
5B Biological Treatment																				
M digested (kt)	1.281	1.294	1.320	1.359	1.414	1.484	1.573	1.684	1.818	1.982	2.180	2.420	2.710	3.063	3.491	4.015	4.657	5.449	6.430	7.652
5D Wastewater Treatment and Discharge																				
TOW septic (kt)	3.10	3.11	3.06	2.06	2.07	2.07	1.45	1.22	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOW collected (kt)	21.14	21.21	21.35	22.68	22.76	22.83	23.65	23.97	24.18	25.58	25.61	25.61	25.61	25.61	25.61	25.61	25.58	25.54	25.50	25.47
Protein, kg/person	28.81	29.81	30.81	31.81	32.81	33.81	34.81	35.81	36.81	37.81	38.81	39.81	40.81	41.81	42.81	43.81	44.81	45.81	46.81	47.81

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
NWWT (t)	1.861	1.867	1.873	1.879	1.885	1.891	1.894	1.897	1.900	1.902	1.905	1.905	1.905	1.905	1.905	1.905	1.903	1.900	1.897	1.894
Anaerobic																				
alcohol	3.5%	3.4%	3.3%	3.2%	3.1%	3.5%	3.9%	4.2%	4.6%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
beer	15.5%	15.1%	14.6%	14.1%	13.7%	14.9%	16.2%	17.5%	18.7%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
soft drinks	3.4%	3.3%	3.1%	3.0%	3.0%	3.4%	3.8%	4.2%	4.6%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
dairy products	3.8%	3.7%	3.6%	3.5%	3.4%	4.1%	4.8%	5.5%	6.3%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
meat & poultry	4.8%	4.7%	4.5%	4.4%	4.2%	5.4%	6.5%	7.7%	8.8%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
soaps & detergents	3.5%	3.4%	3.3%	3.2%	3.1%	3.5%	3.9%	4.2%	4.6%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
vegetable oils	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
vegetables, fruits & juices	0.6%	0.6%	0.6%	0.5%	0.5%	1.4%	2.3%	3.2%	4.1%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
wine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Annex VI: WAM scenario - activity data

Table V.1. Annual Fuel Consumption by Energy Sector per Scenario 2020–2040: WITH ADDITIONAL MEASURES

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Electricity																				
Natural gas	0	0	0	2868	2716	2613	2425	2434	2419	2385	1652	1649	1645	1626	1621	15830	15284	14810	13350	11985
HFO	2768	2641	2650	689	6	5	6	2	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	1233	1336	1223	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry (excluding cement)																				
Diesel	915	887	880	890	897	890	865	851	839	828	815	806	799	795	796	799	805	810	816	821
LPG	362	348	342	342	342	336	325	317	311	305	299	295	292	290	290	291	293	295	296	298
gas biomass	13	15	18	22	26	29	30	33	36	39	42	45	48	51	55	59	63	68	73	78
Kerosene	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4
Other oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RFO	1113	1065	1042	1034	1022	996	955	924	895	868	842	820	802	788	779	773	769	765	762	758
Solid biofuels	17	20	23	28	32	36	38	42	46	50	53	57	60	65	69	74	80	86	92	98
White spirit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A3b Road Transport																				
Gasoline	1344	1260	1195	1172	1125	1079	1024	9422	8612	7804	6967	6153	5357	4548	3713	2763	2605	1993	1394	1001
Diesel	1492	1256	1230	1179	1107	1037	9707	9050	8408	7794	7226	6678	6161	5598	4864	4109	4085	3806	3302	3014
LPG	3	6	9	12	14	17	19	21	24	25	28	30	32	34	15	36	35	36	36	35
Biodiesel	802	675	1074	1039	984	930	876	812	749	688	629	571	516	458	390	316	310	273	226	197
Natural Gas	0	0	0	0	237	236	235	234	233	232	232	231	231	230	230	237	237	236	236	8
1A4a Commercial / Institutional																				
Diesel	530	525	523	543	557	559	547	538	528	517	497	478	459	443	428	414	397	381	365	349
RFO	103	103	103	106	108	108	107	105	103	101	97	93	90	86	83	80	77	74	71	68
LPG	552	546	543	553	556	550	535	521	505	490	467	446	426	407	390	375	358	342	326	310
Other kerosene	101	99	99	101	101	100	97	95	92	89	85	81	78	74	71	68	65	62	59	56
solid biomass	141	140	139	148	156	159	157	157	158	158	154	150	147	144	141	139	135	132	128	123
gas biomass	22	21	21	23	24	24	24	24	24	24	23	23	22	22	22	21	21	20	20	19
Charcoal	172	171	170	181	190	195	192	192	193	193	188	183	179	176	173	170	166	161	156	151
1A4b Residential																				
Other kerosene	515	524	542	559	565	554	548	536	521	507	491	475	457	439	420	400	381	364	347	331
Diesel	2345	2387	2467	2548	2573	2524	2495	2442	2372	2311	2239	2164	2084	1999	1912	1823	1737	1657	1581	1506
LPG	1489	1534	1610	1712	1778	1763	1749	1741	1733	1735	1725	1712	1695	1677	1657	1629	1604	1581	1521	1521

Fuel consumption (TJ)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
solid biomass	641	637	643	643	634	613	599	580	560	544	526	509	493	476	460	444	429	416	404	393
charcoal	302	300	303	303	298	288	282	273	263	256	248	240	232	224	217	209	202	196	190	185
1A4c Agriculture / Forestry / Fishing / Fish farms - stationary																				
Diesel	1029	1019	1024	1035	1041	1033	1014	997	978	960	939	921	905	891	880	871	863	855	845	835
LPG	82	81	81	81	80	79	77	75	73	71	69	67	65	63	62	60	59	58	57	56
Gas biomass	448	443	446	450	453	450	441	434	426	418	409	401	394	388	383	379	376	372	368	363
mobile																				
Diesel	61	60	60	61	61	61	60	59	58	56	55	54	53	52	52	51	51	50	50	49

Table V.2 Activity data for the non-energy sectors per Scenario 2020–2040: WITH ADDITIONAL MEASURES

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2. INDUSTRIAL PROCESSES																				
<i>Urea-based catalysts</i>																				
Diesel (Gg)	347	292	286	274	258	241	226	210	196	181	168	155	143	130	113	96	95	89	77	70
2F Product Uses as Substitutes for Ozone Depleting Substances																				
recovery	0%	0%	0%	2.5%	5.0%	6.0%	7.0%	8.0%	9.0%	10%	11.0%	12.0%	13.0%	14.0%	15.0%	16.0%	17.0%	18.0%	19.0%	20%
2G Other Product Manufacture and Use																				
recovery	0%	0%	0%	2.5%	5.0%	6.0%	7.0%	8.0%	9.0%	10%	11.0%	12.0%	13.0%	14.0%	15.0%	16.0%	17.0%	18.0%	19.0%	20%
5. WASTE																				
5A. Solid waste disposal																				
Waste to disposal sites (kt)	375154	355390	335304	315081	269111	263968	258356	252725	247077	241411	235727	229680	223632	217585	211539	211536	211239	210942	210645	210348
Composition of waste to disposal sites																				
Food	35%	32%	28%	24%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
Garden	6%	5%	5%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Paper	29%	31%	33%	35%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
Wood	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Textile	7%	7%	8%	8%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Nappies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Plastics, other inert	20%	22%	23%	25%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%
5B Biological Treatment																				
M digested (kt)	1.281	1.294	1.320	1.359	1.414	1.484	1.573	1.684	1.818	1.982	2.180	2.420	2.710	3.063	3.491	4.015	4.657	5.449	6.430	7.652

Activity Data	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
5D Wastewater Treatment and Discharge																				
TOW septic (kt)	3.10	3.11	3.06	2.06	2.07	2.07	1.45	1.22	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOW collected (kt)	21.14	21.21	21.35	22.68	22.76	22.83	23.65	23.97	24.18	25.58	25.61	25.61	25.61	25.61	25.61	25.61	25.58	25.54	25.50	25.47
Protein, kg/person	28.81	29.81	30.81	31.81	32.81	33.81	34.81	35.81	36.81	37.81	38.81	39.81	40.81	41.81	42.81	43.81	44.81	45.81	46.81	47.81
NWWT (t)	1.86	1.87	1.87	1.88	1.89	1.89	1.89	1.90	1.90	1.90	1.91	1.91	1.91	1.91	1.91	1.91	1.90	1.90	1.90	1.89
Anaerobic																				
alcohol	3.5%	3.4%	3.3%	3.2%	3.1%	3.5%	3.9%	4.2%	4.6%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
beer	15.5%	15.1%	14.6%	14.1%	13.7%	14.9%	16.2%	17.5%	18.7%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
soft drinks	3.4%	3.3%	3.1%	3.0%	3.0%	3.4%	3.8%	4.2%	4.6%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
dairy products	3.8%	3.7%	3.6%	3.5%	3.4%	4.1%	4.8%	5.5%	6.3%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
meat & poultry	4.8%	4.7%	4.5%	4.4%	4.2%	5.4%	6.5%	7.7%	8.8%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
soaps & detergents	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
vegetable oils	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
vegetables, fruits & juices	0.6%	0.6%	0.6%	0.5%	0.5%	1.4%	2.3%	3.2%	4.1%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
wine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

