Cyprus'

Integrated National Energy and Climate Plan

under the 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

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Preface

This document is the **Integrated National Energy and Climate Plan** (INECP) submitted to the European Commission in accordance to Article 9(1) of 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, which has been prepared in accordance with Article 3(1) and Annex I of the same Regulation.

Contents

Tables

Figures

Part 1

General framework

SECTION A: NATIONAL PLAN

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Executive summary

1.1.1. i. Political, economic, environmental, and social context of the 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.

In October 2014, The European Council endorsed 4 targets on the 2030 climate and energy policy framework at EU level:
(a) a binding EU target of 40% less greenhouse gas emissions by 2030, compared to 1990;
(b) a target of at least 32% renewable energy consumption;
(c) a 32.5% improvement in energy efficiency;
(d) an electivity interconnection of at least 15%.

On energy security, the European Council endorsed further measures to reduce the EU's energy dependence and increase the security of its electricity and gas supplies.

Moreover, under EU legislation adopted in May 2018, EU Member States have to ensure that greenhouse gas emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO_2 from the atmosphere in the period 2021 to 2030. The Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry (LULUCF) into the 2030 climate and energy framework was adopted by the Council on 14 May 2018, following the European Parliament vote on 17 April 2018. The Regulation implements the agreement between EU leaders in October 2014 that all sectors should contribute to the EU's 2030 emission reduction target, including the land use sector. It is also in line with the Paris Agreement, which points to the critical role of the land use sector in reaching our long-term climate mitigation objectives.

At national level, the drafting of Ministries' Strategic Plans in 2014 with the first reference period 2015-2017 began. These strategic plans have been drafted at Ministry level and are reviewed annually. The annual review concerns the strategic plans for the next financial period, which is the Medium Term Financial Framework and covers a period of three years. Strategic plans include (A) at ministry level: mission, vision, values, strategic pursuits and (B) at ministry / department / service level of each ministry: objectives, activities, performance indicators, performance indicators and costing of goals, objectives and activities of each Department, which is budgeted. Along with the preparation of the budget for each subsequent year and the three-year Medium Term Financial Framework, Activity-Based

Budgeting is also included so that this costing can be included in the strategic plans of each Ministry. The strategic plans are approved together with the “traditional” budget by the Council of Ministers and then submitted to the House of Representatives along with the “traditional” budget. The medium-term goal is to move from the “traditional” budget to the budget based on strategic plans. It is noted that when implementing the budget, the objectives and activities of each Department are also estimated.

The strategic documents relevant to the climate and energy policy are the following:

(a) National strategy and action plan for the adaptation to climate change; adopted in May 2017 by the Council of Ministers (decision no. 82.555)
(b) National Action Plan for the improvement of air quality in Cyprus; adopted in May 2018
(c) EU Council conclusions of 13/12/2019 on climate neutrality by 2050

Long-term preparatory work preceded drafting of all of these plans, with the participation of experts from enterprises, research and development institutions, local governments and their representative organisations. The support of SRSS was used with several studies (Appendix 1) that started from 2015 in order to assist Cyprus to reform the Energy System. In addition, a strategic assessment of the environmental impact of these development documents was conducted. Events that were related to drafting the plan were mainly public, and all of the materials related to the drafting of the plan were published on webpages of the Energy Service and the Department of Environment.

Having regard the provisions of Fiscal Responsibility and Budgetary System Law (Law No. 20(I)/2014), the implementation of the fiscal measures of the NECP is subject to the approval of the annual Budgets and the three year Medium Term Budgetary Framework.

The Impact Assessment was carried out through a technical support study funded by the European Union via the Structural Reform Support Service (SRSS) and implemented by a consortium of local universities and research organisations. The consortium was led by the Cyprus University of Technology and also included the Cyprus Institute and the University of Cyprus. All the deliverables of the above study are available at the MECI website[1]. The analysis for the impact assessment was based on detailed modelling of the energy system of the country, which was mainly conducted with the OSeMOSYS optimisation model[2], for the two scenarios explored in the NECP – the scenario With Existing Measures (WEM) and the scenario with Planned Policies and Measures (PPM). Results of OSeMOSYS were then fed into other models to assess macroeconomic, employment and welfare impacts of the two scenarios.

Additionally, a Strategy Environmental Impact Assessment has been carried out for the draft NECP and has been examined under the relevant legal framework.

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[1] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42?OpenDocument

[2] M. Howells, H. Rogner, N. Strachan, C. Heaps, H. Huntington, S. Kypreos, A. Hughes, S. Silveira, J. DeCarolis, M. Bazillian, A. Roehrl, OSeMOSYS: The Open Source Energy Modeling System, Energy Policy 39 (2011) 5850–5870. https://doi.org/10.1016/j.enpol.2011.06.033

1.1.2. ii. Strategy relating to the five dimensions of the Energy Union

The implementation of the energy policy while attaining the climate and environmental targets requires a radical transformation of the energy system over the next decade and, therefore, the implementation of significant investments in energy infrastructure as well as in energy efficiency. Major investments have been planned and scheduled in renewable energy, in the transformation of the network and the introduction of smart meters in power distribution, in power transmission networks, in importing and using natural gas for increasing energy efficiency in power generation, in the energy efficiency in households, businesses, public sector and water sector, in transport infrastructures and sustainable mobility as well as in technological research.

The national targets for the next decade are looked into in detail in this national climate and energy plan (NECP) on a mid-term basis, up to 2030, and should serve as a basis for an ambitious long-term strategy aiming towards the minimisation of greenhouse gas emissions by 2050. Therefore, the decarbonisation dimension is the first and foremost component of the NECP structure.

The national plan elaborates on the five dimensions of the Energy Union, i.e. decarbonisation (which is broken down into two distinct sections: greenhouse gas emissions and renewable energy sources), energy efficiency, security of energy supply, internal energy market, and research, innovation and competitiveness.

In preparing this plan, a significant contribution was made by the technical working groups, which, in accordance with the Council of Ministers Decision No. 83.709, provided the required data, developed and processed the relevant sections. This procedure represented essentially the initial stage of consultation with technical experts from all relevant stakeholders playing an institutional role in respect of the topics discussed, which helped ensure the integrity and completeness of this plan. The groups drafted this plan under the supervision of the NECP technical committee.

The 13% Renewable Energy Sources (RES) goal for 2020 will be overachieved by Cyprus, despite the fact that the 10% RES in Transport target will be more difficult to be achieved. The new RES targets of 23% by 2030 can also be reached.

The main driver for the further increase of RES in electricity sector (RES-e) is the market parity which was already been achieved. Thus, in Cyprus, electricity from renewable sources is no more promoted through subsidies since 2013, where a net metering scheme and self-consumption has been put in place. In addition, the new schemes[3] that were announced in the period 2017-2019 will also operate through the market mechanisms, once those will be put in force. As it was highlighted through a number of studies that were carried out in the process of formulating the NECP and presented in the following chapters, the penetration of RES-e can reach the maximum limit at a very early period, 2023-2024, due to various technical constraints that are related to the isolated nature of the electricity system of

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[3] (1) Net-billing scheme for PVs and Biomass (CHP) plants and (2) Commercial RES Plans, the projects of which will participate in the competitive electricity market.

Cyprus. After the above period and if Cyprus remains electrically isolated from other electricity networks, the penetration from RES-e will only be increased once RES-e, coupled with storage technologies, materialises. Based on the analysis performed this will be achieved in the post 2030 period. It should be highlighted that in the PPM Scenario with electricity interconnection, the RES-e can exceed the 50% of RES penetration in 2030, while in the case without interconnection the RES-e penetration can reach only 30%.

In addition, renewable heating and cooling (RES H&C) is promoted by support schemes offering grants to households and through obligatory measures to new buildings. The new policy and measures described in the relevant chapters will enable Cyprus to meet the indicative targets in RES H&C, provided that the appropriate funding will be available.

RES in Transport (RES-t) will be the most challenging sector. Achieving the 14% RES target, is also affected by the electricity interconnection, since the less penetration of RES-e, cannot contribute to the desired level of transport electrification from RES. Further measures in the RES-t sector are the introduction of support schemes for local biofuels production from waste, modal shift measures through public transport and the introduction of natural gas in the transport sector. The government future plans to exploit its own natural gas reserves could further support the use of natural gas also by CNG/LNG vehicles.

With reference to energy efficiency, a number of polices and measures are described in the relevant chapters that will enable Cyprus to meet its national obligatory target on energy savings at end use by 2030. Cyprus strengthened the focus on energy efficiency in the transport sector by increasing the span of policies and measures related to this specific sector. The national indicative contribution to the EU 2030 energy efficiency target has been increased, taking into account the objectives derived from other dimensions of the energy union as well as the national characteristics and the cost-effective energy efficiency potential in all sectors.

In the area of energy security, the introduction of natural gas via Liquefied Natural Gas (LNG) imports and the development of the necessary infrastructure to import natural gas to Cyprus by early 2022 (via the “CyprusGas2EU” project of common interest), will end the energy isolation of Cyprus, diversify the country’s energy mix and contribute to its energy security. In addition, Cyprus actively promotes two other important projects of common interest, the “EuroAsia Interconnector” and the “EastMed Pipeline”, which will also contribute putting an end to energy isolation.

As far as the internal energy market is concerned and regarding the competitive electricity market, in 2020 and 2021 it is expected that a number of key projects that are under tendering or implementation will materialize and interconnected, so that electricity is traded on competitive terms, based on the design principles of the Regulation (EU) 2019/943 on the internal market for electricity as applied for Cyprus (Article 64). The completion of the two primary systems, i.e. the Meter Data Management System (MDMS) (completion est. December 2020) and the Market Management System (MMS) (completion est. Oct. 2021) will signify the operation of the competitive electricity market based on the Trade and Settlement Rules v.2.1.0. In parallel, the DSO is in the process of initiating the roll out the Advanced Metering Infrastructure (AMI) with 400.000 smart meters (installation will be completed within 7 years) together with a better control of the distribution system (Supervisory Control and Data Acquisition/Advanced Distribution Management System - SCADA/ADMS). All the above systems are a prerequisite for the gradual removal of barriers of entry for new electricity market participants and technologies (active customers, citizen energy communities, aggregators, demand response).

Research and Innovation (R&I) has a significant role in the national efforts to improve energy efficiency and energy security, increase the share of renewable energy and tackle climate change. At the same time the best possible production of research work that will provide innovative products and services can add value to businesses and provide useful insights for policy makers. In 2017 Cyprus has spent €110m in research and innovation which constitutes 0.56% of the Gross Domestic Product (GDP). The national target, set in "Innovate Cyprus" is that investments in R&I will rise up to 1.5% of GDP by 2023, thus an annual spending of €395m is envisaged. The target is also to raise private share in spending from 43% that it was in 2017, to 50% by 2023. Public funding will have the expected results only if it is combined with other measures that will support entrepreneurship in innovation and start-ups. The aim is to bring closer researchers and businesses in order to work together for producing innovative products and services in energy sector. During the NECP drafting and taking into account the Strategic Energy and Technology Plan (SET – Plan) and the Cyprus Smart Specialization Strategy, gave the opportunity for stakeholders to identify priority areas in R&I that will respond to the national targets for decarbonisation, as well as to the market needs. Furthermore, stakeholder engagement has resulted in a number of existing barriers and ideas to overcome them. The newly formed National R&I Governance System is expected to address many of the existing barriers, however further measures with the aim of more effective use of public funding in R&I in energy and climate will be examined up to the next revision of NECP.

Finally, it should be noted, that the final national climate and energy plan for 2030 and the long-term low-carbon strategy will serve as a basis for preparing regulatory acts and instruments, developing strategic plans and implementing financial instruments and tools, towards its implementation.

1.1.3. iii. Overview table with key objectives, policies and measures of the plan

Figure 1.1 shows the quantitative targets in the context of attaining the national energy and climate objectives for 2030. Accordingly, Table 1.1 lists the key policy priorities for each dimension of the national climate and energy plan, which are deemed necessary for attaining these objectives. These policy priorities are the axes for developing specific measures under each dimension.

All these policy priorities and the specific measures resulting from their implementation are part of an integrated plan for the optimal attainment of the national energy, environmental, socio-economic and development objectives, which requires consistency, horizontal combination and coordination in monitoring the priorities and implementing the measures. A key requirement for attaining the objectives set out in the context of NECP is to understand that the progress made in each individual sector automatically affects that made in the other sectors, and consequently the impact of the measures that are finally planned and implemented does not relate to or affects just one topic and section of the NECP, but has an impact on the overall development of the energy system.

Reducing greenhouse gas emissions and environmental objectives

- 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 CO_2 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

- 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%

Impoving Energy Efficiency

- Final Energy Consumption of 2.0 Mtoe in 2030, representing 13% reduction in final energy consumption*
- Primary Energy Consumption of 2.4 Mtoe in 2030, representing 17% reduction in primary energy consumption*
- Achieving cumulative energy saving of 243.04 ktoe during 2021-2030

** compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario*

Figure 1.1: National energy and environmental objectives for the period 2021-2030 in the context of EU policies

Table 1.1: Key policy measures planning priorities

PILAR	Key policy planning priorities
GHG emissions and removals	• 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	• 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

PILAR	Key policy planning priorities
	• 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	• 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	• 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	• 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,	• Fund of funds

PILAR	Key policy planning priorities
innovation and competitiveness	• 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

Renewable Energy Sources

Cyprus key objective in the RES target towards 2030 is to achieve at least 23% RES in final Energy Consumption, while the transport target was set to 14% in final Energy Consumption by 2030. As far as Heating and Cooling is concerned, there is an indicative target of an increase in RES H&C by 1% per year. Both the transport and the heating and cooling targets will be very challenging to achieve, since considerable investments and EU funding will be needed in order to reach the desired levels.

Based on the scenario with existing measures, Cyprus originally set a 19% share of energy from renewable sources in gross final consumption of energy in 2030. This level of ambition was increased significantly with the new proposed policies and measures to reach 23% in 2030, also in accordance with the relevant EC Recommendation.

An overview of the RES policies and measures is listed in Table 3.6 where investments for RES will take place in all three sectors (Electricity, Heating and Cooling and Transport). For Electricity sector the investments without any financial support but with the appropriate framework (revised market rules) will contribute to the RES targets. In the Heating and cooling sector, since there is a saturation for Solar water heaters more emphasis will be given to heat-pumps in the residential sector, while towards the end of the period it seems to be some technical and economic potential for district heating systems in the two tourism areas.

<u>Electricity</u>

Increased investments in RES Electricity sector (mainly PV, Wind and Biomass) will take place in PPM scenario with total accumulative investments up to 2030 to 1 billion Euros as per Table 1.2. The need of storage systems (both behind and after the meter) is also included in the above tables, but their need might be limited if the Cyprus will get electrically interconnected by 2023.

Table 1.2: Annualised investments and fixed costs (Million EUR2016) in RES Electricity Sector

(million €)	**2021**	**2025**	**2030**	**Total 2021-2030**	**Primary energy production (ktoe), 2021-2030**
Annualised investments	**40**	**80**	**128**	**838**	**2853**
Fixed costs	**14**	**24**	**29**	**235**	

Heading and Cooling

Continued investments in renewable energy technologies in buildings, as well as investments in heat pumps lead to an increase in the renewable energy share in the heating and cooling sector. The significant Renewable Energy share increase projected until 2030 will be mainly driven by solar thermal technologies and heat pumps in buildings, while an increase in district heating network is projected during the end of the period. The total estimated investments for the period 2021-2030 will need to increase to 910 million euros, as annual investment cost, cumulative up to 2030. The RES share foreseen in the heating and cooling sector increases and reaches 39% in 2030.

Transport

The total investments in the transport sector will contribute to all sectors - RES, energy efficiency and to the reduction of CO2 emissions using less pollutant fuels. It is estimated that additional cumulative investments in public transport to the order of €800-900m (2016 prices) to develop a tram line in Nicosia and significantly improve the public transport service and an additional €500m (2016 prices) for creating the necessary infrastructure for sustainable transport will be needed in the period up to 2030. Provided investments (including EU funding) are secured, the RES-t share (using the SHARE methodology) has been estimated to rise to 14.1% in 2030.

Energy Efficiency

For reaching the cumulative end use savings target for 2030, a mixture of policies and measures will be implemented in all sectors of the economy. These include, inter alia, regulatory and financing measures for households, services and industrial sector, action plan for reducing energy consumption in transport sector, measures in water sector as well as cross-cutting measures such as energy and CO2 taxes, energy efficiency obligation schemes, as well as informative and capacity building measures.

Increased energy efficiency investments especially in the transport sector seem to be the most challenging ones, as it will require considerable EU funding. More market-oriented financial support scheme will be definitely a challenge and mobilization of the appropriate financial and market instruments will be required. The estimated national and EU funds needed to implement the national energy efficiency plan amounts to about €1,9bn for the transport sector and more than €380m for the other sectors.

1.2. Overview of current policy situation

1.2.1. i. National and Union energy system and policy context of the national plan

The national policy framework within the framework of the national energy and climate plan is governed by the respective EU framework for the implementation of which a sufficiently broad regulatory national framework has been developed. In the context of the NECP, the basic key regulatory and statutory framework is set out in the respective sections of the text.

1.2.2. ii. Current energy and climate policies and measures relating to the five dimensions of the Energy Union

1.2.2.1. Decarbonisation - GHG emissions and removals

The policies and measures currently implemented consist of a mixture of policy measures from different categories (technical, regulatory and financial). The energy related policy measures already implemented with a view to reducing greenhouse gas emissions are presented in detail in the subsections that follow.

Generally, policy measures to utilize natural gas and promote renewable power generation make the most significant contribution towards reaching the objective of reducing greenhouse gas emissions. Also, policy measures for the implementation of energy efficiency improvement measures, especially in transport, along with improvements in waste management towards circular economy also make a significant contribution towards attaining the objective for 2030.

Directives 2010/75/EU and 2015/2193/EU, read in conjunction with the decisions on best available techniques have introduced strict emission ceilings (primarily, but not only, for SO5, NOx and PM2.5) for power plants. These ceilings pose significant difficulties in the effort made by existing plants to comply at a reasonable cost, thus constituting an additional constraint. Finally, additional indirect constraints are introduced by the Framework Directive on Waste (Directive 2008/98/EC), as amended by Directive 2018/851/EU, as well as by the draft Directive on the market in electricity.

Businesses

A new financial support scheme is currently in development that is planned for implementation for 2020 to 2022, to encourage business to take measures towards their reduction of greenhouse gas emissions. The scheme started as an initiative, “Business4Climate”[4] through which the Cyprus Employers and Industrialists Federation, the Cyprus University of Technology and the Department of Environment of the Ministry of Agriculture, Rural Development and Environment, aimed to commit businesses to more actively involved in climate action by reducing their greenhouse gas (GHG) emissions by 8% until 2030 through a voluntary commitment. Currently there are 64 signatories.

Energy

Further details are provided in the sections that follow.

Policies to reduce emissions from conventional power plants contribute to reducing greenhouse gas emissions in the coming period. The most important policy measure relevant to electricity production concerns import and utilisation of natural gas for electricity production.

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[4] http://www.oeb.org.cy/en/drasis/business4climate/

Promoting RES is a top policy priority to move towards the decarbonisation of the economy. All measures for the penetration of RES in electricity generation, in heating and in transport contribute to this objective.

The implementation of energy efficiency improvement measures, which have been included in the policies for improving energy efficiency in all sectors, also contribute to reducing greenhouse gas emissions.

Transport

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.

At the same time, 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 in late 2019. This scheme will have a total cost of €3 million and will come into force in 2020.

Moreover, the Integrated Fleet Management System (Central Government vehicles) includes the installation of an Integrated Fleet Management System by the Department of Electrical and Mechanical Services, on approximately 1800 government owned vehicles. The system was installed in 2017 and its total cost was €1.7 million. This measure aims amongst other benefits, to utilise the vehicle refuelling data to compare and high fuel consumption vehicles and replace them where necessary.

For the promotion of the use of electric cars, the Electricity Authority of Cyprus has deployed a total of 19 recharging stations accessible to the public in Cyprus. Furthermore, the Department of Electromechanical Services is proceeding with the installation of 10 double fast-charging stations in highways and public roads. This action will be completed in 2020 and its total cost is approximately €1 million. 3 additional charging stations will be installed by the Public Works Department in 2020 through the European Programme EnernetMob.

Regarding public transport, new bus concessions are planned to be put in force in 2020 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 and provision for conversion of operator's bus fleet to use Compressed Natural Gas (CNG), when such fuel source is available in Cyprus and the prerequisites for doing so exist.

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.

Concerning biofuels their use was 2.5% at the end of September 2019, and is currently at 5% (December 2019). These percentages will be increased in 2020 in order to meet the obligatory targets. A support scheme is currently under development by the Ministry of Agriculture, Rural Development and Environment for the promotion of local production of biofuels. It is expected to be ready for implementation in 2020 for the period 2020-2022.

LPG vehicles were seen as a possible short-term solution, as the construction of 25 LPG fuel stations was planned within the next years and conversions from petrol cars are often cost efficient. Currently, there are only 8 LPG fuel stations moment and the impact of LPG on the RES goals is negligible. A further development of the technology is not foreseen in the long term – as more efficient technologies using RES such as e-mobility take over. Moreover, the import of natural gas and future plans to exploit the reserves of natural gas, located in its economic exclusive zone, could support the promotion of CNG/LNG vehicles instead of LPG vehicles. The cost for this action is covered by private investments.

Fluorinated gases

The New EU F-gas Regulation adopted in 2014 and applies 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 the provisions of Article 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 recently adopted and harmonized the above Regulation into Cypriot Law 62(I)/2016 and 46(I)/2017. The next step is to adopt a national Law regarding a producer’s responsibility scheme. The main provision of this Law, which is currently discussed at the parliament, follows the “polluter pays” principle and each producer has to participate in an appropriate scheme for management of f-gases that have been recovered for any reason.

At the same time, certified technicians will be encouraged to return to the scheme any fluorinated gases the have recovered, for a pre-decided profit, through the development of a financial support scheme which is currently designed. Its implementation is expected to start in 2021 for the period 2021-2022. The goal is to achieve 5% recovery by 2030.

Agriculture

The Common Agricultural Policy (CAP) promotes sustainable food production, sustainable farm management and environmentally and climate-friendly practices and methods. The measures that implemented aim at preventing desertification, improving water management, reducing the intensity of natural resources, optimising the use of agricultural land, reducing the use of fertilisers and improving animal waste management, where special emphasis is given to the promotion of anaerobic digestion for the treatment of animal waste.

In addition, the Rural Development Programme promotes forestry, which also increases the absorption from the LULUCF sector.

Currently, the contribution of measures other than anaerobic digestion to the country's overall emissions/absorption balance cannot and have not been estimated.

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. In Cyprus there are currently operating more than 10 anaerobic digesters, of which the majority is at large animal farms. 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 (target for 2030: 11.5% for cattle waste, 5% for sheep and goat waste, 22.8% for poultry waste and 66% for pig waste).

Waste

A package of policy measures are contributing towards reducing the quantities of biodegradable waste in solid waste treatment facilities. Measures are promoted for the separate collection of bio-waste, recycling and energy recovery through anaerobic digestion. These measures are primarily aimed at the reduction of the quantities of biodegradable waste in solid waste treatment facilities, not only for electricity and thermal energy generation (e.g. biogas production), but also for recycling. The above measures, which have already been launched in the framework of the National Municipal Waste Management Strategy, will be intensified in the period 2021-2030, as National Planning is currently being revised under the EU circular economy package and the new waste Directives.

With the EU Waste Framework Directive being the main guiding force, in conjunction with the need to improve the waste management infrastructure of the country to ensure the appropriate management of waste in line with EU obligations and targets, Cyprus has developed and is implementing, as part of its Strategy, the National Municipal Waste Management Plan of 2015-2021 which is currently undergoing a major revision. The implementation of the Plan is the responsibility of the Department of Environment.

The National Municipal Waste Management Plan of 2015-2021 (MWMP) 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 target 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 the establishment of separate collection systems by local authorities,
- Establishment of extended producer responsibility (EPR) for 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 following measures have so far been implemented:
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 has been in operation since 2010 serving the 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 the Limassol district came into operation in 2017.
b) The construction of the Green Points Network (22 collection points for various household waste streams– bulky waste, green, textile, furniture, WEEE, etc.) has been completed and all Green Points are now in operation.
c) Currently, there is a system for the separate collection of packaging waste from households, operated by the collective system which has been established under the Packaging Directive. The system carries out door-to-door collection in most urban centres, with a number of smaller communities serviced by central collection points. Draft Regulations have been prepared, as set out in the National Strategy for the Management of Municipal Waste, with a view to their adoption in 2020, which define the obligations of local authorities for the management of municipal waste. The Regulations will provide for the preparation of local waste management plans and waste prevention programmes by the local authorities, the obligatory establishment of separate collection systems for a number of waste streams (specifically paper, glass, plastic and metals, including packaging, wood and synthetic packaging and bulky waste), the obligatory establishment of a separate collection systems for organic waste (including food and garden waste), and the adoption of a pay-as-you-throw scheme.
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, and undertake the appropriate environmental studies as well as feasibility studies for the restoration of the prioritised landfills. These studies were a necessary step for the restoration of all landfills recorded.

The last two (2) illegal landfills were closed in February 2019 and plans for the restoration are underway. According to recent data, these two landfills were fed 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 contacted 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 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 (40% from 2021, 55% in 2025, 60% in 2030).
- Reduction of organics to landfills to 15% from 2021.
- Introduction of anaerobic digestion for the treatment of organic wastes treated by (5% from 2021)

An additional measure considered and not included in the solid waste management strategy is biogas recovery from old landfills, during their restoration (20% from 2020).

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 issues, but could be the apparent cause and consequence of a chain of direct and indirect human effects on all environmental issues.

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.

The work on education, training and public awareness is continuous and its contribution has not been assessed with respect to reduction of greenhouse gas emissions. Further details on the issue are available in the 7th National Communication of Cyprus (Chapter 9)[5].

1.2.2.2. Renewable Energy Sources

Over the period 2008-2018, the Cyprus Government has developed various support schemes, incentives and soft measures in order to support the Renewable Energy Sources penetration, especially in the electricity sector, where penetration was very low (Table 1.3). The overall 2020 RES target of 13% in final Energy Consumption, set by RES Directive 2009/28/EC, was already achieved in 2018, according to preliminary data from Eurostat[6]. The same applies for the Heating and Cooling sector, where the 2020 target of 23.5% has been surpassed already in 2018 reaching 36.76%. This performance was mainly due to the use of high efficiency heat-pumps and wood biomass, as well as, to extensive use of solar water heaters.

The renewable based electricity production over the past 10 years in Cyprus is listed in the Table 1.4.

Table 1.3: Share of Energy from RES according to Directive 2009/28/EC

[%]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2020
RES-E	0.59	1.39	3.45	4.93	6.65	7.40	8.45	8.59	8.91	9.36	16.00
RES-T	2.04	1.99	0.00	0.00	1.13	2.68	2.52	2.69	2.59	2.69	10.00
RES-H&C	17.32	18.84	20.02	21.84	22.62	22.26	24.13	24.54	26.13	36.76	23.50
RES	5.92	6.17	6.26	7.14	8.46	9.17	9.93	9.86	10.49	13.88	13.00

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[5] https://unfccc.int/documents/64731

[6] https://ec.europa.eu/eurostat/documents/38154/4956088/SUMMARY+partial+provisional+results+SHARES+2018/25ce9f29-7053-17c5-12a6-8efe878b6031

Table 1.4: Electricity Generation per Technology until 2018

Electricity production from renewable sources (GWh per year)	Solar	Wind	Biogas	Total
2008	2.55	0	11.54	14.09
2009	3.83	0	26.52	30.35
2010	6.39	31.37	35.12	72.88
2011	11.94	114.31	51.61	177.86
2012	21.54	185.48	50.02	257.04
2013	47.11	231.04	48.86	327.01
2014	83.59	182.85	50.55	316.99
2015	126.66	221.86	51.24	399.76
2016	147.65	226.7	52.02	426.37
2017	173.73	211.45	51.91	421.68
2018	195.29	220.61	36.10	452.01

From 2015 onwards, all new RES projects are not receiving any subsidy, while self-consumption schemes do not support any subsidy in electricity prices. For household owners and for those having a building permit prior to 2017, there is a support scheme in operation for the period 2018-2020. The grant support is set at 250 Euro/kW installed, with a maximum possible grant per system of €1,000. If the above measure is combined with roof insulation, the overall grant is €3,000, where the grant for PV itself is increased to 300 Euro/kW. Furthermore, a support scheme for vulnerable consumes is in place since 2013, currently amounting to €900/kW with a cap of €3,600.

Table 1.5 presents an overview of the specific grant schemes and the specific subsidy of the electricity produced from renewable sources in Cyprus over the past 10 years.

It is also noted that, as of 2015, all new support schemes for RES electricity production receive a tariff based on the current EAC Fuel Cost, calculated according to the methodology set by CERA[7]. Once the competitive electricity market operates, the respective projects will receive only the market price based on the market rules.

In the Heating and Cooling sector, support schemes have been implemented for providing economic incentives for the installation of solar water heaters in homes, as well as for major energy upgrading projects in existing buildings, where high efficiency heat-pumps for heating and cooling, as well as solar collectors for heating were also supported. Some pilot and demonstration projects on CSP Technologies for heat storage, heat process and solar cooling were also developed with very promising results.

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[7] https://www.eac.com.cy/EL/RegulatedActivities/Supply/renewableenergy/resenergypurchase/Pages/default.aspx

Table 1.5: Subsidy per renewable energy source in Cyprus for the period 2008-2019

Specific subsidy of the renewable electricity (EUR/MWh)	2008	2009	2010	2011	2012	2013	2014-2019
Solar	Households Option 1: 0.205€/kWh + 55% Option 2: 0.383€/kWh 15 years contract Commercial Option 1: 0.205€/kWh + 40% Option 2: 0.335€/kWh 15 years contract	Households Option 1: 0.225€/kWh + 55% Option 2: 0.383€/kWh 15 years contract Commercial Option 1: 0.205€/kWh + 40% Option 2: 0.36€/kWh (≤ 20kW) Option 3: 0.34€/kWh (21-150kW) 20 years contract		0.31€/kWh (21-150kW) 20 years contract	Households 0.28€/kWh (≤7kW) 15 years contract Commercial 0.25€/kWh (≤150kW) 20 years contract	Commercial 0.138€/kWh (21-150kW) 20 years contract	No FiT Scheme for net-metering and self-generation for all consumers Households In 2018-2020 Grant support €250/kW up to €1000 Up to €1200 if combined with roof insulation Commercial Capacity based support scheme
Wind		0.166€/kWh 20 years contract			0	0.145€/kWh 20 years contract	Capacity based support scheme
Biomass	0.108€/kWh 20 years contract	0.135€/kWh 20 years contract					Capacity based support scheme
Biogas	0	0.1145€/kWh 20 years contract					Capacity based support scheme

Even though the 10% RES target in transport seems more difficult to be achieved, the increase of the use of biofuels decided in 2019, coupled with statistical transfer, will enable Cyprus to achieve the 2020 target. More specifically:

- Due to the hot climate, in Cyprus only biofuels (mostly 2nd generation) are used. The percentage of biofuels in transport was 2.69%[8] at the end of 2018. This percentage will be increased in 2020 in order to meet the obligatory targets. The suppliers of transport fuels (petrol and diesel) are obliged to blend biofuels to conventional transport fuels in order to achieve the target set by the MECI, which is a percentage of biofuels to whole annual sales of petrol and diesel, in energy content.
- Incentives for the purchase and use of low/zero emission vehicles including the old vehicle scraping scheme and financial incentives for the purchase of electric vehicles were announced in 2019. This scheme will have a total cost of €3m and will come into force in 2020.
- The Department of Electromechanical Services is proceeding with the installation of 10 double fast-charging stations in highways and public roads. This action will be completed in 2020 and its total cost is approximately €1m. Through the European Programme EnernetMob, the Public Works Department is planning install another 3 charging stations in 2020.
- New bus concessions have been decided and are planned to be put in force in 2020. These will further improve the public transportation system. The increase of the use of buses that have low or zero GHG emissions will be implemented by reducing the average age of the public bus fleet from the current 17 years to 10 years, for the contract period 2020-2030. Furthermore, the new bus contracts include specific requirements for the use of electric buses and provisions for the conversion of operator’s bus fleet to using Compressed Natural Gas (CNG), when such a fuel source is available in Cyprus.

1.2.2.3. Energy efficiency

The national energy efficiency action plan for 2020 has been updated in 2017. Moreover, in 2013 and 2014 Cyprus has set its national planning in order to achieve the cumulative end use savings obligation under article 7 of the Energy Efficiency Directive (241.588 toe). The plan has been updated in April 2019 and communicated to the European Commission, based on the progress achieved in the first intermediate reporting period of 2014-2016. The update was prepared in order to take into account new measures that came into force after 2016, existing measures with some changes and other measures launched after 2014. Based on the updated plan, Cyprus will achieve the cumulative end use savings obligation under article 7 of the Energy Efficiency Directive by 2020. The annual progress is reflected in the annual reports[9] submitted to the European Commission.

Cyprus has set a list of policies and measures in order to achieve the national energy efficiency obligations by 2020. The major measures currently implemented and ongoing are:

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[8] https://ec.europa.eu/eurostat/web/energy/data/shares

[9] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B5969066F97FB710C22581D80035DB7F?OpenDocument

Legislative measures

- Minimum energy performance requirements for new buildings, buildings that undergo major renovation and building elements that are replaced/ retrofitted.
- Legislation that defines the technical requirements of Nearly Zero Energy Buildings.
- Compulsory issuing of Energy Performance Certificates (EPC) for new buildings and buildings that are sold or rented and public buildings above 250 sq.m.
- Compulsory inspection of large air conditioning systems and heating systems with boiler.
- Requirements for technical building systems installed in existing buildings.
- Legislation for the qualification of technical building systems installers.
- Legislation for the promotion of combined heat and power generation systems and high efficiency standards in heating and cooling systems.
- Legislation for energy efficiency (incl. energy efficiency in public sector, energy efficiency in metering and billing, transformation, transmission and distribution, energy audits).
- Legislation for regulating the market for energy auditing in buildings, industries and transport and the operation of Energy Service Companies (ESCOs).
- Legislation for energy labelling and market surveillance.
- Legislations for setting up an energy efficiency obligation scheme for energy companies.

Information and training measures

- Training and Licensing of Energy Auditors.
- Licensing of ESCOs.
- Training of Energy Managers.
- Training and Licensing of Qualified Experts (Issuing Energy Performance Certificates of buildings).
- Certification of small scale Renewable Energy Sources installers.
- Training and licensing of technical building system installers.
- Licensing of Heating Systems Inspectors.
- Licensing of Air-conditioning Systems Inspectors.
- Promoting the role of energy managers within organizations and enterprises. The energy manager monitors energy use and promotes the implementation of actions to reduce energy consumption.
- Promotion of energy management systems.
- Training of Energy Saving Officer in the public sector. About 700 officers are assigned on government owned buildings. They are responsible for energy efficiency in each public building and they report back on the measures and savings achieved annually.
- Leaflets, workshops, annual fairs, lectures. Information actions promoting energy efficiency investments, energy performance certificates, energy audits and energy performance contacting.
- Annual information campaigns for energy efficiency using the logo “Save energy-Save money” carried out on electronic media (TV, radio, social media), billboards, daily press and buses.

- Targeted awareness raising actions (electronic tool for energy efficiency, energy days, energy safari, energy efficiency network/voluntary agreements for business) in order to increase awareness of enterprises, industries, citizens, local authorities and journalists of the importance of energy efficiency and of opportunities to save energy and to take action towards saving energy.

Financial incentives and other measures

- €48.27m have been secured by the European and Structural Funds 2014-2020 for grant schemes and projects for energy efficiency investments in private and public buildings. €8.7m will be allocated for improving the energy efficiency for buildings used by SMEs, €18.4m energy retrofits in households, €20m for improving the energy efficiency in central government public buildings and €1.17m for pilot projects of combined heat and power generation in public and semi-public buildings. Projects under this package may be extended up until 2023.
- MECI announced in 2017, the operation of a support scheme for the installation of cogeneration systems fuelled by biomass/biogas for the production of electricity for self-consumption.
- MECI announced a support scheme based on net-billing principle for the installation of High Efficiency combined heat and power generation with capacity up to 5MW.
- Support scheme “Solar Energy for All” for on-the-site production and consumption of RES for own use which provides: (a) the installation of Net-metering photovoltaic systems with capacity up to 10KW connected to the grid for all consumers (residential and non-residential) and (b) the self-generation systems with capacity up to 10MW for commercial and industrial consumers.
- Support scheme for the replacement of old solar domestic hot water heating systems.
- Grant Scheme for the insulation of roofs in the residential sector.
- Grant Scheme for conducting energy audits in SMEs.
- Decision for the establishment of a new energy efficiency revolving fund /soft loan Financing Instrument to promote investments in the fields of Energy Efficiency and Renewable Energy Sources, targeting small and medium-sized enterprises, public bodies and households.
- Private financing institutions offer financing for energy efficiency investments, such as energy loans for thermal insulation and energy efficiency upgrade of buildings.
- In the framework Interregional European programs between Cyprus and Greece governmental buildings are being energy upgraded.
- Targeted energy efficiency measures/investments in public buildings.
- Establishment of an energy efficiency network with voluntary agreements with businesses.
- Financing measures for energy efficiency investments in existing hotels.
- Financing measures in agriculture.
- Targeted measures in transportation and Integrated Fleet Management Systems.
- Street lighting projects-replacing existing lamps / lighting fixtures in road lighting systems with new, more efficient ones.

- Incentives for new buildings with higher energy efficiency than EPBD requirements. New buildings and buildings renovated can receive a 5% extra building factor allowance if they achieve higher energy efficiency than the minimum mandatory levels provided by the legislation.
- Reduced VAT for energy efficiency retrofits of households - applying a lower VAT rate (5%), instead of 19%, for renovation and repair works carried out in existing private dwellings. The lower rate is used, inter alia, for works consisting in applying thermal insulation on the external envelope and replacing external door and window frames as well as photovoltaic systems.
- Targeted energy efficiency measures at schools.
- Increased tax on electricity consumption (levy for promoting energy efficiency and renewable energy).
- In the transport sector measures include incentives to increase the use of bicycles and public transportation, use of integrated fleet management system in governmental fleet, training and information on eco-driving, purchase and use of low/zero emission vehicles, including old vehicle scraping scheme and financial incentives for the purchase of electric vehicles (to take effect in 2020).
- Excise duty on vehicles with a view to reducing CO2 emissions. This measure relates to the tax imposed for the registration of vehicles with a view to reducing CO2 emissions.
- Excise taxes on motor fuels exceeding the minimum taxation levels required by Directive 2003/96/EC.

1.2.2.4. Energy Security

The list of policies and measures currently in place to achieve the national energy security objectives are:

- The construction of a LNG Import Terminal aiming to introduce natural gas in Cyprus by 2022.
- A Single Action Plan for the restoration of the electrical system after power blackout and setting certain Quality of Electricity Supply Indicators.
- Maintaining of emergency oil stocks equivalent to 90 days of net imports of petroleum products.
- The establishment of the New Energy and Industrial Area of Vasilikos in order to develop KODAP’s privately owned oil terminal storage facility and for the relocation of petroleum and liquefied petroleum gas installations from Larnaca to Vasilikos area.

1.2.2.5. Internal energy market

The list of policies and measures currently in place to achieve the internal energy market objectives are:

Electricity market integration and Energy poverty

- Cyprus TSO Ten Year Network Development Plan 2019-2028 according to Article 63 of the Laws for the Regulation of the Electricity Market.

- Regulatory Decision 01/2017 on the Implementation of a Binding Schedule for the Full Commercial Operation of the New Electricity Market Model.
- 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).
- 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).
- Ministerial Decision on 4/7/2018 for amendment the national law to enable operation of the electricity market and make the Market Operator/TSO independent from the vertically integrated electricity company. The revised Bill was forwarded to the Law Office for the necessary legal vetting.
- Regulatory Decision 03/2019 on Storage Systems that are installed before the metering point.
- Ministerial Order regarding the energy poverty, the categories of vulnerable customers of electricity and the measures to be taken to protect such customers.

Energy transmission infrastructure including electricity interconnectivity

- Promotion of the application procedure of the project of common interest EuroAsia Interconnector.
- Ministerial decision that nominates MECI as the National Competent Authority (NCA) for PCIs.
- NCA is responsible to implement all the necessary actions in order to achieve priority status for PCIs in the public sector, to ensure the transparency and public participation before and during permit granting process and to publish a manual of procedures applicable to PCIs and to develop the NCAs’ website "OneStopShopPCIs".
- Financial assistance to PCIs and to relevant studies for natural gas market development (Cynergy).
- Regional Cooperation through a MoU between the countries of Cyprus, Greece, Israel and Italy for EastMed Pipeline PCI Project.
- Regional Cooperation by the establishment of the trilateral cooperation secretariat, aiming for the cross border collaboration between Cyprus, other Member States and third countries involved in the PCIs.

1.2.3. iii. Key issues of cross-border relevance

Key issues of cross-border interest in the fields of energy and climate focus on the transfer of know-how on policies and measures, on the recognition and planning of the implementation of cross-border energy infrastructures, on cooperation to implement innovative and pilot energy projects, on the functioning of energy markets, on cooperation between information systems, and on cooperation as part of financing programmes.

Their implementation often takes place in the context of transnational agreements and transnational memoranda of cooperation/understanding. These transnational partnerships and agreements are designed and finalised in close cooperation with the Ministry of Foreign Affairs.

Cyprus promotes regional dialogue on the creation of the necessary energy infrastructure. There is regional cooperation between Cyprus and neighbouring countries for the implementation of three projects of common interest in gas and electricity sectors.

The planned regional gas infrastructure EastMed Pipeline project between Cyprus, Israel and Greece, will connect East Mediterranean with Europe and enhance the energy security and diversification of energy sources. Through the EastMed Pipeline, natural gas will be able to flow from Eastern Mediterranean region to Europe. Moreover, it will create synergies and cooperation between countries of the Eastern Mediterranean area.

EuroAsia Interconnector is a project aiming to end the electricity isolation of Cyprus. It is a cross border interconnector between Greek, Cypriot, and Israeli power grids via submarine HVDC power. The project is at a mature stage and has achieved considerable progress. Through the partnership between Greece, Israel and Cyprus the interconnectivity target will be met.

1.2.4. iv. Administrative structure of implementing national energy and climate policies

The institution responsible for energy issues in Cyprus is the Ministry of Energy, Commerce and Industry, while climate change is the responsibility of the Ministry of Agriculture, Rural Development and Environment and in particular the Department of Environment. The Department of Environment has a team of seven officers allocated to climate issues, working both on adaptation and mitigation issues. The Ministry of Energy, Commerce and Industry is also responsible authority for the preparation of the National Energy and Climate Plan, with almost all the personnel within the Department of Energy contributing to the above effort.

For the purposes of implementing the Regulation on the Governance of the Energy Union and Climate Action [(EU) 2018/1999][10] 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 1.2), the “National Governance System for Climate and Energy” is a Ministerial Committee, consisting of the Minister of Agriculture, Rural

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[10] 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

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 (NECP) 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 (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.

1.3. Consultations and involvement of national and Union entities and their outcome

1.3.1. i. Involvement of the national parliament

One consultation has taken place in the National Parliament on the National Energy and Climate Plan (June 2019), during which, a detailed presentation was made about the Governance Regulation, the country’s obligations in the field of energy and climate, the mechanism for drawing up the plan and the description of the measures and policies envisaged to achieve the relevant energy and climate objectives, as well as the amount of investment required to achieve these objectives. The final NECP will be presented to the Parliament once this is submitted to the European Commission. The parliament has also been involved in the preparation of the NECP during the face of the public consultation.

1.3.2. ii. Involvement of local and regional authorities

In early October 2019, a bilateral meeting was held with the Union of Cyprus Communities and the Union of Cyprus Municipalities during which the country’s obligations in the field of energy and climate, the mechanism for drawing up the plan and the description of the measures and policies envisaged to achieve the relevant energy and climate objectives. The NECP was also presented during a special event organized with the Cyprus Energy Agency for municipalities and communities in late October.

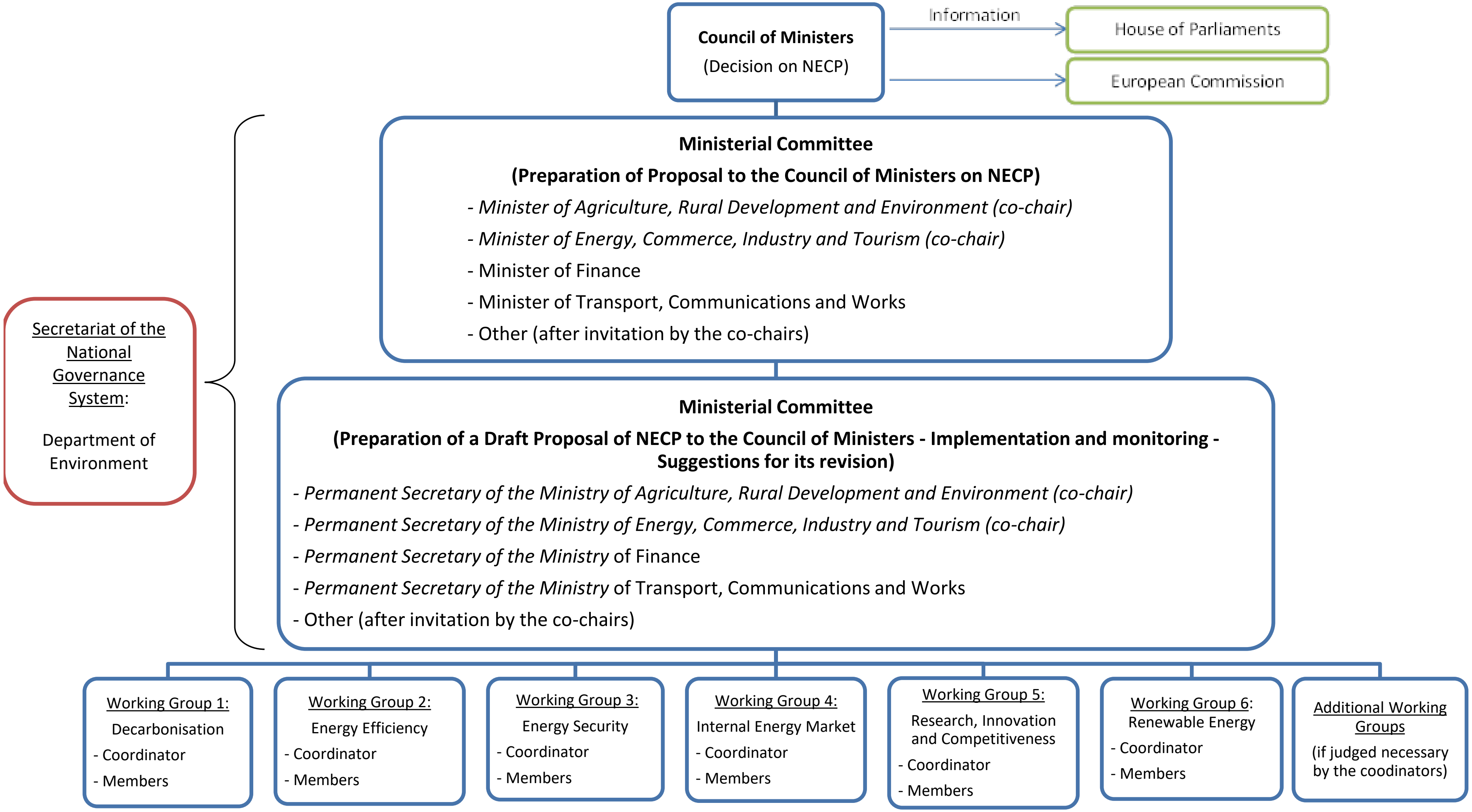

Figure 1.2: **Structure of the national governance system for Climate and Energy**

1.3.3. iii. Consultations of stakeholders, including the social partners, and engagement of civil society and the general public

All relevant stakeholders were involved in the process for the preparation of the NECP from the summer of 2018, through the activity of the working groups and special meetings held for the NECP with various social partners and the civil society.

- 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. The total number of participants amounted to 34, including representatives from academic and research institutions, youth organisations, industries, private firms and institutions of the public sector.
- 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. The total number of participants amounted to 97, including parliamentarians, representatives from the associations of stakeholders, civil society organisations, companies active in the energy sector, universities / research centres and natural persons. 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.

The key issues raised during the public consultation are presented in the Table below by sector. After evaluating the comments of both the consultation and the workshops, the final text of the Plan was drafted.

Table 1.6: Key issues raised during the public consultation

General/decarbonisation
• Increase emission reduction target to 80% by 2030 and zero emissions by 2035 • Companies are liable for their emissions directly or indirectly by taxation. • Utilise nature based solutions • Strengthening natural carbon storage • Announcement of programs to support / reinforce the initiative for emission reduction actions • Highlight the measures proposed by the Common Agricultural Policy (CAP) that can have a contribution to the reduction of emissions or increase of absorptions • Increase the contribution of LULUCF • Better Assessment will is needed for the Environmental impact of RES
Transport
• Provision to channel savings from the proposed measures of the Plan and in particular transport. • Significance of Sustainable Mobility Measures and further analysis of Sustainable Mobility Plans implementation planning • Promotion of trains for interconnecting cities and creating trams in Nicosia and other cities • Further strengthen the measures for the purchase of electric vehicles • Promotion of the use of zero-emission vehicles use and special reference to less polluting trucks and buses • Further action on alternative fuels and energy audits in transport
Renewable Energy Sources
• Promotion of Virtual Net-Metering • Possibility to sell electricity produced by consumers and credit to bills.(Receive income for export energy) • Integration of RES with bids so that it can really reduce costs for consumers. • Promote immediate simplification of licensing procedures for large projects • Adjustment frame for geothermal and heat-pump units • Promotion and Synergy for Biogas Production for Electricity and Biofuel Production • Regulatory framework for the integration of energy storage systems into the electricity market.
Energy efficiency
• Promote zero energy buildings
Research, innovation and competitiveness
• Strengthen research on circular economy and water • Strengthen the cooperation of educational institutions and NGOs in research • Closer cooperation of Ministries with Universities and other research institutes • Lack of specific proposals • Assess the exploitation of CCS and CCU technologies
Horizontal
• Promote education / information on climate change to the public and especially in schools • Increase transparency in the implementation of the Plan • Promote the principles of a circular economy in industry • Reduction of VAT for repairs and reuse • Strengthen the role of local government and share emission reduction targets • Monitoring implementation and evaluation of results / indicators

1.3.4. iv. Consultations of other Member States

Various consultations took place with other MS in the framework of the development of the NECP. Details are provided in the relevant Sectors.

1.3.5. v. Iterative process with the Commission

The comments of the European Commission on the draft National Energy and Climate Plan submitted in January 2019 were received through the Commission Recommendation of 18.6.2019 on the draft integrated National Energy and Climate Plan of Cyprus covering the period 2021-2030 (document SWD(2019) 223 final).

1.4. Regional cooperation in preparing the plan

During the process of drafting the National Energy and Climate Plan, active/existing and ongoing regional cooperation on energy and climate issues has been taken into account in order to assess any synergies and specific actions that may contribute to the achievement of the national energy, environmental and other objectives of the National Energy and Climate Plan. In this context, the following information is reported:

Cyprus-Greece-Jordan

Memorandum of Understanding between the Ministry of Agriculture, Rural Development Environment of the Republic of Cyprus, the Ministry of Energy, Trade and Industry of the Republic of Cyprus, the Ministry of Environment and Energy of the Hellenic Republic and the Ministry of Energy and Mineral Resources of the Hashemite Kingdom of Jordan in the field of Cooperation on Renewable Energy Sources, Nicosia, 16 January 2018.

The purpose of the cooperation on the basis of the signed Memorandum of Understanding is the exchange of information and know-how, policy-making, education and actions for Renewable Energy Sources, Energy Efficiency, Innovation-Research and Exchange of knowledge, best practices and pilot projects in buildings, with a particular emphasis on the integration of near zero energy buildings and on the integration of renewable energy sources.

Cyprus-Greece-Israel-Italy

Memorandum of Understanding between the Government of the State of Israel, the Government of the Republic of Cyprus, the Government of the Hellenic Republic and the Government of the Italian Republic concerning the cooperation on the natural gas pipeline ‘EastMed pipeline’, Nicosia, 5 December 2017.

The purpose of this Memorandum is to confirm the parties’ intent to cooperate in the development and implementation of the EastMed Pipeline project as a viable and strategic choice for natural gas-producing countries, as it will ensure a direct and long-term export route to Greece, Italy and other European markets, and will enhance EU security of supply while promoting competition between natural gas suppliers.

Cyprus-Greece-Israel

Joint Declaration of Cyprus-Greece-Israel in the framework of the Fourth Summit which took place in Nicosia on 8 May 2018 concerning agricultural policy, energy and industry. Emphasis was placed on the completion of Inter-Governmental Cooperation for the East Med pipeline.

Greece, Cyprus, and Israel signed on 2nd of January 2020 an intergovernmental agreement for the construction of the EastMed Pipeline, which aims to link the region's gas reserves to Greece and the rest of Europe.

The purpose of this agreement is to protect-secure the pipeline and promote the appropriate regulatory-licensing framework for the timely construction and operation of the project.

Cyprus-Greece-Egypt

Joint Declaration of Cyprus-Greece-Egypt, at the 6th Summit which took place in Elounda, Crete, on 10 October 2018, on the diversification of energy sources, security of supply, extraction and exploitation of hydrocarbons and the promotion of renewable energy sources.

Other cooperation measures

- Cyprus is a Member of IRENA and the active participation to the organization and the REMAP activity will help Cyprus to further promote the decarbonisation of the Energy system.
- Participation in Concerted Action workshops on RES and energy efficiency.
- MOU with Greece and Lebanon for promoting further the RES and Energy Efficiency between the three countries.

1.4.1. i. Elements subject to joint or coordinated planning with other Member States

Cooperation between Cyprus, Greece is a necessity for the permit granting of EastMed Pipeline and EuroAsia Interconnector. Each Project Promoter has to proceed with permit granting procedure in EU and non-EU countries separately and in parallel. Consequently countries shall cooperate in order to facilitate permit granting process and accelerate planning in their territories for the timely implementation of project timeline that is crucial for them to keep PCI status.

PCI status gives to EastMed Pipeline and EuroAsia Interconnector the right to apply for EU funding from the Connecting Europe Facility and MS shall take any effort for the achievement of PCIs funding.

1.4.2. ii. Explanation of how regional cooperation is considered in the plan

Regional cooperation can help Cyprus in many ways by facilitating the implementation of the Electricity Competitive Market within EU's internal Energy market. In addition will help the island to increase the security of supply and develop Energy projects in the framework of Islands initiative

2. NATIONAL OBJECTIVES AND TARGETS

The National Energy and Climate Plan (NECP) briefly 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. 21% 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 CO_2 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.

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.

2.1. Dimension decarbonisation

The goal of the national energy and climate plan is to achieve a reduction of greenhouse gas emissions of 24% by 2030 compared to 2005. This will be achieved through a phase approach as presented in section 3.1.

2.1.1. GHG emissions and removals

For non-ETS sectors, a target to reduce greenhouse gas emissions by at least 24% compared to the respective emission levels for 2005 is set. The sectors covered by the Emissions Trading Scheme (ETS) are subject to the overall European GHG reduction target of 43% compared to the corresponding 2005 emission levels.

The NECP also adopts the quantitative targets set in the context of the implementation of Directive 2016/2284/EC on the reduction of national emissions of certain air pollutants for the period 2020-2029 and for the year 2030 compared to 2005 (as shown in Table 2.1), which also requires the development, establishment and implementation of National Air

Pollution Control Programmes, as well as the monitoring and reporting of the emission levels for relevant pollutants [sulphur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds other than methane (NMVOC), ammonia (NH3) and fine particulate matter (PM2.5)] and other pollutants (CO, heavy metals, POPs, BC). These emissions are not simulated or further analysed within the framework of the NECP, as their evolution is an obligation of other national emission inventories and of the National Programme for the Control of Air Pollution, further analysing the impact of the NECP on the achievement of the targets set for Cyprus under Directive 2016/2284/EC.

Table 2.1: Quantitative targets for the reduction of national emissions of certain air pollutants for the period 2020-2029 and for the year 2030 compared to 2005

Air pollutant	Percentage of emission reductions compared to 2005	
	Period 2020-2029	2030
Sulphur dioxide (SO2)	83%	93%
Nitrogen oxides (NOx)	44%	55%
Non-methane volatile organic compounds (NMVOCs)	45%	50%
Ammonia (NH3)	10%	20%
Fine particulate matter (PM2.5	46%	70%

LULUCF

Regulation (EU) 2018/841 of the European Parliament and of the Council lays down accounting rules on greenhouse gas emissions and removals relating to land use, land-use change and forestry (‘LULUCF’). Activities that fall under the scope of that Regulation should not be covered by this Regulation. However, while the environmental outcome under this Regulation in terms of the levels of greenhouse gas emission reductions that are made is affected by taking into account a quantity up to the sum of total net removals and total net emissions from afforested land, deforested land, managed cropland, managed grassland and, under certain conditions, managed forest land as well as, where made mandatory under Regulation (EU) 2018/841, managed wetland, as defined in that Regulation, a LULUCF flexibility for a maximum quantity of 280 million tonnes of CO_2 equivalent of those removals divided among Member States should be included in this Regulation as an additional possibility for Member States to meet their commitments when needed. That total amount and its division among Member States should acknowledge the lower mitigation potential of the agriculture and land use sector and an appropriate contribution of that sector to greenhouse gas mitigation and sequestration. In addition, voluntary deletions of annual emission allocations under this Regulation should allow for such amounts to be taken into account when assessing Member States’ compliance with requirements under Regulation (EU) 2018/841.

On 30 November 2016, the Commission presented a proposal for a Regulation of the European Parliament and of the Council on the Governance of the Energy Union (‘governance proposal’), which requires Member States to draw up integrated national energy and climate plans in the context of strategic energy and climate policy planning for all five key dimensions of the Energy Union. According to the governance proposal, the national plans covering the period from 2021 to 2030 are to play a key role in Member States’ planning of their compliance with this Regulation and Regulation (EU) 2018/841. To that end, Member States are to set out the policies and measures to meet the obligations under this Regulation and Regulation (EU) 2018/841, with an outlook to the long-term goal to achieve a balance between greenhouse gas emissions and removals in accordance with the Paris Agreement. Those plans are also to set out an assessment of the impacts of the planned policies and measures to meet the objectives. According to the governance proposal, the Commission should be able to indicate in its recommendations on the draft national plans the appropriateness of the level of ambition and of the subsequent implementation of policies and measures. The possible use of the LULUCF flexibility to comply with this Regulation should be taken into account when compiling those plans.

For Cyprus, total net removals from afforested land, deforested land, managed cropland and managed grassland may be taken into account for compliance for the period 2021 to 2030 pursuant to point (a) of article 7(1) of Regulation (EU) 2018/842 is 600 kt CO2 eq.

Climate Change Adaptation

With regard to climate change adaptation, the Department of Environment of the Ministry of Agriculture, Rural Development and the Environment coordinated the efforts to develop and implement the National Adaptation Strategy to Climate Change. For the implementation of the Strategy, a relevant Action Plan has been prepared, the implementation of which implies the implementation of measures which the competent Ministries / Authorities will promote within their budgets.

The National Adaptation Strategy (NAP) and Action Plan (NAP) to Climate Change were adopted by the Council of Ministers on 18/5/2017. This Decision:

- Calls on all stakeholders involved in the relevant Action Plan to promote the implementation of the envisaged actions, incorporating, where appropriate, relevant provisions in their Budgets. Where necessary, implementing bodies should assess the relevant economic impacts as well as the cost - benefits of implementing the actions, in order to confirm their need of their implementation.
- Designates the Department of the Environment to oversee the implementation of the adaptation measures of the National Adaptation Strategy and the relevant Action Plan, which will submit, through the Minister of Agriculture, Rural Development and the Environment, an annual report to the Council of Ministers. This Report shall, inter alia, indicate the extent to which the actions have been implemented, the reasons for any divergence, and suggestions for corrective action.

The National Adaptation Strategy provides a holistic framework which intends to help the decision-makers, stakeholders and citizens to respond successfully to climate change risks and assess the potential cross-sectional impacts and the vulnerability to climate change and how it might be reduced by various cost-effective adaptation options. The strategy besides the detailed analysis of observed and potential impacts and their vulnerabilities includes adaptation measures that should be taken immediately, as well as policies for future actions, for different sectors of economy. The selected sectors of importance in which climate change is significant for Cyprus are the following: Water resources, Agriculture, Coastal zones, Tourism, Biodiversity, Energy, Fisheries and Aquaculture, Soils, Forests, Public Health and Infrastructure. Reviews of NAS and NAP coordinated by the Department of Environment involve all stakeholders, as stated in the aforementioned Council of Ministers' Decision.

The 1st Annual Report on the Implementation of the adaptation measures of the National Adaptation Strategy to Climate Change and Action Plan was submitted and approved by the Council of Ministers on 5 December 2018, while the 2nd Annual Report was submitted and approved 15 January 2020.

It is noted that some of the effects of regional climate change cannot be effectively addressed by the existing measures of the National Adaptation Strategy and Action Plan and therefore require specific study to determine, as far as possible, how to effectively address them.

To this end, and in support of the National Adaptation Strategy and Action Plan, the outcome expected to be produced under Cyprus' Government Initiative for Coordinating Climate Change Actions in the Eastern Mediterranean & Middle East will be utilized. The purpose of this Initiative is to develop a Regional Action Plan to support countries in the Eastern Mediterranean and the Middle East to meet their obligations under the Paris Agreement and to address and / or adapt to the effects of climate change. This Regional Action Plan will be a dynamic high-level strategic planning document and outline regional climate policy (climate change mitigation and adaptation), taking into account the specificities and challenges of the region.

Waste

Under the EU circular economy package and the new waste directives amending the EU legal framework on waste, including the Waste, the Packaging and Packaging Waste and the Landfill Directives came in force in 2018, new ambitious long-term objectives and obligations have been introduced for the reduction of waste, increases in separate collection, reuse and recycling, and a significant reduction in the amount of waste that is landfilled. Specifically, by 2025 organic waste must be separately collected, while the separate collection of recyclable waste must be significantly increased since the preparation for reuse and recycling must rise to 55% by 2025, 60% by 2030 and 65% by 2035. The objective is to reduce landfill to a maximum of 10% of the total amount of municipal waste generated by 2035.

Table 2.2: **Waste Management** **Targets**

Directive 2018/851/EU amending the Waste Directive	**2025**	**2030**	**2035**
Preparing for reuse and recycling of municipal waste	55%	60%	65%
Bio-Waste By 31/12/2013 bio-waste is either separated and recycled at source or is collected separately and is not mixed with other types of waste.			
Directive 2018/850/EU amending the Landfill Directive			
By 2035 the amount of municipal waste landfilled is reduced to 10 % or less of the total amount of municipal waste generated (by weight)			
Directive 2018/852/EU amending the Packaging		**2025**	**2030**

Directive		
Recycling of packaging waste	65%	70%
• Plastic	50%	55%
• Wood	25%	30%
• Ferrous metals	70%	80%
• Aluminium	50%	60%
• Glass	70%	75%
• Paper and cardboard	75%	85%

As a response to the increased obligations arising from the circular economy package, the National Strategy for the Management of Municipal Waste will be revised in 2020 to determine the future planning needs and measures and actions to be implemented to meet the new requirements and quantitative targets of the circular economy package, including to further promote separate collection, to support local authorities in their new obligations, and to promote the necessary infrastructure for the recycling and treatment of waste on the basis of the principles of the circular economy.

Long-term planning

In the light of the latest available science and of the need to step up global climate action, the Cyprus endorses the objective of achieving a climate-neutral EU by 2050, in line with the objectives of the Paris Agreement.

The transition to climate neutrality will bring significant opportunities, such as potential for economic growth, for new business models and markets, for new jobs and technological development. Forward-looking research, development and innovation policies will have a key role.

Achieving climate neutrality will however require overcoming serious challenges. Cyprus takes note of the Commission Communication on the European Green Deal. Cyprus expects the proposed enabling framework by the European Union that benefits all Member States and encompasses adequate instruments, incentives, support and investments to ensure a cost-effective, just, as well as socially balanced and fair transition, taking into account different national circumstances in terms of starting points.

The transition will require significant public and private investments. In this context, Cyprus welcomes and supports the announcement by the EIB that it intends to support investment in climate action and environmental sustainability in the period from 2021 to 2030. It is underlined that the next MFF will significantly contribute to climate action. InvestEU has an important role in leveraging private investments for the transition. Tailored support for regions and sectors most affected by the transition will be made available from the forthcoming EU Just Transition Mechanism, which, as announced by the European Commission will aim at facilitating EUR 100 billion of investment through the Just Transition Mechanism. Details on the proposal of the European Commission on the Just Transition Mechanism are expected. Funding of transformation efforts must continue after 2030.

All relevant EU and national legislation and policies need to be consistent with, and contribute to, the fulfilment of the climate neutrality objective while respecting a level playing field. It has to be examined whether this requires an adjustment of the existing rules, including on state aid and public procurement. Moreover, the environmental and socio-economic impact of the transition to climate neutrality needs continuous monitoring.

The climate neutrality objective needs to be achieved in a way that preserves the Cyprus' competitiveness, including by developing effective measures to tackle carbon leakage. In this context, the European Commission's proposal of a carbon border adjustment mechanism concerning carbon-intensive sectors is essential for Cyprus. Facilities in third countries need to adhere to the highest international environmental and safety standards.

International engagement will be crucial for the success in addressing climate change and it is necessary to pay particular attention to climate diplomacy. Within this framework, Cyprus initiative on climate change is expected to have an important role in the regional cooperation on climate change. The Cyprus Government Initiative for Coordinating Climate Change Actions in the Eastern Mediterranean & Middle East aims at the development of a Regional Action Plan to address the specific needs and challenges countries are facing in the Eastern Mediterranean and Middle East region, to address and ameliorate the impact of climate change and advance mitigation actions in accordance with the Paris Agreement. To achieve the objective of developing a Regional Action Plan on Climate Action Coordination, a detailed work programme has been developed, consisting of two distinct components: a scientific and an intergovernmental component.

Cyprus will keep progress towards the objective of climate neutrality by 2050 under review and give strategic guidance, as appropriate.

2.1.2. Renewable energy

2.1.2.1. i. The elements set out in point (a)(2) of Article 4

The Cyprus authorities taking into account various studies made[11,12,13,14] towards a sustainable 2030 pathway, as well as the EC Recommendations, have revised their ambition target. Using recent available data and taking into account the recommendations received from the various stakeholders, the new trajectory can almost meet all the EU recommendations for Cyprus to achieve the 23% RES target by 2030.

In the transport sector, while the target is more difficult to be achieved, thus more synergies are needed from other sectors, Cyprus authorities with the PPM proposed, under certain conditions, can also meet the 14% RES target. As indicated in a study funded by SRSS[15], there are some alternative options in the transport sector, that with the appropriate funding in

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[11] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/JRC%20LTEM%20Final%20Workshop%20-%20CyI%20results.pdf

[12] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Long%20Term%20Planning%20overview.pdf

[13] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/IRENA%20REPORT%202030_Jan_2015.pdf

[14] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Cyprus_RESGRID_summary_v16.pdf

[15] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/ifeu%20Transport%20Study.pdf

infrastructure projects (Natural Gas Charging points and Electric Vehicles), besides the Modal Shift that is suggested in the study, Cyprus can achieve the set RES target.

From the various PPM that were examined[16] and taking into account the level of implementation and estimated timeline of each, as shown in Figure 2.1, Cyprus can exceed the recommended trajectory targets set by Article 3 of EU Directive 2018/2001, at both 2022 (18%) and 2025 (45%) reference points. This is true though, in the case where Cyprus will be interconnected by the end of 2023. However, if Cyprus remains isolated, the third indicative reference point target cannot be met, since Cyprus can only reach the 57.3% instead of 65% of the RES target. The results of the sensitivity analysis performed (Appendix 2) show that the electricity interconnector will allow more RES Projects to be installed especially in the electricity sector. Curtailment levels will also be reduced for both Wind and Solar energy produced.

RES 2020 Target (Baseline) and reference points

In the PPM scenario it is assumed that natural gas will become available for use in the electricity supply sector by the end of 2021-beginning 2022, via an LNG regasification facility. This means that the supplied gas will not necessarily originate from the domestic gas reserves, but could be from any potential supplier. At the initial stages, natural gas will be used for electricity production and gradually it will be supplied to other industrial users.

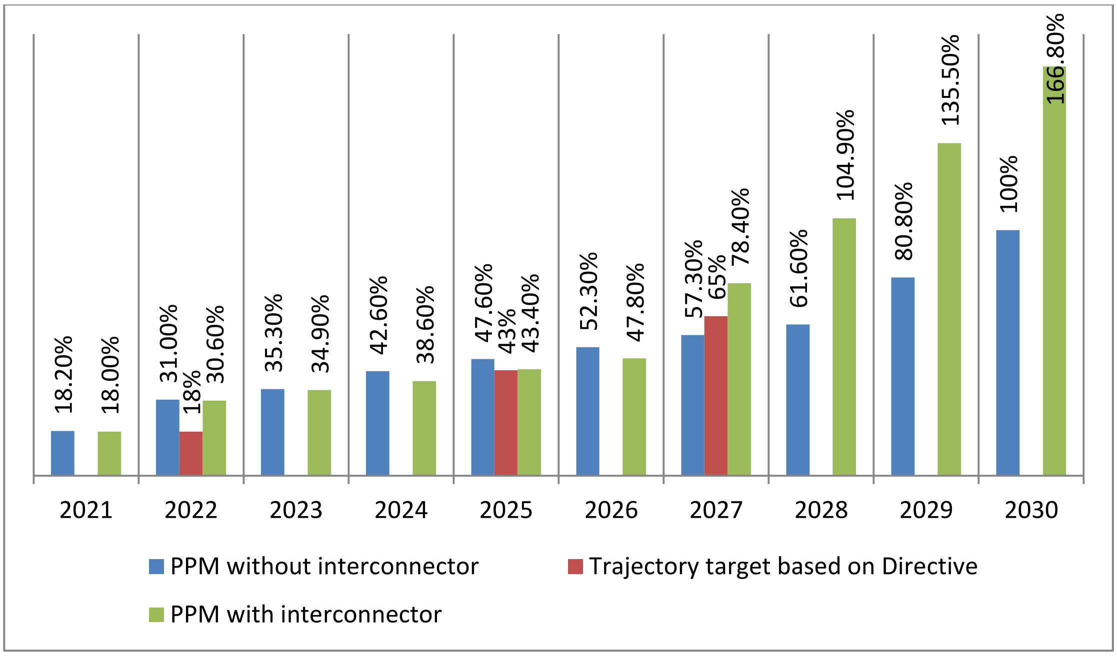

Figure 2.1. RES indicative trajectory towards 2030, in two scenarios based on Article 3 of Directive (EU) 2018/2001

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[16] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/SRSS-C2018-070_Deliverable_3.pdf

2.1.2.2. ii. Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sector

Based on the revised updated results for the RES in Final Energy Consumption, the results shown in Figure 2.2 were obtained in the three sectors, RES-H&C, RES-E and RES-T, under the PPM Scenario.

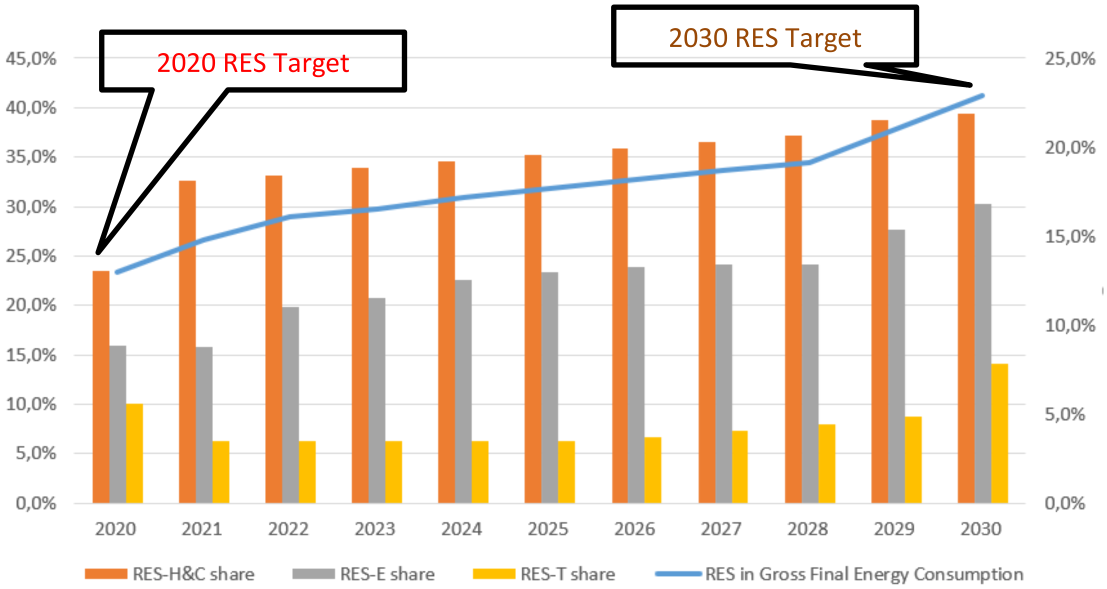

Figure 2.2. **RES Sector evolvement from 2021-2030, estimated trajectories in PPM Scenario**

Table 2.3: **Trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sector in two PPM Scenarios**

Scenario PPM	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
RES in Gross Final Energy Consumption	14.8%	16.1%	16.5%	17.2%	17.7%	18.2%	18.7%	19.1%	21.0%	22.9%
RES-H&C share	32.6%	33.1%	33.9%	34.5%	35.2%	35.8%	36.5%	37.2%	38.7%	39.4%
RES-E share	15.8%	19.9%	20.8%	22.6%	23.3%	23.8%	24.1%	24.1%	27.6%	30.3%
RES-T share	6.3%	6.3%	6.3%	6.3%	6.3%	6.6%	7.3%	8.0%	8.8%	14.1%
Scenario PPM with interconnector										
RES in Gross Final Energy Consumption	14.8%	16.1%	16.5%	16.9%	17.3%	17.8%	20.8%	23.5%	26.6%	29.7%
RES-H&C share	32.6%	33.1%	33.9%	34.5%	35.2%	35.8%	36.5%	37.2%	38.7%	39.4%
RES-E share	15.8%	19.9%	20.8%	21.4%	22.1%	22.7%	31.4%	38.2%	45.1%	51.3%
RES-T share	6.3%	6.3%	6.3%	6.3%	6.3%	6.5%	7.1%	7.9%	9.2%	14.8%

From the results in Table 2.3, it can be easily observed that up to 2023 the two scenarios (PPM with and without Interconnector) are almost identical. This is because the planned policies and measures adopted were used in both scenarios since there was a budget approval already for implementing the PPMs for the period of 2020-2022. Most of the PPMs described in Deliverable 3 of SRSS Study[17], especially RES projects for Electricity generation,

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[17] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/SRSS-C2018-070_Deliverable_3.pdf

will materialise since most of those projects are under implementation. A total additional capacity of 360MW is expected to be installed until the end of 2023 that will bring the total RES penetration for the electricity sector up to the level of 700-750MW.

Based on various studies performed from both MECI[18] and the Transmission System Operator (TSO), the further penetration of RES without storage technologies will cost significantly to the energy system, since more reserves will be needed from the conventional diesel-fired flexible Gas Turbines. In addition, the further deployment of storage technologies that it is assumed in the PPM Scenario without the interconnector, adds extra cost to the hybrid system (RES+Storage) that make it less competitive than the conventional units that will be fired with natural gas. This is not the case for the PPM scenario with the presence of the interconnector (after 2023), where no storage technologies are needed till 2030. The above outcome verifies the assumption made in previous studies[19], where the level of ambition in the electricity sector was lower due to the lack of electricity interconnection.

Based on the modelling results in Table 2.3, it can be observed that electrification of heating and cooling and the electricity sector are boosted in the first short term period (2021-2023). The RES in heating and cooling sector continues to grow almost constantly during the whole period (mainly due to the heat-pumps and solar), while an increase in the RES in transport sector is observed during the end of the period.

Based on the results of the impact assessment study (Chapter 5), it makes economic sense to implement measures in the transport sector towards the end of the period, i.e., 2029-2030. This is due to the expected increase of CO2 and oil prices towards the end of that period. In addition, it is expected that the evolution in technology and the price reduction of batteries will contribute to this effect. Furthermore, it is assumed that the other transport measures (modal shift and electric tram) will take place and be adopted during that period as well.

The introduction of natural gas and the stricter restrictions regarding emissions of greenhouse gases and air pollutants that will be introduced after 2021 affect the electricity generation, transportation, and heating and cooling sectors. Similarly, once domestic gas reserves become operational, demand for natural gas may not be confined to just conventional power generation. Compressed natural gas may become a viable alternative in the transport sector. Also, the use of natural gas in industry, for residential heating purposes or for gasification of the transport sector, are potential alternatives. This was also highlighted in an Ifeu Study for Transport[20], where the introduction of Natural Gas in transport will lead to very interesting results (natural gas can be used in transport sector, especially buses). However, in the PPM Scenario this aspect was not introduced, however, it

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[18] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Cyprus_RESGRID_summary_v16.pdf

[19] http://www.moa.gov.cy/moa/environment/environmentnew.nsf/all/8D6EF81F38772607C225829400343871/$file/NECP_190123_1320_clean.pdf?openelement

[20] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/ifeu%20Transport%20Study.pdf

seems that once natural gas will be available in Cyprus, the gasification of heavy trucks and busses (or even bunkering), will lead to increased decarbonisation levels. It is expected to evaluate this aspect (Gas in Transport) in the first revision of the NECP.

Assumptions and Methodology

In order to extract the above results, wherever data were not available from local sources, assumptions were based on literature, PRIMES or POTEnCIA-IDEES database. The data presented were revised in relation to the draft plan of 2019 with more precise and accurate data. In addition, and as stated before, the PPM scenario with the interconnector has a much greater contribution in RES electricity Sector (51% vs 30%) and thus in total RES contribution in final energy consumption, where the level of RES can reach the 30%. At the same time, input was drawn from other parallel studies conducted for MECI by SRSS.

Due to the vast amount of data used in the modelling exercise, the following subsections present the key input and assumptions used to develop the model for each sector (all the assumptions used are listed in the Appendix 3).

The importance of the interlinkages between these sectors relates to the many plausible synergies that can exist between technologies in one sector and how it affects demand in another sector, which was something that was requested from the European Commission during the evaluation of Cyprus's draft NECP. For instance, in a theoretically more technologically advanced system in 2030, the transmission system operator will be able to temporarily shed load from less important services, such as cooling of a shopping centre or desalination plants, so as to cope with potential rapid drops in generation. Similarly, the batteries in electric vehicles (with PV), can facilitate the use of higher shares of variable renewables and they might be charged when there is an increase in generation. This enables the grid operator to use them as demand response and a means of electric storage from which it can draw (together with selective load shedding) in cases of generation shortage or to smoothen out fluctuations in electricity demand.

Electricity Sector

The scenario with existing measures is dominated by natural gas-fired generation, once this fuel becomes available (Figure 2.3). The renewable energy share in generation is limited between 15% and 25% for the period 2021-2030. However, as gas prices and CO2 costs increase and investment costs of renewable energy technologies decrease along the model horizon, the share of renewable energy in generation increases in a non-linear way towards the years of 2029-2030. As it was illustrated in the corresponding IRENA[21] and KTH[22] work, solar PV is the most competitive of the renewable energy technologies and, as such, this is responsible for the increase in renewable energy. Solar PV capacity increases to a total of 750 MW by 2030 comparing with the 2020 target which is 288MW.

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[21] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/IRENA%20REPORT%202030_Jan_2015.pdf

[22] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Long%20Term%20Planning%20overview.pdf

It should once more pointed out that the modelling exercise confirms the importance of electricity interconnector, since, in that case, no storage technologies will be needed to be deployed and the different penetration of renewables in the electricity sector is more than 20%.

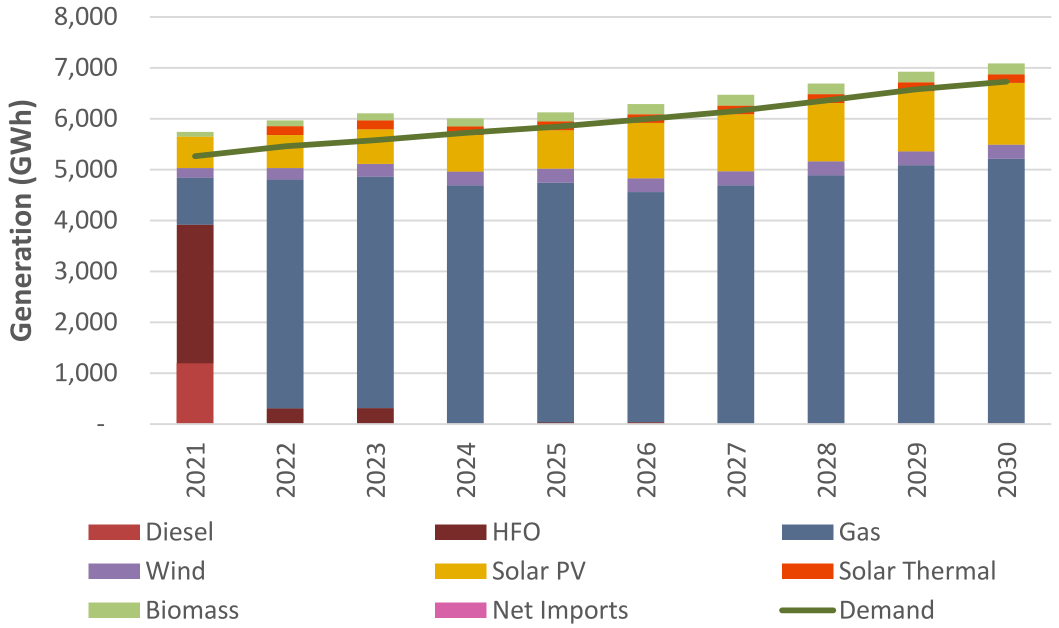

Figure 2.3: **Projected generation mix till 2030 – PPM scenario, with all available Technologies contribution**

Storage Options

Two main electricity storage options were considered during the analysis. The pumped hydro storage facility was used as an option, but its deployment is delayed until 2027, as the earliest possible year, according to MECI's suggestions after discussions with TSO-Cy and also based on the results of a FOSS study[23]. The reasoning for this is that no interest has been shown in such a facility yet and no technical feasibility assessment had been completed at the time of model development. In addition, the policy framework is not yet developed, as well as the cost and performance characteristics assumed for this facility may need to be revised, since the existence of periodic droughts in Cyprus may affect the attractiveness and viability of such a project.

Table 2.4: **Techno economic assumptions for pumped hydro facility**

Power Capacity (MW)	130
Storage Capacity (MWh)	1,040
Capital Cost (EUR2016/kW)	1,155
Fixed O&M Cost (EUR2016/kW)	11
First possible year	2027
Efficiency	77%

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[23] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/JRC%203%20Pumped%20Storage.pdf

Heating and Cooling

Information for heating and cooling has been obtained from a separate JRC study focusing on this sector[24]. Demand forecasts for heating and cooling, as well as techno-economic characteristics of technology options were also provided in the same study. Four levels of demand were examined based on various energy efficiency Policies and Measures.

The technologies evaluated were residential cooling, residential heating, cooling in all other sectors, and heating in all other sectors. The seasonal variation in demand for heating and cooling was estimated based on historical measurements of heating and cooling degree days.

An estimate of the demand profile within each day had to be assumed for each of the demands. In the case of cooling, this was based on the recorded electricity demand profile of each sector.

However, analysis providing a more accurate demand profile may be needed for future enhancements of the model.

Heat pumps and split units are the most competitive technology, as these increase their share substantially, displacing oil boilers and electric resistance heaters. Additionally, fuel-efficient oil boilers provide a considerable amount of heating in the services, industrial and agricultural sectors. Solar thermal panels in these sectors also increase their contribution by about twice their current yield, while solar thermal panels in the residential sector stay stable at the current levels. However, in the residential sector heat pumps/heat pump split-units take up the majority of the heating demand, as they are conceived to be the most cost-competitive technology. On the other hand, electric resistance heaters are not seen as efficient or cost-competitive and are phased out. Similarly, heat pumps/heat pump split-units take up the entire cooling demand throughout the model horizon, as currently is the case, with minimal contribution from efficient oil boilers. It should be clarified that the biomass CHP plants providing part of the heating demand refer to existing and future agricultural facilities making use of biogas, both for heating purposes as well as to generate electricity.

Table 2.5: Share of RES in Heating Sector (PJ), PPM scenario

	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Electricity	7.83	8.12	8.3	8.51	8.69	8.91	9.14	9.38	9.64	9.79
Other Oil Products	6.88	6.83	6.7	6.67	6.69	6.7	6.69	6.68	6.65	6.62
Pet Coke	3.16	2.95	2.74	2.58	2.49	2.41	2.33	2.26	2.18	2.13
LPG	2.61	2.6	2.56	2.57	2.61	2.65	2.7	2.74	2.78	2.82
Biomass	1.04	1.02	0.99	1.04	1.1	1.16	1.21	1.25	1.29	1.33
Geothermal	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05
Solar thermal	3.01	3.03	3.03	3.11	3.2	3.29	3.4	3.51	3.63	3.75
RES share	**32.6%**	**33.2%**	**33.9%**	**34.8%**	**35.5%**	**36.2%**	**36.9%**	**37.6%**	**38.3%**	**39%**

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[24] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Energy%20Efficiency%20Strategy_170710.pdf

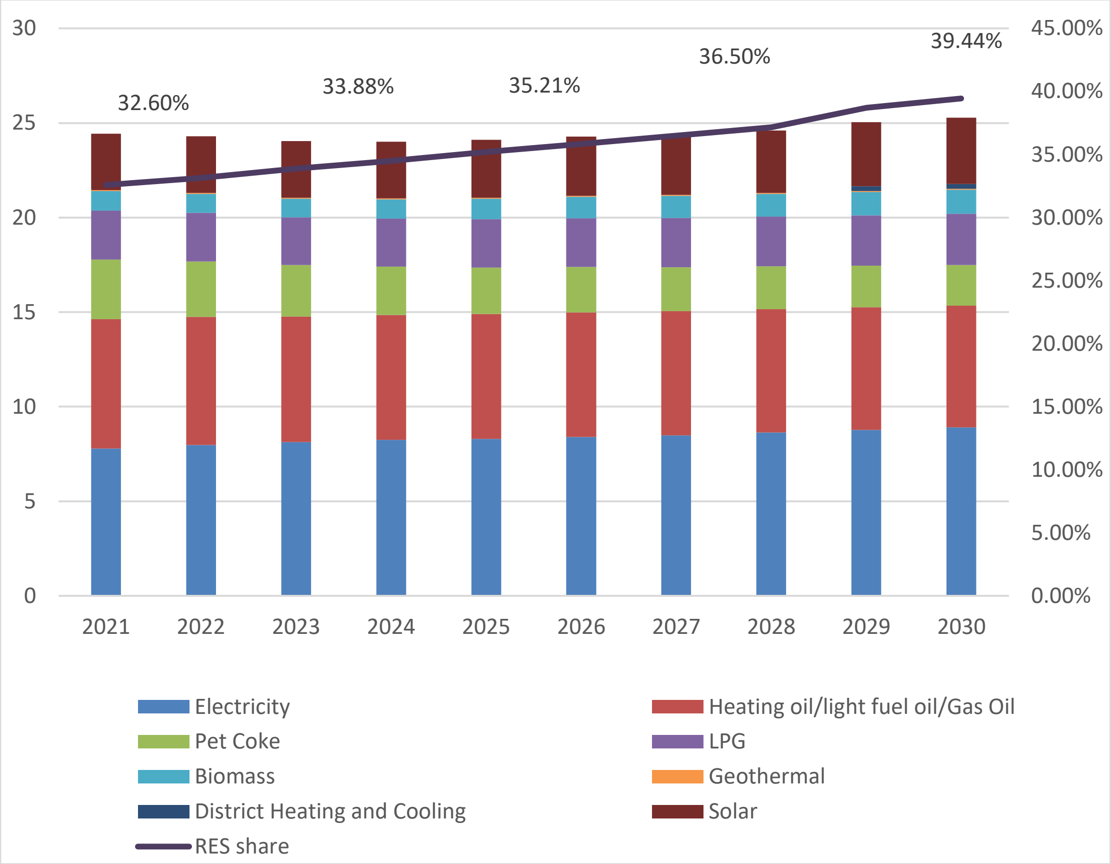

Figure 2.4: RES in Heating and Cooling Sector towards 2030 (PJ)

Transport Sector

Only biofuels are used in transport sector up to 2020. The percentage of biofuels in transport in energy content was 2.6% in 2018 and it is estimated to reach at 3.1% by 2019. The greenhouse gas emission reduction was at 1% for 2018 and it is estimated at 1.3% for 2019. These percentages will be increased in 2020 in order to meet the obligatory targets. According to the specific level, the suppliers of transport fuels (petrol and diesel) are obliged to blend biofuels to conventional transport fuels in order to achieve a certain target, which is a percentage of biofuels to whole annual sales of petrol and diesel, in energy content. The cost of biofuels is included in the retail price of petrol and diesel.

In terms of policies and measures, the current biofuel blending was considered in the model. It should be noted that biodiesel is blended with diesel, but no bioethanol blending with petrol takes place due to concerns raised regarding fuel quality standards by local oil-product import companies. MARDE promotes a scheme for the local production of biofuels from waste, as a measure of management/recovery of waste. In case the project is successful, the prices of biofuels in diesel fuel will not be reduced significantly but this can change the penetration of biofuels since local biofuels will be make sense to be used for various reasons, such as, job creation, local content, environmental issues. Finally, as the model shows, the achievement of the EU objective for reaching a 14% share of renewable energy in transport by 2030 with PPM, as opposed to just 7% in the WEM scenario is achievable, if the appropriate EU funding is obtained as shown in the impact assessment study (Chapter 5).

2.1.2.3. iii. Estimated trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectoral trajectories for renewable energy from 2021 to 2030, including expected total gross final energy consumption per technology and sector in Mtoe and total planned installed capacity (divided by new capacity and repowering) per technology and sector in MW

Most of the existing RES projects were licenced for 15 or 20 years with a few of them starting operation in 2005, whilst the majority of them commenced operations after 2010. It is expected that after the expiration of their PPAs, the projects will be operated under a net-billing scheme or participate directly to the competitive electricity market.

For the period up to 2030, a few biomass projects are expected to end their Feed-in-Tariff (FiT) Regime. These projects are expected to participate in the Electricity Market, while they will be able at the same time to use any energy needed for their own use. Alternatively, they could take advantage of a net-billing scheme.

As far as other technologies (wind and solar) are concerned, only some small household PV systems up to 5kW will have their PPAs expired. These projects can continue their operation, based on the support scheme that will be in force at the time. So it is more likely that some of those projects will be converted to net-metering or net-billing scheme.

In that respect, the estimated energy amounts needing repowering up to 2030 are 10,4MW of Biomass plants and 5-10MW of small PV systems, mainly residential. The rest of the projects are expected to have their PPA’s expiring in the post 2030 period.

The revised capacity projections (MW) for the Electricity Sector are listed below. Table 2.6 assumes no market operation since data are not available at present and cannot be estimated how market forces will distort the above results.

Table 2.6: Capacity projections in the electricity supply sector (MW) for PPM Scenario.

(in MW)	**2020**	**2021**	**2025**	**2030**	**2035**	**2040**
New CCGT[25]	0	216	432	432	432	648
Solar PV	360	380	460	804	1.653	1.892
Solar Thermal	0	0	50	50	50	500
Wind	158	158	198	198	198	198
Biomass & waste	17	22	42	58	58	58
Pumped Hydro	0	0	0	0	130	130
Li-Ion Batteries	0	0	0	0	211	655

As for Heating and Cooling, the results of the PPM scenario presented in Table 2.5 and Figure 2.5 comply in general with the new RES Directive 2018/2001/EC, while for some years the increase of RES in the Heating and Cooling sector might be marginally below the indicative target of 1.1% per year. This is because due to the small size of the country, some projects that are consider small for other countries can play an important role for Cyprus (i.e. a small district heating network). A moderate decrease in the primary energy supply can be

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[25] (CCGT) Combined Cycle Gas Turbine was selected among other possible technologies.

observed across the time horizon. The main driver of this is the incorporation of greater shares of renewable energy, which displaces fossil-fired generation in the electricity sector. Additionally, up to 2021 heavy fuel oil is till used to a considerable extent until the introduction of less carbon-intensive natural gas in the power sector by the end of 2021.

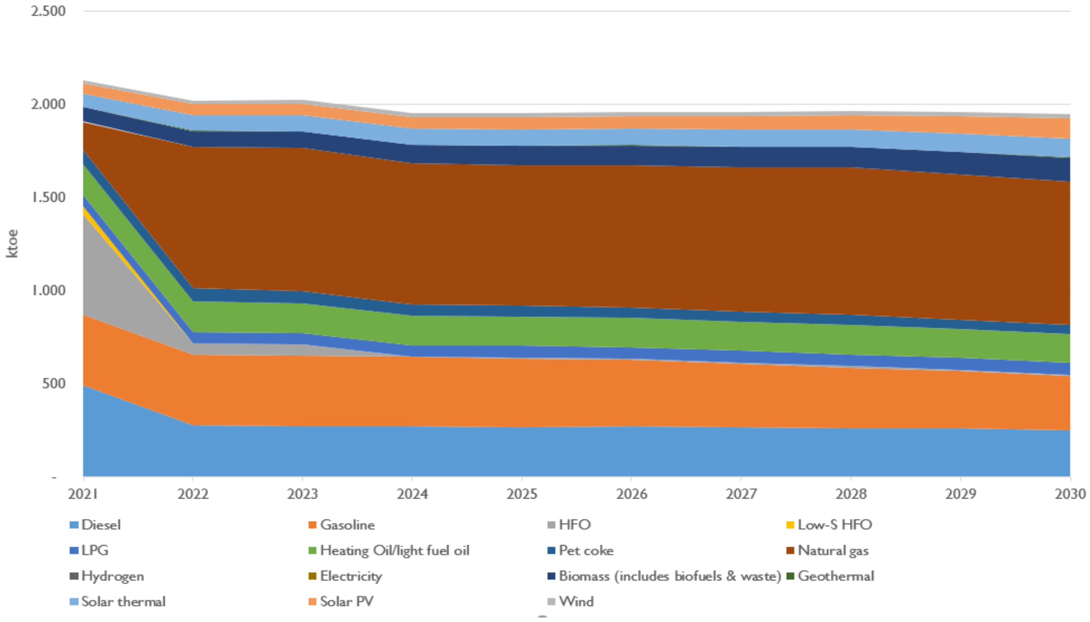

Figure 2.5: **Energy Demand from all Sectors in ktoe, from 2021-2030 in PPM Scenario.**

National strategy for heating and cooling sector

Following Article 14 and the recently revised Annex VIII of the EED, the Comprehensive Assessment (CA) of efficient heating and cooling potential shall be updated by 31 December 2020. It is anticipated that after the update of the CA, a national strategy for energy efficiency in heating and cooling will be set. It will consist of implementation steps and milestones for the shares of renewable energy sources (RES) in heating and cooling sector. This strategy will be included in the first revision of the NECP.

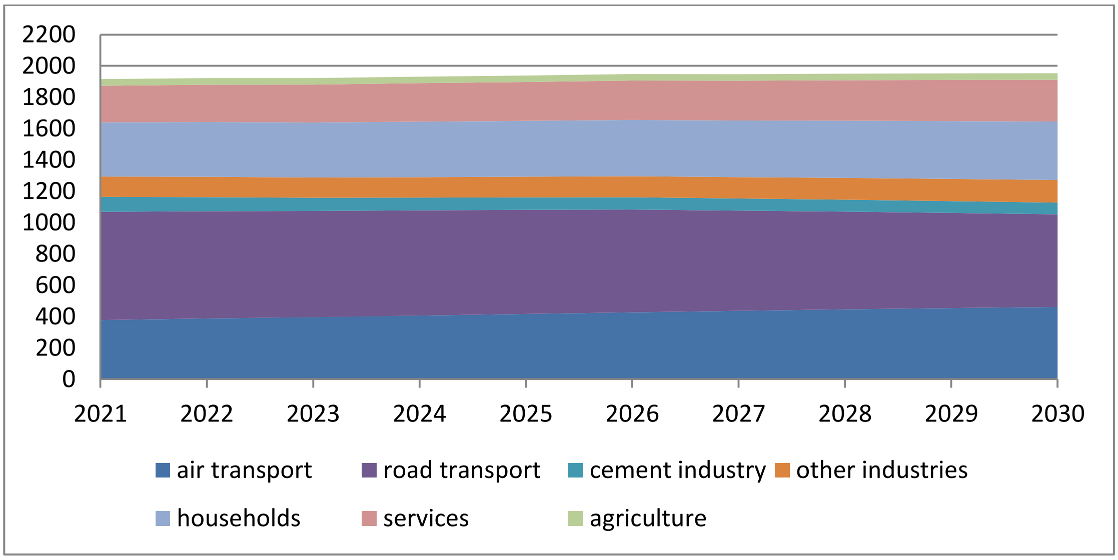

Figure 2.6: **Final Energy Demand in Cyprus, 2021-2030 by sector (ktoe) Scenario with Planned Policies and Measures**

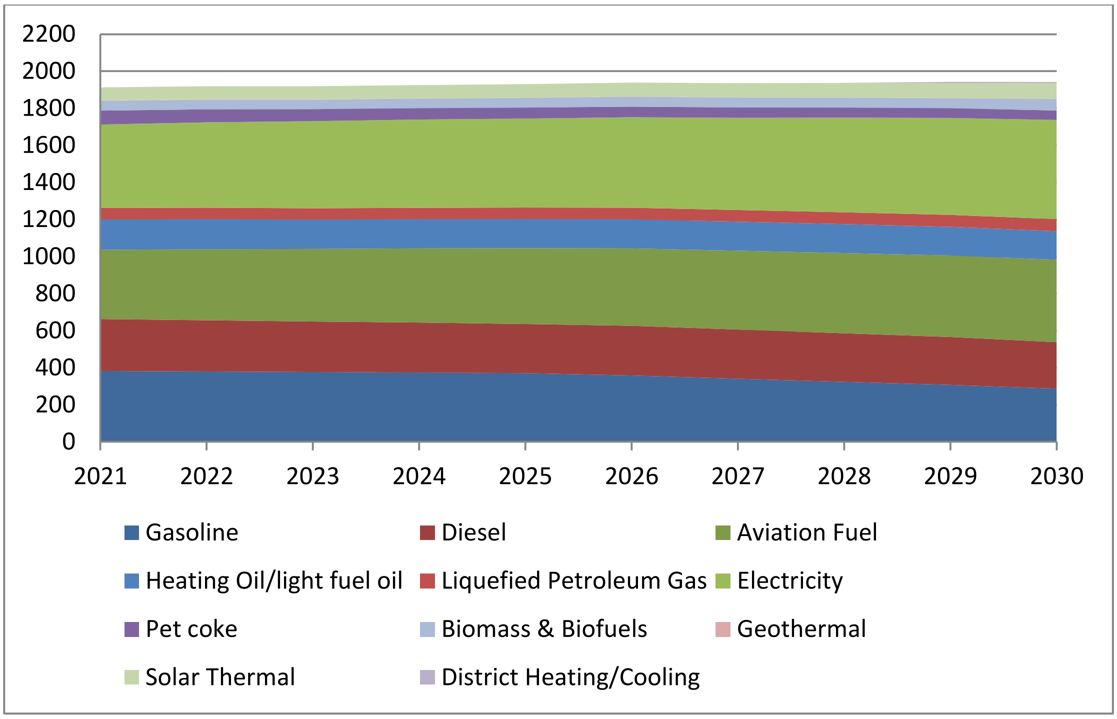

Figure 2.7: Final Energy Demand in Cyprus, 2021-2030 by fuel (ktoe) Scenario with Planned Policies and Measures

In Figure 2.7, the Electricity sector includes all the technologies (RES and Conventional together), while the other fuels are used in other sectors listed in Figure 2.6.

Despite the reduction in primary energy supply, final energy demand is projected to be almost stable. The main driver in this case is increased electricity demand, which in turn is generated by more efficient gas-fired plants and renewable energy technologies. Continued electrification of the heating and cooling sector, as well as the considerable volume of electricity consumed in the transport sector have a significant role in the growth of electricity demand. The contribution of fossil fuels decreases with time. Furthermore, the total contribution of solar thermal in the electricity supply sector and the heating and cooling sector is projected to meet the yearly target for increasing RES in heating and cooling sector from 2021 to 2030, however it will be important to gather more data for heat-pumps and also develop a calculation methodology for renewable cooling.

Useful insights can be provided through a comparison of the final energy demand with the primary energy supply. Even though final energy demand undergoes a moderate increase between 2020 and 2030, primary energy supply illustrates a moderate decrease. This is an indication of improved energy efficiency. Specifically, when final energy demand is measured as a share of primary energy supply, total energy efficiency amounts to 72% in 2020; this value increases to 78% in 2030.

2.1.2.4. iv. Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

The estimated trajectories for bioenergy demand, disaggregated between heat, electricity and transport as estimated with the PPM scenario up to 2030 are presented in Figure 2.8. Currently there is domestic production of biogas and no domestic production of biofuels. It is however foreseen that with the financial support schemes under preparation, local production of biofuels will occur from waste. This quantity however it is currently not possible to be estimated. No forest biomass is used or foreseen to be used in Cyprus; therefore there is no impact on LULUCF sink.

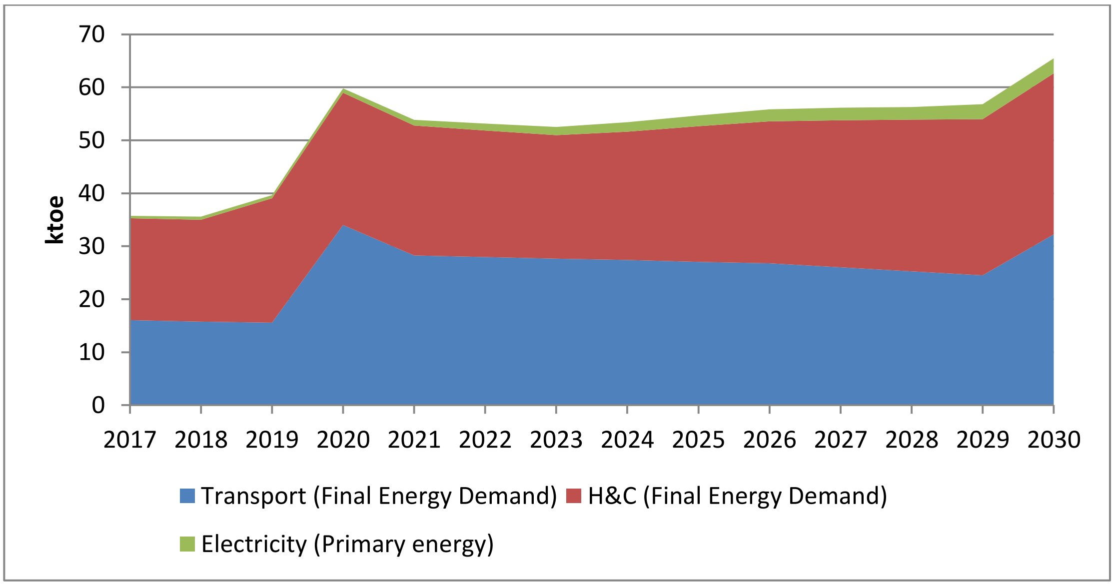

Figure 2.8: Trajectories for bioenergy demand, disaggregated between heat, electricity and transport

2.1.2.5. v. Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

Regarding renewable energy use in buildings, as of 1.1.2017, a new legislation was applied for a minimum percentage of primary energy consumption to be covered by RES, indicating that at least 25% of primary energy consumption to be covered by RES for new single-family homes, 3% for new multi-apartment residential buildings, and 7% for non-residential ones. It is envisaged that the new buildings will be Nearly Zero Energy Buildings (NZEB) by 31st of December and thus implies that all the new buildings will be covered at least by 25% of RES. In practice more of the systems installed over-exceed this capacity since it makes more sense with the existing net-metering scheme to cover almost 100% of Energy needs of each individual household, assuming that there is enough space on the roof to install such system.

Installation of solar water heater for the production of hot water, especially in residential buildings, is very popular and is expected to continue and enhanced in the future by introducing new innovative technologies.

Regarding district heating or cooling several studies where done [26,27], while the studies initially showed that there was a technical potential after the impact assessment results and further analysis performed by another study[28] it was shown that the economic potential does not exist for such systems. Moreover, as it was discussed during the concerted action for RES, it seems that in some regions in other MS, that already have district heating networks, consumers tend to prefer other more efficient options such as the use of heat pumps. This indicates that the economic potential is moving towards the use of heat-pumps and not to district heating and cooling. Hence more actions should be taken regarding the use of more RES in the electrification of heating and cooling sector (e.g. use of PV). This is especially true for Cyprus, where the heating degree days are being reduced, the cooling needs are increased and no waste cooling exists.

More details in section 3.1.2 (vi)

2.2. Dimension energy efficiency

2.2.1. i. The elements set out in point (b) of Article 4

Projections of Primary Energy and Final Energy Consumption

The projections of energy consumption have taken into account:

- The updated energy balances of years 2016 and 2017 as well as the more recent energy balance of year 2018.
- The updated list for additional Policies and Measures after 2021, as presented in paragraph 5 (impact assessment) and in the attached excel file (Appendix 4).
- The latest developments regarding the use of natural gas for power generation. According to the latest government plans, supported by relevant contract preparations, show natural gas penetration happening in the last quarter of year 2021, as described in paragraph 3.3.i (dimension energy security).
- The macroeconomic forecasts of the Ministry of Finance of Cyprus, which were published in September 2018. According to these, a stronger economic growth is foreseen up to 2030. For example, GDP in year 2020 is expected to reach €21.7bn (at 2010 prices), whereas the macroeconomic forecast that was used in 2017 reported a GDP of €20,2bn (at 2010 prices) in 2020.

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[26] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/52DA7EEECDF7D532C225828D00203A1B?OpenDocument

[27] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/RDF-District%20H-C.pdf

[28] http://www.mcit.gov.cy/mcit/energyse.nsf/page27_gr/page27_gr?OpenDocument

- The Euro - US dollar exchange rate assumed by the European Commission. The figures below display the projected evolution of final energy and electricity demand according to the two scenarios (With existing measures and with PPM without interconnector, as presented in paragraph 5 (impact assessment). Policies adopted in the Scenario with PPM can help accelerate improvements in energy intensity and thus essentially stabilize total final energy demand after 2025. Electricity demand, however, is still projected to increase in absolute levels (although it declines per unit of GDP) because the further electrification of the economy, including the introduction of electric cars, counterbalances energy efficiency improvements.

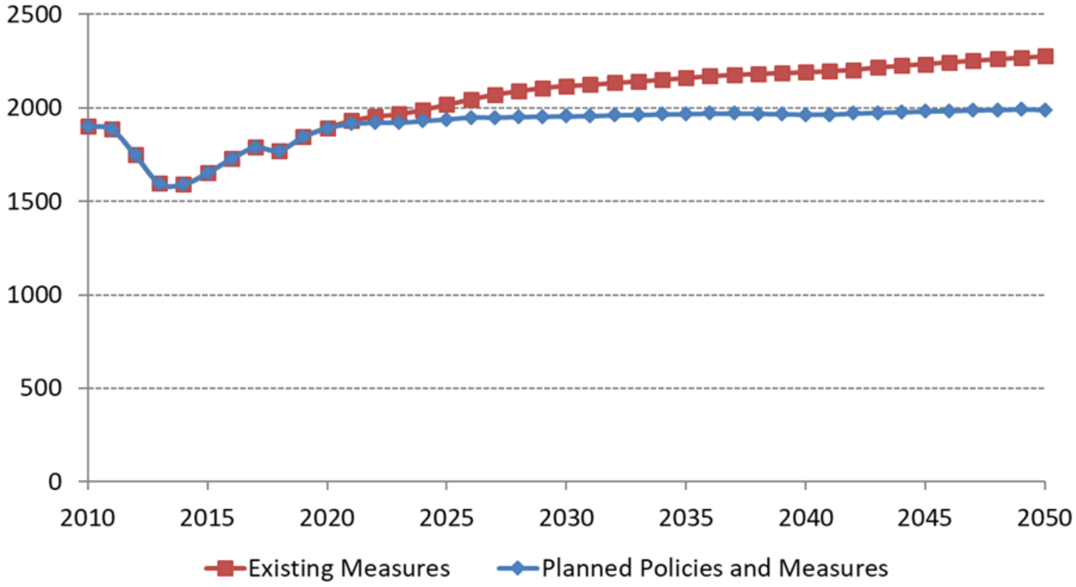

Figure 2.9: Forecast of final demand in Cyprus (ktoe)

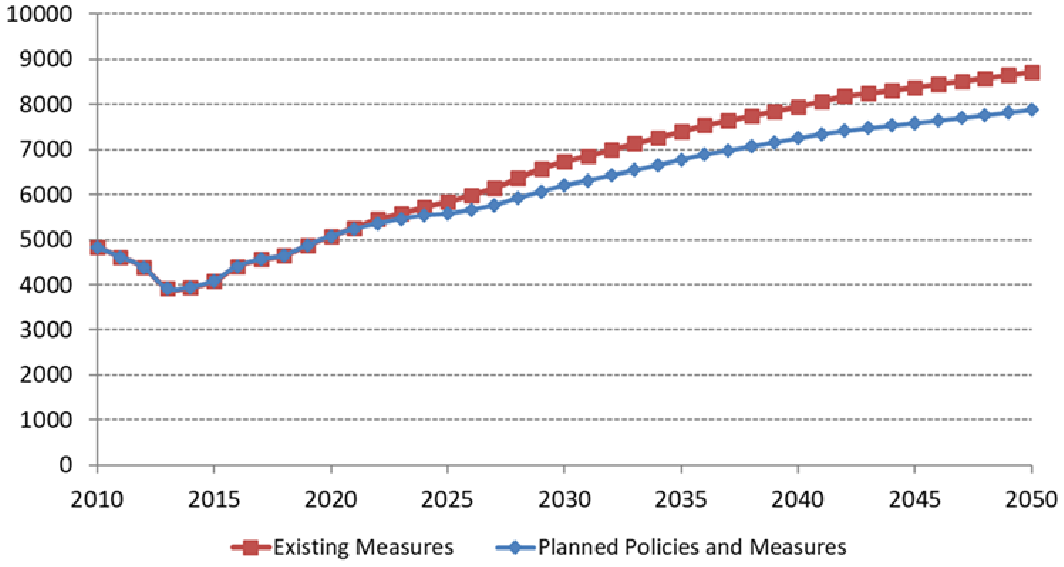

Figure 2.10: Forecast of final electricity demand in Cyprus (million kWh)

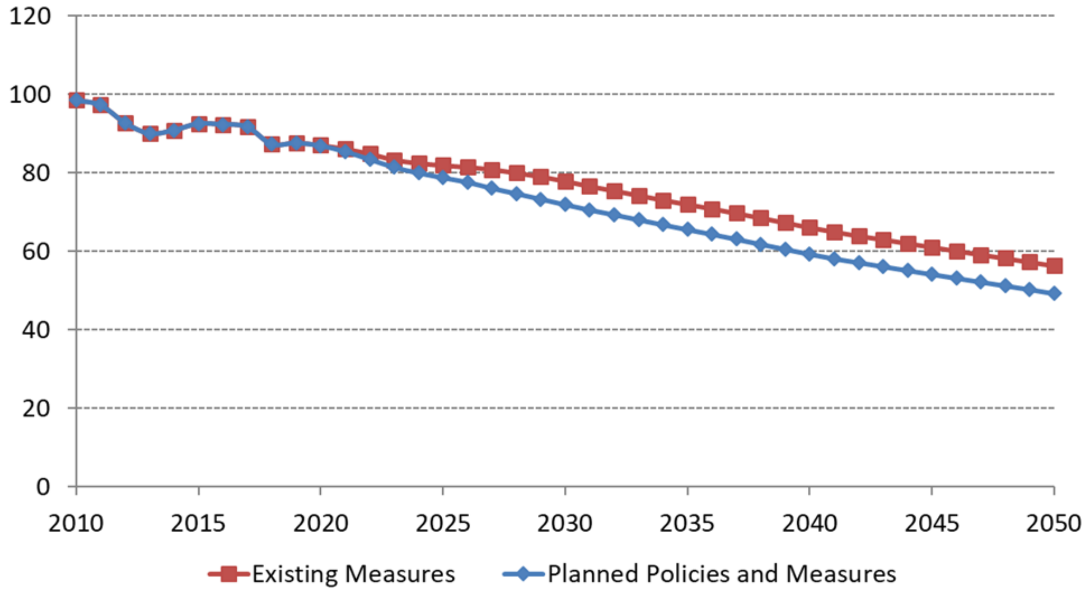

Figure 2.11: Forecast of final energy intensity in Cyprus (toe/MEuro'2010)

The updated outlook of primary energy demand in Cyprus combines the final energy demand projections with projections for the power generation sector which were conducted in the frame of Technical Assistance[29] studies that were performed for MECI in 2019. Most of these forecasts have been performed with the OSeMOSYS energy systems model, as described in more detail in the Impact Assessment chapter.

To calculate the demand for primary energy in power generation, the efficiency parameters of the power generation system presented in Table 2.7 that are based on the technical specifications of the existing and future power plants in Cyprus, were used.

Table 2.7: Key parameters of power generation according to forecasts with the OSeMOSYS optimization model.

	Average efficiency of all power generation	Thermal efficiency of power plants		
	Scenario with Planned Policies and Measures (natural gas end of 2021)	Steam turbine plants using fuel oil (average)	CCGT plant using diesel oil	CCGT plant using Natural Gas
2018	38.8%	39.0%	48.2%	--
2019	39.5%	38.3%	48.2%	--
2020	41.2%	38.1%	48.2%	--
2021	47.4%	38.1%	48.2%	51.5%
2022	53.3%	--	--	51.5%
2023	53.3%	--	--	51.5%
2024	55.3%	--	--	51.5%
2025	55.4%	--	--	51.5%
2026	55.3%	--	--	51.5%

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[29] Technical Support on Long-Term Energy Modelling (available at http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/JRC LTEM Final Workshop - CyI results.pdf)

2027	55.3%	--	--	51.5%
2028	55.3%	--	--	51.5%
2029	55.9%	--	--	51.5%
2030	56.6%	--	--	51.5%
2031	57.3%	---	---	51.5%
2032	59.3%	---	---	51.5%
2033	62.1%	---	---	51.5%
2034	62.5%	---	---	51.5%
2035	62.7%	---	---	51.5%
2036	63.1%	---	---	51.5%
2037	63.6%	---	---	51.5%
2038	65.9%	---	---	51.5%
2039	73.8%	---	---	51.5%
2040	73.3%	---	---	51.5%

In the PPM scenario the projections for primary energy consumption of Cyprus for 2020 and 2030 are both lower than the respective projections for Cyprus in the 2007 EU Reference Scenario[30] (the projection for Cyprus in PRIMES 2007 EU Reference Scenario was 2.8 Mtoe for 2020 and 2.9 Mtoe for 2030). It can be concluded that the forecast for national primary energy consumption of no more than 2.4 Mtoe in 2030 is lower by about 17%, than the respective projection for primary energy consumption in 2030 that was projected in the PRIMES 2007 Reference Scenario.

The same applies for the final energy consumption, where in PRIMES 2007 EU Reference Scenario the projection was 2.3 Mtoe in 2030, whilst the respective projection in the PPM Scenario, is 2 Mtoe for 2030. It can be concluded that the forecast for national final energy consumption no more than 2 Mtoe in 2030 is lower of about 13% than respective projection for Cyprus final energy consumption in 2030 that was projected in the EU PRIMES 2007 Reference Scenario.

The aforementioned assessment is in line with the methodology in the framework of the amendment of the Energy Efficiency Directive, in order to calculate the EU Energy Efficiency target of 32.5% for 2030. Therefore, using the same approach, Cyprus sets its indicative contribution to the EU 2030 energy efficiency target as:

- 17% reduction in primary energy consumption, compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario and
- 13% reduction in final energy consumption, compared to the respective projection for Cyprus in the 2007 in the EU PRIMES 2007 Reference Scenario.

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[30] https://ec.europa.eu/energy/sites/ener/files/documents/trends_to_2030_update_2007.pdf

Compared to the EU-wide target of 1,273 Mtoe of primary energy consumption in year 2030, Cyprus (under PPM Scenario) is expected to account for 0.21% to the EU wide target for primary energy consumption in 2030, which is higher than its current annual contribution of the EU primary energy consumption.

Table 2.8: Trajectory of primary energy consumption and final energy consumption (Mtoe) with PPM Scenario, 2021-2040

	Primary energy consumption (Mtoe)
2021	2.5
2022	2.4
2023	2.4
2024	2.3
2025	2.3
2026	2.3
2027	2.3
2028	2.4
2029	2.4
2030	2.4
2035	2.3
2040	2.2

Cyprus, taking into account the Commission Recommendation of 18.6.2019 (recommendation number 3 on energy efficiency) and in view of the need to increase the level of efforts to reach the Union's 2030 energy efficiency target, increases its ambition towards reducing both final and primary energy consumption in 2030 (indicative contribution to the EU 2030 energy efficiency), as shown in the table below.

Table 2.9: Comparison of final and primary energy between draft NECP and final NECP

Projections for 2030	Draft NECP	Final NECP	Increase in the level of ambition (reduction %)
Primary Energy Consumption	2.6	2.4	7.7%
Final Energy Consumption	2.2	2.0	9.1%

Moreover, Cyprus has carried out complete projections and scenarios to allow assessing the expected impacts of the new planned policies, measures and programmes on primary and final energy consumption for each sector, at least until 2040, including an indicative trajectory from 2021 onwards. The results are shown Table 2.10.

The split between road and air transport is presented in Table 2.11.

Table 2.10: Sectoral energy demand forecasts in years 2021-2040 - with planned Policies and Measures

Sectoral projections (Mtoe)	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Primary Energy Consumption	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.2	2.2
Total final energy consumption	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2	2	2	2	2	2	2	2	2	2	2	2	2
Final energy consumption – industry	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
Final energy consumption - households	0.3	0.3	0.3	0.3	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	0.4	0.4
Final energy consumption - agriculture	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Final energy consumption – transport	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1	1	1	1	1	1	1
Final energy consumption - services	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table 2.11: Sectoral energy projections in transport sector for 2021-2040 - with planned Policies and Measures

Final energy consumption (Mtoe)	Road Transport	Air Transport
2021	0.7	0.4
2022	0.7	0.4
2023	0.7	0.4
2024	0.7	0.4
2025	0.7	0.4
2026	0.7	0.4
2027	0.7	0.4
2028	0.6	0.5
2029	0.6	0.5
2030	0.6	0.5
2031	0.6	0,5
2032	0.5	0.5
2033	0.5	0.5
2034	0.5	0.5
2035	0.5	0.5
2036	0.5	0.5
2037	0.5	0.5
2038	0.5	0.5
2039	0.5	0.5
2040	0.5	0.5

Under the PPM, Cyprus strengthened the focus on energy efficiency in the transport sector by increasing the span of measures related to this specific sector, considering that it would represent half of the energy consumed in the country in 2030. The list of measures in the transport sector are presented in Chapter 5 (impact assessment) and in paragraph 2.2 v below.

National indicative contributions for primary energy and final energy consumption in 2020

Based on the National Energy Efficiency Action Plan of 2017 (4th NEEAP 2017), Cyprus′ national indicative target for energy efficiency was expressed in primary energy consumption of 2.2 Mtoe in 2020.

However, based on the latest modelling results, the anticipated level of national primary energy consumption in 2020 is estimated to be about 2.5 Mtoe.

More specifically, compared to the previous projections used in 4th NEEAP 2017, the latest projections of energy consumption have taken into account the following:

- The updated macroeconomic forecasts of the Ministry of Finance, which were published in September 2018. According to these, a stronger economic growth is foreseen up to 2030. For example, GDP in year 2020 is expected to reach € 21.7 bn (at 2010 prices) whereas the macroeconomic forecast that was used in 2017 reported a GDP of € 20,2bn (at 2010 prices) in 2020.
- The latest developments regarding the use of natural gas for power generation plants. According to the 4th NEEAP 2017, this was expected to happen by the end of 2018,

whereas current government plans, supported by relevant contract preparations, show natural gas penetration happening in the last quarter of year 2021.

As stated in the 4th NEEAP 2017, a major reduction in primary energy consumption will be achieved through the switch from oil to natural gas in the power generation sector, which was planned to enter into the national energy mix by the end of 2018, and thus contribute to achieving the projected indicative level of 2.2 Mtoe. However, given that the aforementioned changes and latest developments show that natural gas penetration would happen in the last quarter of year 2021, the primary energy consumption for power generation in 2020 is now projected to reach 0.94 Mtoe, compared with 0.7 Mtoe in the 4th NEEAP 2017.

This explains why the anticipated level of primary energy consumption in 2020 will increase to about 2.5 Mtoe instead of 2.2 Mtoe. It should be noted that, taking into account the measures implemented in order to reduce end-use energy consumption by 2020 and based on the latest modelling results, the national projection included in the 4th NEEAP 2017 for indicative absolute level of final energy consumption of 1.9 Mtoe in 2020, can be achieved.

Methodology and conversion factors used

The methodology to forecast final energy demand is based on a simplified energy model that was developed at the National Technical University of Athens and used by Cyprus University of Technology (CUT). The model calculates future annual energy consumption in each major economic sector of Cyprus (agriculture, cement industry, other industry, households, services, road passenger transport, road freight transport and air transport) as a function of future macroeconomic variables and energy prices. It also calculates fuel shares in each sector, depending on technology costs (investment, operation, maintenance and fuel costs), the penetration potential of various technologies and technical constraints for the uptake of new technologies, and allows for computing of future final energy consumption by sector and fuel. Chapter IV of the study for Energy Efficiency Potential in Cyprus[31] describes the mathematical formulation for calculating aggregate energy demand by sector. Final energy demand was then converted to primary energy demand taking into account the conversion table of Annex IV of 2012/27/EE apart for electricity demand where the efficiency coefficients of Table 2.7 were used.

Energy Efficiency First Principle

The “Energy Efficiency First Principle” has been considered in the preparation of the final NECP by giving priority to policies and measures that improve the efficiency of the energy system and by taking into account that other decarbonisation measures can be considered only after energy efficiency actions are deemed unfeasible or very costly.

The PPM scenario is in line with the Energy Efficiency First Principle, for the following reasons:

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[31] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B5969066F97FB710C22581D80035DB7F/$file/Study%20results-%20Developing%20a%20national%20Energy%20Efficiency%20Strategy%20up%20to%202050.pdf

- The measures of the PPM scenario are sufficient to comply with the energy efficiency obligations of the country as required in Article 7 of the Energy Efficiency Directive; this means that the appropriate measures have been taken into account.
- As a result of energy efficiency measures, the energy supply of Cyprus will be lower in comparison to that of the WEM scenario. This means that energy efficiency has indeed been given priority in comparison, for example, to stronger deployment of renewable energy.
- All cost-effective policies and measures that are related to energy efficiency have been included in the PPM scenario. As is being shown in the impact assessment, all these measures have a negative or near-zero total lifetime cost and are therefore cost-effective. Further, energy efficiency measures are not recommended to be deployed because they have a very high cost per tonne of carbon abated (e.g. the renovation of very old buildings to become nearly-zero energy buildings), or are considered to be unrealistic (e.g. an increase in the number of energy renovations of buildings up to 2030, which would reach unprecedented levels of refurbishments that would require very high financial and human resources to realize).
- It is particularly important to note that the PPM scenario foresees energy efficiency measures in transport (modal shift towards public and non-motorized transport and electrification of cars) which involve very significant investments, at substantial levels for the size of the Cypriot economy. This underlines how strongly the Energy Efficiency First principle has been taken into account.
- Apart from the cost-effectiveness argument mentioned above, further prioritizing demand-side measures such as energy efficiency improvements, and would put Cyprus at risk of not meeting two main Energy Union objectives which are related to energy supply: the renewable energy target and the reduction in emissions of ETS sectors – which in the case of Cyprus is predominantly power generation. Therefore, measures in the electricity supply that have been foreseen in the PPM scenario are indeed those which are absolutely necessary for Cyprus to meet the above-mentioned commitments.
- As a result of the above considerations, energy efficiency measures in all end uses of the Cypriot economy, as foreseen in the PPM scenario and to the extent that they will be fully deployed, can greatly improve the security of energy supply of the country.
- The only further policy that is worth examining is the implementation of a green tax reform that would involve carbon pricing in non-ETS sectors of the Cypriot economy. Such a reform can indeed stimulate further improvements in energy efficiency and substitution of liquid fossil fuels by low- or zero-carbon energy forms. In September 2019 the Finance Minister announced that a green tax reform will be put in consultation in 2020 with the aim to adopting the relevant legal framework and implementing such a reform in 2021. However, considerations for the adoption of such a reform were still at an early stage by the time of finalising this report, so that it could not be considered as part of the government's Planned Policies and Measures. Decisions on green tax reform will be presented in the next NECP update.

Projects and Developments that could potentially increase energy consumption by 2030

The government is working towards the realization of its exploration program in the Exclusive Economic Zone of the Republic of Cyprus. The below projects, in case one or both are implemented, could potentially increase the primary and/or final energy consumption during the period 2020 – 2030:

- Production from the Aphrodite Field (Information presented is according to the approved Development Plan): Cyprus expects initial natural gas production from the Aphrodite field to begin in 2025. The field is estimated to produce 10 MMscfd (million standard cubic feet per day) for 18 years. There is no information on energy needs for the construction phase (2022 – 2025).
- Vasilikos Liquefied Natural Gas (LNG) Plant (Information regarding the energy needs are according to a 2013 pre-FEED study): At present, there are no sufficient quantities of natural gas to support the supply of an LNG Plant. However, exploration activities are ongoing and in case more gas discoveries are discovered, the LNG Plant may go forward. If the LNG Plant is decided to be materialised, it is not expected to commence operations before 2025. It is further expected that the LNG terminal would require a dedicated generation unit of approximately 200 MW.

As a result, it is estimated that if an LNG plant operates in Cyprus, an increase of at least 10-15% will occur in the projected national primary and final energy consumption by 2030. This will have a negative effect on achieving the national indicative targets for energy efficiency in 2030. Given the aforementioned uncertainties on its implementation and the quantities produced, currently an LNG plant cannot be incorporated in the national scenario with planned polices and measures.

Cumulative amount of energy savings to be achieved over the period 2021-2030 under Article 7 on energy saving obligations of Directive 2012/27/EU

The cumulative target of the period 2021-2030 is estimated to be 243.04 ktoe. Given that no official data from Eurostat is available for the national final energy consumption of the year 2018, the national cumulative target of the period 2021-2030 will be recalculated and submitted to the Commission in the update of the NECP by 30 June 2023, pursuant to Article 14(1) of the Regulation. More information on data and the methodology used to calculate the target is given in paragraph 3.2.i.

2.2.2. ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contributions to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2a of Directive 2010/31/EU

The household sector accounts for 19% of the final energy consumption, while another 13% of final energy consumption is due to commerce, hotels and services. The building stock comprises of 431,059 residential buildings and more than 30,000 non-residential buildings. Of the residential buildings almost half are single-family houses and 22% apartments. The majority of dwellings (67%) are occupied by their owners and a large part (78%) is located in the coastal and low land areas. The building sector is expected to play a key part in the achievement of the national targets for 2020 covering almost 98% of the energy saving target. The potential is huge since 91% of all buildings (94% of residential buildings 83% in the service sector) were built before the introduction of mandatory energy performance requirements and 50% do not have any kind of thermal insulation.

The GIZ study "An Energy Efficiency Strategy for Cyprus up to 2020, 2030 and 2050"[32] provides an estimate of the building's sector energy saving potential. Based on the study, the following tables provides the "theoretical" and the "economically viable" energy savings that could be achieved in the building sector.

Table 2.12: Maximum "theoretical" and the "economically viable" energy saving potential in the housing sector

		Maximum "theoretical" potential		**Economically viable potential**	
	Current consumption (ktoe)	Future consumption (ktoe)	Savings	Future consumption (ktoe)	Savings
Heating	123	32	73.7%	114	7.2%
Cooling	42	8	80.3%	38	9.9%
DHW	68	68	0%	68	0%
Lighting & Appliances	63	34	55%	60	3.9%
Total	**299**	**145**	**51.3%**	**283**	**5.2%**

It has to be noted that regarding Domestic Hot Water (DHW) the final energy consumption appears in both scenarios unchanged, because already large part of it is covered by solar thermal. However, on conventional fuels the "theoretical" and the "economically viable" scenario result in 75% and 18.9% energy savings respectively.

Table 2.13: Maximum "theoretical" and the "economically viable" energy saving potential in the service sector

		Maximum "theoretical" potential		**Economically viable potential**	
	Current consumption (ktoe)	Consumption (ktoe)	Savings	Consumption (ktoe)	Savings
Electricity	149	39	73%	137	8.4%
Gas oil	27	0	100%	25	6%
LPG	12,9	25	-115%	12.1	6%
Kerosene	2	0	100%	2	0%
LFO	0,1	0	100%	0.1	0%
Biomass	4.9	1.9	60%	4.8	0%
Total	**192**	**68**	**64.7%**	**183**	**6%**
Solar & Recovery	10.3	14	-35.1%	13.1	-29.3%

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[32] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B5969066F97FB710C22581D80035DB7F/$file/Study%20results-%20Developing%20a%20national%20Energy%20Efficiency%20Strategy%20up%20to%202050.pdf

In respect to the household sector, taking into account indicative nominal savings per investment and their cost and a mean mix of single interventions along with deep renovations, it results that on average around 33.000 dwellings, assuming that only 1 out of the 6 affected dwellings will undergo a deep renovation, can be expected to be renovated under the realistic scenario. This would include all different building typologies: single-family house up to multi-family blocks of flats. This housing stock that undergoes a kind of energy efficiency upgrade and improvement, after considering some market related characteristics and stakeholder's opinion, could be indicatively allocated per construction period as follows:

a) 4% renovation of the building stock constructed before 1970 (1.635 dwellings)
b) 9% renovation of the building stock constructed during 1971-1990 (10.250 dwellings)
c) 20% renovation of the building stock constructed during 1991-2007 (21.200 dwellings)
d) 1% renovation of the building stock constructed from 2008 up to now (315 dwellings)

However, the optimum cost-efficient distribution of interventions will result in a possible range of affected households between 43,000 and 79,000, with a most likely number in the range of around 63,000 households that could proceed to a mix of energy interventions until 2030. On an annual basis this translates to an average number of close to 5.000 households that could be energy upgraded. Around 25% of these are expected to proceed only to renovation and substitution of their lighting equipment/electronic appliances to the most energy-efficient ones and/or to the installation of solar thermal systems.

Nevertheless, with this distribution of energy efficient interventions and having a threshold for the cumulative total budget until 2030, on average around 3,700 households could be targeted annually for significant energy interventions, a figure that is also representing around 1% of the existing number of households. Considering the service sector, the total number of affected buildings is estimated to be around 10,000 until 2030, resulting to an average annual number of approximately 800 buildings for which some kind of intervention could be foreseen. Similarly, around 30-40% of this annual number is expected to proceed only to the least expensive intervention with the shortest payback period and around 400 buildings annually are considered that will implement a more comprehensive type of interventions and/or one involving higher investment cost.

The Long-term Renovation Strategy (LTRS) which was initially formulated in 2014 and revised in 2017 contains existing policies and measures in the building sector, as well as projections for the building stock up to 2030. The LTRS examines how possible adjustments in regulatory measures and incentives in renovation could reduce even further energy consumption of buildings by 2030.

LTRS will be revised for a second time by April 2020, according to the requirements set by Directive 2018/844/EU, which among other things requires measurable progress indicators to be set according to the energy efficiency targets set by Directive 2012/27/EU and with a view to the long-term 2050 goal of reducing greenhouse gas emissions.

The PPM, which adopts the abovementioned assumptions considering expenditure in building renovation, is expected to lead in reduction of energy consumption in the housing and tertiary sector, compared to the WEM scenario. The indicative milestones in the building sector for 2030, 2040 and 2050 will not to exceed the final energy demand, as it is estimated for the sector in the PPM scenario.

Table 2.14: Indicative milestones in the building sector for 2030, 2040 and 2050

Year	Final energy demand (ktoe)			Savings in final energy demand compared with the WEM scenario (ktoe)
	Total	Household sector	Service sector	
2030	640	373	266	56
2040	650	373	277	112
2050	640	361	279	163

The following graph provides, for each scenario, an estimate of the consumption for the building stock up to 2050.

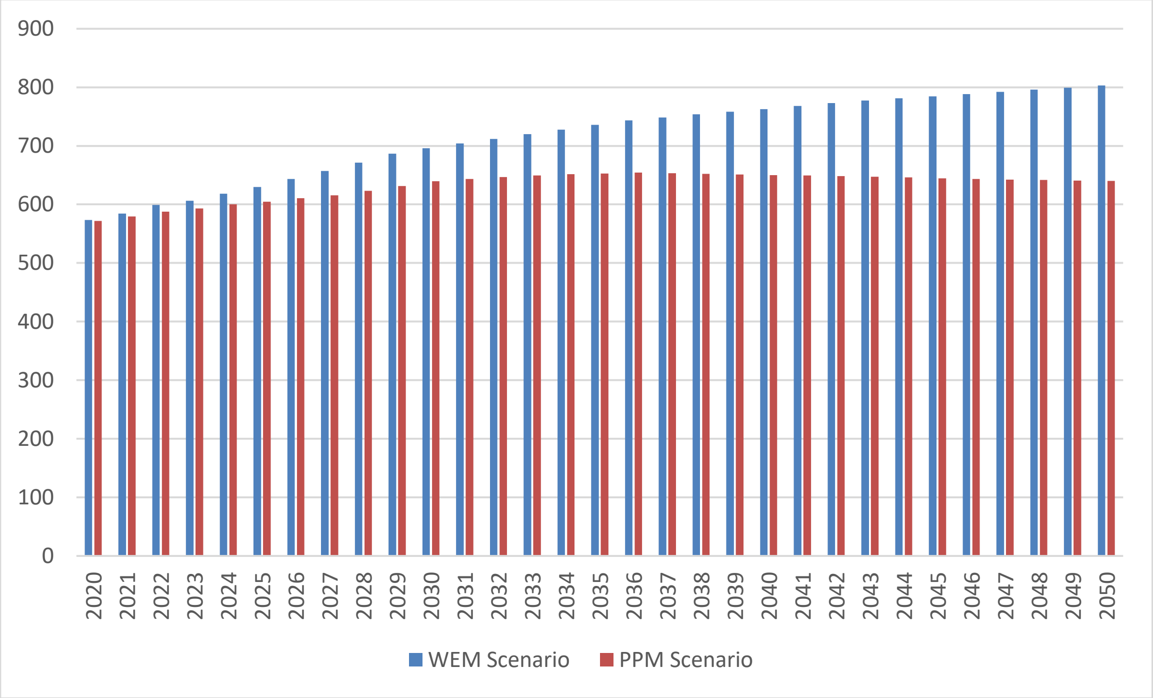

Figure 2.12: Estimated building sector energy consumption comparing WEM and PPM scenarios

The renovation of the existing building stock is promoted with various regulatory measures, incentives, voluntary agreements training and information activities. These are described in paragraph 1.2.ii. The list includes policies and measures which they don't target the building sector implicitly, but it is expected that buildings will be largely affected by their implementation.

The planned polices and measures are described on paragraph 3.2.i. Further policies and measures might be examined in the view of achieving the carbon emission goal for 2030, and the vision for decarbonizing the building stock by 2050. The following policies and measures will be examined up to next revision of NECP:

- Enhancement of the Energy Performance Certificates (EPC) in the real estate market. This will require a revision of the existing legislative framework considering the sale and rent of buildings, the connection of EPC with financial incentives, and how EPC can be connected with tax policies.

- Further engagement of local authorities in building renovation. Local authorities have a dual role in building renovation. As building permit authorities, they have a responsibility for the implementation of minimum energy performance requirements. This seems harder to be overseen in existing buildings as renovation might not be declared in the local authority by the owner or the local authority personnel lacks capacity. On the other hand, local communities are using buildings for their administrative needs that are usually of poor energy performance. It should be examined how synergies with the Convent of Mayors should be utilized, how buildings of local authority could serve as "light house" projects, and how training of the local authorities' personnel will improve the implementation of minimum requirements in renovation.

The implementation of the above-mentioned will depend on their technical and financial feasibility and their estimated contribution in national goals in energy and climate. Stakeholders' engagement will be an integrated part of forming these policies.

National objectives for buildings owned and used by central government authorities

The Cabinet of Ministers by its decision on the 14th of April 2016 has established the Committee for the Improvement of the Energy Performance of Central Government Buildings. The committee consists of representatives of the MECI, the Department of Public Works, the Department of Electromechanical Services, and the Control Department of the Ministry of Transport. It is tasked with planning the implementation of energy saving measures on the basis of technical data and available financial resources, as the main task of the committee is to fulfil the obligation of article 5 of Directive 2012/27/EU.

Article 5 of Directive 2012/27/EU that Member States should either renovate annually 3% of the total area of buildings owned and used by central government authorities or choose an alternative approach including other cost-effective energy-saving measures in selected privately-owned public buildings (including, but not limited to, deep renovations and measures to change the behaviour of users), in order to achieve by 2020 an equivalent amount of energy savings.

Since the alternative approach gives more flexibility in implementing cost-effective energy saving measures as appropriate, Cyprus has chosen this alternative approach. It has been estimated that annual energy savings of 3.31 GWh or 0.285 ktoe have to be achieved for the period 2014–2020. The annual obligation was calculated assuming that 3% of the public building stock will be renovated from energy class E to energy class B. The primary energy consumption before and after renovation is assumed to be the one calculated for the typical building, as this is set in the cost–optimum calculation of minimum energy performance requirements (see paragraph 4.iv). A report has been submitted to European Commission which lists and quantifies the measures that will be taken.

The same approach will be followed for the period 2021 – 2030, though the annual energy saving obligation that has been recalculated based on the modifications of public building stock. These are:

1. Renovation to at least energy class B: 3 office buildings have undergone major renovation, while one more is expected to be completed by the year 2020.

2. New buildings as replacements for specific central government: 2 new office buildings have been built as replacements of existing buildings.

It has to be noted that central government authorities building stock has been reduced in comparison with the calculation done for the 2014 – 2020 period. This is due to the recently established National Health System which has formed the State Health Services Organization (SHSO). Hospitals, health centres and other buildings related to medical services have been transferred from the Ministry of Health to SHSO. As SHSO in an independent body, these buildings have been removed from the central government building stock. The following table shows the building stock of central government, the total floor area and the energy savings that could be achieved if 3% was renovated per year. The new annual energy saving obligation for the period 2021 – 2030 is 1.31 GWh or 0.11 ktoe. It has to be noted that the proposed minimum energy performance requirements will require minimum energy class B+ for major renovation of non-residential buildings. This will slightly increase the annual target.

Table 2.15: Buildings owned and used by central government – estimated savings to achieve the target of article 5

Building type	Number of buildings	Primary Energy before renovation (kWh / m^2 year)	Primary Energy (kWh / m^2 year) after renovating to energy class B (kWh / m^2 year)	Total floor area (m^2)	Estimated energy savings (GWh)
Office	93	332	177	210,042	32.55
Education and training	17	96	50	52,200	2.4
Other types of building	41	332	177	57,369	8.89
Total	**151**			**318,831**	**43.85**
Annual energy savings that have to be achieved to equal 3% renovation rate					**1.31**

Table 2.16: Buildings owned and used by central government– estimated savings to renovate all public building to NZEB

Building type	Number of buildings	Primary Energy before renovation (kWh / m^2 year)	Primary Energy (kWh / m^2 year) after renovating to energy NZEB (kWh / m^2 year)	Total floor area (m^2)	Estimated energy savings (GWh)
Office	93	332	71	210.042	54,32
Education and training	17	96	24	52.200	3,76
Other types of building	41	332	71	57.369	14,97
Total	**151**			**318.831**	**73,55**
Annual energy savings that could be achieved if 3% is renovated every year to NZEB					**2,2**

The obligation for the period 2021 – 2030 is scheduled to be fulfilled mainly with the following measures:

1. Deep renovations: Proposal to secure funds from European Cohesion and Development Funds, for the period 2021 – 2027
2. Individual target measures: Measures identified as cost optimum as well as measures combined with maintenance works will be undertaken by the Department of Public Works and the Department of Electromechanical Services mainly funded by national funds.
3. Behavioural measures: The Energy Saving Officer appointed in every public building is entitled to record energy consumption and promote energy efficiency mainly with soft measures. He/she plays a central role in change occupants' habits towards a more rationale use of energy.

More information about the measures is given in paragraph 3.2.i.

Moreover, according to article 6 of Directive 2012/27/EU, the central government is obliged to buy and rent only buildings that at least comply with the minimum energy efficiency requirements. The Ministry of Finance has recently made a call to buy buildings that will substitute rented buildings currently housing central government authorities. It expected that this measure will change the situation where central government is a tenant in many buildings of poor energy performance.

2.2.3. iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

National strategy for energy efficiency in transport sector

Cyprus΄ national planning for increasing the energy efficiency in the transport sector by 2030 will be achieved by continuing the measures and policies that have already being implemented/adopted by the end of 2019 and by planning additional actions to be implemented in the immediate future. This strategy will be implemented in steps, as follows:

STEP -1 –Policies and measures for the period up to 2023:

1) 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 (Law 47(I)/2019).
2) 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 that was announced in late 2019. This scheme will have a total cost of €3m and will come into force in 2020.
3) The Integrated Fleet Management System (Central Government vehicles) includes the installation of an Integrated Fleet Management System by the Department of Electrical

and Mechanical Services, on approximately 1.800 government owned vehicles. The system was installed in 2017 and its total cost was €1,7m.

4) New bus concessions are planned to be put in force in 2020 and will further improve the public transportation system. The increase of the use of buses that have low or zero GHG emissions will be implemented by reducing the average age of the public bus fleet from 17 years which is now, to 10 years for the contract period 2020-2030. Furthermore, the new bus contracts include specific requirements for the use of electric buses and provision for conversion of operator's bus fleet to use Compressed Natural Gas (CNG), when such fuel source is available in Cyprus and the prerequisites for doing so exist.
5) The Ministry of Transport, Communications and Works has installed a telematic system that manages the bus services and records data for further optimization of the public transport system. 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. The action was completed in 2018 and its cost was approximately €7m, including maintenance for 5 years.
6) 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). The Limassol SUMP was completed in June 2019 and the Larnaca SUMP is expected to be completed in March 2020. Furthermore, the remaining cities in Cyprus are planning to start preparing their own SUMPs within 2020.
7) SUMPs 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. The modal share of cars in Cyprus is currently over 90% and based on the plans and studies that have already been completed; a modal share of 75% car, 13% public transport, 12% walking/ cycling can be achieved and is set as a national target.

Based on the plans and studies (including the Limassol SUMP final report[33]) that have already been completed, the cost of implementing this action is estimated at €1,4bn. and includes both capital and operational costs for the period 2020-2030. It is worth noting that part of this cost is already included in the annual budget of the relevant authorities, while some of this cost can also be sourced from European, as well as, private funding

Other measures include the financing Scheme for promoting energy audits in SMEs, which promotes energy audits in the transport sector, the obligation Scheme for imposing energy efficiency obligations to distributors of motor fuel, as well as the continuation of current fuel tax levels.

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[33] http://www.mcw.gov.cy/mcw/PWD/pwd.nsf/All/E6D9FA846477D5B9C225844100229DB3 ?OpenDocument

STEP 2 –Policies and measures with effect after 2023

1) Most of the measures indicated in Step 1 will continue implementation after 2023.SUMPs will increase implementation after 2023.
2) The promotion of the purchase and use of vehicles with low or zero emission takes into consideration the harmonisation and implementation of European Directives (e.g. Cleans Vehicle Directive) for the purchase of new vehicles both for the private and public sector. Based on these parameters, the impact assessment has estimated that approximately 11% of the passenger car fleet could be electric and 9% could be hybrid until 2030.

   In addition to the results of the impact assessment (Chapter 5), this action also includes further incentives for the purchase and use of low/zero emission vehicles including additional old vehicle scrapping schemes, further financial incentives for the purchase of electric vehicles and further amendment of the Motor Vehicles and Road Traffic Law (Law 100(I)/2013) for revision of the vehicle taxes and annual circulation taxes. Based on these additional measures, the target for the penetration of electric vehicles is set at 20% as a proportion of the total vehicle fleet. The emission reduction impact of this higher target is not included in the latest impact assessment and its cost is based on the current old vehicle scraping scheme/ financial incentives but proposed to be implemented on an annual basis with a budget of €3 million every year. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric vehicles.

3) The promotion of the purchase and use of low/zero emission buses is based on the incorporation of the new public transport contracts terms, the Clean Vehicles Directive and the incentives for the use of low/zero emission tourist buses. Based on these parameters, the impact assessment has estimated that approximately 7% of the bus fleet could be electric until 2030. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric buses.
4) Decisions on implementing additional policies and measures will be presented in the first revision of the NECP.

National strategy for energy efficiency in heating and cooling sector

Following Article 14 and recently revised Annex VIII of the EED, the Comprehensive Assessment (CA) of efficient heating and cooling potential shall be updated by 31 December 2020. It is anticipated that after the update of the CA, a national strategy for energy efficiency in heating and cooling will be set. It will consist of implementation steps and milestones for the shares of renewable energy sources (RES) in heating and cooling sector. This strategy will be included in the first revision of the NECP.

2.3. Dimension energy security

2.3.1. ii. National objectives with regard to increasing: the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

Cyprus is a small isolated energy system, with high dependency on oil products for its energy needs. More than 90% of Cyprus energy inland consumption is from oil products and the rest is from renewables. The introduction of natural gas via Liquefied Natural Gas (LNG) imports, the development of the necessary infrastructure to import natural gas to Cyprus by early 2022 (via the "CyprusGas2EU" project of common interest) as well as the two other projects of common interest, the "EuroAsia Interconnector" and the "EastMed Pipeline", will end the current energy isolation, contribute to the security of supply dimension and the diversification of Cyprus' energy sources (for a more detailed description see 2.4.1, and 2.4.2.i).

Cyprus imports around 2.5 million MT per year (2018) of refined oil products, while most of them are imported from neighbouring countries, e.g. Greece and Israel. The possibility to diversify the current energy supply is very limited because of the small amounts of petroleum products that are imported to Cyprus due to the size of its internal market, the lower transport (shipping) costs from neighbouring countries and the availability of petroleum products with the required specifications due to similar climatic conditions.

The Cyprus Government decided the relocation of the oil, including liquefied petroleum gas (LPG), terminals as well as other related facilities from the seafront of Larnaca area. Based on that decision and following the decision to develop the necessary infrastructure for LNG import, the New Energy and Industrial Area of Vasilikos was established on November of 2014. The relocation of the oil products except LPG is expected to be completed in the first quarter of 2020 and that of LPG around the end of 2020 early 2021. The modern and upgraded larger oil storage facilities will contribute to security of supply, since larger quantities of petroleum products would be stored on the island as it will also be possible to unload larger ships. Alongside with the abovementioned procedures, the Cyprus Organization for the Storage and Management of Oil Stocks (KODAP), the Central Stockholding Entity of Cyprus established by "The Maintenance of Oil Stocks Law of 2003", (N.149(I)/2003), is planning to build its own oil storage terminal to the Energy and Industrial Area of Vasilikos in order to relocate its own oil stocks which are held abroad and in private terminals in Cyprus, as well as, to reduce the annual storage cost. For this project, KODAP secured funding of €35m by the European Investment Bank in 2018. This is another measure of security of supply since the majority of the oil stocks will now be kept on the island.

2.3.2. iii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

It is not applicable. Cyprus imports oil products from neighbouring countries (See 2.3.ii.)

2.3.3. iv. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

The use of indigenous sources of energy, such as hydrocarbon deposits and RES will contribute to increasing the flexibility of the national energy system and ensuring the security of energy supply. The promotion of RES and objectives regarding demand response and energy storage are included in sections 2.1.2 and 2.4.3, respectively.

Regarding indigenous hydrocarbon deposits offshore Cyprus, the Aphrodite natural gas field contractor and the Republic of Cyprus have completed discussions on the Aphrodite Field Development and Production Plan (AFDPP), which was approved. As a result, an Exploitation License for the production of the Aphrodite Field has been issued in November 2019. According to the AFDPP, natural gas production is expected to begin in 2025. The Aphrodite Field gas, is going to be transmitted to Egypt via a subsea pipeline, mainly to Idku LNG Terminal for liquefaction and re-export, as well as for the domestic market.

In February 2018, the ENI / Total joint venture completed the first exploratory well "Calypso 1" in Block 6, which resulted in a gas discovery. Moreover, in February 2019, the ExxonMobil/ Qatar Petroleum Consortium discovered a gas reservoir in their Glaucus-1 well in Block 10. Finally, hydrocarbons exploration activities in Cyprus Exclusive Economic Zone are ongoing and a number of exploration wells are planned for the next two years, with the aim to discover more hydrocarbons.

2.4. Dimension internal energy market

2.4.1. Electricity interconnectivity

In case the electricity interconnection is materialized the expected increase of socioeconomic welfare could reach € 10.2 billion[34].

- The EuroAsia Interconnector will be implemented in two phases, 1000 MW being the first and 2000 MW the second phase. By 2030 the interconnector shall satisfy /address the peak demand of Cyprus (1000 MW). According to ENTSO-E guidelines and other practices in MS, the usual target for interconnection capacity is 20%- 30%.
- The expected total installed capacity by 2030 in Cyprus will be 1500MW (without RES) and 2500 MW (including RES).

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[34] Investment Request Dossier 2016 (submitted to CERA/RAE for their CBCA decision)

Cyprus is aiming to set the national target based on the actual flow and also the findings in the CBA studies of the EuroAsia Interconnector on 15% interconnection and the capacity of 150 MW.

Taking into account the assumed electricity prices as presented in the table below, the price difference between Cyprus and Israel and Cyprus and Greece exceed the threshold of 2€/MWh.

Table 2.17: Assumed electricity prices in Greece and Israel and calculated prices in Cyprus in the PPM scenario (EUR2016/MWh).

Country	**2025**	**2030**
Greece	73.5	74.2
Israel	63.0	75.9
Cyprus	*85.6*	*92.2*

Regarding nominal transmission capacity of interconnectors below 30% of installed renewable generation, there is no available information at the moment.

The incorporation of the EuroAsia interconnector in the system at a Net Transfer Capacity of 1,000 MW and to a lesser degree the lower electricity demand in the Planned Policies and Measures (PPM) scenario, leads to major changes in the investment outlook of the electricity supply sector (Table 11 from CUT study for Impact Assessment of NECP[35]). Specifically, investments in new CCGT units are reduced by one unit as compared to the WEM scenario (with existing measures). Similarly, no investments occur in new steam turbines, gas turbines and CHP facilities. In addition, investments in batteries are also reduced drastically and are delayed to the end of the modelling horizon. The above changes in the Electricity System are reflected in the sensitivity analysis scenarios that are included in section 5.4.

2.4.2. Energy transmission infrastructure

2.4.2.1. i. Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects, that are necessary for the achievement of objectives and targets under the five dimensions of the Energy Union Strategy

Key electricity transmission infrastructure projects

In total 67 transmission projects for the construction of new and the upgrade of existing infrastructure are planned for the period 2019-2028. In addition, an upgrade in the Ripple Control System for the control of non-critical loads will reduce high generation costs related to primary fuel, CO2 emissions and increased reserve requirements during peak load conditions. The list of the projects is shown in the Ten Year Transmission Network Development Plan for the period 2019-2028 (Appendix 5).

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[35] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/SRSS-C2018-070_Deliverable_5.pdf

EuroAsia Interconnector is an electricity transmission infrastructure and also a Project of Common Interest (no. 3.10.1, 3.10.2). It is a cross border interconnector between Crete, Cypriot, and Israeli power grids via the world's longest submarine HVDC power. HVDC onshore converter stations with a total capacity of 2000MW will be located at each connection point. It is also a priority Electricity Highway Interconnector Project. The Interconnector is an energy highway bridging Asia and Europe. The quantified objective is market integration but also ending the energy isolation of Cyprus and contributes to energy security of supply. The planned budget of the EuroAsia Interconnector project is approximately 1.5 billion Euros (stage 1).

The Governments of Cyprus and Greece have recently made a common statement to ensure the technical interoperability for the interconnection between Cyprus and Greece, after the Hellenic Government decision to proceed with the implementation of the Crete-Attica interconnection as a national project. Due to the common statement, the Project Promoter of EuroAsia Interconnector, the Project Promoter of the Internal line Crete-Attica and the transmission operators from both MS have to collaborate in order to find the solution on the interoperability issue. The Project Promoter has submitted the PCI application file to the National Competent Authority of Cyprus.

This Project of Common Interest is also related to Energy Security Dimension, as it promotes diversification of energy sources and ends the energy isolation of Cyprus. In addition, it contributes to the Decarbonisation Dimension because electricity imports will preferably come from natural gas or renewable sources which contribute to the reduction of greenhouse emissions.

Key gas transmission infrastructure projects

The **EastMed pipeline** (Project of Common Interest no. 7.3.1), promoted by IGI-Poseidon S.A. aims at connecting the European market with the gas resources of the Eastern Mediterranean region.

The EastMed pipeline will have an initial capacity of up to approximately 10 Bcm/year. In a second phase, the pipeline’s capacity may expand up to 20 Bcm/y. It is an approximately 1900 km off-shore-pipeline divided into the five following sections: 1) offshore in the Levantine basin to Cyprus; 2) Cyprus-Crete; 3) Crete-Peloponnese; 4) Peloponnese-W. Greece; 5) W. Greece-Thesprotia. From there, at Florovouni, it will connect to the off-shore section of the Poseidon pipeline enabling the direct flow of gas to Italy and beyond in the European continent. Moreover, via the potential connection with the Greece-Bulgaria Interconnector, the EastMed pipeline can also allow the Levantine gas to reach the Balkan markets while the metering & regulating station at Megalopoli provides a connection to the Greek gas transmission system.

The Project Promoter notified the project to the NCA of Cyprus in November 2019.

This Project of Common Interest is also related to the Energy Security Dimension, as it promotes diversification of energy sources and routes, ends the isolation of Cyprus and Crete, supports new gas production in the Eastern Mediterranean, including EU indigenous sources, and facilitates gas exchanges in South-eastern Europe. It also contributes to the Energy Efficiency Dimension, as natural gas is more efficient fuel than the other fossil fuels and to the Decarbonisation Dimension because of the import of natural gas in Cyprus fuel market which has lower greenhouse gas emissions than those from conventional fuels.

CyprusGas2EU (Project of Common Interest no. 7.5 former 7.3.2) promoted by MECI aims at introducing Natural Gas via LNG imports to the island of Cyprus in order to end the current energy isolation of Cyprus, by establishing the required infrastructure. In October 2018, a tender was announced by ETYFA (Natural Gas Infrastructure Company of Cyprus) for the construction of a LNG Import Terminal in Vasilikos Bay. The target date for the completion of the entire LNG imports and infrastructure development project and the commencement of the supply of natural gas to the domestic market of Cyprus is by the beginning of year 2022. For more details, see 3.3.i.

This Project of Common Interest is also related to the Energy Security Dimension, as it is removing internal bottlenecks in the Trans-European Networks of Energy (TEN-E), it is ending the energy isolation of Cyprus and allowing transmission of natural gas from Eastern Mediterranean. It also contributes to the Energy Efficiency Dimension, as natural gas is more efficient fuel than the other fossil fuels and to the Decarbonisation Dimension, because LNG has lower greenhouse gas emissions than those from conventional fuels.

2.4.2.2. ii. Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)

Electricity infrastructure projects

EuroAfrica Interconnector is an interconnector between Greek, Cypriot, and Egypt power grids via submarine power cable. The interconnector will link Egypt with Cypriot and Greek power grids through the island of Crete. It is an energy highway bridging Africa and Europe and it will have a capacity to transmit 2.000 MW of electricity in either direction. The indicative cost for the 1.707 km interconnector is €4 billion. The project ensures secure energy supply for Cyprus, Greece and Egypt connecting them with Trans-European Networks of Energy (TEN-E), allowing significant economic and geopolitical benefits to the three involved countries.

Gas infrastructure projects

Aphrodite-Egypt Export pipeline. The Aphrodite-Egypt Export pipeline is designed to export gas produced from the Aphrodite field to gas buyers in Egypt. The pipeline will mainly transmit gas from the Aphrodite field to Idku LNG Terminal. An Intergovernmental Agreement between Cyprus and Egypt was signed in 2018 to facilitate the project.

The pipeline distance will be approximately 240-340km, depending on the landing point. The pipeline diameter is expected to be between 24 and 28”. The current base case capacity is 800mmscfd. The landing point and the identity of gas buyers are not finalised, but potential gas buyers will be the owners of Egypt LNG liquefaction facilities in Idku, as well as domestic consumers.

2.4.3. Market integration

2.4.3.1. i. National objectives related to other aspects of the internal energy market such as increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

Introduce System Flexibility

Currently, the electricity market in Cyprus cannot support neither flexibility services nor aggregation and demand response. Flexibility services, aggregators and demand response will be able to participate through a fully functioning competitive electricity market (CEM), which is planned to become operational by the end of 2021. For a description of the CEM and related obstacles refer to "Introduction of an intraday market" under this section.

Estimated timeframe for meeting this objective is 8-12 months after the deadline of transposition of the recast Electricity Directive to the national legislation i.e. September 2021 to January 2022.

Expand aggregation

Currently, the Trade and Settlement Rules (TSRs) allow for the aggregation of RES-only generation and the size of the aggregated capacity is limited in the range of a minimum 1MW up to a maximum of 20 MW. A new bill has been submitted which, among other measures, expands the aggregation scope to allow the aggregation of sources of generation irrespective of the primary type of fuel or technology, of storage systems as well as of the supply side (demand response). TSRs will be reviewed and amended in accordance to the new law. Aggregators will also be allowed to participate in the wholesale energy market, the balancing and reserve markets on an equal footing with conventional generation.

Estimated timeframe for meeting this objective is 8-12 months after the deadline of transposition of the recast Electricity Directive to the national legislation i.e. September 2021 to January 2022.

Use of flexibility by the DSO

Subject to the provisions of the recast Electricity Directive, enable the DSO to procure flexibility services, including congestion management in their service area, especially from distributed generation, demand response, storage and other market participants (including those engaged in aggregation). The specifications for the flexibility services shall be defined by the DSO in close cooperation with CERA and the TSOC. The local flexibility markets shall be operated by the Market Operator in close cooperation with the DSO.

Estimated timeframe for meeting this objective is 8-12 months after the deadline of transposition of the recast Electricity Directive to the national legislation i.e. September 2021 to January 2022.

Non-discriminatory participation of "Demand Response" in the envisaged CEM

It is estimated that by 2030 there is going to be in Cyprus an untapped Demand Response potential of around 50 MW. The existing Trade and Settlement Rules (version 2.0.1) were reviewed in October 2019 and a related proposal was submitted by the TSOC to the Regulator for approval. This proposal better reflects the provisions of Article 15(8) of the Directive 2012/27/EU.

Non-discriminatory participation of Electricity Storage in the envisaged CEM

There is an estimated 130MW pumped storage potential by 2030 in Cyprus. The Regulator on 5/7/2019 has published its Regulatory Decision No. 03/2019 (ΚΔΠ 224/2019) in the Official Gazette of the Republic of Cyprus with which the Storage Systems installed upwards the metering point and which are not combined with local consumption of electricity could potentially participate in the Wholesale Electricity Market. This Regulatory Decision also instructs the TSOC to take into consideration the technical parameters of Storage Systems and proceed with the necessary amendments to the Trade and Settlement Rules (TSRs) and the Transmission and Distribution Rules (TDRs) until the 31/7/2020. These systems will be able to participate in all the stages of the CEM and be able to contract bilaterally with RES Generators and Aggregators of RES-E for clearing their imbalances collectively. The storage systems will not be charged for use of the grid during the charging cycle.

Specific products for high-performance ancillary services could be defined (e.g. fast primary regulation, synthetic inertia.), to be provided by storage systems and remunerated according to a "pay-for-performance" scheme.

Introduction of an intraday market

Currently, the electricity market is open to independent suppliers and generators that may engage in energy-only bilateral contracts, which are cleared on a monthly basis. All balancing and ancillary services are provided by the incumbent Electricity Authority of Cyprus. A fully functioning competitive electricity market (CEM) is scheduled to become commercially operational by the end of 2021. The CEM will comprise of a Forward, a Day-Ahead, a centrally run Integrated Scheduling Process and a Balancing Market. An Intraday market will be introduced at a later stage. Specifically, the revised Trade and Settlement Rules provide for the introduction of an intraday market 24 months after the operation of the CEM. Intraday trading is required in order to minimize the exposure of market participants to imbalances. If the interconnection of Cyprus with Greece via the Euroasia Interconnector takes place, a cross-border intraday market with a continuous trading up to one hour before delivery will be introduced.

Estimated timeframe for meeting this objective is October 2021 to December 2021.

Introduction of dynamic-pricing retail contracts

According to the final provisions of the Electricity Directive (recast), dynamic pricing retail contracts will be introduced gradually as the installation of smart meters is roll out and the competitive electricity market becomes operational. This target is also related to Energy Efficiency Dimension (See 3.2.i). Cyprus shall provide the necessary regulatory framework to ensure that final customers who have a smart meter installed can request to conclude a dynamic electricity contract from a supplier that has more than 200.000 final customers. Suppliers with less than 200.000 final customers will not be obliged to offer dynamic-pricing retail contracts.

Estimated timeframe for meeting this objective is 8-12 months after the installation of 200.000 smart meters i.e. September 2025- December 2025.

2.4.3.2. ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

Priority Dispatch for RES and High Efficient Combine Heat and Power (HECHP)

CERA, in close cooperation with the TSO and DSO, shall amend, if necessary, the existing TSRs to provide for a correct interpretation of the concept of priority dispatch for RES and HECHP. Day-ahead and upward balancing offers by RES and HECHP should be cleared before offers of other sources with the same price; thus, RES and HECHP shall have priority only if they offer the same price as other sources.

Estimated timeframe for meeting this objective is December 2020.

Technical Bidding Limits

CERA will review and decide whether to allow for the submission of a Negative Priced Downward Offers in the Balancing Market, so as to provide an incentive to RES to participate in downward balancing.

Estimated timeframe for meeting this objective is December 2020.

Strategic Reserve

CERA and the TSOC (Market Operator) to review the need and if required introduce a strategic (contingency) reserve mechanism to address short-term capacity adequacy concerns. Units participating in this mechanism will be held outside the electricity market and will be dispatched in case day-ahead and intraday markets have failed to clear and the TSO has exhausted all balancing resources. The TSO shall conduct Yearly Auctions for the procurement of Contingency Reserve. The Contingency Reserve will be technology-neutral, i.e. will allow the participation of DR, Storage and RES with the necessary technical capability.

The design of the Contingency Reserve is already provisioned in Chapter 5 of the most recent version of the Trade and Settlement Rules (v2.0.1). These provisions shall be reviewed by the Regulator and the TSOC so as to ensure compliance with Articles 21 and 22 of the Regulation (EU) 2019/943 on the internal market for electricity and in light of the position of the European Commission to the pre-notification of this mechanism by the TSOC (DG Competition, State-Aid, Case no. SA. 53729).

2.4.3.3. iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters;

Advanced Metering Infrastructure

The objective to deploy an Advanced Metering Infrastructure, including the roll-out of 400.000 smart meters by January 2027 will enable the optimization and control of the distribution system, increase the penetration of distributed renewable sources, enable aggregation of RES, demand response and storage and increase direct final customer participation in all market stages (active customers). Furthermore, it will contribute to increased system observability, load and generation forecasting accuracy, accurate system analysis and planning, load management alternative to ripple control, optimization of the operation of the distribution system, supervisory control and data acquisition of Photovoltaic systems.

The existence of a smart meter is necessary for the provision of consumer functionalities, such as near real-time feedback on their energy consumption or generation. Smart meter functionalities will be prescribed according to the requirements of Article 20 of the Electricity Directive (recast), which, among others, foresee for the provision of information to final customers on actual time of use.

Timeline: 400.000 smart meters will be equally divided in seven (7) installation rounds, each round consisting of the installation of 57.143 smart meters. The completion date for the first round is January 2021 and for the seventh round in January 2027.

Meter Data Management System

Competitive market operation and customer participation require the installation of an MDMS system for the central data management of the Advanced Metering Infrastructure (AMI). The MDMS shall provide integration with the Meter Data Collection Systems and other utility information systems (SCADA, GIS) and functionalities such as Data Warehousing and Management, Meter Operations, Data Validation-Editing-Estimation (VEE). Third-party (suppliers, MO) connection to Meter Management through the External Information System (EIS), to implement the energy market provisions related to the provision of the metering data of individual customers to their Suppliers as well as the aggregated invoices to the Energy Suppliers in the market. MDMS also allows the DSO to operate as an independent entity in a multi-energy supplier market and to facilitate DSOs main business processes.

Timeline: MDMS is expected to be completed by December 2020.

SCADA/ADMS

The project includes the design, engineering, supply, installation, configuration, testing and commissioning of a Supervisory Control and Data Acquisition/Advanced Distribution Management System (SCADA/ADMS) and its integration with the GIS and Transmission SCADA/EMS System operated by the TSOC. The SCADA communicates with 175 RTUs installed at MV Level equipment. The ADMS shall provide, among other functionalities, applications for Power Flow, Switching Order Management, Short Circuit Analysis, Short-Term Load and Generation Forecasting, RES Management and Curtailment, Emergency Load Shedding and Restoration, Cyclic Load Shedding and Restoration, Outage Management System and Power Quality Monitoring.

Timeline: SCADA/ADMS is expected to be completed in 2021.

2.4.3.4. iv. National objectives with regard to ensuring electricity system adequacy, as well as for the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives are to be met

Covered by previous sections.

2.4.3.5. v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

Protect Energy Consumers

Independent Comparison Tools

According to Article 14 of the Electricity Directive (recast), the national legislation shall be amended to provide at least one independent comparison tool to small customers (households and microenterprises with an expected yearly consumption of below 100.000 kWh) in order to assess the merits of different energy offers available on the market. The comparison tool will provide clear, concise and comprehensive information by including the available offers in the whole market. The information given will be trustworthy, impartial and transparent. The comparison tool will be operated by a national authority or by a private company.

Timeline: Independent Comparison Tool is expected to become operational in 2022.

Right of customers to switch suppliers within a maximum of three weeks

According with the Electricity Directive (recast), the national legislation will be amended to provide the right to customers for switching suppliers within a maximum of three weeks. By 2026 the technical process of switching suppliers shall take no longer than 24 hours and shall be possible on any working day.

Citizen Energy Communities

In order to empower citizens, the national legislation will be amended, according with the Electricity Directive (recast), to provide a framework for the activation of citizen energy communities, ensure fair treatment, a level playing field and a well-defined catalogue of rights and obligation, such as the freedom of contracting, supplier switching rules, distribution system operator responsibilities, network charges and balancing obligation. The rights and obligations should apply according to the roles undertaken such as the roles of final customers, generators, suppliers, distribution system operators. Access to an energy community's network should be granted on fair and cost-reflective terms.

Timeline: The Regulatory Framework for the Citizens Energy Communities to be ready 8 to 12 months after the transposition of the Electricity Directive (recast) into law i.e. September 2021-December 2021.

Improve the competitiveness of the retail energy sector

Quantitative and other targets will be introduced at a later stage pending the operation of the new electricity market in 2021.

2.4.4. Energy poverty

Where applicable, national objectives with regard to energy poverty, including a timeframe for when the objectives are to be met

Based on the provisions of Directive 2009/72/EC that «*each Member State shall define the concept of vulnerable customers which may refer to energy poverty and, inter alia, to the prohibition of disconnection of electricity to such customers in critical times*..» the definition of energy poverty which was transposed in the Electricity Law[36] is:

«*Energy poverty may relate to the situation of customers who may be in a difficult position because of their low income as indicated by their tax statements in conjunction with their professional status, marital status and specific health conditions and therefore, are unable to respond to the costs for the reasonable needs of the supply of electricity, as these costs represent a significant proportion of their disposable income*».

There are also additional provisions in the Electricity Law as to which categories may be included in the categories of vulnerable customers of electricity.

Based on the provisions of the Electricity Law, the Minister of Energy, Commerce and Industry, after consultation with CERA and the Minister of Labour, Welfare and Social Insurance, has issued an 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. According to the above Order the following categories were determined as categories of vulnerable customers of electricity:

(a) Public Assistance recipients from the Social Welfare Services of the Ministry of Labour, Welfare and Social Insurance.

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[36] http://www.mcit.gov.cy/mcit/EnergySe.nsf/page06_gr/page06_gr?OpenDocument

(b) Beneficiaries of the guaranteed minimum income provided by the Welfare Benefits Administration Service of the Ministry of Labour, Welfare and Social Insurance.
(c) Five-member family or family with 3 or more dependent children that receive child benefit from the Welfare Benefits Administration Service of the Ministry of Labour, Welfare and Social Insurance and with an annual gross family income up to € 51.258. The income criterion of € 51.258 increases by €5.126 for each additional child beyond the four.
(d) The recipients of the allowance to pensioners with low incomes provided by the Welfare Benefits Administration Service of the Ministry of Labour, Welfare and Social Insurance provided that they have completed the seventieth (70th) year of age and do not cohabit with another person who has not attained the seventieth (70th) year of age.
(e) The recipients of severe motor disability allowance from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance.
(f) The recipients of care allowance for quadriplegic persons from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance.
(g) The recipients of care allowance for paraplegic persons from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance
(h) The recipients of special allowance for blind persons from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance.

Additionally, the above Order defines the measures to protect vulnerable categories of electricity customers as follows:
(a) Reduced prices on electricity tariffs (special electricity tariff 08) which is based on a Ministerial Decision (no. K.D.P. 286/2016).
(b) Financial incentives for installing a net-metering Photovoltaic system.
(c) Financial incentives for upgrading the energy efficiency of their houses.
(d) Safeguarding the continuous supply of electricity, during critical periods, to those vulnerable consumers that uninterrupted power supply is essential for reasons related to their health.

The total number of the beneficiaries of all the above vulnerable categories of electricity is 52,645 representing approximately 5.8 % of the total population.

It has to be noted that categories (a) and (b) of the vulnerable customers of electricity, as indicated above, fall within the definition of energy poverty through the Ministerial Order. The total number of beneficiaries who fall within this definition is 23,593, representing approximately 2.62% of the total population. Furthermore, the number of vulnerable consumers who fall within the definition of energy poverty and have applied and benefited since 2013 from the measures is 13.370 representing 1.5% of the total population.

It has further been decided to expand the categories of vulnerable customers of electricity and to introduce income criteria in order to target the measures in a fairer way and to those consumers most in need. A new Order to that effect will be issued in 2020.

2.5. Dimension research, innovation and competitiveness

2.5.1.1. i. National objectives and funding targets for public and, where available, private research and innovation relating to the Energy Union, including, where appropriate, a timeframe for when the objectives are to be met

The National Board for Research and Innovation has issued in May 2019 the Cyprus Strategy Framework for Research and Innovation 2019 – 2023, entitled “Innovate Cyprus”. The current strategic framework adopts the following vision:

“*Cyprus to become a dynamic and competitive economy, driven by research, scientific excellence, innovation, technological development and entrepreneurship, and a regional hub in these fundamental areas*”

According to “Innovate Cyprus” addressing this vision, the Research and Innovation (R&I) strategic framework revolves around nine (9) pillars and enablers of strategic importance, as presented in the following diagram. The strategy framework will be put into action through a first set of policy measures and activities targeting the aforementioned strategic pillars and enablers, aiming to kick-start this reform and to facilitate a strong boost of the research and innovation ecosystem. The nine pillars and enablers of the R&I strategy are depicted in Figure 2.13[37].

The governance enabler (SE.1 in the above diagram) has been materialized through the Council of Ministers decision of the 9th of October 2018 (Decision No. 85.883), which has set a new national Governance System of R&I. Among other things the decision:

1. Establishes the National Board for Research and Innovation (NBRI), succeeding the National Committee for Research and Innovation,
2. Establishes the institution of the Chief Scientist and R&I coordinators in every ministry,
3. Authorizes the Minister of Finance to take all necessary steps to modify the Research Promotion Foundation (currently Research & Innovation Foundation) statute to appoint the Chief Scientist ex-officio as President. The Research & Innovation Foundation statute should also be formulated, where needed, to reflect new developments in the research and innovation governance system and the role of the Foundation as the executive arm of the Government on research and innovation issues.

The new R&I Governance system is depicted in Figure 2.14[38].

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[37] Source: National Board for Research and Innovation, “Innovate Cyprus – Cyprus Research and Innovation Strategy 2019 – 2023”, May 2019

[38] Source: National Board for Research and Innovation, “Innovate Cyprus – Cyprus Research and Innovation Strategy 2019 – 2023”, May 2019

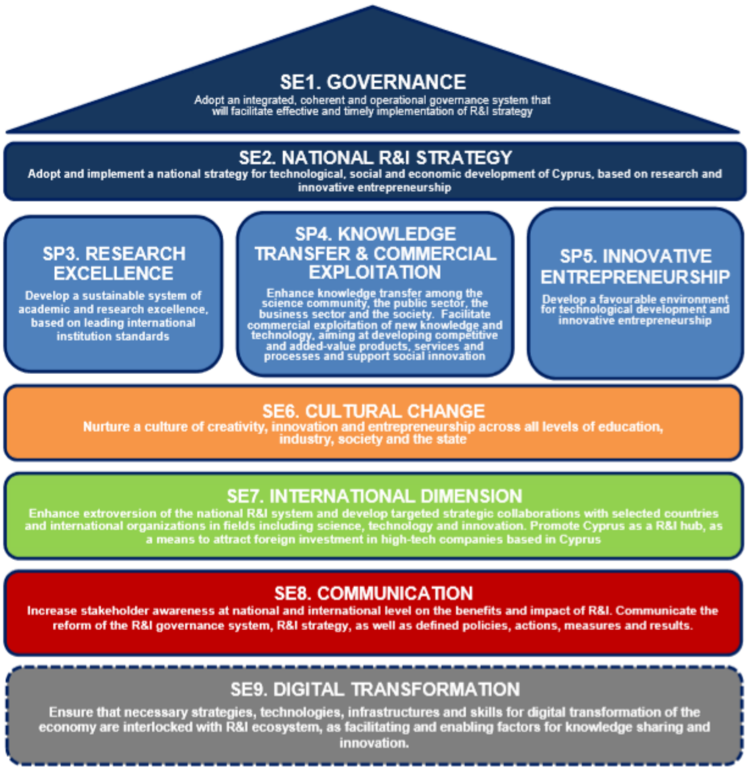


Figure 2.13: The nine pillars and enablers of the R&I national strategy

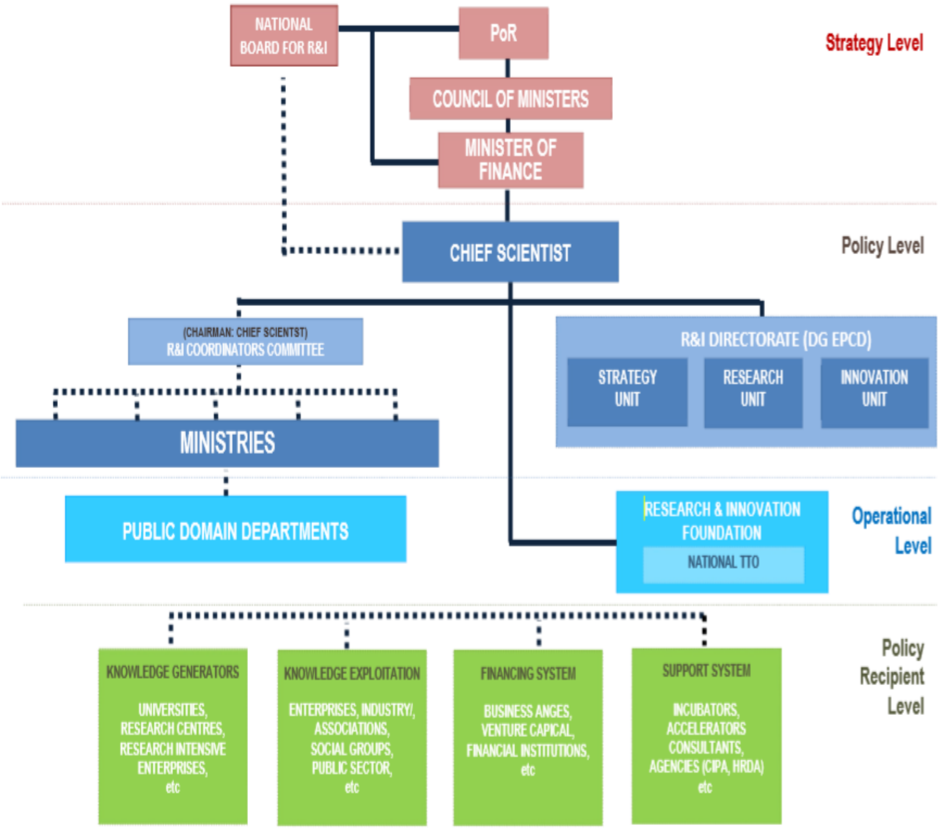
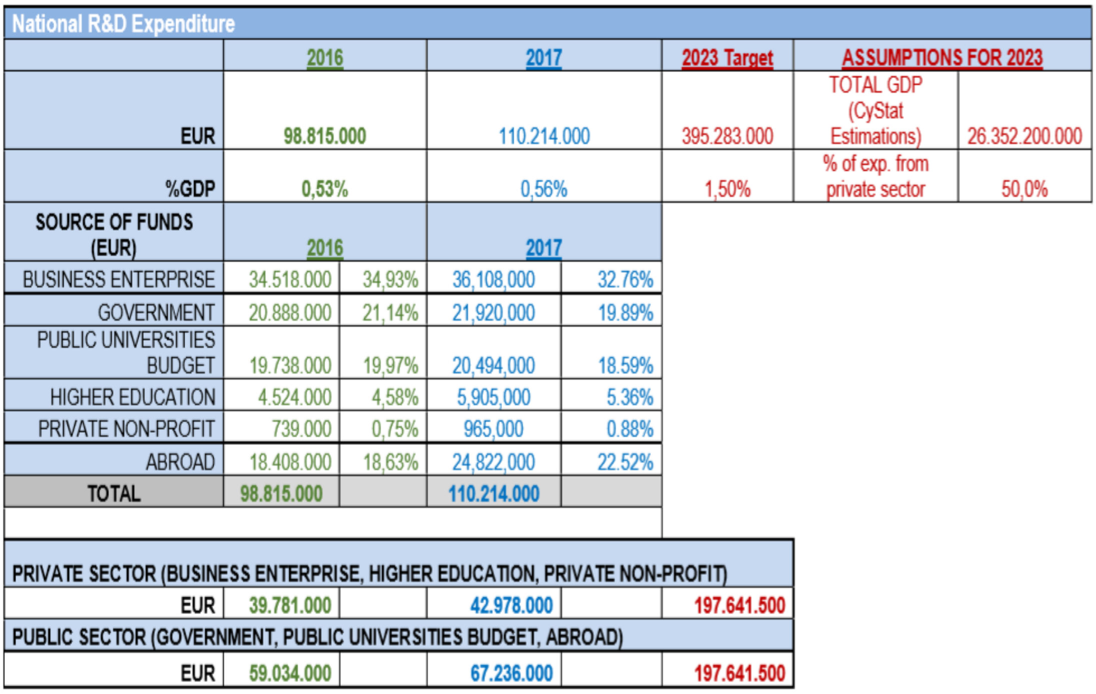


Figure 2.14: National R&I Governance System

"Innovate Cyprus" will be put into action through a first set of policy measures and activities. For this purpose, an implementation roadmap is designed for the initial period of 2019-2021. Each policy measure is subject to agile implementation and enhancement along the way, in collaboration with stakeholders involved so that to ensure efficient delivery and maximization of impact. Moreover, the roadmap will be updated and further enhanced according to progress and developments in the national R&I ecosystem, as well as with the support of further case-studies and the elaboration of a detailed R&I strategy.

In 2017 Cyprus spent €110m in research and innovation which constitutes 0.56% of the Gross Domestic Product (GDP). The national target, set in "Innovate Cyprus" is that investments in research and innovation will rise up to 1.5% of GDP by 2023, thus an annual spending of €395m is estimated. The target is also to raise private share in spending from 43% that was the case in 2017 to 50% by 2023. Table 2.18 provides a breakdown of the national R&D expenditure for 2016 and 2017 and how is projected to be in 2023[39].

Table 2.18: Breakdown of the national R&D expenditure for 2016 and 2017 and how is projected to be in 2023



National R&D Expenditure							
	2016		2017		2023 Target	ASSUMPTIONS FOR 2023	
EUR	98.815.000		110.214.000		395.283.000	TOTAL GDP (CyStat Estimations)	26.352.200.000
%GDP	0,53%		0,56%		1,50%	% of exp. from private sector	50,0%
SOURCE OF FUNDS (EUR)	2016		2017				
BUSINESS ENTERPRISE	34.518.000	34,93%	36,108,000	32.76%			
GOVERNMENT	20.888.000	21,14%	21,920,000	19.89%			
PUBLIC UNIVERSITIES BUDGET	19.738.000	19,97%	20,494,000	18.59%			
HIGHER EDUCATION	4.524.000	4,58%	5,905,000	5.36%			
PRIVATE NON-PROFIT	739.000	0,75%	965,000	0.88%			
ABROAD	18.408.000	18,63%	24,822,000	22.52%			
TOTAL	98.815.000		110.214.000				
PRIVATE SECTOR (BUSINESS ENTERPRISE, HIGHER EDUCATION, PRIVATE NON-PROFIT)							
EUR	39.781.000		42.978.000		197.641.500		
PUBLIC SECTOR (GOVERNMENT, PUBLIC UNIVERSITIES BUDGET, ABROAD)							
EUR	59.034.000		67.236.000		197.641.500		

Considering the abovementioned, as well as the investments that have to be done up to 2030 to reach national targets, annual spending in research and innovation related to energy and climate, has to be tripled by 2023, while currently is less than €5m per year.

Energy and water resource efficiency, as well as mitigation of climate change are among the sectors which are considered crucial to be addressed by R&I according to "Innovate Cyprus". Thus, the objective in R&I in energy and climate is the best possible production of research work and innovative products and services that will help increase energy efficiency, energy

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[39] Source: National Board for Research and Innovation, "Innovate Cyprus – Cyprus Research and Innovation Strategy 2019 – 2023", May 2019

security, and renewable energy and tackle climate change. At the same time R&I must add value to businesses and provide useful insights for policy makers.

Smart specialization has been addressed during the period 2015-2020 through the Smart Specialization Strategy for Cyprus (S3CY)[40], issued in March 2015. S3CY prioritized domains, areas and economic activities where the country was identified to have a competitive advantage or the potential to generate knowledge-driven growth through investments in R&I (including investments co-financed by European Structural and Investment Funds), thus upgrading its competitiveness. Energy was identified as the main priority along with tourism.

More specifically S3CY identified the following priority areas in the energy sector:

- Development or improvement of RES technologies and Storage
    - A.1 Solar energy
    - A.2 Solar heating and cooling technologies
    - A.3 Wind energy
- B. Innovative applications in RES
    - B.1 Solar thermal technologies
    - B.2 Photovoltaics
    - B.3 Innovative applications in RES (tourism, agriculture, farming etc.)
- C. Development of hydrocarbons
    - C.1 Storage of natural gas
    - C.2 Use of natural gas
- D. Energy use – Energy saving
    - D.1 Development of innovative and cost-effective technologies to optimize energy use in new and existing buildings
    - D.2 ICT for monitoring energy consumption and for improving energy efficiency in urban environment and transport
    - D.3 Energy transmission and distribution networks

The above priorities are in line with the European Strategic Energy and Technology Plan (SET -Plan) targets and objectives. More details regarding the participation of Cyprus in SET-Plan are provided paragraph 3.5 (ii). The design of funding Programs for the support of R&I during the period 2015-2020 of the RESTART 2016-2020 framework Program announced by the Research & Innovation Foundation and the program supporting innovative entrepreneurship announced by the MECI was based on the S3CY recommendations.

Taking into consideration the new developments in the national R&I ecosystem (including new and emerging technologies, companies and sectors of the economy), the new R&I governance system, as well as the requirements of the European Structural Investment Fund (ESIF) for the new programming period 2021-2027, an updated Smart Specialization Strategy

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[40] DG EPCD, Cyprus University of Technology, Research Promotion Foundation, “Smart Specialization for Cyprus”, March 2015

is required. This is scheduled to start in April 2019 and be completed by June 2020[41]. Energy and climate in this context should be repositioned.

In the framework of NECP, a Working Group for Research, Innovation and Competitiveness was formed consisting of stakeholders from the public sector, the private sector and academia and is operating as a consultation forum to identify priority Source: National Board for Research and Innovation, "Innovate Cyprus – Cyprus Research and Innovation Strategy 2019 – 2023", May 2019 areas of research and innovation that correspond to the national targets for decarbonisation. The Working Group took into account the SET-Plan deliberations, the Cyprus Smart Specialization Strategy, the feedback from the other Working Groups of NECP and the strengths of Cyprus related to the global market of research and innovation.

This effort was backed by the national network of Climate – KIC which has done a series of interviews and an interactive, facilitated workshop, to identify and map the needs of the various stakeholders in terms of R&I. The interviews and workshop followed a semi-structured format in which stakeholders were invited to discuss the NECP targets, the challenges faced by their respective sectors in achieving the targets (challenges included technical/technological, social, regulatory, resource needs etc.), and the role of R&I in helping meet the NECP targets. The results are indicated in Table 2.19.

The detailed feedback obtained can be found in Appendix 7. The stakeholders engagement process and consultation is ongoing, and through a continual meaningful elicitation of needs, the R&I targets which underpin the NECP are being shaped and will be regularly updated (see section 3.5).

Table 2.19: Overview of Stakeholders Engagement

Stakeholder Organization	NECP Areas of Interest
Agricultural Research Institute	Land use change, waste, renewable energy use in agriculture, climate change adaptation
Union of Cyprus Municipalities	Energy communities, local transport
Cyprus Energy Regulatory Authority	Internal market, interconnection, further integration of renewable energy sources
Water Development Department	Energy-water nexus, desalination, water recycling, use of renewable energy sources
Transmission System Operator	Grid stability, grid flexibility, further penetration of renewable energy sources
Deputy Ministry of Tourism	Energy use in hotel units, waste generation and water use by the tourism industry, new forms of sustainable tourism
The Cyprus Institute- Energy, Environment and Water Research Centre	Climate change projections, air quality, renewable energy (e.g. CSP), water use in agriculture, desalination and renewable energy
Frederick University	Transport, renewable fuels
Vasilikos Cement Works	Carbon dioxide mitigation, alternative fuels, renewable energy use

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[41] Source: National Board for Research and Innovation, "Innovate Cyprus – Cyprus Research and Innovation Strategy 2019 – 2023", May 2019

Cyprus Employers and Industrialist Federation	Carbon dioxide mitigation, circular economy, waste management, sustainable business and industrial practices
ISOTECH Ltd Environmental Research and Consultancy	Waste management, air quality, coastal management, blue growth
RISETech Media	Innovation, entrepreneurship and competitiveness
MarineEM	Offshore energy and sub-sea technologies, competitiveness in the maritime sector
University of Cyprus, FOSS Research Centre for Sustainable Energy	Solar PV, grid flexibility, smart grids, building integration of PVs
University of Nicosia, Marine and Carbon Lab	Renewable energy, ocean energy
Cyprus University of Technology, Sustainable Energy Laboratory	Renewable energy, energy efficiency, entrepreneurship
Electricity Authority of Cyprus	Renewable Energy production, smart grids and smart metering
Department of Public Works	Transport, sustainable mobility, electric vehicles

2.5.1.2. ii. Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives, including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

This envisaged scenario for 2050 (Figure 2.15) shows that Cyprus will become an exporting country in electricity generation mainly produced from solar energy. At the same time, gas will be available for backup purposes and for security of energy supply. From the preliminary results of the model, it appears that in addition to photovoltaics, other technologies such as concentrated solar thermal systems will contribute to the dominance of RES in the energy system. However, it has been noted that emerging technologies like hydrogen and carbon capture and storage have not been considered in the above scenario due to the lack of available data. Nevertheless, the high penetration of RES will enable electrification of the transport sector and process heat which will benefit hard to decarbonize sectors like cement and brickworks industry.

This scenario provides an indication on how clean energy technologies should develop to best cater for the energy transformation needs of the country. Some of them, like solar thermal technologies and photovoltaics are already within the priorities of Smart Specialization Strategy, but other technologies that will play an important role in the long-term, like electrification of transport, storage and decarbonised process heat are not sufficiently addressed. These are factors that need to be considered in updating the Smart Specialisation Strategy mentioned above.

2.5.1.3. iii. Where applicable, national objectives with regard to competitiveness

Dependence on the import of petroleum products and extremely low performance in terms of endogenous energy sources create a framework of reduced security in the continuous supply of energy, and exposure of the economy to fluctuations of global oil price. The high cost of supplying petroleum products significantly increases the cost of energy production. Thus, energy costs are passed on to electricity-consumers with adverse social impacts and act as a brake on growth, as it negatively affects the competitiveness of products and services. Additionally, the Cyprus electricity grid has no energy interconnections with other countries. Isolation of the grid, and seasonality of demand caused by tourist industry, poses unfavourable conditions to ensure adequate reserve power generation capacity.

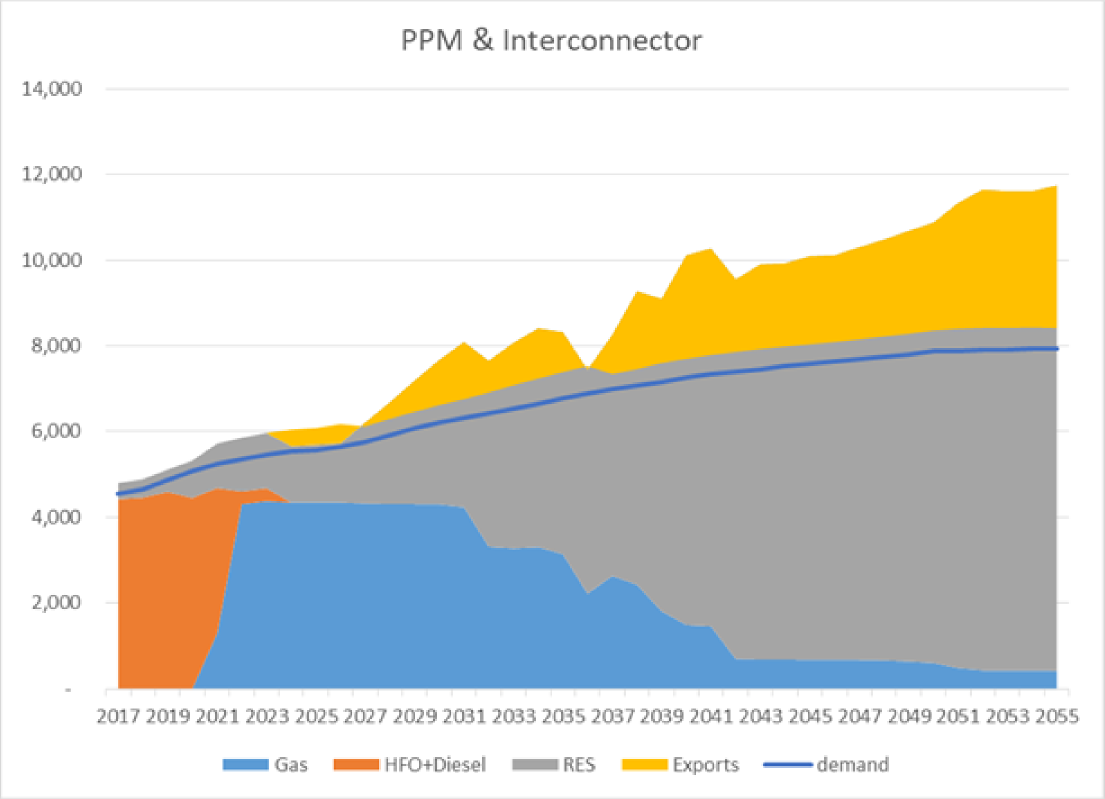

Figure 2.15: Envisaged scenario of the national energy mix up to 2055

Responding to the challenges is the decoupling of economic activity from the use of fossil fuels by increasing energy efficiency first and then maximizing the use of RES. Development of innovative technologies and energy saving systems in the built environment, transport and industry will contribute towards this goal.

The Comprehensive Impact Assessment has shown that additional investments to realise the PPM scenario (which can come from private, national and EU Funds) are entirely feasible for the standards of the Cypriot economy and will pay off because fuel import costs throughout the lifetime of these measures can decline considerably with an increase in national GDP and employment of about 0.3% compared to the WEM scenario. Successful implementation of the package of PPM requires significant investments for energy renovations in buildings and industry and – most importantly – a substantial commitment to promote public transport and non-motorised transport modes (walking and cycling) as well as a shift to electric cars. Table 2.20 shows the cumulative additional investment needs in the period 2020-2030 to implement the PPM scenario without the EuroAsia Interconnector, in comparison to the WEM scenario and Table 2.21 shows the annual total economic output (in million Euros'2016) and annual total employment (in thousand persons) associated with the investments for the period 2021-2030.

Table 2.20: Cumulative additional investment needs in the period 2020-2030 to implement the PPM scenario without the EuroAsia Interconnector, in comparison to the WEM scenario

Sector	Million Euros'2016	% of total GDP of 2021-2030
Power generation (new CCGT plants, PVs etc.)	-46	-0.02%
Electricity storage technologies (pumped hydro & batteries)	-72	-0.03%
Sustainable Mobility (buses & tram, bus lanes, cycle lanes etc.)	1,378	0.48%
Private transport (shift to sustainable transport modes, more efficient cars, electric cars, biofuels etc.)	-2,098	-0.73%
Residential & commercial buildings (energy efficiency renovations)	715	0.25%
Industry	77	0.03%
Total Additional Investments	-46	-0.02%

For the industrial sector, the New Industrial Policy for 2019 – 2030 sets the following vision[42]:

The creation of a robust, flexible, intelligent and technologically advanced industry with relevant services that will contribute substantially to the growth and competitiveness of the Cypriot economy and to the well-being of citizens.

The above-mentioned vision is addressed by six strategic pillars:

1. Infrastructure for Sustainable Development / Production.
2. Improvement of Industrial / Business Environment.
3. Digitization of Industry.
4. Developing New Skills and Enhancing / Upgrading Existing Skills.
5. Enhance Access to Financing.
6. Enhance Market Access / Extraversion, Exports and Investments.

Through the implementation of the six strategic pillars the aim is to overcome the main challenges faced by the industry. According to the New Industrial Policy one of these challenges is "Decreased competitiveness, mainly due to low productivity, high production costs and more generally increased supply chain costs due to small market size, insularity of the economy and geographical and energy "isolation", limited resources, low the ability to innovate, the inadequate utilization and implementation of quality standards, the lack of a holistic industrial policy and adequate infrastructure."

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[42] Ministry of Energy, Commerce and Industry, "Cyprus New Industrial Policy 2019 – 2030 – Action Plan for the Period 2019 - 2022"

Achieving Sustainable Development and Production is foreseen through the creation of appropriate infrastructures and projects, institutions and mechanisms, business models, cyclic production processes and alternative energy systems. In the epicentre of developing the appropriate infrastructure for industry is improving energy efficiency, integration of RES and R&I. A list of actions is adopted to promote energy efficiency and RES in industry within the timeframe of 2019 – 2022 (see paragraph 3.5i).

Table 2.21: Annual total economic output (in million Euros'2016) and annual total employment (in thousand persons) associated with the investments for the period 2021-2030

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total economic output										
With Existing Measures	59.038	60.610	62.119	63.553	64.916	66.380	67.944	69.464	71.037	72.514
With Planned Policies and Measures without electricity interconnection	59.187	60.756	62.261	63.691	65.047	66.510	68.060	69.646	71.257	72.725
Difference between Scenarios	0,25%	0,24%	0,23%	0,22%	0,20%	0,19%	0,17%	0,26%	0,31%	0,29%
Total employment										
With Existing Measures	477.810	490.408	502.484	513.952	524.825	536.458	548.936	560.590	572.776	584.814
With Planned Policies and Measures without electricity interconnection	479.173	491.684	503.675	515.089	525.884	537.489	549.866	562.166	574.636	586.502
Difference between Scenarios	0,29%	0,26%	0,24%	0,22%	0,20%	0,19%	0,17%	0,28%	0,32%	0,29%

3. POLICIES AND MEASURES

3.1. Dimension decarbonisation

3.1.1. GHG emissions and removals

3.1.1.1. i. Policies and measures to achieve the national target

Policies to reduce emissions from conventional power plants will contribute to reducing greenhouse gas emissions in the coming period. The most important policy measure relevant to electricity production concerns import and utilisation of natural gas for electricity production.

Promoting RES is a top policy priority to move towards the decarbonisation of the economy. All measures for the penetration of RES in electricity generation, in heating, cooling and in transport contribute to this objective. In addition, reduction of the quantities of biodegradable waste in solid waste treatment facilities through separate collection, not only for electricity and thermal energy generation (e.g. biogas production), but also for complementary actions such as recycling. The above measures, which have already been launched in the framework of the National Solid Waste Management Plan, will be intensified in the period 2021-2030, as National Planning is currently being revised under the new package of Directives on waste.

The improvement of energy efficiency in all sectors has been examined in the framework of the energy efficiency first principle. The policies and measures set for improving energy efficiency contribute significantly to reducing greenhouse gas emissions.

Transport is a major contributor to greenhouse gas emissions and to the improvement of energy efficiency and, therefore, calls for interventions that will make a substantial contribution towards the sustainability of the sector. To this end, policy measures in the transport sector contribute to promoting RES and improving energy efficiency. Examples include the promotion of electrification in road through the development of the necessary infrastructure. Other examples of measures are the development of public transport, the promotion of alternative fuels, the promotion of low emission busses and vehicles and the implementation of the sustainable urban mobility plans. Moreover, the promotion of biofuels and the use of electricity will contribute to reducing emissions in the transport sector.

A combination of policy measures additional to the current/existing will be implemented to reduce fluorinated gases, focusing on the implementation of a proper recovery system for F-gases in equipment.

The revised Common Agricultural Policy (CAP) introduces specific measures in the context of Green Direct Aid by promoting sustainable food production, sustainable farm management and environmentally and climate-friendly practices and methods. The measures that will be implemented aim at preventing desertification, improving water management, reducing the intensity of natural resources, optimising the use of agricultural land, reducing the use of fertilisers and improving animal waste management.

Furthermore, the Rural Development Programme will promote a more intensified implementation of the forestry measure, which will also increase the absorption from the LULUCF sector. Currently, the contribution of the measure to the country's overall emissions/absorption balance cannot be estimated.

Table 3.1 summarises the policies foreseen for reducing greenhouse gas emissions as detailed in the following sections.

Table 3.1: Planned policies to reduce greenhouse gas emissions

	Name of policy	Sector Category
PP1	Promotion of natural gas as an intermediate fuel for the decarbonisation of the energy system	Electricity
PP2	Promotion of renewable energy sources	Energy – all
PP3	Improvement in energy efficiency in all sectors	Energy – all
PP4	Reduction of emissions in the transport sector	Transport
PP5	Reduction of fluorinated gas emissions	Industry
PP6	Reduction of emissions in the agricultural sector	Agriculture
PP7	Reduction of emissions in the waste sector	Waste
PP8	Reduction of emissions from the businesses	All non-ETS
PP9	Increase of absorptions by LULUCF	LULUCF

The majority of policies and measures planned for sectors other than energy are further implementation of the policies and measures already described in section 1.2. A summary of how the existing measures change is presented in the table below.

Table 3.2: Planned policies and measures for sectors other than energy.

Name of policy measure	Existing	Planned
Reduction of emissions from the businesses	8% reduction of emissions	No additional measures
Reduction of fluorinated gas emissions	5% recovery in 2030	5% recovery in 2020 increasing to 10% recovery in 2030
Reduction of emissions in the agricultural sector	Increase of anaerobic digestion for 2030: 11.5% for cattle waste, 5% for sheep and goat waste, 22.8% for poultry waste and 66% for pig waste	Increase of anaerobic digestion for 2030: 14.7% for cattle waste, 10% for sheep and goat waste, 25.7% for poultry waste and 69% for pig waste
Reduction of emissions in the waste sector	- Reduction of waste to solid waste disposal sites from sorting at production level (40% from 2021, 55% in 2025, 60% in 2030). - Reduction of organics to landfills to 15% from 2021. - Introduction of anaerobic	- Reduction of waste to solid waste disposal sites from sorting at production level: No additional measures. - Reduction of organics to landfills: No additional measures. - Introduction of anaerobic

	digestion for the treatment of organic wastes treated by (5% from 2021) - Biogas recovery from old landfills, during their restoration (20% from 2020).	digestion for the treatment of organic wastes: No additional measures. - Biogas recovery from old landfills, during their restoration (30% from 2020).

LULUCF

The Department of Forests 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 semperivines, 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.

Transport

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) is taken into consideration for the purpose of the PPM scenario. The Limassol SUMP was completed in June 2019 and the Larnaca SUMP is expected to be completed in March 2020. Furthermore, the remaining cities in Cyprus are planning to start preparing their own SUMPs within 2020.

SUMPs include costed policies and measures which scientifically prove (via world leading traffic prediction software) that a specific modal shift from car trips to sustainable modes of transport can be achieved. This group of measures include significantly improved bus services (routes, frequency, 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. The modal share of cars in Cyprus is currently over 90% and based on the plans and studies that have already been completed; a modal share of 75% car, 13% public transport, 12% walking/ cycling can be achieved and is set as a national target.

Based on the plans and studies that have already been completed, the cost of implementing this action is estimated at €1.4 billion and includes both capital and operational costs for the 2020-2030 period. It is worth noting that part of this cost is already included each year in the budget of the relevant authorities, while some of this cost can also be sourced from European funding as well as private funding.

Another measure is the promotion of the purchase and use of vehicles with low or zero emission takes into consideration the harmonisation and implementation of European Directives (e.g. Cleans Vehicle Directive) for the purchase of new vehicles both for the private and public sector. Based on these parameters, the impact assessment has estimated that approximately 11% of the passenger car fleet could be electric and 9% could be hybrid until 2030.

In addition to the results of the impact assessment, this action also includes further incentives for the purchase and use of low/zero emission vehicles including additional old vehicle scrapping schemes, further financial incentives for the purchase of electric vehicles and further amendment of the Motor Vehicles and Road Traffic Law (Law 100(I)/2013) for revision of the vehicle taxes and annual circulation taxes. Based on these additional measures, the target for the penetration of electric vehicles is set at 20% as a proportion of the total vehicle fleet. The emission reduction impact of this higher target is not included in the latest impact assessment and its cost is based on the current old vehicle scraping scheme/ financial incentives but proposed to be implemented on an annual basis with a budget of €3 million every year. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric vehicles.

Furthermore, the promotion of the purchase and use of low/zero emission buses is based on the incorporation of the new public transport contracts terms, the harmonization/ implementation of European Directives (etc. Cleans Vehicle Directive) for the purchase of new buses for the private/public sector and the incentives for the use of low/zero emission tourist buses are expected to contribute towards the reduction of emissions from transport. The cost of vehicles and cost of infrastructure will be sourced mainly from private sources. Based on these parameters, the impact assessment has estimated that approximately 7% of the bus fleet could be electric until 2030. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric buses.

Finally, extensive tree planting of up to 650,000 trees along the urban road network and up to 350,000 trees along the interurban road network is an ambitious measure currently studied by the Ministry of transport. The cost of this action is estimated at €85 million and includes the planting cost and infrastructure changes required along the urban network, but it does not include the maintenance and watering costs. The positive impacts for this measure include C02 absorption, aesthetic upgrading, shading, lowering temperatures and better conditions for cycling and walking that could have a significant impact in the use of sustainable modes of transport. It is noted that the effects of this measure are long term, due to the amount of years required for a tree to reach a significant size and for the benefits mentioned above to be effective.

3.1.1.2. Achieving the national target of reduction of greenhouse gas emissions

The goal of the National Energy and Climate Plan is to achieve a 24% reduction of greenhouse gas emissions by 2030 compared to 2005.

The greenhouse gas emission reduction target for Cyprus in accordance with Annex I to Regulation (EU) 2018/842 is 24% reduction of greenhouse gas emissions by 2030 compared to 2005. The expected annual emission allowances for the years from 2021 to 2030 was calculated taking into account the relevant provisions of the Regulation, and is presented in Table 3.3.

Table 3.3: Expected annual allocation of allowances for the years 2021-2030 for Cyprus

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Allowances (kt CO_2 eq.)	4190	4085	3979	3874	3769	3663	3558	3453	3347	3242

Note: The average 2016-2018 emissions were estimated at 4190 kt CO2 eq., while non-ETS emissions in 2005 based on the most recent greenhouse gas inventory report (November 2019) were 4265 kt CO2 eq.

The expected GHG emissions for Cyprus for the period 2021 to 2030 for the non-ETS sectors according to WEM and PPM scenarios are presented in Table 3.4 and Figure 3.1.

Table 3.4: Expected GHG emissions for the period 2021 to 2030 for WEM and PPM

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WEM emissions (kt CO2 eq.)	3995	3983	3970	3964	3959	3954	3941	3926	3880	3829
PPM emissions (kt CO2 eq.)	3920	3878	3836	3801	3761	3714	3635	3556	3477	3374

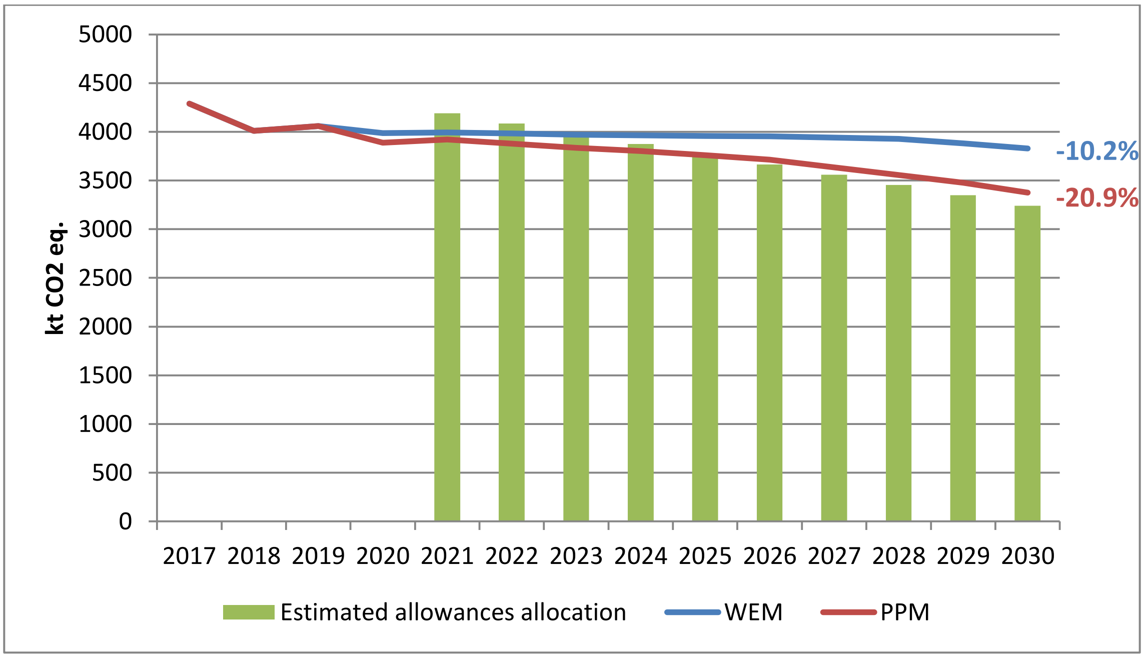

Figure 3.1: Projected evolution of GHG emissions of non-ETS sectors according to the WEM and PPM scenarios

According to the projection of GHG emissions, it appears that during the period 2021-2030, Cyprus will have in some years a small surplus and in some years a small deficit in terms of the annual allowances that are expected to be allocated. Table 3.5 presents the relative annual and total deficits / surpluses.

Table 3.5: WEM and PPM GHG projections compared to expected allocation

kt CO_2 eq.	Expected allocation	WEM projections	Surplus/ deficit of AEAs with WEM	PPM projections	Surplus/ deficit of AEAs with PPM
2021	4190	3995	*195*	3920	*270*
2022	4085	3983	*101*	3878	*206*
2023	3979	3970	*9*	3836	*144*
2024	3874	3964	*-90*	3801	*73*
2025	3769	3959	*-190*	3761	*8*
2026	3663	3954	*-290*	3714	*-51*
2027	3558	3941	*-383*	3635	*-77*
2028	3453	3926	*-474*	3556	*-103*
2029	3347	3880	*-533*	3477	*-129*
2030	3242	3829	*-587*	3374	*-132*
2021-2030 total	37160	39400	*-2240*	36952	*208*

In view of the above, it appears that while the national mandatory target for reducing greenhouse gas emissions at the end of the period is not expected to be fully met, making use of the flexibility mechanisms of the ESR and provided that all the Policies and measures are implemented according to the presented schedule, Cyprus is not expected to have the to purchase additional AEAs.

Additional measures under examination to achieve the reduction target of -24% are:
- Fiscally neutral green tax reform – expected to be ready in 2020 for gradual implementation to start in 2021. No details are yet available to be included in the planned measures.
- Additional reductions in emissions from the implementation of measures to be included in the Common Agricultural Policy
- Further reductions in emissions from industries through the support scheme (expected to reach 15%).
- Design of nature based solutions for the increase of CO2 absorption (e.g. promotion of green roofs, increase of private forests, Increase of urban public green spaces, improvement of urban green spaces)
- Additional shift of modal share from car trips to sustainable modes of transport. The modal share for cars in Cyprus is currently over 90% and with the effects of the proposed tax reform, a modal share of 68% car, 20% public transport, 12% walking/ cycling can be achieved and is set as a national target. Potential revenues from the tax reform can also be used to finance part of the proposed measures.
- Higher penetration of vehicles and buses with low or zero emissions based on the effects of the proposed tax reform. Possible revenues from the tax reform can also be used to finance part of the proposed measures.
- Further tree planting along the urban and suburban network for a total of 2 million trees. Potential revenues from the tax reform can also be used to finance the proposed measure.
- Strengthen the involvement of local authorities

- Replacing of oil-fired boilers with Heat-pumps and further study the district heating and cooling network

3.1.1.3. ii. Where relevant, regional cooperation in this area

Cyprus Government Initiative

Recent studies from prominent institutions (e.g. the Intergovernmental Panel on Climate Change, the World Meteorological Organization) have classified the Eastern Mediterranean and Middle East (EMME) region as a global "climate hot-spot" with particularly high vulnerability to climate change impacts. The Cyprus Government Initiative builds upon the work that led to the International Conference held in Cyprus, in May 2018, which focused on "Climate Change in the Mediterranean and the Middle East". The Conference which was organized by the Cyprus Institute and placed under the aegis of the President of the Republic of Cyprus, drew international attention, attended by eminent scientists and policy makers (e.g. L. Fabius, P. Taalas, J. Sachs *et al.*) from thirty countries as well as leaders of global stature. The principal conclusion of the Conference was that regional concerted action is urgently needed. It is noteworthy that all EMME countries have underlined their serious concerns about regional and national climate change impacts and expressed their willingness to comply with the Paris Agreement.

3.1.1.4. iii. Financing measures, including Union support and the use of Union funds

As already mentioned, a significant part of the funding for the implementation of the proposed measures, especially in the areas of waste, rural development and forestry, comes from European Union resources and involves infrastructures and programmes that are either implemented within the current (2014-2020) programming period, or will be planned for the coming (2021-2027) programming period through the corresponding NSRF and Rural Development Programme.

3.1.2. Renewable energy

3.1.2.1. i. Policies and measures to achieve the national contribution to the binding 2030 Union target for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in point 2.1.2 of this Annex, including sector- and technology-specific measures

Over the last 15 years, the Cyprus Government has developed various support schemes with incentives and soft measures in order to further support the Renewable Energy Sources penetration, especially in the electricity sector. This experience and lessons learned from previous support schemes (over 30 different support schemes)[43], were used by MECI, to develop its new policy and measures for the period 2021-2030.

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[43] Renewable energy policy database and support – RES-LEGAL EUROPE National profile: Cyprus

A concise list of the planned measures is provided in the Appendix 4 and deliverable of the Impact Assessment Study[44], where the most important of them are listed in Table 3.6.

Table 3.6: Major PPMs for RES Sector towards 2030.

no	Title of the measure	Short description of the policy measure	STEP 1 – 2020-2023	STEP 2 – 2024-2030
1a	Self-Consumption Scheme for households	Estimated installed capacity based on existing trends.	✓	✓
1b	Self-Consumption Scheme for Vulnerable Consumers	Net-Metering support Scheme for Vulnerable Consumers.	✓	NA
1c	Repowering & Net-Billing for home use	Net metering will be converter to net-billing after 2023. The same applies for all the PPAs for household use		✓
2	Replacement of Boilers and Heat Pumps	The scheme will target (in combination with other measures) the replacement of old boilers and split-units.	✓	✓
3	Net-Metering for EV Charging	Net Metering Scheme will be extended to households for the installation of EV Charging.	✓	✓
4	Net Billing for EV Charging	Net Billing Scheme will be extended to companies for the installation of EV charging infrastructure in public/private spaces, incl. storage.	NA	✓
5	Take advantage of synergies between waste and RES	Electricity and Biodiesel Production from Landfills and animal waste.	✓	✓
6a	Solar Heating and Cooling	Replacement for Solar Collector for households.	✓	NA
6b	Solar Heating and Cooling	Replacement for Solar Collector for Commercial purposes and use of Solar Technologies for High process heat and/or Solar Cooling	NA	✓
7	Use of Electric Vehicles	Old vehicle scrapping scheme and financial incentives for the purchase of electric vehicles	✓	NA
8	Promotion of the open loop Geothermal Energy	Development of Framework and possible financial incentives.	NA	✓
9	Public Buildings Energy Renovation	Installation of RES and Energy Efficiency technologies in Public Buildings.	✓	✓
10	Storage Installations	Framework development and	✓	✓

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[44] Deliverable 3, Policies and measures (and relevant data) to be taken into consideration in the Impact Assessment (SRSS/C2018/070)

		possible financial incentives.		
11	RES in Transport	New bus contracts (using alternative fuels and biofuels)	✓	✓
12	RES in Transport	Use of Biofuels (and biogas) in Transport Sector	✓	✓
13	RES in Transport	Other indirect measures that will help the increase in energy efficiency and thus the RES Share in transport will be increased: (i) Amendment of the Motor Vehicles and Road Traffic Law for revision of the vehicle taxes and annual circulation taxes (ii) Telematics infrastructure (iii) Integrated fleet management (iv) EV charging points	✓	✓

Electricity for own Consumption

Net Metering

Support schemes for the production of electricity from renewable energy sources for own use such as Net-metering for self-consumption have been implemented since 2013 as national policy to promote RES electricity. Currently the Net-metering category is applied for small scale photovoltaic systems with capacity up to 10KW, for all consumers (residential and non-residential). The scope of the net-metering is to provide the option to residential and small commercial consumers to cover all or part of their electricity consumption from a PV. The generated RES electricity is subtracted from the building's overall electricity consumption. Consumers pay only for the difference between the energy consumed and energy produced (net electricity used) plus a cost that reflects the cost of the electricity grid to support continuous supply and taxes (VAT, RES levy).

The above scheme is expected to continue, with some modifications in the near future in order to enhance better the self-consumption for small systems.

For household owners and for those having a building permit prior of 2017, there is a support scheme in operation for the period 2018-2020. The grant support was set at a level of 250 Euro/kW installed with a maximum possible grant per system of 1,000 Euro.

In addition, if the above measure is combined with rood insulation there is a total grand of 3,000 Euros, where the grand for PV itself is increased to 300 Euro/kW. Furthermore, a support scheme for vulnerable consumes is in place since 2013 with the financial grant of 900 Euro/kW with the cap recently revised from €2,700 to €3,600.

Self-consumption / Net billing

With Self-consumption and Net-billing schemes, PV generated energy has to be self-consumed within the same 20-min time period it was generated in. If local energy demand exceeds PV production, energy is imported from the grid. With Self-consumption scheme, excess PV generation is exported to the grid without any economic compensation nor any additional fee. A compensation for excess energy is foreseen by the Net-Billing scheme. The size of these systems is basically unlimited (up to 10MW). This support scheme is the most effective for both industrial and commercial consumers, since the self-consumption is almost excluded for all the taxes for the energy that is self-consumed.

Consumers are billed on energy consumed from the grid at the retail electricity price and receive a credit based on a variable tariff known as the 'avoidance cost' for any excess power they inject back into the grid. The avoidance cost is intended to reflect the savings offered to the country by avoiding the generation of fossil-fuel based energy. If the PV system owner generates more power than they consume during any two-month period, the avoidance cost credit is rolled over into subsequent billing periods and is likely to be cancelled out over the course of each year because of the constraints applied to the generation capacity of eligible arrays. In the unlikely instance of a system owner exporting more power to the grid than they consume, the excess does not secure any credit.

Prosumers who qualify for net billing are taxed on all the energy they consume, whether generated on-site or imported from the grid, and also pay a fee for using the network. There was a debate during the public consultation regarding the self-consumption fee, which is something that needs to be examined in more detail, taking into account the results of the study contacted from JRC, under the Administrative arrangement of SRSS/C2017/077. The study concluded that the existing framework for network charges has to change moving towards a usage-based capacity charging system.

In the next paragraphs two tools are presented that can indirectly assist in the further penetration of RES. These tools were the result of recommendations from an IRENA[45] and a JRC[46] study.

Development of a specific Software tool to perform technical and economical evaluations of simple energy systems taking into account Cyprus's regulatory and tariff context/framework.

In order to enhance the above schemes (net-metering, net-billing and self-consumption), a software tool was developed[47] and provided free of charge to both energy consultants and to the end users. With this tool, the end user can have an indication of what size system to install that will make economic sense, and can also evaluate the offer received from various installers.

The advance mode of the software tool, will give some more insights to the consultants in order to advice better the pronsumers in other sectors as well (Energy efficiency, storage, etc.).

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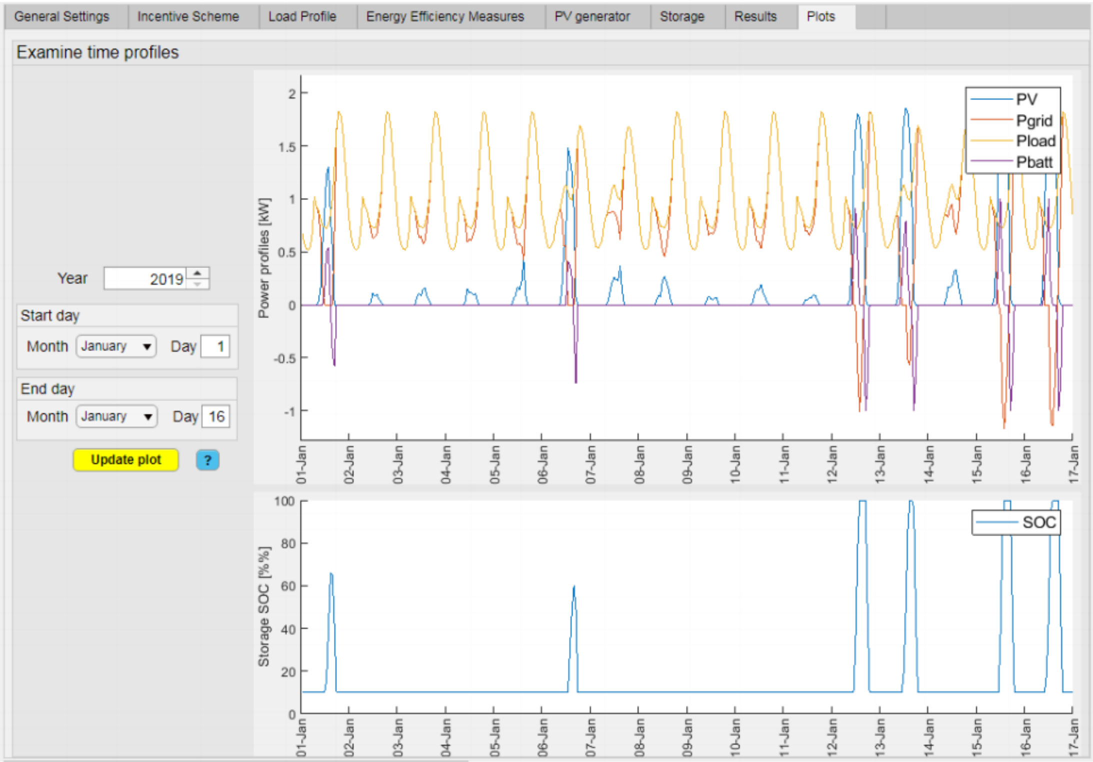
[45] http://www.mcit.gov.cy/mcit/EnergySe.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/IRENA%20REPORT%202030_Jan_2015.pdf

[46] http://www.mcit.gov.cy/mcit/EnergySe.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Cyprus_RESGRID_summary_v16.pdf

[47] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/312EB6608C682704C22582CF0025445D?OpenDocument

The operation of the whole system can be simulated by making energy balance calculations in each time step (interval) of the year. For each time step, the SW tool compares the electricity demand to the energy that the system can supply in that time step, and calculates the flow of energy to and from each component of the system and the corresponding cash flows. For systems that include batteries, SW tool will determine in each time step whether to charge or discharge the batteries.

The tool estimates also the cost of installing and operating the system over the lifetime of the project, defined by the user as an input. Economic and Financial calculations account for costs such as initial investment, replacement, operation and maintenance, network fees and tariffs, RES incentive schemes etc.



Year 2019

Start day

Month January Day 1

End day

Month January Day 16

Figure 3.2: Cost-optimization Software tool specific designed for Support schemes of Cyprus.

- *New Forecasting Tool that will help further the penetration for RES*

At a basic level Variable Renewable Energy (VRE) forecasting aims to predict the generation of renewable energy technologies with variable outputs that are strongly affected by weather (wind, sunshine, etc.). VRE forecasting was first developed for use by the wind power industry but has been adapted to provide forecasts for solar technologies including PV and CSP. Modern VRE forecasting has achieved a high level of accuracy through a combination of models and analysis tools that use historic and real-time weather observations along with characteristics and real-time generation of VRE assets to predict VRE power generation. VRE generation can be forecast across numerous different time scales, from minutes to hours to days and across various system scales, from single wind turbines to PV panels to CSP units up to regional systems with gigawatts of generation capacity.

Due to the isolation of the island and the various weather phenomena in Cyprus, deterministic numerical weather prediction (NWP) model forecast can provide useful information for decision-making.

MECI has requested a Technical Assistance, through SRSS (SRSS/S2017/048), in order to improve and correlate all the existing forecasting models in an effort to create a new weather to energy model tool for RES that will participate to the market and also for the Transmission System Operator for the smoother penetration of Renewables. One important aspect that was identified and examined, is the dust forecast prediction, which occurs vary often in the Area of Cyprus. The study was performed by RSE (Italy) and there were several stakeholders involved (Department of Metereological Service, Department of Energy, Inspection and Labor, Transmission System Operator, Distribution System Operator and one research Center in Cyprus, Cyprus Institute).

Forecasting tool, aims to provide an accurate prediction of when and how much power VRE assets will generate at a given time in the following hours (i.e. up to 4-6 hours), along with an associated probability. This information will support TSO in reducing VRE integration costs and assists utilities and independent power producers (IPP) in more efficient operation of VRE assets, which increases revenue and makes VRE more attractive to investors as it was highlighted in IRENA study.

In general forecasting (and nowcasting[48]) will help to increase the share of VRE generation that can be safely and economically integrated into an electricity grid.

By evaluating, with high accuracy, the future production from the non-programmable renewable plants and the knowledge at least one day in advance of the generation profile from renewable energy sources (RES) enables to improve the reserve calculation, the grid management and the competitiveness on the energy market, in addition to a better plan of the plants maintenance. The deliverables of the study and the tool itself were presented and provided to the Transmission and Distribution System Operators in an effort to enhance the existing forecasting tools.

Alternative fuels – Biofuels in transport

Charging points and infrastructures for electric vehicles have been installed in public buildings and in public roads. There are currently 18 double charging stations in Cyprus: 6 charging stations in Nicosia, 5 in Limassol, 2 in Larnaca, 2 in Ammochostos and 3 in Paphos. Additionally, the Department of Electromechanical Services is proceeding to the installation of 10 fast charging stations in highways and public roads. These numbers are expected to grow as the electric vehicles are increasing, the expectation is that the registration of electric cars will increase considerably after the year of 2024-2025. New electric car sales are expected to comprise the major vehicles on the road by 2030, since Cyprus has end to end distance of less than 350 km. This means that with the autonomy that the new cars are

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[48] Nowcasting: a continuous update of the generation forecast during the day, devoted to gain a more accurate profile in the next few hours, brings benefits for grid and reserve management and for participating in intra-day market

having with 64kWh-80kWh batteries, they can cover a distance over 500km. On top of that, other support schemes that will be put in place, i.e. net-metering (up to 2kW) for car charging can also help reducing the cost of electricity charging significantly.

Regarding biofuels more details are listed in section 2.1.2 (iii) and 4.2.2(i).

RES in buildings

Minimum energy performance requirements for new buildings foresee a mandatory minimum level of energy consumption to be covered by RES. Obligatory installation of RES in new buildings has been introduced since 2010, but it has been gradually tightened up in order to meet by 31st of December, 2020 NZEB requirements (for more details see paragraph 4.3(iv)).

According to the Order 1/2014 of the Minister of Interior, incentives are provided regarding the increased RES in certain types of developments. These incentives associated with increased building ratio (5%) and in some cases a minimum amount of RES is required for the application of other incentives, under the Development Plans. The regulation is associated with the installation of PV and solar systems in new or existing developments (sizeable composite use developments, tall buildings, Industries etc.). All developments covered by the Order must meet the minimum renewable energy use requirements in conjunction with the relevant energy efficiency requirements of the development. These incentives are currently under re-examination by the Town Planning and Housing Department in association with the Energy Service, based on the new minimum energy performance criteria in building that are set by the new Directive.

3.1.2.2. ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in point 2.1.2

Cyprus, in the PPM scenario (without Euroasia Interconnector) is remaining isolated with the relevant consequences as highlighted throughout this report.

As illustrated in Appendix 2, the impact of the EuroAsia interconnector on the electricity supply outlook is substantial. It enables further investments on renewable energy technologies and increases the share of RES-E considerably, turning Cyprus into a net exporter of electricity by 2030. The key differences between the two PPM scenario alternatives in the electricity supply sector are shown in Table 3.1.2. In the absence of an interconnector, an additional CCGT unit must be installed in 2024 to supply low-cost electricity and provide flexibility that would otherwise be offered by the interconnector. The lack of electricity trade potential reduces the installed capacity of solar PV drastically, as a difference of nearly 880 MW is observed between the two scenarios in 2030. In turn, the lower deployment of variable renewable energy technologies eliminates the necessity for the development of the 130 MW pumped hydro facility (or other similar storage infrastructure) before 2030.

In terms of generation, fossil-fired generation is higher by 270 GWh, while renewable electricity generation is lower by 1,420 GWh in 2030; most of this volume of electricity is destined for electricity exports in the PPM scenario with interconnector development. As a result, the share of renewable electricity generation is restricted to 30% in this scenario, instead of 51%. The increased generation from fossil fuels results in an increase in GHG emissions of 140 kt CO2 eq. in 2030.

Table 3.7: Installed Capacity difference (MW) between the PPM without interconnector and the PPM with interconnector scenarios.

	2024	2025	2026	2027	2028	2029	2030
New CCGT (MW)	216	216	216	216	216	216	216
Solar PV (MW)	0	0	0	-280	-557	-707	-876
Pumped Hydro (MW)	0	0	0	-130	-130	-130	-130

Lack of interconnector development has milder impacts in the outlook of road transport. Due to the reduced RES-E share, in order to achieve the renewable energy target of 14% in the transport sector, the fleet of battery electric vehicles increases by approximately 3.200 units by 2030. This leads to a small reduction in GHG emissions in this sector, amounting to 15 kt CO2 eq. in 2030. In this scenario, the renewable energy share in the total final energy demand reaches 22,9% in 2030, instead of the relevant 23% target. Additionally, the macroeconomic analysis carried out (Chapter 5) shows that this case will lead to slightly lower positive effects on GDP and employment, in comparison to the PPM scenario, due to the reduced investments in power generation if the interconnector is not built.

Finally, in case Cyprus and Greece will be interconnected, there will be a net export opportunity for Cyprus in the range of 92 ktoe in 2030 with the trend to be further increased up to 2040 to 179 ktoe of export electricity. This energy could potentially transferred to other MS based on the Article 8 of the RES Directive.

3.1.2.3. iii. Specific measures on financial support, where applicable, including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

EU Funding

As far as it concerns EU Funds, Cyprus has already used several Funds for RES projects. Such Funds include the NER300 support program and the Structural and Cohesion Funds 2014-2020. Some projects will be implemented during the period of 2020-2022. The total allocation budget was €38.1m.

From the Structural and Cohesion Funds the RES Technologies that were supported directly were: Heat-pumps, Solar Water heaters for hot water use, while indirectly, the RES Technologies supported were the Photovoltaics for own consumption, through net-metering Scheme (i.e. additional money allocation was given to Energy Efficiency measures if the building was installing RES without any subsidy).

RES and Energy Efficiency National Fund

Furthermore, the RES and Energy Efficiency National Fund ("Fund") which is established under the Renewable Energy Directive (Law N.112(I)/2013) is the tool that has been used from 2004 to 2019 to finance and promote both renewable energy technologies and energy efficiency measures.

The Fund's annual income derives primarily from a fee imposed on all energy consumers based on their energy consumption. The fee was varying over the time from 0,13 eurocent per kWh to 1 eurocent per kWh and was intended to cover the cost of the long-term PPAs and the grant schemes that the MECI wanted to promote for achieving the RES and Energy Efficiency targets.

Table 3.8: RES and Energy Efficiency National Fund Levy

Year	2003-2007	2008	2010	2012	2015	2020
Levy* (€cent/kWh)	0.13	0.22	0.44	0.5	1	0.5

* imposed on all consumers for the RES and Energy Efficiency Fund

The Fund's approved 2020 budget and 2021-2022 medium-term budgetary framework, provide for a total annual budgeted amount of €40-50m for subsidies (2020: €49,3m, 2021: €40,4m, 2022: €46,3m). About half of the said amount is attributed to the PPAs and the remaining to grant schemes.

The Fund is monitored by a Management Committee provided in the relevant Law.

A list of proposed measures that have been included for the period 2020-2022 are listed in Appendix 8.

There are more measures that are listed in that can be promoted through Energy Communities, while some other RES measures are promoted through other pillars of the NECP. For example, the new obligation in buildings to have at least 25% RES penetration indirectly force all the new buildings to take into consideration the best available RES Technologies based on specificities of their location and the type of building.

3.1.2.4. iv. Where applicable, the assessment of the support for electricity from renewable sources that Member States are to carry out pursuant to Article 6(4) of Directive (EU) 2018/2001

The required assessment will be presented at the next update of the NECP. A comparison of various support schemes and financing models in the EU compared to those in Cyprus was performed from Adelphi and OEB[49].

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[49] www.oeb.org.cy/wp-content/uploads/2019/02/Report_GHG-financing-models-Cyprus_final.pdf

3.1.2.5. v. Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements

Currently there is not a dedicated one stop shop for RES Projects. However, there is a general framework for big projects[50] that can indirectly support this effort. MECI is in the process of establishing specific measures to introduce one or more contact points along with all the relevant stakeholders and create the one-stop-shop as indicated by the RES Directive (2018/2001/EC).

Training and information

Certification of small-scale RES system installers is provided through four accredited institutions for issuing certificates[51]. Currently these accredited institutions are monitored from MECI and as of 11/2019 there were 62 [52]certified small-scale PV installers and 25 Solar water heater certified installers. In parallel the MECI is participating in various public places in order to promote the various support schemes. In that respect the website is going to be redesigned and the use of social media can help also towards to that direction. MECI also is in the process of creating a digital platform where all the installers will be able to register (and re-register) electronically. In parallel, newsletter can be delivered and an online forum can be created to support all the certified installers.

Power Purchasing Agreements

PPAs are supported through the support schemes for all rooftop PV projects that are used for self-consumption. The PPAs have duration from 10 to 15 years and the producer is able to choose their supplier, once the electricity market will be in operation. For large scale projects there was a support scheme that enabled a short-term contract with the state-owned company of electricity (EAC). The terms and conditions of such a contract are being monitored by CERA and have a short duration (till the operation of the competitive electricity market).

Administrative Procedures

The Republic of Cyprus has taken a number of measures aiming at improving administrative procedures and removing barriers to the promotion of RES Energy.

There are various simplified procedures specifically for RES Electricity projects that have been improved over time by the various authorities involved, such as, Ministry of Interior[53],

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[50] http://www.moi.gov.cy/moi/moi.nsf/All/0886B91AFE961083C22581D000247B8A/$file/%CE%9A%CE%A0%20%CE%95%CF%80%CE%B5%CE%BD%CE%B4%CF%85%CF%84%CE%B9%CE%BA%CE%BF%CC%81%CF%82%20%CE%9D%CE%BF%CC%81%CE%BC%CE%BF%CF%822.pptx

[51] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/EDE50CAB048EE2B7C22581AE00331331?OpenDocument

[52] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/3FCDDDF3AF023C34C225822F00266422?OpenDocument

[53] www.publicaccess.tph.moi.gov.cy

Cyprus Energy Regulator[54], Department of Environment and Transmission[55] and Distribution System Operator[56].

More specifically, the following apply:

- Continued exemption of RES electricity generation systems with a capacity of up to 5MW from the obligation to obtain construction and operating licences from CERA.
- To set up RES electricity generation systems with a total capacity between 1kW to 20kW, it is necessary to apply to CERA for an exemption from the obligation to obtain a licence. There is an exemption from that obligation in the case of photovoltaic systems included in, and operating under, net metering and self-consumption support systems.
- Exemption of photovoltaic systems up to 150kW from the obligation to obtain a town planning permit, on condition that the systems are installed in accordance with the General Town and Country Planning Decree of 2014. An exemption from the obligation to obtain a building permit exists for photovoltaic systems up to 20kW installed in legally existing buildings.

Environmental impact assessments are not required in the following cases:

- Wind turbines with a capacity of up to 30kW (a preliminary environmental impact assessment is required for wind turbines with capacity over 30kW).
- Photovoltaic systems with a capacity of up to 100kW and no limit for the rooftop Photovoltaic Systems.
- Electricity generation plants using biomass with an installed capacity of up to 20kW.

Additionally, MECI, in cooperation with all competent authorities, is looking into ways to further simplify the licensing procedures for small RES systems with a view to significantly reducing the time taken to review applications. Finally, MECI is aiming to create a digitalized cross platform that will connect all the different stakeholders and thus facilitate the procedures for licencing of both large- and small-scale projects.

3.1.2.6. vi. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

Based on a project during a technical assistance received from SRSS, by Ricardo Energy & Environment (SRSS/C2017/004), in order to identify the potential for high efficiency heating and cooling solutions in agreed areas of Cyprus, where high efficiency solutions include District Heating and Cooling (DHC) and local, building level heating solutions, including Combined Heat and Power (CHP), heat pumps and solar thermal solutions, a model (excel based) was developed. The key findings arising from the Technical Assistance Report were as follows:

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[54] https://www.cera.org.cy/en-gb/ilektrismos/details/apallagi-ape

[55] https://www.dsm.org.cy/el/electricity-market/new-connections

[56] https://www.eac.com.cy/EL/RegulatedActivities/Distribution/renewableenergy/Pages/default.aspx

- District Heating and Cooling (DHC) solutions based upon the CHP technologies fired by Refuse Derived Fuel (RDF) and oil fired CHP are the only solutions found to be cost effective relative to the baseline on an economic basis (i.e. using a Discount Rate of 6%).
- With one or two isolated exceptions, these solutions are only found to be cost effective in two of the 10 Geographical Areas evaluated.
- The areas where economic cost-effective potential is found are the two tourist areas evaluated: Area 3 Poseidonos Avenue, Paphos and Area 4 Kryo Avenue. These areas are comprised entirely of hotels. The positive potential found for these two areas is primarily due to assumed higher hours of occupancy for hotels, compared with other building types, which increases the load factor on the plant and, therefore, reduces plant Capex for the same quantity of heating and cooling energy delivered.
- When viewed from a financial perspective (i.e. using a Discount Rate of 12%), some of the above mentioned solutions, which were cost effective from an economic perspective (DR=6%), cease to be cost effective, implying that private investment in these particular solutions would not come forward without support. We caution against assuming that projects that are shown to be cost effective with DR=12% in this work would automatically attract private sector investment. In Ricardo's experience, in order to bring forward private sector investment for District heating and cooling, returns on investment consistent with DRs greater than 20% would be needed. Therefore, the model should be used to explore other DRs, consistent with the private sector investment environment in Cyprus, to understand better the bounds of financial cost effectiveness. The model developed, is an ideal tool for doing this.
- The cost effectiveness of the RDF based solutions is strongly driven by the relatively low cost assumed for this fuel in the above study. Further consideration should be given to the possibility of supplying RDF at this price so that this finding can be validated. In that respect there are consultations between relevant stakeholders in order to promote such support scheme.
- While District Heating and cooling based upon Refuse Derived Fuel (RDF) CHP is attractive from a cost effective and CO_2 savings point of view, the modelling indicates that it would not generate Primary Energy Savings, relative to the baseline. This finding is driven by the assumption made in this study about how efficiently grid electricity would be generated in the future based on the PPM Scenario.

3.1.2.7. vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account: — biomass availability, including sustainable biomass: both domestic potential and imports from third countries — other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

Under examination.

3.1.3. Other elements of the dimension

3.1.3.1. i. National policies and measures affecting the EU ETS sector

No national policies have been prepared explicitly for the ETS sector. However, there are national policies and measures included in the NECP that will also affect the EU ETS sector and in particular the electricity production:

(a) Promotion of natural gas as an intermediate fuel for the decarbonisation of the energy system
(b) Promotion of renewable energy sources in all sectors by further emphasizing on synergies between various sectors
(c) Improvement of energy efficiency in all sectors
(d) Research and Innovation and new technologies.

The impact of the implementation of these policies to the emissions of the ETS sectors is presented in Chapters 4 and 5.

3.1.3.2. ii. Policies and measures to achieve other national targets, where applicable

There are no other national targets. Not applicable.

3.1.3.3. iii. Policies and measures to achieve low emission mobility (including electrification of transport)

The planned policies and measures to achieve low emission mobility include the following:

1) 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). The Limassol SUMP was completed in June 2019 and the Larnaca SUMP is expected to be completed in March 2020. Furthermore, the remaining cities in Cyprus are planning to start preparing their own SUMPs within 2020.

   SUMPs include costed policies and measures which scientifically prove (via world leading traffic prediction software) that a specific modal shift from car trips to sustainable modes of transport can be achieved. This group of measures include significantly improved bus services (routes, frequency, 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. The modal share of cars in Cyprus is currently over 90% and based on the plans and studies that have already been completed, a modal share of 75% car, 13% public transport, 12% walking/ cycling can be achieved and is set as a national target.

Based on the plans and studies that have already been completed, the cost of implementing this action is estimated at €1.4 billion and includes both capital and operational costs for the 2020-2030 period. It is worth noting that part of this cost is already included each year in the budget of the relevant authorities, while some of this cost can also be sourced from European funding as well as private funding.

2) The promotion of the purchase and use of vehicles with low or zero emission takes into consideration the harmonisation and implementation of European Directives (e.g. Cleans Vehicle Directive) for the purchase of new vehicles both for the private and public sector. This action also includes further incentives for the purchase and use of low/zero emission vehicles including additional old vehicle scraping schemes, further financial incentives for the purchase of electric vehicles and further amendment of the Motor Vehicles and Road Traffic Law (Law 100(I)/2013) for revision of the vehicle taxes and annual circulation taxes. The cost of vehicles and cost of infrastructure for this action will be sourced mainly from private sources. Based on these parameters, the impact assessment has estimated that approximately 11% of the passenger car fleet could be electric and 9% could be hybrid until 2030. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric vehicles.

3) The promotion of the purchase and use of low/zero emission buses is based on the incorporation of the new public transport contracts terms, the harmonization/ implementation of European Directives (e.g. Cleans Vehicle Directive) for the purchase of new buses for the private/public sector and the incentives for the use of low/zero emission tourist buses. The cost of vehicles and cost of infrastructure will be sourced mainly from private sources. Based on these parameters, the impact assessment has estimated that approximately 7% of the bus fleet could be electric until 2030. This measure is expected to be more effective after 2025 when the market conditions are expected to be more favourable for the purchase and use of electric buses.

4) Extensive tree planting of up to 650,000 trees along the urban road network and up to 350,000 trees along the interurban road network. The cost of this action is estimated at €85 million and includes the planting cost and infrastructure changes required along the urban network, but it does not include the maintenance and watering costs. The positive impacts for this measure include $C0_2$ absorption, aesthetic upgrading, shading, lowering temperatures and better conditions for cycling and walking that could have a significant impact in the use of sustainable modes of transport. It is noted that the effects of this measure are long term, due to the amount of years required for a tree to reach a significant size and for the benefits mentioned above to be effective.

3.1.3.4. iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

Not applicable

3.2. Dimension energy efficiency

3.2.1.1. i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation

By way of derogation from Article 7 of Directive 2018/2002 amending the Energy Efficiency Directive (2012/27/EU), Cyprus shall achieve new savings each year from 1 January 2021 to 31 December 2030 equivalent to 0.24 % of annual final energy consumption, averaged over the most recent three-year period prior to 1 January 2019. The cumulative amount of end-use energy savings for the period 2021-2030, amounts 243.04 ktoe and has been calculated taking into account the provisions of Energy Efficiency Directive. These savings will be achieved by a combination of energy efficiency obligation schemes and alternative measures. The detailed calculations and measures are represented in the Appendix 4. Based on the national planning, the measures will be implemented in steps, as presented in Table 3.9.

Table 3.9: **Energy efficiency obligation schemes and alternative measures under Article 7a and 7b of Directive 2012/27/EU**

a/a	Title of the measure	Short description of the policy measure	STEP -1 – effective by 2023	STEP 2 –effective after 2023	EU+ National funding needs-2021-2023 (Million euro)	EU+ National funding needs 2024-2030 (Million euro)	Total Investment cost taking into account private contribution (Million euro)
1	Energy efficiency obligation scheme (EEO).	In the EEO energy suppliers (electricity and transport fuels) are obligated to trigger energy savings actions on final customer level.	✓	The measure will continue in 2024-2030	Not applicable	Not applicable	€150m
2	Energy Fund of Funds providing soft loans for energy efficiency.	As part of the National Operational Programme "Competitiveness and Sustainable Development 2014-2020", the Directorate General for European Programmes Coordination and Development, acting as Managing Authority (MA), has dedicated resources to the implementation of an Energy Fund of Funds (EnergyFoF) managed by European Investment Bank. The financial product that will be offered through the EnergyFoF is loans to legal or natural persons to materialise investments that aiming to increase the energy efficiency.	✓	Upon a successful operation of the fund, it will be used after 2023 in order to continue its operation, utilizing the resources that will be returned to the fund.	€60m (EU funds and national funds)	€60m	€240m
3	Additional floor space "allowance" for new buildings and buildings that are renovated.	In the case of new buildings and buildings undergoing renovation, it is possible to increase the building rate by 5 % for energy class A building, and primary energy consumption will not exceed 50 (kwh / m2 year). The aim is to incentivize the construction or renovation of buildings that go beyond NZEB requirements.	✓	✓	Not applicable	Not applicable	Currently not available
4	Individual energy efficiency interventions and energy efficiency retrofits in selected governmental	Article 5 of Directive 2012/27/EU foresees that Member States are obliged to renovate annually 3% of the total area of buildings owned and used by central government authorities or to choose an alternative approach including other cost-effective energy-saving measures in selected privately-owned public buildings (including, but not limited to, deep	✓	✓	Part (€15m) of the €20m that has been secured by the European Structural and Investment	€20m	€40m

	buildings.	renovations and measures to change the behavior of users) in order to achieve by 2020 an equivalent amount of energy savings. Cyprus for the period 2014-2020 adopted the alternative approach and same approach will be followed for the period 2021 – 2030. For fulfilling the new obligation for the period 2021-2030 a mix of measures (deep renovations, individual energy efficiency interventions and measures to change the behavior of users) will be implement. To this end, a proposal for allocating €25m for deep renovation of public buildings has been submitted to the Directorate General for European Programmes Coordination and Development (DG EPCE) within the context of submitting proposals for the utilization of funds through European Structural and Investment Funds for the period 2021-2027. The final funding needs will be estimated in collaboration with the Ministry of Transport, Communications and Works.			Funds for the period 2014-2020 will be used for investments for 2021-2022. + €5m for 2023 under new proposal to DG EPCE =€20m		
5	Implementation of soft measures (information campaigns, trainings, workshops, etc).	MECI, places particular emphasis on disseminating information on energy issues, with a view to increasing awareness among citizens and among different professionals. For this purpose, MECI in cooperation with other bodies will continue organising workshops associated with Energy Saving, training seminars, energy efficiency awareness campaigns, development of energy savings tool for citizens, lectures at schools, distribution of leaflets on energy efficiency issues, awareness for taking behavioral changing measures in public sector etc. In addition, MECI will participate in the annual 'Save Energy' exhibition organised by Cyprus Employers and Industrialist Federation. Various media, incl.	✓	✓	National funds € 0,167m annually for energy efficiency campaigns		€1,67m

		Facebook, Twitter and YouTube will be utilized to promote, among other things, ES and RES.					
6	European Regional Cooperation Program "GREECE CYPRUS - Renovation of public buildings.	During the period 2018-2021 MECI is participating in the co-funded project entitled Sustainable Energy Development in Regional, Interregional and Cross-border level «STRATENERGY» which is implemented under the European Regional Cooperation Program "GREECE CYPRUS "). The aim of the project for Cyprus is the renovation of seven buildings of the wider public sector, funded by the program. The buildings will be renovated in 2021.	✓	Currently no information for new projects after 2021	€1,68m	Not applicable	€1,68m
7	Supporting scheme for promoting energy efficiency renovation in dwellings through European Structural and Investment Funds (Programming Period 2021-2027).	A proposal concerning the renovation of existing dwellings has been submitted by the MECI to the Directorate General for European Programmes Coordination and Development (DG EPCE) within the context of submitting proposals for the utilization of funds through European Structural and Investment Funds for the period 2021-2027. Dwellings after the renovation should be Nearly Zero Energy Buildings. It is estimated that under the supporting scheme 1.600 dwellings will be renovated. The proposal, for allocating €40m has been submitted in 2019 and is being examined by DG EPCE.		✓	€7m	€33m	€80m
8	Supporting scheme for promoting energy efficiency investments in Small and Medium Enterprises (SMEs) through	A proposal concerning the implementation of energy efficiency measures in SMEs has been submitted by the MECI to the Directorate General for European Programmes Coordination and Development (DG EPCE) within the context of submitting proposals for the utilization of funds through European Structural and Investment Funds for the period 2021-2027. Eligible measures will be the renovation of buildings and individual energy efficiency interventions. It is		✓	€3m	€12m	€30m

	European Structural and Investment Funds (Programming Period 2021-2027).	estimated that under the supporting scheme more than 100 renovations and individual energy efficiency measures will be implemented. The proposal, for allocating €15m has been submitted in 2019 and is being examined by DG EPCE.					
9	Supporting Scheme for promoting energy efficiency in municipalities and communities through European Structural and Investment Funds (Programming Period 2021-2027).	A proposal concerning the implementation of energy efficiency measures in municipalities and communities has been submitted by the MECI to the Directorate General for European Programmes Coordination and Development (DG EPCE) within the context of submitting proposals for the utilization of funds through European Structural and Investment Funds for the period 2021-2027. Eligible measures will be renovation of buildings and individual energy efficiency interventions. The proposal, for allocating €15m has been submitted in 2019 and is being examined by DG EPCE.		✓	€3m for 2023	€12m for the period 2024-2026	€30m
10	Supporting Schemes operated by the RES and Energy Efficiency National Fund for promoting energy efficiency investments in Residential and Public sector and energy audits in SMEs.	The policy measure concerns the various subsidy/financing schemes that will be operated the next years by the Management Committee of the RES and Energy Efficiency National Fund (national funds).	✓	✓	€37m	It is anticipated that similarly budget will be approved per 3 -years and after 2023 =€86m	€190m

11	Energy efficient street lighting.	**Communities:** The measure concerns the gradually replacement of street lighting (100.000 lamps approximately) in all Communities of Cyprus. According to the planning, the replacement will start in the 1st semester of 2020 and will be accomplished by the end of 2021. **Municipalities:** In 2018 was established a financial instrument for the Municipalities and the Communities through which they can apply for a loan to the Ministry of the Interior for the replacement of street lighting. At the moment, eleven municipalities have been approved. It is expected that more Municipalities will participate in the financial instrument in 2020 and 2021.	✓	No information yet	**Communities** €15,3m (2019 and 2020). The project is financed 100% from national resources (Government Budget). **Municipalities** Currently not available. Depends on the needs of Municipalities. National resources.	Not applicable.	€15,3m based on current data
12	Advanced Metering Infrastructure Plan.	The measure concerns the gradually installation of 400.000 electricity smart meters on building stock of the country. The timetable of the installation is: 1st Installation: 57.143 smart meters by the end of January 2021. 2nd Installation: 57.143 smart meters by the end of January 2022. 3rd Installation: 57.143 smart meters by the end of January 2023. 4th Installation: 57.143 smart meters by the end of January 2024. 5th Installation: 57.143 smart meters by the end of January 2025.	✓	✓	Not applicable	Not applicable	Currently not available

		6th Installation: 57.143 smart meters by the end of January 2026. 7th Installation: 57.143 smart meters by the end of January 2027.					
13	Promotion of energy Efficiency in enterprises, through voluntary agreements under the “Business 4 climate” initiative.	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. Up to date the declaration has been signed by 64 enterprises. It is foreseen that the implementation of the energy efficiency measures will start in 2020. It was decided that incentives are required for participating the enterprises in the project and step up their emissions reduction efforts by 2030. For mobilizing the enterprises, supporting schemes are under preparation from the Department of Environment, utilizing national funds. It is anticipated that the first supporting scheme will be in place in 2020. Enterprise that will manage to reduce their emissions, will receive as a reward, for each tCO2eq. reduced in a specific year, the Carbon Market Price in that specific year.	✓	✓	€13,5m for the period 2020-2022	Currently not available	€37m
14	Action plan for the road	To be implemented during the period 2021-2030 as per paragraph 2.2.v:	✓ implementati	✓ the measure will continue in 2024-	Estimated Budget (only for modal shift)		1.890+11..003 for Private transpor[57]t

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[57] According to the impact assessment there would be approx. 2 billion euros **saving** from private spending due to the reduction in the use and purchase of private vehicles.

	transport sector.	1.Modal Shift: Modal share of all modes of transport are set/will be set targets in the Sustainable Urban Mobility Plans and the National Strategic Plan Actions/ measures include: • Significantly improved bus service (new contracts, buses, etc.). • Upgrading of infrastructure for pedestrians and cyclists and public transport. • Development and implementation of a holistic parking policy. • Configuration of zero or low emission zones. • Promotion of a tram system in Nicosia. • Development and implementation of high-quality public transport axes for other cities. 2. Use of buses with low or zero emissions. 3. Use of vehicles with low or zero emissions.	on in 2021-2023	2030	Total Infrastructure and Operation / Maintenance Costs from 2020-2030 = € 1.890m (this includes approx. 500 m which is the current government investment between 2020 -2030 for public transport based on the existing public transport operating costs)		=12.893
15	Energy efficiency in water sector.	The Department of Water Development of Ministry of Agriculture, Rural Development and Environment is planning to implement the following energy efficiency measures by 2030: Energy efficient design of water networks. Energy efficiency-based procurement. Predictive maintenance of pumping equipment. Leak detection. Energy efficient water management. Introduction of energy management.The planning is at early stages and the available information is limited.	Not applicable	✓	Currently not available	Currently not available	Currently not available
16	Vehicle excise duty based on CO_2 emissions.	According to the law on motor vehicles, car owners pay road tax on the basis of the levels of pollutants from emissions, the engine category and the vehicle's age. Overall, the older the vehicle and the larger its engine capacity, the higher the road tax.	✓	✓	Not applicable	Not applicable	Not applicable
17	Energy	From 2021 onwards it is expected that energy	✓	✓	Not applicable	Not applicable	Not applicable

	consumption fee applied on electricity.	consumption fee (i.e. the contribution to the RES and Energy Efficiency National Fund) that is paid by all consumers of electricity, will be maintained at least to an average value of 0,8 Eurocents/kWh. Compared to the minimum electricity tax level of 0,1 Eurocent per kilowatt-hour foreseen in Directive 2003/96/EC, the RESEE fee leads to higher retail prices of electricity. Energy savings due to this taxation exceeding the minimum EU levels is taken into account, as energy tax imposed for energy efficiency.					
18	Excise tax on road transport fuels exceeding the minimum levels as required in Directive 2003/96/EC.	Energy savings from taxation measures exceeding the minimum levels of taxation applicable to fuels as required in Directive 2003/96/EC are taken into account, as energy taxes imposed for energy efficiency. Excise tax on road transport fuels to be maintained up to 2030 at least at the levels of 2019, as set by Consumption Tax Laws 2004 to 2018.(the national taxation for unleaded petrol and automotive diesel to exceed the EU minimum taxation to at least 0,07 Euros/litre)	✓	✓	Not applicable	Not applicable	Not applicable

Tables that summarise the estimated EU funds and national, financing needs, as well as, the estimated total cost of the investments needed (by taking into account also the need for triggering private financing) are presented in paragraph 3.2 viii. The proposed policies and measures are classified according to the sector and category covered.

The table below shows eight cross sectoral measures that target all sectors. The households and service sectors are targeted by several specific instruments in addition to the cross-sectoral measures. In both sectors theses specific measures concentrate mainly on buildings. The industry sector seems underrepresented but can profit from the cross-sectoral measures. Policies and measures that attribute to the national indicative target for 2030 are presented in the attached excel file (Appendix 4).

Table 3.10: PAMs and sectoral coverage

Title	Sector	Category
Energy Efficiency Obligation Scheme (EEO).	all	all
Energy Fund of Funds providing soft loans for energy efficiency	all	all
Additional floor space “allowance” for new buildings and buildings that are renovated.	all	buildings
Levy applied on all energy consumption (Law 2013/112(I)).	all	Appliances buildings processes
Vehicle excise duty taxes based on CO2 emissions	all	transport
Excise tax on road transport fuels exceeding the minimum levels as required in Directive 2003/96/EC.	all	transport
Action plan for transport sector	all	transport
Supporting Scheme for promoting energy efficiency in municipalities and communities through European Structural and Investment Funds (Programming Period 2021-2027).	service (public)	buildings
Supporting scheme for promoting renovation in dwellings through European Structural and Investment Funds (Programming Period 2021-2027).	households	buildings
Promotion of energy Efficiency in enterprises, through voluntary agreements under the “Business for climate” initiative.	Service Industry	Buildings / processes
European Regional Cooperation Program "GREECE CYPRUS - Renovation of public buildings.	Service (public)	buildings
Advanced Metering Infrastructure Plan	Households Service	buildings
Energy efficient street lighting	Service (public)	lighting
Energy efficiency in water sector	Service	all
Supporting scheme for promoting energy efficiency investments in Small and Medium Enterprises (SMEs) through European Structural and Investment Funds (Programming Period 2021-2027)	Service Industry	Buildings / processes
Implementation of soft measures (information campaigns, trainings, workshops, etc)	all	all
Renovation of public buildings through European Structural and Investment Funds (Programming Period 2021-2027)	Service (public)	buildings
Supporting Schemes through the RES and Energy Efficiency National Fund for promoting energy efficiency investments in Residential and Public sector and energy audits in SMEs.	Service, households	buildings

3.2.1.2. ii. Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, including policies, measures and actions to stimulate cost-effective deep renovation and policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

The long term renovation strategy will be finalised by to April 2020.

3.2.1.3. iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

The Cypriot energy services market suffers from a lack of trust on the clients' side, as well as lack of technical expertise, especially in preparing and managing public tenders. There is already an interest on the supply side (there are 19 ESCOs registered), the legal framework has been created, including supporting documents, awareness raising is ongoing and a number of projects are expected to be initiated soon.

For further developing the energy service market in Cyprus, MECI, with technical assistance from SRSS, completed two studies, one provided by JRC entitled "Long-term strategy for mobilising investment in renovating Cyprus national building stock"[58]and one by GIZ titled "An energy efficiency strategy for Cyprus up to 2020, 2030 and 2050"[59], that looked into the barriers that hinder the development of the ESCO market in Cyprus. These studies provide a list of solutions, measures and actions that can be taken by MECI in order to overcome these barriers. Among the finding are the lack of appropriate forms of finance, the lack of standardization, the inexperience of actors, the mistrust from the (potential) clients, the perceived business and technical risk, the small size of the projects and the high transaction costs, as well as need to remove procurement hurdles for energy efficiency services in the public sector. Some of these solutions will be taken forward within the period 2021-2030. Specific actions will include, inter alia, targeted trainings and capacity building of involved actors, information dissemination about the benefits of energy service contracts and opportunities for ESCOs to implement the outcomes of the obligatory energy audits performed by non-SME. There will also be an opportunity for ESCOs to participate in the energy efficiency obligation scheme via an electronic platform that will offer trading system for energy savings. The next update of the NECP will include more information on specific measures introduced about the above-mentioned.

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[58] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/7E8188C6CD612FB5C22581C4002CD533/$file/Study%20Results%20Final%20Report%20Long%20trem%20strategy%20for%20mobilizing%20investments%20for%20renovating%20Cyprus%20national%20building%20stock.pdf

[59] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B5969066F97FB710C22581D80035DB7F/$file/Study%20results-%20Developing%20a%20national%20Energy%20Efficiency%20Strategy%20up%20to%202050.pdf

Especially for the public sector, an additional technical assistance from SRSS has been provided to the Ministry of Transport, Communications and Works (MTCW)[60]. Under Deliverable 4 of this project, a Guide on Energy Performance tendering specifications for the public sector has been prepared. MECI is currently preparing template procurement documents especially for Energy Performance Contracts in the Public Sector. The availability of these templates will be a positive step for promoting energy services and Energy Performance Contracts in the Public Sector. These documents will be communicated to public and wider public authorities in order to facilitate them, accompanied with a brief step by step guide for each tendering procedure.

3.2.1.4. iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency)

With regards to energy efficiency in public procurement, MECI will strengthen monitoring related to purchasing highly efficient products and buildings by the central government. The monitoring will be implemented by requesting all central government authorities to inform MECI (every 3 years) about contracts signed in each calendar year that include provisions for high-energy-efficient products, services or buildings.

The main barriers identified that prevent a broader uptake of energy efficiency measures (such as limited financing, limited interest of final consumers for investing in energy efficiency, lack of spit incentives between tenants and owners in buildings, not fully functional market for energy services) will be adequately addressed in the post 2020 period. The measures will include, inter alia, adjustments in the existing legislative framework, development of guidance documents, targeted actions to increase of public awareness on the benefits of energy efficiency interventions, such as information campaigns and provision of training to selected target groups etc. Emphasis will be given on standardizing procurement procedures for energy services in public sector, as described in paragraph 3.2.iii

Moreover, energy audits and energy management systems will be further promoted by providing targeted information to enterprises though workshops and seminars. In this area cooperation with other stakeholders will be strengthened and the energy efficiency network for businesses, established under the Business4 Climate initiative, will be utilized. With respect to the enterprises that are obliged to perform energy audits, MECI will strengthen compliance checks.

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[60] Technical Assistance to the Cyprus Ministry of Transport, Communication and Works on Energy Performance Contracting, new energy efficient technologies and Cogeneration for public buildings

MECI will also consider measures for implementing the suggestions of the energy audit reports, such as directly linking of energy audit recommendations with support schemes (either with the direct financing of the enterprises or via energy service projects). Although the structure of the small domestic energy market currently does not leave big room for competition among energy suppliers, the introduction of the energy efficiency obligation scheme is expected to foster and accelerate the establishment of a functioning national energy service market.

The existing regulatory provisions with regard to the building codes, energy performance certificates, will be further enhanced in terms of increasing monitoring and implementation.

Capacity building activities for various stakeholders groups (e.g. building installers, energy managers, lawyers, bankers) will be designed to support the development and strengthening the capacities of individuals and institutions for the broader uptake of energy efficiency measures. Moreover, the introduction of standardised tools and procedures as well as electronic databases, online registries and communication platforms for energy efficiency professionals, are considered important. Such instruments will be operational in the post 2020 period and they will contribute to better monitoring the quality of services provided by the professionals in the energy efficiency sector.

However, the most important barrier for the achievement of the planned savings is the limited available budget. The private sector has been accustomed to be responsive only when a significant public subsidy is available, while the public sector tends to request full upfront capital coverage. For this reason, the transition to a more market-oriented financial support scheme will be definitely a challenge and a careful planning along with the mobilization of the appropriate financial and market instruments will be required. The aim from the side of the State is not to reduce its overall share in the support of the energy efficiency interventions, but mainly to drive the public financial resources to more cost-efficient support instruments and types of energy efficiency interventions with a higher leverage.

All financing instruments will be designed to be cost-attractive as well as implementable in market terms. Programs with a fast market uptake (i.e. roof insulation, heat pumps, solar thermal) allowing both comprehensive and stand-alone interventions will be prioritized. The Energy Efficiency Obligation Schemes will bridge the regulatory and financial gaps to allow an upscale of the deemed beneficiaries.

Scaling up investments in the post 2020 period will require more private financing and more market-based solutions. The establishment of a revolving fund “the Energy Fund of Funds providing soft loans for energy efficiency” as described in paragraph 3.2.i, is the first step towards a more market-oriented financial support scheme. The success or not of this fund is closely associated with the involvement and cooperation with the domestic banking sector.

More information on specific measures introduced on the above-mentioned will be included in the next update of the NECP.

3.2.1.5. v. Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv

Currently not applicable. This will be further examined in the revision of the NECP. Several workshops[61] took place in Cyprus and various ideas and best practices, where exchange with other Member States. During the workshops it was highlighted that new obligation that arise from the new Directives will need to revise legislation, develop new tools and introduce new disruptive technologies and new concepts that will alert the end consumer to participate actively in the energy community.

3.2.1.6. vi. Description of measures to develop measures to utilise energy efficiency potentials of gas and electricity infrastructure

In relation to the installation of smart meters, CERA's Regulatory Decision (**RD**) 02/2018 – Administrative Act 259/2018 «The application of a binding timetable for the mass installation and operation by the Distribution System Operator (DSO) of Smart Metering Infrastructure (Advanced Metering Infrastructure)» was issued. Based on point 5 of this regulatory decision, the DSO has submitted a timetable for the implementation of the project, where based on the latest update from the DSO he is currently in the process of recruiting a consultant to help him implement the tasks.

It is noted that on the basis of point 4 of the RD and the fact that Directive 2019/944 on common rules for the internal market for electricity and amending Directive 2012/27/EU, CERA request DSO, to take appropriate action "so that by 14 September 2025 at least 80% of final customers are equipped with smart metering systems as provided by the new directive, in order to avoid the subsequent requirement for corrective measures, which may increase the total cost of the purchase and installation of smart metering systems". In relation to the progress of this project, half-yearly progress reports will be submitted to CERA.

Regarding any other measures and policies planned to be implemented during the period 2021-2030 that could contribute to the energy upgrade of the electricity infrastructure, a study was carried out by an external consultant (RSE) with the participation of MECI, the DSO and the TSO which assessed the potential "energy efficiency of existing electricity infrastructure, in particular with regard to transport, distribution, load management and interoperability, as well as the connection with power plants, including the possibility of access to very small scale power plants". In the results and conclusions of this study, it is mentioned among other things that "the level of efficiency of the electricity system in Cyprus is well within the international benchmark".

Given the above, it has emerged that there is no need for any measures to reduce losses and some of the measures recommended by the consultant are already implemented by the DSO. One of the measure of the consultant was the increase of the level of the network voltage, which has been already adopted since many years by the DSO, with the practice

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[61] FOSS Workshop , May 8, 2019 Energy Communities and Operational functional needs

adopted being that for new connections 22 kV is used and for existing connections when and where the DSO considers it necessary an upgrade from 11 kV to 22 kV is performed. Therefore, on the basis of the above, a timetable for upgrading predefined areas from 11 kV to 22 kV has not been elaborated. However, CERA has proceeded with a series of actions that may not directly target the energy upgrade of electricity infrastructures, but will allow more efficient use of the network by the consumers and better management by the DSO and TSO. These actions are listed below:

- Issuance of regulatory decision 02/2019 – Administrative Act 204/2019 “on the elaboration of a thorough techno-economic study for the redesign of the transmission system and distribution system 2021-2030” where it is expected until 31 March 2021 to submit a study for the redesign of the system by the DSO and the TSO so that, among other things, it is possible to install more RES-E and eliminate the problems of lack of power absorption of new RES-E.
- Issuance of regulatory decision 03/2019 - Administrative Act 224/2019 “establishing basic principles of a regulatory framework for the operation of electricity storage installations upstream of the meter in the wholesale electricity market” in order to make all necessary modifications of the TDR and/or the TSR, and submit “to CERA for approval a final proposal for the amendment of the TDR and the TSR until 31 July 2020, so as to allow non-discriminatory participation of the electricity storage facilities upstream of the meter in the Electricity Market”.
- Issuance of a tender and implementation of a SCADA by the DSO at the distribution level through which the distribution system observability will be increased and which will be the basis for smart and more efficient management of the distribution system (load and RES -E which are connected to the distribution system).

3.2.1.7. vii. Regional cooperation in this area, where applicable

The EU Cross-Border Operational Program "Greece-Cyprus" enhances regional cooperation since it aims at economic and social development along the maritime border between Greece and Cyprus. The vision for the Cooperation Area is to highlight the region as a pole of sustainable development in the wider South Eastern Mediterranean region in the direction of enhancing competitiveness. Under the European Regional Cooperation Program Interreg V-A GREECE CYPRUS 2013-2020, projects aiming on increasing the energy efficiency have been approved and are being implemented. The projects are financed 85% by the European Regional Development Fund and 15% by National Resources of Greece and Cyprus.

Project «STRATENERGY»

The project «STRATENERGY» aims at the development and implementation of a modern common - in the cross-border area - strategy for integrating the buildings of the public and wider public sector by 2030 and actions and measures related to the improvement of energy efficiency. The implementation of mature Energy Efficient Projects in representative public buildings in the cross-border area and the finalization of the common strategic and operational planning framework for highlighting the "exemplary role" of public sector in promoting the energy efficiency is the overall objective of the project.

To this end seven buildings owned by organisations of the wider public sector will be renovated, improving dramatically their energy efficiency in Cyprus. Some of the main energy efficiency measures that will be implemented on the buildings is the thermal insulation of roofs and walls, the replacement of windows, the replacement of lighting, the replacement of heating and cooling systems, the installation of smart meters and the installation of PV Systems. The buildings will be renovated during the period 2020-2021. The total budget of the project is € 3.7m for all beneficiaries, while for Cyprus is €1.9m. The beneficiaries from Cyprus are the MECI and the Nicosia Development Agency.

More information for the project is available on the project's website[62].

Project «SYNERGEIN»

The project «SYNERGEIN» aims at the development of a common approach concerning the design, implementation and monitoring of energy efficiency measures/projects in municipal buildings with a vision of applying this approach to all municipalities in the area. The implementation of mature demonstration projects in six municipalities in the cross-border area and the identification of the framework for future projects through an integrated common cross-border energy planning across all municipalities is the overall objective of the project.

To this end, four buildings owned by municipalities and communities will be renovated in Cyprus. Some of the main energy efficiency improvement measures that will be implemented on the buildings is the thermal insulation of roofs and walls, the replacement of windows, the replacement of lighting, the replacement of heating and cooling systems, the installation of smart meters and the installation of PV Systems. The buildings will be renovated during the period 2019-2020. The total budget of the project is €2.1m for all beneficiaries, while for Cyprus is €1.1m. The beneficiaries from Cyprus is the MECI and the Nicosia Development Agency.

More information for the project is available on the project's website[63].

Project «ΑΥΤΟΝΟΜΩ»

The project aims at the development of a common strategy between the two countries for addressing the common challenges associated with the renovation and construction of more efficient buildings. The project intends to develop a guide (template) describing all steps required for a building to convert to a Green, Intelligent and Zero Energy building. For this reason, two public buildings in the eligible cross-border area will be renovated, highlighting the energy efficiency, the smart management, the ecological sensitivity and the technological intelligence as fundamental features of future buildings.

Furthermore, it is expected that these two public building will be the reference point for the construction, operation and maintenance of more energy efficient public buildings in the

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[62] https://www.stratenergyproject.eu/ and on the Program's website http://greece-cyprus.eu/

[63] https://www.synergein.eu/ and on the Program's website http://greece-cyprus.eu/

eligible area. The project in Cyprus, concerns the deep renovation of Aradippou Police Station. After the renovation, the building will be Nearly Zero Energy Building. The building will be renovated during the period 2020-2021. The total budget of the project is € 1,9m for all beneficiaries, while for Cyprus is €1m. The beneficiaries from Cyprus is the Department of Public Works and the Department of Electromechanical Services of the Ministry of Transport, Communications and Works and the University of Cyprus.

More information for the project is available on the Program's website[64].

Project «ΕΝΕΔΗ»

The academic / research community uses large data centers that consume large amounts of energy. The energy needs of the universities in Crete and Cyprus are very high and the cost of purchasing electricity is an important part of their operating costs. In addition, the geographical location of both Crete and Cyprus with high temperatures most of the year, make the use of heat exchangers in data centers necessary. The aim of the project is to apply methods for maximizing the energy efficiency and the smart energy management. At the same time, photovoltaics systems will be installed for generating a significant part of the electricity needed in the universities. In Cyprus the project concerns the installation and operation of RES and smart energy management systems in one complex of buildings in the University of Cyprus in Nicosia. The project is being implemented during the period 2018-2019. The total budget of the project is €1 m for all beneficiaries, while for Cyprus is €0.33m.

More information for the project is available on the project's website https://enedi.eu/ and on the Program's website[65].

3.2.1.8. viii. Financing measures, including Union support and the use of Union funds, in the area at national level

A detailed table on the financing measures under Article 7 of Directive 2012/27/EU is presented on paragraph 3.2.i, indicating the needs for EU and national funds per measure. The tables below summarize the EU and nation financing needs and the total cost of investments needed by taking into account also the need for triggering private financing.

Financing of Polices and measures also related to the indicative energy efficiency target can be found and in the attached excel file Appendix 4.

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[64] http://greece-cyprus.eu/ The website of the project is under construction.

[65] http://greece-cyprus.eu/

Table 3.11: Estimated total cost of investments needed (including EU funds, national financing and private financing)

Sector	Total cost of investments needed (million Euro)		
	STEP -1: Period 2021-2023	STEP -2: Period 2024-2030	Total
Energy Efficiency in residential, tertiary and Industry	331	485	816
Road Transport	1.196	11.697	12.893

Table 3.12: Estimated financing needed (including EU funds and national financing)

Sector	EU financing and national financing needed (million Euro)		
	STEP -1: Period 2021-2023	STEP -2: Period 2024-2030	Total
Energy Efficiency in residential, tertiary and Industry	161	225	386
Road Transport	567	1.323	1.890

3.3. Dimension energy security

3.3.1. i. Policies and measures related to the elements set out in point 2.3

Import of Liquefied Natural Gas (LNG)

Following the completion of a feasibility study in 2016, the Government of Cyprus (GoC) decided to proceed with a policy which will result in the import of Liquified Natural Gas (LNG) in Cyprus market, by approving the import of LNG to Cyprus in a manner leading to the commencement of natural gas supply to Cyprus. The LNG import route shall act as the single gas supply route until the indigenous gas sources become available for the Cyprus market, and will serve as an alternative supply route, for ensuring the security of inland gas supply.

As per the above, a tender was announced by ETYFA (Natural Gas Infrastructure Company) in October 2018 for the LNG Import infrastructure in Vasilikos Bay), aiming for a completion by early 2022. This infrastructure aims to end the energy isolation of Cyprus and has many cross-border impacts/ benefits for Cyprus and the Eastern Mediterranean region.

The tender entails the design, construction and operation of the project, which consists of (a) the procurement of a floating storage and regasification unit (FSRU), of at least 125,000 cubic meters storage capacity, to unload LNG from LNG carriers ranging in size from 120,000 cubic meters to 217,000 cubic meters (Q-Flex), (b) the Construction of offshore infrastructure for the permanent berthing of the FSRU, and (c) Onshore natural gas infrastructure and related construction components for gas delivery to the Vasilikos power station and potentially other gas consumers. On 13th of December 2019, the tender was awarded to the joint venture China Petroleum Pipeline Engineering, Metron, Hudong-Zhongua Shipbuilding and Wilhelmsen Ship Management.

The capital cost of the Project is estimated to be €300 m, spread over three years (2020 – 2022). It is also expected that the Project capital costs will be financed through a combination of a grant from the EU CEF (Connecting Europe Facility) of up to €101 m (project was approved by CEF in January 2018), debt financing (e.g. EIB, etc.) and an investment by the Electricity Authority of Cyprus (EAC) of €43m. The Operational and Maintenance cost is estimated to be around €200mn for a 20-year period.

Action Plan for the restoration of the electrical system after a power blackout

In the case of constrained or interrupted supply of electricity, TSOC implements the Action Plan for the restoration of the electrical system after a power blackout. TSOC submits to CERA, whenever it is considered necessary, an updated action plan for the restoration of the electrical system after a power blackout. The Action Plan includes among other issues, the steps/actions to be taken by the TSOC and the Power Plants themselves, the critical support staff, alert mechanisms, means of communication and any other possible actions for the implementation of the Plan. The Action Plan is in force since 2014 and since then several revisions have been made. Additionally, in order to improve the quality of supply and taking into account CEER's recommendations to harmonise Electricity Continuity of Supply (CoS) indicators, data collection procedures and the methodology to calculate the value of CoS as well as other major aspects such as voltage and commercial quality, CERA is in the process of taking the decision on preparing such indicators with external assistance.

Emergency procedures in the event of constrained or interrupted supply of oil products

Due to the limited storage tanks in the Republic of Cyprus, a part of the own stocks of KODAP is stored in oil companies in Cyprus and the rest is held in Greece. Furthermore, a quantity of KODAP stocks is in the form of tickets that are held abroad on other Member States. In the event of a major supply disruption, the Minister of Energy, Commerce, and Industry may implement the emergency procedures and measures provided by the law, including the release of emergency oil stocks. KODAP, at that scenario, will implement the specified procedure and planning, following Minister's instructions.

3.3.2. ii. Regional cooperation in this area

Not available.

3.3.3. iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The LNG import Terminal project (CyprusGas2EU) was awarded a Grant from the EU CEF (Connecting Europe Facility) of € 4.5 m for studies under the Cynergy project (see also 3.4.2.ii) and up to €101 million for the project (for more details see 3.3.i).

Description regarding the EU funding of other PCIs, see 3.4.1.iii and 3.4.2.iii.

3.4. Dimension internal energy market

3.4.1. Electricity infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

The National Competent Authority (NCA) of Cyprus for PCIs has accepted the application file of EuroAsia Interconnector submitted by the Project Promoter and the statutory permit granting procedure started in November 2019.

Taking into account the achievement of the interconnection target, Member States participating at EuroAsia Interconnector, Cyprus and Greece, will implement the following measures:

- Exchange of best practices and national electricity market standards or network codes for the cross-border exchange of electricity of renewable electricity between Cyprus and Crete.
- Coordination of the Transmission System Operators (TSOs) of Greece, Cyprus and Israel.
- Coordination of the National Regulatory Authorities (NRAs) of Greece, Cyprus and Israel.
- Implementation of ACER and ENTSO-E Guidelines from both Member States.

ii. Regional cooperation in this area

To promote regional cooperation for the EuroAsia Interconnector, the NCA of Cyprus and Greece are aligning their efforts for the interoperability of this cross-border interconnection. Also, according to the provisions of the Regulation 347/2013 the two NCAs may collaborate or exchange know-how for the permit-granting of this PCI.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The electricity interconnection, requires a substantial amount of investments; based on preliminary information, it is estimated (Chapter 5) that the national contribution of Cyprus up to 2030 may amount to 118 million Euros. This is a low amount, but one has to keep in mind that: a) three countries will be involved in financing the interconnector and b) the total investment cost for the interconnector will be much higher, but will extend to a much longer period in the future. In relation to the EU support the Project of Common Interest EuroAsia Interconnector received €15,825,000. The Project Promoter of EuroAsia Interconnector is preparing to apply for CEF grants for works in CEF Energy call in 2020.

3.4.2. Energy transmission infrastructure

i. Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

The current PCI in Cyprus for electricity is EuroAsia interconnector which is categorised according to EU Regulation 347/2013/EC in NSI East electricity corridor. The PCIs for gas, EastMed Pipeline and CyprusGas2EU, are both categorised in SGC gas corridor. The quantified objectives of these projects are market integration, increase the flexibility of the national energy system, ending the energy isolation of the island and contribution to the security of energy supply (related to energy security dimension) and reduce greenhouse emissions due to lower emissions of natural gas than those from conventional fuels (related to decarbonisation dimension mostly for gas projects). Gas supply transmitted by PCIs will be used for power generation in the island.

In the coming years, IGI Poseidon will focus its efforts on the development of the EastMed Pipeline project completing the engineering and survey activities, obtaining needed construction permits, defining the financial and regulatory framework and starting negotiations and cooperation with the key partners (at local and regional level) aiming the timely implementation of the Project. In this framework, on November 4th 2019, IGI Poseidon signed with the Israel Natural gas Lines Company LTD (INGL), the TSO of Israel, a Memorandum of Understanding that outlines the cooperation on the joint development of the EastMed Pipeline Project in coordination with existing, planned or under development gas infrastructure in the Region. Furthermore, regarding the cooperation on the EastMed Pipeline, the Intergovernmental Agreement (IGA) between Cyprus, Greece and Israel for the EastMed gas pipeline was signed on 2nd of January 2020.

Specific measures adopted to enable the delivery of Projects of Common Interest (PCIs)

A Ministerial decision appointed MECI as the National Competent Authority (NCA) for Projects of Common Interest (PCIs). Therefore the NCA proceeds to the actions below:

Following the notification submitted by the PCI EastMed Pipeline, the NCA will complete assessment of the maturity of the project in collaboration with other involved Authorities in Cyprus in the Q1 2020. After the acceptance of the notification by Cyprus and Greece the pre-application procedure will begin.

It has accepted the application file submitted by the PCI EuroAsia Interconnector for the starting of the statutory permit granting procedure in November 2019. After the completion of the statutory procedure by end of 2020 the construction phase will begin (total duration as submitted by Project Promoter is two years).

Preparation of the Manual of Procedures for PCI permitting in Cyprus (version 2) that will accelerate and simplify permitting procedure, prioritize PCIs in public sector and lift bureaucracy.

Development of the One-Stop Shop PCIs interactive website. This website will increase efficiency, promote transparency and help enhance cooperation among MS.

Specific measures for other key electricity infrastructure projects

Cyprus TSO Ten Year Network Development Plan 2019-2028, according to Article 67 of the Law for the Regulation of the Electricity Market.

The main objective of this measure is the development and the secure operation of the Transmission Network in the years 2019-2028. The criterion employed is n-2 for the backbone network and n-1 for the rest of the network circuits and the transmission transformers. The Transmission TYNDP analyses the investments to be carried out during the ten-year period 2019 to 2028 for the development and the secure operation of the transmission electricity system.

The T-TYNDP takes into consideration the total yearly demand forecast for the period 2016-2025 as well as the maximum forecasted demand for each transmission substation. The average long-term expected capacity growth of new PV systems was also taken into consideration. The TYNDP is implemented by the Transmission System Owner, which is part of the Electricity Authority of Cyprus, but is functionally unbundled from Generation and Supply Activities.

Details regarding this Policy and Measure are included in the Impact Assessment Study.

Key infrastructure modernisation projects are detailed in Section 2.4.3[66].

Specific measures that enable the delivery of PCIs (EuroAsia Interconnector) include the upgrade of Kofinou Transmission substation so as to ensure the security and reliability of the transmission system at a cost of € 2.650.000 between the years 2021-2022.

Specific measures for other key gas infrastructure projects

DEFA has carried out studies for the development of the internal gas network for the transition of gas from Vasilikos area to the other EAC power stations and the other IPPS.

MECI is updating the Master Plan of Vasilikos in order to ensure the inclusion of the required area for the Compressor Station and onshore landfall facilities of the EastMed Pipeline, as jointly identified by the IGI Poseidon specialists and the NCA officers in October 2019.

ii. Regional cooperation in this area

Cyprus's goal is to lead and promote regional dialogue on the creation of the necessary energy infrastructure that will lift its energy isolation. Partnerships in the EastMed region aspire to create a climate of stability, trust and cooperation in the EastMed region that can foster investment in sustainable development.

There is regional cooperation between Cyprus and Greece for the implementation of studies related to a regional market between the two MS for the use of LNG and promotion of LNG bunkering through two European programmes (CYnergy and PoseidonMed II).

Furthermore, a MoU was signed between the countries of Cyprus, Greece, Israel and Italy on the 5th of December 2017 at Nicosia for the EastMed Pipeline project, aiming at the development of this Gas PCI. EastMed Pipeline in combination with the Poseidon Pipeline, may transport gas from EastMed region to Greece and Italy.

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[66] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/SRSS-C2018-070_Deliverable_3.pdf

Additionally, Cyprus actively participates in the Eastern Mediterranean Gas Forum (EMGF) through which a regional platform for the discussion of energy issues among Mediterranean countries is provided.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Details regarding the financing of the project of the development of the necessary infrastructure to import natural gas to Cyprus (via the “CyprusGas2EU” project of common interest) are in Section 3.3.i of Dimension of Energy Security.

The Project Promoter of EastMed Pipeline has received €2.000.000 million for Pre-FEED studies. The Pre-FEED results, which clarified that the project was technically feasible, economically viable and commercially competitive, allowed the project promoter to proceed to the FEED phase, that has been supported by a €34.5 million CEF grant.

Additionally, the Cynergy programme responsible for the preparation of the Natural Gas Market in Cyprus has being supported by CEF Grant of €4,5 million.

CYnergy project is a holistic approach towards the establishment of a Natural Gas (NG) system in Cyprus aiming to end the energy isolation of the island through establishing strategic synergies between the sectors of Energy and Transport. Embarking on turning Cyprus into an energy hub in the East Mediterranean, CYnergy targets the development of a sustainable and fully functional NG/LNG market for providing clean and affordable energy to the end user. The project, which is co-financed by the EU, is a collaboration of energy, transport and finance experts as well as public and governmental institutions of Cyprus and Greece. The total Cynergy project[67] cost is €7.470.000 and the CEF Contribution was 60% of the total project cost. This policy is related to 3.4.2i "..specific measures to enable the delivery of PCIs and other key infrastructure projects " and 3.4.2ii "regional cooperation in this area".

3.4.3. Market integration

Policies and measures related to the elements set out in point 2.4.3

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[67] More details on the programme and the studies for the use of natural gas can be found at CYnergy project website http://www.cynergyproject.eu

ii. Measures to increase the flexibility of the energy system with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

Development of the Transmission System

Name of policy or measure	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 2018.
Main objective	The development and the secure operation of the Transmission Network in the years 2019-2028.
Quantified objective	Criterion n-2 for the backbone network, Criterion n-1 for the rest of the network circuits and the transmission power transformers.
Planned budget	€ 299 320 404
Type of Policy Instrument	Planning
Status of Implementation	Adopted
Implementation Period	2019-2028

Modernization Systems – Meter Data Management System

Name of policy or measure	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).
Main objective	Access of new Suppliers to the electricity market- MDMS enables the registration and entry of the meters in a particular registry. The meter readings of all consumers are registered and communicated to respective suppliers. Manages the supplier switching process.
Planned budget	€7 500 000
Type of Policy Instrument	Regulatory
Status of Implementation	Adopted
Implementation Period	04/2019-12/2020

Modernization Systems – AMI and Smart Meters

Name of policy or measure	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).
Main objective	Observability, monitoring, data recovery and electrical energy and power measurements-AMI offers the necessary observability, monitoring and recoverability of data and measurements of electric energy and power at the customer's connection point. AMI increases the accuracy of load and demand forecasting, improves the system analysis, enables the load and demand management and in effect the optimization of the operation of

	the Distribution System. AMI aids at managing EV Charging, PV System management and generation monitoring, optimization of RES generation forecasting, maximizes RES penetration, enables remote DSO operations (connections/ disconnections, meter reading), aids at the reduction of non-technical losses.
Quantified Objective	Roll out of 400 000 smart meters by 2027.
Planned budget	€55 500 000
Type of Policy Instrument	Regulatory
Status of Implementation	Adopted
Implementation Period	03/2019 – 01/2027

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

Network Flexibility - Storage Systems

Name of policy or measure	Regulatory Decision on Storage Systems that are installed before the metering point
Main objective	Amend the TSRs and TDRs to allow the participation of storage systems that are installed before the metering point in the electricity markets. The Regulatory Decision permits the participation in the electricity market of licensed storage systems installed before the meter that are not combined with consumption of energy locally and calls the TSOC to amend the Market and Network Rules to enable their non-discriminatory participation in the market.
Quantified Objective	N/A
Planned budget	N/A
Type of Policy Instrument	Regulatory
Status of Implementation	Adopted
Implementation Period	Until 31/7/2019

Network Flexibility - Demand Response

Name of policy or measure	Amend Trade and Settlement Rules and Transmission and Distribution Rules to allow for Demand Response in the market
Main objective	Participation of Demand Response in the Day-Ahead Market and the Balancing and Ancillary Services Markets. Define technical modalities.
Quantified Objective	N/A
Planned budget	N/A
Type of Policy Instrument	Regulatory

Status of Implementation	Implemented
Implementation Period	October 2019 (proposal submitted to the Regulator – Awaiting final approval)

iv. Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

Competitiveness and Contestability of the retail energy market

Name of policy or measure	Regulatory Decision 01/2017 on the Implementation of a Binding Schedule for the Full Commercial Operation of the New Electricity Market Model.
Main objective	Introduce Forward, Day Ahead, Intraday and Balancing Market with a Contingency Reserve to operate a competitive electricity market in Cyprus and to aid in the increase of the share of renewable energy sources to the electricity balance. *Wholesale Tariff (T-W) of the Incumbent EAC* The Wholesale Tariff (T-W) is calculated based on the Allowed Revenues of EAC Generation, which include the recovery of expenses related to the return on the capital, the depreciation of the capital and operation. All expenses are reviewed by CERA and only those deemed reasonable are approved for inclusion in the Allowed Revenues and therefore recovery through tariffs. T-W is then calculated taking into account the Long Run Marginal Cost methodology and grouped into the STOD periods as approved by CERA. The above methodology of calculating the T-W is based on the published Regulatory Decision No. 02/2015 “Statement of Regulatory Practice and Electricity Tariffs Methodology” (Κ.Δ.Π. 208/2015).
Quantified Objective	The participation in the electricity market of (1) 375 MW of RES Generation, (2) IPPs with a total licensed capacity of 507.5 MW, (3)13 licensed independent suppliers.
Planned budget	€8 000 000
Type of Policy Instrument	Regulatory
Status of Implementation	Adopted
Implementation Period	End 2021

Independence of the Transmission System Operator (Market Operator)

Name of policy or measure	Amend the national law to enable operation of the electricity market and make the TSO (Market Operator) independent from the vertically integrated electricity company.
Main objective	Enable the operation of the electricity market and establish a TSO (MO) who is independent financially and organizationally (management, human resources) from the incumbent Electricity Authority of Cyprus.
Quantified Objective	n/a
Planned budget (Euro Million)	n/a
Type of Policy Instrument	Legislative
Status of Implementation	Adopted
Implementation Period	End 2021

For vulnerable and energy poor consumers please refer to Section 2.4.4

v. Description of measures to enable and develop demand response, including those addressing tariffs to support dynamic pricing

See 3.4.3. iii.

3.4.4. Energy poverty

3.4.4.1. i. Where applicable, policies and measures to achieve the objectives set out in point 2.4.4

Refer to Section 2.4.4.

3.5. Dimension research, innovation and competitiveness

3.5.1. i. Policies and measures related to the elements set out in point 2.5

Existing policies and measures

- National funds that promote research in energy and climate, and the development by businesses innovative products and services i.e. RESTART 2016-2020 and Grant Scheme to Enhance Business Innovation.
- EU Competitive funds i.e. Horizon 2020 and Life.
- European Territorial Cooperation Programs i.e. Cross-Border Cooperation Program Greece - Cyprus 2014-2020 and Transnational Cooperation Program Balkan-Mediterranean 2014-2020.
- Council of Ministers decision of the 24th of October 2018 (Decision No. 86.012) foresees that the Technical Committee of the NECP will utilize the technical knowledge of the

Cypriot Climate-KIC network, which is a European knowledge and innovation community, working to accelerate the transition to a zero-carbon economy. Supported by the European Institute of Innovation and Technology, it identifies and supports innovation that helps society mitigate and adapt to climate change. Climate - KIC accelerates climate innovation across Europe by connecting the established Climate-KIC innovation hubs, currently in nine countries, which in turn act as a bridge into a pan -European network. Partners in Cyprus are the Cyprus University of Technology, Cyprus Energy Agency and Chrysalis LEAP who are committed to making the country a hub for cleantech innovation in the region. Activities such as a start-up acceleration program or the Journey summer school focus on promoting the nascent innovation and entrepreneurship ecosystem in Cyprus.

- Business4Climate has developed by Cyprus Employers and Industrialists Federation (OEB) in collaboration with Cyprus University of Technology, the Department of Environment and funded by the Climate - KIC. The aim of this initiative is to commit more than 250 companies from all sectors of economic activity in Cyprus to reduce their emissions by at least 8% by 2030. Within this framework, companies are expected to implement energy saving and renewable energy measures that will reduce their operating costs and make them more competitive.
- A new Governance System for R&I which establishes the National Board for Research and Innovation (NBRI), the Chief Scientist, and Ministry R&I coordinator. NBRI is the principal advisory body for defining R&I strategy, under the President of the Republic. The mission of the Chief Scientist is to coordinate and guide the national R&I governance system at policy level. Each Ministry appoints a R&I coordinator from existing personnel as a central point of communication for science, research and innovation topics. A Committee of R&I Coordinators is created, where all Ministry R&I Coordinators participate under the chairmanship of the Chief Scientist. The Committee provides a forum for communication, coordination and cooperation among the Ministry R&I Coordinators aiming to coordinate and align national sectoral policies and activities relating to R&I, and to address inter-departmental and bi-ministerial subjects.
- Support “teaming” projects to create or update existing centres of excellence through coupling of leading scientific institutions. Council of Ministers decision of the 9th of October 2018 (Decision No. 85.881) has committed €150m in the public budget to finance any possible proposals that will be selected under Horizon 2020 for receiving financial support to implement the future centres of excellence.
- Amendment of the legal framework regarding the operation of public universities that will allow them to transform scientific knowledge to commercial products and services.

Planned policies and measures

- Fund of Funds (sees paragraph 3.2 iv).
  Support schemes to promote energy efficiency investments in agricultural sector (sees paragraph 3.2 iv).
- New Industrial Policy which seeks to achieve sustainable development and production through upgrading energy efficiency and integrating RES in production and industrial infrastructure. The list of proposed measures includes the participation of the sector in

the Energy Efficiency Obligation Schemes, the utilization of “Fund of Funds”, the participation of the sector in voluntary agreements like Business4Climate and a technical and financial study on the feasibility to use waste of industrial areas for electricity production.

New Industrial Policy which seeks to improve industrial R&I infrastructure by creating the legal framework of “Patent Attorneys” with the aim of boosting the number of new patents. Additionally, it is foreseen the creation of a Technology Transfer Centre for enhancing cooperation between industry, academia, and research community to develop new innovative commercial products and services.

- Establishment of the Deputy Ministry of Innovation and Digital Transformation. The operation of the proposed institution will help to optimally coordinate activities to promote modernization, notably through the integration of information technologies and research and innovation, in which the Deputy Ministry will gather all relevant responsibilities, which are currently exercised fragmented by different departments and services.
- European Structural and Investment Funds in the new Programming Period 2021 – 2027: Under the "Greener low carbon Europe" thematic priority, actions to promote energy efficiency and the use of renewable energy sources will be promoted. It expected that 30% of the resources available from the European Regional Development Fund, which are expected to be in the range of € 225 to € 250 million, should be allocated to the above thematic priority.
- Revision of national funds regarding research and innovation with the aim to boost climate and energy priorities taking into consideration the update of Smart Specialisation Strategy and the NECP.

Policies and Measures that would be examined in the view of achieving the carbon emission goal for 2030

These measures will be examined up to the next review of NECP and their implementation will depend on their technical and financial feasibility, their impact on national goals, as well as stakeholders feedback and engagement.

Streamlining funds for R&D in energy and climate and optimize results

As a result of the stakeholder consultation process (section 2.5), the need for ringfenced research and innovation funds in energy and climate has clearly emerged. It is proposed that a National Energy and Climate Fund (NECF) is set up. Climate – KIC is proposing an annual budget of €7 million (this will be in addition to any budget increases to Research and Innovation mentioned elsewhere), made available from the trade of emission allowances from the ETS sector. With a dedicated administrator and team, the NECF will be committed to the setting of specific energy and climate R&I goals, targets and KPIs in a coherent R&I Plan; monitoring the progress of the R&I actions; reviewing and updating, as required, the R&I Plan; and to the overall management of the NECF and reporting to the relevant Ministerial Committee of the NECP.

Based on the feedback obtained from stakeholders, the R&I Plan developed and supported by the NECF will comprise of sub-pillars which correspond to the main findings of the stakeholders' needs mapping, all supported by different types of funding calls (as shown in Figure 3.3 and Table 3.13). It should be noted that the sectors/actions will be constantly updated based on annual evaluations. Adaptation to climate change and the implementation of Nature-Based Solutions are cross-cutting themes that will be applied horizontally across sub-pillars and funding calls.

Fiscally neutral green tax reform (see paragraph 3.2 iv)

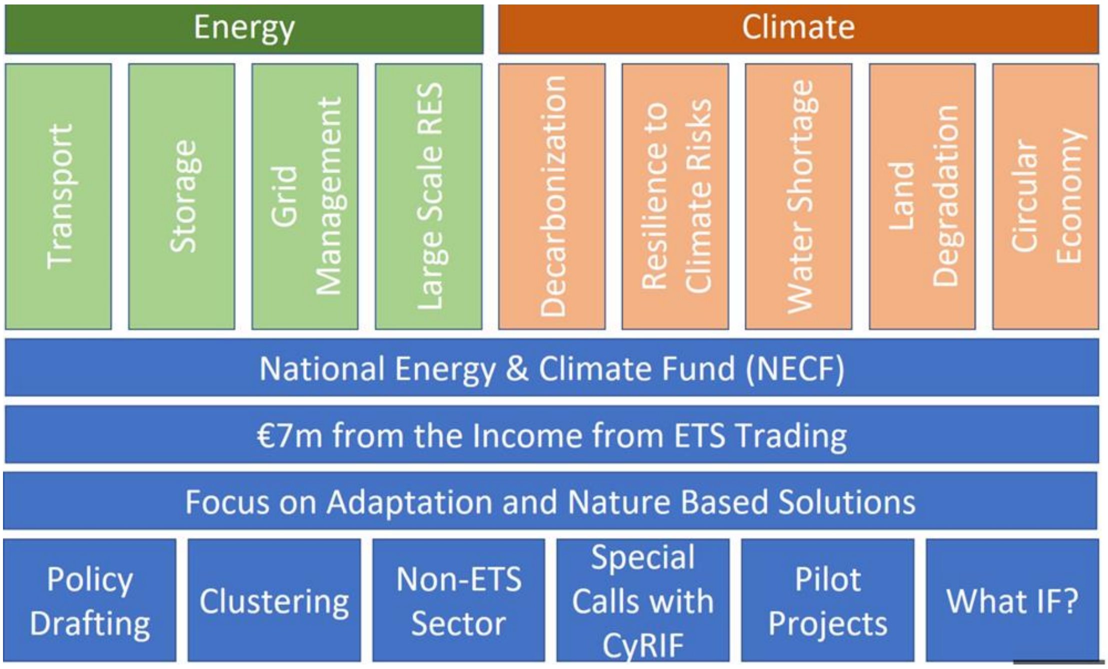

Figure 3.3: Suggested National Energy and Climate Fund

Table 3.13: Suggested R&I activities and budget allocation of the National Energy and Climate Fund

Action	**Description**	**Annual Budget (mil. €)**
Policy Drafting	Vision Setting, Research Mapping, Positioning Cyprus to the Global Market, Future trends, etc.	0.25
Clustering	Assisting the Business Development of Research Groups in Cyprus (not research funding)	0.75
Non-ETS Sector	Assisting all kinds of enterprises and organisations, both in the manufacturing and in the services sectors (including municipalities) reduce their emissions	1
Special Calls with the Cyprus Research and Innovation Foundation (CyRIF)	Special calls for the NECP pillars, for research and innovation at different maturity levels (i.e. Circular Economy, Adaptation) CyRIF to manage, funded by NECF	2
Pilot Projects	Mature technologies (pre-commercialization) to pilot in Cyprus. Low levels of co-funding by NECF (25-30%).	2

	Problem Owner (i.e. Municipality) co-funded specific calls.	
What IF? Calls	Fund technologies that are too risky to be funded by other calls, but that if successful, can reduce at least 1% of Global CO_2 emissions, if they achieve 100% penetration	1

3.5.2. ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SET Plan objectives and policies are being translated to a national context

SET Plan is the pillar of EU energy and climate policy research and innovation, contributing to the structure of European and national research programs and stimulating significant investments in low carbon technologies.

The European Technology Priorities, grouped according to the main objective of the Energy Union under the SET, are as follows:
(a) Becoming world number one in renewables
(b) Delivering a smart consumer-centric energy system
(c) Developing and strengthen energy efficient systems
(d) Diversify and strengthen energy options for sustainable transport
(e) Driving the ambition of carbon capture, use and storage
(f) Increase safety in the use of nuclear energy

Cypriot Universities and research institutions participate in the Temporary Working Group of ten SET Implementation Plans of:
(a) Solar PV
(b) Concentrated Solar Power
(c) Ocean Energy
(d) Smart Solutions for Energy Consumers
(e) Towards Positive Energy Districts for Sustainable Urbanization
(f) Energy Systems
(g) Energy Efficiency in Industry
(h) Renewable Fuels and Bioenergy
(i) Geothermal Energy
(j) Energy Efficiency in Buildings

Work on further aligning national research funds for the period 2021-2030 with the SET-Plan is ongoing.

Cooperation with other MS is mainly materialized through programs funded by Horizon 2020, Interreg MED (see Appendix 6).

3.5.3. iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

- RESTART 2016-2020 has as a vision to promote the Research, Technological Development and Innovation sector, as a key contributor to the economic development of Cyprus by contributing to addressing key economic and social challenges and developing the conditions for sustainable development, in line with the principles outlined in the Europe 2020 strategic framework for smart, sustainable and inclusive growth. RESTART 2016 - 2020 sets energy as a priority area based on the outcomes of Smart Specialization Strategy. At the same time, it is part of the Operational Program "Competitiveness and Sustainable Development 2014 - 2020", the Cyprus Development Strategy for the utilization of the ERDF resources under Priority Axis 1 "Enhancing the Competitiveness of the Economy". The program has a total budget of €99m from which €45m will be covered by ERDF. RESTART 2016-2020 has been designed and is managed by Research and Innovation Foundation.

- The Grant Scheme to Enhance Business Innovation supports existing, start-ups and other businesses investing in research and innovation to develop competitive innovative products and services that they plan to make available in the market, as well as innovative processes and processes in production of their products. The Scheme is co-funded by ERDF, it is part of the Operational Program "Competitiveness and Sustainable Development 2014-2020", the Cyprus Development Strategy for the utilization of the ERDF resources under Priority Axis 1 "Enhancing the Competitiveness of the Economy". The first call has a total budget of €18m.
- Horizon 2020 has the general objective to contribute in building a society and an economy based on knowledge and innovation across the Union by leveraging additional research, development and innovation funding and by contributing to attaining research and development targets, including the target of 3 % of GDP for research and development across the Union by 2020. It shall thereby support the implementation of the Europe 2020 strategy and other Union policies, as well as the achievement and functioning of the European Research Area (ERA). Cyprus has so far, managed to secure €129m EU contribution by participating in 435 projects.
- The LIFE program is the EU's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value. After 22 years, €3.4 billion and 4.170 projects, the LIFE Programme continues to finance actions for nature, environment and climate. For the 2014-2020 the total budget of the LIFE Programme was €3,46 billion
- ut of the total €784m allocated to Cyprus for the implementation of Cohesion Policy for the programming period 2014-2020, an amount of €32.7m will be assigned to the Objective of European Territorial Cooperation, which supports cross-border, transnational and interregional cooperation programs. During 2014-2020, Cyprus will be participating in the following European Territorial Cooperation Programs:
  a) Cross-Border Cooperation Program Greece - Cyprus 2014-2020
  b) Transnational Cooperation Program MED 2014-2020 – Interreg V-B MED
  c) Transnational Cooperation Program Balkan-Mediterranean 2014-2020 – Interreg V – B Balkan Med
  d) Cross-Border Cooperation Program Mediterranean Basin ENI Med 2014-2020
  e) Interregional Cooperation Program INTERREG EUROPE 2014-2020
  f) Program for Sustainable Urban Development URBACT III
  g) European Spatial Planning Observation Network ESPON 2020

The following table provides information about the energy and climate related projects that have been funded up to now by the abovementioned financing measures.

Appendix 6 provides a detailed list of the programs funded by EU competitive funds related to research in energy and climate for the period 2014 – 2020.

Table 3.14: Energy and climate projects funded up to now by the financing measures in Cyprus

Program	Public funding (€ million)	Private funding (€ million)
RESTART 2016-2020	14	-
Grant Scheme to Enhance Business Innovation	1.84	1.84
Horizon 2020	23.71	-
LIFE	-	-
European Territorial Cooperation	2.3	-

SECTION B: ANALYTICAL BASIS

4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments

There are various offshore activities regarding the oil & gas sector in Cyprus. Cyprus have granted 9 exploration licenses and one exploitation licence for the Aphrodite field. Moreover, there are another two gas discoveries (Calypso and Glaucus), which are under appraisal, while a number of exploration wells are planned for the next two years.

Aphrodite will be produced using a floating host facility and exported to Egypt through a subsea pipeline. The Government together with the licencees are exploring the various options for the exploitation of the other discoveries. The impact of these activities (exploration wells and production facilities) in CO2 emissions has not be evaluated yet. This will be done after the first revision of the NECP, when the Exploitation activities in the Republic of Cyprus will be mature.

More details are listed in section 2.2.1.

4.1.1.1. i. Macroeconomic forecasts (GDP and population growth)

Assumptions relevant to the country’s aggregates and population figures have been provided by the Ministry of Finance and are summarised in the following table.

Table 4.1: Macroeconomic and demographic projections

	2015	2020	2025	2030	2035	2040
Population [million]		910	926	934	936	930
GDP [millions €2010]		21754	24614	27173	30002	33124

4.2. Dimension Decarbonisation

4.2.1. GHG emissions and removals

4.2.1.1. Trends in GHG emissions and removals

This section presents the current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors.

According to the latest GHG inventory report submitted to the UNFCCC secretariat in November 2019[68], the total greenhouse gas emissions in 2017 (including LULUCF) were 8429 Gg CO2 eq., showing a decrease of 6% between 2005 and 2017. Compared to 1990, total emissions increased by 55% (Figure 4.1).

High dependence of the energy sector on fossil fuels, of transport on private cars and of solid waste management on landfilling is evident in the trends and associated to high values of the greenhouse gas intensity indicator compared to other member states of the European Union. The reduction in emissions during the recent years is predominately due to the increased RES penetration in the final consumption, the energy efficiency improvement measures and the economic recession. The impact of anaerobic digestion for the treatment of animal waste also slightly stabilises the agricultural emissions.

The contribution of the energy sector in the overall greenhouse gas emissions is the highest when compared to emission produced by other sectors of the economy. In particular, fossil fuel combustion for the electricity generation and heat constitutes the most important factor which contributes to the development of the existing situation.

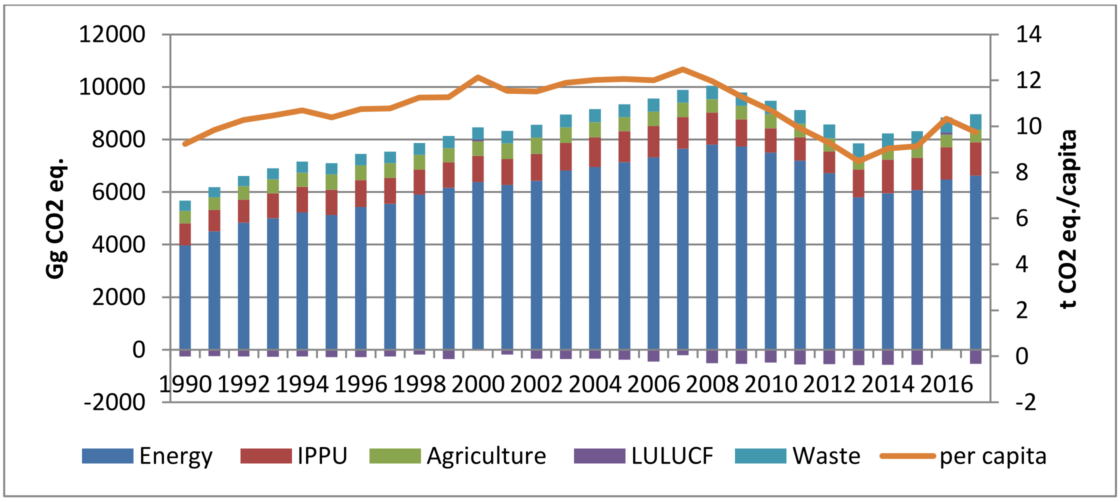

Figure 4.1: GHG emissions by sector for the period 1990 – 2017

Figure 4.2 shows the development emissions with respect to the year 2005 in the total greenhouse gas emissions as well as the sectoral trends. More specifically, the reduction of emissions in the energy sector has been significant (reduction of 7% for 2017 with respect to the year 2005 [after an increase of 9% observed by 2008]) and along with agriculture, was higher than the corresponding percentage reduction achieved in the total of the emissions sectors. Greenhouse gas emissions in industrial processes increased by 8% while emission from waste management showed the largest increase compared to 2005 (17%). The increase in emissions of the IPPU sector is a result in the increase in the use of fluorinated gases, while for waste the increase is attributed to the increase of solid waste production.

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[68] https://unfccc.int/documents/201011 (CRF tables only)

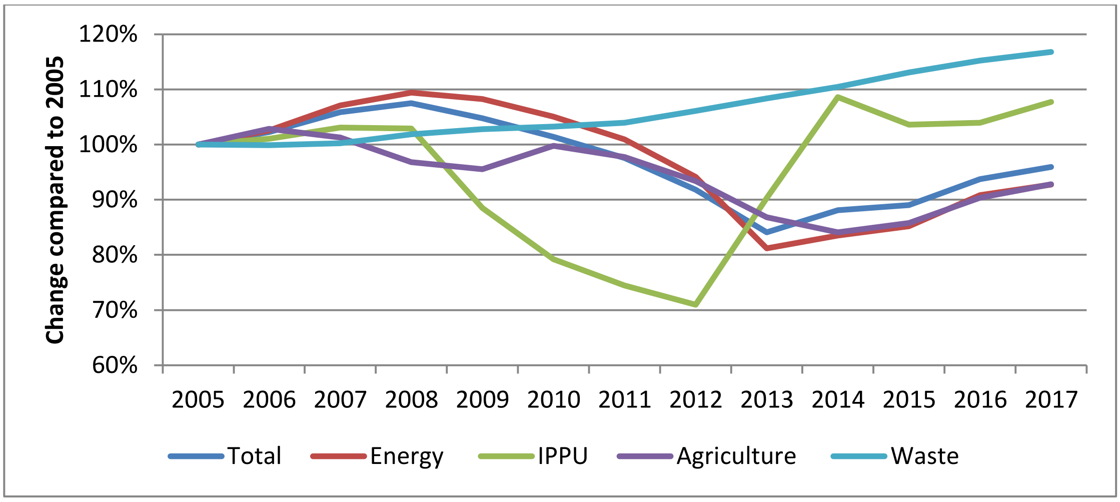

Figure 4.2: **Change in sectoral greenhouse gas emissions compared to 2005 (excluding LULUCF emissions)**

The ETS in Cyprus includes the three electricity production installations, one cement producing installation and six installations producing ceramics. These installations contributed 52% to the total national emissions in 2017.

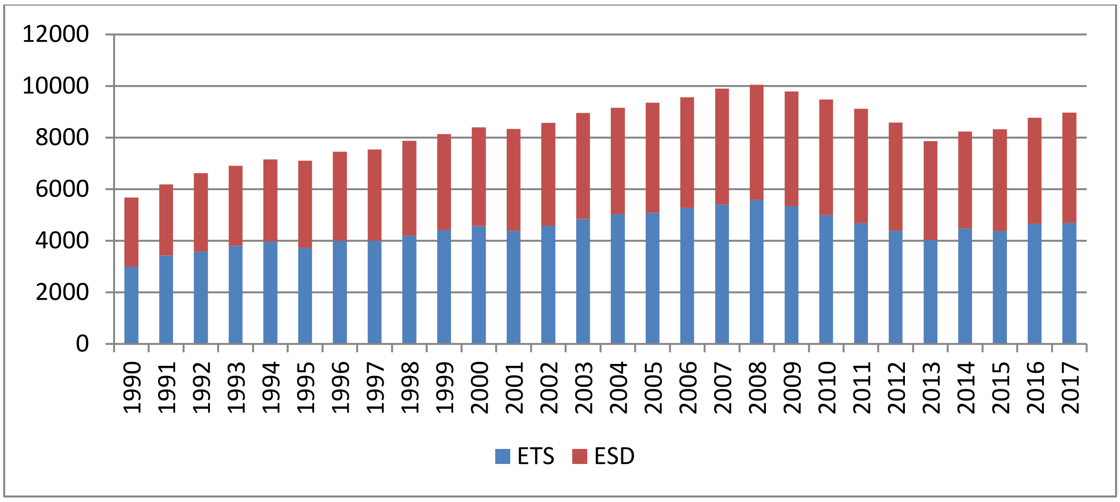

Figure 4.3: **Contribution of ETS and non-ETS emissions to the total (excluding LULUCF emissions)**

According to the latest GHG inventory, the majority of the non-ETS emissions come from road transport with 49% (Figure 4.4), followed by non-ETS energy (18%), solid and liquid waste management (14%), agriculture (12%) and use of fluorinated gases (6%). The remaining 2% comes from non-ETS industrial processes. For the ETS sectors, the majority of the emissions come from the production of electricity (70% in 2017) followed by cement production (29% in 2017) and ceramics (1% in 2017) (Figure 4.5).

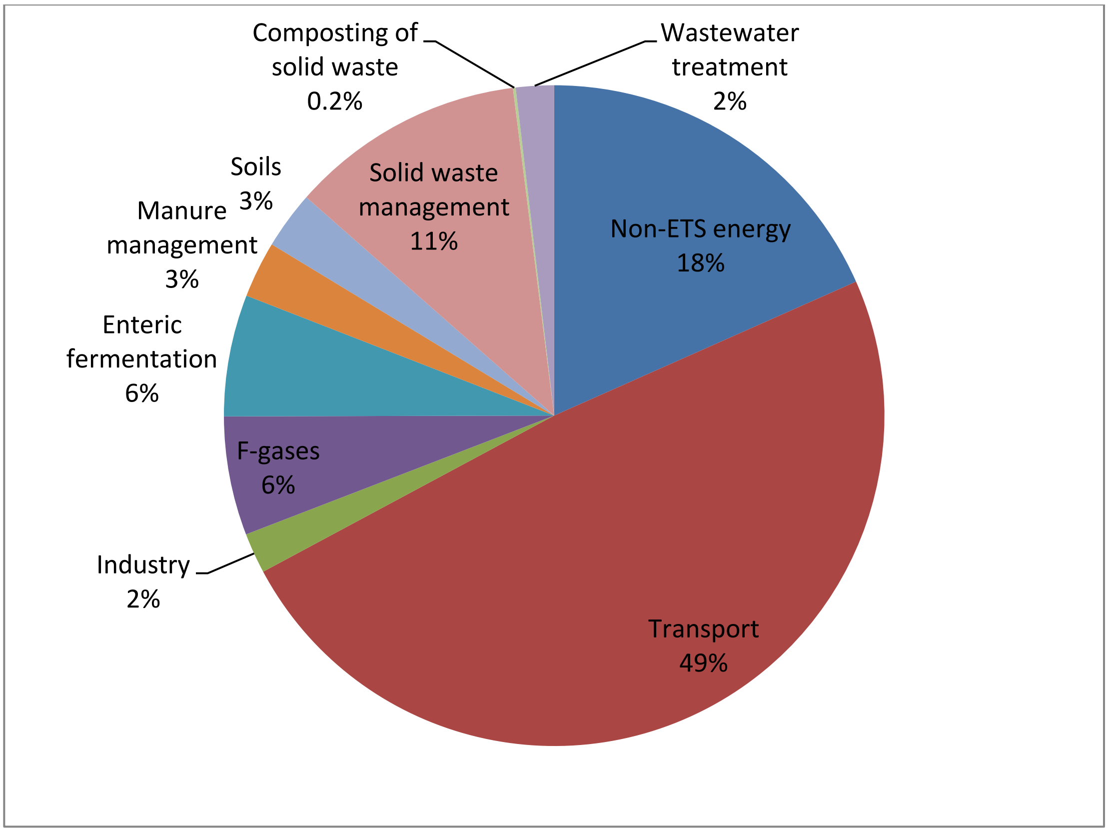

Figure 4.4: Contribution of non-ETS sectors to emissions (excluding LULUCF emissions)

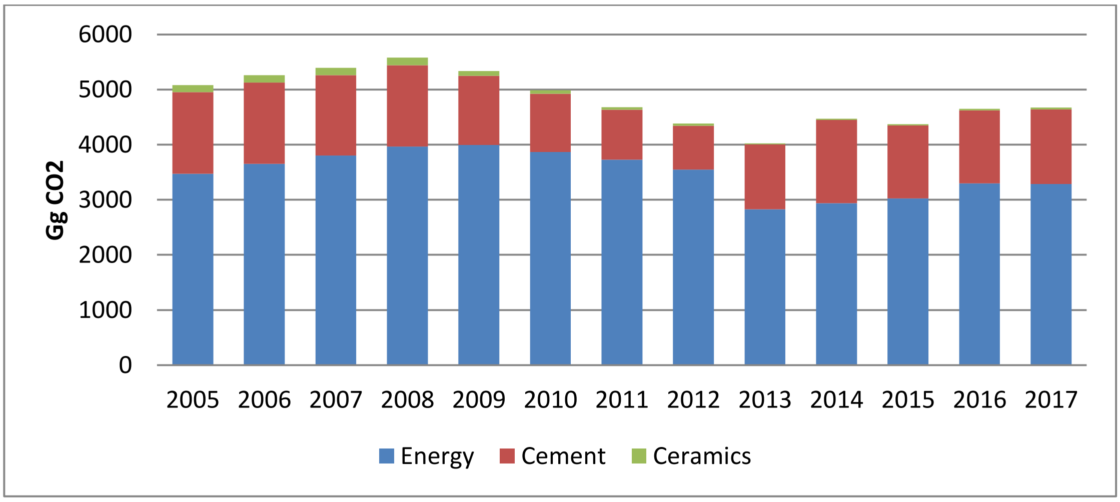

Figure 4.5: Contribution of ETS sectors to ETS emissions

The contribution of the energy-related activities to the total emissions of the energy sector is presented in Figure 4.6. As it is clearly visible the fluctuations are predominately due to the fluctuations in the electricity production which contribute 50% to the total energy emissions, while the growing trend of transport is also obvious.

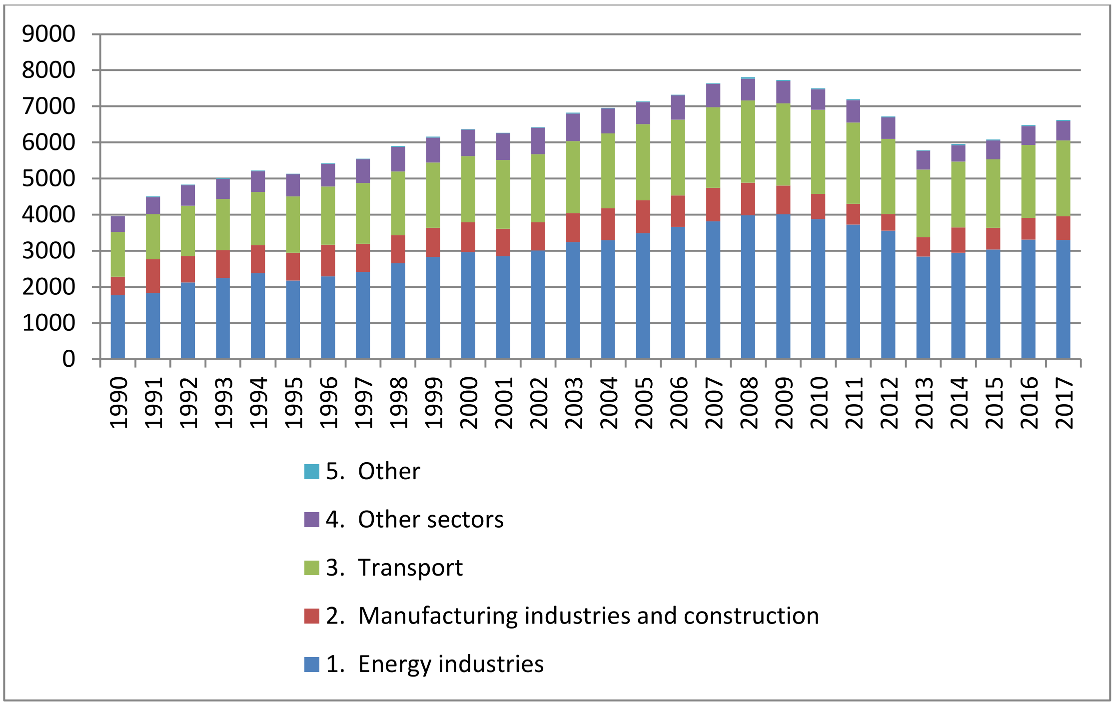

Figure 4.6: Contribution of the energy-related activities to the total emissions of the energy sector

With respect to LULUCF, there is an overall increasing trend in absorptions. In some occasions, absorptions reduce or there is even emission from the sector, due to wildfires.

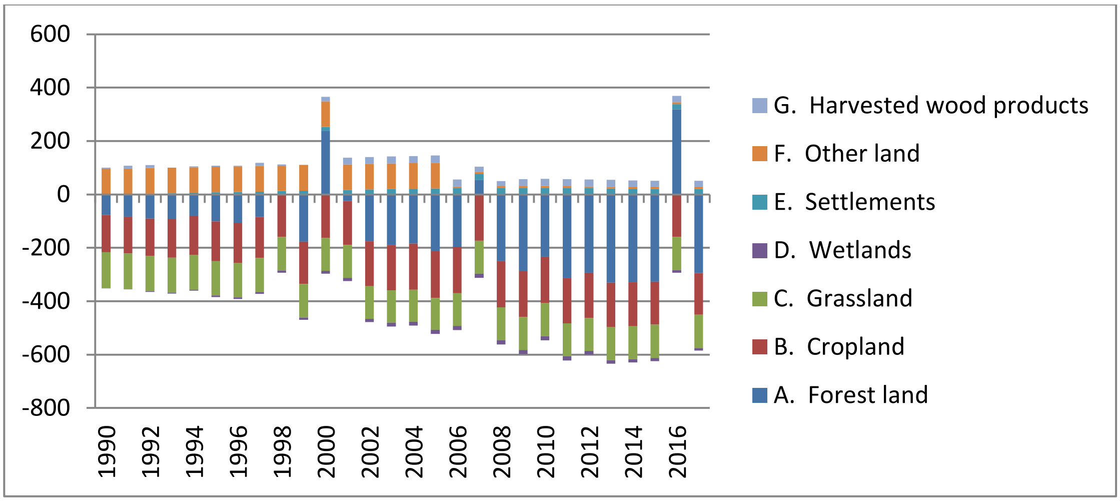

Figure 4.7: Contribution of the LULUCF-related activities to the total emissions of the LULUCF sector

4.2.1.2. Projections with existing national and Union policies and measures

This section presents the projection of emissions based on expected sectoral developments with existing national and Union policies and measures at least until 2040 (including for the year 2030).

Establishing and implementing the policies and measures described in the section outlining existing measures, it is assessed that the greenhouse gas emissions outside the EU ETS will reduce to 3829 Gg CO2 eq. in 2030 as shown in Figure 4.8, which corresponds to a reduction of 10.2% compared to 2005.

With regards to ETS sectors, the emissions are expected to reduce to 4195 Gg CO2 eq. in 2030, corresponding to a decrease of 17% compared to the 2005 emissions. A sharp decrease in the ETS emissions is expected in 2021, with the introduction of natural gas for electricity production.

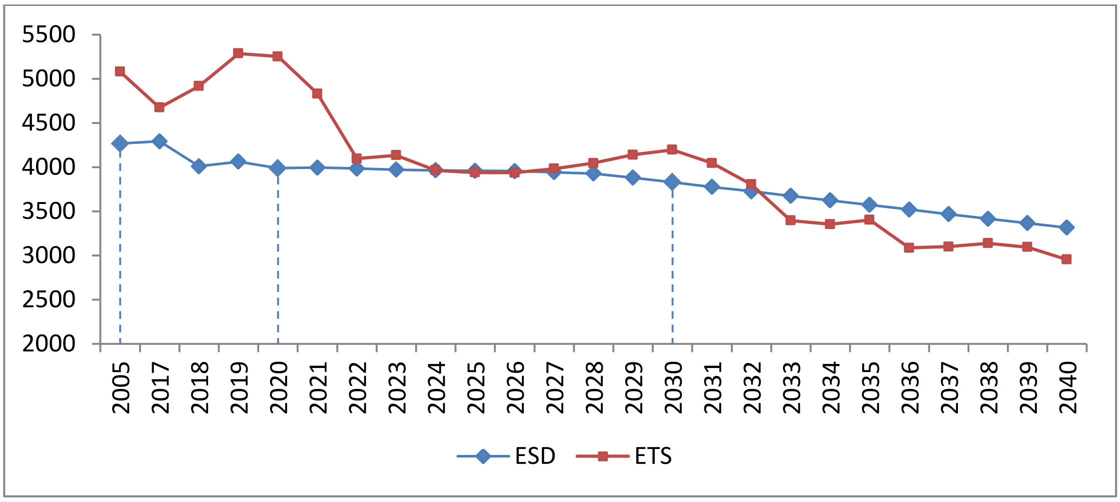

Figure 4.8: **Projected greenhouse gas emissions with existing policies and measures**

Figure 4.9 shows the expected emissions until 2040 with respect to the year 2005 in the total greenhouse gas emissions as well as the sectoral trends. In the future, considerable reduction in emissions is expected from the waste sector, due to the implementation of the new EU waste and circular economy obligations (25% in 2030 compared to 2005). The energy sector also shows a notable reduction of 20% until 2030 compared to 2005. The agricultural and industrial processes sectors are expected to stabilise their emissions due to the limitations these sectors have in reducing emissions.

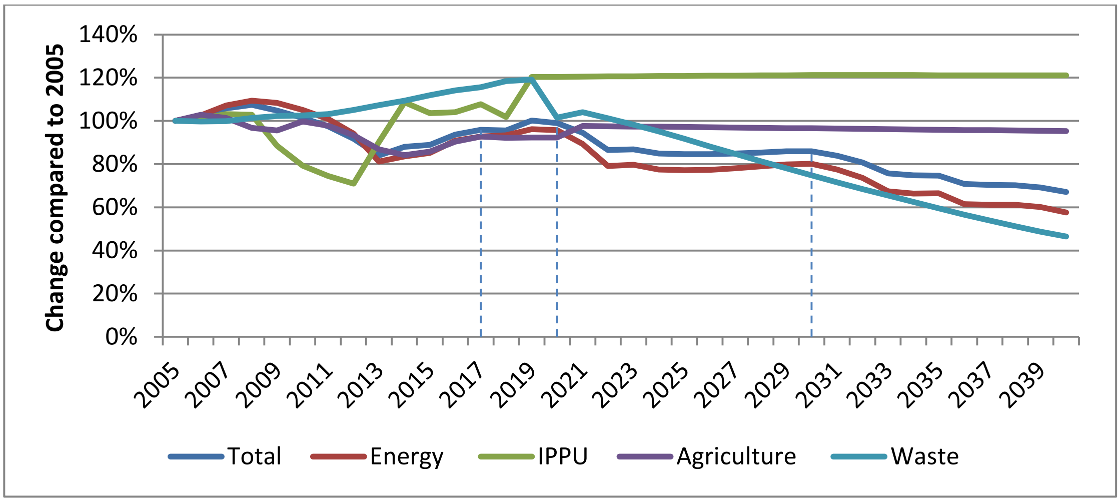

Figure 4.9: **Change in sectoral greenhouse gas emissions compared to 2005 (excluding LULUCF emissions)**

4.2.2. Renewable energy

4.2.2.1. i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

Cyprus must comply with a national renewable energy target currently set at 13% of gross final energy consumption from renewable energy by 2020. The renewable energy share for the power sector has been set at 16%, for heating and cooling 23.5% and for transport 4.9% (10% according to RES directive) by 2020 in the first National Renewable Energy Action Plan (NREAP)[69]

The existing contribution of RES in Cyprus is listed in Table 4.2. From the preliminary results of 2018 it seems that Cyprus can exceed the overall target of 2020 for 13% of RES based on directive 2009/28/EC, since the RES contribution in 2018 was calculated at 13.8%. This is not the case though for transport target, while there are a lot of efforts needed in the next period to achieve the RES target.

Table 4.2: Existing Status of RES in Final Energy Consumption as per 2009/28/EC provisions

	2015	2016	2017	2018*
RES in Heating and Cooling	23.60%	23.72%	24.95%	36.76%
RES in Final Electricity Consumption	8.48%	8.64%	8.98%	9.36%
RES in Transport	2.45%	2.65%	2.53%	2.69%
Total RES in final Energy Consumption		9.27%	9.72%	13.8%
Indicative Target for RES	7.45%		9.47%	

*preliminary Results from Eurostat [70]

The leading technology in Cyprus due to favourable conditions is the Solar Technology where the solar thermal contribution, by the end of 2018 had a significant share of more than 44%. What is interesting though (as it will be explained in sections below) is the contribution also of heat-pumps and local biomass that had played a significant role in achieving the RES target of 2020. The 13% target RES share in gross final energy consumption in Cyprus by 2020 was achieved, without the anticipated contribution from transport (10 % RES) since an equal amount of RES was used in heating sector. The general target of 13 % was attained in a more cost-effective manner.

The RES contribution in transport in Cyprus has resulted entirely from the obligation imposed in 2011 on all transport fuel suppliers, to mix biofuels that meet the sustainability criteria with conventional transport fuels (petrol and diesel) with a view to ensuring that the average annual biofuel energy content of conventional fuels represents 2.4% of the total energy content of the conventional fuels they place on the market. This obligation has remained unchanged to date (RAA 431/2011).

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[69] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/24D7A7A5980258B7C225822F0023CC EC?OpenDocument

[70] https://ec.europa.eu/eurostat/web/energy/data/shares

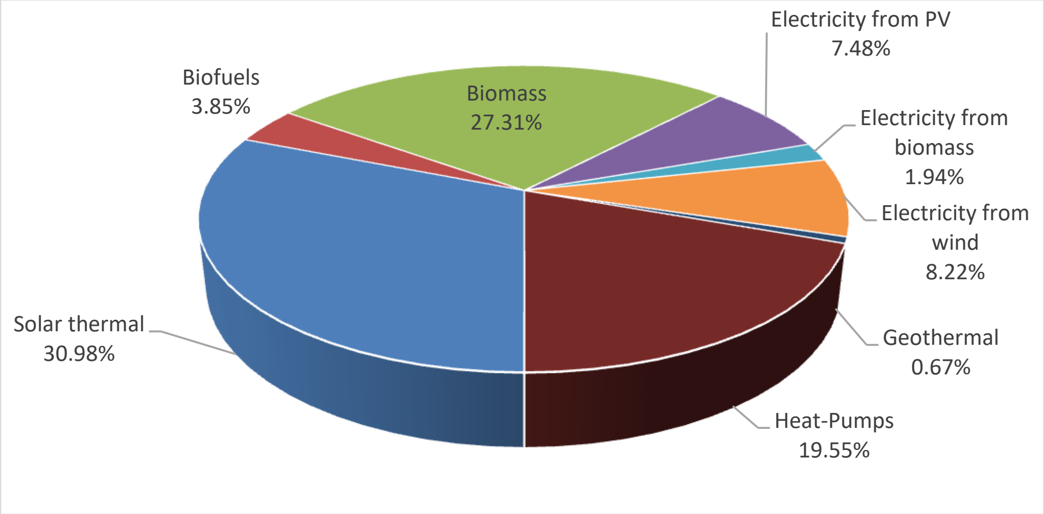

Figure 4.10: Share by Technology for Renewable Energy Share as of the end of 2018

To draw up a financially and technically optimal strategy for attaining the 10 % RES target in transport and to ensure the optimal penetration of alternative fuels in transport in Cyprus, the study ‘Penetration of alternative fuels in Cyprus road and maritime sectors’ was conducted by GIZ GmbH[71], which was financed by the SRSS (European Commission Structural Reform Support Services) and the German Ministry of Economic Affairs and Energy. The results of this study have been reviewed by the competent authorities in order to implement optimal actions towards attaining the 10 % RES target in transport by 2020. During the study the following concerns resulted:

- The 10 % RES consumption target in transport by 2020 is hard to attain and cost-ineffective for Cyprus due to a number of technical difficulties associated with its attainment.
- The very hot climate of Cyprus combined with the volatile nature of bioethanol does not allow for using petrol mixed with bioethanol, as the petrol specification laid down in standard EN 228, the vapor pressure specifications in particular, is not met. The study recommended the use of petrol mixed with bioethers, as the specifications of petrol are met for petrol mixtures with bioethers up to 15%.
- The cost-optimal option for attaining the 10% RES target in transport by 2020 is to use double counting biofuels. However, to attain the target, it is necessary to convert a large number of petrol-driven vehicles into diesel-driven ones (approximately 40 %), which is unrealistic within such a short period of time.
- The study also recommended the use of B100 in buses (in approximately 50 % of the fleet) as the most cost-effective method for attaining the 10 % RES target in transport. Due to restrictions in the contracts with public transport companies and other technical obstacles, the use of B100 in buses cannot be implemented till 1.1.2020.

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[71] Deutsche Gesellschaft für Internationale Zusammenarbeit

The detailed analysis of the technologies used are published in the RES progress report for 2014-2016[72]. The progress report for 2017-2018 is not available yet and it will be published in the MECI website once it is available.

In the section below a breakdown for the various technologies used in each category is shown, based on the analysis performed during the studies of SRSS (SRSS/C2018/070 & SRSS/C2017/077) for the NECP. Full reports of the above studies and analysis is listed in the MECI website[73].

Electricity from RES

The technologies used in Cyprus are Solar Photovoltaics, Wind Parks and Biomass plants that producing Biogas from animal Waste. The breakdown of the generation in GWh is presented in Table 4.3.

Table 4.3: RES Electricity Generation per Technology until the end of 2018 – Current Status

Electricity production from renewable sources (GWh per year)	Solar	Wind	Biogas	Total	RES %
2008	2,55	0	11,54	14,09	0,29%
2009	3,83	0	26,52	30,35	0,59%
2010	6,39	31,37	35,12	72,88	1,39%
2011	11,94	114,31	51,61	177,86	3,45%
2012	21,54	185,48	50,02	257,04	4,93%
2013	47,11	231,04	48,86	327,01	6,65%
2014	83,59	182,85	50,55	316,99	7,40%
2015	126,66	221,86	51,24	399,76	8,45%
2016	147,65	226,7	52,02	426,37	8,59%
2017	173,73	211,45	51,91	421,68	8,91%
2018	195,29	220,61	36,10	452,01	9,36%

RES in Transport

In Cyprus up to 2018 the only available source of RES in transport sector was the Biofuels. The biofuels used were the total sustainable biofuels, produced from feedstock listed in Annex IX Part B of Directive (EE) 2015/1513.

The average RES share in transport in the two-year period 2017-2018 was 2,64 % and had no significant increase. The intermediate targets specified in the National Action Plan, for the two-year periods concerned, were not attained. In the two-year period 2017-2018, there was a small increase in the use of biofuels produced from used cooking oil, the contribution of which towards a 10 % RES target in transport is twice their energy content. All the biofuel used in 2018 was produced from used cooking oil.

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[72] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/24D7A7A5980258B7C225822F0023CCEC?OpenDocument

[73] http://www.mcit.gov.cy/mcit/energyse.nsf/page27_gr/page27_gr?OpenDocument

Table 4.4: RES contribution in Transport Sector – Current Status

	2013	2014	2015	2016	2017	2018
RES contribution in Transport Sector	2.69%	2.59%	2.69%	2.52%	2.68%	2.6%

Heating and Cooling

Solar Thermal: Solar Panels for hot water use and for heating purposes.

Geothermal: Both Close loop and open loop systems

Biomass: Solid Biomass for both household and process heat in industry. More specific the biomass supply for heating and electricity was:

1) Biomass supply for heating and electricity
2) Direct Supply of wood biomass from forests and other wooden land energy generation (fellings etc.)
3) Indirect supply of wood biomass (residues and co-products from wood industry, Scrap Wood / Wood residues, process wood fuel (charcoal), wood pellets
4) Agricultural by-products / processed residues and fishery by-products (Charcoal from olive pit and meat meal)
5) Biomass from waste (municipal, industrial etc.), Sludge from Municipal waste
6) Biomass from used cooking oil

Table 4.5: RES contribution in Heating and Cooling – 2010-2018

RES in Heating and Cooling (toe)	Solar	Heat Pumps	Biomass	Total	RES %
2010	61.07	0.753	18.54	80.36	18.84%
2011	62.99	1.05	19.55	83.59	18.90%
2012	64.47	1.48	16	81.95	21.50%
2013	65.71	1,477	21.11	88.3	20.49%
2014	66.79	1,551	24.1	92.44	20.85%
2015	67.86	1.55	29.81	99.21	23.60%
2016	68.97	1.55	31.46	101.98	23.72%
2017	70.23	1.55	41.14	112.92	24.95%
2018*	71.63	45.2	63.16	184.1	36.76%

*The results of 2018 are preliminary

In Heating and Cooling Sector, recently there was an assessment of the calculation methodology for the contribution of heat-pumps in the RES Sector. Based on the methodology followed (as defined in Article 5(1)(b) and (4) of Directive 2009/28/EC) there was a significant increase in RES share in heating due to Renewable Energy from heat-pumps. In addition, there was a re-assessment from Statistical Service of Cyprus as far as it concerns the wood biomass for house use. The results of the recent assessment were submitted to Eurostat and a historical re-adjustment was made for the previous years as well. This re-adjustment has not affected the historical records of Cyprus and is not expected to affect the future RES share in this sector, since there is a declining trend of using wood-based biomass for home heating purposes.

4.2.2.2. ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

In the short-term, as oil-fired generation is substituted by gas-fired generation, decarbonisation of the electricity sector is achieved to an extent. A key finding in the electricity supply sector is that conventional thermal generation retains its share of the generation mix in absolute terms until 2030 and 2040. However, growing electricity needs are satisfied by increased penetration of renewable energy technologies, and primarily an increasing deployment of solar photovoltaics. This is driven by decreasing capital cost of photovoltaics, and enabled by substantial investments in flexible thermal generation, as well as partial electrification of the transport sector. Renewable energy share in electricity reaches 26.5% by 2030. All the existing policies and measures for Self-Consumption will continue, and the participation of RES in the electricity market will materialized.

In the scenario WEM there is a lack of substantial policies and measures in the transport sector and the dependence on passenger cars and marginalisation of public transport modes. Nonetheless, improvements in alternative technology performance and cost lead to the adoption of hybrid and electric vehicles, whose total corresponds to nearly 10% of the total passenger fleet by 2030. Continued investments in renewable energy, and especially solar thermal in buildings, increases the renewable energy share in the Heating and Cooling sector by 10% till 2030. The overall RES share increases to 20% by 2030 instead of 23% as recommended by EU, which is not adequate to meet the EU indicative targets. The results as well as the policies and measures of this scenario are included in the Appendix 4 and Deliverable 3 of the Impact Assessment study.

Scenario WEM Results for RES

From Figure 4.11 it clear that the transport sector is lagging behind while the other sectors, i.e. Electricity and heating and cooling have a constant increase of their RES contribution over the Horizon 2021-2030. It should be noted that the RES in transport is the most challenging sector, especially for Cyprus where there are not electric trams or adequate public transport (due to economies of scale) for public needs. In addition, the further penetration of Electric Vehicle (while there are favorable conditions in Cyprus due to the short distance and weather conditions) are not cost optimum to be deployed since the RES in electricity cannot further evolve due to the end of 2030. On the other hand, it is clear that as the RES electricity evolves the RES in Transport also increase in the post 2030 period. This is due to the significant reduction in purchase price of EVs. Also, during that period, the prices of Storage also decrease and thus more RES Technologies can enter into the Electricity System.

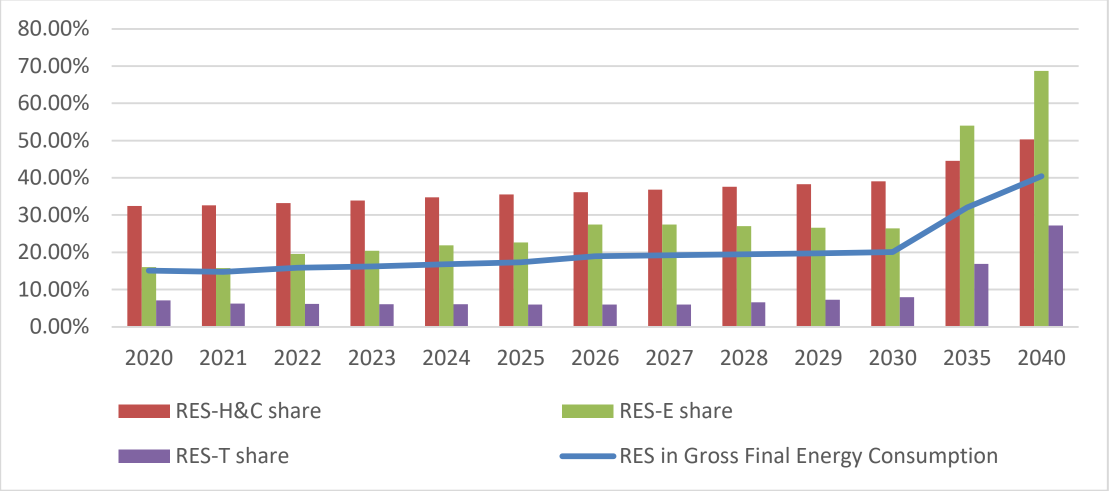

Figure 4.11: The evolution of RES in Sectors: Electricity, Heating and Cooling and Transport, till 2040 in the scenario WEM

For the electricity sector, from the evolution of Technologies, in the case of no Electricity Interconnector, there is an increase need of Storage Technologies in order to avoid curtailing energy. It is more likely in order to avoid distorting the energy prices that RET can be curtailed without compensation if TSO requests to do so because of system security concerns, and no cap is set on max curtailment which creates a substantial risk for Renewable Energy Technology investors. As it is shown in sector 3.1.2 the use of Interconnector can help the RES to further penetrate earlier, while in the WEM scenario it seems that more RES will be introduced in the post 2030 period with technologies that using storage behind the meter. These technologies, based on the existing available data, include Concentrated Solar Thermal (CSP) and other storage technologies like Li-Ion Batteries and Pumped Hydro. A detailed overview of Storage technologies that can be deployed in Cyprus was made under an SRSS study by University of Cyprus[74] and JRC[75].

The scenario results (WEM) have not evaluated the possibility and the effects of the Electricity Market.

The outcome of the above scenario (WEM) as far as it concerns the final technology mix is presented in Table 4.6 and the corresponding electricity generation is displayed in Figure 4.2.2.2.

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[74] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/JRC%203-%20Storage.pdf

[75] JRC Study for Storage

Table 4.6: RES Technologies in Electricity Sector up to 2040

MW	2021	2025	2030	2035	2040
Light fuel oil CHP	0	0	0	4	26
Solar PV	380	468	750	1,447	1,631
Solar Thermal	0	50	50	350	700
Wind	158	198	198	198	198
Biogas	22	42	50	50	64
Pumped Hydro	0	0	130	130	130
Li-Ion Batteries	0	22	41	97	179

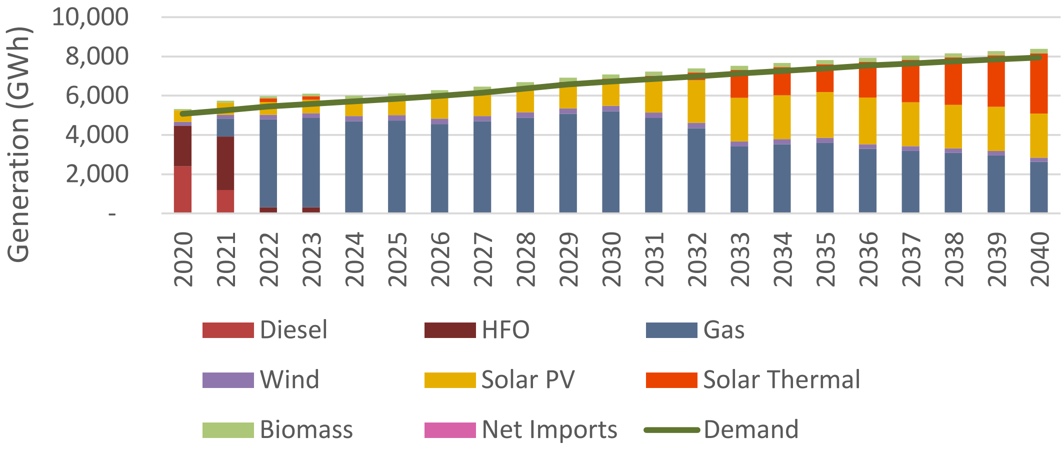

Figure 4.12. RES Energy mix Generation till 2040 in the scenario WEM

For the transport sector, only biofuels and electric vehicles are considered as optimum solutions in the period up to 2040. The development of these technologies as well as their shares is presented in the Table 4.7.

Table 4.7: RES Share in Transport in the Scenario WEM, and the evolution of Electric Vehicles

	2021	2025	2030	2035	2040
Biofuels (All litres)	56,735,415	46,699,480	45,424,207	42,036,290	38,958,780
Electricity (MWh)	613	1,255	99,084	343,787	590,870
Fleet (EVs only)	241	467	41,770	112,672	187,184
Share of RES	6.22%	5.99%	7.93%	16.92%	27.1%

It is anticipated to use the new methodology, mentioned before, also for cooling in the next NECP revision which was not taken into account, since the RES-Directive does not offer any indications on how to account for renewable cooling. Due to the lacking of methodological guidelines on how to account for renewable cooling, cooling currently does not play a role for target achievement. In addition, there were some technologies that were not examined in this scenario such as Open loop geothermal Technology and Process heat applications using Solar thermal (CSP technologies) or Solar Cooling (and Cooking) using solar panels or CSP Fresnel Technology.

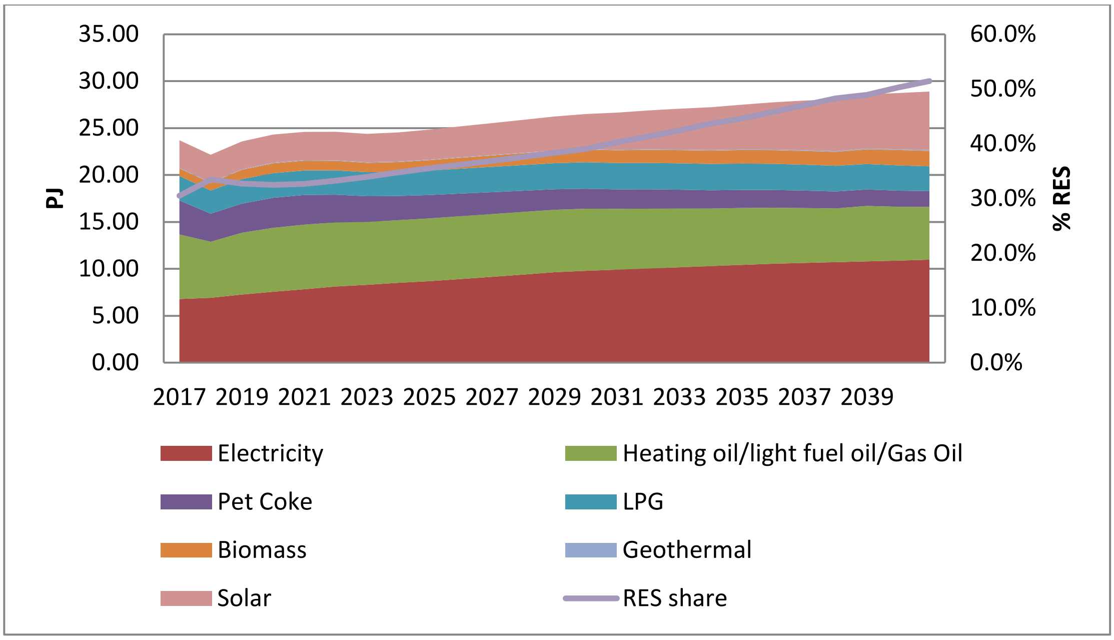

Figure 4.13: Heating and Cooling Share in towards 2040 in WEM Scenario

As it is shown in Figure 4.2.2.4, while there is a significant solar potential in Cyprus, the increase of solar technologies is limited. The high penetration of solar water heaters limits the room for further development in the domestic hot water sector since almost the 92% of households and more than 55% of Commercial applications are using already the above technology. It should also be noted that based on the findings of a long term research study[76] (see Figure 4.12) the heating needs for Cyprus will be reduced and this is also fact from the preliminary results of November 2019 (was the 2nd hottest November in last 140 years[77]).

This implies that the assumptions used in other modelling tools (as in IDEES (EU-JRC) Database) differ due to the fact that the heating degree days (HDD) and Cooling Degree Days (CDD) are not in line with the forecast of Figure 4.12.

In other words, the impacts of the climate change and the increase in temperature will affect the days that the cooling will be needed based on thermal comfort while in contrary will reduce the days needed for heating. Based on the above it seems that the future trend in total average energy consumption will be increased especially for Cyprus, and thus the RES penetration will be reduced, since the RES technologies available at the moment in Cyprus that can produce renewable cooling are limited only to Solar Cooling, which is very expensive and not a mature technology.

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[76] Zachariades and Hadjinicolaou, 2014

[77] http://www.moa.gov.cy/moa/ms/ms.nsf/DMLindex_gr/DMLindex_gr

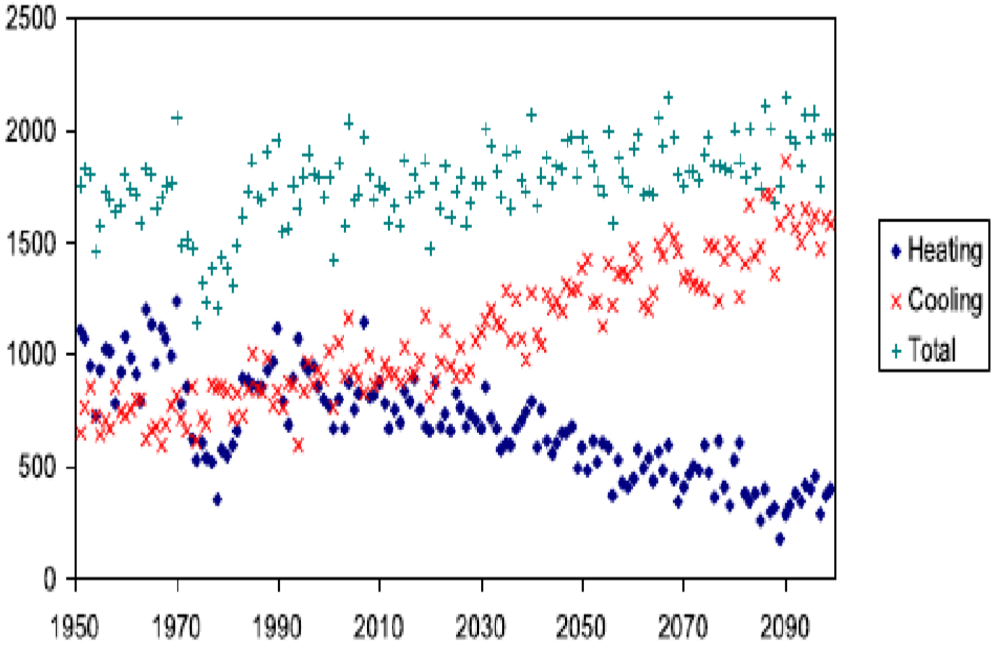

Figure 4.14: Nicosia's heating and cooling days (Zachariades and Hadjinicolaou, 2014)

4.3. Dimension Energy efficiency

4.3.1.1. i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

Table 4.8: Current primary and final energy consumption in the economy and per sector (official Eurostat data are available for current year -2)

Cyprus Energy data for year 2017 (Eurostat)	**ktoe**
Primary energy consumption (Europe 2020-2030)	2,522.58
Final energy consumption (Europe 2020-2030)	1,851.60
Final consumption - industry sector - energy use	229.53
Final consumption - transport sector - energy use	676.58
Final consumption - other sectors - commercial and public services - energy use	229.52
Final consumption - other sectors - households - energy use	336.71
Final consumption - other sectors - agriculture and forestry - energy use	45.01
International aviation	315.12

4.3.1.2. ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

The Comprehensive assessment[78] of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling identified an economic potential for high-efficiency cogeneration of around 50 MW in 2020.

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[78] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/52DA7EEECDF7D532C225828D00203A1B?OpenDocument

4.3.1.3. iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

Table 4.9: Sectoral energy projections for 2021-2040 -With Existing Measures

Sectoral projections (Mtoe)	Primary Energy Consumption	Total final energy consumption	Final energy consumption – industry	Final energy consumption - households	Final energy consumption - agriculture	Final energy consumption - – transport	Final energy consumption - services
2021	2.5	1.9	0.2	0.3	0.04	1.1	0.2
2022	2.4	2	0.2	0.4	0.04	1.1	0.2
2023	2.4	2	0.2	0.4	0.04	1.1	0.2
2024	2.4	2	0.2	0.4	0.04	1.1	0.2
2025	2.5	2	0.2	0.4	0.04	1.1	0.3
2026	2.5	2	0.2	0.4	0.04	1.1	0.3
2027	2.5	2.1	0.2	0.4	0.04	1.2	0.3
2028	2.6	2.1	0.2	0.4	0.04	1.2	0.3
2029	2.6	2.1	0.2	0.4	0.04	1.2	0.3
2030	2.6	2.1	0.2	0.4	0.04	1.2	0.3
2031	2.6	2.1	0.2	0.4	0.04	1.2	0.3
2032	2.6	2.1	0.2	0.4	0.04	1.2	0.3
2033	2.5	2.1	0.2	0.4	0.04	1.2	0.3
2034	2.5	2.1	0.2	0.4	0.04	1.2	0.3
2035	2.5	2.2	0.2	0.4	0.04	1.2	0.3
2036	2.5	2.2	0.2	0.4	0.04	1.2	0.3
2037	2.5	2.2	0.2	0.4	0.05	1.2	0.3
2038	2.5	2.2	0.2	0.4	0.05	1.2	0.3
2039	2.5	2.2	0.2	0.4	0.05	1.2	0.3
2040	2.5	2.2	0.2	0.4	0.05	1.2	0.3

The split between road and air transport is presented in the table below.

Table 4.10: Sectoral energy projections in transport sector for 2021-2040- With Existing Measures

Final energy consumption (Mtoe)	Road Transport	Air Transport
2021	0.7	0.4
2022	0.7	0.4
2023	0.7	0.4
2024	0.7	0.4
2025	0.7	0.4
2026	0.7	0.4
2027	0.7	0.5
2028	0.7	0.5
2029	0.7	0.5
2030	0.7	0.5
2031	0.7	0.5
2032	0.7	0.5
2033	0.7	0.5
2034	0.7	0.5
2035	0.7	0.5

2036	0.7	0.5
2037	0.7	0.5
2038	0.7	0.5
2039	0.7	0.5
2040	0.7	0.5

4.3.1.4. iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

The first minimum energy performance requirements for buildings have been adopted on the 21st of December 2007, and since then they have been revised three times. From 2013 and onwards any revision of the requirements is based on the results of calculating the cost-optimal levels of minimum energy performance requirements as it is foreseen by article 5 of Directive 2010/31/EU. The following tables show the development of minimum energy requirements through time for new and existing buildings.

Table 4.11: Minimum energy performance requirements for new buildings

	Minimum requirements of 2007 (Κ.Δ.Π. 568/2007) In effect from 21.12.2007	**Minimum requirements of 2009 (Κ.Δ.Π. 446/2009)** In effect from 1.1.2010	**Minimum requirements of 2013 (Κ.Δ.Π. 432/2013)** In effect from 11.12.2013	**Minimum requirements of 2016 (Κ.Δ.Π. 119/2016 και Κ.Δ.Π. 379/2016)** In effect from 1.1.2017	**Nearly Zero Energy Building (NZEB) requirements (Κ.Δ.Π. 366/2014)**
Walls maximum U - value	0.85 W/m^2 K	0.85 W/m^2 K	0.72 W/m^2 K	0.4 W/m^2 K Walls can be up to 0,6 W/m2K if windows up to 2,5 W/m2K	0.4 W/m^2 K
Roof and floor in contact with external environment maximum U - value	0.75 W/m^2 K	0.75 W/m^2 K	0.63 W/m^2 K	0.4 W/m^2 K	0.4 W/m^2 K
Floor above closed unheated spaces maximum U - value	2.0 W/m^2 K	2.0 W/m^2 K	2.0 W/m^2 K	-	-
Window maximum U - value	3.8 W/m^2 K	3.8 W/m^2 K	3.23 W/m^2 K	2.9 W/m^2 K	.,25 W/m^2 K
Maximum average U - value of the building envelope excluding the horizontal elements	-	1.3 W/m^2 K for residential buildings 1.8 W/m^2 K for non – residential buildings	1.3 W/m^2 K for residential buildings 1.8 W/m^2 K for non – residential buildings	-	-
Maximum window shading factor	-	-	0.63	0.63	-
Maximum average installed lighting power for office buildings	-	-	-	10 W/m^2	10 W/m^2
Renewable Energy	-	Installation of solar	Installation of solar water	At least 25% of primary	For all buildings, at

Sources		water heater for Domestic Hot Water in residential buildings Provision for installing RES electricity system	heater for Domestic Hot Water in residential buildings Provision for installing RES electricity system At least 3% of primary energy consumption must come from RES for non-residential buildings	energy consumption must come from RES for single-family homes At least 3% of primary energy consumption must come from RES for residential apartment buildings At least 7% of primary energy consumption must come from RES for non-residential buildings	least 25% of primary energy consumption must come from RES

Table 4.12: Minimum energy performance requirements for existing buildings

		Minimum requirements of 2007 (Κ.Δ.Π. 568/2007) In effect from 21.12.2007	**Minimum requirements of 2009 (Κ.Δ.Π. 446/2009)** In effect from 1.1.2010	**Minimum requirements of 2013 (Κ.Δ.Π. 432/2013)** In effect from 11.12.2013	**Minimum requirements of 2016 (Κ.Δ.Π. 119/2016 και Κ.Δ.Π. 379/2016)** In effect from 1.1.2017
Major renovation	**Walls maximum U - value**	0.85 W / m^2 K only for buildings above 1000m^2	0.85 W / m^2 K only for buildings above 1000m^2	0.72 W / m^2 K only for buildings above 1000m^2	-
	Roof and floor in contact with the external environment maximum U - value	0.75 W / m^2 K only for buildings above 1000m^2	0.75 W / m^2 K only for buildings above 1000m^2	0.63 W / m^2 K only for buildings above 1000m^2	-
	Floor above closed unheated spaces maximum U - value	2.0 W / m^2 K only for buildings above 1000m^2	2.0 W / m^2 K only for buildings above 1000m^2	2.0 W / m^2 K only for buildings above 1000m^2	-

	Window maximum U - value	3.8 W / m^2 K only for buildings above 1000m^2	3.8 W / m^2 K only for buildings above 1000m^2	3.23 W / m^2 K only for buildings above 1000m^2	-
	Maximum window shading factor	-	-	0.63 only for buildings above 1000m^2	-
	Minimum energy class on the Energy Performance Certificate (EPC)	-	B only for buildings above 1000m^2	B only for buildings above 1000m^2	B for all buildings
Building elements that are replaced or retrofitted	**Walls maximum U - value**	-	-	0.72 W / m^2 K for all buildings	0.4 W / m^2 K for all buildings
	Roof and floor in contact with the external environment maximum U - value	-	-	0.63 W / m^2 K for all buildings	0.4 W / m^2 K for all buildings
	Floor above closed unheated spaces maximum U - value	-	-	2.0 W / m^2 K for all buildings	-
	Window maximum U - value	-	-	3.23 W / m^2 K for all buildings	2.9 W / m^2 K for all buildings
	Maximum window shading factor	-	-	0.63 for all buildings	-

The results of the second calculation of cost-optimal levels, which took place in 2018, have clearly indicated that new residential buildings and offices should be Nearly Zero Energy Buildings (NZEB), as they are in the spectrum of cost-optimality. Exception appears to be hotels, though tightening of current minimum energy performance requirements for this type of buildings also applies. Considering existing buildings which are renovated, higher energy performance should be required than category B, but lower than the NZEB level. It has to be noted that the definition of NZEB is the same for new and existing buildings. Additionally, according to the calculation single measures that provide high economic benefit in the life cycle of the existing building are:

1) Roof insulation
2) Heat pumps for heating
3) Photovoltaics
4) High efficiency air conditioning units
5) LED lighting
6) Solar Water Heaters for hot water
7) Biomass boilers

The abovementioned results describe the investors' point of view and not the societal point of view.

MECI after finalizing the calculation results has prepared the new minimum energy performance requirements which have gone through public consultation. The new requirements are currently being legally vetted by the Legal Service of the Republic of Cyprus, and the aim is to be set in force by the 1st of January 2020. The table below shows the draft of the new requirements.

Table 4.13: Proposed minimum energy performance requirements for new buildings

Walls maximum U - value	0.4 W/m^2 K
Roof and floor in contact with external environment maximum U - value	0.4 W/m^2 K
Window maximum U - value	2.25 W/m^2 K
Maximum average U - value of the building envelope	0.65 W/m2K alternative to complying with the maximum U – value for each building element as listed above
Maximum window shading factor	0.63
Maximum average installed lighting power for office buildings	10 W/m^2 or a Building Automation and Control System for lighting should be installed
Renewable Energy Sources (RES)	For all buildings, except hotels, at least 25% of primary energy consumption must come from RES. For hotels at least 9% of primary energy consumption must come from RES.
Minimum energy class on the Energy Performance Certificate (EPC)	A
Maximum consumption of primary energy per annum	100 kW/m^2 for residential buildings 125 kW/m^2 for non -residential buildings
Maximum energy demand for heating per annum	15 kW/m2 for residential buildings

Table 4.14: Proposed minimum energy performance requirements for existing buildings

Major renovation	Minimum energy class on the Energy Performance Certificate (EPC)	A for residential buildings B+ for non-residential buildings
Building elements that are replaced or retrofitted	Walls maximum U - value	0.4 W/m^2 K
	Roof and floor in contact with the external environment maximum U - value	0.4 W/m^2 K
	Window maximum U - value	2.25 W/m^2 K

4.4. Dimension energy security

4.4.1. i. Current energy mix, domestic energy resources, import dependency, including relevant risks

The following table shows Cyprus energy mix for 2018.

Table 4.15: Cyprus Energy Mix for 2018 per sector in ktoe

	RES ktoe	Oil products ktoe	Other (Industrial waste) ktoe	Coal ktoe
Domestic Sources	187,3	0	0.3	0
Imports	46,5	2.312,8	19,2	13,6
Energy consumption	233,8	2.312,8	22,9	13,6

Almost all domestic energy resources are renewables (see Figure 4.10) and an amount of 0.3 ktoe (0.2%) is from industrial waste. The share of oil products is more than 92% of the country energy mix. The oil products of retail market are imported from neighbouring countries, Greece and Israel. For 2018, oil products for the production of electricity were mainly from Spain and Italy.

Oil Companies conclude and sign an annual contract with a refinery for the supply of oil products. Electricity Authority Cyprus supplies heavy fuel oil and gas oil after tender and the relevant contract includes strict conditions regarding delays in supply. In the case of oil companies, the relevant risk in supply is considered high as they depend on one import source, but in the case of EAC, the risk is low as according to the contract, the trader is obliged to deliver the product.

4.4.2. ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

For projections of development of energy mix with existing policies and measures at least until 2040, see Impact Assessment, Primary Energy Supply evolution till 2050 (ktoe) – WEM scenario.

4.5. Dimension internal energy market

4.5.1. Electricity interconnectivity

4.5.1.1. i. Current interconnection level and main interconnectors

Zero interconnection level, there is no interconnector.

4.5.1.2. ii. Projections of interconnector expansion requirements (including for the year 2030)

It is expected that EuroAsia Interconnector construction will be completed by end of 2023. The statutory permit granting procedure for PCI "EuroAsia Interconnector" started in November 2019 and will be completed until the comprehensive decision is taken by NCA, by end of 2020. Immediately after the completion of the granting procedure, construction phase will begin and will last for three years. Consequently, commercial operation will start by Q1 2024 where an interconnectivity level of 15% will be achieved.

4.5.2. Energy transmission infrastructure

4.5.2.1. i. Key characteristics of the existing transmission infrastructure for electricity and gas

Key characteristics of the existing transmission infrastructure for electricity include:
- Transmission Lines rated at 220kV but operating at 132kV
- Transmission Lines rated and operating at 132kV
- Underground Cables rated at 132kV but operating at 66Kv
- Underground Cables rated and operating at 66kV
- Transmission Lines rated at 132kV but operating at 66Kv
- Transmission Lines rated and operating at 66kV
- 132/66kV Interbus Transformers
- 132/11kV Step Down Transformers
- 132/6,6kV Step Down Transformers
- 132/3,3kV Step Down Transformers
- 66/11kV Step Down Transformers
- 66/3,3kV Step Down Transformers
- 15,75/132kV Step Down Transformers
- 11/132kV Step Down Transformers
- 11/66kV Step Down Transformers
- Shunt Reactor 75 MVAr
- Substations (GIS and Open Air)

Currently, there is no transmission infrastructure for gas.

4.5.2.2. ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

The expansion and upgrade of existing electricity network planned for the period 2019-2028 is described in the Ten Years Transmission Network Development Plan for the period 2019-2028 (Appendix 5). There are no available projections from TSOCy beyond 2028.

4.5.3. Electricity and gas markets, energy prices

4.5.3.1. i. Current situation of electricity and gas markets, including energy prices

Although no transactions have been recorded yet, from the 1st of September 2017 the Electricity market allows the participation of new generators and suppliers based on a transitional regulation that allows bilateral contracts between producers and suppliers above a threshold set by CERA:

(a) for producers with a production license above 50kW and
(b) for suppliers with contracts for supply of energy to consumers with total agreed power above 10 MW.

Transactions are cleared on a monthly basis. The contracts involve only the provision of energy and exclude the participation of the Electricity Authority of Cyprus (the incumbent) from directly participating in energy contracts. The transitional regulation will be annulled with the commencement of the application of the Trading & Settlement Rules (TSR) in line with the EU Electricity Target Model will take place in end of 2021. Contracts that were concluded in the transitional regulation will be grandfathered in the competitive electricity market

Electricity prices for domestic customers between September 2019 - November 2019 were recorded at 24.2 Eurocent per kilowatt-hour (incl. VAT). This is based on the following elements:

1. Energy Cost €0.00946 /kWh (for a basic fuel cost of €300/MT adjusted to the Real Cost of Fuel. Adjustment is done by multiplying the excess cost (Real cost-€300/MT) with the coefficient of fuel adjustment. The cost of fuel as well as the fuel adjustment coefficients are listed in EAC website[79].
2. Network Cost €0.03 /kWh
3. Cost of ancillary services €0.0064 /kWh
4. Cost of Metering €0.98
5. Cost of Supply €4.76 (bi-monthly / monthly)
6. Public Service Obligations €0.0007//kWh
7. Energy consumption Fee €0.01/kWh (to be adjusted from 1.1.2020 to €0,005/kWh)
8. VAT 19%

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[79] https://www.eac.com.cy/EN/RegulatedActivities/Supply/tariffs/Pages/Fuel-Cost.aspx

More details regarding the cost of fuel for other categories of customers can be found under Section 4.6 iii.

Currently, there is no gas market.

4.5.3.2. ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Projections of development with existing policies and measures at least until 2040, see Impact Assessment, section 3.2.2 Changes in energy prices between WEM and PPM scenarios.

4.6. Dimension research, innovation and competitiveness

4.6.1. i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)

According to Smart Specialization Strategy, Cyprus has a high level of research potential in human capital that should be exploited to the greatest extent possible. This potential must include Cypriot scientists living and working outside Cyprus and foreigners working in Cyprus. Additionally, the development of public and private universities the last 10 years has significantly improved the research facilities. Especially, the establishment of research centres of KOIOS and FOSS by University of Cyprus and the establishment of Cyprus Institute have provided useful infrastructure dedicated research and innovation in energy and climate. Recent developments in establishing centres of excellence in research such as the Research Centre of Excellence on Interactive media, Smart systems and Emerging technologies (RISE), the Cyprus Marine and Maritime Institute (CMMI/ MARITEC- X) and the Eastern Mediterranean and Middle East – Climate and Atmosphere Research Centre (EMME-CARE), are expected to further enhance infrastructure.

4.6.2. ii. Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

The current allocation of national funds for projects that have started in the year of 2018, within the frame of RESTART 2016-2020, reached approximately €25m in total. It must be highlighted that the program has been designed and is managed by Research and Innovation Foundation and has a total budget of €99m from which €45m will be covered by ERDF.

Figure 4.15 shows the allocation of the aforementioned budget for year 2018, into various categories, of which the highest funds received are for research in biological/human studies and on IT. Energy sector ranks third on funding engagement, whilst transport and environment sectors have much lower allocations (also see Table 3.10).

The total a breakdown of the national R&D expenditure for 2016 and 2017 and how is projected for 2023 is mentioned in paragraph 2.5.

As of the number of patents filed in, they appear to be low so far.

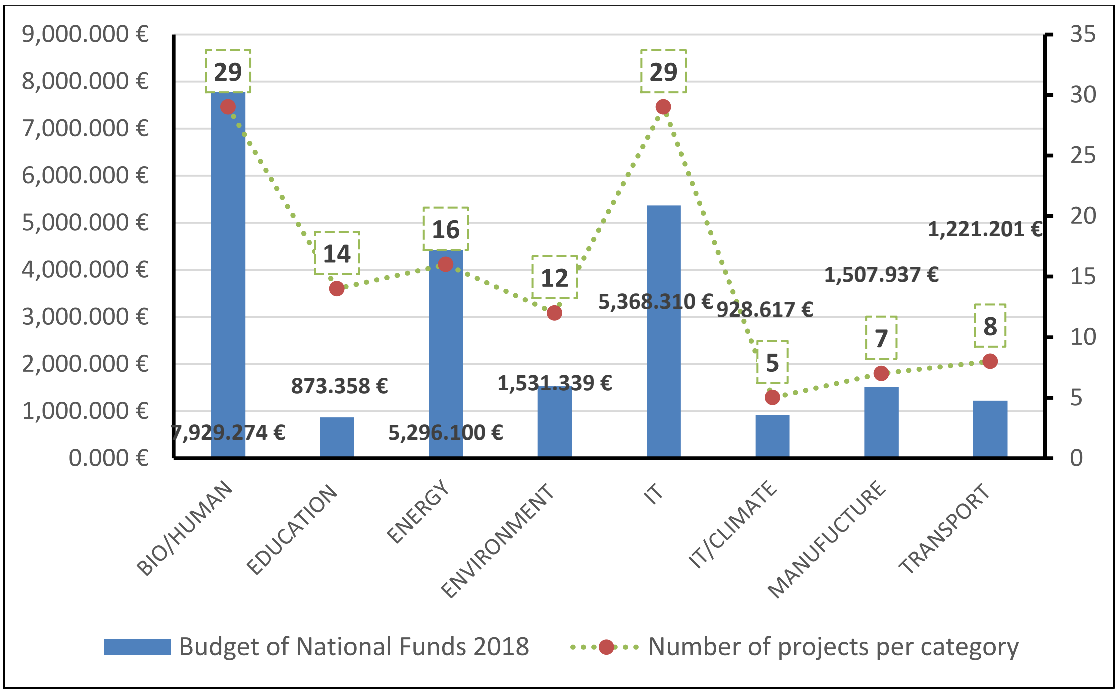

Figure 4.15: Allocation of national funds RESTART 2016-2020, for projects started within the year of 2018

4.6.3. iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

Considering electricity prices for commercial consumers EAC which is the only supplier, implements five tariffs as follows:

1) Low Voltage Single Sign-On Bimonthly Tariff (Code 10)

   The charges, at a basic fuel price of € 300 / MT, for every two months for a supply electricity according to this tariff are:

   - Energy Cost per Unit Provided 9.51 Cent
   - Network Cost per Unit Provided 3.21 Cent
   - Cost of Ancillary Services for each unit provided 0.67 cent
   - Cost of Metering € 0.98
   - Cost of Supply € 4.68

2) Low Voltage Subscription Binomial Industrial Use (Code 20)

   The charges, at a basic fuel price of € 300 / MT, for every two months for a supply electricity according to this tariff are:

   - Energy costs per unit provided 9.57 cent
   - Network Cost per Unit Provided 3.22 Cent
   - Cost of Ancillary Services for each unit provided 0.67 cent

- Cost of Metering € 0.98
- Cost of Supply € 4.68

Table 4.16: Monthly Seasonal Two Rate Commercial and Industrial Use Low Voltage Recording (Code 30)

Charge per unit provided cent / kWh						Monthly charge €
	Period	October – May		June – September		
		Weekdays	Weekends and holidays	Weekdays	Weekends and holidays	
Energy costs	Peak	8.89	8.54	14.29	8.61	-
	Off - peak	7.63	7.25	8.49	8.31	-
Network Cost	Peak	3.21	3.21	3.24	3.21	-
	Off - peak	3.21	3.21	3.21	3.21	-
Cost of Ancillary Services	Peak	0.67	0.67	0.67	0.67	-
	Off-peak	0.67	0.67	0.67	0.67	-
Cost of Metering	-	-	-	-	-	0.49
Cost of Supply	-	-	--	-	-	2.34

Table 4.17: Monthly Seasonal Two Rate Commercial and Industrial Use Medium Voltage Recording (Code 40)

Charge per unit provided cent / kWh						Monthly charge €
	Period	October – May		June – September		
		Weekdays	Weekends and holidays	Weekdays	Weekends and holidays	
Energy costs	Peak	8.72	8.38	13.83	8.45	-
	Off- peak	7.49	7.12	8.34	8.15	-
Network Cost	Peak	2.03	2.03	2.04	2.03	-
	Off- peak	2.03	2.03	2.03	2.03	-
Cost of Ancillary Services	Peak	0.66	0.66	0.66	0.66	-
	Off- peak	0.66	0.66	0.66	0.66	-
Cost of Metering	-	-	-	-	-	0.49
Cost of Supply	-	-	--	-	-	2.34

Table 4.18: Monthly Seasonal Double Use Commercial and Industrial Use High Voltage Recording (Code 50)

Charge per unit provided cent / kWh						Monthly charge €
	Period	October – May		June – September		
		Weekdays	Weekends and holidays	Weekdays	Weekends and holidays	
Energy costs	Peak	8.58	8.25	13.46	8.31	-
	Off- peak	7.37	7	8.2	8.02	-
Network Cost	Peak	0.7	0.7	0.7	0.7	-
	Off-peak peak	0.7	0.7	0.7	0.7	-
Cost of Ancillary Services	Peak	0.65	0.65	0.65	0.65	-
	Off- peak	0.65	0.65	0.65	0.65	-
Cost of Supply	-	-	--	-	-	2.34

For all above tariffs EAC imposes the following additional charges: energy consumption fee 0.01€/kWh (which will be revised from 1.1.2020 to 0.005€/kWh). This levy is used for supporting the RES and Energy Efficiency National Fund (no VAT is imposed on this charge), 0.00065 €/kWh public benefit obligations and 19% VAT.

The price of petroleum products consists of the following elements[80] :

- Estimated weighted average cost of the product (price and cost of import)
- Estimated average gross margin of companies and petrol stations (operational cost and profit)
- Taxes and levies
- Value Added Tax (VAT)

Details regarding the taxation of petroleum products are shown in Table 4.19.

Table 4.19: Taxation of oil products

Petroleum Product	Duty	Excise duty in €	Levy of KODAP in €	V.A.T.
Petrol RON 95	4.7%	0.429 /liter	0.0107 /liter	19%
Petrol RON 98	4.7%	0.429 /liter	0.0107 /liter	19%
Diesel 10ppm	0%	0.400 /liter	0.0107 /liter	19%
Heating gas oil	0%	0.07473 /liter	0.0107 /liter	19%
Kerosene	4.7%	0.07473 /liter	0.0107 /liter	19%
Kerosene jet fuel Passenger	4.7%	0	0.0107 /liter	19%

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[80] More details regarding the breakdown of the prices of petrol RON 95, diesel and heating gas oil are available in the website

http://www.consumer.gov.cy/mcit/cyco/cyconsumer.nsf/index_gr/index_gr?OpenDocument

Private	4.7%	0.45 /liter	0.0107 /liter	19%
LPG Propane Butane	 8% 0%	 0 0	 0 0	 5% 5%
Automotive LPG	8%	0.125 /kilo	0	8%
Agriculture gas oil	0%	0.021/liter	0.0107 /liter	0%
Light Fuel Oil, Sulphur content more than 1%	3.5%	0.015 /kilo	0.0027 /kilo	3.5%
Light Fuel Oil, Sulphur content up to 1%	3.5%	0.015 /kilo	0.0027 /kilo	3.5%
Heavy Fuel Oil, Sulphur content more than 1%	3.5%	0.015 /kilo	0.0027 /kilo	3.5%
Heavy Fuel Oil, Sulphur content up to 1%	3.5%	0.015 /kilo	0.0027 /kilo	3.5%

4.6.4. iv. Description of energy subsidies, including for fossil fuels

Energy subsidies in Cyprus are divided in two main categories: Subsidies provided to support Renewable Energy Technologies, and subsidies in oil prices.

The long-term subsidies in RES technologies arise for the various PPAs that the RES and Energy Efficiency National Fund had signed in the period 2004-2015 due to old support schemes.

Table 4.20 shows the broken-down cost, by technologies and the actual subsidy payed to renewable energy producers for the last 10 years. As explained, is very difficult to estimate the actually prices, since there are no real market conditions at the moment in Cyprus. Since the market is expected to operate in 2021, the future subsidy prices (Table 4.7) will be re-evaluated after the first revision of the NECP.

Table 4.20: Subsidy paid to RES Producers in million Euro per Year

	Solar	Wind	Biogas*
2008	0.03	0	
2009	0.135	0	
2010	0.055	0	0.122
2011	1.365	3.607	0.696
2012	2.369	2.223	0
2013	4.402	5.725	0
2014	9.624	10.433	0.266
2015	11.349	19.637	1.565
2016	14.005	24.815	1.783
2017	11.957	18.299	1.222
2018	9.887	14.722	0.718

*In 2013-2014 the avoidance cost of electricity the so called market Price, was higher than FiT Price for Biomass Projects. The excess amount was returned to the RES and Energy Efficiency National Fund.

As far as it concerns the PPM scenario (i.e. without the operation of the Electricity Market), the average subsidy till 2030 is not expected to change significantly. For Wind Farm's, there is a provision to compensate with less subsidy if the projects exceed a certain limit of production (i.e. 2 wind farms will receive no subsidy after their first 7000 hours of operation, for all the production that exceeds a certain threshold, while the new Wind Parks will receive no subsidy (at least 30MW). In that respect it is expected that the Average subsidy will be reduced by 20% for all the energy produced from Wind Parks.

As mentioned before since 2015, all the new RES Commercial projects for Electricity production will receive the so-called avoidance cost, which corresponds to an ideal market price. Once electricity market will operate (in 2021), the RES projects will receive only the market price based on the market rules. The current and historical selling price for electricity produced by renewable sources (avoidance cost) is available at Electricity Authority of Cyprus website[81]. The details of the support scheme and all the relevant revisions are available on MECI website[82].

Assuming ideal market conditions and taking into consideration the evolution and the cost of technologies, it is estimated that the electricity prices (i.e. Avoidance cost) will be reduced when the natural Gas will be available in 2022 and the cost will drop in the range of 85 Euro/MWh. This Average price will gradually increase, up to 94 Euro/MWh towards 2030.

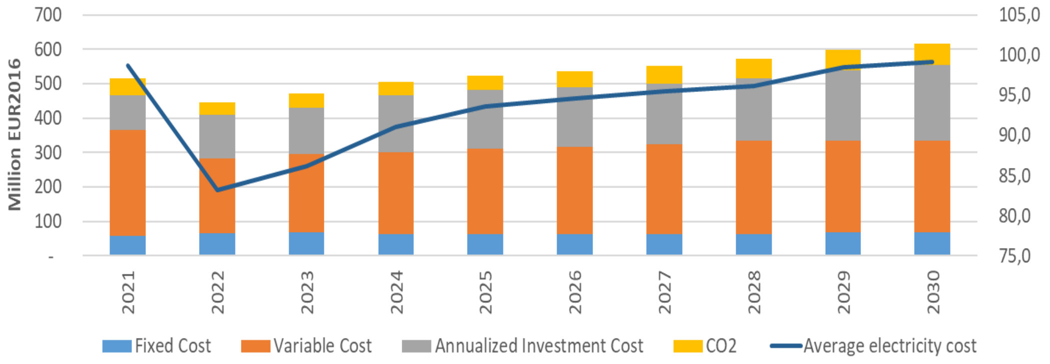

Figure 4.16: Electricity prices in the PPM Scenario, assuming ideal market conditions

However, is hard to estimate the actual price of subsidy since in real market conditions it is expected than RES technologies will compete between them (i.e. Solar and Wind as well as Biomass). The energy modelling used was not able to provide detail pricing per half hour over the whole horizon of 2030. In that respect this analysis will be done by using more detail models in the future (PLEXOS model can be used).

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[81] https://www.eac.com.cy/EL/EAC/RenewableEnergySources/Pages/resenergypurcheac.aspx.

[82] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/822B56F7E4D67965C225849B0034558 2?OpenDocument

As mentioned above, since 2015 onwards all new commercial RES projects do not receive any subsidy from the RES and Energy Efficiency National Fund. The same applies to the self-consumption scheme and net-billing scheme.

As far as it concerns the subsidies in oil prices a short summary was provided during the public consultations from Ministry of Finance[83] (Table 4.21).

Table 4.21: Estimated Subsidy to paid to RES Producers in million Euro per Year 2021-2030

	Solar	Wind	Biogas*
2021	12	15	1
2022	8.3	18	1
2023	10.4	17.6	<1
2024	9	16	<1
2025	8.5	16	<1
2026	8.3	15.7	<1
2027	8.1	15.5	<1
2028	7.9	15.3	<1
2029	7.4	14.8	<1
2030	7.1	14.7	<1

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[83] http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/4CFADF62B303D228C22584D6004AAB42/$file/Διάφορες%20Επιδοτήσεις%20στα%20καύσιμα.pdf

5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

NOTE

The Impact Study was completed in November 2019 and therefore the results reflect the data available at the time.

On 12 December 2019, the Secretariat of the United Nations Framework Convention on Climate Change, through the publication of the "Report on the individual review of the annual submission of Cyprus submitted in 2019" on its website[84], announced the acceptance of the revised Cyprus greenhouse gas emission inventories for the period 1990 - 2017. As a result the emissions of the non-ETS sectors for 2005 (reference year for the national reduction target) increased from 3954 kt CO2 eq. to 4266 kt CO2 eq. This affects the results of the impact analysis only on the issue of achieving the greenhouse gas emissions reduction target and the associated costs for purchasing greenhouse gas emission allowances for compliance.

Specifically, taking into account the expected results of the implementation of the policies and measures included in the National Plan, and in particular of the new planned policies and measures, it appears that based on the revised emissions of 2005 (4265 kt CO2 eq.) the national mandatory target for reducing greenhouse gas emissions of the greenhouse is covered to a great extend (a 21% decrease is expected by the end of the period compared to 24% which is the target).

In view of the above, it appears that while the national mandatory target for reducing greenhouse gas emissions at the end of the period is not expected to be fully met, due to the use of the flexibility mechanisms available in the ESR, Cyprus is not expected to have any financial cost for purchasing additional greenhouse gas emission allowances.

5.1. Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals, including comparison to projections with existing policies and measures (as described in section 4).

Having noted the above, the projected impacts of WEM and PPM scenarios on the energy mix and emissions are presented in the next sections until 2030. The outputs of the cost-optimisation model employed for the two scenarios until 2030 are subject to technical constraints, development plans and policy options conveyed to the project team by the authorities. For instance, in the WEM scenario solar PV capacity is constrained to a maximum of 750 MW, while this limit is removed for the period 2031-2050. Scenario results

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[84] https://unfccc.int/sites/default/files/resource/arr2019_CYP.pdf

for the entire period 2020-2050 have been provided in the underlying impact assessment study which is publicly available.

5.1.1. Existing Policies and Measures Scenario

The results for this section have been broken down by sector (i.e. electricity, transport, heating and cooling). Additionally, results regarding the primary energy supply and final energy demand are provided along with a forecast on the carbon dioxide emissions from both ETS and non-ETS sectors.

5.1.1.1. Electricity Supply Sector

Capacity

The projection offered by the model for the electricity supply sector is quite interesting and can be considered optimistic. Following the expected deployment of renewable energy technologies until 2020, as promoted by the existing support schemes and the development of the planned 50 MW CSP plant by 2021, an additional 390 MW of solar PV and 33 MW of biomass-fired facilities are deployed between 2021 and 2030. The increase in solar PV in this period coincides with the development of two new combined cycle gas turbines with a total capacity of 432 MW, which can operate as baseload and also offer flexibility to the system; flexibility is necessary when levels of variable renewable electricity generation increase. The new CCGT units allow a higher volume of low-cost gas-fired electricity generation, as these are the most efficient thermal units available. Despite the low fossil fuel price projections and the higher renewable energy technology prices adopted in the analysis as compared to EC recommendations, a substantial deployment of solar PV occurs in the period 2020-2030 (Table 5.1). This deployment is enabled by the deployment of Li-ion batteries during the same period, as these reach 41 MW in 2030.

Table 5.1: Capacity projections in the electricity supply sector (MW) – WEM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Vasilikos	836	836	836	836	836	836	836	836	836	836
Dhekelia	450	450	450	102	102	102	102	102	102	102
Moni	128	128	128	128	128	128	128	128	128	128
New CCGT	216	216	216	432	432	432	432	432	432	432
New ICE	0	0	0	0	0	0	0	0	0	0
New ST	0	0	0	0	0	0	0	0	0	0
New GT	0	0	0	0	0	0	0	0	0	0
Light fuel oil CHP	0	0	0	0	0	0	0	0	0	0
Solar PV	380	400	420	440	468	670	690	710	730	750
Solar Thermal	0	50	50	50	50	50	50	50	50	50
Wind	158	180	198	198	198	198	198	198	198	198
Biomass	22	27	32	37	42	47	50	50	50	50
Pumped Hydro	0	0	0	0	0	0	130	130	130	130
Li-Ion Batteries	0	0	0	0	22	22	22	22	22	41

It should be noted that based on a relevant IRENA publication[85], optimistic techno-economic characteristics were assumed for Li-ion batteries. This publication foresees that by 2030 battery life will exceed 15 years and round-trip efficiency will reach 95% at an installation cost of approximately 160 EUR2016/kWh. These projections are further corroborated by other recent publications examining the subject (e.g. by NREL[86]). All Li-ion batteries deployed are in-front-of-the-meter facilities and have 4 hours of storage; this results in 164 MWh of battery storage in 2030. No behind-the-meter battery storage is deployed as from a system's perspective it is deemed cost-optimum to deploy storage at the centralised level, where it can serve a larger array of generation technologies. It should be mentioned though that behind-the-meter storage could be profitable for end-consumers under a net-billing plan and in case Time-of-Use electricity tariffs are adopted in the future. Furthermore, in 2027 a 130 MW (1,040 MWh) pumped-hydro facility is also developed.

The deployment of batteries and solar PV can be attributed to the reduction of their respective capital cost over time. At the same time, increasing fuel and ETS prices make fossil-fired plants less competitive. However, the feasibility of these results has to be scrutinized thoroughly, as during low electricity demand and high PV output periods, a significant amount of curtailment may be observed. The results presented here estimate a curtailment level of 0.1% for solar PV and 0.5% for wind in 2030. Nonetheless, curtailment is not accurately captured by a long-term energy systems model as the one employed here. Hence, a separate detailed grid analysis study, like the one performed by JRC in a previous project[87], focusing on a single year in a much finer temporal resolution may be needed to properly assess this proposed outlook.

Generation

The technology deployment presented in Section 2.1.1.1 provides the generation mix shown in Figure 5.1. The substitution in the latter part of 2021 (i.e. in the period November-December) of oil-fired generation with gas-fired generation results in a transitional period as indicated below. In the post-2020 period, gas-fired generation dominates the electricity mix. The RES-E share in 2030 reaches 26%, as more solar PV and solar thermal is introduced in the system. It should be noted that the absolute contribution of fossil-fired generation remains relatively stable until 2030, and the increased demand in electricity drives solar PV deployment.

The deployment of solar PV discussed above increases the share of PV in the generation mix, which occurs gradually until 2030. Another factor which leads to the expansion of solar PV is the electrification of the transport sector, as this raises the demand for electricity throughout the year. Specifically, in 2030 approximately 148 GWh are consumed in the

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[85] IRENA, 2017. Electricity Storage and Renewables: Costs and Markets to 2030, International Renewable Energy Agency, Abu Dhabi.

[86] Cole, W.J., Frazier, A., 2019. Cost Projections for Utility-Scale Battery Storage (No. NREL/TP-6A20-73222, 1529218). NREL. https://doi.org/10.2172/1529218

[87] http://www.mcit.gov.cy/mcit/energyse.nsf/C1028A7B5996CA7DC22580E2002621E3/$file/Cyprus_RESGRID__summary_v16.pdf

transport sector. This aspect is further elaborated in the relevant section later on in the report.

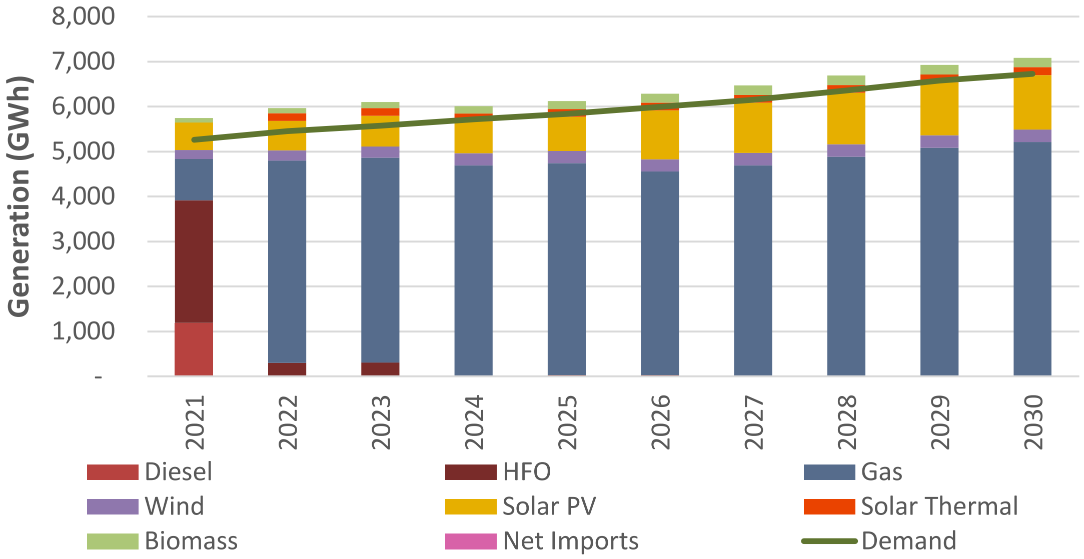

Figure 5.1: **Projected generation mix till 2030 – WEM scenario.**

5.1.1.2. Transport Sector

The forecast for the transport sector foresees penetration of alternative fuels and technologies (Table 5.2). Regarding the passenger car fleet, the number of diesel vehicles are reduced over time; these are replaced by gasoline, gasoline hybrid and battery electric vehicles. Additionally, a moderate number of LPG conversions occurs. It is worth highlighting that a significant penetration of new electric vehicles appears in the fleet in the latter part of the modelling horizon. Significant investments occur in the period 2028-2030 which bring the number of BEVs to nearly 42,000 by 2030. The number of gasoline hybrid vehicles is also substantial as these increase to 60,000 by 2030.

The projected shift in the road transport fleet results in an equivalent change in the fuel consumption in the transport sector. As indicated in Table 5.3, gasoline remains as the main fuel consumed in road transportation for the entire model horizon. Gasoline consumption stays relatively constant until 2030, with a slight increase observed in the middle of the decade. However, the use of diesel decreases slightly, dropping from 11.7 (325 million litres) in 2021 to 10.7 (297 million litres) by 2030. Similarly, biodiesel used for blending follows a similar trend, as the current blending mix is kept constant throughout the whole period. Forced blending was implemented for 2nd generation biodiesel, as the government of Cyprus has issued decrees which force such blending.

Electrification of the transport sector is regarded as a key step in the decarbonisation and diversification of fuel supply of this sector. A degree of electrification occurs in the projected scenarios by fully-electric vehicles. Therefore, electricity demand in the transport sector increases proportionally, reaching 0.5 PJ (148 GWh) in 2030; this corresponds to **2.2%** of the total final electricity demand.

If the electricity demand in the transport sector increases further, it could pose challenges to the grid, but could also offer opportunities. On the one hand, electricity demand rises; this will not happen uniformly as charging will primarily occur at specific hours of the day. It can be expected that the overall load profile will be affected as a consequence. This is something that perhaps is not captured adequately by the current version of the model and may need to be amended in the future. The assumed charging profile can have a significant impact on the results and with increasing penetration of BEVs in the system, more information could become available to assist such an analysis.

Smart charging of vehicles and potential use of vehicle-to-grid systems, in which vehicle batteries can be used as additional supporting infrastructure by the grid operator, can offer demand response services that in turn can add flexibility and have an enabling effect for intermittent renewable energy technologies, subject to wider regulatory and market developments such as the introduction of Time-of-Use or dynamic pricing retail contracts. It has to be noted that changes in the transport sector are subject to the social behaviour of individuals, which is not a trivial matter to address in optimization models. The willingness of consumers to change their behaviour is a factor that may limit the transition of the transport sector to alternative fuels and technologies.

Table 5.2: Projected vehicle fleet (total number of vehicles) – WEM scenario.

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Passenger cars	**Diesel**	63,430	57,686	51,942	46,117	40,372	34,628	33,252	35,680	36,893	37,055
	Diesel hybrid	-	-	-	-	-	-	-	-	-	-
	Diesel PHEV	-	-	-	-	-	-	-	-	-	-
	Gasoline	485,181	498,305	512,262	525,256	538,687	552,959	548,566	526,681	505,780	485,950
	Gasoline Hybrid	5,170	5,170	5,170	5,170	5,170	5,170	18,738	32,387	46,117	59,927
	Gasoline PHEV	-	-	-	-	-	-	-	-	-	-
	BEV	241	297	354	411	467	524	581	14,229	27,959	41,770
	LPG	320	424	529	633	739	843	948	1,061	1,174	1,174
	Natural gas	-	-	-	-	-	-	-	-	-	-
	Hydrogen	-	-	-	-	-	-	-	-	-	-
Buses	**Diesel**	3,058	3,097	3,141	3,186	3,230	3,274	3,318	3,362	3,406	3,450
	Diesel hybrid	-	-	-	-	-	-	-	-	-	-
	BEV	-	-	-	-	-	-	-	-	-	-
	CNG	-	-	-	-	-	-	-	-	-	-
MCs	**Gasoline**	51,685	52,442	53,175	53,910	54,667	55,424	56,133	56,893	57,626	58,383
	BEV	-	-	-	-	-	-	-	-	-	-
Trucks	**Diesel**	13,166	13,355	13,545	13,734	13,923	14,112	14,301	14,175	14,044	13,907
	BEV	-	-	-	-	-	-	-	314	635	961
	Natural gas	-	-	-	-	-	-	-	-	-	-
Light Trucks	**Diesel**	121,355	123,095	124,842	126,583	128,323	130,064	131,810	133,551	135,291	137,032
	BEV	-	-	-	-	-	-	-	-	-	-
	PHEV Diesel	-	-	-	-	-	-	-	-	-	-
	Hybrid diesel	-	-	-	-	-	-	-	-	-	-
Grand Total		**743,606**	**753,873**	**764,960**	**774,999**	**785,578**	**796,997**	**807,647**	**818,334**	**828,924**	**839,609**

Table 5.3: Evolution of fuel consumption (PJ) in the transport sector until 2030 – WEM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biofuels	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.18	1.16	1.15
Diesel	11.66	11.46	11.25	11.09	10.91	10.73	10.71	10.73	10.71	10.66
Gasoline	16.46	16.79	17.10	17.40	17.69	17.97	18.00	17.49	17.01	16.58
LPG	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Natural gas	-	-	-	-	-	-	-	-	-	-
Electricity (road)	0.003	0.003	0.004	0.005	0.005	0.006	0.006	0.181	0.357	0.533
Electricity (rail)	-	-	-	-	-	-	-	-	-	-

5.1.1.3. Heating and Cooling Sector

Continued investments in renewable energy technologies in buildings, as well as investments in heat pumps lead to an increase in the renewable energy share in the heating and cooling sector. The significant RE share increase projected until 2030 will be mainly driven by solar thermal technologies and heat pumps in buildings. The projected final energy demand of the Heating and Cooling sector is provided in Table 5.4. The RES share foreseen in the Heating and Cooling sector increases and reaches 39% in 2030.

Table 5.4: Final energy demand in the Heating and Cooling sector (PJ) – WEM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	7.83	8.12	8.30	8.51	8.69	8.91	9.14	9.38	9.64	9.79
Other Oil Products	6.88	6.83	6.70	6.67	6.69	6.70	6.69	6.68	6.65	6.62
Pet Coke	3.16	2.95	2.74	2.58	2.49	2.41	2.33	2.26	2.18	2.13
LPG	2.61	2.60	2.56	2.57	2.61	2.65	2.70	2.74	2.78	2.82
Biomass	1.04	1.02	0.99	1.04	1.10	1.16	1.21	1.25	1.29	1.33
Geothermal	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05
Solar thermal	3.01	3.03	3.03	3.11	3.20	3.29	3.40	3.51	3.63	3.75
RES share	32.6%	33.2%	33.9%	34.8%	35.5%	36.2%	36.9%	37.6%	38.3%	39%

5.1.1.4. Primary Energy Supply and Final Energy Demand

A moderate decrease in the primary energy supply can be observed in the middle of the period 2021-2030, but then increases back by 2030 (Table 5.5). The main driver of this is the incorporation of greater shares of renewable energy, which displaces fossil-fired generation in the electricity sector. Additionally, in 2021 heavy fuel oil is still used to a considerable extent until the introduction of less carbon-intensive natural gas in the power sector in the last two months of the same year.

Table 5.5: Primary Energy Supply evolution till 2030 (ktoe) – WEM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel	491	274	269	265	260	256	256	256	256	255
Gasoline	393	401	408	416	423	429	430	418	406	396
HFO	581	61	63	3	6	7	1	2	3	3
LPG	63	62	61	62	63	64	65	66	67	68
Other Oil Products	164	163	160	159	160	160	160	160	159	158
Pet coke	75	70	65	62	59	58	56	54	52	51
Natural gas	154	782	793	794	799	770	790	824	859	882
Electricity	-	-	-	-	-	-	-	-	-	-
Biomass/ biofuels	79	84	89	96	103	110	114	115	115	116
Geothermal	1	1	1	1	1	1	1	1	1	1
Solar thermal	72	87	87	89	91	94	96	99	101	104
Solar PV	53	56	58	61	65	93	96	99	102	104

Wind	17	20	22	23	24	23	24	24	24	24
Total	***2,144***	***2,062***	***2,078***	***2,030***	***2,054***	***2,065***	***2,089***	***2,116***	***2,146***	***2,162***

Despite the relatively stable trend of primary energy supply, final energy demand is projected to increase (Table 5.6). The main driver in this case is the increased final electricity demand due to the broad trend for electrification in the economy (which in turn is generated by more efficient gas-fired plants and renewable energy technologies and therefore reduces primary energy needs). Continued electrification of the heating and cooling sector, as well as the considerable volume of electricity consumed in the transport sector have a significant role in the growth of electricity demand. The contribution of fossil fuels decreases with time. Furthermore, the total contribution of solar thermal in the electricity supply sector and the heating and cooling sector is projected to increase by 44% from 2020 to 2030.

Useful insights can be provided through a comparison of the final energy demand with the primary energy supply. Even though final energy demand undergoes a moderate increase between 2021 and 2030, primary energy supply stays at comparable levels. This is an indication of improved energy efficiency. Specifically, when final energy demand is measured as a share of primary energy supply, total energy efficiency amounts to 72% in 2021; this value increases to 77% in 2030. As shown in Table 5.7, the RES share in final energy demand is projected to increase gradually. The key sector driving this transition is the electricity supply sector. The 13% target for 2020 is expected to be achieved, while the share increases further to 20.1% by 2030. It should be noted that the above takes into account fuel consumption of aviation and the special treatment of this sector in the case of Cyprus, in line with Directive (EU) 2018/2001.

Table 5.6: Final Energy Demand evolution till 2030 (ktoe) – WEM scenario.

	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Diesel	279	274	269	265	260	256	256	256	256	255
Gasoline	393	401	408	416	423	429	430	418	406	396
LPG	63	62	61	62	63	64	65	66	67	68
Other Oil Products	164	163	160	159	160	160	160	160	159	158
Natural gas	-	-	-	-	-	-	-	-	-	-
Pet Coke	75	70	65	62	59	58	56	54	52	51
Electricity	452	469	480	492	502	515	529	547	566	579
Biomass/ biofuels	53	53	52	53	55	56	57	58	59	59
Geothermal	1	1	1	1	1	1	1	1	1	1
Solar thermal	72	72	72	74	76	79	81	84	87	90
Total	***1,553***	***1,566***	***1,570***	***1,584***	***1,600***	***1,618***	***1,635***	***1,643***	***1,653***	***1,656***

Table 5.7: RE share in final energy demand across the energy system – WEM scenario

	All sectors	Electricity	Heating and cooling	Transport (RED Recast methodology)
2021	14.8%	15.7%	32.6%	6.2%
2022	15.9%	19.6%	33.2%	6.2%
2023	16.2%	20.4%	33.9%	6.1%
2024	16.8%	21.9%	34.8%	6.0%
2025	17.3%	22.6%	35.5%	6.0%
2026	18.9%	27.5%	36.2%	5.9%
2027	19.2%	27.5%	36.9%	5.9%
2028	19.5%	27.0%	37.6%	6.6%
2029	19.7%	26.6%	38.3%	7.3%
2030	20.1%	26.5%	39.0%	7.9%

5.1.1.5. Greenhouse Gas Emissions

Drawing directly from the model outputs, a greenhouse gas emission trajectory is extracted for the energy system (Figure 5.2 and Table 5.8). A degree of decarbonisation is achieved initially by gas-fired generation and later by solar PV and solar thermal generation in the ETS sector in this scenario; total CO_2 eq. emissions in the ETS sector drop from 3,220 kt in 2021 to 2,290 kt in 2030. The reduction in CO_2 eq. emissions in the non-ETS sector is relatively moderate. Emissions in the energy portion of the non-ETS sector decrease from 2,800 kt in 2021 to 2,750 kt in 2030. The main driver for this is the continued dependence of the transport sector on oil products.

Table 5.8: GHG emission trajectory in the ETS and Non-ETS energy-related sectors.

	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ETS CO_2	Mt	3.21	2.32	2.33	2.12	2.14	2.07	2.09	2.16	2.24	2.29
Non-ETS CO_2	Mt	2.74	2.74	2.74	2.74	2.76	2.77	2.77	2.74	2.71	2.67
ETS CH_4	kt	0.12	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Non-ETS CH_4	kt	1.77	1.81	1.84	1.87	1.90	1.92	2.09	2.27	2.45	2.61
ETS N_2O	kt	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Non-ETS N_2O	kt	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

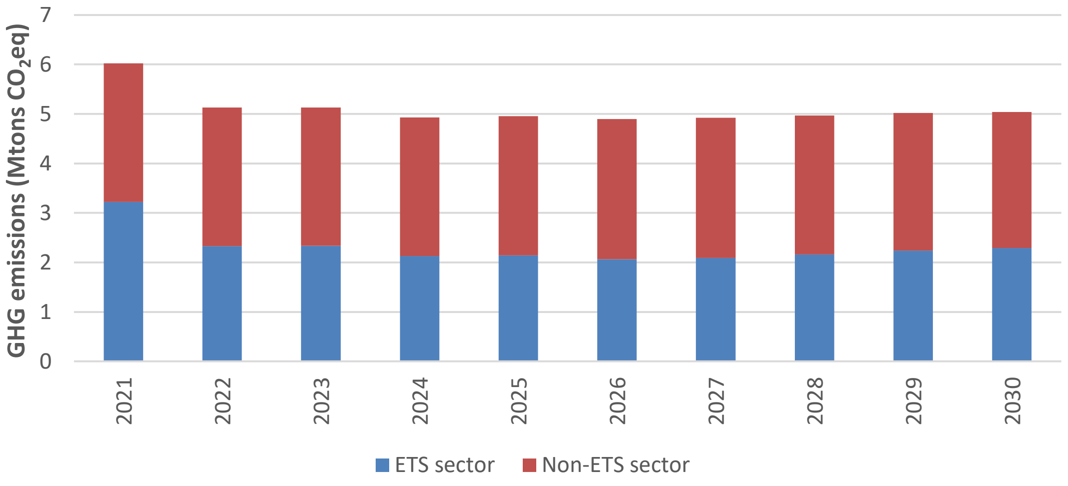

Figure 5.2: Trajectory of greenhouse gas emissions in the ETS and non-ETS energy-related sectors – WEM scenario.

5.1.1.6. Air Pollutant Emissions

The aforementioned choices in energy technologies and fuel mix results in the air pollutant emissions projections shown in Table 5.9. Even though the increased renewable energy share across the economy leads to a reduction in NO_x and SO_2 emissions, $PM_{2.5}$ and PM_{10} 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 SO_2 constrains the use of HFO with high sulphur content from 2020 onward.

Table 5.9: 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 5.10).

Table 5.10: 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

5.1.2. Planned Policies and Measures Scenario

5.1.2.1. Electricity Supply Sector

Capacity

The incorporation of energy efficiency measures and the resulting lower electricity demand in the PPM scenario lead to mild changes in the investment outlook of the electricity supply sector (Table 5.11). This scenario removes the constraint implemented on the total installed capacity of solar PV, thus increasing the technology capacity from 750 MW in the WEM scenario to 804 MW in the PPM scenario in 2030. The lower electricity demand reduces the need for storage technologies, as a portion of the electricity consumption in peak demand periods is eliminated.

Table 5.11: **Capacity projections in the electricity supply sector (MW) – PPM scenario.**

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Vasilikos	836	836	836	836	836	836	836	836	836	836
Dhekelia	450	450	450	102	102	102	102	102	102	102
Moni	128	128	128	128	128	128	128	128	128	128
New CCGT	216	216	216	432	432	432	432	432	432	432
New ICE	0	0	0	0	0	0	0	0	0	0
New ST	0	0	0	0	0	0	0	0	0	0
New GT	0	0	0	0	0	0	0	0	0	0
Light fuel oil CHP	0	0	0	0	0	0	0	0	0	0
Solar PV	380	400	420	440	460	480	500	523	673	804
Solar Thermal	0	50	50	50	50	50	50	50	50	50
Wind	158	180	198	198	198	198	198	198	198	198
Biomass & waste	22	27	32	37	42	47	50	50	58	58
Pumped Hydro	0	0	0	0	0	0	0	0	0	0
Li-Ion Batteries	0	0	0	0	0	0	0	0	0	0

Generation

The above technology deployment provides the generation mix shown in Figure 5.3. Exported electricity is largely dependent on the increased solar PV generation. As compared to the WEM scenario, electricity generation reduces by 550 GWh in 2030 in the PPM scenario. Fossil-fired generation is also reduced by 650 GWh in this case, while electricity from RES increases by 105 GWh. The higher deployment of solar PV and the lower electricity demand lead to a RES-E share of 30% in 2030, as opposed to 26% in the WEM scenario.

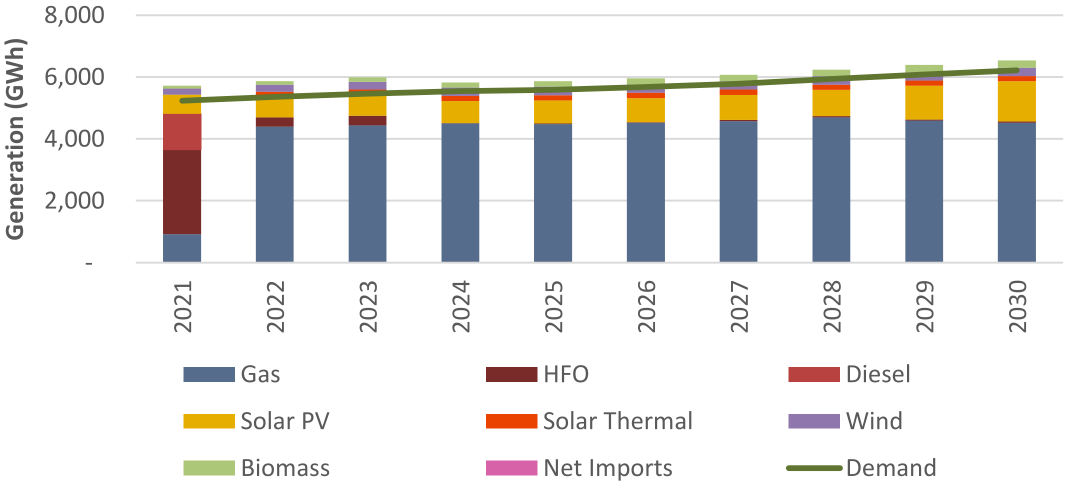

Figure 5.3: **Projected generation mix till 2030 – PPM scenario.**

5.1.2.2. Transport Sector

Due to the assumed modal shift from passenger cars to sustainable transport modes, significant changes occur in the vehicle fleet of the PPM scenario. The most notable change is the lower projection in passenger cars compared to the WEM scenario. Specifically, the present scenario's passenger car fleet is lower by nearly 145 thousand vehicles in 2030.

Most of this reduction is experienced by gasoline-fired passenger cars; these are lower by about 140 thousand in 2030. The rollout of gasoline hybrid passenger cars is comparable to WEM, while BEVs are increased by 18 thousand vehicles in 2030. On the other hand, a small number of diesel PHEV purchases can be noticed which were not present in the WEM scenario. In addition, a reduction in light truck and motorcycle fleets can be noticed, driven by the relevant mileage demand assumptions. On the contrary, the shift towards public transport creates a necessity for additional buses, which are higher by 2,560 units in 2030. As a result of the Clean Vehicles Directive for the public procurement of clean vehicles, a large number of these additional buses are fully-powered by electricity.

The outlook of fuel consumption in the transport sector changes as a result of the aforementioned transport fleet outlook (Table 5.13). The biggest variation can be noticed in the consumption projection of gasoline. This decreases by 27% in 2030 as compared to the WEM scenario. This is attributed to the reduced use of passenger cars and higher use of sustainable transport modes. Increased use of buses does not affect diesel fuel sales, as they remain at similar levels as in the WEM scenario. As regards biofuels, the same assumption is made as in the WEM scenario, i.e. forced blending for 2nd generation biodiesel, as the government of Cyprus has issued decrees which force this blending; especially in the PPM scenario it is assumed that the use of biofuels complies with the minimum share of 3.5% of 'advanced biofuels' as defined in Part A of Annex IX of Directive 2018/2001/EU, whereas the rest is satisfied by the use of used cooking oils (blended with diesel fuel) and bioethers (blended with gasoline). Despite the penetration of natural gas in power generation and the assumed investments in at least one CNG refuelling station in each district of Cyprus, use of natural gas in motor vehicles is not deemed cost-effective in either of the two scenarios; this is of course directly affected by the relevant techno-economic assumptions adopted in the analysis.

In terms of electricity consumption in the transport sector, total consumption increases by 0.3 PJ (90 GWh) in 2030 as compared to the WEM scenario. Annual electricity consumption in rail transport is assumed to remain at the same levels throughout the model horizon as the number of trips by the tram line in Nicosia was kept constant. **It is important to highlight the drastic reduction in overall energy demand of the transport sector through the promotion of sustainable transport modes.** It is estimated that additional cumulative investments in public transport for this scenario amount to 800-900 million EUR2016 to develop a tram line in Nicosia and increase the bus fleet, and an additional 500 million EUR2016 for creating the necessary infrastructure for sustainable transport until 2030. These levels of investment are very large compared to what's foreseen in other sectors, but they also lead to lower private investments in passenger vehicles of approximately 2 billion EUR2016 during the same period. It is noted that the materialisation of these projections will necessitate infrastructure investments that will need to be partly financed by EU funds, and an equivalent level of public acceptance and adoption of these modes of transport to make such investments successful. Using the SHARES methodology, RES-T share in this case has been estimated to rise to 14.1% in 2030. In the case of the WEM scenario, the equivalent value is limited to 7.9% in 2030.

Table 5.12: Projected vehicle fleet (total number of vehicles) – PPM scenario.

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Passenger cars	Diesel	63,430	57,686	51,942	46,117	40,372	44,733	41,052	37,217	33,212	28,964
	Diesel hybrid	-	-	-	-	-	-	-	-	-	-
	Diesel PHEV	-	56	127	189	252	367	465	587	692	799
	Gasoline	471,880	472,116	472,350	472,675	472,909	460,124	431,217	402,301	373,386	344,664
	Gasoline Hybrid	5,170	5,170	5,170	5,170	5,170	5,170	18,738	32,387	46,117	59,927
	Gasoline PHEV	-	-	-	-	-	-	-	-	-	-
	BEV	241	297	354	411	467	3,439	17,007	30,656	44,385	58,196
	LPG	320	424	529	633	739	843	948	1,061	1,174	1,174
	Natural gas	-	-	-	-	-	-	-	-	-	-
	Hydrogen	-	-	-	-	-	-	-	-	-	-
Buses	Diesel	3,314	3,579	3,840	4,106	4,372	4,609	4,856	5,089	5,332	5,574
	Diesel hybrid	-	-	-	-	-	-	-	-	-	-
	BEV	-	30	69	103	138	200	254	320	377	436
	CNG	-	-	-	-	-	-	-	-	-	-
MCs	Gasoline	50,442	49,981	49,471	48,961	48,476	47,990	47,505	46,971	46,485	46,000
	BEV	-	-	-	-	-	-	-	-	-	-
Trucks	Diesel	13,209	13,442	13,675	13,912	13,848	13,778	13,703	13,621	13,534	13,441
	BEV	-	-	-	-	297	600	909	1,223	1,544	1,870
	Natural gas	-	-	-	-	-	-	-	-	-	-
Light Trucks	Diesel	121,024	122,434	123,850	125,260	126,670	128,080	129,490	130,906	132,316	133,726
	BEV	-	-	-	-	-	-	-	-	-	-
	PHEV Diesel	-	-	-	-	-	-	-	-	-	-
	Hybrid diesel	-	-	-	-	-	-	-	-	-	-
Grand Total		**729,030**	**725,215**	**721,378**	**717,537**	**713,710**	**709,934**	**706,142**	**702,340**	**698,554**	**694,771**

Table 5.13: Evolution of fuel consumption (PJ) in the transport sector till 2030 – PPM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biofuels	1.18	1.17	1.16	1.15	1.13	1.12	1.09	1.06	1.03	1.35
Diesel	11.72	11.57	11.41	11.30	11.10	11.24	11.11	10.97	10.83	10.50
Gasoline	16.02	15.90	15.78	15.65	15.53	14.98	14.26	13.56	12.86	12.02
LPG	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Natural gas	-	-	-	-	-	-	-	-	-	-
Electricity (road)	0.003	0.006	0.010	0.014	0.042	0.104	0.282	0.462	0.642	0.823
Electricity (rail)	-	-	-	-	-	-	-	0.033	0.033	0.033

5.1.2.3. Heating and Cooling Sector

The additional energy efficiency measures adopted in the PPM scenario lead to a decrease in the total final energy demand of the Heating and Cooling sector. A reduction of 5% is estimated by 2030 as compared to the WEM scenario. As shown in Table 5.14 all of the fuels indicate lower figures, while the RES share in the Heating and Cooling sector is comparable to that in the WEM scenario.

Table 5.14: Final energy demand in the Heating and Cooling sector (PJ) – PPM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	7.79	7.97	8.12	8.24	8.29	8.41	8.49	8.63	8.77	8.90
Other Oil Products	6.84	6.78	6.65	6.61	6.60	6.59	6.56	6.53	6.48	6.45
Pet Coke	3.15	2.93	2.72	2.56	2.47	2.40	2.33	2.26	2.20	2.15
LPG	2.59	2.57	2.53	2.53	2.56	2.58	2.61	2.63	2.66	2.70
Biomass	1.03	1.00	0.98	1.01	1.07	1.12	1.16	1.20	1.23	1.27
Geothermal	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
District Heating & Cooling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.26
Solar thermal	2.98	2.98	2.99	3.00	3.06	3.13	3.21	3.30	3.39	3.51
RES share	32.6%	33.1%	33.9%	34.5%	35.2%	35.8%	36.5%	37.2%	38.7%	39.4%

5.1.2.4. Primary Energy Supply and Final Energy Demand

Primary energy supply decreases considerably in this scenario, due to the changes in the energy mix and demand indicated in all the sectors (i.e. electricity, transport, heating and cooling). Specifically, by 2030 a 10% is achieved compared to the WEM scenario; this corresponds to a difference of 215 ktoe (Table 5.15). A considerable decrease is achieved in the use of gasoline, due to measures in the transport sector, which is reduced by 110 ktoe in 2030. Similarly, a higher deployment of renewable energy technologies in the electricity supply sector reduces the supply of natural gas by 115 ktoe in 2030. On the other hand, primary energy supply from solar photovoltaics increases by 8 ktoe for the same year.

Table 5.15: Primary Energy Supply evolution till 2030 (ktoe) – PPM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel	489	276	272	270	265	268	265	262	259	251
Gasoline	383	380	377	374	371	358	341	324	307	287
Heavy Fuel Oil	579	61	62	1	5	5	7	8	6	7
LPG	62	62	61	61	62	62	63	64	64	65
Other Oil Products	163	162	159	158	158	157	157	156	155	154
Pet coke	75	70	65	61	59	57	56	54	53	51
Natural gas	154	763	771	761	755	763	772	794	778	767
Electricity	-	-	-	-	-	-	-	-	-	-
Biomass/ biofuels	78	83	88	94	101	108	110	111	122	130
Geothermal	1	1	1	1	1	1	1	1	1	1
Solar thermal	71	86	86	86	88	90	91	94	96	99
Solar PV	53	56	58	61	64	67	70	73	94	112
Wind	17	20	22	23	23	23	23	23	23	23
Total	**2,127**	**2,019**	**2,022**	**1,952**	**1,952**	**1,960**	**1,957**	**1,963**	**1,957**	**1,948**

Even though final energy demand in the WEM scenario shows a moderate increase over the period 2020-2030, a moderate decrease is illustrated in the PPM scenario (Table 5.16). This results in a total difference of 160 ktoe in 2030. Other than the aforementioned difference in gasoline consumption in the transport sector, a difference of 45 ktoe by 2030 is also observed in the final electricity demand.

In terms of overall system efficiency, through a comparison between primary energy supply and final energy demand, slightly improved figures compared to present can be noticed. This is estimated at 77% in 2030, same as in the WEM scenario.

Table 5.16: Final Energy Demand evolution till 2030 (ktoe) – PPM scenario.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Diesel	280	276	272	270	265	268	265	262	259	251
Gasoline	383	380	377	374	371	358	341	324	307	287
LPG	62	62	61	61	62	62	63	64	64	65
Other Oil Products	163	162	159	158	158	157	157	156	155	154
Natural gas	-	-	-	-	-	-	-	-	-	-
Pet Coke	75	70	65	61	59	57	56	54	53	51
Hydrogen	-	-	-	-	-	-	-	-	-	-
Electricity	450	461	470	476	480	488	497	511	523	535
Biomass/ biofuels	53	52	51	52	53	54	54	54	54	63
Geothermal	1	1	1	1	1	1	1	1	1	1
District Heating and Cooling	-	-	-	-	-	-	-	-	6	6
Solar thermal	71	71	71	72	73	75	77	79	81	84
Total	**1,539**	**1,535**	**1,527**	**1,525**	**1,521**	**1,521**	**1,510**	**1,504**	**1,503**	**1,497**

As shown in Table 5.17, reduced primary energy supply and final energy demand in combination with an increased renewable energy share in electricity supply, lead to a noticeable increase in the overall renewable energy share. In the present scenario, this is estimated at 22.9% (Table 5.17) versus 20.1% in the WEM scenario by 2030.

Table 5.17: RE share in final energy demand across the energy system – PPM scenario.

	All sectors	**Electricity**	**Heating and cooling**	**Transport (RED Recast methodology)**
2021	14.8%	15.8%	32.6%	6.3%
2022	16.1%	19.9%	33.1%	6.3%
2023	16.5%	20.8%	33.9%	6.3%
2024	17.2%	22.6%	34.5%	6.3%
2025	17.7%	23.3%	35.2%	6.3%
2026	18.2%	23.8%	35.8%	6.6%
2027	18.7%	24.1%	36.5%	7.3%
2028	19.1%	24.1%	37.2%	8.0%
2029	21.0%	27.6%	38.7%	8.8%
2030	22.9%	30.3%	39.4%	14.1%

5.1.2.5. Greenhouse Gas Emissions

As opposed to the WEM scenario, a greater level of decarbonisation is achieved in both energy-relevant ETS and non-ETS sectors (Figure 5.4). In the PPM, the deployment of the EuroAsia Interconnector enables further penetration of solar PV, and reduces CO2 eq. emissions by 250 kt in 2030 (with a total of 2,040 kt) as compared to the WEM scenario. A lower electricity demand also plays a role in this reduction. Similarly, in comparison to the WEM scenario, non-ETS sector CO2 eq. emissions reduce further by 415 kt in 2030 (with a total of 2,335 kt). In this case, the reduction is largely driven by a modal shift in the transport sector away from passenger cars towards sustainable transport modes.

Table 5.18: GHG emission trajectory in the ETS and Non-ETS energy-related sectors.

	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ETS CO_2	**Mt**	3.20	2.27	2.28	2.04	2.03	2.04	2.06	2.11	2.06	2.03
Non-ETS CO_2	**Mt**	2.65	2.62	2.59	2.57	2.55	2.52	2.46	2.40	2.34	2.26
ETS CH_4	**kt**	0.11	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Non-ETS CH_4	**kt**	1.76	1.80	1.82	1.84	1.86	1.94	2.08	2.22	2.36	2.48
ETS N_2O	**kt**	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-ETS N_2O	**kt**	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

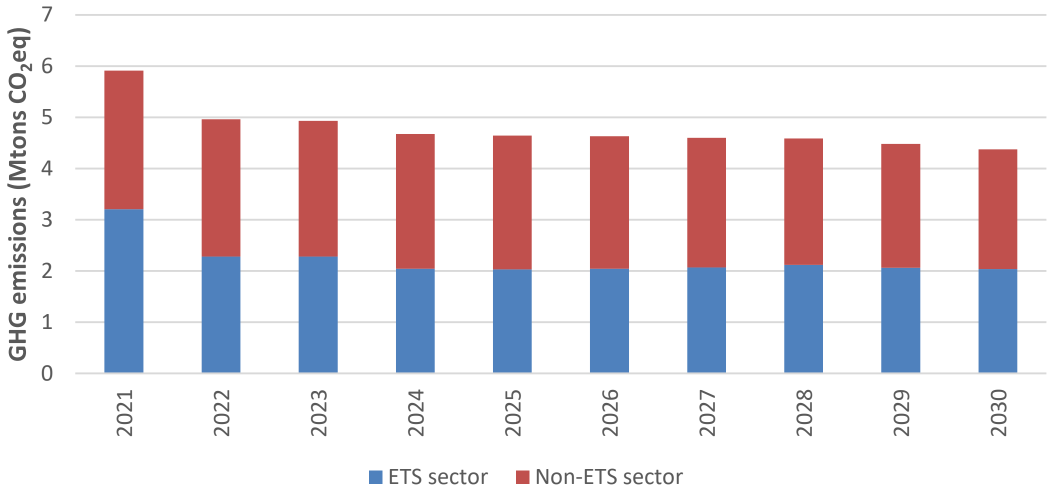

Figure 5.4: Trajectory of greenhouse gas emissions in the ETS and non-ETS sectors – PPM scenario.

5.1.2.6. Air Pollutant Emissions

As compared to the WEM scenario, a reduced projection in air pollutant emissions is observed, as illustrated by Table 5.19. 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 PPM scenario necessitates an increased use of the flexibility offered by the Dhekelia ICE units. Finally, NOx emissions are lower in the PPM 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 5.19: Air pollutant emission projections until 2030 in the PPM 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 5.20).

Table 5.20: Economy-wide air pollutant emissions projections in the PPM scenario until 2030.

Pollutant	Unit	2020	2025	2030
NOx	kt	10.78	8.13	7.60
PM2.5	kt	1.56	1.32	1.38
SO2	kt	3.64	0.69	0.72

5.1.3. Energy Savings and their Effect on Energy Supply

As explained in the previous sections, the scenario with PPM (or PPM scenario) assumes the implementation of diverse energy efficiency policies for buildings and equipment in the Heating and Cooling sector, as well as important measures to enable a shift from passenger cars towards public and non-motorised transport modes. As a result of these measures, the energy system of Cyprus is expected to become considerably more efficient by 2030 in comparison to that foreseen in the scenario with Existing Policies and Measures (or WEM scenario). This is illustrated in Table 5.21, which displays key energy consumption data and the calculated energy savings between the two scenarios. It is evident that the main portion of energy savings comes from the road transport sector. Electricity supply also requires less primary energy input in the PPM scenario, both because of the reduction in electricity demand and because of the marginally higher penetration of renewables in the power generation system.

Despite the reduced needs for energy supply due to energy efficiency improvements, it seems that there is no risk of stranded investments in the PPM scenario. The implementation of this scenario leads to a drop in new investments only in storage technologies, while no new investments occur in steam turbines, gas turbines and CHP facilities. Existing power plants will continue to operate until the end of their technical lifetime. Therefore, there is no issue of stranded assets in the Cypriot economy due to the implementation of PPM.

Table 5.21: Projected evolution of savings in final and primary energy consumption in Cyprus up to 2030. All values are expressed in ktoe.

Scenario with Existing Measures	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Final energy consumption	1931	1955	1966	1990	2017	2046	2072	2090	2107	2118
Final electricity consumption	452	469	480	492	502	515	529	547	566	579
Final non-electricity consumption, of which:	1479	1485	1487	1499	1515	1530	1543	1543	1542	1539
Industry	140	134	128	125	124	124	123	122	121	121
Households	185	186	185	186	190	193	195	198	201	203
Services	49	48	47	47	47	48	48	49	50	50
Agriculture	26	25	25	24	24	24	24	25	25	25
Road Transport	701	704	706	709	712	715	715	703	691	679
Air Transport	377	388	396	406	417	427	437	446	454	461
Primary energy input for power generation	1043	965	988	938	957	962	983	1020	1059	1084
Primary energy consumption	**2521**	**2451**	**2475**	**2437**	**2471**	**2492**	**2526**	**2563**	**2600**	**2624**
Scenario with Planned Policies and Measures	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Final energy consumption	1916	1922	1922	1931	1939	1951	1950	1953	1955	1956
Final electricity consumption	450	461	470	476	480	487	496	509	522	533
Final non-electricity consumption, of which:	1465	1461	1452	1455	1460	1464	1454	1443	1433	1422
Industry	140	134	127	124	124	123	122	122	121	121
Households	183	183	181	183	184	186	187	189	190	192
Services	48	47	46	45	46	46	46	46	47	47
Agriculture	26	25	25	24	24	24	24	25	25	25
Road Transport	691	684	677	672	665	658	637	616	595	575
Air Transport	377	388	396	406	417	427	437	446	454	461
Primary energy input for power generation	1038	945	965	866	874	883	926	966	1018	1057
Primary energy consumption	**2503**	**2406**	**2417**	**2321**	**2334**	**2347**	**2380**	**2409**	**2451**	**2479**
Energy Savings	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Savings in final energy consumption	15	32	44	59	77	95	122	137	152	162
Savings in final electricity consumption	2	8	10	15	22	28	33	37	44	45
Savings in final non-electricity consumption, of which:	13	24	34	44	55	67	89	100	109	117
Industry	0	1	1	1	1	1	0	0	0	0
Households	2	3	4	4	5	7	8	10	11	11
Services	1	1	1	2	2	2	2	3	3	3
Agriculture	0	0	0	0	0	0	0	0	0	0
Road Transport	10	19	29	38	47	57	78	87	96	104
Savings in primary energy input for power generation	5	20	23	72	82	79	56	54	41	28
Savings in primary energy consumption	**18**	**44**	**58**	**116**	**137**	**146**	**146**	**153**	**149**	**145**

5.1.4. Comparison with EU Climate and Energy Targets

Table 5.22 presents the projected total GHG emissions for the period 2021-2030, split into the emissions of ETS and non-ETS sectors. These aggregate forecasts come from the calculations of MARDE to be included in the final report of the NECP of Cyprus. Similarly, Table 5.23 illustrates the projected evolution of non-ETS GHG emissions for the two scenarios of the NECP.

In line with these emission forecasts, Table 5.23 provides an overview of the projected progress up to 2030 for meeting the EU energy and climate targets according to the WEM and PPM scenarios presented up to now. Although not all of these targets are entirely linked with the energy system (GHG emissions also depend on non-energy activities such as waste management, land use and the use of fluorinated gases), the energy modelling results of this study play a crucial role for assessing the achievement of Energy Union related policy objectives. The package of PPM included in the corresponding scenario seems to be sufficient for meeting[88]:

- The renewable energy targets related both to total energy consumption and to road transport;
- The energy efficiency target declared by the Republic of Cyprus.

Even though until recently it was expected that, fulfilling the emissions abatement target for non-ETS sectors was going to be very challenging for the Cypriot economy due to the revised 2005 estimate available, emissions are expected to reduce by 20.9% by 2030, leaving a gap of 208 kt CO_2eq. for complying with the country's Effort Sharing Regulation target of 24% reduction in emissions of 2030 compared to those of 2005. **These are new information and have not been taken into account and are not presented in the financial analysis in the sections that follow.**

Table 5.23 demonstrates how much more is needed for aligning the emissions of Cyprus with the deep decarbonisation target.

Table 5.22: Projected evolution of GHG emissions according to the WEM and PPM scenarios.

(kt CO2eq)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WEM Scenario	**8826**	**8078**	**8103**	**7928**	**7896**	**7890**	**7922**	**7972**	**8020**	**8024**
ETS	4831	4095	4133	3964	3938	3937	3981	4045	4140	4195
non-ETS	3995	3983	3970	3964	3959	3954	3941	3926	3880	3829
PPM Scenario	**8841**	**7865**	**7838**	**7576**	**7535**	**7509**	**7460**	**7436**	**7313**	**7190**
ETS	4921	3987	4002	3775	3774	3795	3825	3880	3837	3815
non-ETS	3920	3878	3836	3801	3761	3714	3635	3556	3477	3374

Source: MARDE calculations

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[88] We do not provide an assessment of the ability to meet the GHG emission reduction target in sectors subject to the EU ETS, because ETS installations have their own obligations which are separate from the national obligation that is relevant for non-ETS sectors. Moreover, each ETS sector that is relevant for Cyprus (power generation, cement production and ceramics/tiles production) has different allocations of emissions depending on provisions of the relevant EU legislation.

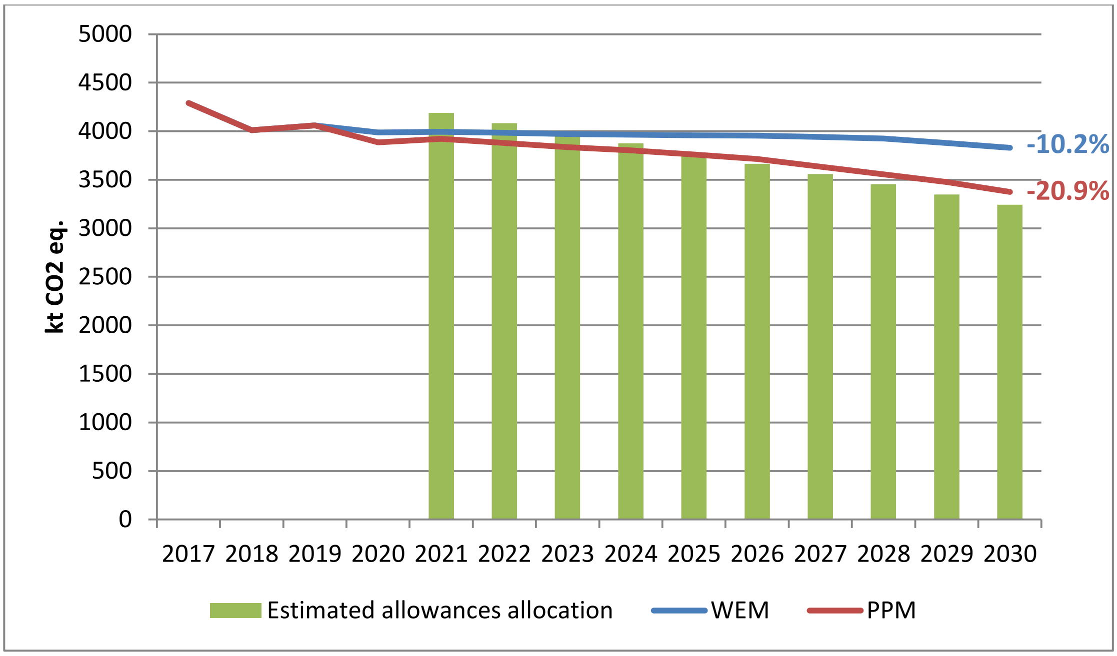

Figure 5.5: **Projected evolution of GHG emissions of non-ETS sectors according to the WEM and PPM scenarios. Source: MARDE calculations**

Table 5.23: **Progress towards meeting 2030 Energy Union objectives according to the two scenarios of the NECP of Cyprus**

		Progress Towards Target in Scenario:	
Energy Union Objective	**Target for 2030 Relevant for Cyprus**	**With Existing Measures**	**With Planned Policies and Measures**
Reduction of GHG emissions	Non-ETS Sectors: -24% compared to 2005	-10.2%	-20.9% *National target to be met through the use of flexibility mechanisms provided in the ESR*
Promotion of Renewable Energy	Energy-Wide Share of Renewables: 23%	20%	23%
	Renewable Energy in Transport: 14%	8%	14%
Energy Efficiency obligatory target	Cumulative target for achieving 243,045 toe end use savings in the period 2021-2030	To be met	To be met

5.1.5. Application of the Energy Efficiency First Principle in Planned Policies and Measures

According to guidance provided by the European Commission, when designing their energy and climate policies, Member States should apply the Energy Efficiency First Principle, meaning that priority should be given to policies and measures that reduce primary or final energy consumption and improve energy security, and other measures should be considered only after energy efficiency actions are deemed unfeasible or very costly.

The package of Planned Policies and Measures foreseen in the PPM scenario of the Cypriot National Energy and Climate Plan seems to be in line with the Energy Efficiency First Principle, for the following reasons:

- As explained in the relevant section of the NECP of Cyprus, the measures of the PPM scenario are sufficient to comply with the energy efficiency obligations of the country as required in Article 7 of the Energy Efficiency Directive; this means that the appropriate measures have been taken into account.
- As a result of energy efficiency measures, energy supply of Cyprus will be lower in comparison to that of the WEM scenario. This means that energy efficiency has indeed been given priority in comparison e.g. to stronger deployment of renewable energy.
- All cost-effective policies and measures that are related to energy efficiency have been included in the PPM scenario; these involve renovations of residential and tertiary buildings and industrial equipment, strong promotion of public and non-motorised transport and switch to electric cars. These measures have a negative or near-zero total lifetime cost and are therefore cost-effective. Further energy efficiency measures are not recommended to be deployed because they have a very high cost per tonne of carbon abated (e.g. the renovation of very old buildings to become nearly-zero energy buildings) or are considered to be unrealistic (e.g. an increase in the number of energy renovations of buildings up to 2030, which would reach unprecedented levels of refurbishments that would require very high financial and human resources to realise). This finding is based on two studies that were funded by the European Commission's Structural Reform Support Service in the recent past, and whose results were utilised in the NECP of Cyprus and in the current Impact Assessment study[89,90].
- It is particularly important to note that the PPM scenario foresees energy efficiency measures in transport (modal shift towards public and non-motorised transport and electrification of cars) which involve very significant investments that reach unprecedented levels for the standards of the Cypriot transport system. This underlines how strongly the Energy Efficiency First principle has been taken into account.
- Apart from the cost-effectiveness argument mentioned above, further prioritising demand-side measures such as energy efficiency improvements would put Cyprus at risk of not meeting the two main objectives of Table 5.23 which are related to energy supply: the renewable energy target and the reduction in emissions of ETS sectors – which in the case of Cyprus is predominantly power generation. Therefore, measures in the electricity supply that have been foreseen in the PPM scenario are indeed those which are absolutely necessary for Cyprus to meet the above mentioned commitments.

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[89] Vougiouklakis Y., Struss B., Zachariadis T. and Michopoulos A. (2017), An energy efficiency strategy for Cyprus up to 2020, 2030 and 2050. Study funded by the European Commission Structural Reform Support Service under grant agreement SRSS/S2016/002 and from the German Federal Ministry of Economy and Energy.

[90] Zachariadis T., Michopoulos A. and Sotiriou C. (2018), Evaluation of the Effectiveness of Possible Climate Change Mitigation Policies and Measures. Final Report submitted to the European Commission's Structural Reform Support Service under Service Contract No. SRSS/C2017/024.

- As a result of the above considerations, energy efficiency measures in all end uses of the Cypriot economy, as foreseen in the PPM scenario and to the extent that they will be fully deployed, can greatly improve the security of energy supply of the country.
- The only further policy that is worth examining is the implementation of a green tax reform that would involve carbon pricing in non-ETS sectors of the Cypriot economy. Such a reform can indeed stimulate further improvements in energy efficiency and substitution of liquid fossil fuels by low- or zero-carbon energy forms. In September 2019 the Finance Minister of Cyprus announced that a green tax reform will be put in consultation in 2020 with the aim to adopt the relevant legal framework and implement such a reform in 2021. However, considerations for the adoption of such a reform were still at an early stage by the time of this writing, so that it could not be considered as part of the government's Planned Policies and Measures.

5.2. Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts, including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

5.2.1. Macroeconomic impacts

5.2.1.1. Methodology

To assess the macroeconomic impacts of the PPM scenario in comparison to the WEM scenario, input-output (IO) analysis was applied. IO is a quantitative technique for studying the interdependence of production sectors in an economy over a given time period, which has been extensively applied for policy impact evaluation, technical change analysis and forecasting[91].

For this purpose, the national Cyprus IO table available by the European Statistical Service (Eurostat) for 2015 was transformed to a system of linear equations accounting for the way in which the output of each economic sector is distributed through sales to other sectors (intermediate demand) and final demand (consumers). The IO framework has been incrementally extended to employ physical units to trace energy use and related environmental activities[92].

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[91] Miller, R.E., Blair, P.D. (2009). *Input-output analysis: Foundations and extensions* (2nd edn). Cambridge University Press, New York.

[92] Giannakis, E., Kushta, J., Giannadaki, D., Georgiou, G.K., Bruggeman, A., Lelieveld, J. (2019). Exploring the economy-wide effects of agriculture on air quality and health: Evidence from Europe. *Science of the Total Environment*, 663, 889-900.

Thus, a dynamic input-output model was developed and applied to estimate the economy-wide effects of the two different scenarios examined for the economy of Cyprus over time (to 2030). The rationale of this approach is that the PPM scenario will involve additional and/or different types of investments during the period 2020-2030 in comparison to the WEM scenario. These changes in investment needs were used as input in the IO model of Cyprus in order to simulate their effects on the economic output and employment of each main sector of the Cypriot economy.

5.2.1.2. Input data

As a result of the simulations of the energy system with the OSeMOSYS model, for each one of the two scenarios (With Existing Measures and With Planned Policies and Measures) there is a projection of annual investments in each production sector of the economy as well as a projection of the annual expenditures of households for energy goods. For this analysis, investments were classified in seven categories, namely: (a) industry, (b) power generation technologies, (c) electricity storage technologies, (d) gas infrastructure, (e) electricity interconnector, (f) public transport, (g) private transport, and (h) buildings (energy efficiency measures).

Model results of OSeMOSYS, outlined in Chapter 5.1, were introduced in the IO model through changes in its exogenous variables, that is, expenditure for investments per sector of economic activity. A critical parameter of the impact assessment is to what extent the production of the necessary equipment for implementing the investments of the two scenarios, and thus the relative expenditures, occurs inside the economy of Cyprus or abroad. The estimation of the associated macro-economic impacts is based on those investment expenditures that are spent inside the national economy and not directly imported from abroad. This analysis takes also into account the induced effects from energy savings, i.e., the reduced household expenditures for energy consumption.

Table 5.24 presents the total estimated vector of spending within the national economy associated with the development and operation of all the interventions under the WEM scenario, and Table 5.25 presents the corresponding figures for the PPM scenario. The allocation of spending to the various economic sectors has been carried out on the basis of information obtained from a literature review[93,94] as well as based on experience from our earlier application of such studies for Cyprus. It is noted that the investment costs consist of the capital and operation and maintenance cost. As mentioned above, to measure more accurately the impact of investments in the economy investments for each sector are divided into local investments and imports.

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[93] Tourkolias, C., Mirasgedis, S., Damigos, D. and Diakoulaki, D. (2009), Employment benefits of electricity generation: A comparative assessment of lignite and natural gas power plants in Greece. *Energy Policy* 37(10), 4155-4166.

[94] Markaki, M., Belegri-Roboli, A., Michaelides, P., Mirasgedis, S. and Lalas, D.P. (2013), The impact of clean energy investments on the Greek economy: An input–output analysis (2010–2020). *Energy Policy* 57, 263-275.

5.2.1.3. Results

Table 5.26 presents the economy-wide effects in terms of generated economic output and employment created by the investments under the two scenarios. The investments in the PPM scenario results in an annual increase of the economic output of the country ranging between 0.17% and 0.32% higher compared to the annual increase due to the investments under the WEM scenario for the period 2020-2030. Similarly, investments in the PPM scenario results in an annual increase of national employment ranging between 0.17% and 0.31% higher compared to the annual increase due to the investments under the WEM scenario for the same period. Specifically, in 2030, the economic output and employment of the country under the PPM scenario will be higher by 0.29%, compared to the respective figures of year 2030 under the WEM Scenario.

The estimated macro-economic effects associated with the Planned Policies and Measures are relatively higher during the last years of the study period, i.e., from 2027 to 2030. The notable change in 2027 is attributed to the increased capital and operational investments for the Transportation and Construction sectors, i.e., the sectors with the highest output multipliers in the economy of Cyprus. This change is mainly due to the large investments foreseen in the PPM scenario in the road transport sector, with substantial investments in new buses, the Nicosia tramline and other interventions for sustainable urban mobility. Thus, the increase in the final demand for products and services of those sectors through demand for investments, generate indirect growth effects to the other sectors of the economy (e.g., Machinery and Equipment, Banking-Financing, Real Estate, Accommodation and Food Services and others).

Table 5.24: Annual spending associated with investments and private consumption under the WEM Scenario by sector of economic activity for the period 2020-2030 (in million Euros'2016).

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Agriculture	1.1	1.5	1.9	2.3	2.7	3.1	3.6	3.6	3.7	3.8
Forestry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Food Manufacturing	3.6	4.9	6.2	7.6	9.0	10.4	11.9	12.0	12.2	12.6
Textile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood and Paper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chemical and Plastic Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Metal Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Machinery and Equipment	14.9	14.1	13.7	12.8	12.4	12.1	12.5	12.6	12.8	12.8
Energy	475.5	498.3	516.8	532.0	545.4	566.2	586.4	603.3	625.0	637.4
Construction	88.8	106.1	119.3	135.9	150.6	165.7	188.0	190.0	194.9	195.3
Trade	62.4	75.7	89.3	102.6	116.0	129.9	143.8	145.5	148.5	151.7
Accommodation and Food Services	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.5
Transportation	10.0	11.2	12.4	14.3	15.5	16.8	18.0	18.2	19.3	18.0
Banking-Financing	21.2	25.0	28.5	32.1	35.7	39.4	43.5	44.0	44.9	45.8
Real Estate	9.9	11.6	12.1	13.7	14.5	15.4	17.2	17.4	17.8	17.6
Public Administration	4.9	5.8	6.7	7.8	8.7	9.7	10.7	10.8	11.0	11.2
Education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.25: Annual spending associated with investments and private consumption under the PPM Scenario by sector of economic activity for the period 2020-2030 (in million Euros'2016).

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Agriculture	1.1	1.4	1.7	2.0	2.3	2.7	3.1	3.1	3.1	3.1
Forestry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Food Manufacturing	3.5	4.5	5.5	6.6	7.7	8.9	10.4	10.4	10.4	10.4
Textile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood and Paper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chemical and Plastic products	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.2
Metal Products	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.1	4.1	4.1
Machinery and Equipment	17.5	16.7	16.5	15.7	15.6	15.5	15.4	16.1	16.0	15.8
Energy	473.1	493.6	511.0	524.0	534.3	552.1	569.1	583.8	603.1	614.5
Construction	127.8	149.2	166.6	186.8	203.2	220.8	239.2	257.6	272.1	272.6
Trade	61.8	72.9	84.1	95.1	106.5	118.6	133.0	136.9	138.1	137.8
Accommodation and Food services	1.1	1.3	1.5	1.8	1.9	2.1	2.3	2.6	2.8	2.8
Transportation	12.5	16.0	19.6	23.7	27.0	30.6	34.0	41.3	45.2	44.2
Banking-Financing	20.1	23.6	26.8	30.0	33.1	36.5	40.3	41.9	42.8	42.8
Real Estate	9.9	12.9	14.5	16.8	18.0	19.2	20.3	22.6	24.6	24.7
Public Administration	4.7	5.6	6.4	7.5	8.3	9.1	10.1	10.4	10.7	10.7
Education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.26: Annual total economic output (in million Euros'2016) and annual total employment (in thousand persons) associated with the investments under both scenarios for the period 2021-2030.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Economic Output										
With Existing Measures	59,038	60,610	62,119	63,553	64,916	66,380	67,944	69,464	71,037	72,514
With Planned Policies and Measures without electricity interconnection	59,187	60,756	62,261	63,691	65,047	66,510	68,060	69,646	71,257	72,725
Difference between Scenarios	0.25%	0.24%	0.23%	0.22%	0.20%	0.19%	0.17%	0.26%	0.31%	0.29%
Total Employment										
With Existing Measures	477,810	490,408	502,484	513,952	524,825	536,458	548,936	560,590	572,776	584,814
With Planned Policies and Measures without electricity interconnection	479,173	491,684	503,675	515,089	525,884	537,489	549,866	562,166	574,636	586,502
Difference between Scenarios	0.29%	0.26%	0.24%	0.22%	0.20%	0.19%	0.17%	0.28%	0.32%	0.29%

Note: Total economic output includes both intermediate and final demand and is hence higher than GDP which includes final demand only.

Table 5.27 presents the sectoral distribution of the generated economic output in the Cypriot economy in 2030 associated with the investments under the two scenarios. Evidently, the economic sectors that mainly benefit in the PPM scenario are: (a) Construction, (b) Metal products, (c) Wood and paper, (d) Transportation, and (e) Chemical and plastic products. The highest negative effects are observed in the economic output of the energy sector due to the reduced energy demand attributed to the implementation of energy efficiency measures in the PPM scenario. In the rest of the economy, there is a notable increase in the metal products output of the PPM scenario due to their use in the energy efficiency measures adopted in the PPM scenario, and an even larger increase in investments in construction. The construction sector has a strong local character and is skewed by large-scale investments, as the ones found in the PPM scenario, notably in new transport and energy infrastructure.

The differences are overall quite small however, without a single sector showing disproportionately large changes compared to the others. A minor negative effect in the economic output of traditional activities of the economy such as agriculture is created, principally due to lower numbers of biofuels to be blended with transport fuels (these are forecasted to be used in larger quantities in the WEM scenario).

It is important noting that the above analysis is bound by the use of IO modelling as a tool for investigating the distribution of investments cross-sectorally. The IO model does not allow for the simulation of fiscal effects, which may be important in this case since the measures in the PPM scenario assume large public investments in public transport infrastructure, and associated reductions in private investments in private vehicles. This alone could have a large effect on the government budget, but it is not captured in this model.

Table 5.27: Change in economic output by main sector of the national economy of Cyprus in 2030 due to investments in the PPM scenario, in comparison to the WEM scenario.

Sectors of economic activity	2030
Agriculture	-0.08%
Forestry	0.00%
Mining	0.23%
Food Manufacturing	-0.07%
Textile	0.03%
Wood and Paper	0.55%
Chemical and Plastic Products	0.32%
Metal Products	1.24%
Machinery and Equipment	0.09%
Energy	-1.32%
Construction	2.04%
Trade	-0.25%
Accommodation and Food Services	0.06%
Transportation	0.64%
Banking-Financing	0.23%
Real Estate	0.24%

Public Administration	0.03%
Education	0.01%
Health	0.00%
Other Services	0.15%

5.2.1.4. Competitiveness Aspects

As will be explained in more detail in the next Section, in the absence of other policies (e.g. change in energy taxation) that could affect energy prices, changes between the WEM and PPM scenarios can be foreseen only in the retail prices of electricity and automotive fuels, while prices of other fuels used for heating or in industry are not affected. In the case of electricity, consumer prices are projected to remain essentially the same in the two scenarios. In the case of automotive fuels, due to additional blending of advanced biofuels in the PPM scenario, retail prices of gasoline are expected to rise by 1.5% in 2030 in comparison to those of the WEM scenario.

These changes are very small and constitute a negligible share of production costs in the different sectors of the Cypriot economy. As shown in a previous productivity modelling study[95], fuel price increases of the order of 7% for fuels and 12% for electricity were expected to affect production costs by less than 0.4%. This means that, in the case of the Cyprus NECP, with much lower changes in energy prices, no competitiveness concerns should arise.

5.2.2. Socio-economic impacts

The implementation of strong energy and climate policies typically leads to changes in the relative prices of energy commodities in comparison to a ‘business as usual’ price trajectory. These price changes in turn affect the cost of living of households in different ways. This section focuses on analysing the distributional effects induced by policies of the Planned Policies and Measures Scenario in comparison to the Existing Policies and Measures Scenario; this involves an assessment of how much Cypriot households of different income, location (urban and non-urban areas) and demographic characteristics are affected by the changes in prices of electricity and fuels due to the implementation of the PPM scenario.

5.2.2.1. Expenditures of Cypriot households on energy goods

A main concern with energy and environmental policies is that they may have a disproportionate effect on the most vulnerable parts of society by raising energy prices. Expenditures for energy goods are generally found to be regressive, i.e. low-income households spend a higher fraction of their income on these goods than high-income households. Despite this widespread belief, regressivity of energy expenditures is not always the case. Table 5.28 shows the annual expenditures of Cypriot households on main energy

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[95] Keteni E., Mamuneas T. and Zachariadis T., 2013. The Effect of EU Energy and Climate Policies on the Production Sectors of the Economy of Cyprus – Final Results. Economic Policy Paper 01-13, Economics Research Centre, University of Cyprus.

items (electricity, heating fuels and transport fuels), both in absolute terms and as a fraction of their annual income. This information comes from the latest Household Expenditure Survey conducted by the Statistical Service of Cyprus on a representative sample of about 2,700 households in year 2015.

According to the information of Table 5.28, Cypriot households used to spend on average about 3,100 Euros per year on fuels and electricity or 10.6% of their income in year 2015; poorest households spent around 1,300 Euros (19% of their income) while richest ones close to 5,000 Euros per year (6% of their income). This means that overall the expenditures on energy goods are indeed regressive. Half of these expenditures are for transport fuels on average, but the distribution among income groups is quite different: the poorest spend more on electricity and automotive fuels, and the rich spend more on automotive fuels. Overall, regressivity is strongest in the case of electricity, where poor households spend (as a fraction of their income) over three times more than rich households. This means that a change in the prices of electricity has a greater distributional effect than a change in the prices of other energy commodities.

Table 5.28: Annual expenditure of Cypriot households on energy goods in year 2015.

	Expenditures in Euros'2015 for:			
Income Group	**Electricity**	**Heating Fuels (oil, LPG, biomass)**	**Transport Fuels (gasoline, diesel)**	**All Energy Goods**
Poorest 10%	426	164	710	1300
10%-20%	517	222	1059	1797
20%-30%	607	278	1325	2210
30%-40%	696	312	1466	2474
40%-50%	815	311	1677	2803
50%-60%	863	353	2227	3442
60%-70%	940	425	2197	3562
70%-80%	1002	554	2646	4203
80%-90%	1042	592	2701	4335
Richest 10%	1383	788	2786	4957
All households	**829**	**400**	**1879**	**3107**

Expenditures as % of annual income for:

Income Group	**Electricity**	**Heating Fuels (oil. LPG. biomass)**	**Transport Fuels (gasoline. diesel)**	**All Energy Goods**
Poorest 10%	6.3	2.4	10.4	19.1
10%-20%	4.7	2.0	9.6	16.2
20%-30%	4.3	2.0	9.4	15.7
30%-40%	4.0	1.8	8.4	14.2
40%-50%	3.8	1.4	7.8	13.0
50%-60%	3.3	1.4	8.6	13.3
60%-70%	3.0	1.4	7.1	11.4
70%-80%	2.7	1.5	7.0	11.1
80%-90%	2.2	1.2	5.6	9.0
Richest 10%	1.8	1.0	3.5	6.3
All households	**2.8**	**1.4**	**6.4**	**10.6**

Source: Household Expenditure Survey 2015 of the Statistical Service of Cyprus; data analysed by Economics Research Centre, University of Cyprus.

5.2.2.2. Changes in energy prices between WEM and PPM scenarios

Table 5.29 and Table 5.30 present the projected evolution of prices of fuels and electricity respectively, according to the WEM and PPM scenarios of the NECP. In the absence of other policies (e.g. change in energy taxation) that could affect energy prices, changes between the two scenarios can be foreseen only in the retail prices of electricity and automotive fuels, while prices of other fuels used for heating or in industry are not affected.

In the case of electricity, changes in power generation costs will be the composite result of various differences between the WEM and PPM scenarios as explained in Chapter 5.1 – mainly due to the higher penetration of renewables and the lack of electricity interconnection with neighbouring countries, which leads to additional investment needs for electricity storage. As a result, electricity costs are expected to be 2.7% higher in the PPM scenario in 2030. Taking into account other fixed costs of power generation, this decrease in generation costs is estimated to lead to a rise in consumer prices of electricity of about 1.5% by 2030.

In the case of automotive fuels, the change in prices is due to the assumption that the 2030 renewable energy target obligation in the transport sector is achieved in the PPM scenario. This leads to additional blending of automotive gasoline and diesel with (more costly) advanced biofuels in line with the requirements of Article 25 of Directive 2018/2001/EU, thereby increasing the retail prices of gasoline and diesel by 2.0% and 0.9% respectively in 2030, or by 1.5% as a weighted average of the increases in total automotive fuel expenditure of Cypriot households.

If households were not able to react to these price changes, it would be possible to compute the change in the cost of living of each income group by multiplying the percentage change in prices of Table 5.29 and Table 5.30 by the corresponding expenditures of Table 5.28. However, in reality households adjust their consumption and their expenditures after a price change according to their preferences. The way each household reacts depends on different socio-demographic characteristics and on each household’s consumption pattern. Therefore, detailed modelling of consumer behaviour is necessary, and the modelling approach that was adopted here is briefly explained in the next section.

Table 5.29: Projected evolution of electricity generation costs in the WEM and PPM scenarios.

Existing Policies and Measures Scenario

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Average electricity cost (EUR2016/MWh)	98.6	82.7	85.7	87.6	90.4	91.8	94.5	95.0	95.5	96.5
Annual growth rate	-6.6%	-16.1%	3.6%	2.3%	3.1%	1.5%	3.0%	0.5%	0.5%	1.1%
Rate of change as compared to 2018	8.0%	-9.4%	-6.2%	-4.0%	-1.0%	0.5%	3.4%	4.0%	4.5%	5.7%

Planned Policies and Measures Scenario

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Average electricity cost (EUR2016/MWh)	98.7	83.1	86.1	91.1	93.6	94.6	95.5	96.2	98.4	99.1
Annual growth rate	-6.5%	-15.7%	3.6%	5.7%	2.8%	1.0%	0.9%	0.7%	2.3%	0.7%
Rate of change as compared to 2018	8.0%	-9.0%	-5.7%	-0.3%	2.5%	3.5%	4.5%	5.3%	7.8%	8.5%

Difference (Planned - Existing Policies and Measures)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Average electricity cost	0.0%	0.5%	0.5%	3.9%	3.6%	3.1%	1.1%	1.3%	3.1%	2.7%
Retail electricity price (estimated)										1.5%

Table 5.30: Projected evolution of automotive fuel prices in the WEM and PPM scenarios. Excise taxes are included; 19% Value Added Tax not included.

Existing Policies and Measures Scenario

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Blended Gasoline Price (EUR2016/GJ)	41.9	43.1	44.3	45.6	47.0	47.3	47.6	47.9	48.2	48.5
Annual growth rate	1.3%	2.8%	2.9%	2.9%	3.0%	0.6%	0.6%	0.6%	0.6%	0.6%
Rate of change as compared to 2018	10.8 %	14.0%	17.2%	20.6%	24.2%	25.0%	25.8%	26.6%	27.4%	28.2%
Blended Diesel Price (EUR2016/GJ)	37.7	38.8	39.9	41.1	42.4	42.7	42.9	43.2	43.5	43.8
Annual growth rate	2.8%	2.9%	2.9%	2.9%	3.1%	0.7%	0.6%	0.6%	0.6%	0.6%
Rate of change as compared to 2018	8.0%	11.1%	14.4%	17.7%	21.4%	22.1%	22.9%	23.7%	24.5%	25.3%

Planned Policies and Measures Scenario

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Blended Gasoline Price (EUR2016/GJ)	41.9	43.1	44.3	45.6	47.0	47.3	47.6	47.9	48.2	49.4
Annual growth rate	1.3%	2.8%	2.9%	2.9%	3.0%	0.6%	0.6%	0.6%	0.6%	2.6%
Rate of change as compared to 2018	10.8 %	14.0%	17.2%	20.6%	24.2%	25.0%	25.8%	26.6%	27.4%	30.7%
Blended Diesel Price (EUR2016/GJ)	37.7	38.8	39.9	41.1	42.4	42.7	42.9	43.2	43.5	44.2
Annual growth rate	2.8%	2.9%	2.9%	2.9%	3.1%	0.7%	0.6%	0.6%	0.6%	1.6%
Rate of change as compared to 2018	8.0%	11.1%	14.4%	17.7%	21.4%	22.1%	22.9%	23.7%	24.5%	26.5%

Difference (Planned - Existing Policies and Measures)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Blended Gasoline Price	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%
Blended Diesel Price	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%

5.2.2.3. Modelling approach

Household demand for energy and the subsequent distributional effect of energy efficiency or renewable energy policies has been analysed in several countries. These studies rely, inter alia, on data from household expenditure surveys conducted annually by national statistical agencies; this enables the empirical estimation of detailed income and substitution patterns. However, in some countries (Cyprus being one of them) household expenditure surveys are conducted less frequently. This poses problems to performing empirical demand analysis, as price variation over time is limited. To overcome this problem, an alternative approach was developed and applied with data from Cypriot households by Pashardes *et al.*[96]. This approach is based on the fact that price changes differ across goods, hence their effect can vary between households due to preference heterogeneity. For example, vegetarians are not affected by changes in the price of meat; therefore, when the only item in the food basket that increases in price is meat, only meat eaters face an increase in the unit cost of food.

In the case of energy, the unit cost is made from the prices of items such as electricity, gasoline, gas, heating oil, solid fuels and renewable sources. To the extent that these items do not increase proportionately in price and their shares in consumption vary across households due to preference heterogeneity, then the unit cost of energy also varies across households. Similar to the vegetarian example mentioned above, households without a car are not affected by a change in automotive fuel prices, whereas multi-car households may see a considerable increase in their cost of living if fuel prices rise.

Thus, Pashardes *et al.* constructed a consumer theory based measure of the unit cost of composite goods commonly used for empirical demand analysis, and used the variation in this cost across households to estimate a demand system from a limited household expenditure surveys. They applied the method to estimate the price elasticity of household demand for energy in the context of an integrable complete demand system using data drawn from three household expenditure surveys conducted in Cyprus in 1996, 2003 and 2009 by the Statistical Service of Cyprus. Then they simulated the welfare effects of price increases assumed to result from the adoption of EU's 2020 energy and climate package on households grouped by income, location and demographic characteristics.

This study uses the same model, simulating the effect of the above mentioned price changes in electricity and automotive fuel for the year 2030, in order to explore the welfare impact of the PPM scenario as compared to the 'business as usual' evolution foreseen in the WEM scenario.

5.2.2.4. Simulation of welfare impacts

Based on the relative weight of expenditures on different energy goods (last row of Table 5.28), and on the outcome of Table 5.29 and Table 5.30 that the PPM scenario foresees changes in consumer prices of 1.5%, 1.5% and 0% for electricity, transport fuels and heating

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[96] Pashardes P., Pashourtidou N. and Zachariadis T., Estimating welfare aspects of changes in energy prices from preference heterogeneity. *Energy Economics* 42 (2014), 58–66.

fuels respectively compared to the WEM scenario, the weighted average of the change in all energy goods is about 1.3%.

This means that the PPM scenario will have a slightly negative effect (i.e. an increase) on the cost of living of Cypriot households up to 2030, but overall the changes in household welfare are expected to be very small. This becomes evident if one observes the results of the welfare simulations shown in Tables 4, 5 and 6 of Pashardes *et al.*, keeping in mind that the effects of that study were simulated assuming a 7.6% increase in the composite cost of all energy goods by 2020[97], whereas we assume here an increase of less than 1.5% in total energy costs in 2030.

In our case, households in the low-income deciles may experience an increase in their costs of the order of 10-20 Euros'2015 per year, and high-income groups may incur additional costs of 30-50 Euros'2015; these correspond to about 0.1% of the income for poor, medium-income and rich households alike. Obviously these changes are too low to be considered substantial. This holds both for urban and rural households.

To summarise, the implementation of the PPM scenario is not expected to cause any substantial costs or benefits to households nor affect the distribution of income or poverty levels in the Cypriot society. Despite the considerable investments required and emission reductions achieved in the PPM scenario, as described in other sections of this Impact Assessment, there will be essentially no impact on energy affordability and social equity.

5.2.3. Employment impacts

5.2.3.1. Additional human resources in renewable power generation

Investments in renewable energy technologies could have substantial local economy benefits in terms of job creation. Based on the results described in Chapter 3 of this report and on average figures provided through a relevant IRENA report[98], a quantification of the employment potential is conducted for utility-scale PV installations in each scenario (Table 5.31).

Table 5.31: Human resource requirements (person days) for different stages of utility-scale solar PV investments in each scenario (2020-2030).

	WEM scenario (358 MW)	PPM scenario (412 MW)
Planning (e.g. environmental, health and safety legal, real estate and taxation experts)	15,179	17,469
Manufacture (e.g. factory workers, industrial engineers, logistics experts)	360,000	413,854

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[97] See Pashardes et al. (*Energy Economics* 42 (2014)), end of page 63.

[98] IRENA, "Renewable Energy Benefits: Leveraging Local Capacity for Solar PV" (Abu Dhabi: International Renewable Energy Agency, 2017), https://www.irena.org/publications/2017/Jun/Renewable-Energy-Benefits-Leveraging-Local-Capacity-for-Solar-PV.

Installation and Connection (e.g. civil, electrical and mechanical engineers, construction workers, technical personnel)	281,961	324,491
Operation and Maintenance (e.g. operators, energy regulation, electrical and telecommunication experts, accountants)	97,090/year 1,941,800 over 20 years	111,735/year 2,234,692 over 20 years
Decommissioning (e.g. construction workers, truck drivers, environmental, safety and logistic experts)	36,874	42,436
Total	**2,635,814**	**3,032,943**

Assuming 220 working days in a year, and a total project lifetime of 20 years, the above totals are equivalent to 599 permanent employment positions for the WEM scenario, and 2,155 positions for the PPM scenario. These figures are broadly in line with the findings of increased employment found though the IO macroeconomic analysis in paragraph 5.2.1.3.

In the case of wind installations, these are limited to 40.5 MW in both scenarios. As such when IRENA's average estimates in regards to human resource requirements for onshore wind[99] are employed, the employment potential is significantly lower than for solar PV (Table 5.32). Again, the total new positions for wind are equivalent to 24, using the assumption of the previous paragraph.

Table 5.32: Human resource requirements (person days) for different stages of wind investments (2020-2030).

	Existing and PPM scenarios (40.5 MW installed capacity)
Planning (e.g. environmental, health and safety legal, real estate and taxation experts)	2,090
Manufacture (e.g. factory workers, industrial engineers, logistics experts)	15,362
Installation and Connection (e.g. civil, electrical and mechanical engineers, construction workers, technical personnel)	27,929
Operation and Maintenance (e.g. operators, energy regulation, electrical and telecommunication experts, accountants)	2,159/year 53,981 over 25 years
Decommissioning (e.g. construction workers, truck drivers, environmental, safety and logistic experts)	6,820
Total	**106,182**

It should be noted that the above estimates refer to gross additions in human resources; in other words, they assess the additional employment in renewable power generation but do not consider the fact that reduced investments in other sectors (e.g. fossil fuelled power plants or petrol stations) may lead to elimination of jobs in those sectors. The following

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[99] IRENA, "Renewable Energy Benefits: Leveraging Local Capacity for Onshore Wind" (Abu Dhabi: International Renewable Energy Agency, 2017), https://www.irena.org/publications/2017/Jun/Renewable-Energy-Benefits-Leveraging-Local-Capacity-for-Onshore-Wind.

sections provide more information on this topic. Furthermore, since wind and solar PV equipment is primarily imported, aspects such as the manufacture of the components may not have an impact in the local economy.

5.2.3.2. Net employment impacts: The international evidence

As outlined in Chapter 5.1 and will be further elaborated in Chapter 5.3, the scenario with PPM involves substantial additional investments in renewable power generation, energy efficiency in buildings and public transport, accompanied by reductions in the investments in fossil fuel power plants and conventional motor vehicles in comparison to the scenario with WEM.

As 'green sectors' account for a significant fraction of jobs in Europe and worldwide, there has been a growing interest in assessing the employment impact of the energy transition. According to a review of available studies conducted by the UK Energy Research Centre[100], the renewable energy and energy efficiency sectors are clearly more labour-intensive than the sectors related to fossil fuel power generation, both in terms of short-term construction phase jobs and in terms of average plant lifetime jobs. On average, 0.35 jobs are created per annual GWh of renewable energy generated or per energy saved thanks to an energy efficiency measure, compared to 0.2 jobs per annual GWh for fossil fuelled power plants.

When using such data, however, one should be cautious because it is not always clear i) whether such figures always express a net growth in jobs (i.e. jobs created minus jobs eliminated in other economic sectors); ii) whether this is a long-lasting effect or is meaningful only for the short to medium term; and iii) to what extent this effect is different if an economy is close to reaching full employment levels.

Other studies in European countries have found that the adoption of renewable energy and energy efficiency policies yield net employment effects ranging from neutral (i.e. close to zero) to slightly positive (i.e. increase in employment)[101,102]. The European Commission's impact assessment related to its strategic long-term vision for a climate-neutral Europe by 2050 contains, apart from modelling results, an extensive review of the available literature on employment impacts of green policies in Europe[103]. There seems to be a consensus that the transition towards more renewable energy and energy efficiency is unlikely to lead to negative aggregate effects on employment at both national and EU-wide level. What is particularly important in the assessment of the employment impact is how the additional

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[100] UK Energy Research Centre (2014), Low Carbon Jobs: the Evidence for Net Job Creation from Policy Support for Energy Efficiency and Renewable Energy, UKERC Technology & Policy Assessment Function, London, UK.

[101] Pestel N. (2014), Employment effects of green energy policies. IZA World of Labor 2014: 76; doi: 10.15185/izawol.76.

[102] Meyer I. and Sommer M.W. (2014), Employment Effects of Renewable Energy Supply – A Meta Analysis. WWWforEurope Policy Paper No. 12.

[103] See especially Section 4.10.6 in European Commission's "In-Depth Analysis in Support of the Commission Communication COM(2018) 773 - A Clean Planet for all", Brussels, 28 November 2018.

green investments are financed, e.g. through public or private investments, taxes, subsidies etc.

According to the UK Energy Research Centre, investment in renewables and energy efficiency can contribute to short-term job creation so long as the economy is experiencing an output gap, such as is the case during and shortly after recession. In the long term, if the economy is expected to return to full employment, 'job creation' is not as important as overall economic efficiency, taking into account environmental externalities, the desired structure of the economy, and the dynamics of technology development pathways. "In other words, the proper domain for the debate about the long-term role of renewable energy and energy efficiency is the wider framework of energy and environmental policy, not a narrow analysis of green job impacts".

5.2.3.3. Overall assessment of the net employment impacts in Cyprus

In the case of Cyprus, one can express with reasonable confidence the conclusion that the risk of reducing country-wide employment from the implementation of the PPM scenario is very low. This is based on:

- Results from the economic modelling reported earlier in Chapter 5.2, which indicate a slight increase in net employment (1,688 new positions in 2030 between the two scenarios, see Table 5.26);
- The international evidence mentioned above about positive employment effects of green policies;
- The fact that the number of employees in the fossil fuel sector (power plants, oil companies etc.) is relatively limited. On the contrary, it should be expected that a significant number of additional jobs may be created to enable deployment of energy efficiency and renewable energy measures because of the substantial shift of investment towards these sectors up to 2030.

At any rate, the implementation of the PPM scenario in Cyprus is very likely to yield positive employment impacts, at least in the short to medium term. **These are expected to be stronger if the measures assumed in the scenario are implemented without reducing the purchasing power of Cypriot households and without absorbing a large amount of national public funds**. Public investments that can be supported from the EU budget and private investments that may be facilitated through financing instruments of the European Investment Bank or Cypriot banks may be particularly beneficial in this regard.

5.2.4. Environmental and health impacts

As shown in Chapter 5.1, implementation of the PPM scenario leads to reductions in the emissions of air pollutants which cause health effects. Table 5.33 uses information from Table 5.10 and Table 5.19 and shows the relative change in emissions of the three main air pollutants in the year 2030, compared to those of the WEM scenario. The decrease in PM emissions by 4.8% 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. NOx emissions are lower in the PPM scenario by 3.9% due to a lower gas-fired generation, as well as a lower dependence on gasoline and diesel passenger cars. Conversely, an increase is expected in SO_2 emissions (by 9.1%), because increased renewable power generation in the PPM scenario in the absence of electricity interconnection with other countries leads to slightly more oil-fired generation compared to the WEM scenario.

The health effects of the main air pollutants are well documented in the literature, and there is a growing number of assessments about the actual impacts to human health due to exposure of people to high levels of ambient concentrations of certain air pollutants. The impacts are usually expressed in premature deaths and in years of life lost. Premature deaths are deaths that occur before a person reaches an expected age. This expected age is typically the life expectancy for a country stratified by sex. Years of life lost (YLL) are defined as the years of potential life lost due to premature death. It is an estimate of the average number of years that a person would have lived if he or she had not died prematurely[104].

According to the European Environment Agency, exposure of Cypriot population to high levels of ambient concentrations of PM, NO_2 and ozone gave rise to about 580, 240 and 30 premature deaths per year respectively in year 2016[105]. Emission reductions shown in Table 5.33 for the PPM scenario will lead to an improvement in air quality, especially in cities, and thus to a decrease in premature deaths and years of life lost. It has to be noted that there is no direct relationship between emissions and ambient air concentrations, and a part of air pollution is due to transport of air pollutants from other countries. These two facts underline that it is not straightforward to assess the change in health impacts from the reduction of national air emissions alone. Still, one can reasonably estimate that under the PPM scenario, the number of premature deaths caused by emissions of PM and NOx may decrease by about 20-25 per year.

Exposure to SO_2 concentrations has decreased over the past few decades in Europe. Since 2007, the exposure of the urban population to concentrations above the EU daily limit value has remained under 0.5%. Therefore, seriously adverse impacts on human health are expected to be very few. However, SO_2 emissions are still regulated at EU level because of the role of this substance to corrosion in buildings and acidification of soils causing loss of biodiversity. Under the Directive (EU) 2016/2284 on the Reduction of National Emissions of Certain Atmospheric Pollutants, Cyprus is committed to reducing its national SO2 emissions (compared to those of year 2005) by 83% by 2029 and by 93% from 2030 onwards. Implementation of the PPM scenario, in the absence of higher levels of electricity storage or electricity interconnection with other countries, will make compliance with these targets difficult. On the other hand, implementation of the PPM scenario will help Cyprus achieve the corresponding obligations about the emissions of NOx and $PM_{2.5}$.

The health benefits mentioned above can also be expressed in monetary terms by using assessments of the external cost of each pollutant; this is the sum of the economic damage

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[104] European Environment Agency (2018), Assessing the risks to health from air pollution. https://www.eea.europa.eu/themes/air/health-impacts-of-air-pollution/assessing-the-risks-to-health

[105] European Environment Agency (2019), Air quality in Europe – 2019 report. EEA Report No. 10/2019, Copenhagen. doi: 10.2800/822355.

caused per tonne of pollutant emitted to the atmosphere on human health, crops, materials and biodiversity – although damages related to human health dominate. For assessing the cost of NOx, PM and SO_2 emissions, calculations of European studies were used: results from the CASES project[106] for emissions from power plants, and from Ricardo-AEA[107] for road transport emissions. All values were transformed to constant Euros per tonne of pollutant. As explained elsewhere[108], these damage costs increase over the years, so that a variable external cost is used per year. The last column of Table 5.33 contains an estimate of the reduction in damage costs thanks to the reductions in pollutant emissions in the PPM scenario; overall the economic benefit due to reduced air pollution of the PPM scenario exceed 11 million Euros'2016 in 2030; as a total over the whole decade 2020-2030 the benefit exceeds 70 million Euros'2016. Benefits are strongest from the reduction in PM emissions because these have the most adverse health impacts and hence the highest damage costs per tonne[109].

Table 5.33: Reduction in emissions of air pollutants in the PPM scenario compared with the WEM scenario, and avoided damage costs in year 2030 thanks to these reductions.

Pollutant	Change in emissions in 2030	Avoided damage costs in 2030 (mio Euros'2016)
NO_x	-3.9%	2.8
PM	-4.8%	9.8
SO_2	9.1%	-1.0
Total benefit		11.6

5.3. Overview of investment needs

5.3.1. Financial Implications of WEM scenario in the Electricity Supply Sector

Investments foreseen in power generation will significantly affect electricity costs in total. Thus, due to the considerable investments in the electricity supply sector, the average cost of gross electricity generation increases gradually during the modelling period. Undeniably, this is a function of the assumed fuel price and technology costs adopted in the model. Figure 5.6 provides a breakdown of the different system cost components; these are all undiscounted[110]. As illustrated, a reduction in cost is achieved when the system shifts fully

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[106] FEEM (2008), CASES (Cost Assessment for Sustainable Energy systems) – Final Conference Proceedings and External Costs Database. 2008.

[107] Ricardo-AEA (2014), Update of the Handbook on External Costs of Transport. Report for the European Commission's Directorate General for Mobility and Transport.

[108] Sotiriou C. and Zachariadis T., Optimal Timing of Greenhouse Gas Emissions Abatement in Europe. *Energies* 12 (2019), 1872; doi:10.3390/en12101872.

[109] As explained, the damage cost varies over the years; for the year 2030, based on the literature cited in the text, the assumed marginal damage costs per tonne of NOx, PM and SO2 were 9,006, 140,000 and 17,122 Euros'2016 respectively.

[110] Undiscounted costs are reported to avoid giving the wrongful impression that costs are expected to decrease dramatically with time. Taking into account that the discount rate adopted is 8.5% for

towards gas-fired generation in 2021-2022. It can be noticed that variable costs (i.e. fuel costs) are the main driver of the electricity cost till 2030. Regarding the actual investment costs, these are illustrated for each technology in Figure 5.7.

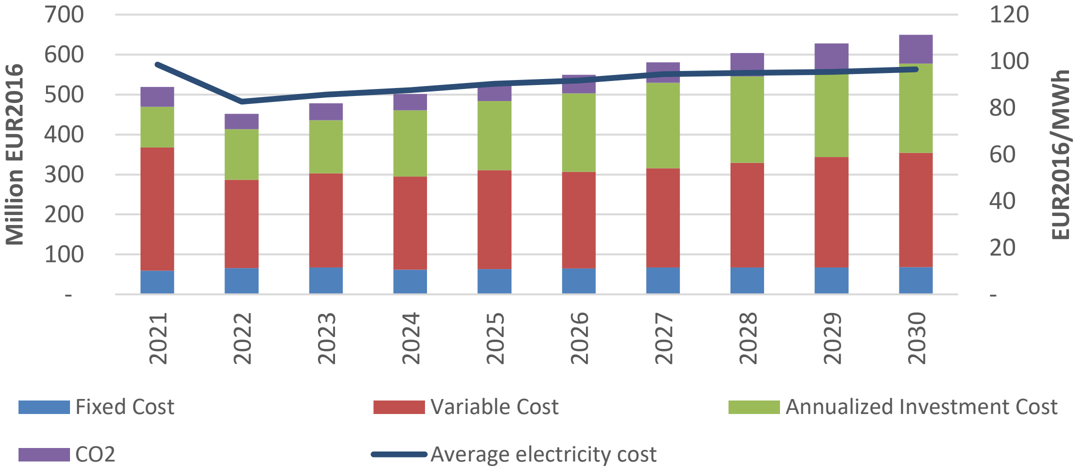

Figure 5.6: Average cost of electricity and breakdown of system cost components – WEM scenario.

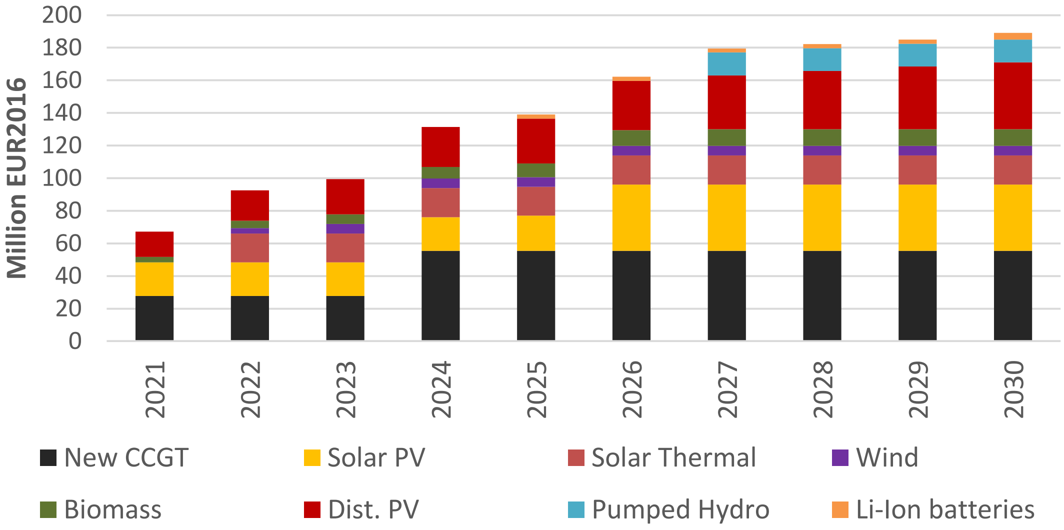

Figure 5.7: Annualized investment costs in generation and storage technologies in the period 2020-2030 – WEM scenario.

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most technologies in the electricity sector, if the cost were to be discounted to the first year, then the values after the first few years would be distorted (i.e. reduced) substantially.

5.3.2. Financial Implications of PPM scenario in the Electricity Supply Sector

Due to the higher RES penetration, and reduced dependence on fossil-fired generation, both enabled by the interconnector, the cost of electricity remains relatively stable throughout the model horizon in the PPM scenario (Figure 5.8). In comparison to the WEM scenario, electricity cost increases by 2% in 2030. The increase in cost is driven by the fact that less electricity is generated for a similar level of generation investments, despite the lack of investments in storage technologies.

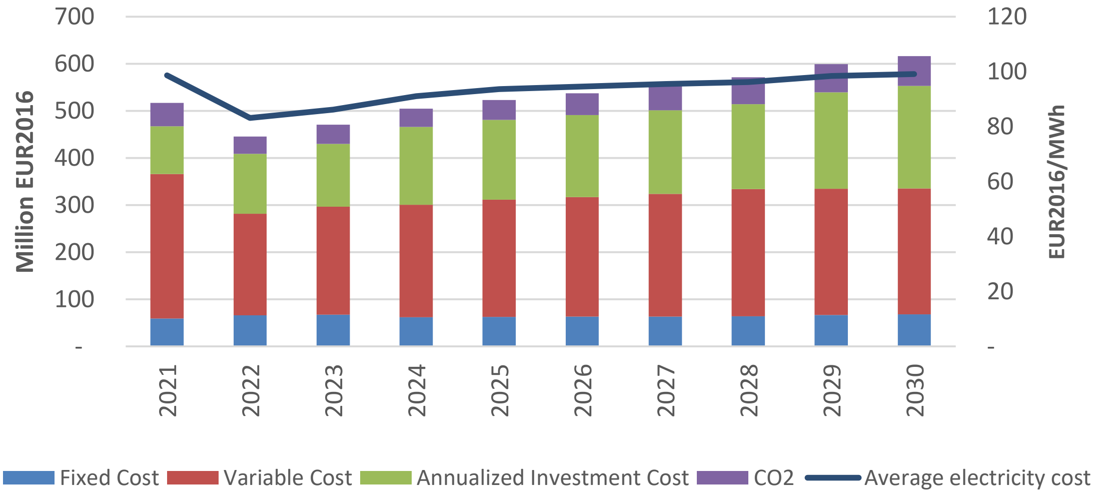

Figure 5.8: Average cost of electricity and breakdown of system cost components – PPM scenario.

As compared to the WEM scenario, investment requirements in the electricity supply sector (which are presented in Figure 5.9) are marginally lower in the PPM scenario. There are no investments in battery storage or pumped hydro, but these are higher for utility-scale solar PV deployment; annualised investments in this technology amount to 44 million EUR in the PPM scenario, as opposed to 40 million EUR in the WEM scenario in 2030.

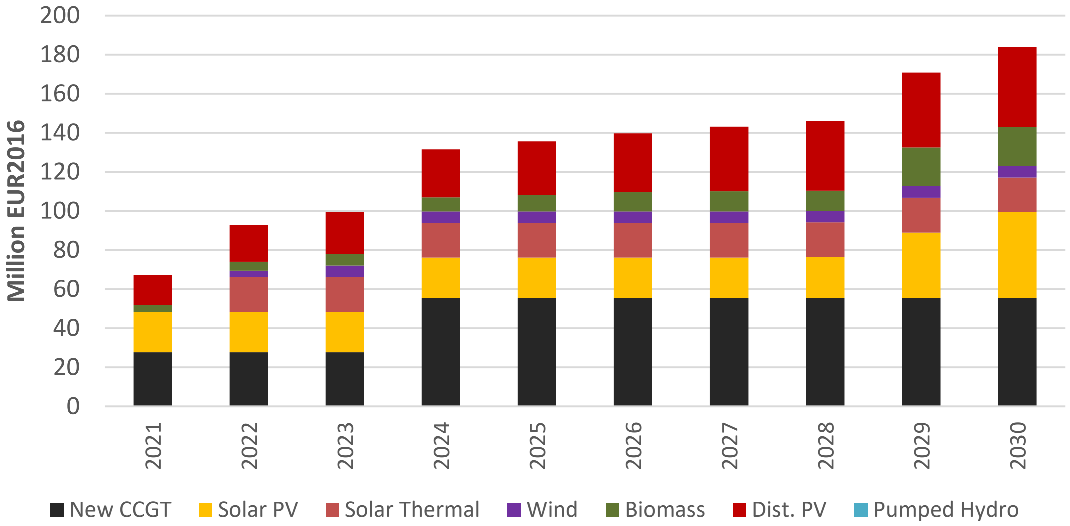

Figure 5.9: Annualized investment costs in solar PV, solar thermal and storage technologies in the period 2020-2050 – PPM scenario.

5.3.3. Additional Economy-Wide Investment Needs in the PPM Scenario

In contrast to what is projected for electricity supply alone, the PPM Scenario foresees that the level of economy-wide investments needed up to 2030 to implement all these measures is lower than that of the WEM Scenario. **Error! Reference source not found.**Chapter 5.1 resents these estimated investment needs.

The power generation and electricity storage sector needs fewer investments in the PPM Scenario because, as explained in Chapter 5.1, energy efficiency measures reduce the demand for electricity compared to WEM.

Enabling a significant modal shift towards sustainable modes of transport is an important ingredient of a serious decarbonisation policy, and this is reflected in the PPM Scenario. The purchase of new, clean buses and the construction of a tram line are costly measures, with investments expected to exceed 1.3 billion Euros'2016. However, these additional investment needs – which are expected to be covered by the national budget and perhaps partly through EU funds – are counterbalanced by the decline in purchases of new vehicles, which saves (mainly private) expenditures of about 2 billion Euros'2016 throughout the 2020-2030 period. These very substantial savings account for 15-20% of the annual purchase costs of new cars foreseen in the WEM Scenario.

Energy renovations in buildings of the residential and tertiary sector, if implemented actively up to an extent that is considered realistic in Cyprus, will require by the year 2030 additional investments of about 715 million Euros. This amount is expected to come from a combination of public and private investments and is the result of extensive data collection and discussions with MECI in the frame of previous Technical Assistance studies[111]; this amount is consistent with the level of achievable energy savings in households and services which have been calculated in the PPM scenario. Similarly, investments in industry to reach realistic energy savings foreseen in this scenario amount to 77 million Euros'2016 for the period 2020-2030.

In total, as shown in Table 5.34, implementation of the PPM is projected to economy-wide investments for the period up to 2030 that are lower by 46 million Euros'2016 than those foreseen in the WEM Scenario. The main reason for this, as explained above, is the substantial decline in the expenditures for new cars because of the significant shift towards public and non-motorised transport foreseen in this scenario. This counterbalances the amount of investments required for promoting public transport, cycling and walking through the implementation of Sustainable Urban Mobility Plans that the government of Cyprus is currently preparing. Even if the above mentioned decline in private car investments is considered ambitious and optimistic and one assumes lower reductions in the purchase of new cars, the additional investment needs are not expected to amount to more than 1.4 billion Euros'2016 for the entire period 2020-2030; these may account for about 0.5% of the

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[111] For a summary, see Zachariadis T., Michopoulos A., Vougiouklakis Y., Piripitsi K., Ellinopoulos C. and Struss B., Determination of Cost-Effective Energy Efficiency Measures in Buildings with the Aid of Multiple Indices. *Energies* 11 (2018), 191; doi:10.3390/en11010191. The full Technical Assistance study is available on the webpage of MECI.

GDP of that decade, which means that they are modest and entirely feasible for the Cypriot economy.

Out of the investments shown in Table 5.34, those for private transport are expected to come from private sources, whereas those for sustainable transport modes are expected to come from public funds. As regards buildings and industry, it should be expected that about half of the amount of 792 million Euros will come from public funds in order to mobilise an equal amount of private funds for energy renovations and replacement of equipment, appliances and machinery. This is in line with the experience obtained by national authorities from the implementation of energy efficiency subsidy schemes during the last years. As a result, it should be expected that about 1.4 billion Euros for sustainable transport investments and about 400 million Euros for renovations in buildings and industrial plants will have to be funded from the government budget, or from EU funds.

In total, the required additional investments to realise the PPM scenario are entirely feasible for the standards of the Cypriot economy and, as will be shown later in this report, will pay off because fuel import costs throughout the lifetime of these measures may decline considerably due to these investments. Still, in view of the substantial amount of public funding needed, it is advisable that a considerable portion of this may come from EU funds such as the EU Structural Funds or loans from the European Investment Bank.

An indication about the cost-effectiveness of these investments is provided in the separate impact assessment study.

Table 5.34: Cumulative additional investment needs in the period 2020-2030 to implement the PPM scenario in comparison to the WEM scenario.

Sector	**mio Euros'2016**	**% of total GDP of 2021-2030**
Power generation (new CCGT plants, PVs etc.)	-46	-0.02%
Electricity storage technologies (pumped hydro & batteries)	-72	-0.03%
Sustainable Mobility (buses & tram, bus lanes, cycle lanes etc.)	1378	0.48%
Private transport (shift to sustainable transport modes, more efficient cars, electric cars, biofuels etc.)	-2098	-0.73%
Residential & commercial buildings (energy efficiency renovations)	715	0.25%
Industry	77	0.03%
Total Additional Investments	**-46**	**-0.02%**

5.4. Impacts of planned policies and measures described in section 3 on other Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

5.4.1. Regional Infrastructure Projects

A key theme that arises implicitly is that of regional cooperation. The Cypriot NECP has regional impact directly associated to two major pieces of infrastructure, which may enable trade of electricity, via the EuroAsia Interconnector on the one hand, and natural gas, via the EastMed pipeline on the other hand. Through a conducted sensitivity analysis, the modelling effort in the supporting impact assessment study has attempted to illustrate the benefits offered by the EuroAsia Interconnector on the electricity supply system of Cyprus. It should be noted that in this study the systems of Greece and Israel are represented as simple nodes of electricity demand and supply; as such, the insights offered by the analysis have significant limitations. Overall, the sensitivity analysis indicated that if the interconnection is established, Cyprus can become a net exporter of electricity, fuelled primarily by solar PV facilities.

Even though domestic gas production and the potential development of the East Med pipeline are not explicitly modelled in the present analysis, it is expected that the project will not have direct impacts on the energy mix of the island. Since natural gas, whether imported or domestic, will be provided to the internal market at international market prices, the cost-competitiveness of gas-fired technologies will remain unaffected.

Nonetheless, revenues attained through the exports of domestic natural gas may be recirculated in the Cypriot economy, thus affecting the purchasing power of economic actors. Similarly, the revenue secured by the state could to a degree be utilised for the support of clean energy technologies. For instance, the existence of financial incentives could promote further investments in technology options that facilitate the decarbonisation of the system; such technologies include but are not limited to solar photovoltaics, electric vehicles, heat pumps or energy efficiency measures.

Efforts of the local authorities in the near future should be directed to reaching an agreement with neighbouring countries as to the assumptions to be employed in regards to major infrastructure projects. This is of critical importance in the case of the EuroAsia Interconnector[112], especially since it can have a drastic effect on the Cypriot energy outlook. However, assumptions regarding size and development schedule of other projects such as

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[112] Recent developments regarding the EuroAsia Interconnector occurred after finalisation of the bulk of the present analysis. Specifically, it has been decided that development of the portion of the cable connecting Crete with Attica will not be undertaken within the PCI-status EuroAsia Interconnector project, but will rather be developed as a national project. As such, this could have a significant impact on the electricity exchange potential between Cyprus, Israel and Greece. The degree of this impact will depend on the capacity of the two separate projects (i.e. Crete-Attica and Crete-Cyprus-Israel), the timeline for their full operation, as well as the interoperability between the two projects.

the EastMed pipeline that will connect Israel, Cyprus and Greece's gas markets (and potentially Italy's) also have to be agreed upon, as these affect the projected energy balance and trade potential of the countries in question. Similar observations apply for the case of other potential gas pipeline development between Cyprus and Egypt.

5.4.2. Market Integration

A long-term cost-optimisation model has been used for the scenario analysis. These types of models assume that a perfectly functioning and predictable market exists in the system in question. This in turn implies that perfect competition occurs between the market participants, who act as price-takers and provide energy at a marginal production cost, while perfect foresight allows market participants to be fully aware of all present and future conditions affecting the cost at which they provide or purchase energy. In essence, since optimisation models assume perfect market conditions, model outputs are presented in terms of potential for improvement so as to recognize the extent at which cost-competitive investments of certain technology choices are financially viable. The EU has placed significant importance in the full liberalisation of the internal electricity market.[113] It should be noted that the plans for the full implementation of a competitive electricity market in Cyprus are gradually moving forward. Once fully implemented, the electricity market would create a favourable environment for investors, under which the technology investments foreseen in generation and storage infrastructure can occur.

For instance, in the WEM scenario a pumped-hydro project of 130 MW is deemed as cost-competitive, not only for energy arbitrage, but also for provision of operational reserve. This centralized storage option can store electricity from variable RET in periods of high output, as a preferred alternative to curtailment. Additionally, if flexibility of existing thermal units in Cyprus is not improved and output from thermal plants cannot be ramped down or even shut off easily to accommodate variable generation, storage can be useful for the operation of these units as well. For instance, the most efficient units in Cyprus are the combined-cycle gas turbines, but these cannot be turned on and off constantly as the cost of operation would increase dramatically. Instead, they could potentially be run constantly for long periods of time, even at low loads, making use of the storage infrastructure.

Therefore, it can be argued that centralized storage – while primarily an enabler for RET – can act for the benefit of the whole system. Control of the centralized storage to an extent can be handled by the Transmission System Operator (TSO), but the most complex issue is agreeing on which stakeholder would act as the investor of such a project and hence bear the financial risk. The market environment in which the project operator will function and generate profit has to be clear. Since a functioning liberalized electricity market structure is still in its early development stages in Cyprus, conditions are not yet ideal for investors. Generally, in Europe the legal framework of handling storage assets in unbundled markets is

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[113] European Union, "Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 Concerning Common Rules for the Internal Market in Electricity and Repealing Directive 2003/54/EC (Text with EEA Relevance)," Pub. L. No. 32009L0072, OJ L 211 (2009), http://data.europa.eu/eli/dir/2009/72/oj.

not perfectly clear as requirements such as grid support become more prominent[114]. Depending on the status of the network operator, a complete or partial ownership and operation by either the transmission and distribution system operator or a third-party is a plausible business model that allows provision of both network and market services.

Despite the fact that deployment of lithium-ion batteries is capital-intensive, it is calculated as economically optimal to also develop this storage option, as it allows for additional cost-competitive generation from variable renewable energy options. In this case, a lower system cost is achieved through time of use arbitrage, where cheap electricity from solar PV can be used to charge the storage during the day and then be used during peak demand periods in the evening. Provision of ancillary services, in terms of operational reserves, can further increase the attractiveness of this technology as an option.

Further, lithium ion batteries can be deployed at both the centralized and the distributed level; for instance, at residential or commercial buildings. In order for the technology option to provide grid support, installation of ICT infrastructure is a prerequisite, as it assumes operation of a smart grid[1144], which will have a cost associated to it. At the same time, even though decentralized batteries can potentially offer both energy arbitrage and ancillary services for the grid, the cost of capital lies with the consumer. As such, incentives will have to be given to provide the market conditions for consumers to invest in such a technology and be willing to offer use of their infrastructure for facilitating in a smooth operation of the grid.

Furthermore, the establishment of a competitive electricity market internally is important for the operation of a regional electricity market. In case the EuroAsia interconnector project proceeds successfully, it can allow for an increase in the renewable energy share in the electricity supply sector. According to conducted sensitivity analysis, this increased RET deployment corresponds mainly to solar PV and assumes that at times when generation will exceed domestic demand, the excess can be transmitted to Israel or Greece. Similarly, it is assumed that during periods of low PV output, electricity can be readily procured from these neighbouring systems. This assumes the existence of a framework through which the involved systems can trade at cost-efficient prices and volumes, similar to the way Nord Pool is structured. This Nordic power exchange currently operates in 9 countries (Nordics, Baltics, Germany and UK)[115] and trades electricity between market participants at the intraday or day-ahead stages, as well as allowing for long-term contracts of up to five years[116]. A similar

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[114] Abhishek Shivakumar et al., “Business Models for Flexible Production and Storage,” Policy Report (INSIGHT_E, December 2015), http://www.insightenergy.org/system/publication_files/files/000/000/041/original/PR_4_Business_models_final.pdf?1465204190.

[115] Nord Pool, “Power Without Borders - Annual Report 2015,” 2016, http://www.nordpoolspot.com/globalassets/download-center/annual-report/annual-report_nord-pool_2015.pdf.

[116] N. Flatabo et al., “Experience with the Nord Pool Design and Implementation,” *IEEE Transactions on Power Systems* 18, no. 2 (May 2003): 541–47, https://doi.org/10.1109/TPWRS.2003.810694; Audun Botterud, Tarjei Kristiansen, and Marija D. Ilic, “The Relationship between Spot and Futures Prices in the Nord Pool Electricity Market,” *Energy Economics* 32, no. 5 (September 2010): 967–78, https://doi.org/10.1016/j.eneco.2009.11.009.

approach could be adopted for the development of an Eastern Mediterranean market in the future to facilitate integration of greater shares of RET in the region.

5.5. Discussion of Policy Options

The Impact Assessment of the National Energy and Climate Plan of Cyprus, as presented in this Chapter, leads to some clear indications about the outlook of energy and climate policy of the country with a view to meeting the objectives foreseen in the EU Energy Governance Regulation. The following sections focus on a cost-benefit and a cost-effectiveness assessment of the policy options that seem to be available to Cyprus at this stage.

5.5.1. Costs and Benefits of Planned Policies and Measures

Table 5.35 displays a summary of the projected change in total energy system costs of the PPM scenario in comparison to the corresponding costs of the WEM scenario. Cost differences are presented for each main group of measures that are included in the PPM scenario: power generation, electricity storage, construction of the electricity interconnector, measures for promoting public and non-motorised transport, measures related to motor vehicles, and policies related to energy efficiency improvements in buildings and industry.

Cost differences are presented separately for investment costs and operation & maintenance costs; the latter also include fuel costs, and in many cases these are negative, reflecting the savings in fuel expenditures that can be achieved in the case of energy efficiency measures in transport, buildings and industry. Note that fuel costs that were included in these calculations are net of taxes and duties in order to reflect the societal effect from the reduction of fuel import costs. At the end of the table we have added the economic benefits foreseen due to reduced damages from air pollution, in line with the assessment shown in Chapter 5.2.

It is evident that the policies and measures foreseen in the PPM scenario are expected to be beneficial to society. Total benefits, including the environmental ones, are over 500 million Euros’2016 by 2030, representing 1.6% of the country’s projected GDP in that year. The additional investments, especially in energy efficiency measures and sustainable transport modes, although designed to be effective over a longer time horizon, pay off to a large extent by the end of the decade: fuel cost savings in buildings and industry as well as reduction in the purchase and use of private cars lead to a substantial decrease in operation costs and therefore to the total energy system costs. The benefits become also somewhat larger thanks to the improvements in air quality and the associated benefits from lower health impacts.

One might argue that these results are optimistic because of the projected strong reduction in the fleet of passenger cars, which leads to much lower investments for private transport in the PPM scenario. However, if one observes the figures of Table 5.35, it is evident that the PPM scenario leads to lower energy system costs even without the reductions in investments of private transport. This leads to a clear conclusion that the implementation of

Planned Policies and Measures will be beneficial to society, leading to a reduced fuel import bill and improved air quality. This finding is in line with international evidence, such as the European Commission's in-depth analysis of the carbon neutrality objective, [117] the World Bank[118] or other organisations.[119]

The above conclusion is valid as long as the policies and measures foreseen in the PPM scenario are actually realised. There are financial and behavioural barriers that may delay or cancel the deployment of some of these measures. However, the analysis shows that these measures seem to be the only way for the country to approach its long-term energy and climate policy commitments.

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[117] European Commission, "In-Depth Analysis in Support of the Commission Communication COM(2018) 773 - A Clean Planet for all", Brussels, 28 November 2018.

[118] World Bank (2014), *Climate Smart Development*. International Bank for Reconstruction and Development/The World Bank and ClimateWorks Foundation, Washington, DC.

[119] Coalition for Urban Transitions (2019), Climate Emergency, Urban Opportunity. Washington, DC.

Table 5.35: Projected change in energy system costs in Cyprus according to the PPM scenario without electricity interconnection in comparison to the WEM scenario.

Sector	Costs (mio Euros'2016)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Power Generation (new thermal and renewable power plants)	Investment	63	82	64	64	43	40	12	10	11	21
	Operation & Maintenance	-2	-6	-7	-12	-16	-5	-5	-10	-29	-41
	Total	61	77	57	53	27	35	6	0	-17	-20
Electricity storage technologies (pumped hydro & batteries)	Investment	0	0	0	0	-3	-3	-16	-16	-16	-18
	Operation & Maintenance	0	0	0	0	0	0	-2	-2	-2	-2
	Total	0	0	0	0	-3	-3	-19	-19	-19	-21
Electricity interconnector	Investment	0	0	0	0	0	0	0	0	0	0
	Operation & Maintenance	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Sustainable mobility (buses & tram, cycle lanes, bus lanes etc)	Investment	29	50	71	92	113	135	156	215	258	250
	Operation & Maintenance	2	4	6	8	10	12	14	16	18	20
	Total	31	54	77	100	124	147	170	231	276	270
Private transport (shift to sustainable transport modes, more efficient cars, electric cars, biofuels etc.)	Investment	-43	-83	-126	-165	-202	-234	-243	-291	-336	-374
	Operation & Maintenance	-33	-66	-100	-134	-174	-214	-278	-301	-334	-394
	Total	-75	-149	-226	-299	-376	-448	-522	-592	-670	-768
Energy efficiency improvements (buildings & industry)	Investment	72	72	72	72	72	72	72	72	72	72
	Operation & Maintenance	-3	-6	-7	-10	-16	-20	-26	-30	-32	-34
	Total	69	66	65	62	56	52	46	42	40	38
Difference in Total System Costs	Investment	122	121	82	63	24	11	-20	-11	-11	-50
	Operation & Maintenance	-36	-74	-109	-148	-196	-228	-297	-327	-380	-452
	Total	85	47	-27	-85	-172	-217	-317	-337	-391	-501
Difference in Environmental Costs		-2	-3	-5	-6	-7	-8	-9	-10	-11	-12
Difference in Total System Costs Including Environmental Costs		84	44	-31	-91	-179	-225	-326	-347	-402	-513

5.5.2. Ranking of Policies and Measures According to their Cost-Effectiveness

Which measures should be prioritised among those included in the list of Planned Policies and Measures? A first answer could be that all measures have to be implemented because, as shown in Table 23, even their full deployment is not sufficient to make Cyprus comply with the legally binding target of the Effort Sharing Regulation, i.e. to reduce its non-ETS emissions by 24% in 2030. However, as public policy always has to take into account practical or political constraints, it is still useful to provide recommendations about the costs and emissions abatement potential of each measure.

Such an analysis can only partly be made with models like OSeMOSYS, because it requires detailed 'bottom-up' information on each technology or measure, which is not always available in energy system models. We therefore report in this section some results of a previous Technical Assistance study that was conducted for the government of Cyprus, which was also funded by the European Commission's Structural Reform Support Service and has undergone peer review in an academic journal[120]. Data used in that study are consistent with those used in the OSeMOSYS model and in the present report.

The study led to the construction of a baseline and several alternative marginal emission abatement cost curves for policies and measures in the Cypriot non-ETS sectors. Nationally appropriate data were collected from earlier studies and from the local market. The results of this detailed analysis showed that the most cost-effective measures are the following:

- Roof insulation in pre-2008 residential multi-family buildings;
- The installation of heat pumps in pre-2008 residential buildings;
- Cogeneration in the industrial and tertiary sector;
- Increased use of anaerobic digestion for animal waste;
- Replacement of oil-fired burners in industry.

Measures that are not recommended to deploy because they have a very high cost per tonne of carbon abated are the renovation of very old buildings to become nearly-zero energy buildings, and wall insulation of pre-2008 buildings. All other measures are worth investing in, and most of them lead to negative social costs, which means that they yield benefits to society because the fuel cost savings during the lifetime of these investments outweigh the initial investment costs. The benefits are even stronger if the reduction in health damages because of lower air pollutant emissions are also taken into account.

However, at a realistic rate of building and equipment renovations, many of the above cost-effective measures have a relatively limited potential to reduce GHG emissions up to 2030. Therefore, **it is absolutely necessary to proceed with policies for decarbonising road transport, i.e. with the promotion of public and non-motorised transport and the electrification of the car fleet. Only these measures can yield significant emission reductions, and although they seem to be more costly than others, they are beneficial to society if all their benefits are taken into account.**

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[120] Sotiriou C., Michopoulos A. and Zachariadis T., On the cost-effectiveness of national economy-wide greenhouse gas emissions abatement measures. *Energy Policy* 128 (2019) 519–529.

Obviously, the findings of that project are in line with the results reported in the previous section of this report. Therefore, the recommendations mentioned above are fully relevant for this study as well.

That study dealt with non-ETS sectors only. As regards the justification of ETS-related measures that are included in the PPM scenario of this Impact Assessment study, i.e. those related to power generation and electricity storage, it is clear that they are necessary for reaching the ETS emission reduction target and the renewables penetration target as shown in Table 5.23.

The measures described above relate to energy use, agriculture and waste. Apart from these measures, additional options are included in the PPM Scenario, namely a) the proper recovery of fluorinated gases in industrial equipment and b) afforestation. The following paragraphs comment on the cost-effectiveness of these two measures.

- As regards fluorinated gases, a legislative obligation is under preparation, which will apply to new installations and new amounts of gases to be used in existing installations. For gases that are currently in use, which have not been regulated up to now, a financial support scheme has been prepared by MARDE in order to facilitate their proper recovery. The scheme has been designed in such a way that it leads to emission reductions which correspond to avoided costs (for purchasing additional emission allowances due to non-compliance with the ESR target) that are higher than the cost of the scheme. In other words, benefits of emission reductions outweigh the costs. This has been estimated assuming gradually increasing emission allowance prices, which overall lie around 30-35 Euros per tonne of CO_{2eq}. Therefore, one can safely state that fluorinated gas recovery passes the cost-effectiveness test and is worth pursuing.
- As far as afforestation is concerned (the main LULUCF-related measure that seems to be relevant for Cyprus), MARDE announced in September 2019 plans to proceed with planting of trees around Cyprus. Starting from around 70,000 trees in 2020, it is planned to reach 300,000 trees planted per year in 2030. Moreover, MTCW prepared a proposal 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. MARDE's proposal does not include a cost assessment. 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). As regards the emission reductions due to absorption of CO_2, MCTW estimates a capture of about 2.5 kt CO_2 per year by 2030, starting from very low levels and increasing gradually as trees grow. If one assumes a total absorption of 10 kt throughout the period 2020-2030, to account for the gradually increasing number of trees planted, at a cost of 72 M€ (plus watering and maintenance), this action leads to a very high cost per tonne of CO_2 abated. This clearly does not pass the cost-effectiveness test. However, if one keeps in mind that trees have a very long lifetime and will absorb higher amounts of CO_2 when they grow further, this measure can be considered as important (and maybe cost-effective) in the longer term. Still, for achieving the 2030 non-ETS emission target, it seems to be an option with low potential and large uncertainty about its feasibility.

Keeping in mind the above information, Table 5.36 provides a summary of the cost-effectiveness assessments mentioned in the last two Sections. It describes the contribution of all major non-ETS sectors to emissions covered by the Effort Sharing Regulation in year 2017, based on the latest data of the National Inventory Report of greenhouse gases submitted by the Republic of Cyprus. It also displays the evolution of emissions of these sectors between 2017 and 2030. The fifth and sixth column present the estimated investment costs and total net costs (from investment, operation and maintenance) for the entire period 2020-2030 by sector, on the basis of the assessments made in our study; such costs are not provided for the policies and measures related to waste management, agriculture and recovery of fluorinated gases, as it has not been possible to collect or reliably estimate costs for the relevant measures foreseen by national authorities. It should be underlined that, even of this cost information were available, it would not be appropriate to calculate a cost-effectiveness index on the basis of costs and emission abatement during the decade 2020-2030 only. Most of these measures have a much longer lifetime and will hence continue to yield emission benefits over a period much beyond 2030. The proper way to compare cost-effectiveness of measures with different lifetimes is to calculate the annualised discounted costs and the corresponding emission abatement of each investment.

This is done in the eighth and ninth column of Table 5.36, which provide summary information on costs per tonne of $CO_{2eq.}$ abated for each sector, based on the results of the study of Sotiriou *et al.* (*Energy Policy* 128 (2019) 519–529). The last column shows assessments made with the aid of information provided by governmental authorities on the management of fluorinated gases and afforestation – measures that had not been considered by Sotiriou *et al.*

The overall conclusion that can be drawn from Table 5.36 is that most policies and measures considered in the PPM scenario pass the cost-effectiveness test as their costs are lower than the central estimates of damage costs of GHG emissions (also called the ‘social cost of carbon’), which are around 40 Euros’2015 per tonne[121]. Especially if the economic benefits due to reduced emissions of air pollutants are taken into account, most measures show a negative social cost, which means that they yield net benefits to society and are therefore particularly worth implementing immediately. The only sector for which cost-effectiveness is not clear is that of solid waste management, where important measures have to be taken for proper treatment of municipal waste, as outlined in the relevant section of the NECP. As regards afforestation, it seems to be costly over the short and medium term, but if one takes into account that trees have a very long lifetime and can therefore reduce carbon emissions for many decades, it turns out to be a beneficial measure; it has to be noted, however, that the costs of afforestation may have been underestimated because cost estimates do not include water and maintenance costs, which may be particularly important for trees planted around the road network.

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[121] IWG (Interagency Working Group on Social Cost of Carbon), 2013. Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866. United States Government, revised November 2013.

Table 5.36: Summary of emissions, costs and cost-effectiveness estimates for the major non-ETS sectors of Cyprus.

Sectors	% of non-ETS Emissions in 2017 (national emissions inventory data)	Emissions 2017 (kt CO_{2eq})	Emissions 2030 in PPM Scenario (kt CO_{2eq})	Investment Cost 2020-2030 (mio Euros'2016)	Net Cost 2020-2030 (mio Euros'2016)	Cost-effectiveness (Euros'2016 per tonne of CO_{2eq} abated)*	Cost-effectiveness (Euros'2016 per tonne of CO_{2eq} abated), including reduced damages from air pollution improvement*	Other cost-effectiveness assessments
Road Transport - public measures				1356	1465			
Road Transport - private measures				-2157	-4127			
Total Road Transport	49%	2093	1681	-801	-2662	Ranging between 59-95 €/tn: 59 (electrification of cars); 69 (promotion of public transport; 95 (CNG fuelled trucks)	-2 €/tn (electrification of cars and promotion of public transport); -100 €/tn (CNG fuelled trucks)	
Energy Use in Buildings and in Non-ETS Industry	19%	715	701	792	606	Ranging from -500 €/tn for roof insulation and heat pumps to >1000 €/tn for wall insulation & deep renovations of old buildings; most policies and measures in this sector have negative costs and should be adopted		
Agriculture (including livestock waste)	12%	495	512	not available	not available	4 €/tn	-41 €/tn	
F-Gases	6%	250	268	not available	not available	not considered in that study		-7,5***
Waste Management - solid & liquid waste	14%	514	305	not available	not available	not considered in that study		not available
LULUCF**		-534	-635	72	100	not considered in that study		> 500****

* Source: Sotiriou, Michopoulos & Zachariadis, *Energy Policy* 128 (2019) 519–529

** Calculations of MARDE based on data from Forestry Department

*** Information from MARDE for the period 2020-22: 1.5 mio Euros in avoided allowance purchases; 1.125 mio Euros cost of measure; 50 kt CO_{2eq} abated

**** estimated cost If one considers a 30-year period; much lower if one assumes that CO_2 absorption will continue to the distant future

It should be emphasized that RES self-consumption energy was not examined as a possible sector that can reduce the energy demand due to the self-consumption energy for heat-pumps.

5.5.3. Multi-criteria assessment of the two scenarios

Based on the main results of the impact assessment that were presented in Chapters 5.1-5.4, and on the cost-benefit and cost-effectiveness appraisals reported earlier in this Chapter, it is possible to compare the WEM and PPM scenarios of the Cypriot NECP on the basis of a set of criteria. This section provides a brief multi-criteria evaluation of the two scenarios.

1. **Energy and environmental criteria**: The Planned Policies and Measures Scenario is clearly the preferred scenario with regard to all energy and environmental criteria included in the energy Union strategy. It can lead to:
    - Lower GHG emissions (14.7% lower in 2030 compared to 2005, as opposed to only 3% emission reductions in the WEM scenario);
    - Improved energy efficiency, which can lead to compliance with the requirements of Article 7 of the Energy Efficiency Directive, as opposed to non-compliance in the WEM scenario;
    - Improved penetration of renewable energy sources, reaching 30% of total energy consumption in 2030 and leading to compliance with the corresponding EU-wide objective, as opposed to 20.7% in the WEM scenario which is not sufficient to meet the EU-wide commitment;
    - Achievement of the EU objective for reaching 14% share of renewable energy in transport by 2030, as opposed to just 7% in the WEM scenario;
    - Improvement in air quality thanks to a reduction in emissions of most air pollutants in 2030 compared to the WEM scenario, leading to fewer public health problems in the population of Cyprus, to a decrease in premature pollution-related deaths and to a reduction in health-related economic damages of over 70 million Euros'2016 throughout the decade 2020-30.

Thus the PPM scenario is the one that can enable Cyprus to contribute to the EU's objective to comply with its international climate obligations deriving from the Paris Agreement.

2. **Economic criteria**: The Planned Policies and Measures Scenario is the preferred scenario with regard to the economic criteria considered in this study. More specifically, it can result in:
    - A small increase in national GDP by the year 2030, of the order of 0.3% compared to the WEM scenario; this will be a result of the re-allocation of investments in the PPM scenario and the re-adjustment of economic output towards activities with higher local value added, coupled with a decline in costs for importing fossil fuels thanks to the substantial decrease in fossil fuel consumption compared to the WEM scenario;
    - An overall benefit to society that can reach more than 500 million Euros'2016 in 2030 (or 1.6% of that year's GDP) compared to the WEM scenario; this benefit will be a combination of reduced energy system costs (thanks to energy savings in buildings, industry and primarily in road transport) and reduced health-related economic damages.

3. **Social criteria**: The Planned Policies and Measures Scenario is also estimated to yield slightly better results in employment and social welfare because:
    - It is projected to lead to somewhat higher employment, about 0.3% higher in 2030 compared to the WEM scenario, which means about 1700 more full-time work positions; this will be a result of the re-structuring of the economy towards jobs in economic sectors that benefit from the increased promotion of energy efficiency and renewable energy.
    - It is expected to have an essentially zero effect on social equity, i.e. negligible effects on the distribution of income between households of different income groups; this will be the composite result of changes in electricity and fuel prices between the WEM and PM scenarios as explained in Chapter 5.2.
4. **Governance criteria**: In terms of administrative costs, simplification of planning, reporting and monitoring obligations, and ensuring a coordinated and coherent implementation of the Energy Union strategy across its five dimensions, the PPM scenario is not expected to add considerable administrative burden compared to the WEM scenario; conversely, because the PPM scenario is clearly superior to the WEM scenario in all other criteria mentioned above, it will certainly contribute to a better implementation of the Energy Union strategy across its five dimensions.

5.6. Conclusions of the Impact Assessment

NOTE

The Impact Study was completed in November 2019 and therefore the results reflect the data available at the time.

On 12 December 2019, the Secretariat of the United Nations Framework Convention on Climate Change, through the publication of the "Report on the individual review of the annual submission of Cyprus submitted in 2019" on its website[122]*, announced the acceptance of the revised Cyprus greenhouse gas emission inventories for the period 1990 - 2017. As a result the emissions of the non-ETS sectors for 2005 (reference year for the national reduction target) increased from 3954 kt CO2 eq. to 4266 kt CO2 eq. This affects the results of the impact analysis only on the issue of achieving the greenhouse gas emissions reduction target and the associated costs for purchasing greenhouse gas emission allowances for compliance.*

Specifically, taking into account the expected results of the implementation of the policies and measures included in the National Plan, and in particular of the new planned policies and measures, it appears that based on the revised emissions of 2005 (4265 kt CO2 eq.) the national mandatory target for reducing greenhouse gas emissions of the greenhouse is covered to a great extend (a 21% decrease is expected by the end of the period compared to 24% which is the target).

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[122] https://unfccc.int/sites/default/files/resource/arr2019_CYP.pdf

In view of the above, it appears that while the national mandatory target for reducing greenhouse gas emissions at the end of the period is not expected to be fully met, due to the use of the flexibility mechanisms available in the ESR, Cyprus is not expected to have any financial cost for purchasing additional greenhouse gas emission allowances.

The following are the original conclusions of the Impact assessment.

The Impact Assessment of the National Energy and Climate Plan of Cyprus has been based on detailed modelling of the energy system of the country, which was mainly conducted with the OSeMOSYS optimisation model. Final energy demand projections for sectors other than road transport have been derived from a separate demand forecast model that has been used for the assessment of national energy efficiency action plans of Cyprus in the recent past, which were then input to OSeMOSYS. The optimisation results, as shown in Chapter 5.1, along with the associated costs and calculated emissions of GHGs and air pollutants, have been fed into other models in order to assess the macroeconomic and employment impacts of the two scenarios that were explored. Apart from the above energy-related data and results, information about emissions abatement and costs for non-energy-related GHG emissions were obtained from the relevant calculations of national authorities that are included in the NECP of Cyprus.

Taking into account that national authorities have decided to proceed in their energy and climate policy in three stages time steps base on the 3 reporting periods (Stage 1 implement all PPMs till 2022, Stage 2 additional PPMs based on the progress of stage 1 and Stage 3 being an intention to proceed with more ambitious measures in the near future in order to fill the gap towards the -24% CO2 target), the main findings of the Impact Assessment can be summarised as follows:

1. Existing policies and measures (Stage 1 of the national climate policy) are clearly insufficient to lead Cyprus to compliance with its obligations stemming from the Energy Union Governance Regulation. They cannot lead to compliance with the national renewable energy and energy efficiency targets, and they can only lead to 3% reduction in non-ETS emissions in 2030 compared to 2005; this will require purchasing a significant amount of emission allowances to fill the 2030 emissions gap, which, under optimistic assumptions, will cost the Republic of Cyprus at least 131 million Euros[123] in the period up to 2030. Moreover, non-compliance with the 2030 target of 14% renewable energy in transport will lead to additional costs in the WEM scenario, because the gap in renewable share will have to be covered through the Statistical Transfer procedure.
2. The Planned Policies and Measures scenario that will be implemented in stages, is able to make Cyprus meet its goals. If fully implemented, these measures will lead to net economic benefits to the society of more than 500 million Euros'2016 by 2030, accompanied by small positive effects on economic indicators – a 0.3% increase in

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[123] This calculation is based on assumptions provided by MARDE about the evolution of ETS allowance prices up to 2030. They are considered to be optimistic because Cyprus will not have the right to 'borrow' emission allowances from ETS installations, and since most EU Member states expect to be in deficit of allowances for meeting their 2030 ESR targets, it is likely that the cost for purchasing allowances to cover the non-ETS emissions gap will be considerably higher.

national GDP and a 0.3% rise in economy-wide employment in 2030. The changes in energy costs to end consumers will be very small and overall will have essentially no adverse impact on the welfare of households and social equity.

3. Road transport holds the key to emissions abatement both for 2030 and for the longer term. Investments in sustainable mobility may exceed 1.3 billion Euros throughout the period 2020-2030 and can therefore be considered as costly. However, these investments are expected to fully pay off because of multiple benefits from the reduction of the use of passenger cars, which can yield aggregate economic benefits to society of the order of 2 billion Euros'2016. Coupled with a fast electrification of the passenger car sector, they can enable achieving the 2030 non-ETS emission reduction target and shifting the whole Cypriot economy to a low-carbon path towards 2050.

4. There are essentially no higher investment requirements to realise the PPM scenario, but a re-allocation towards public investments for sustainable transport; these are expected to pay off because fuel import costs throughout the lifetime of these measures may decline considerably due to these investments.

5. However, successful implementation of the package of Planned Policies and Measures is not guaranteed because it requires significant investments for energy renovations in buildings and industry and – most importantly – a substantial commitment to promote public transport and non-motorised transport modes (walking and cycling) as well as a shift to electric cars.

6. Among the list of Planned Policies and Measures, some measures are more cost-effective than others (e.g. roof insulation or installation of heat pumps in buildings and further deployment of rooftop PVs and solar panels for hot water use). However, with very few exceptions, all other measures pass the cost-effectiveness test and can be deployed without delay.

7. Non-energy-related measures can also contribute to emission reductions. Recovery of fluorinated gases seems to be cost-effective, while extensive planting of trees may be a measure with relatively limited potential and high cost up to 2030, but is an important ingredient of decarbonisation policy in the longer term.

8. In the event that the project of electricity interconnection of Cyprus with Greece and Israel is realised, penetration of renewable energy will be considerably higher. This will enable substantial additional investments for decarbonising the electricity system, and will be able to put Cyprus on track to meet its long-term decarbonisation targets. On the other hand, if the project is not materialized substantial investments are needed in Energy Storage to support at least the minimum level of RES penetration that is required for the Cyprus to meet the RES targets for 2030. On the other hand, if the project is not materialized substantial investments are needed in Energy Storage to support at least the minimum level of RES penetration that is required for the Cyprus to meet the RES targets for 2030.

9. On the way to decarbonisation of the energy system, research and innovation can play an important role. Although great technological breakthroughs are unlikely to come

from research in Cyprus alone, the existence of a critical mass of researchers in topics such as energy efficiency, renewable energy sources and fuels, and emission abatement measures can accelerate a) the demonstration and deployment of novel technologies in Cyprus, b) the implementation of innovative measures under the particular conditions of the Cypriot market, and c) the development of expertise for innovative services related to low-carbon technologies.

10. Even if implemented fast and effectively, Planned Policies and Measures are not sufficient for reaching the non-ETS GHG emission reduction target of 24% by 2030, as required from Cyprus in the Effort Sharing Regulation; the reduction can only reach 14.7% in the PPM scenario. In order to achieve full compliance, the government of Cyprus has to choose between three options:

    a. Not proceed with further GHG emission abatement measures and use instead flexibility mechanisms to purchase emission allowances, with the associated costs; these are estimated to reach at least 55 million Euros up to 2030 but as indicated in point 1 above, may reach much higher levels if several EU Member States are in need to purchase emission allowances to fill their own emission abatement gap.

    b. Implement stronger emission abatement policies and measures (e.g. double the number of energy renovations of buildings, increase cogeneration plants or biogas production plants from waste, encourage accelerated replacement of conventional cars with electric ones); however, all these measures are extremely difficult to implement at such a scale within the short time frame available; therefore they cannot be considered as a realistic alternative.

    c. Induce energy conservation measures through the adoption of a fiscally neutral green tax reform, by imposing a gradually increasing carbon tax on all non-ETS sectors. The revenues of such a tax can be recycled in the economy by reducing labour taxes and providing financial support to energy conservation and green transport policies. Such a reform can have substantial economic benefits without harming low-income households or the competitiveness of firms[124].

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[124] Zachariadis T., A Proposed Green Tax Reform for Cyprus and its Co-Benefits for Urban Sustainability In: *Critical Issues in Environmental Taxation*, Ezcurra M.V., Milne J., Ashiabor H. and Andersen M.S. (Eds.), Edward Elgar, 2019.

11. In view of the declared political commitment of the European Union to carbon neutrality by 2050, the measures foreseen in the NECP of Cyprus and the options mentioned above for filling the non-ETS emissions abatement gap have to be assessed in light of the need for deep decarbonisation. It has been shown that it is impossible to attain the 2050 target if there is low ambition about decarbonisation in 2030.[125,126,127] Therefore, purchasing allowances to fill the 2030 emissions gap is both costly and does not lead to a strong decarbonisation path towards 2050; hence it is not the preferred option for the government of Cyprus.

12. In September 2019 the Finance Minister of Cyprus announced that a green tax reform will be put in consultation in 2020 with the aim to adopt the relevant legal framework and implement such a reform in 2021. As this measure is still provisional and no specific details have been agreed, it has not been included by authorities in the Planned Policies and Measures scenario of the NECP. Based on the previous considerations outlined in this section, the gradual implementation of a green tax reform from 2021 onwards (Stage 3) seems to be a necessary additional policy, both for leading Cyprus to achievement of the non-ETS emission reduction target of 2030 and for enabling the transition to a net-zero-carbon economy by 2050.

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[125] Zachariadis T., Michopoulos A., Vougiouklakis Y., Piripitsi K., Ellinopoulos C. and Struss B., Determination of Cost-Effective Energy Efficiency Measures in Buildings with the Aid of Multiple Indices. *Energies* 11 (2018), 191; doi:10.3390/en11010191

[126] Sotiriou C. and Zachariadis T., Optimal Timing of Greenhouse Gas Emissions Abatement in Europe. *Energies* 12 (2019), 1872; doi:10.3390/en12101872.

[127] Vogt-Schilb A. and Hallegatte S., Climate policies and nationally determined contributions: Reconciling the needed ambition with the political economy. WIREs Energy Environ. 2017, 6, e256.

Part 2

List of parameters and variables to be reported in Section B of National Plans

The following parameters, variables, energy balances and indicators are to be reported in Section B ‘Analytical Basis’ of the National Plans, if used:

1. General parameters and variables

1.1. (1) Population [million]

Available in the templates accompanying the National Plan

1.2. (2) GDP [euro million]

Available in the templates accompanying the National Plan

1.3. (3) Sectoral gross value added (including main industrial, construction, services, and agriculture sectors) [euro million]

Available in the templates accompanying the National Plan

1.4. (4) Number of households [thousands]

Available in the templates accompanying the National Plan

1.5. (5) Household size [inhabitants/households]

Available in the templates accompanying the National Plan

1.6. (6) Disposable income of households [euro]

Available in the templates accompanying the National Plan

1.7. (7) Number of passenger-kilometres: all modes, i.e. split between road (cars and buses separated if possible), rail, aviation and domestic navigation (when relevant) [million pkm]

Available in the templates accompanying the National Plan

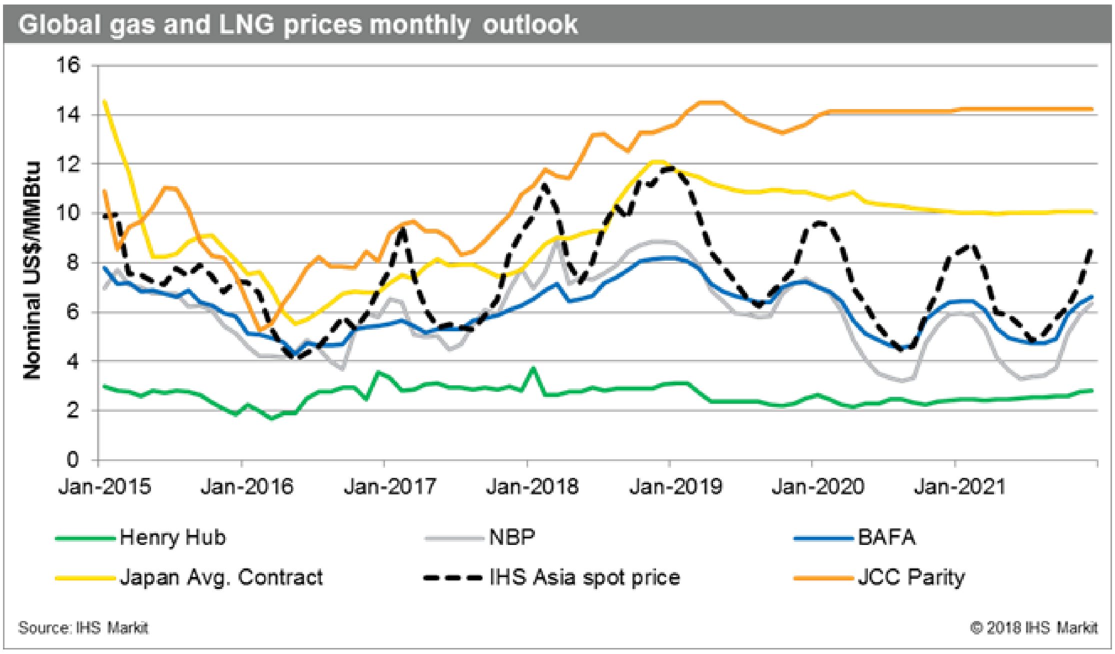
1.8. (8) Freight transport tonnes-kilometres: all modes excluding international maritime, i.e. split between road, rail, aviation, domestic navigation (inland waterways and national maritime) [million tkm]

Available in the templates accompanying the National Plan

1.9. (9) International oil, gas and coal fuel import prices [EUR/GJ or euro/toe] based on the Commission's recommendations

There are ongoing discussions on the possibility of US flooding the market with cheap shale LNG, and as a matter of fact this is the strategy of the US, to establish the demand markets in order to land the chilled molecules to various buyers around the world. As discussed during our meeting in the case of US sourced LNG, the price indexation we have to focus is HH (Henry Hub). As shown on the below graph HH has been historically traded lower than other regional indices, but we have to keep in mind that for this particular region we have to add on top of the HH price the liquefaction and shipping cost. Therefore, although a very valid argument on the cheapest LNG option from the US, there are two variable elements which at any case when market dictates can rise for a number of reasons (especially shipping rates) and deem the LNG more expensive than alternative options.

The graph below, along with other details on gas prices can be found on the attached document IHS Market LNG and Gas Prices.



Source: IHS Markit

© 2018 IHS Markit

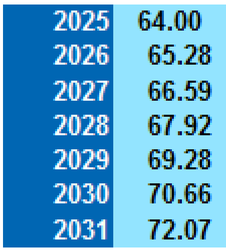
Figure. Global gas and LNG prices monthly outlook

1. The prices of futures

Future prices run up to 2026 and forecasted up to 2040, and the importance of the futures lays on the volume of money, traders, banks, oil majors, producers and other related parties are committing to the specific future. A single snapshot from today's monthly future prices is as per below:

+	CBQ25 (Aug '25)	63.92s	+0.69	0.00	63.92	63.92	63.23
+	CBU25 (Sep '25)	63.94s	+0.69	0.00	63.94	63.94	63.25
+	CBV25 (Oct '25)	63.96s	+0.69	0.00	63.96	63.96	63.27
+	CBX25 (Nov '25)	63.98s	+0.69	0.00	63.98	63.98	63.29
+	CBZ25 (Dec '25)	64.00s	+0.69	0.00	64.00	64.00	63.31
+	CBF26 (Jan '26)	64.02s	+0.69	0.00	64.02	64.02	63.33
+	CBG26 (Feb '26)	64.04s	+0.69	0.00	64.04	64.04	63.35
+	CBH26 (Mar '26)	64.06s	+0.69	0.00	64.06	64.06	63.37

We can safely assume that the market is not expecting Brent to trade through 2025-2026 above $70/bbl. We then assume a 2% annual inflation rate, based of the Ministry of finance assumptions, of the Brent prices which gives us the results below.



2025	64.00
2026	65.28
2027	66.59
2028	67.92
2029	69.28
2030	70.66
2031	72.07

2. Forecasts from Banks

We have been gathering and recording a number of forecasts from various banks and other intelligence service providers to create our own view of the market.

The general outlook we have up to date is as per graph below, please note that we have taken the various reported forecasted prices from the banks and other service providers up to 2025 and then we escalated each reported price with 2% (based in inflation rate) for the remaining 5 years. Even with the escalation the most optimistic scenario does not overpass the $70-$75/bbl threshold.

Full data and graphs of the below can be found on various public and internal documents.

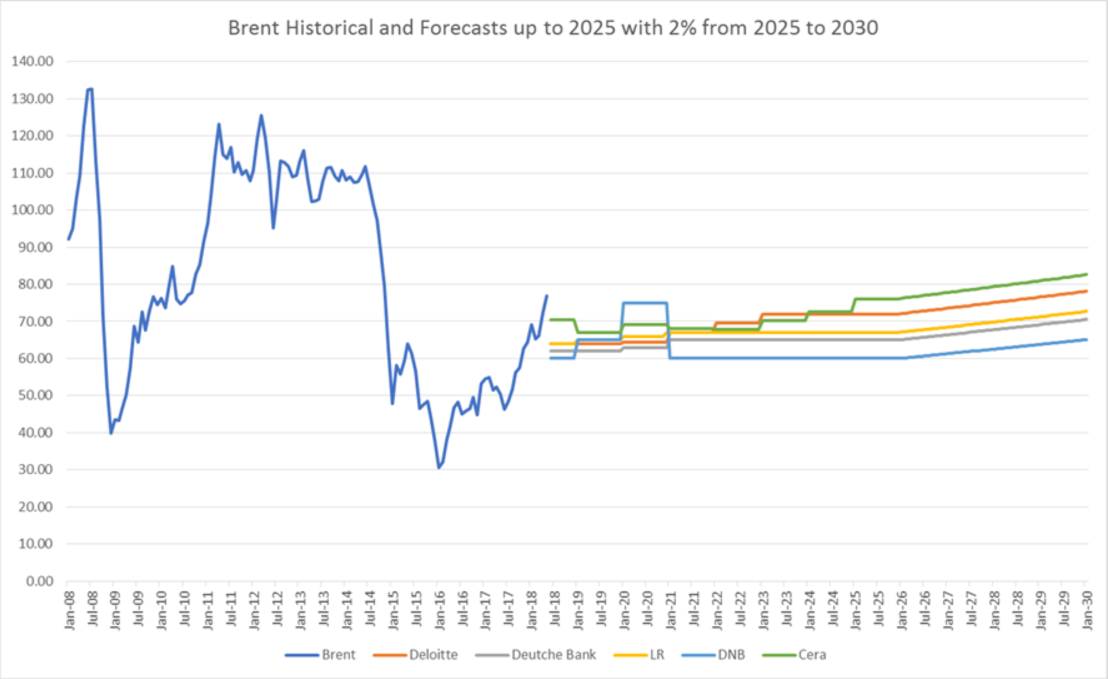


Figure. Brent Historical and Forecasts up to 2025 with 2% from 2025 to 2030

Please note that most of majors oil companies, usually do not forecast that far in the future and the reports we currently have reach 2025.

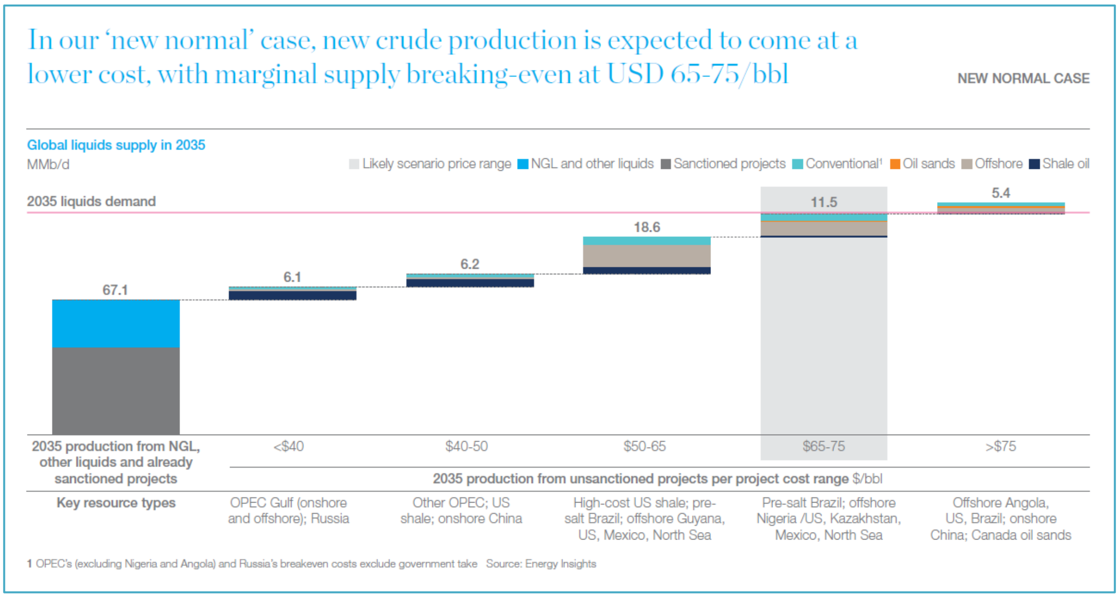
From various presentations MECI has attended the last couple of months we have seen various forecasts from reporting agencies on Brent and especially from Platts where they presented their view on Brent forecasts until 2040.

The forecasted values we have been presented were based on three scenarios: Low Case Expected and High Case. The results are shown on the below table:

Scenarios	Low Case	Expected	High Case
Average Price in $/bbl	$42	$61	$84

In addition to that there a probabilistic distribution which was also presented during that presentations which illustrated that the Brent price will fluctuate around $64/bbl for the period 2020-2040 with a 50% probability. The probability to drop below $50/bbl was estimated at 30% and the remaining 20% was on the high case where prices rise over $80/bbl

In addition, in the McKinsey report page 28:



On the matter of the regional developments we should just mention that East Med is a frontier exploration play and as further exploration is expected in the region, local reserves might feed the regional demand in a more economical method and consequently replace the imported and more expensive oil distillates products for power production.

We have strong indications, from various confidential on-going discussions that the oil prices and natural gas prices in the region will remain to the levels indicated above up to 2030 (i.e. $60-70/bbl).

3. Projections of oil prices

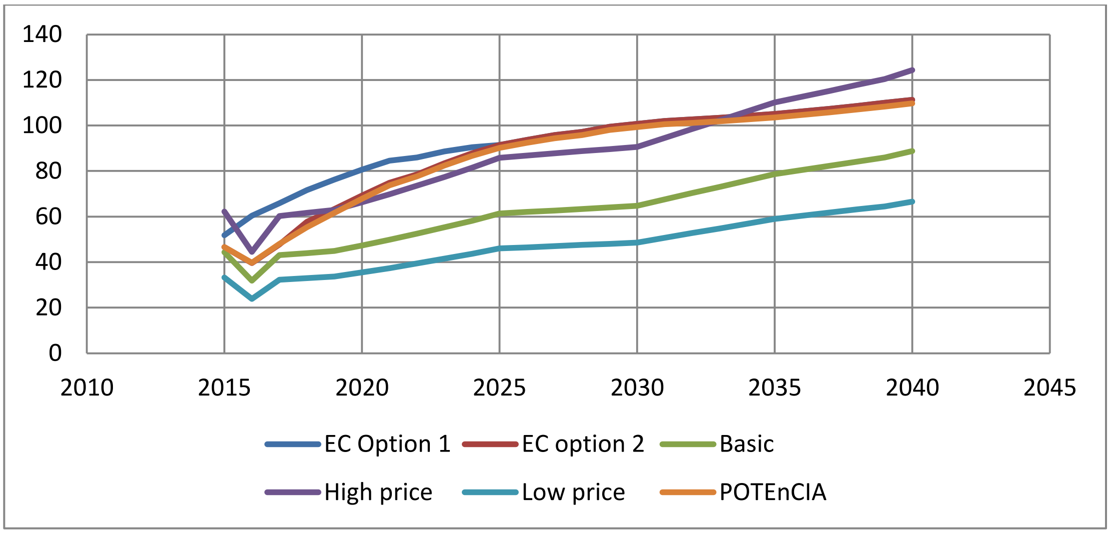


Figure. Comparison of oil prices projections (prices in €$_{2016}$/boe)

Table 17: Oil cost projections (prices in €$_{2016}$/boe)

Year	EC Option 1	EC option 2	Basic	High price	Low price	POTEnCIA
2021	84.57	74.92	49.85	69.80	37.39	73.72
2022	85.95	78.53	52.54	73.55	39.40	77.64

2023	88.61	83.48	55.31	77.44	41.48	82.45
2024	90.45	87.81	58.18	81.45	43.63	86.62
2025	91.47	91.47	61.32	85.85	45.99	90.15
2026	93.75	93.75	62.01	86.81	46.51	92.40
2027	95.82	95.82	62.69	87.77	47.02	94.44
2028	97.23	97.23	63.38	88.73	47.53	95.82
2029	99.43	99.43	64.06	89.69	48.05	97.99
2030	100.77	100.77	64.75	90.64	48.56	99.31

Table 18: Natural gas cost projections (prices in €2016/boe)

Year	EC Option 1	EC option 2	Basic	High	Low	POTEnCIA
2021	53.84	47.51	32.97	61.55	16.49	45.13
2022	54.01	49.35	34.75	64.86	17.37	47.46
2023	54.88	51.76	36.58	68.29	18.29	50.22
2024	55.57	54.02	38.48	71.83	19.24	52.82
2025	56.08	56.08	40.56	75.71	20.28	55.27
2026	56.97	56.97	41.01	76.55	20.51	56.15
2027	57.80	57.80	41.46	77.40	20.73	56.97
2028	58.72	58.72	41.92	78.24	20.96	57.88
2029	59.65	59.65	42.37	79.09	21.18	58.78
2030	60.99	60.99	42.82	79.93	21.41	60.11

4. Projections on natural gas prices

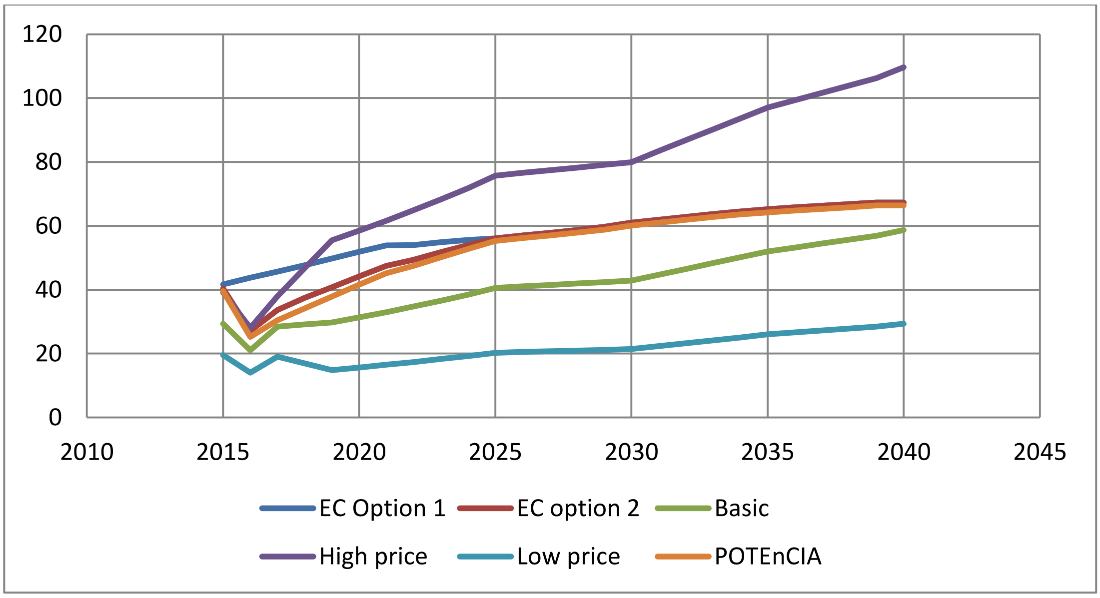


Figure: Comparison of oil prices projections (prices in €$_{2016}$/boe)

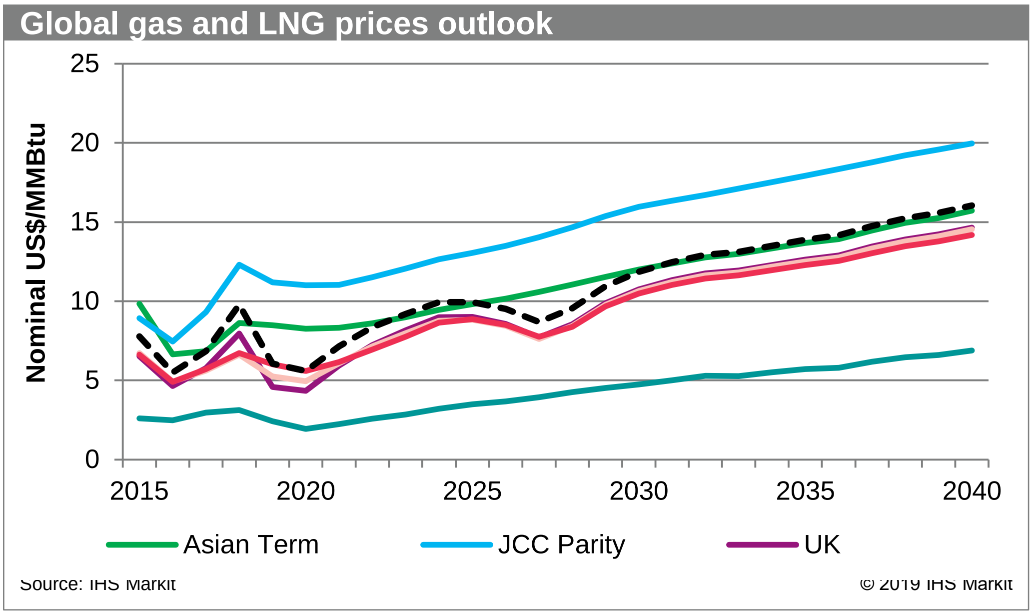


Figure: Global gas and LNG prices outlook

Reviewing recently, the various forecasts published during 1H 2019 from banks, NOCs, IOCs and subscribed service providers we can safely conclude that no significant changes have been reported especially for the near-term period 2020-25. More specifically a significant number of publishers such as EIA, Goldman Sachs, IHS Cera have marginally dropped their price forecast for the same period down 5% from the previous forecast.

Growth is expected in oil supply to come from OPEC, US shale oil and selected offshore basins e.g. Brazil that are breaking-even below USD75/bb

Ample resource base and cost discipline keeps long term average prices at $65-75/bbl.

For the period 2025-2030 there is uniformly reporting on Oil price increase of 1-3% annually depending on the industry each publisher is involved. The most bullish views on this price increase are resulting to Brent prices reaching the low 90's levels by the end of 2030.

1.10. (10) EU-ETS carbon price [EUR/EUA] based on the Commission's recommendations

For EU-ETS carbon price, Cyprus has followed EU Recommendations.

1.11. (11) Exchange rates to EUR and to USD (where applicable) assumptions [euro/currency and USD/currency]

Available in the templates accompanying the National Plan

1.12. (12) Number of Heating Degree Days (HDD)

Available in the templates accompanying the National Plan

1.13. (13) Number of Cooling Degree Days (CDD)

Available in the templates accompanying the National Plan

1.14. (14) Technology cost assumptions used in modelling for main relevant technologies

Available in the templates accompanying the National Plan

2. Energy balances and indicators

Available in the templates accompanying the National Plan

3. GHG emissions and removals related indicators

3.1. (1) GHG emissions by policy sector (EU ETS, effort sharing and LULUCF)

	WEM			PPM			LULUCF
	ETS	ESD	TOTAL	ETS	ESD	TOTAL	
2018	4917	4009	8926	4917	4009	8926	-505
2019	5286	4060	9345	5286	4059	9346	-516
2020	5251	3987	9146	5259	3886	9238	-534
2021	4831	3995	8841	4921	3920	8826	-557
2022	4095	3983	7865	3987	3878	8078	-573
2023	4133	3970	7838	4002	3836	8103	-589
2024	3964	3964	7576	3775	3801	7928	-606
2025	3938	3959	7535	3774	3761	7896	-622
2026	3937	3954	7509	3795	3714	7890	-656
2027	3981	3941	7460	3825	3635	7922	-677
2028	4045	3926	7436	3880	3556	7972	-699
2029	4140	3880	7313	3837	3477	8020	-721
2030	4195	3829	7190	3815	3374	8024	-743
2031	4045	3775	7130	3795	3335	7820	-765
2032	3804	3726	6952	3665	3287	7529	-787
2033	3395	3674	6739	3509	3230	7069	-809
2034	3354	3623	6685	3512	3173	6976	-831
2035	3401	3572	6649	3534	3115	6973	-853
2036	3084	3519	6594	3538	3056	6603	-875
2037	3099	3466	6508	3508	3000	6566	-897
2038	3137	3415	6302	3357	2945	6552	-918
2039	3094	3365	5772	2882	2891	6458	-940
2040	2952	3315	5761	2918	2842	6267	-960

3.2. GHG emissions by IPCC sector and by gas [tCO2eq]

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
ENERGY											
CO2	6569437	6763459	6688899	6344713	5388730	5375425	5129825	5105808	5098615	5068548	5063982
CH4	23054	23957	24466	24368	22891	23013	23149	23234	23072	22773	22498
N2O	67739	69081	70143	68811	64115	64091	63671	63154	62027	60153	58306
HFC	0	0	0	0	0	0	0	0	0	0	0
SF6	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**6660231**	**6856497**	**6783509**	**6437891**	**5475736**	**5462529**	**5216645**	**5192196**	**5183714**	**5151474**	**5144787**
ETS	4055920	4208568	4181998	3843994	2910145	2924717	2697533	2696923	2717603	2747441	2803129
ESD	2604311	2647930	2601511	2593897	2565591	2537811	2519112	2495273	2466111	2404033	2341658
INDUSTRY											
CO2	888472	1105214	1105533	1105862	1106189	1106515	1106843	1107216	1107567	1107908	1108237
CH4	0	0	0	0	0	0	0	0	0	0	0
N2O	60903	61283	61678	62071	62459	62841	63213	63574	63922	64255	64573
HFC	249869	251428	253047	254659	256251	257818	259345	260827	262253	263622	264927
SF6	167	168	169	171	172	173	174	175	176	177	177
TOTAL	**1199412**	**1418094**	**1420427**	**1422762**	**1425070**	**1427347**	**1429575**	**1431791**	**1433917**	**1435962**	**1437915**
ETS	860837	1077253	1077254	1077255	1077256	1077257	1077258	1077259	1077259	1077259	1077259
ESD	338575	340840	343173	345506	347814	350090	352316	354531	356658	358703	360656
AGRICULTURE											
CO2	418	418	418	418	418	418	418	418	418	418	418
CH4	303396	303316	303058	325114	324353	323591	322830	322069	321308	320547	319786

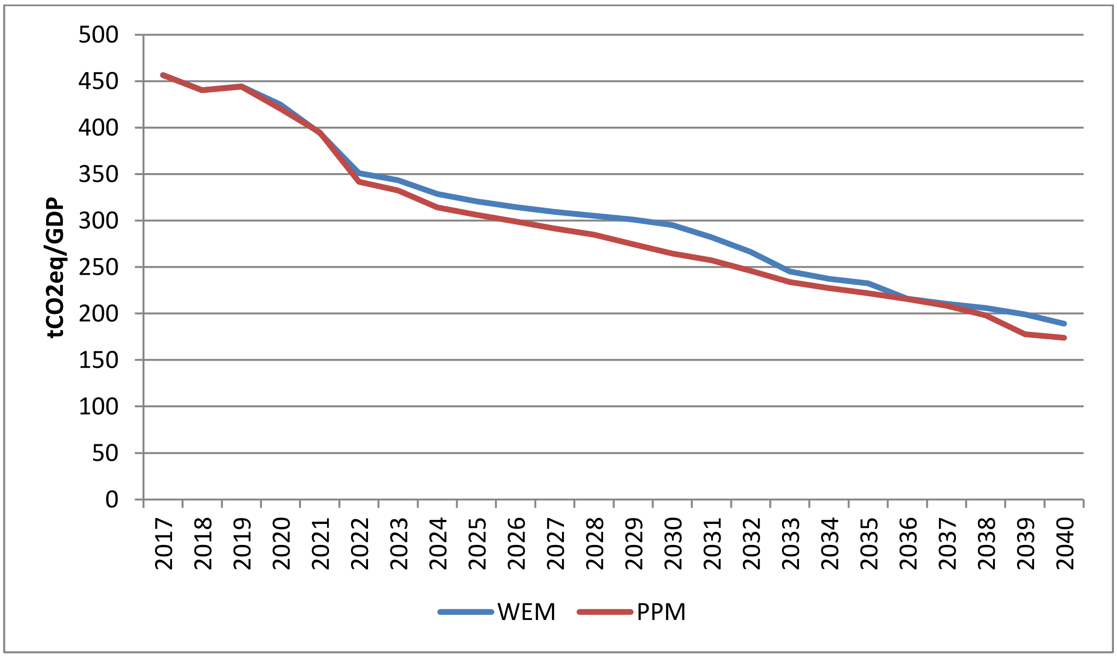
Year	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
N2O	187126	187698	188121	194451	194311	194171	194031	193890	193749	193608	193466
HFC	0	0	0	0	0	0	0	0	0	0	0
SF6	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**490940**	**491432**	**491597**	**519983**	**519082**	**518181**	**517279**	**516377**	**515475**	**514573**	**513670**
ETS	0	0	0	0	0	0	0	0	0	0	0
ESD	490940	491432	491597	519983	519082	518181	517279	516377	515475	514573	513670
WASTE											
CO2	0	0	0	0	0	0	0	0	0	0	0
CH4	555696	558509	429187	439280	424037	407878	390776	372676	353665	335114	316982
N2O	19801	20306	20822	21352	21529	21706	21880	22052	22223	22393	22563
HFC	0	0	0	0	0	0	0	0	0	0	0
SF6	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**575496**	**578815**	**450009**	**460632**	**445566**	**429584**	**412657**	**394728**	**375888**	**357507**	**339545**
ETS	0	0	0	0	0	0	0	0	0	0	0
ESD	575496	578815	450009	460632	445566	429584	412657	394728	375888	357507	339545
LULUCF											
TOTAL	**-503816**	**-514750**	**-525684**	**-536618**	**-547552**	**-558486**	**-569420**	**-580354**	**-591288**	**-602222**	**-613156**

Year	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
ENERGY												
CO2	4960086	4854996	4812830	4651902	4456691	4419306	4399778	4361366	4291298	4100385	3586073	3588062
CH4	22229	21862	21785	21582	21234	20969	20709	20429	20105	19766	19298	19083
N2O	56432	54601	53807	53028	51873	50902	49922	49011	47984	46993	45854	45079
HFC	0	0	0	0	0	0	0	0	0	0	0	0
SF6	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**5038747**	**4931459**	**4888422**	**4726512**	**4529798**	**4491177**	**4470409**	**4430806**	**4359386**	**4167144**	**3651226**	**3652224**
ETS	2759374	2737815	2717510	2587561	2432071	2434434	2456745	2460314	2430891	2279886	1804644	1840947
ESD	2279373	2193643	2170911	2138952	2097728	2056743	2013665	1970492	1928496	1887257	1846582	1811277
INDUSTRY												
CO2	1108539	1108815	1108931	1109033	1109145	1109255	1109359	1109463	1109549	1109633	1109717	1109757
CH4	0	0	0	0	0	0	0	0	0	0	0	0
N2O	64877	65166	65441	65703	65953	66193	66425	66650	66869	67086	67297	67506
HFC	266171	267358	268486	269562	270586	271572	272525	273447	274347	275234	276101	276959
SF6	178	179	180	181	181	182	183	183	184	184	185	185
TOTAL	**1439765**	**1441518**	**1443037**	**1444479**	**1445865**	**1447202**	**1448492**	**1449743**	**1450949**	**1452137**	**1453300**	**1454408**
ETS	1077259	1077259	1077259	1077259	1077259	1077259	1077259	1077259	1077259	1077259	1077259	1077259
ESD	362506	364259	365778	367219	368606	369943	371233	372483	373689	374878	376041	377149
AGRICULTURE												
CO2	418	418	418	418	418	418	418	418	418	418	418	418
CH4	319025	318264	317503	316742	315981	315220	314459	313698	312937	312176	311415	310654
N2O	193324	193181	193039	192896	192753	192609	192465	192321	192176	192032	191886	191741
HFC	0	0	0	0	0	0	0	0	0	0	0	0

Year	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
SF6	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**512767**	**511864**	**510960**	**510056**	**509152**	**508247**	**507342**	**506437**	**505532**	**504626**	**503720**	**502813**
ETS	0	0	0	0	0	0	0	0	0	0	0	0
ESD	512767	511864	510960	510056	509152	508247	507342	506437	505532	504626	503720	502813
WASTE												
CO2	0	0	0	0	0	0	0	0	0	0	0	0
CH4	299223	281796	264581	247795	231293	215047	199030	183217	168140	153762	140048	126967
N2O	22733	22904	23023	23170	23314	23455	23594	23731	23867	24003	24137	24271
HFC	0	0	0	0	0	0	0	0	0	0	0	0
SF6	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**321956**	**304700**	**287605**	**270965**	**254606**	**238502**	**222624**	**206948**	**192007**	**177765**	**164185**	**151238**
ETS	0	0	0	0	0	0	0	0	0	0	0	0
ESD	321956	304700	287605	270965	254606	238502	222624	206948	192007	177765	164185	151238
LULUCF												
TOTAL	**-624090**	**-635024**	**-645958**	**-656892**	**-667826**	**-678760**	**-689694**	**-700628**	**-711562**	**-722496**	**-733430**	**-744364**

3.3. (3) Carbon Intensity of the overall economy [tCO2eq/GDP]

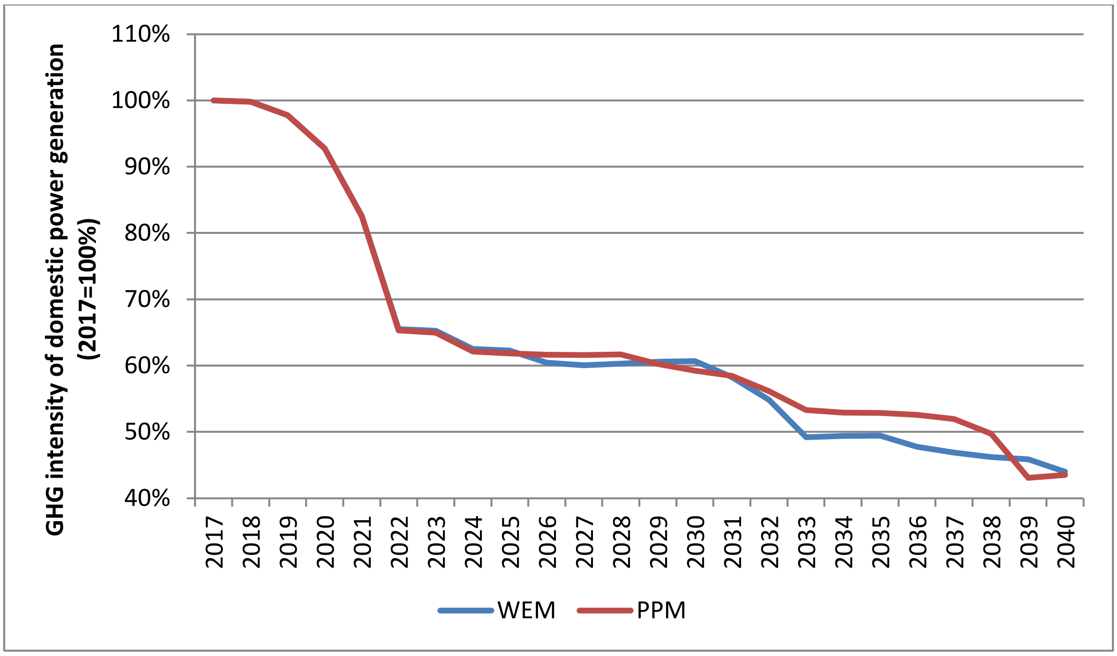
Year	WEM	PPM
2018	440	440
2019	444	444
2020	425	420
2021	394	395
2022	351	342
2023	344	332
2024	329	314
2025	321	306
2026	314	299
2027	309	291
2028	305	285
2029	301	275
2030	295	265
2031	282	257
2032	266	246
2033	245	234
2034	237	227
2035	232	222
2036	216	215
2037	210	208
2038	206	198
2039	199	178
2040	189	174



3.4. (4) CO2 emission related indicators

3.4.1. (a) GHG intensity of domestic power and heat generation [tCO2eq/MWh]

	WEM			PPM		
Year	t CO2 eq.	MWh generated	GHG intensity [tCO2eq/MWh]	t CO2 eq.	MWh generated	GHG intensity [tCO2eq/MWh]
2018	3349799	4889678	0.69	3349754	4889620	0.69
2019	3400318	5115206	0.66	3400450	5115381	0.66
2020	3272775	5325882	0.61	3272571	5325618	0.61
2021	2944159	5741854	0.51	2928900	5716252	0.51
2022	2042441	5966563	0.34	1994516	5863576	0.34
2023	2072568	6102859	0.34	2016587	5984080	0.34
2024	1874509	6006191	0.31	1793102	5818505	0.31
2025	1897201	6125051	0.31	1791284	5863293	0.31
2026	1832233	6288706	0.29	1810978	5961004	0.30
2027	1861340	6469839	0.29	1839891	6070487	0.30
2028	1942179	6691966	0.29	1894439	6235312	0.30
2029	2028547	6925010	0.29	1849708	6390427	0.29
2030	2082543	7084509	0.29	1827203	6535372	0.28
2031	1949470	7228162	0.27	1809094	6653873	0.27
2032	1738235	7383674	0.24	1680721	6766604	0.25
2033	1346627	7521718	0.18	1526161	6935488	0.22
2034	1389504	7668557	0.18	1529367	7066720	0.22
2035	1417618	7814328	0.18	1552255	7190449	0.22
2036	1306929	7935827	0.16	1556196	7314453	0.21
2037	1255403	8046304	0.16	1526880	7396356	0.21
2038	1216070	8151995	0.15	1376002	7457008	0.18
2039	1206999	8274868	0.15	900695	7641156	0.12
2040	1066791	8389788	0.13	937564	7683925	0.12


GHG intensity of domestic power generation (2017=100%)
110%
100%
90%
80%
70%
60%
50%
40%
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
WEM
PPM

3.4.2. (b) GHG intensity of final energy consumption by sector [tCO2eq/toe]

	With existing measures												
t CO2 eq./toe	electricity	cement	other industry	domestic aviation	road transport	domestic navigation	commercial	residential	stationary agriculture	mobile agriculture	non-specified stationary	non-specified mobile	weighted average
2018	8.733	8.579	3.013	3.020	3.086	3.156	3.015	2.966	3.090	3.121	3.029	3.012	4.979
2019	8.611	7.603	3.041	3.020	3.084	3.156	3.017	2.966	3.091	3.121	3.029	3.012	4.929
2020	8.505	8.605	3.051	3.020	3.086	3.156	3.018	2.965	3.093	3.121	3.029	3.012	4.951
2021	7.076	9.923	3.055	3.020	3.084	3.156	3.019	2.965	3.102	3.121	3.029	3.012	4.633
2022	4.948	11.736	3.056	3.020	3.083	3.156	3.019	2.965	3.103	3.121	3.029	3.012	4.029
2023	4.959	14.386	3.056	3.020	3.081	3.156	3.019	2.964	3.103	3.121	3.029	3.012	4.070
2024	4.645	18.625	3.055	3.020	3.080	3.156	3.020	2.963	3.104	3.121	3.029	3.012	3.998
2025	4.654	18.625	3.052	3.020	3.079	3.156	3.023	2.962	3.104	3.121	3.029	3.012	3.999
2026	4.672	18.625	3.047	3.020	3.078	3.156	3.025	2.961	3.105	3.121	3.029	3.012	3.993
2027	4.612	18.625	3.042	3.020	3.078	3.156	3.027	2.959	3.105	3.121	3.029	3.012	3.980
2028	4.626	18.625	3.037	3.020	3.079	3.156	3.029	2.957	3.106	3.121	3.029	3.012	3.998
2029	4.641	18.625	3.030	3.020	3.080	3.156	3.030	2.955	3.106	3.121	3.029	3.012	4.018
2030	4.648	18.625	3.023	3.020	3.080	3.156	3.032	2.953	3.106	3.121	3.029	3.012	4.033
2031	4.657	18.625	3.016	3.020	3.080	3.156	3.034	2.951	3.107	3.121	3.029	3.012	4.031
2032	4.649	18.625	3.009	3.020	3.080	3.156	3.036	2.949	3.107	3.121	3.029	3.012	4.015
2033	4.580	18.625	3.001	3.020	3.081	3.156	3.038	2.947	3.107	3.121	3.029	3.012	3.965
2034	4.583	18.625	2.993	3.020	3.081	3.156	3.040	2.944	3.108	3.121	3.029	3.012	3.979
2035	4.591	18.625	2.984	3.020	3.082	3.156	3.041	2.942	3.108	3.121	3.029	3.012	3.993
2036	4.612	18.625	2.975	3.020	3.082	3.156	3.043	2.939	3.108	3.121	3.029	3.012	3.995
2037	4.583	18.625	2.966	3.020	3.083	3.156	3.045	2.936	3.109	3.121	3.029	3.012	3.993
2038	4.583	18.625	2.956	3.020	3.084	3.156	3.046	2.933	3.110	3.121	3.029	3.012	3.998
2039	4.746	18.625	2.946	3.020	3.084	3.156	3.048	2.930	3.111	3.121	3.029	3.012	4.041
2040	4.723	18.625	2.935	3.020	3.085	3.156	3.049	2.927	3.111	3.121	3.029	3.012	4.028

t CO2 eq./toe	With planned measures												
	electricity	cement	other industry	domestic aviation	road transport	domestic navigation	commercial	residential	stationary agriculture	mobile agriculture	non-specified stationary	non-specified mobile	weighted average
2018	8.733	8.579	3.109	3.020	3.086	3.156	3.015	2.966	3.090	3.121	3.029	3.012	4.984
2019	8.611	7.603	3.116	3.020	3.084	3.156	3.017	2.966	3.091	3.121	3.029	3.012	4.934
2020	8.505	8.605	3.118	3.020	3.086	3.156	3.018	2.965	3.093	3.121	3.029	3.012	4.957
2021	7.077	9.923	3.118	3.020	3.085	3.156	3.018	2.965	3.103	3.121	3.029	3.012	4.645
2022	4.938	11.736	3.118	3.020	3.085	3.156	3.018	2.965	3.103	3.121	3.029	3.012	4.039
2023	4.946	14.386	3.117	3.020	3.084	3.156	3.018	2.964	3.103	3.121	3.029	3.012	4.086
2024	4.629	18.625	3.116	3.020	3.084	3.156	3.020	2.963	3.104	3.121	3.029	3.012	4.018
2025	4.633	18.625	3.114	3.020	3.084	3.156	3.022	2.962	3.105	3.121	3.029	3.012	4.024
2026	4.639	18.625	3.112	3.020	3.085	3.156	3.024	2.961	3.106	3.121	3.029	3.012	4.035
2027	4.644	18.625	3.109	3.020	3.086	3.156	3.026	2.959	3.107	3.121	3.029	3.012	4.054
2028	4.653	18.625	3.107	3.020	3.088	3.156	3.028	2.957	3.108	3.121	3.029	3.012	4.078
2029	4.651	18.625	3.104	3.020	3.089	3.156	3.030	2.956	3.113	3.121	3.029	3.012	4.089
2030	4.663	18.625	3.102	3.020	3.091	3.156	3.032	2.954	3.115	3.121	3.029	3.012	4.114
2031	4.673	18.625	3.099	3.020	3.090	3.156	3.033	2.952	3.116	3.121	3.029	3.012	4.122
2032	4.678	18.625	3.096	3.020	3.090	3.156	3.035	2.950	3.119	3.121	3.029	3.012	4.120
2033	4.583	18.625	3.093	3.020	3.091	3.156	3.036	2.948	3.121	3.121	3.029	3.012	4.092
2034	4.593	18.625	3.091	3.020	3.092	3.156	3.037	2.945	3.124	3.121	3.029	3.012	4.108
2035	4.596	18.625	3.088	3.020	3.093	3.156	3.039	2.943	3.128	3.121	3.029	3.012	4.125
2036	4.630	18.625	3.085	3.020	3.094	3.156	3.040	2.941	3.132	3.121	3.029	3.012	4.149
2037	4.583	18.625	3.082	3.020	3.095	3.156	3.042	2.938	3.137	3.121	3.029	3.012	4.148
2038	4.565	18.625	3.079	3.020	3.096	3.156	3.043	2.936	3.143	3.121	3.029	3.012	4.144
2039	4.565	18.625	3.075	3.020	3.097	3.156	3.044	2.933	3.149	3.121	3.029	3.012	4.111
2040	4.565	18.625	3.072	3.020	3.098	3.156	3.045	2.930	3.157	3.121	3.029	3.012	4.130

3.5. (5) Non-CO2 emission related parameters

3.5.1. (a) Livestock: dairy cattle [1 000 heads], non-dairy cattle [1 000 heads], sheep [1 000 heads], pig [1 000 heads], poultry [1 000 heads]

	Livestock population [1000 heads]					
Year	dairy cattle	other cattle	Sheep	Swine	Goats	Poultry
2018	30.1	36.6	321.5	359.2	257.6	3359.2
2019	30.1	36.6	321.5	359.2	257.6	3391.8
2020	30.1	36.6	321.5	362.7	257.6	3424.4
2021	34.2	38.0	334.6	373.3	257.6	3522.2
2022	34.2	38.0	334.6	373.3	257.6	3522.2
2023	34.2	38.0	334.6	373.3	257.6	3522.2
2024	34.2	38.0	334.6	373.3	257.6	3522.2
2025	34.2	38.0	334.6	373.3	257.6	3522.2
2026	34.2	38.0	334.6	373.3	257.6	3522.2
2027	34.2	38.0	334.6	373.3	257.6	3522.2
2028	34.2	38.0	334.6	373.3	257.6	3522.2
2029	34.2	38.0	334.6	373.3	257.6	3522.2
2030	34.2	38.0	334.6	373.3	257.6	3522.2
2031	34.2	38.0	334.6	373.3	257.6	3522.2
2032	34.2	38.0	334.6	373.3	257.6	3522.2
2033	34.2	38.0	334.6	373.3	257.6	3522.2
2034	34.2	38.0	334.6	373.3	257.6	3522.2
2035	34.2	38.0	334.6	373.3	257.6	3522.2
2036	34.2	38.0	334.6	373.3	257.6	3522.2
2037	34.2	38.0	334.6	373.3	257.6	3522.2
2038	34.2	38.0	334.6	373.3	257.6	3522.2
2039	34.2	38.0	334.6	373.3	257.6	3522.2
2040	34.2	38.0	334.6	373.3	257.6	3522.2

3.5.2. (b) Nitrogen input from application of synthetic fertilisers [kt nitrogen]

Nitrogen input from application of synthetic fertilisers (FSN) is assumed constant for the whole period at 7.841 kt nitrogen, with existing and planned measures.

3.5.3. (c) Nitrogen input from application of manure [kt nitrogen]

Year	WEM [kt nitrogen]	WAM [kt nitrogen]
2018	13.578	13.585
2019	13.631	13.645
2020	13.662	13.683
2021	14.230	14.249
2022	14.226	14.241
2023	14.222	14.233

2024	14.218	14.225
2025	14.215	14.217
2026	14.211	14.210
2027	14.207	14.202
2028	14.203	14.194
2029	14.199	14.186
2030	14.195	14.179
2031	14.191	14.171
2032	14.187	14.163
2033	14.183	14.156
2034	14.179	14.148
2035	14.175	14.140
2036	14.172	14.133
2037	14.168	14.125
2038	14.164	14.117
2039	14.160	14.110
2040	14.156	14.102

3.5.4. (d) Nitrogen fixed by N-fixing crops [kt nitrogen]

Included in FCR reported in the next section.

3.5.5. (e) Nitrogen in crop residues returned to soils [kt nitrogen]

Nitrogen in crop residues returned to soils is estimated at 0.4526 kt N for 2017, 0.2513 kt N for 2018 and 0.2525 kt N for 2019. For the period 2020-2040, the nitrogen crop residues returned to soils is assumed constant at 0.2538 kt N.

3.5.6. (f) Area of cultivated organic soils [hectares]

Cultivation of organic soils does not take place in Cyprus.

3.5.7. (g) Municipal solid waste (MSW) generation

Year	Municipal solid waste (MSW) generation [Gg]
2018	573.07
2019	581.43
2020	589.52
2021	598.37
2022	607.20
2023	616.31
2024	625.52
2025	634.91
2026	644.69
2027	654.77
2028	665.46
2029	676.68

2030	688.54
2031	693.73
2032	703.18
2033	712.62
2034	722.07
2035	731.52
2036	740.96
2037	750.41
2038	759.86
2039	769.31
2040	778.75

3.5.8. (h) Municipal solid waste (MSW) going to landfills

Year	Municipal solid waste (MSW) going to landfills [Gg]
2018	320.76
2019	325.44
2020	329.97
2021	269.86
2022	256.73
2023	243.21
2024	229.21
2025	214.75
2026	213.22
2027	211.63
2028	210.08
2029	208.54
2030	207.02
2031	203.36
2032	200.85
2033	198.19
2034	195.39
2035	192.45
2036	194.93
2037	197.42
2038	199.90
2039	202.39
2040	204.87

3.5.9. (i) Share of CH4 recovery in total CH4 generation from landfills [%]

Biogas recovery is assumed 20% for WEM and 30% for PPM from 2020.

Appendix 1 (Studies from SRSS)

Following a request by Cyprus and since July 2015 the Structural Reform Support Service (SRSS) of the European Commission has been coordinating and providing technical support with implementing reforms and developing institutional and administrative capacity, receiving financial assistance in the context of the EU economic governance framework.

Structural reforms have been identified as crucial to accelerating economic recovery, boosting growth and reducing unemployment.

Based on experience relating to reforms in Cyprus, the programme helped CY authorities, to improve administrative and institutional capacity and to facilitate better implementation of EU law as well as the NECP. All the Technical Assistance projects that were completed towards this direction are listed below.

Technical request	**Grant Agreement or Contractor**
Workshop on Electricity Market set-up by providing advice on the planned market model	FSR
Resident Expert on Energy Issues	Stephan Ressle
Workshop on Energy Self Consumption	SRSS
Conference 'Heating and cooling in the European energy transition'	SRSS
Impact Assessment regarding the implementation of the proposed Final Detailed Electricity Market Design in Cyprus	E3MLAB
Workshop "Supporting investments in Smart Grids in 2014-2020 JASPERS Networking Platform"	SRSS
Workshop "Cost Benefit Analysis of Smart Metering Systems"	SRSS
ClimaMed2015	SRSS
Technical assistance for assessing the current state of the transmission and distribution electricity systems and proposing optimum solutions for increasing the amount of Renewable Energy Sources (RES) generation that can be fed on the electricity system	JRC
MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impacts) tool	KTH
Energy Efficiency in Buildings: Technical Assistance in the framework of the Directive 2 2012/27/EU for the preparation of the long-term strategy for mobilizing investment in renovating Cyprus national building stock and Directive 2010/31/EU for the Promotion of the transition toward Nearly Zero Energy Buildings (NZEB) for improving the energy efficiency and reducing the cost of energy bills in the buildings sector"	JRC
Development of a cogeneration/trigeneration feasibility tool	Ricardo-AEA
"Technical Assistance for energy efficiency and sustainable transport in Cyprus"	GIZ1
Technical assistance in the form of a study for examining the economic feasibility and technical suitability for installing individual consumption meters in multi-apartment and multi-purpose	GIZ1

buildings	
Technical assistance in order to make a comprehensive study for assessing the Cypriot energy efficiency potential and propose a strategy to exploit it	GIZ1
Technical Assistance in order to design an Energy Efficiency Awareness Campaign in the Republic of Cyprus	GIZ1
Support to MECIT Trade and Settlement Electricity Market Rules (‘TSRs’)	RSE
Development of a Heating and Cooling Strategy at Local Level	RICARDO
Preparation of technical specifications regarding the design, supply, installation, commissioning, setting to work and handover of cogeneration units and an appropriate support scheme strategy for cogeneration/trigeneration units	Costas Theofylactos
Development of a code of practice and rules, policies concerning heat network operation	RICARDO
Training for ship fuel sampling (sulphur) inspections	German Ministry of Environment
Technical support in the field of Energy Union: Governance, internal market and infrastructures” Work Package 1 - Governance- Clean Energy for All Europeans-	JRC3
Technical support to improve the penetration of renewable energy sources and energy efficiency in Cyprus. (WP1+ WP2+WP3+WP4) WP1: Support to MECIT Trade and Settlement Electricity Market Rules (‘TSRs’) phase 2	RSE1
WP2: Provide a software tool, in an easily accessible form, that it can be used by accredited consultants, for the optimum design of self-consumption PV systems for enterprises	RSE1
WP3: Determine the actual energy demand to a statistically significant percentage of different types of buildings and processes of the residential, services and industrial sectors in Cyprus.	RSE1
WP4: Development of a localized forecasting tool for the prediction of Variable Renewable Energy output in Cyprus and its integration in the electricity grid.	RSE1
Development of Methodology for calculating the obligatory cumulative end-use energy saving target and comprehensive study on the optimal combination of energy saving measures, under Article 7 of Directive 2012/27/EU [as amended by proposal COM(2016)761]	EAA (Energy Agency Austria)
Impact assessment of planned policies and measures of integrated national energy and climate plans of Cyprus under the regulation proposal for energy union governance (document COM (2016) 759 final)	CUT /CYI

Appendix 2 (Sensitivity Analysis)

Sensitivity Analysis 1: Planned Policies and Measures Scenario without Interconnector development

As illustrated in section 2.2.1, the impact of the EuroAsia interconnector on the electricity supply outlook is substantial. It enables further investments on renewable energy technologies and increases the share of RES-E considerably, turning Cyprus into a net exporter of electricity by 2030. Nonetheless, since the project is not yet developed, there is a degree of risk associated with potential dependence of decarbonisation efforts on a single such project. As such, a sensitivity analysis was conducted, in which the Planned Policy and Measures scenario was assessed in the absence of the interconnector.

The key differences between the two PPM scenario alternatives in the electricity supply sector are shown in Table 5.37. In the absence of an interconnector, an additional CCGT unit is installed in 2024 to supply low-cost electricity and provide flexibility that would otherwise be offered by the interconnector. The lack of electricity trade potential reduces the installed capacity of solar PV drastically, as a difference of nearly 880 MW is observed between the two scenarios in 2030. In turn, the lower deployment of variable renewable energy technologies eliminates the necessity for the development of the 130 MW pumped hydro facility before 2030.

In terms of generation, fossil-fired generation is higher by 270 GWh, while renewable electricity generation is lower by 1,420 GWh in 2030; most of this volume of electricity is destined for electricity exports in the PPM scenario with interconnector development. As a result, the share of renewable electricity generation is restricted to 30% in this scenario, instead of 44%. The increased generation from fossil fuels results in an increase in GHG emissions of 140 kt CO2 eq. in 2030.

Table A1: Installed Capacity difference (MW) between the PPM without interconnector and the PPM with interconnector scenarios.

	2024	2025	2026	2027	2028	2029	2030
New CCGT	216	216	216	216	216	216	216
Solar PV	0	0	0	-280	-557	-707	-876
Pumped Hydro	0	0	0	-130	-130	-130	-130

Lack of interconnector development has milder impacts in the outlook of road transport. Due to the reduced RES-E share, in order to achieve the renewable energy target of 14% in the transport sector, the fleet of battery electric vehicles increases by approximately 3,200 units by 2030. This leads to a small reduction in GHG emissions in this sector, amounting to 15 kt CO2 eq. in 2030.

Finally, in this scenario the renewable energy share in the total final energy demand reaches 22.9% in 2030, falling just short of the relevant 23% target.

Macroeconomic analysis (under way) shows that this sensitivity case will lead to slightly lower positive effects on GDP and employment in comparison to the PPM scenario, due to the reduced investments in power generation if the interconnector is not built.

Sensitivity Analysis 2: Ambitious Scenario

A carbon tax is gradually introduced on all non-ETS sectors. This means that fuels used in residential, tertiary and agricultural sectors as well as in industry except the cement industry will be subject to an additional tax that is proportional to the carbon content of each fuel. The level of the tax has been determined so that it can lead to lower energy consumption and carbon emissions, which will be sufficient to close the gap between non-ETS emission reduction in the PPM scenario (-14% in 2030 compared to 2005) and the binding commitment of Cyprus (-24%).

After a number of iterations it turned out that a carbon tax level of the order of 100 Euros per tonne of CO2 equivalent (at constant prices of year 2015), implemented gradually over the five-year period 2021-2025, can lead to attainment of the necessary reduction of non-ETS GHG emissions by 24% in 2030. In practice, this means that fuel prices will have to increases by 5-6 cents per litre each year of the five-period 2021-2025, so that from 2025 onwards the carbon tax will be around 27 and 32 eurocents per litre for automotive petrol and automotive diesel respectively.

Appendix 3 (Input Assumptions used)

The information relevant to data input and assumptions used in the modelling exercise for each sector are sensitive and are available only upon request from the Energy Service (gpartasides@mcit.gov.cy).

Appendix 4 (Policy and Measures in All Sectors)

Annex related to section 3.2.i.Dimens

Annex xxx_Energy Efficiency PAMs-fina

RES Measures PPMs.xlsx

Internal Energy Market.xlsx

PaMs_All Summury.xlsx

COST OF RES.xlsx

Appendix 5 (Ten Year Development Plan of DSO, TYTNDP)

www.dso.org.cy

Appendix 6 (EU competitive programs related to energy and climate for the period 2014 – 2020)

HORIZON 2020

A/A	Name of the project	Participant	Subject	EU funding
1	Compete4SEC AP (C4S)	Cyprus Energy Agency	Promotes the adaption of standardized energy management systems in local authorities	€ 117887
2	HAPPEN	Cyprus Energy Agency	Boost building energy renovation market, targeting the development of NZEB	€133312
3	ENERFUND	CUT– Department of Environment, Cyprus Energy Cyprus	Tool for evaluating the opportunities in building energy renovation, similarly as banking institutions evaluate potential customers	CUT - €154375 Cyprus Energy Agency - €89406
4	Energy Water	Cyprus Energy Agency	Reduction of energy consumption by 20% in industries that they use water	€87687.50
5	GreenS	Cyprus Energy Agency	Database to facilitate Green Public Procurement in line with the local authorities needs	€93325
6	ZERO-PLUS	Cyprus Institute	A comprehensive, cost-effective system for Net Zero Energy (NZE) settlements will be developed and implemented. A primary objective of the project will be to develop a system whose investment costs will be at least 16% lower than current costs	€177500
7	SUI - Smart Urban Isle	Cyprus Institute	Exploring how energy mini-ecosystems are integrated in the existing urban fabric, having as main objective to move forward with the urban energy savings through a whole new urban planning that allows	€130000

A/A	Name of the project	Participant	Subject	EU funding
			cities to grow in a sustainable way.	
8	SOCLIMPACT	Cyprus Institute	Modelling downscaled Climate Change effects and their economic impacts in European islands and archipelagos for 2030 – 2100 in the context of the EU Blue Economy, and assess corresponding decarbonisation and adaptation pathways, thus complementing current available projections for Europe, and nourishing actual economic models with non-market assessment.	€155798
9	SMART GEMS	Cyprus Institute CUT – Department of Civil Engineers	Fully analyze all aspects of smart grids targeting in the improvement of reliability, mitigation of security risks, increase load shaping and energy efficiency, optimal integration and generation-consumption matching as well as smart monitoring and control.	Cyprus Institute - €153000 CUT - €135000
10	NESTER	Cyprus Institute	Upgrading the scientific and innovation performance of the Cyprus Institute in the field of Solar-Thermal Energy	€424940
11	INSHIP	Cyprus Institute	Focuses on engaging major European research institutes with recognized activities on Solar Heat for Industrial Processes, into an integrated structure	€270215
12	EoCoE	Cyprus Institute	Establish an Energy Oriented Centre of Excellence for computing applications (EoCoE). EoCoE will use the prodigious potential offered by the ever-growing computing infrastructure to foster and accelerate the European	€238000

A/A	Name of the project	Participant	Subject	EU funding
			transition to a reliable and low carbon energy supply.	
13	EMME – CARE	Cyprus Institute	Provides scientific, technological and policy solutions through the establishment of a world-class Research and Innovation Centre of Excellence, focusing on environmental challenges.	€160000
14	CySTEM	Cyprus Institute	Consolidating and upgrading the already substantial activity at the Cyprus Institute in Solar Energy, principally solar-thermal and related activities. This will be accomplished by attracting and installing a cluster of outstanding researchers, led by a professor of international stature to maximally utilize and upgrade the existing facilities, and pursue a program of excellence in Cyprus with local and regional focus in the region of Eastern Mediterranean and Middle East.	€3499375 (including €2.5 Million from the EC)
15	FLEXITRANSTORE	University of Cyprus – FOSS, KOIOS	Aims to contribute to the evolution towards a pan-European transmission network with high flexibility and high interconnection levels. This will facilitate the transformation of the current energy production mix by hosting an increasing share of renewable energy sources. Novel smart grid technologies, control and storage methods and new market approaches will be developed, installed, demonstrated and tested introducing flexibility to	

A/A	Name of the project	Participant	Subject	EU funding
			the European power system.	
16	TwinPV	University of Cyprus – FOSS	Stimulating scientific excellence through twinning in the quest for sustainable energy. The concept underpinning the project foresees the strengthening of a research field in an academic institution of a low performer country through linking effectively with internationally-leading research partners in the specific field.	
17	GOFLEX	University of Cyprus – FOSS	The main objective of GOFLEX is to make a set of technology solutions for distributed flexibilities and automated dynamic pricing market ready which enables regional actors like Generators, Prosumers, Flexible Consumers and Demand Side Operators, Energy Suppliers, Microgrid Operators and Energy Communities to aggregate and trade flexibilities.	
18	inteGRIDy	University of Cyprus – FOSS	Aims to integrate cutting-edge technologies, solutions and mechanisms in a framework of replicable tools to connect existing energy networks with diverse stakeholders, facilitating optimal and dynamic operation of the Distribution Grid, fostering the stability and coordination of distributed energy resources and enabling collaborative storage schemes within an increasing share of renewables.	
19	BestRES	University of Cyprus – FOSS	Aims to develop innovative business models for	

A/A	Name of the project	Participant	Subject	EU funding
			integration of renewable energy sources by aggregating distributed generation such as wind, PV, biogas, biomass, hydro, Combined Heat and Power (CHP) and combining this with demand side management and energy storage.	
20	HYBUILD	University of Cyprus – FOSS	Aims at developing cost-effective and environmental-friendly solutions, while ensuring comfort conditions in residential buildings located in two different climates: Mediterranean climate where cooling is critical; and Continental climate where a stronger focus is put on heating demand.	
21	INTERPLAN	University of Cyprus – FOSS	Aims to provide an integrated operation planning tool towards the pan-European network, to support the EU in reaching the expected low-carbon targets, while maintaining network security.	
22	DELTA	University of Cyprus – FOSS EAC	DELTA proposes a Demand-Response (DR) management platform that distributes parts of the Aggregator's intelligence into a novel architecture based on Virtual Power Plant (VPP) principles. It will establish a more easily manageable and computationally efficient DR solution and will deliver scalability and adaptiveness into the Aggregator's DR toolkits.	
23	ESPResSo	University of Cyprus – FOSS	Targets alternative cost-effective materials, novel cell concepts and	

A/A	Name of the project	Participant	Subject	EU funding
			architectures, and advanced processing know-how and equipment to overcome the current limitations of this technology.	
24	Domognostics	University of Cyprus – KOIOS	Aims at reducing energy losses in buildings using intelligent building automation diagnostics.	
25	ODYSSEE-MURE	CUT – Department of Environment	The general objective of the project is to provide a comprehensive monitoring of energy consumption and efficiency trends as well as an evaluation of energy efficiency policy measures by sector for EU countries and Norway	€31355
26	ItHERM	CUT – Department of Electrical Engineering	Investigate, design, build and demonstrate innovative plug and play waste heat recovery solutions to facilitate optimum utilization of energy In selected applications with high replicability and energy recovery potential in the temperature range of 70°C – 1000°C.	€145525
27	Sol-Pro	CUT – Department of Mechanical Engineering	Lifetime, cost, flexibility and non-toxicity have to be equally considered, regarding the technological progress of solution processed PVs. The ambit of the Sol-Pro research programme is to re-design solution processed PV components relevant to the above product development targets	€1840940

INTERREG MED 2014-2020

A/A	Project name	Participant	Subject	EU funding
1	LOCAL4GREEN	Cyprus Energy Agency	Implementation of new policies specifically green	€162813

			tax by local authorities to finance and promote RES in their territory.	
2	TEESCHOOLS	Cyprus Energy Agency	New solutions in local authorities, in technical and financial terms, in order to implement measures of renovating schools of the Mediterranean to NZEB.	€270000
3	PRISMI	Cyprus Energy Agency	Development of a comprehensive tool box for evaluating and mapping RES and their penetration in island electricity grids.	€74870
4	ENERJ	Cyprus Energy Agency	Supports local authorities in the implementation of energy efficiency measure in public buildings, as part of their local energy and climate plans.	€205340
5	Pegasus	University of Cyprus – FOSS	Aims to promote the development of microgrids in cities, islands and remote areas.	
6	STORES	University of Cyprus – FOSS	Boost PV self-consumption on the Mediterranean through an optimal storage solution.	€600000

INTERREG EUROPE 2014-2020

A/A	Project name	Participant	Subject	EU funding
1	VIOLET	Cyprus Energy Agency	Promotion and development of policies the will upgrade the energy performance of historical and traditional buildings with respect to their heritage value	€158805
2	Resor	Cyprus Energy Agency	The aim of the project is to support energy efficiency and renewable energy use in businesses of the secondary and tertiary sector of the partner regions by improving current regional policies. The project	€143536

			activities will envisage an interregional learning process involving staff from public authorities and representatives of relevant stakeholder groups. This learning process will result in the identification of best practices for the improvement of regional policy instruments supporting energy efficiency and RES use and in the draft of Action Plans to be implemented in each partner region.	

INTERREG Balkan Med 2014-2020

A/A	Project name	Participant	Subject	EU funding
1	ZenH Balkan	Cyprus Institute	Facilitate the implementation of the EPBD by defining the characteristics and Standards for Zero Energy Hospitals in the South Balkan region.	€180000
3	PV-ESTIA	University of Cyprus – FOSS	Enhancing Storage integration in buildings with Photovoltaics	
4	SMecoMP	CUT – Department of Environment	A knowledge Alliance in Eco-Innovation Entrepreneurship to Boost SMEs Competitiveness	€110000
5	PRO ENERGY	Cyprus Energy Agency	Aims to address energy efficiency of buildings by developing and implementing a Joint Strategy and Action Plan, increasing competences of buildings' owners and operators, developing& applying technologies and tools to reduce energy consumption in public buildings, promoting	€102000

			generated good practices and results to local/regional/national entities in the Balkan-Med region. The project addresses the policy and institutional level (Joint Strategy& Action Plan), human resources level (Capacity Building of Energy Managers) and the managerial systems to reduce energy consumption, as literature & practice suggests.	

INTERREG Greece - Cyprus 2014-2020

A/A	Project name	Participant	Subject	EU funding
1	ERMIS-F	Cyprus Institute	Intends to create a model of an Integrated Public Service, a Digital System and an Online Information Platform regarding floods and other natural and environmental risks	€380000
2	STEP2SMART	University of Cyprus – Department of Civil Engineering	Development of a prototype system for an open source system of urban transport management and their environmental impact	
3	ΕΝΕΔΗ	University of Cyprus – ΕΠΛ	Installation of PV for providing electricity in data centers and the development of smart management system based on consumption.	

Appendix 7 (Summary of key topics covered in interviews with stakeholders)

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
Agricultural Research Institute	1. Protection of land that is in good agricultural condition 2. Green points/ waste management and the circular economy concept 3. Use of compost for improving soil, as soil in Cyprus is in poor condition 4. Promotion of rural clusters 5. Extreme Weather Events 6. Climate change and Agriculture 7. Energy Communities 8. Energy Efficiency in Agriculture 9. Water Infrastructure and distribution	1. There is a need to protect of land that is in good agricultural condition, as it is a source of carbon sequestration, as well ensuring local food supply. Same applies for green zones/areas adjacent to protected areas, which can be vulnerable to changes in new planning zones in order to satisfy the construction boom 2. Green Points are not properly designed and structured so that the citizens may easily deposit special materials which include wood, timber, leaves, and pruning. 3. Compost has many benefits in agriculture, including managing of pests such as nematodes, protection against soil erosion, increase of soil organic matter, which further increases crop yields (citrus + wheat). These have benefits in that the use of compost can lead to a reduction in the use of fertilisers and pesticides. 4. Need to promote the production of compost; at least 30% of waste in Cyprus is organic and suitable for conversion into compost. This will have dual benefits: better waste management in Cyprus and improvement in agriculture. 5. Research at ARI (Adapt2Clima) has identified that certain agriculture areas are vulnerable to climate change. In addition, extreme weather events (EWE)	- Studies which identify and record all land that is in good agricultural condition across Cyprus, and then further identify best practices and measures for their protection. Include issues of carbon sequestration. - Better/strict governance measures to protect green areas and protected areas with protected species. - Three streams of green waste deposits can be utilised as useful products to produce revenue as follows: wood - thick prunes- for energy, leaves for compost, and thin small prunes for ground cover –circular economy - Incentives for agricultural industries to move to circular economy – (waste treatment plants anaerobic digesters for biomass utilization to produce energy, compost or other useful products that can lead to revenue increase). - Specialised research in compost, in order to improve its quality for the different crops. Also scope for CY to develop a specialised lab for the standardisation of the quality of compost. - Further specialised studies using climate models which determine the impacts of climate change on agriculture in order to develop new agricultural zones/ Demarcation

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
	10. Cypriot products – food origin provisions	can have negative impacts on agriculture. 6. RES could be applied for greenhouse gases. However, the current framework forces farmers to install PVs on good land adjacent to their greenhouse and does not allow farmers to form cooperatives and install joint PVs on one piece of land. As a result, farmers do not want to install RES as it consumes valuable agricultural land. There is a role of energy communities here. 7. Energy efficiency in greenhouses. The aim of greenhouses is a form of climate control system, they control and regulate temperature, water, soil and pests. There is scope for improvement in their energy efficiency, and for them to become smart and for greenhouses to become small Internet of Things. 8. Over the past few years, there has been a lack of funding for setting up labs for research in these matters, and there is an urgent need for funding for specialised labs, researchers and equipment. 9. There is a huge problem with the water distribution; water network- needs upgrading and expansion. Water scarcity is a significant problem and in coastal areas there is saltwater intrusion into groundwater resulting in a lack of water availability to farmers. 10. Mandatory origin provisions for labelling. For instance, meat produced in Cyprus can only be considered as a Cypriot product if the animal is fed by ingredients/products that are of 50 % Cypriot origin exclusively, i.e. *alfalfa* fed to livestock - should be at	of agricultural zones to specific cultures, which will be restructured with new crops/plants that are suitable under climate change. - Use modelling/spatial resolutions for areas suffering water scarcity or water shortage for emergency responses - Research into smart greenhouses, sensors, automation and the use of IoT. - Research into the heating and cooling systems of livestock, to increase their efficiency. - Research into the use of shallow geothermal in greenhouses and livestock. - Funding for specialised labs and researchers. - Development of rural clusters, which combine agriculture, processing, agritourism etc. with the necessary infrastructure. - Imperative research into climate change adaptation and extreme weather events, particularly with respect to floods, and in how this water can be exploited and repurposed for aquifer recharge and irrigation (e.g. proper management of storm water/collection to be use in recharge) - Advances in wastewater treatment so there is more water available for irrigation - More technical training /diplomas Post-Secondary Vocational Education and Training is needed, - Research and innovation on green roof/green

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
		least 50% of Cypriot origin/cultivation - REGULATION (EU) No 1169/2011	walls – wetlands. Tackle microclimate changes due to heat storms, purify air-better air quality, carbon sinks.
Union of Cyprus Municipalities	1. Powers and duties of local authorities 2. Technical know-how 3. Extreme weather events	1. Local authorities and duties related to energy, environment and climate are limited. 2. Currently, local authorities do not have the technical know-how or appropriate resources for actions in energy, environment and climate. 3. In addition, there is no funding for local authorities to allow them to take action in these fields. Recommend that central government gives low interest loans to local authorities so that they can undertake investments and projects related to energy, environment and climate. 4. The concept of energy communities is in conflict with the Municipal Law. 5. A main issue faced by local authorities is flooding, flash flooding and stormwater management. 6. Recommend that more local authorities and municipalities become signatories of the Covenant of Mayors and develop their own Sustainable Energy (and Climate) Action Plans, which can then be implemented.	- Learning and exchange of best practices with other local authorities, particularly with respect to transport - Studies on local authorities, and the appropriate legal and regulatory framework and powers that will allow them to take action on energy, environment and climate. - Adaptation to climate change and extreme weather events, particularly flooding.
Cyprus Energy Regulatory Authority	1. Renewable Energy Sources 2. Storage 3. Energy Communities 4. Clean energy	1. CERA has an interest in renewable gases including hydrogen and biomethane, as it is part of the RES Directive (EU) 2018/2001 2. Waste to energy- there is significant scope in Cyprus. Could examine the potential for large centralised waste-to energy units, to minimise any concerns	- Demand response services and flexibility services, particularly tied to prosumers and electromobility - Electromobility and storage and how electric vehicles and contribute to grid stability - Technical study related to the internal

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
	Package 5. Biomass and energy	related to land use. 3. Storage can help in further RES penetration 4. The internal market for electricity Directive 2019/955 needs to be transposed into national legislation, in order to enable Energy Communities	electricity market - Risk Assessment study: in the case there is no interconnection, how can Cyprus meet its RES targets. - Not a lot of national research –funds for clean energy packages - Research in biomass and energy - Tailor-made calls for research that are applicable to Cyprus specific problems
Water Development Department	1. Desalination 2. Research 3. Water Management	1. Policy of WDD is the de-linking of potable water and weather conditions (e.g. precipitation). They aim to fully supply (100%) all potable water demand. In order to achieve this, they rely on desalination and water recycling. In addition, their goal is to have **redundancy** in the water supply network, which means that the networks of the Government Water Works have two supplies of water: the reservoirs and desalination. Thus, CY will only increasingly rely on desalination. 2. The Wastewater Treatment Plants (WTTPs) currently do not cover water needs, as they are not operating at full capacity (only 22 million m3 are currently being produced while the capacity of 65 million m3). Once the WTTPs are operating at full capacity, they expect that they will be able to cover 40% of irrigation needs, which are currently never met by the GWW. 3. Currently the desalination plants operating in Cyprus are of very high efficiency, with no real scope for improvement. In addition, they rely heavily on Israel	1. Water Management including smart monitoring of networks and leakage control. 2. Demand management from all sectors of the economy. 3. Smart metering –optimization plans 4. Low cost waste water treatment techniques that demand less land 5. Research into using waste water to its maximum potential 6. Smart agriculture – hydroponics 7. Incentives/ R&I and demos for water use industries and waste water producers – related to the circular economy so they can increase their revenues

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
		to develop the desalination technology, which the WDD then buys. 4. However, the EAC in collaboration with the WDD, announced an innovation challenge whereby they invited expressions of interest (EoIs) for new desalination technologies (not based on Reverse Osmosis). There were 11 EoIs and 8 proposals. The main issue with the proposals submitted is that the solutions proposed so far have high land requirements. 5. Desalination and RES. RES such as PVs are more suitable for standalone desalination plants, and are less suitable for Cyprus's desalination plants. 6. They are exploring new ways of using RES. In Asprokremmos they plan to test and pilot floating solar panels. Expected benefits include the need for using less land and also minimisation of evapotranspiration. The project will also monitor for any potential drawbacks related to the ecosystem and water quality of the reservoir. Need a Power Purchase Agreement, before this can be fully deployed. 7. In the Moni Dam they have been testing a floating membrane with the aim of minimising evapotranspiration. To date they have been pleased with it: it has minimised evapotranspiration, and it has also reduced the need for use of chemicals to treat algae. They have also added PVs onto the membrane, but these need to be connected. 8. Pumped hydro is currently not a feasible option, due	

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
		to the requirements for a certain level of water in the dams, which cannot be achieved with the weather conditions of Cyprus. They have carried out several studies and at the moment the technology and requirements do not make it feasible. The WDD have also explored pumped hydro using wastewater reservoirs, but the energy required makes it untenable. 9. Water leakages are a significant issue, some networks may have up to 40% leakages. Due to the commitment of WDD to meet all water demand, this means that they must use the desalination units to supply more water to make up for this water that is lost. If water leakages and water demand in general were better managed, then there would be less water supplied and therefore less use for the desalination plants, bringing down the energy use of the water sector.	
Transmission System Operator	1. Further penetration of RES 2. Storage	1. The challenge to meet the RES targets in the NECP is significant. In an in-house study that the TSO conducted, they found that without storage, grid interconnection and the ability to shut down RES installations, the maximum amount of RES penetration can be 22% by 2030. 2. If the TSO is allowed to shut down RES installations when their supply is greater than the consumption, then this would create unfavourable economic conditions for RES companies and investors. Investment in RES is a lot of money, and if the TSO is	- Storage (although doubtful that Cyprus researchers can have much of an impact, as major companies in the battery field have not managed a breakthrough yet). - Forecasting for RES (although so far this has not been successful)

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
		forced to shut them down when there is not enough demand, then the investors will not recoup their investment. This creates an unfavourable investment environment. The only way for the investor to have high IRR buying price should be increased. 3. Storage could be an option, but it is currently very expensive. If the costs fall, then storage could help. 4. Forecasting has been put forward us a way to integrate RES into grids, however to date it has not been successful. The forecasts have rarely been accurate and EAC has just terminated its contract with its current provider, and has gone to tender for a new forecaster provider. 5. Energy communities would help the consumer, particularly in terms of the costs of electricity, and are a positive development. **However**, they will not have a role in increasing further penetration of RES. 6. The capacity factor of the CY grid is 17%	
Deputy Ministry of Tourism	1. Existing Hotels and their consumption 2. Forms of Tourism 3. Horizontal matters such as transport	1. There is scope for existing hotels to reduce their energy and water consumption, as well as to manage their waste. The Cyprus Hotel Association has conducted a study related to water savings and the development of a jointly owned water treatment plant (however this has not progressed further). 2. Hotels have expressed interest in installing PVs, but in many cases they have been constrained by a lack of available space. 3. There is a need for developing new forms of tourism that are even friendlier to the environment. The	- New forms of tourism - Incentives for agro tourism and new forms of tourism – Also Incentives- disincentives – for instance sea sports spots to pivot to canoes (incentives) and decrease jet ski use (disincentives) - Attract tourists in low seasons - Hotel energy management, including smart energy management - Retrofit /energy/resource management solution on existing touristic infrastructures

Organisation	Key Topics Discussed	Issues Identified	R&I Areas Identified
		Deputy Ministry has a goal to develop alternative forms of tourism, (such as sport, walking, cycling and religious tourism) with the aim of increasing the number of visitors to Cyprus and also reducing the seasonality of tourism. If this is successful, then the number of tourists will increase (tourist arrivals for 2019 will be 4 million) with a significant impact on energy and water use. 4. There is also a plan to further develop tourism in the Troodos area, which needs to be managed carefully. There is a need for developing new forms of agritourism that are radical and innovative, that CY can export to other countries. 5. Need to consider transport, and the fact that most tourists use vehicles, including motorbikes (2000) and cars, to get around which add to the emissions of the local transport sector.	- For future touristic infrastructures –research into softer developments that are more environmental friendly.

Results from the interactive and facilitated workshop

The workshop utilised the Climate KIC Challenge -Led Approach, a participatory approach which brings 'analysts' and 'actors' together to co-produce a shared 'map' of a certain challenge, in this case the challenge of achieving the NECP targets. The interactive workshop allowed the curation of the knowledge of the participants and identify gaps and opportunities related to Research and Innovation across the NECP dimensions.

Topic	Themes	Challenges		
		Social	Technical	Resource Gap
Energy	1. Energy Transition 2. Clean Power Generation 3. Renewable Energy Penetration	• Lack of Public Awareness, need to educate the general public regarding energy generation and associated benefits of Distributed Energy Sources • Lack of Public Acceptance • Energy Poverty • Opportunities for green jobs • Cooperation at a local level and formation of energy communities	• Grid stability for energy injected from distributed energy • Adequate capacity of grid to satisfy the demand in case of failure or peak loads • Control of microgrid • Energy losses from energy transfer • Lack of storage and currently storage solutions too expensive • Lack of Smart Grids • Inflexible grid • Lack of Available area for technologies at an urban level	• High initial investment cost of renewable energy sources (RES) • Lack of available framework • Lack of Policies for promotion and incentives to develop distributed generation • Researchers with local know-how • Researchers critical mass • Available earmarked funding • Regulatory framework is not enabling
Transportation	1. Goods Transportation 2. Sustainable Mobility 3. Green Public	• There is an increase in the conventional logistics fleet (couriers/distributers/delivery) and a concomitant increase in fuel use	• Structure of Roads • Urban Planning • Production of Biomethane in a cost-effective manner • Distribution of Biomethane	• Negligible share of renewables within local transport sector • Policy Framework • Funding Pillars for sustainable mobility

Topic	Themes	Challenges		
		Social	Technical	Resource Gap
	Transportation 4. Renewable Energy in Transport	- Heavy traffic - Car-dependent societies leading to congestion, accidents, pollution, low exercise - Society is used to driving to satisfy all mobility needs - Social behaviour and low willingness to use public transport. Although there are public transportation options people still choose to use their own cars causing traffic, high emissions, more costs etc. - Car as a social status symbol - Bad perception of buses - Raising awareness in the use of renewable fuel	to end-user - Utilising bio-methane in existing vehicles energy efficiently - Lack of infrastructure	- No local production of alternative transport - lack of space-small country
Buildings	1. Thermal Comfort 2. Hotel energy use	- Old building stock - Lack of information about the benefits of new materials - Lack of awareness on the available technology - Hotel users do not care about energy use - Mentality and priorities of hotel owners - Interruption to hotel function in order to renovate hotels and	- Hotels are energy intensive with high energy consumption - Technical Restrictions due to age of hotels - Few field studies which evaluate models related to energy efficiency upgrades - Impact of old-fashioned building materials - Limited availability of	- Regulations - Lack of appropriately trained workforce for renovation - Financial costs of renovating buildings - Outdated building guidelines and codes - Lack of experience and expertise of engineers in energy efficiency and renovations

Topic	Themes	Challenges		
		Social	Technical	Resource Gap
		increase their energy efficiency - Seasonality of hotel industry	building materials with low absorbivity and emissivity	

Appendix 8 (RES Fund Budget for 2020-2022)

ΠΡΟΫΠΟΛΟΓΙΖΟΜΕΝΟ ΥΠΟΛΟΙΠΟ
ΤΑΜΕΙΟΥ ΑΝΑΝΕΩΣΙΜΩΝ ΠΗΓΩΝ ΕΝΕΡΓΕΙΑΣ ΚΑΙ ΕΞΟΙΚΟΝΟΜΗΣΗΣ ΕΝΕΡΓΕΙΑΣ
ΚΑΤΑ ΤΗΝ 31 ΔΕΚΕΜΒΡΙΟΥ 2020

Προϋπολογιζόμενες Δαπάνες για το έτος 2020	€ 40,388,009.46	Εκτίμηση Υπόλοιπου Ταμείου κατά την 31 Δεκεμβρίου 2019	€ 34,962,166.71
Προϋπολογιζόμενο υπόλοιπο Ταμείου κατά την 31 Δεκεμβρίου 2020	€ 4,838,998.25	Προϋπολογιζόμενα Έσοδα για το Έτος 2020	€ 10,264,841.00
ΣΥΝΟΛΟ	**€ 45,227,007.71**	**ΣΥΝΟΛΟ**	**€ 45,227,007.71**

ΔΕΛΤΙΟ ΕΣΟΔΩΝ

			2020	2019-2020	**2021**	**2022**
	Περιγραφή Εσόδων	ΚΑΤ	Προτεινόμενος Προϋπολογισμός	Αύξηση + Μείωση -	Μεσοπρ. Δημοσιον. Πλαίσιο	Μεσοπρ. Δημοσιον. Πλαίσιο
			€	€	€	€
50.75	**ΕΞΟΙΚΟΝΟΜΗΣΗ ΕΝΕΡΓΕΙΑΣ ΚΑΙ ΕΝΘΑΡΡΥΝΣΗ ΤΗΣ ΧΡΗΣΗΣ ΤΩΝ ΑΝΑΝΕΩΣΙΜΩΝ ΠΗΓΩΝ ΕΝΕΡΓΕΙΑΣ**		**20,387,514**	-28,898,443	**40,695,552**	**48,016,131**
507500	**Κεντρικά Γραφεία**		**20,387,494**	-24,098,443	**40,695,532**	**48,016,111**
1100	**Έμμεσοι Φόροι**		20,387,484	-24,098,443	40,695,522	48,016,101
1200	**Άλλοι Έμμεσοι Φόροι**		**20,387,484**	-24,098,443	**40,695,522**	**48,016,101**
1258	Τέλος Ανανεώσιμων Πηγών Ενέργειας	9	19,587,317	-24,120,601	39,895,522	47,216,101
1278	Αντισταθμιστικά Οφέλη	9	800,167	22,158	800,000	800,000
1520	**Άλλοι πρόσοδοι**		**10**	0	**10**	**10**
1525	Άλλα ωφελήματα από επενδύσεις	9	10	0	10	10
1650	**Έσοδα μη Άλλως Κατατάξιμα**		**10**	0	**10**	**10**
1689	Άλλα Έσοδα	9	10	0	10	10
1750	**Χορηγίες**		**0**	-4,800,000	**0**	**0**
1850	**Άλλες Χορηγίες**		0	-4,800,000	0	0
1870	Κυβερνητική Χορηγία στα Ειδικά Ταμεία	9	0	-4,800,000	0	0
10001	**Αποπληρωμή Εκδοθέντων Δανείων**		**10**	0	**10**	**10**
10163	Άλλα Δάνεια	9	10	0	10	10
	Αποθεματικό από προηγούμενο έτος		34,962,167	-	4,931,661	4,047,816
	Αποθεματικό από προηγούμενο έτος + Συνολικά Έσοδα		**55,349,680**		**45,627,213**	**52,063,948**
	Εκτίμηση αποθεματικού τέλος του έτους		4,931,661		4,047,816	4,632,974
			50,418,019		**41,579,396**	**47,430,973**

ΠΡΟΫΠΟΛΟΓΙΣΜΟΣ ΔΑΠΑΝΩΝ

			2020	2019-2020	**2021**	**2022**
	Περιγραφή Δαπανών	ΚΑΤ	Προτεινόμενος Προϋπολογισμός	Αύξηση + Μείωση -	Μεσοπρ. Δημοσιον. Πλαίσιο	Μεσοπρ. Δημοσιον. Πλαίσιο
			€	€	€	€
50.75	**ΕΞΟΙΚΟΝΟΜΗΣΗ ΕΝΕΡΓΕΙΑΣ ΚΑΙ ΕΝΘΑΡΡΥΝΣΗ ΤΗΣ ΧΡΗΣΗΣ ΤΩΝ ΑΝΑΝΕΩΣΙΜΩΝ ΠΗΓΩΝ ΕΝΕΡΓΕΙΑΣ**		**50,418,019**	-14,851,667	**41,579,396**	**47,430,973**
507500	Κεντρικά Γραφεία		50,418,009	-14,851,677	41,579,396	47,430,973
2100	**Κρατικοί Υπάλληλοι**		**30,000**	0	**30,000**	**30,000**
2260	**Επιδόματα Υπερωριακής Απασχόλησης**		30,000	0	30,000	30,000
2261	Υπερωριακή Αμοιβή	1	30,000	0	30,000	30,000
3000	**Λειτουργικές Δαπάνες**		**14,010**	0	**14,010**	**14,010**
3020	**Λειτουργικά Έξοδα Γραφείου**		10,010	0	10,010	10,010
3022	Τηλεφωνικά Τέλη	1	10	0	10	10
3029	Διαφημίσεις, Δημοσιεύσεις, Δημοσιότητα	1	5,000	0	5,000	5,000
3049	Διάφορα	1	5,000	0	5,000	5,000
3150	**Αγορά Αναλώσιμων Γραφείου**		4,000	0	4,000	4,000
3151	Φωτοτυπικά Υλικά	1	2,000	0	2,000	2,000
3155	Γραφική ύλη και εκτυπωτικά	1	2,000	0	2,000	2,000
3500	**Εκπαίδευση προσωπικού / Συνέδρια, Σεμινάρια, και άλλα γεγονότα**		**7,010**	0	**7,010**	**7,010**
3502	Ντόπια Εκπαίδευση	1	10	0	10	10
3520	**Συνέδρια, Σεμινάρια και άλλα γεγονότα**		7,000	0	7,000	7,000
3521	Συνέδρια, Σεμινάρια και άλλα γεγονότα στην Κύπρο	1	2,000	0	2,000	2,000
3531	Συνέδρια, Σεμινάρια και άλλα γεγονότα στο Εξωτερικό	1	5,000	0	5,000	5,000
3550	**Συμβουλευτικές Υπηρεσίες / Έρευνες**		**200,213**	10,000	**200,213**	**200,213**
3556	Μελέτες και έρευνες	1	2,000	0	2,000	2,000
3565	Ελεκτικά Δικαιώματα		3,213	3,213	3,213	3,213
3580	**Σύμβαση Υπηρεσιών**		195,000	6,787	195,000	195,000
3581	Αντιμισθία	1	140,000	10,000	140,000	140,000
3583	Αγορά Υπηρεσιών	1	55,000	-3,213	55,000	55,000
3650	**Εκδόσεις και Δημοσιότητα**		**35,000**	0	**35,000**	**35,000**
3651	**Εκδόσεις βιβλίων και εντύπων**		5,000	0	5,000	5,000
3667	Εκδόσεις βιβλίων και εντύπων	1	5,000	0	5,000	5,000
3730	**Συμμετοχή σε εκθέσεις**		30,000	0	30,000	30,000
3734	Συμμετοχή σε εκθέσεις ή/ και Άλλες εκδηλώσεις	1	30,000	0	30,000	30,000
3936	**Αντισταθμιστικά Οφέλη**		**800,167**	22,158	**800,000**	**800,000**
4189	**Διακρατικές και Διεθνείς Συμφωνίες**		**10**	10	**0**	**0**
4193	Αμοιβ Συνδρ Εισπρ Απαιτήσεων	1	10	10	0	0
4200	**Επιχορηγήσεις**		**49,316,609**	-9,594,158	**40,478,163**	**46,329,740**
4230	**Βιομηχανικά Προϊόντα**		49,316,609	-9,594,158	40,478,163	46,329,740
4250	Προώθηση και Ενθάρρυνση Χρήσης ΑΠΕ και ΕΞΕ	1	49,316,609	-9,594,158	40,478,163	46,329,740
7650	**Αγορά Εξοπλισμού**		**15,000**	0	**15,000**	**15,000**
7652	Αγορά Μηχανογραφικού Εξοπλισμού	1	10,000	0	10,000	10,000
7654	Αγορά Εξοπλισμού Γραφείων	1	5,000	0	5,000	5,000
10111	Άλλα Δάνεια	1	0	-5,289,677	0	0