Cyprus'

Draft Integrated National Energy and Climate Plan for the period 2021-2030

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Preface

This document is the **Draft Integrated National Energy and Climate Plan** (DINECP) 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.

The DINECP v.1.1 does not contain the necessary information on consultations (section 1.3) and the impact assessment (chapter 5).

Abbreviations

BaU	Business as Usual
CO2	Carbon dioxide
CERA	Cyprus Energy Regulatory Authority
CBA	Cost Benefit Analysis
CBCA	Cross Border Cost Allocation
CEF	Connecting Europe Facility
CHC	Cyprus Hydrocarbons Company
CYGAS	Natural Gas Public Company (DEFA in Greek)
DEFA	Natural Gas Public Company
DINECP	Draft Integrated National Energy and Climate Plan
DoE	Department of Environment
DSO	Distribution System Operator (Electricity Authority of Cyprus)
EAC	Electricity Authority of Cyprus
EIA	Environmental Impact Assessment
ESR	Effort Sharing Regulation - Regulation (EU) 2018/842 of the European Parliament and of the council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013
FEED	Front End Engineering Design
FiT	Feed-in-Tariff
FSRU	Floating Storage and Regasification Unit
ETYFA	Natural Gas Infrastructure Company of Cyprus
GHG	Greenhouse gas emissions
IFEU	The Institut für Energie- und Umweltforschung Heidelberg GmbH in Germany
INDC	Intended Nationally Determined Contributions
INECP	Integrated National Energy and Climate Plan
IPP	Independent power producers
LNG	Liquefied Natural Gas

LULUCF Land Use, Land Use Change and Forestry

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

MARDE Ministry of Agriculture, Rural Development and Environment

MECI Ministry of Energy, Commerce and Industry

MC Ministerial Committee

MTCW Ministry of Transport, Communications and Works

MoU Memorandum of Understanding

MOF Ministry of Finance

NCA National Competent Authority, responsible for PCIs in the Republic of Cyprus (MECI)

OSS One Stop Shop 4 Energy PCIs (MECI), in the Republic of Cyprus

PAMs Policies and Measures as described by the Governance Regulation

PCI Project of Common Interest according to EU Regulation 347/2013/EC

RES Renewable Energy Sources

TDRs Transmission and Distribution Rules

TSOC Transmission System Operator Cyprus

TSRs Trade and Settlement Rules

WAM With Additional Measures

WEM With Existing Measures

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General framework

SECTION A: NATIONAL PLAN

1. Overview and process for establishing the plan

1.1. Executive Summary

This document is the **Draft Integrated National Energy and Climate Plan** (DINECP) for the period 2021-2030 submitted to the European Commission in accordance to the Governance Regulation. It presents the current policy situation in the fields of climate and energy, in addition to several policies that have been developed, are currently under development or are considered for the future. The achievement of the national GHG reduction target requires considerable effort and investments, especially in the field of transport.

1.2. Overview of current policy situation

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

The island also saw the biggest increase in energy demand among the EU28, growing 41% since 1990 from 1.6 million tonnes of oil equivalent (Mtoe) to 2.3 Mtoe in 2015. However, Cyprus is determined to find a cleaner solution until it can exploit its own reserves.

The 13% Renewable Energy Sources (RES) goal for 2020 is set to be generated by wind farms, photovoltaic (PV) systems, solar thermal plants and biomass and biogas utilisation plants. Latest data show that RES accounted for 8.4% of electricity production in 2016. RES power production rose 6% in 2016, compared to 2015, mainly on increased output generated by private photovoltaic systems. Wind farms generated almost 55% of electricity from RES in 2016, while the private-owned photovoltaic systems generation rose by approximately 15% from 2015 to 2016. This trend is increasing and it is expected that till 2020 the increase of PV installations that will participate to the competitive electricity market will meet or even exceed the target of 2020 which is 288MW for PV Plants.

In Cyprus, electricity from renewable sources is no more promoted through subsidy since 2013 where a net metering scheme and self-consumption has been put in place. In addition two new schemes were recently announced for RES: (1) net-billing scheme for PVs and Biomass (CHP) plants and (2) RES plants that will participate in the competitive electricity market.

Access of electricity from renewable energy sources to the grid shall be granted according to the principle of non-discrimination. With regard to the use of the grid renewable energy shall be given priority. Grid development is a matter of central planning (Transmission Grid Development Plan 2007-2016 by the Cypriot TSO). In addition, renewable heating and cooling (RES H&C) is promoted by support schemes offering subsidies to households and through obligatory measures to the new buildings.

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

unforeseen production of RES systems (Wind and PVs), and a lack of centralised storage framework.

To tackle these problems the country is exploring ways to introduce smart grids in the national network and is on the look-out for projects that could facilitate energy storage. In addition various forecasting tools have been exploited from Transmission and Distribution System operator in order to limit the reserves needed due to unpredictability of RES Technologies. Furthermore, the EuroAsia Interconnector, which is under study, could bring more solutions in its wake.

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

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

The Cyprus Energy Regulatory Authority (CERA) has worked towards the full opening up of the energy market and granting consumers the right to choose their own supplier – with expectations of a full liberalisation by in 2020-2021. CERA's proposition is a 'net pool' model, where the operations of the state power company, EAC, are unbundled and the production and supply operations separated. EAC production would then enter into bilateral agreements with suppliers for the sale of energy at regulated prices. However, these plans have experienced some resistance from unions, as they are seen as moves which could put pressure to privatise the state power company.

«In respect to the supply of natural gas to Cyprus, the Council of Ministers, at its meeting in June 2016, decided to approve the import of Liquefied Natural Gas (LNG) to Cyprus in a manner leading to the commencement of natural gas supply preferably by the end of the year 2020. On the basis of the results of various studies that were made, the Council of Ministers, at its meeting on May 18th 2017, DEFA issued an invitation for tenders regarding the long-term supply of LNG to Cyprus to satisfy electricity requirements and an invitation for tenders for the construction and operation of the necessary infrastructure. The anticipated time plan for the implementation of the tenders is expected to be finalized in 2019.

The electrical interconnection with Israel and Greece will be the next major challenge in the country energy sector. Cyprus is promoting the «EuroAsia Interconnector» project as aiming at commissioning in 2022-2023. The project will effectively contribute to the security of energy supply and reduction in CO_2 emissions by allowing the countries in the region renewable energy sources for electricity generation.

Energy use is the largest source of GHG emissions. The following sections provide a high-level overview of the most relevant factors. Climate policy drivers have had some impact on changes in the national energy system to-date (for-example leading to improvements in energy efficiency or increases in the share of renewables), although to a large extent these have been driven by other factors. Historic trends in GHG emissions from energy-related

activities are shown in later sections. However, the impacts of future climate policy in the energy sector are likely to be far more significant, particularly as a result of the new EU Climate and Energy package. These will lead to more sizeable shifts in energy use towards renewables as well as an overall impact on primary and final energy consumption due to improvements in energy efficiency; these effects should become more noticeable within these indicators in coming years.

Total primary energy consumption in Cyprus rose over the period from 1990 despite continued efforts to improve energy efficiency. Trends in the consumption of different energy types within the total have changed significantly since 1990. Since 1990 there has been a decrease of nearly 38% in the consumption of carbon intensive coal used in cement industry.

Renewables have the most marked increase with consumption increasing by 213% from 1990 levels.

Fossil fuels continue to dominate total energy consumption and the share of renewable energy sources remains small despite the increase in use. The overall increase in total primary energy consumption has also acted to counteract some of the environmental benefits from fuel switching.

The final energy needs of the economy of Cyprus for 2015 represent 73% of the country's primary energy consumption. There are very significant energy losses linked to the transformation and distribution of useful energy (e.g. as electricity) to the end users. Energy losses broadly depend on the average efficiency of conventional thermal power stations and CHP plants and the penetration of non-thermal renewables.

Energy Supply

All the oil consumed is from imports and the trend, although cyclical since 1990, has been upwards of 35% in 2015 since 1990. In the case of solid fuels, overall consumption has increased by 85% between 1990 and 2004, due to the thrive of the constructing industry. From 2004 until 2008 the consumption of solid fuel was stable, while after 2008, it decreases substantially to reach 1990s levels.

Although the absolute amount of electricity production from renewables has increased by more than 310 times since 2006 (Figure 1.3), renewable electricity still makes only 8.6% contribution to total generation. Overall, the generation mix of electricity in Cyprus has become less carbon intensive since 2008, when the first combined cycle unit for the production of electricity entered in operation and the contribution of renewable sources started to be significant. The increase in total electricity production was 225% from 1990 to 2015.

The share of primary energy met by renewables has increased steadily over time to around 6.07% of total primary energy consumption in 2016. The bulk of renewable energy consumed, about 68 %, comes from solar thermal and biomass. Wind is the next biggest contributor, providing 13% of total renewable energy). Biofuels has seen the biggest increase - from zero 0 in 1990 to contributing around 6% of total renewable energy in 2016.

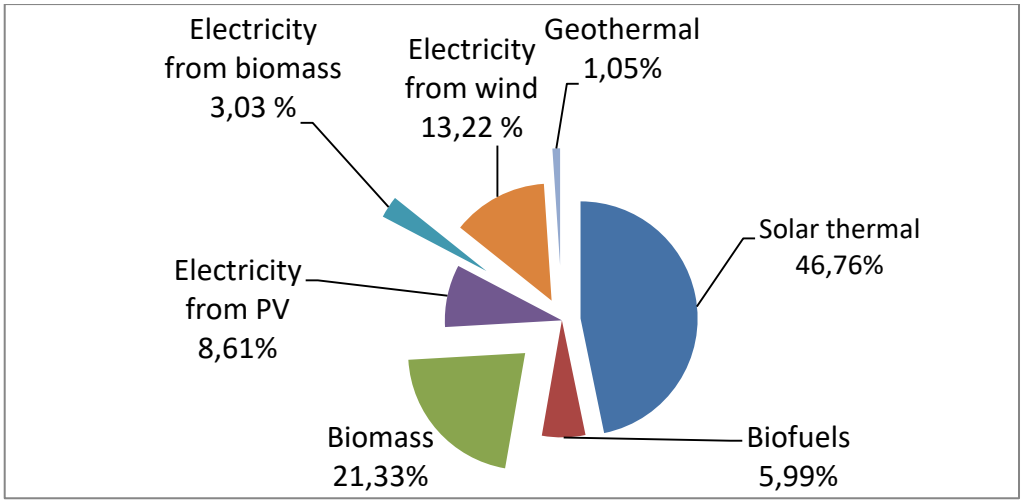


Figure 1.2. Existing Renewable Energy Share between technologies as of the end of 2016

Based on 2016 figures Cyprus, as all EU countries, has a significant challenge ahead to reach the new Renewable Energy Sources (RES) targets for 2020. The RES targets include all sources of electricity, heat and transport fuel. Cyprus' target is 13% of the final energy consumption to be from renewable sources by 2020.

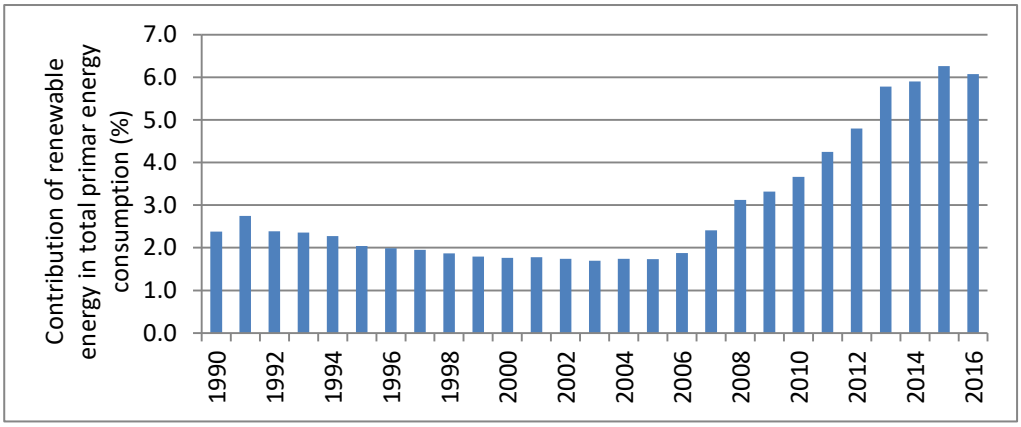


Figure 1.3. Share of renewable energy in total primary energy consumption in per cent, 1990-2016

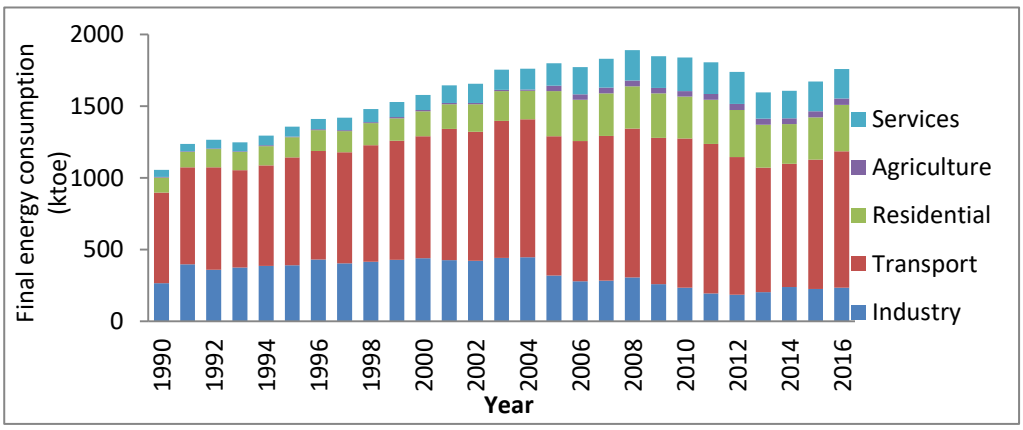


Figure 1.4. Final energy consumption by sector in ktoe, 1990-2016

Energy consumption in different sectors

Final energy consumption in Cyprus increased by about 38% between 1990 and 2015. The electricity sector has seen the biggest increase in overall energy consumption, increasing its consumption by over 174% since 1990. The final consumption of electricity produced from conventional fuels increased by 152% between 1990 and 2016. This is having a significant impact on GHG emissions. The Services sector has also increased its energy consumption markedly, by 358% since 1990, which correlates with an increasing share of GVA coming from this sector. Households are also one of the largest consumers of final energy in the EU. Space heating and cooling are the most significant components of household energy demand, and can vary substantially from year to year depending on climatic conditions. In very recent years, household energy consumption has declined partly as a result of higher fuel prices. Final energy consumption in industry has fallen since 1990, largely as a result of a shift towards less energy-intensive manufacturing industries, as well as the continuing transition to a more service oriented economy.

Liberalisation of energy markets

As far as the electricity domestic market is concerned the new regulatory regime has been established since 2004 by liberalising 35% of the market. The proportion of the liberalised market increased from 35% to 65% from 1/1/2009, so eligible customers (those who can choose their supplier) are all non-domestic customers. From 1/1/2014, the electricity market in Cyprus was fully liberalized and eligible customers are all the customers. The main objective of the liberalization process is to provide competitive prices and improved services to all electricity customers. With respect to the further structuring of energy markets, one major change is the EU's Third Energy Package. Cyprus has achieved compliance on transposition of the 3rd Energy Package.

Energy prices

The graph below shows how the average end-user prices of electricity have varied since 1990 for industry, households and agriculture in Cyprus. In addition, it illustrates how disposable income has varied over this period, as this provides a very broad indication of how expenditure on energy varies as a share of income. Recently EAC, after the approval of CERA, have revised the tariff methodology with the main target to make those cost-reflective.

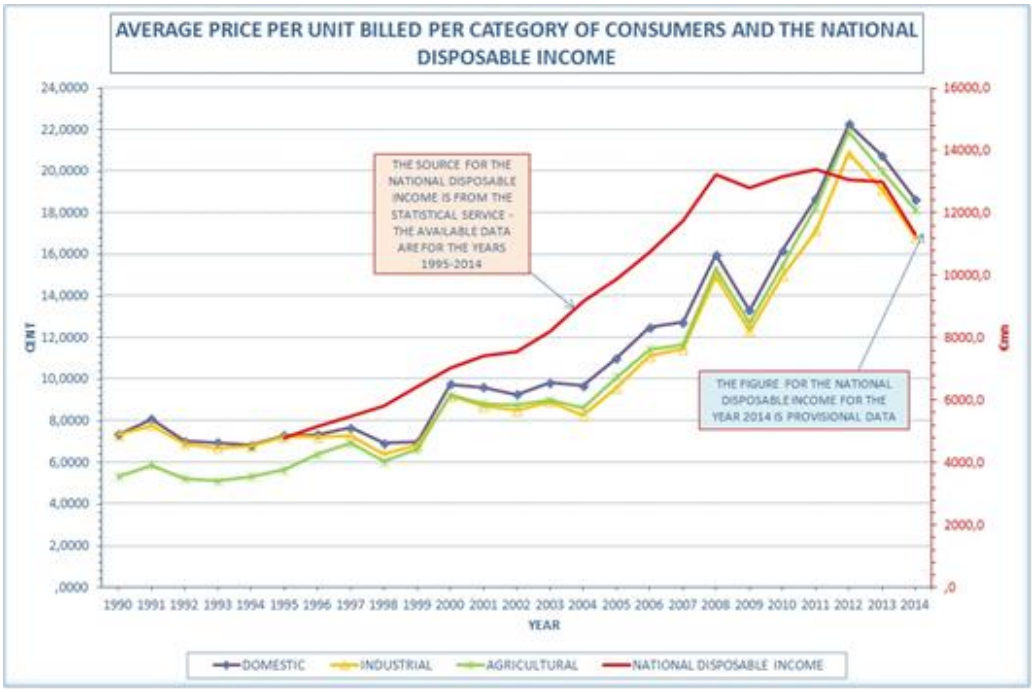


Figure 1.5. Change in average end-user energy prices in Cyprus compared to the gross disposable income for households, industry and agriculture, 1990-2014

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

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

1.2.3. Key issues of cross-border relevance

1.2.4. 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.

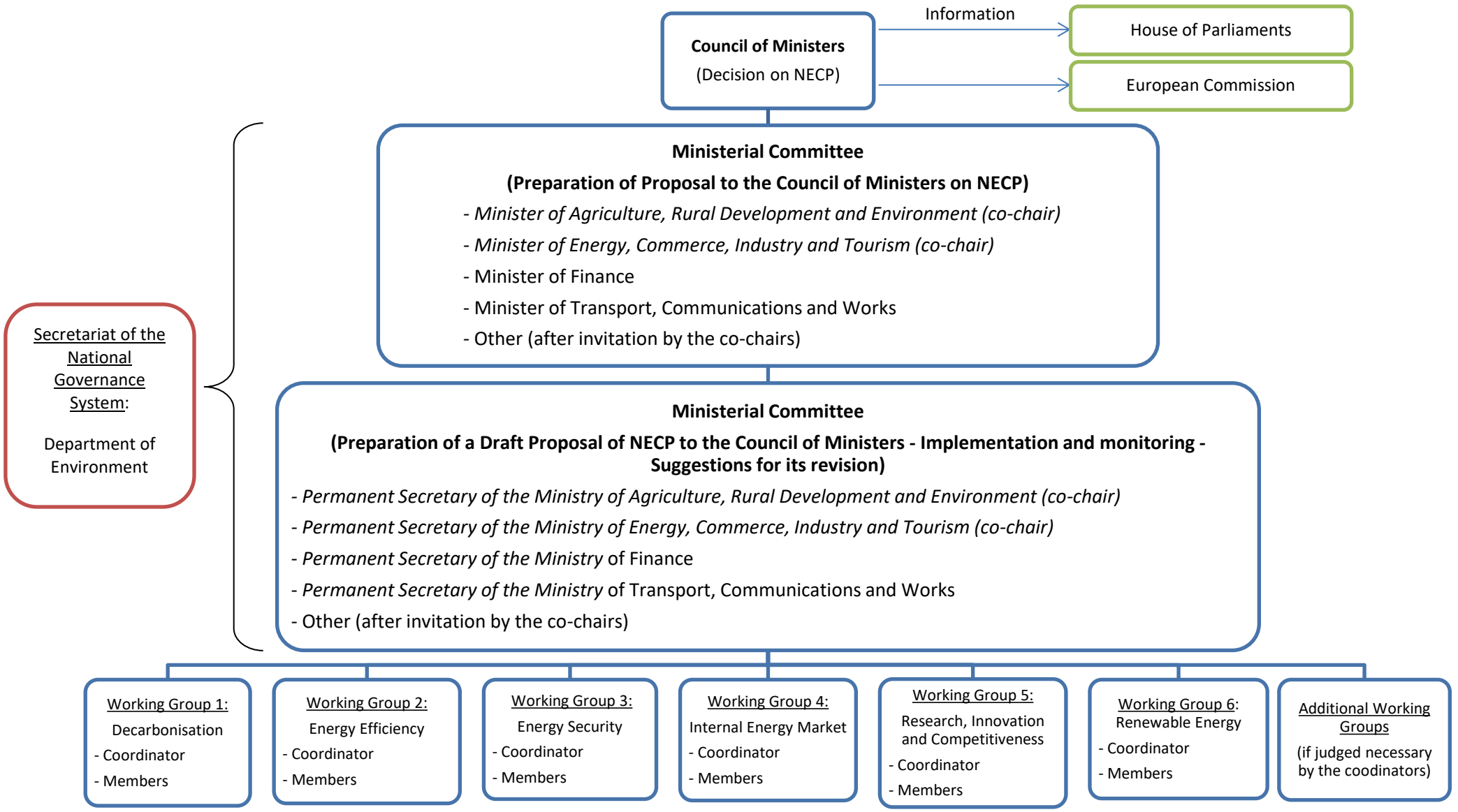
For the purposes of implementing the Regulation on the Governance of the Energy Union and Climate Action [(EU) 2018/1999][1] and in particular to set out the necessary foundation for a reliable, inclusive, cost-efficient, transparent and predictable Governance that ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (the "Paris

[1] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council

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 1.1), the "National Governance System for Climate and Energy" is a Ministerial Committee, consisting of the Minister of Agriculture, Rural Development and Environment, the Minister of Energy, Commerce and Industry, the Minister of Finance and the Minister of Transport, Communications and Works. The Ministerial Committee is co-chaired by the Minister of Agriculture, Rural Development and Environment and the Minister of Energy, Commerce and Industry. This committee has to propose the National Energy and Climate Plan (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.

Figure 1.1. Structure of the national governance system for Climate and Energy



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

i. Involvement of the Parliament

The House of Parliament was presented with the new national obligations related to climate and energy and the means to achieve them in a special meeting held in June. The final NECP will be presented to the Parliament once this is submitted to the European Commission. The parliament will also be involved in the preparation of the NECP during the face of the public consultation.

ii. Involvement of local and regional authorities

The local authorities have been and will be involved in the preparation of the NECP during the face of the public consultation. Most of the working groups have presented the information to the public where local authorities had the opportunity to discuss the various polices and measures.

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

All the relevant stakeholders, including social partners and professional organisations have been included to the preparation of the NECP from the beginning of the process. The general public will be involved once the final draft is ready for the final submission to the European Commission through public presentations, hearings and discussions.

iv. Consultations with other Member States

v. Iterative process with the European Commission

1.4. Regional cooperation in preparing the plan

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

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

2. National objectives and targets

2.1. Dimension Decarbonisation

2.1.1. GHG emissions and removals

i. The elements set out in Article 4(a)(1)

i. the Member State's binding national target for greenhouse gas emissions and the annual binding national limits pursuant to Regulation ESR;

The EU submitted an Intended Nationally Determined Contributions (INDC) for the Paris Agreement in 2014 to reduce GHG emissions by 40 % compared with 1990 levels by 2030. Because this INDC under the Paris Agreement was only submitted by the EU and its 28 Member States together (EU-28) and not by each Member State, there are no specified INDCs under the Paris Agreement for individual Member States. For this reason, Cyprus, as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all other Member States.

With the 2030 climate and energy framework, the EU is on its way to set internal rules which will underpin the implementation of the NDC in accordance with the Paris Agreement. The 2030 climate and energy framework introduced a clear approach to achieving the 40 % reduction of total GHG emissions from 1990 levels, which is equivalent to a 36 % reduction compared with 2005 levels. This 36 % reduction objective is divided between two sub-targets, where 43 % of the reduction effort is assigned to the Emission Trading System (ETS) and 30% to non-ETS sectors, (Effort Sharing Regulation, No. 2018/842).

In the ESR, national emission reduction targets for 2030 for each Member State will be between 0% and -40% compared to 2005. Cyprus' binding national target for GHG according to Regulation 2018/842 is to limit GHG at least by 24% in relation to its greenhouse gas emissions in 2005. The modalities and procedures for monitoring and review under ESR will be harmonised for all EU member States by the Governance [ ] Regulation.

According to Article 4, paragraph 3 of the ESR, the annual emission allocations for the years from 2021 to 2030 in terms of tonnes of CO2 shall be adopted by the Commission through implementing acts using the national inventory data for the years 2005 and 2016 to 2018 submitted by Member States pursuant to Article 7 of Regulation 525/2013[2].

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

ii. the Member State's commitments pursuant to Regulation LULUCF;

To ensure the contribution of the LULUCF sector to the achievement of the Union's emission reduction target of at least 40 % and to the long-term goal of the Paris Agreement, a robust accounting system is needed to be applied by Member States.

For the periods from 2021 to 2025 and from 2026 to 2030, taking into account the flexibilities provided for in Articles 12 and 13 of the LULUCF Regulation, each Member State shall ensure that emissions do not exceed removals, calculated as the sum of total emissions and total removals on its territory in all of the land accounting categories referred to in Article 2.

Member States should ensure that sinks and reservoirs, including forests, are conserved and enhanced, as appropriate, with a view to achieving the purpose of the Paris Agreement and meeting the ambitious greenhouse gas emissions reduction targets of the Union by 2050.

Each Member State shall account for emissions and removals resulting from managed forest land, calculated as emissions and removals in the periods from 2021 to 2025 and from 2026 to 2030 minus the value obtained by multiplying by five the forest reference level of the Member State concerned.

Where the result of the calculation is negative in relation to a Member State's forest reference level, the Member State concerned shall include in its managed forest land accounts total net removals of no more than the equivalent of 3,5 % of the emissions of that Member State in its base year or period as specified in Annex III, multiplied by five. Net removals resulting from the carbon pools of dead wood and harvested wood products, except the category of paper in the land accounting category of managed forest land shall not be subject to this limitation.

Member States shall submit to the Commission their national forestry accounting plans, including a proposed forest reference level, by 31 December 2018 for the period from 2021 to 2025 and by 30 June 2023 for the period from 2026 to 2030.

The forest reference level shall be based on the continuation of sustainable forest management practice, as documented in the period from 2000 to 2009 with regard to dynamic age-related forest characteristics in national forests, using the best available data.

Maximum amount of compensation available under the managed forest land flexibility referred to in point (B) of article 13(3) for Cyprus:

a. 0.15 for reported average removals by sinks from forest land for the period from 2000 to 2009 in million tonnes of CO 2 equivalent per year

b. 0.03 in regards to the compensation limit expressed in million tonnes of CO2 equivalent for the period from 2021 to 2030

iv. where applicable to meet the objectives and targets of the Energy Union and the long term union greenhouse gas emissions commitments consistent with Paris Agreement, other objectives and targets, including sector targets and adaptation goals;

ii. If applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies.

There are no other national objectives and targets consistent with the Paris Agreement and long-term strategies in place related to climate change mitigations.

The National Adaptation Strategy and Action Plan have been in formally adopted by Cyprus' Government in 2017 (Council of Ministers Decision no. 82.555 of 18/5/2017). A revision of the strategy and action plan has been adopted on 5/12/2018 by the Council of Ministers. The responsible authority for the development and implementation of the National Adaptation Strategy and its Action Plan is the Department of Environment of the Ministry of Agriculture, Rural Development and Environment. The responsibility for the implementation of specific sectoral actions lies with the responsible authorities for each specific action (e.g. Department of Agriculture for agricultural issues). Meetings with all the stakeholders are taking place at a regular basis to assess the status of implementation of the activities included in the Action Plan.

2.1.2. Renewable energy

The CY authorities are currently faced with major challenges in the Cypriot energy sector. The well-functioning system of the past 40 years has outlived its performance and it is for several reasons, mainly based on climate change policy and EU legislation, that a major shift is necessary. The isolated location of the network and the potential domestic natural gas resources found and expected to be found off-shore are major elements to take into consideration while reforming the energy policy. In addition, the long investment cycle and the often significant size of investments needed in the energy sector impact considerably the way of (political) decision making.

Under the general quest to reduce climate change and hence the establishment of a decarbonised economy several topics must be challenged in a symbiotic way:

1) The need to provide a safe, reliable, high-quality and effective servicing of energy needs to the citizen on a day-to-day basis
2) The aspect of security of supply in the sense of availability of resources in potentially challenging times in a generally unstable political region (external dependence versus autonomy versus potential export revenues)
3) International commitments: UN Climate Change commitments as well as EU legislation
4) General economic growth aspects including sustainability, social welfare, environmental protection

More precisely the energy sector is currently described as such:

- Dominated by one vertically integrated publicly owned utility company which operates very few, quite large power plants based on oil derivate in a relatively inflexible way
- The final customer has up to date no choice of supplier, all supply is under regulated tariff, reformation though, is in progress,
- RES penetration is limited due to (1) unclear grid capabilities to accept volatile generating units (2) public awareness, (3) forecasting tools that needed to be improved
- Isolated in energy infrastructure terms

- Recent discoveries of some natural gas in exclusive economic zone of the Republic of Cyprus, with a potential to increase and the perspective to establish CY as a "gas hub" for export
- The ending of emission related derogations of EU law until 2020
- CY has a very high potential on future integration of decentralised RES generation which might shift the focus of the remaining thermo-electrical generation to provide flexibility rather than base load which is strengthened by the need to reduce the emissions massively in this sector by 2040/50.

The current stakeholders are, besides the governmental representatives:

1. EAC: (Electricity Authority of Cyprus), vertically integrated utility with tasks attributed to it by constitutional law
2. DEFA: (Natural Gas Public Company) publicly owned company of private law, who is tasked to evaluate a gas solution to bring gas into CY the earliest possible, (via a monopolistic import contracts for building of relevant infrastructure & introducing through a contract with take or pay terms)
3. CERA: Cyprus Energy Regulator Authority deriving from EU legislative compliance needs
4. CHC: (Cyprus Hydrocarbons Company Ltd)public company tasked to market off-shore assets for the government,
5. TSOCy: Transmission system Operator of Cyprus, publicly owned company tasked to operate the EAC transmission system using EAC assets including EAC staff.
6. IPP: Independent Power Producers, holding regulatory licenses to build independent power plants
7. RES producers: currently all major plants active under feed-in tariff, minor plants under net metering and net billing. A huge potential recently showed up after opening the new support scheme for participating within the competitive electricity market.

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

The contribution of Cyprus to the Union's binding target of at least 32% is very challenging and is relying on various different parameters and assumptions.

Based on the bi-annual report that it is submitted to the EU the following existing status of Renewable Energy Sources exists in Cyprus energy mix as of 2016.

As of the end of 2016, the following RES contribution the Sectors was recorded:

Table 2.1. Existing Status of RES in Final Energy Consumption

	2015	2016
RES in Heating and Cooling	23.60%	23.72%
RES in Final Electricity Consumption	8.48%	8.64%
RES in Transport	2.45%	2.65%
Total RES in final Energy Consumption		9.27%
Indicative Target for RES	7.45%	

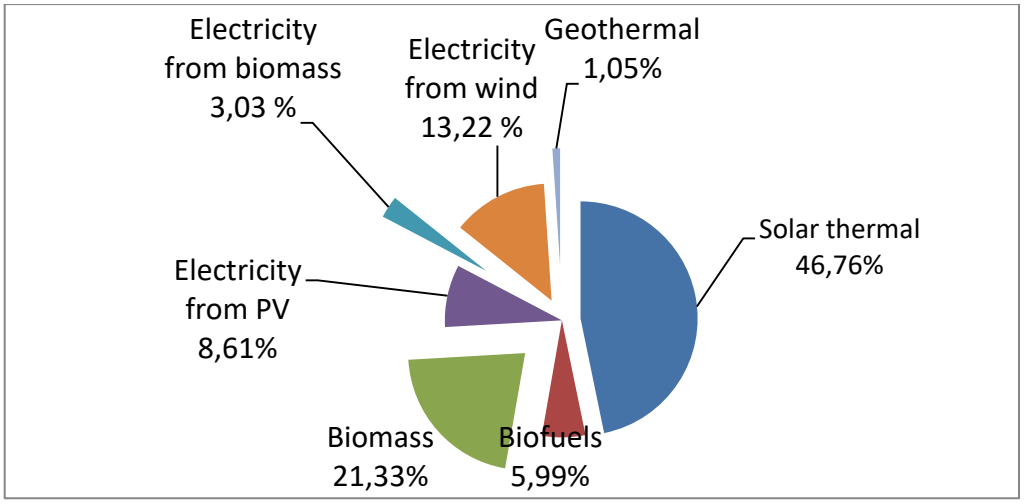


Figure 2.1. Existing Renewable Energy Share between technologies as of the end of 2016

The reference scenario of this report assumed that natural gas will become available for use in the electricity supply sector by the end of 2020 via an LNG regasification facility. This means that the supplied gas does not necessarily originate from the domestic gas reserves, but could be from any potential supplier. Natural gas was allowed to gradually commence supply of the transport sector by 2021-2022, assuming that a small transition period will be required before the necessary infrastructure is set in place.

No electricity interconnector becomes established, while investments in new technologies were allowed in all the sectors. A fixed 10% RES target in transport was defined for 2020, while additional targets relating to the used of advanced biofuels and renewable electricity were set for the period 2021-2030. The 13% renewable energy target in final energy consumption for 2020 was developed as an overall target, meaning that the share of renewable energy can originate either from electricity supply or the heating and cooling sector. Emission targets were not set in this modelling exercise, since we have approached a bottom-up methodology.

Energy Planning Scenarios

These first Energy Planning Scenarios were very well demonstrated in very early efforts done with the support of IRENA in 2014-2015 where various energy pathways were examined for the Electricity Sector.

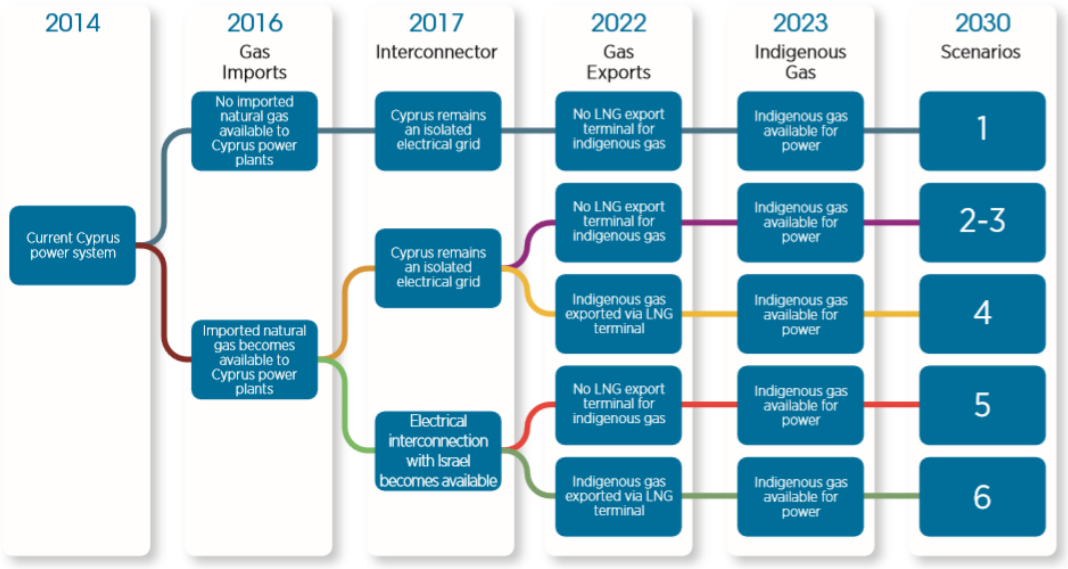


Figure 2.2. Various Energy Pathways examined up to 2030 for Electricity Sector in IRENA Roadmap Study, Nicosia 2015

In the IRENA roadmap report[3], it was demonstrated that some policy decisions (that are depending on various externalities), can affect the penetration on Renewable Energy Sector in the various scenarios. The Renewable Energy Roadmap for the Republic of Cyprus is based on three complementary Sections.

Since the development of the IRENA Roadmap, there was recommendation to proceed with additional studies. In that respect, Cyprus (with the support of SRSS), has develop a specific open source, linear optimization model (called OSeMOSYS) in order to plan the RES contribution in all the sectors (Electricity, Heating and Cooling and Transport).The development of the modelling exercise is shown in the graph below:

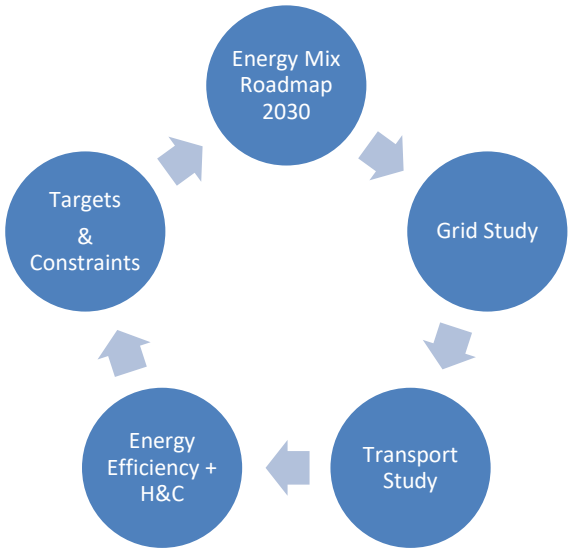


Figure 2.3. Energy Planning methodology and steps that were followed

[3] https://www.irena.org/publications/2015/Jan/Renewable-Energy-Roadmap-for-the-Republic-of-Cyprus

OSeMOSYS[4] is an open source modelling system for long-run integrated assessment and energy planning and is widely used by various countries and modelers.

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. For instance, in a theoretically more technologically advanced system in 2030 and 2050, 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 can facilitate the use of higher shares of variable renewables. 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. Even though the present effort can be considered as ambitious, it was in no way a novelty in the field.

Renewable energy offers a way for Cyprus to reduce both the cost and the environmental impact of generating electricity at least up to a certain limit. In the wake of the recent energy transition, turning to renewables can help to reduce fuel imports, strengthen the trade balance and create local jobs. Cyprus Government, taking advantage of the success of solar water heaters, with various measures and support is trying to replicate solar photovoltaics (PV) up to the level where no other sectors of energy union will be underestimated.

Cyprus has set out to attain a higher share of renewables, and this national energy and climate plan helps to assess optimal investment strategies in both ETS and non-ETS Sectors. Solar Technologies will play a major role in this roadmap and in parallel with major policy decisions in European Level, can increase even further. The NECP (national Energy and climate plants) findings will play an important role to revise existing energy policies and develop new ones.

The energy planning model used to quantify the possible pace and benefits of renewable energy deployment given different conditions has been presented already to various stakeholders and various presentations have been developed for the past few years.

A list of reports is provided in Appendix I.

The above model is an important tool for assessing future energy policies and examining different energy pathways. It is assisting in determining the optimal penetration of renewable energy in all sectors such as electricity supply and in identifying the technical and economic potential for further increasing electricity production from renewable energy.

Public Consultations, Presentations and presentation in various conferences:

Various presentations and public consultations were organized, to demonstrate the results delivered from the various scenarios:

- Conference in Nicosia, 2015[5] where the IRENA Roadmap was presented to public, where more than 100 stakeholders and individuals participated. The conference was organized in coordination with IRENA and Cyprus Government.

[4] http://www.osemosys.org/

[5] http://www.irena.org/publications/2015/Jan/Renewable-Energy-Roadmap-for-the-Republic-of-Cyprus

- Various Conference and Workshops within the Ministry inviting various stakeholders and other public authorities that took place in the period 2016-2018[6].
- Presentation in EU Reference Scenario NECP committee about the various options and Scenarios
- Other International conference such as
  - CPS4Climate[7]
  - ETIP-SNET (23.11.2017)
- 6th International conference on Renewable Energy Sources and Energy efficiency, organized in Nicosia, where a special sessions was dedicated for Energy planning pathways and Scenarios.[8]

Electricity Section Major Results

Assumptions:

The Electricity Generation Section is among the most challenging sections not only in Cyprus but in EU as a whole due to the following Reasons:

1. Island remains isolated in the Business as usual Scenario (or Reference Scenario) and this leads to various system constraints such as:
   a. **Variation from year to year in production of RES**. i.e. the variation in production from both Wind and Solar from year to year varies in Cyprus and this can influence the energy mix for a specific year up to 20% (at high penetration levels of RES). Thus capacity credits for RES play a major role in the final Energy mix.
   b. **Seasonal variation of Demand and daily variation**. As indicated in the energy-map below there are certain periods of times that the system minimum stable generation is met due to the low demand periods. In that respect if any further energy efficiency improvements are achieved during the low peak hours, this might have negative implications to the system stability.

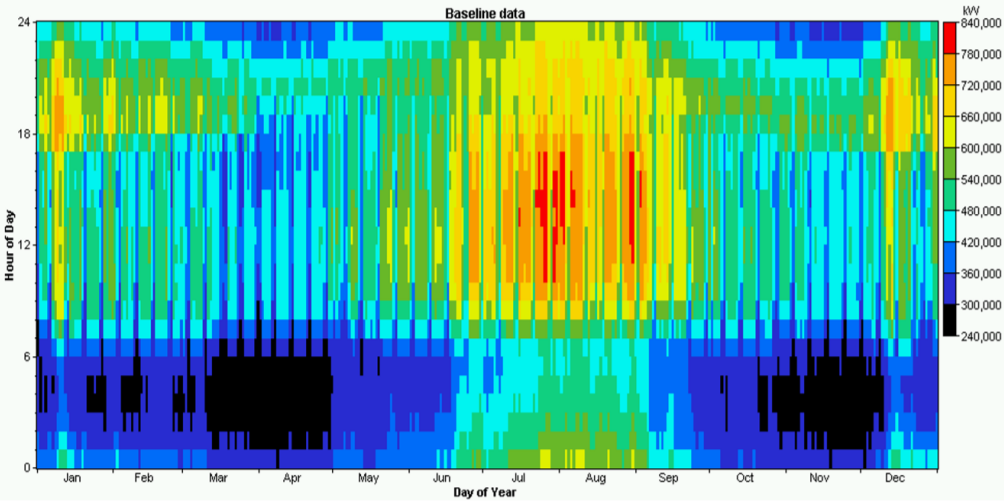


Figure 2.4. Typical Electricity Demand throughout the year (typical year 2014)

[6] http://www.mcit.gov.cy/mcit/energyse.nsf/page27_gr/page27_gr?OpenDocument
[7] https://csp2018.cyi.ac.cy/
[8] www.mse.com.cy/energy/

c. **Weather Forecast Scenarios**. As seen from the graph below, there is a forecast for the heating degrees days versus the cooling degree days. This forecast will affect both Electricity Sector and Heating and cooling sector, since more electrification is expected to be needed up to 2030. On the other hand, the high penetration of solar water heaters limits the room for further development in the DHW sector since almost the 92% of households and more than 55% of Commercial applications are using already the above technology. As it was assumed in IDEES (EU-JRC Database) the heating degree days (HDD) and Cooling Degree Days (CDD) are not in line with the forecast below.

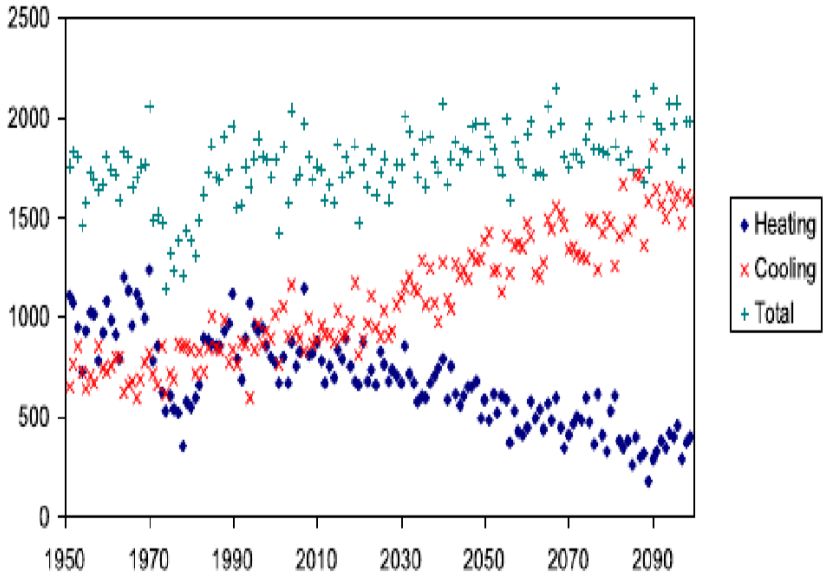


Figure 2.5. Nicosia's heating and cooling days (Zachariades and Hadjinicolaou, 2014)

d. High Reserve Margins are required increasing the System cost up to a certain level of RES penetration.

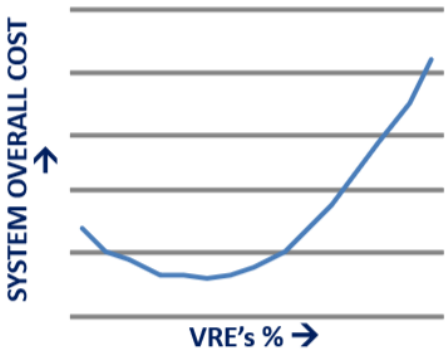


Figure 2.6. Impact of the Variable Renewable Energy Sources on System Overall Cost.

2. There are no Storage Plants to support the further penetration of RES targets. This leads to various reserves margin requirements as analysed in the JRC Study for the Grid Stability.
3. The existing baseload energy generation fleet has operating life up to 2031-2032. In that respect no, major changes can be done in the flexibility of conventional generation system, while most of the new units introduced to the system are inflexible Renewable Energy Sources.

4. Some old plants that are used for load flexibility and are going to be decommissioned in the year 2024, while some De-NoX units are going to be installed in some of the existing conventional plants.

   Emission constraints should be defined taking into considerations the impact on RES integration. In the JRC simulations, pre-defined environmental considerations (limits on NOx, CO and SOx emissions) are adding constraints that significantly reduce the operational flexibility of ICE and GT generators. However, higher operational flexibility has the potential to reduce RES curtailment and reduce the fuel consumption, which would consequently reduce emissions. In that respect, instead of defining emissions targets for each of the conventional generators, it was suggested to define in the long term planning of simulations only a global target for the whole generation fleet.

iii. Estimated trajectories for the sectorial share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sectors

Based on the Preliminary Results for the RES Final Energy Consumption, the following results were obtained in the three sectors for the Scenario WEM.

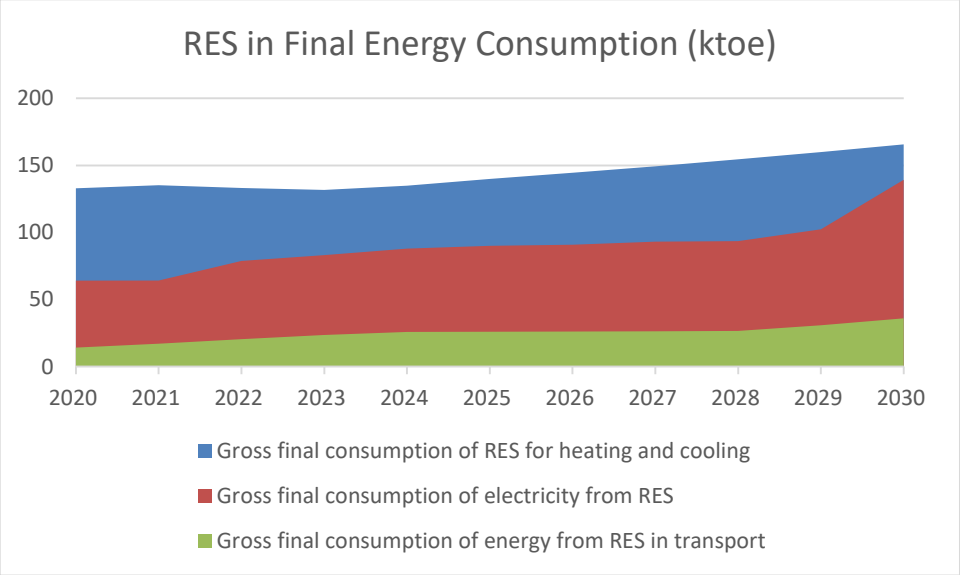


Figure 2.7. Renewable Energy Sources in Final Energy Consumption in ktoe, Reference Scenario

From the above results, which will be analysed and further discussed in the sections that are followed, it can be easily observed that an electrification of heating and cooling and transport sector is observed during the end of the period, and the most rapid measures are make economic sense to be implemented in the years 2029-2030. This is due to the increase of CO_2 price and Oil prices towards the end of the period. In addition, it is expected that the evolution in technology and price reduction of batteries will contribute to this effect.

The introduction of natural gas and the stricter restrictions regarding emissions of greenhouse gases and air pollutants that were introduced after the 2020, affected the electricity generation, transportation, and heating and cooling sectors. Frequently, energy planning decisions are made in a disaggregated manner. The transport sector was treated

separate for the purposes of this report. However, based in JRC study[9] it was obvious that in case of an increased electric vehicle fleet (and plug-in hybrid) there were some important outcomes.

By introducing both the EVs and PV integrated into the Medium Voltage reference grid, the voltage levels are improved in comparison to the base case simulated when no PV are included. The results showed that the lines are not significantly affected when the surplus energy consumed by EVs charging is covered by the local PV system production. Also, the results showed better performance in terms of voltage levels compared to the other voltage regulatory methods. This voltage regulatory scheme can therefore contribute in the improvement of the voltage levels at both low and medium voltage side.

Finally, the results showed that the introduction of PV offered positive results capable of counterbalancing the effect of large scale EV integration.

Similarly, once domestic gas reserves become operational, demand for natural gas may not be confined to conventional power generation. Compressed natural gas may become a viable alternative in the transport sector. Also, even though outside the scope of this study, use of natural gas in industry, residential heating purposes or gasification of the transport sector are potential alternatives.

This was also highlighted in Ifeu Study for Transport[10], where the introduction of Natural Gas in transport will lead to very interesting results. However, in the Scenario WEM this aspect was not introduced, but it seems that once the GAS will be available for Cyprus, the Gasification of Heavy Trucks and busses (or even bunkering), will lead to increased decarbonization levels.

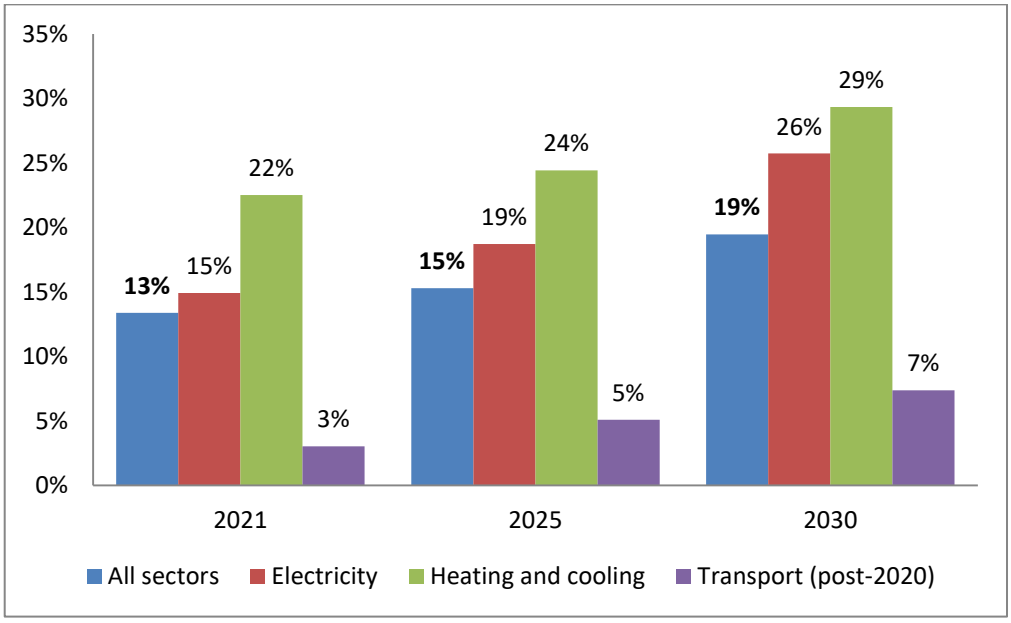


Figure 2.8. RES in final energy demand per Sector - With Existing Measures until 2030

In order to extract the above results, it should be noted that wherever data were not available from local sources, assumptions were based on literature, PRIMES or POTEnCIA-

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

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

IDEES database. It is expected that the above data will be revised in 2019 with more precise and accurate data.

At the same time, input was drawn from other parallel studies conducted for MECIT by SRSS (see Appendix II).

Due to the vast amount of data used in this study, the following subsections present the key input and assumptions used to develop the model, while all of the data will be made available separately as supplementary material to this report.

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. 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. 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 2.9). 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 was illustrated in the corresponding IRENA and KTH 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 614 MW by 2030 comparing with 2020 target which is 288MW. However, it should be noted that since a policy decision is in place and all the RES technologies have to participate in the competitive Electricity Market, the share indicated is just indicative. It should be also noted that there is no Capacity Regulation in place in Cyprus yet and since some RES technologies are already more competitive than Renewable Energy Sources (without taking into account the various ancillary services), it is expected that the final energy mix it should be different.

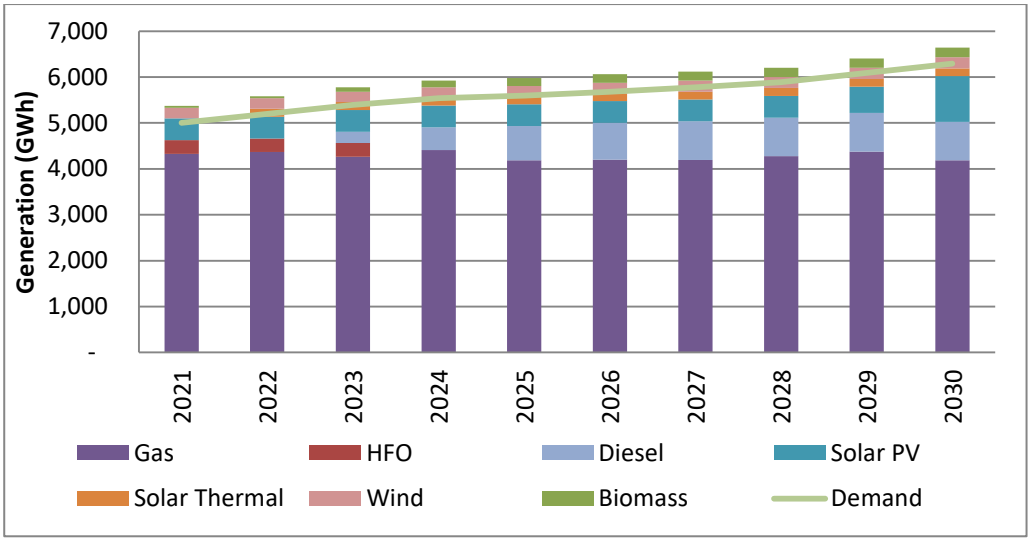


Figure 2.9. Total Electricity Generation with all available Technologies contribution

Remarks:

a. In the previous runs of the modelling system where different storage technology was examined (i.e. Pumped Storage entering at earlier stage) indicated slightly different penetration of Renewables.

b. As far as it concerns the existing Policy and Measures it is uncertain of how long the net-metering scheme will last since there is an intention to switch from net-metering to asymmetric net-billing (as it was recommended from IRENA study). This will decrease the penetration rate of the RES in the Electricity Sector, but it is envisaged that due to the new regulatory framework in building sector (Nearly Zero Buildings) the effect will not be significant.

c. The delay of liberation of the competitive Market and the monopolistic electricity Market affects the penetration of RES in electricity sector, since a capacity regulation in not in place yet.

In developing the Electricity long term scenarios, a lot of simulations took place, reconstructing and simulating the whole Energy System of Cyprus. The methodology approach that was followed is described in JRC Study “for the further Integration of RES into the System”.

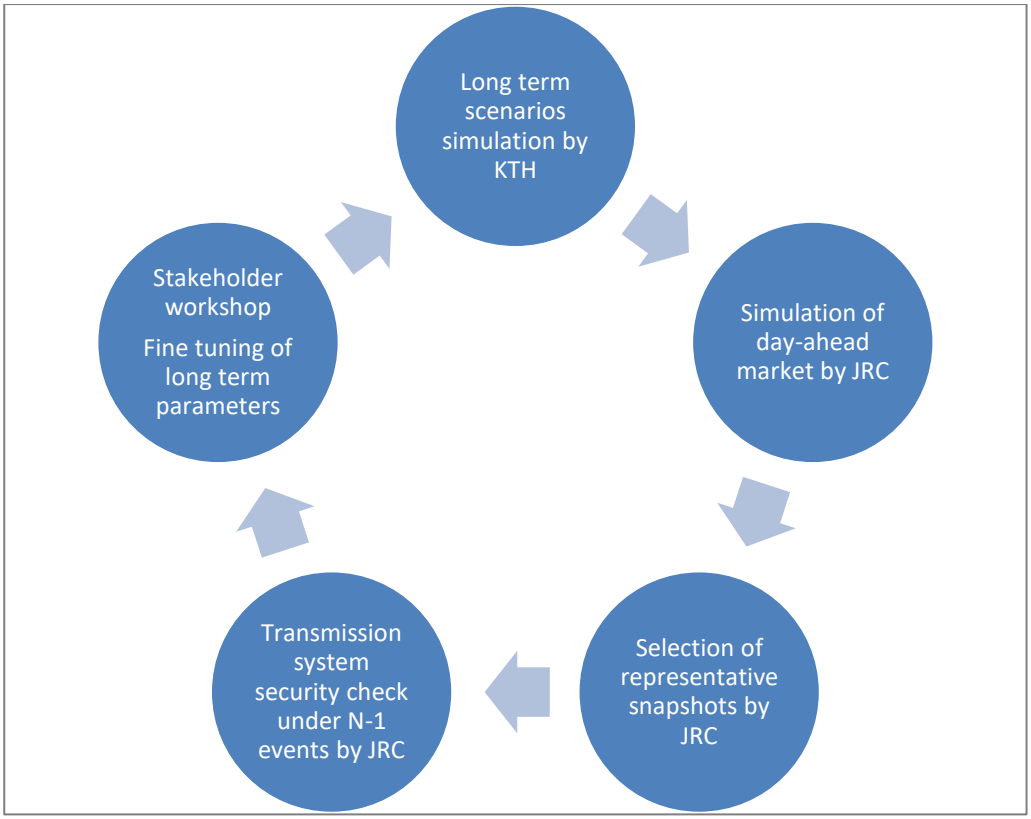


Figure 2.10. JRC Methodology Approach for RES integration study

The executive summary of the Results is reported and is public available [11]. This report was essential in order to identify various aspects of the pillars of the governance of the energy union, such us the security of supply, demand response measures, system stability and the possibility of better use of the desalination plants and irrigation of water. In additions insights to other sectors such as Vehicle to Grid and storage technologies were analyzed.

The study is divided into four activities:

Activity 1 studies mainly the collection of required data needed to perform the other activities. The main deliverable was a database with key parameters concerning distribution, transmission and generation of power.

Activity 2, the current TSOC dynamic system model was updated to define the reference system. Models for future components were developed and added to allow the simulation and analysis of the power system in 2020 and 2030 for different scenarios

Activity 3 dealt with the realization of reference distribution grid models and then the simulation of the impacts due to the large integration of PV, electric vehicles and demand response. It should be noticed that Distributed Storage was not investigated and it was set to be studied further in other studies.

Activity 4 dealt with the detailed modelling of unit commitment and economic dispatch of the generation fleet, which dispatch results were used as input for the transmission model (activity 2).

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

The three different Scenarios were selected in order to evaluate, among other aspects the below:

1. The impact of high RES in order to identify the bottlenecks of the system, and improvements needed to be done.
2. The effect of Energy Efficiency and how this can impact the stability and security of the Grid
3. Analyze and examine the existing system parameters and improve the daily operation of the system
4. Analyze the effect of oil prices in the daily operation of the system

Scenario A1 (Assumption: High oil and gas prices) combines baseline energy efficiency demand with high gas and oil prices. Very high levels of RES are expected to be integrated in the system. With high levels of intermittent renewables, several storage technologies become also cost effective. A new CCGT (216MW, same characteristics as existing units) became available from 2024. Gas is becoming available for power generation in 2020. Scenario was examined in order to test the stamina and stability of the system and the Grid.

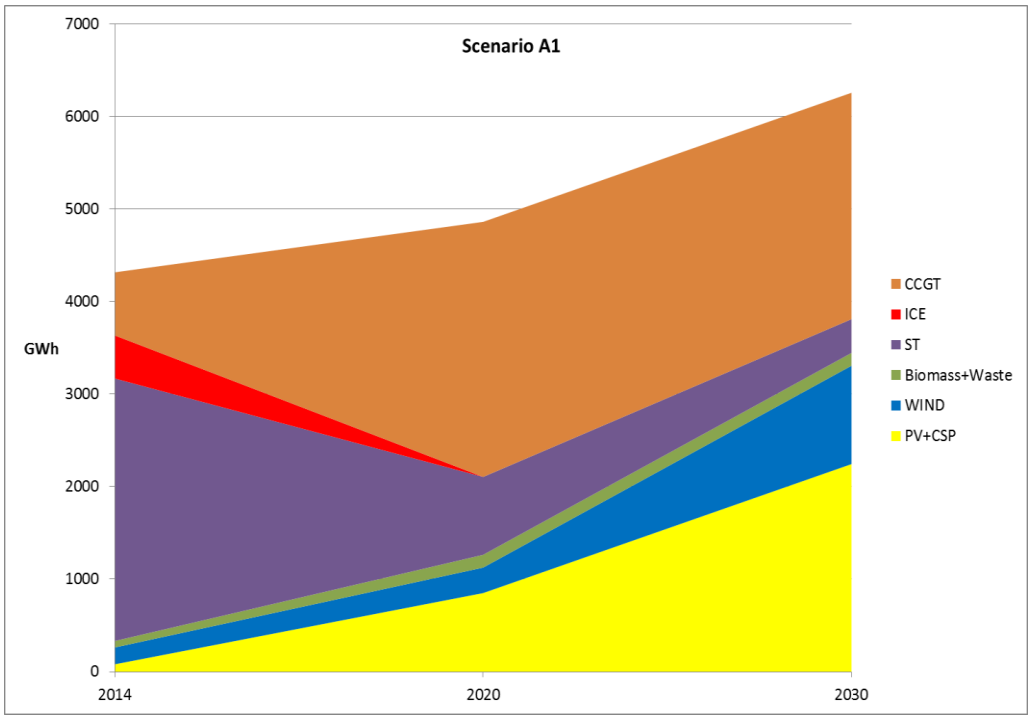


Figure 2.11. Scenario A1, with 55% RES penetration, 17% Curtailment, Pumped Storage (non-Realistic)

Scenario A2 (Lower oil or gas prices) combines baseline energy efficiency demand with low gas and oil prices. In this scenario, the renewable energy technologies are getting competitive up to a certain level due to price and investments needed for storage technologies. Once the cost of Energy Storage systems is reduced towards the latest years of the planning horizon more RES were introduced. A new CCGT unit becomes available from 2024 (due to decommission of other old gas units).

Scenario A3 (Energy saving) combines extra energy efficiency demand with BAU gas and oil prices. With a lower demand level, there is no need to build any additional conventional units, but more investments are needed in storage technologies, in order to maintain the system stability.

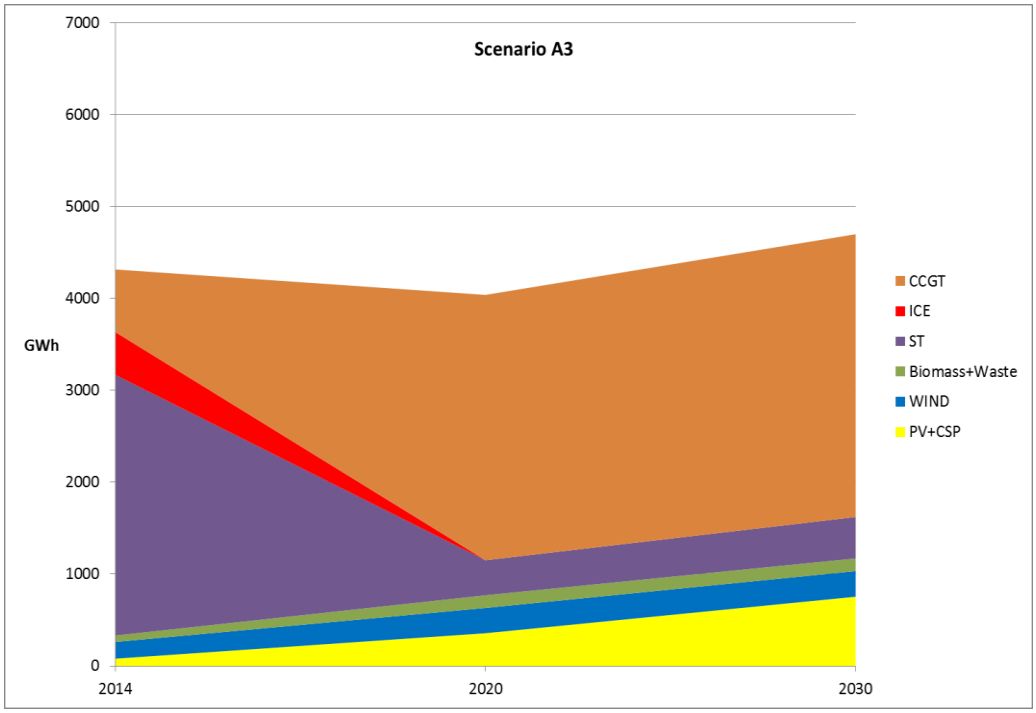


Figure 2.12. Energy Efficiency Scenario with Additional Measures (WAM) and RES scenario with existing measures.

This scenario was the closest to the existing Scenario finally adopted as the scenario with Existing Measures.

Table 2.2. Scenarios parameters

Scenario	Unit	Base	A1		A2		A3	
Year		**2014**	**2020**	**2030**	**2020**	**2030**	**2020**	**2030**
Fuel cost NG	EUR/GJ		13.8	21.7	1.1	1.5	6.9	10.8
Fuel cost HFO	EUR/GJ		18	28.2	11.1	15.2	18	28.2
Fuel cost diesel	EUR/GJ		19.6	29.8	12.8	16.8	19.6	29.8
Vasilikos Gen*	MW	836	836	836	836	836	836	836
Dhekelia Gen	MW	450	450	102	450	102	450	102
Moni Gen	MW	128	128	128	128	128	128	128
New CCGT unit	MW			216		216		
Total conventional Gen	MW	1414	1414	1282	1414	1282	1414	1066
Trans. Wind	MW	144	173	173	173	173	173	173
Dist. Wind	MW	2	2	2	2	2	2	2
Total Wind	MW	147	175	175	175	175	175	175
Trans. PV	MW	0	181	310	42	42	40	40
Dist. PV	MW	61	151	1167	79	438	99	234
Total PV	MW	61	332	1477	121	480	139	274
CSP Tower	MW	0	50	50	50	50	0	50
CSP Dish	MW	0	50	50	50	50	50	50
Total CSP	MW	0	100	100	100	100	50	100
Dist. Biomass	MW	10	30	27	30	30	30	30
Waste	MW	0	9.5	9.5	9.5	9.5	9.5	9.5
Dist. Fossil	MW	19	0	0	0	0	0	0
Storage Hydro 130MW-8h	Units	0	0	1	0	1	0	1

Storage Li-ion 1MW-2h	Units	0	11	61	0	2	23	69
Storage CSP 50MW-0.3h	Units	0	1	1	1	1	1	1
Demand Response 50MW	Units	0	1					
Demand	GWh	3925	4641	5897	4641	5897	3851	4476
Total net generation	GWh	4180	4862	6178	4862	6178	4034	4689

The above data were reconsidered later after changing some assumptions to the model due to real data. It should be noted that in the Electricity Sector there is a very huge interest for RES Plants to participate in the open market. In that respect, more than applications of 400MW installed capacity were received so it is expected that the trend will lead to more Renewables to the transmission system rather than in the distribution system.

The revised capacity projections that were finally adopted to the draft NECP are listed below:

Table 2.3. Capacity projections in the electricity supply sector (MW).

	2020	2025	2030
Vasilikos	868	868	868
Dhekelia	460	102	102
Moni	150	150	150
New CCGT	0	216	216
New ICE	0	0	0
New ST	0	0	0
New GT	0	0	0
Light fuel oil CHP	0	85	96
Solar PV	292	292	614
Solar Thermal	0	50	50
Wind	175	175	175
Biomass	12.4	25	29
Pumped Hydro	0	0	0
Li-Ion Batteries	0	0	72

All Li-ion batteries deployed are in-front-of-the-meter facilities and have 4 hours of storage; this results in 288 MWh of battery storage in 2030. No behind-the-meter battery storage is deployed as this is not deemed cost-optimum under the current assumptions followed. Furthermore, at the latter part of the modelling period, after 2030, a 130 MW (1040 MWh) pumped-hydro facility is also developed.

The aggressive deployment of batteries and solar PV can be attributed to the reduction in capital cost assumed over time for both of these technologies. 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. This curtailment is not easily captured by a long-term energy systems model, as employed here. Hence, a separate detailed analysis focusing on a single year in a much finer temporal resolution may be needed to assess this proposed outlook.

d. Heating and Cooling

Information for the heating and cooling has been obtained from a separate JRC study focusing on this sector (JRC, 2016b). Demand forecasts for heating and cooling as well as

techno-economic characteristics of technology options were provided from energy efficiency sector.

Four levels of demand were examined based on various energy efficiency PaMs.

Based on following the breakdown of technologies to be evaluated; namely 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 (Figure 2.13). However, analysis providing a more accurate demand profile may be needed for future enhancements of the model.

Table 2.4. Share of RES in Heating Sector (Reference Scenario with Measures)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Res Share (%)	22.5	23.1	23.2	23.7	24.4	24.9	25.6	26.1	27.0	29.3
Res Share (%), **without Electricity**	24.9	24.9	25	25.6	26.4	27.2	28	28.9	29.8	30.7

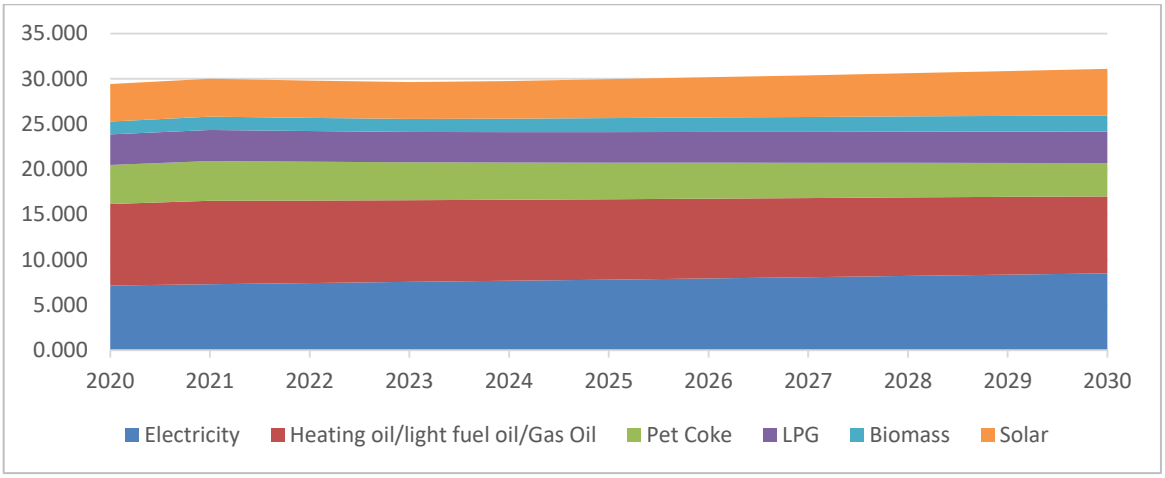


Figure 2.13. RES in Heating and Cooling Sector towards 2030 (PJ) **(RES share in Electricity varies from 15%-26%)**

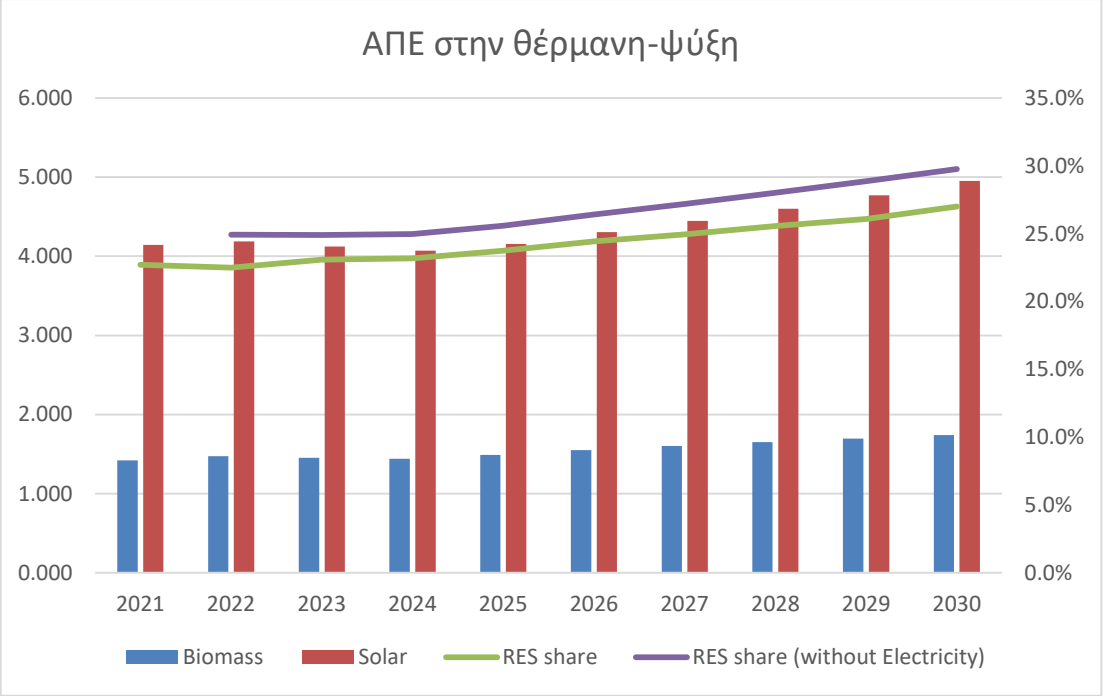


Figure 2.14. RES share in heating and Cooling Sector (with and without Electricity Contribution)

Table 2.5. Techno-economic characteristics of technologies

Resource	Technology	Investment cost (EUR/kW)	Fix O&M (EUR/kW)	Lifetime (years)	Heat efficiency	Electric efficiency	Cooling efficiency
Electricity	Heat pumps	810	16.2	20	3	--	4
Electricity	Resistance heaters	98	1.1	15	0.9	--	0.63
Gas oil, kerosene, light fuel oil	Boilers	77	3.9	20	0.77	--	0.54
Gas oil, light fuel oil, livestock/ industrial waste, LPG	CHP	1200	16.1	20	0.47	0.34	0.33
Gas oil, kerosene, light fuel oil	Efficient Boilers	314	15.7	20	0.9	--	0.63
LPG	Boilers	182	9.1	20	0.66	--	0.46
Municipal waste, biomass	CHP	1400	19	20	0. 47	0.34	0.33
Livestock/industrial waste, LPG	Efficient Boilers	316	22.1	20	0.96	--	0.67
Biomass	Boilers	338	16.9	20	0.77	--	0.54

Resource	Technology	Investment cost (EUR/kW)	Fix O&M (EUR/kW)	Lifetime (years)	Heat efficiency	Electric efficiency	Cooling efficiency
Municipal waste, biomass	Efficient Boilers	702	7.9	20	0.81	--	0.57
Solar	Solar panels	863	17.3	20	6.54	--	4.58

Additionally, high and medium heat requirements were taken into consideration, as it was assumed that only boilers and CHP technologies can provide heat at the required temperatures. Similarly, data were provided from MECI regarding each technology's contribution in the current energy mix. This formed the basis of estimating the existing installed capacity of each technology. Following the historical production of technologies provided through the JRC heating and cooling study, it was assumed that only heat pumps/split-unit heat pumps from the current stock of technologies could satisfy the cooling demand[12]. Thus, if other technologies (e.g. LPG boilers) were to provide energy for cooling, new installations would be necessary.

Table 2.6. Techno-economic characteristics of technologies in the residential sector (JRC, 2016b)

Resource	Technology	Investment cost (EUR/kW)	Fix O&M (EUR/kW)	Lifetime (years)	Heat efficiency	Electric efficiency	Cooling efficiency
Electricity	Heat pumps	1221	9	20	3.79	--	2.65
Electricity	Resistance heaters	176	1.9	15	0.9	--	1
Gas oil, kerosene, light fuel oil	Boilers	209	10.5	20	0.77	--	1
Gas oil, light fuel oil, LPG	CHP	1500	21.4	10	0.5	0.4	0.35
Gas oil, kerosene, light fuel oil	Efficient Boilers	314	15.7	20	0.96	--	1
LPG	Boilers	182	9.1	20	0.77	--	1
LPG	Efficient Boilers	418	20.9	20	0.96	--	1
Biomass	Boilers	487	24.4	20	0.77	--	1
Biomass	CHP	1700	27	10	0.5	0.4	0.35
Biomass	Efficient Boilers	926	23.3	20	0.85	--	1
Solar	Solar panels	1151	23	20	6.54	--	1

The existing renewable energy share in this sector originates from use of biomass in boilers, renewable electricity and solar thermal panels. According to JRC estimates, solar thermal panels in Cyprus currently provide 580 GWh of useful heat demand, mainly for residential hot

[12] Geothermal applications and solar cooling were not proven to be cost-competitive

water use. Estimates on the annual yield of this technology in Cyprus were obtained from international literature (IEA Solar Heating & Cooling Programme, 2014). As in the case of other technologies in this sector, only new installations of solar thermal panels were allowed to contribute towards meeting the cooling demand. This is because from the existing stock of technologies, currently only heat pumps provide cooling.

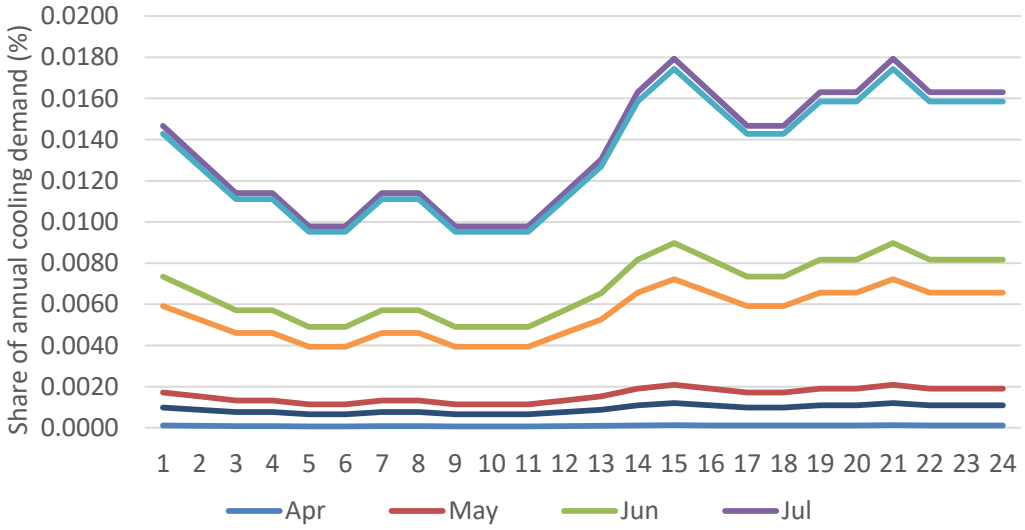


Figure 2.15. Assumed share of annual cooling demand for each hour within each month

The demand profile for each of the fuels driving the heating and cooling sector could potentially change in the future. For instance, if energy efficient heat pumps are installed, the peak electricity demand of the hot summer days may drop, while if the use of heat pumps for heating increases, electricity demand may rise in the winter. Further, once natural gas enters the market and sufficient infrastructure is put in place, this fuel might take up a substantial share in the island's energy intensive (e.g. cement and brick) industries or be used for space heating purposes. Even though of importance, the aspect of natural gas use in the heating and cooling sector was not taken into consideration. This was due to the fact that considerable investments would be required to distribute this fuel to the respective consumers as indicated in JRC study (JRC, 2016b). Once cost estimates for a potential domestic gas network arise in the future, this aspect can be revisited.

Similarly, the JRC heating and cooling study indicated that much waste heat could be recovered from the thermal power plants of Vasilikos and Dhekelia and be used for district heating for the cities of Limassol and Larnaka respectively. However, this aspect was not taken into consideration in this version of the model, due to lack of data on what heat network costs, timeframe and pipeline capacities would be required to utilize this waste heat. Including this in future enhancements of this work, if the option is deemed to be feasible and politically acceptable, is encouraged.

Heat pumps/heat pump split units are the most competitive technology, as these increase their share substantially, displacing oil boilers and electric resistance heaters **(Table 2.6)**. 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.

The outlook of this sector could potentially change substantially, if the electricity demand is allowed to vary. For instance, even though fuel efficient oil boilers contribute to the heating demand in services, industry and agriculture, if the level of electricity was allowed to increase, the contribution of heat pumps/heat pump split-units would likely increase further, since this is deemed to be the most cost-competitive option in this sector. Of course, this would also depend on the respective scenario. In a scenario without natural gas or with high fossil fuel prices in electricity generation, the average cost of electricity increases considerably. In this case, other technologies may be deemed more competitive. For this reason, it is advised that a sensitivity analysis be carried out before making any drastic policy decisions.

The aspect of decommissioning of aging renewable energy technologies from the system arises in this sector. As seen in the results, contribution from solar thermal panels in the residential sector does not change over time. This is due to the assumed refurbishment that occurs at the end of the technology's lifetime. Even though this assumption does not increase the technology's cost-competitiveness in the residential sector, it affects the level of solar panel deployment in the rest of the economy. This relates to the difference in investment costs, as indicated in Tables 2.5 and 2.6.

Another aspect that should be raised is that of the deployment of small CHP facilities at the final end-user level. This CHP capacity, which reaches 96 MWe in 2030, is deployed due to the direct adoption in the model of the final energy demand projections in the Heating and Cooling sector as provided by the Cyprus University of Technology. The model simply deems that this is the most efficient way of consuming the fuel forcibly allocated to the system. It is expected that if the limits on fuel use for the Heating and Cooling sector are lifted from the model, this option will not appear to this high degree in the optimal solution. To do this, updated demands for Heating and Cooling will need to be expressed in terms of useful energy demand.

e. Transport Sector

Biofuels are liquid or gaseous transport fuels such as biodiesel and bioethanol which are made from biomass. They serve as a renewable alternative to fossil fuels in the EU's transport sector, contributing to reduction of greenhouse gas emissions and improvement the EU's security of supply.

Each member state is obliged to fulfil two obligatory targets for road transport fuels by 2020, setting by the relevant EU Directives, 2009/28/EC and 2009/30/EC: 10% of the energy consumption of transport sector comes from renewable sources such as biofuels, and fuel suppliers are required to reduce the greenhouse gas intensity of the transport fuels that they enter in the market by 6% compared with the fuel baseline standard (greenhouse gas emission of EU transport fuels mix in 2010). Currently, only biofuels are used in transport sector and the percentage of biofuels to transport fuels is at 2.5% and the greenhouse gas

emission reduction is at 1%. These targets will gradually be increased until 2020 in order to meet the obligatory targets.

Taking into account the provisions of new RES Directive (recast), the RES target for transport sector will be at the level of 10% for the period 2021-2030.

According to the results and all scenarios examined, the renewable energy targets is very challenging and very costly to be met comparing with the other sectors. The use of second generation biofuels, as its contribution counts double towards the achievement of the target will be the main RES in transport sector. Further penetration of plug in hybrid vehicles and electric vehicles contribute to meet the targets, while the use of natural gas to transport sector will be examine later.

iv. estimated trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectorial 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 RES projects were licenced for 15 or 20 years with the year of operation staring in 2005 and the majority of them after 2010. It is expected that after the expiration of their PPA, the projects will be operated under net-billing scheme or participate directly to the competitive electricity market.

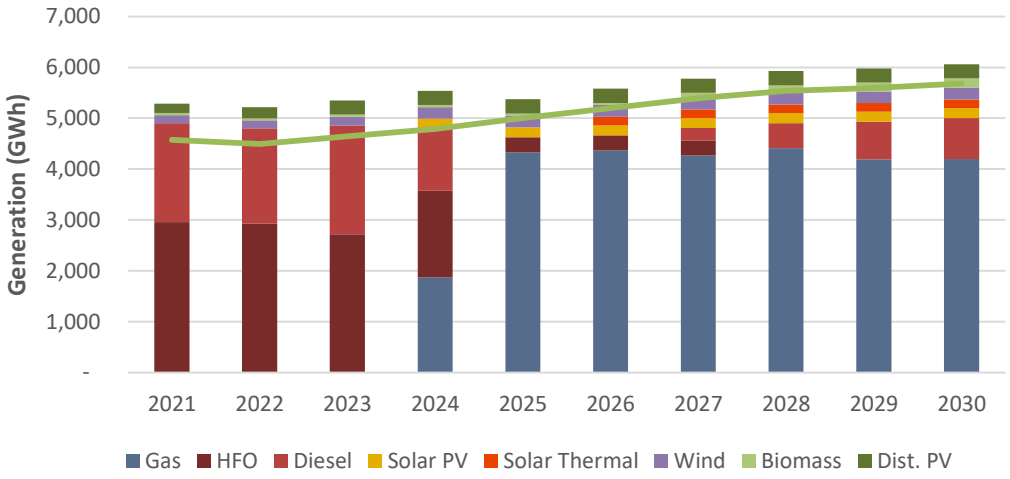


Figure 2.16. Energy Mix Generation for Various fuels from 2021-2030

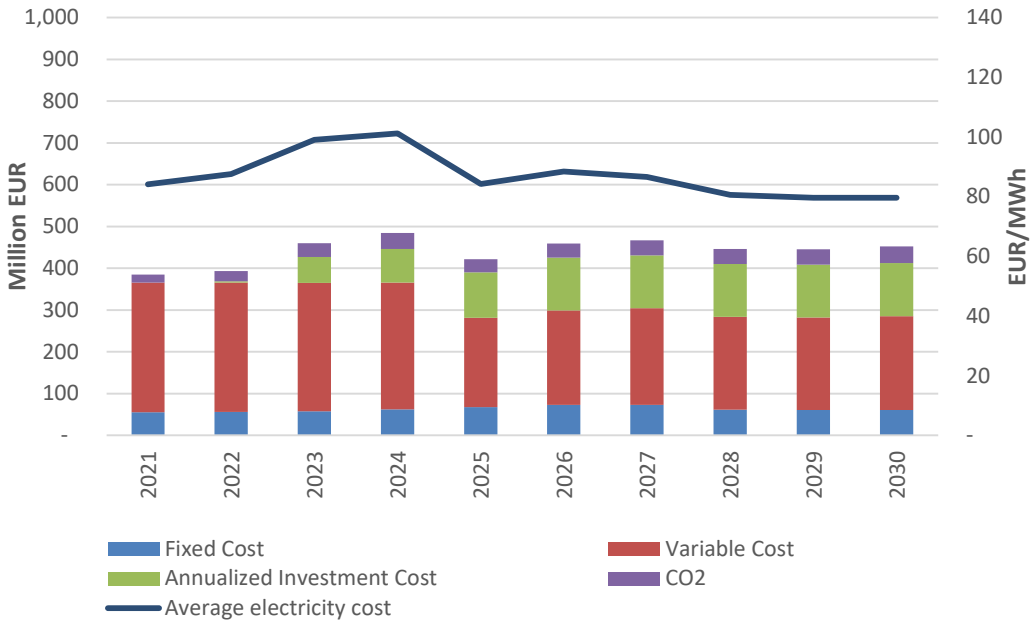


Figure 2.17. Breakdown of the Annualized system cost and the expected price of electricity assuming ideal market conditions.

Table 2.7. Capacity (MW) Mix of various Renewable Energy Technologies evolution.

Technology (MW)	**2020**	**2025**	**2030**
Light fuel oil CHP	0	85	96
Solar PV*	292	292	614
Solar Thermal	0	50	50
Wind	175	175	175
Biogas	10	25	29
Li-Ion Batteries	0	0	72
RES Penetration in Electricity		17.52%	24.39%

* This will be revised and normalized over time in order to take into account the existing policies and measures of the building Sector.

While the modelling exercise indicated that the Solar PV will be cost-optimum to be installed towards the end of the period, it is expected that the penetration will increase due to the competitive electricity market till to 2025 at least with up to 200 MW. This scenario will be re-examined shortly in order to identify the Grid Stability and the required reserves needed to support the systems at earlier stage. It should be noted that in previous modelling exercise, high level of RES at earlier stage where Electricity demand was lower, lead to higher level of curtailment, even with battery storage.

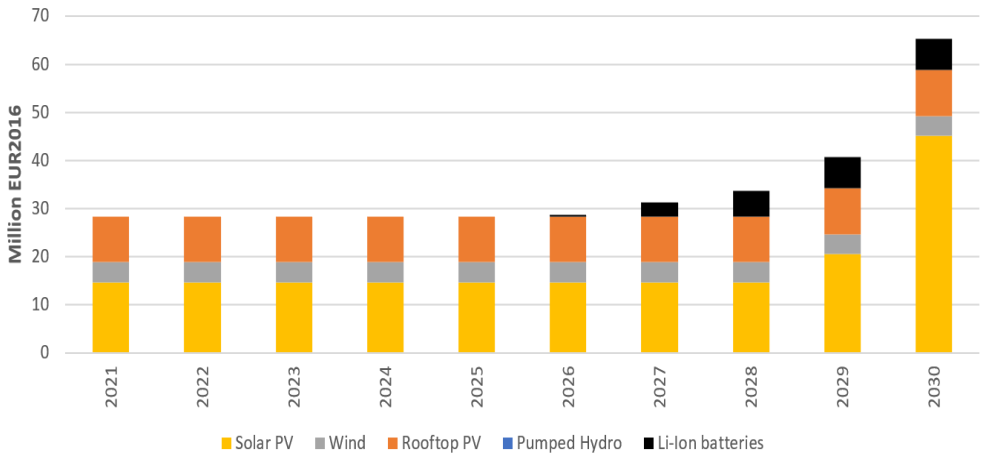


Figure 2.18. Yearly Investment Cost per Technology from 2021-2030

Extensive strategic planning and considerable investments in infrastructure are required to integrate indigenous energy sources in the power supply system, as well as to promote Energy Efficiency and Alternative Transport within the island.

It should be noted that while the generation assets at Vasilikos, Cyprus' main power station, are currently fired with diesel and heavy fuel oil, significant investment has already taken place to allow these assets to run on natural gas when it becomes available.

The cumulative expenses (include all the investments + fuel costs + O&M + CO2 costs) needed to achieve the Scenario with Existing Measures for the period 2021-2030 is shown in the Appendix III.

v. 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

vi. If applicable , other national trajectories and objectives, including long-term or sectorial ones (e.g. , share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, energy communities and self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

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 from 1.1.2021 will be nearly zero energy buildings 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 make 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[13], while the studies initially showed that there was a technical potential after the impact assessment results and further analysis performed by another study 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 going towards the heat-pumps and not to district heating and cooling. Hence more actions shall be taken regarding the use of more RES in the electrification of heating and cooling sector (e.g. use of PV).

Especially in the case of Cyprus where:

- The heating degrees days have been reduced
- the cooling needs are increased
- no waste cooling exists, it is seeming that such network will be difficult to implemented in the near future and make economic sense.

2.2. Dimension Energy efficiency

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

The indicative national energy efficiency contribution to achieving the Union's binding energy efficiency target of 30% in 2030 as referred to in Article 1(1) and Article 3(4) of Directive 2012/27/EU [version as amended in accordance with proposal COM(2016)761], based on either primary or final energy consumption, primary or final energy savings, or energy intensity; expressed in terms of absolute level of primary energy consumption and final energy consumption in 2020 and 2030, with a linear trajectory for that contribution from 2021 onwards; including the underlying methodology and the conversion factors used.

1. Projections of Final Energy Demand

In preparation of the National Energy and Climate Plan of Cyprus, long-term forecasts of final energy demand were updated. Compared to the previous projections, which were published in 2017 and were also used in the 4th National Energy Efficiency Action Plan of Cyprus, the current projections of energy consumption have taken into account the following updates:

- The updated energy balance of year 2015 and the more recent energy balances of years 2016 and 2017.
- The updated 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 21.7 billion Euros (at 2010 prices), whereas the macroeconomic forecast that was used in 2017 reported a GDP of 20.2 billion Euros (at 2010 prices) in 2020.
- The Euro - US dollar exchange rate assumed by the European Commission.

13 http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/52DA7EEECDF7D532C225828D00203A1B?OpenDocument

- The forecast of energy consumption in transport, which was based on a technical assistance study carried out by the German firm ifeu and had been used in the 4th NEEAP, was adapted to the latest official transport fuel consumption data of year 2017.
- The latest developments regarding the use of natural gas for power generation. According to the 4th NEEAP, this was expected to happen by the end of 2018, whereas current projections show natural gas penetration happening in the last quarter of year 2020.

Based on the above, the current update leads to an increase in projected final energy consumption in 2020 which is mainly due to:

a) the higher than previously expected energy consumption in 2016-2017; and
b) the stronger macroeconomic growth forecast for years 2018-2020.

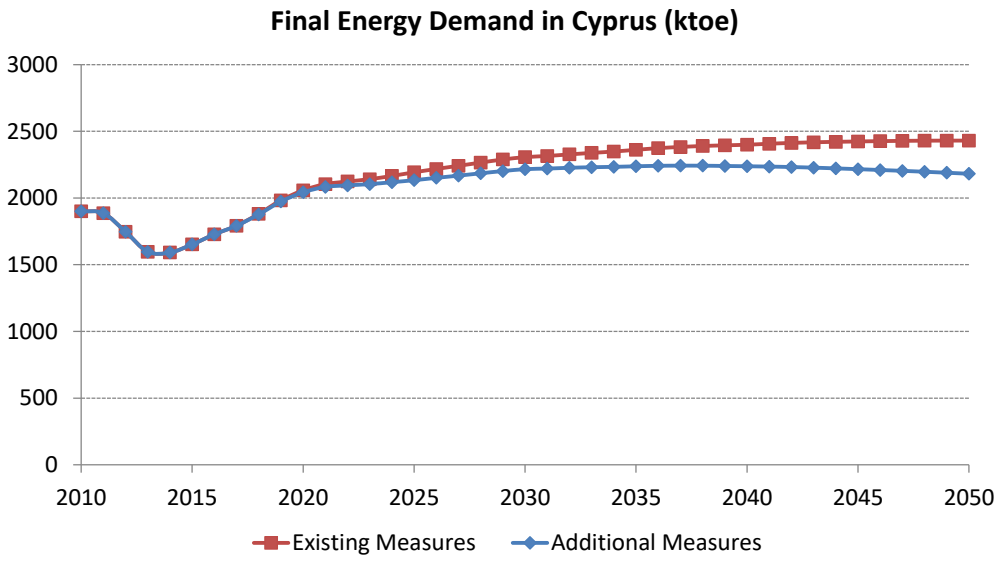
Final energy demand in all sectors is expected to increase faster according to our latest projections, mainly because of the stronger economic growth foreseen, despite a higher increase in energy prices because crude oil prices are expected to reach somewhat higher levels than those of the 4th NEEAP.

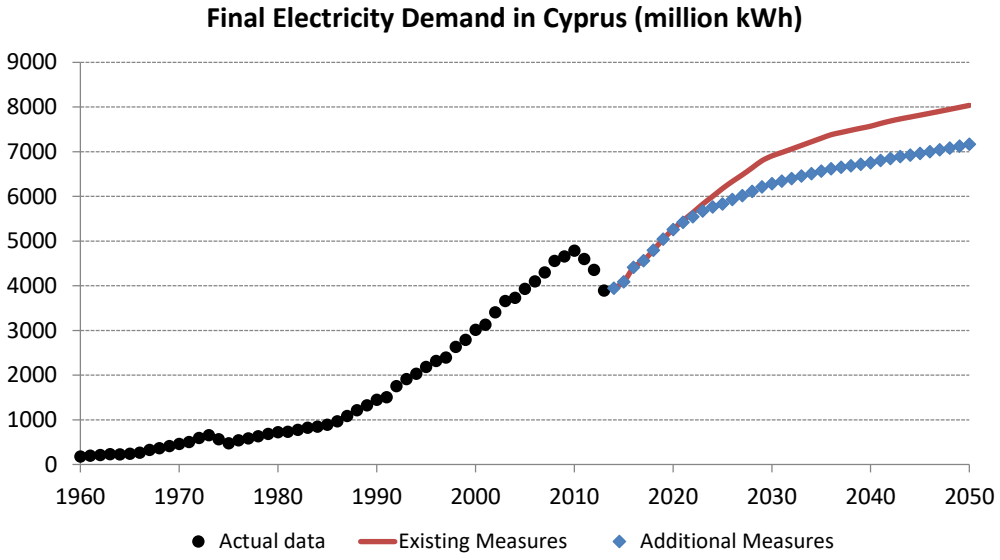
Figure 2.19 displays the projected evolution of final energy and electricity demand according to the two scenarios. Policies adopted in the Scenario with Additional Measures can help accelerate improvements in energy intensity and thus stabilise total final energy demand in the 2030s. Electricity demand, however, is still projected to increase because the further electrification of the economy counterbalances energy efficiency improvements; stronger measures would be needed in order to revert the increasing trend of electricity consumption.

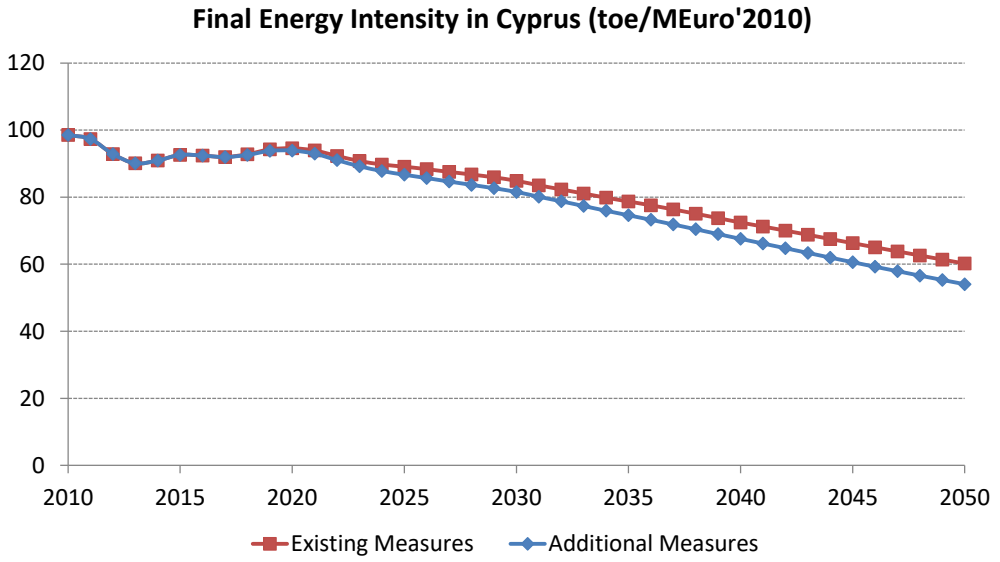
2. Projections of Primary Energy Demand

The updated outlook of primary energy demand in Cyprus, combines the final energy demand projections described in the previous section with projections for the power generation sector which were conducted in the frame of the JRC study that was performed for MECI.

The Scenario with Additional Measures of this study was combined with power generation scenario, but taking into account a delay in the arrival of natural gas in Cyprus, it is foreseen to be used in power plants only in the last quarter of 2020. This is in line with what is considered by the government of Cyprus as a realistic policy option by the time of this writing (November 2018).


Final Energy Demand in Cyprus (ktoe)
3000
2500
2000
1500
1000
500
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Existing Measures
Additional Measures


Final Electricity Demand in Cyprus (million kWh)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Actual data
Existing Measures
Additional Measures


Final Energy Intensity in Cyprus (toe/MEuro'2010)
120
100
80
60
40
20
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Existing Measures
Additional Measures

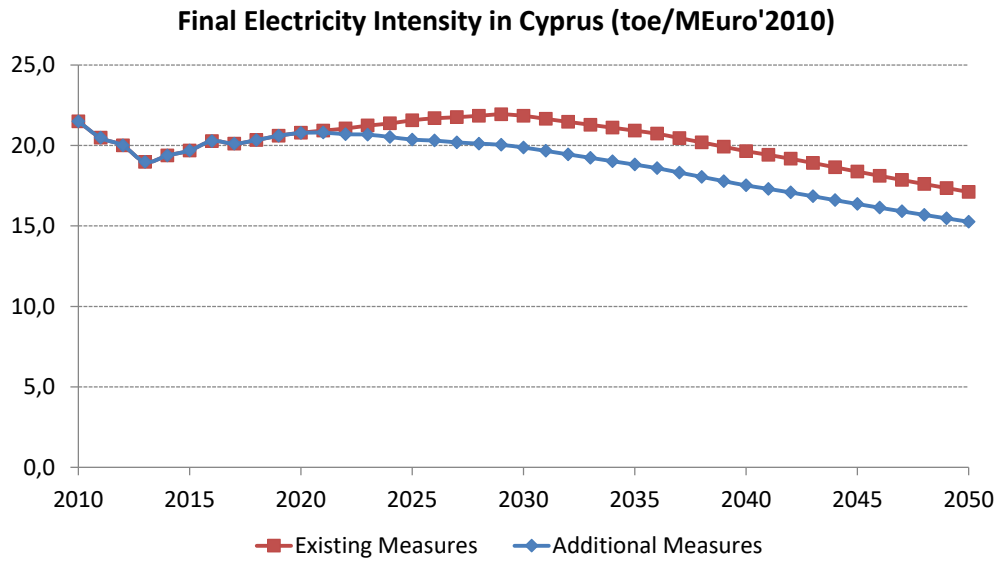


Figure 2.19. Forecast of final energy and electricity demand in Cyprus (in absolute terms and related to national GDP) up to 2050

Table 2.8. Key parameters of power generation according to forecasts with an optimization model.

	Average efficiency of all power generation	Thermal efficiency of power plants		
	With additional measures (natural gas end of 2020)	Steam turbine plants using fuel oi	CCGT plant using diesel oil	CCGT point using Natural Gas
2018	43,6%	35%	49%	52%
2019	45,0%			
2020	48,0%			
2021	57,4%			
2022	57,5%			
2023	57,6%			
2024	59,2%			
2025	59,3%			
2026	59,4%			
2027	59,4%			
2028	59,5%			
2029	59,7%			
2030	59,9%			

Table 2.9 displays the projected evolution of primary energy consumption in Cyprus in years 2020 and 2030, and the energy savings foreseen in these two years. Compared to the EU-wide targets of 1312 Mtoe and 1128 Mtoe of primary energy consumption in years 2020 and 2030 respectively[14], Table 2.9 shows that **Cyprus (under the additional measures scenario) is expected to account** for 0.19% of the EU-wide target in 2020 and to **0.23% of the EU-wide target for primary energy consumption in 2030**.

[14] The corresponding EU28 targets were 1483 and 1273 Mtoe respectively. Taking into account the baseline primary energy consumption of the UK in 2020 and 2030 according to the EU Reference Scenario of 2007, and applying the 20% target in 2020 and the 32.5% target in 2030 for EU27, the EU27 targets become 1312 and 1128 Mtoe for 2020 and 2030 respectively.

In the additional measures scenario, the projections for primary energy consumption of Cyprus for 2020 and 2030 are lower than the respective projections for Cyprus in the 2007 EU Reference Scenario (the projection for Cyprus in 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 no more than 2.6 Mtoe in 2030 is lower of about 9.5% than respective projection for Cyprus primary energy consumption in 2030 as was projected in the 2007 Reference Scenario.**

A reduction of 9.5% results in having primary energy consumption for Cyprus in 2030, no more than of 2,6 Mtoe, which means reducing the primary energy consumption of the country about **300Ktoe** compared to what is has been projected in the 2007 EU Reference Scenario. Table 2.10 provides the sectoral energy demand forecasts in year 2030.

Table 2.9. Trajectory of primary energy consumption (Mtoe) with additional measures, 2020-2030

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary energy consumption (Mtoe)	2.5	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.6	2.6

Table 2.10. Sectoral projections of final energy demand in 2030

Sectoral projections of final energy demand in 2030 *(Mtoe)*	**With Additional Measures**
Primary Energy Consumption	2,6
Total final energy consumption	2,2
Final energy consumption – industry	0,3
Final energy consumption - households	0,4
Final energy consumption - agriculture	0,05
Final energy consumption - transport	1,1
Final energy consumption - services	0.3

Moreover, the "energy efficiency first" principle, has been considered in the preparation of the DINECP. In the development of the national scenario "with additional measures", energy efficiency measures were prioritized. Therefore, the most cost-effective measures energy efficiency measures are included in it, instead of other measures, aiming to contribute in reaching the national energy and climate obligations for 2030.

ii. 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 [version as amended in accordance with proposal COM(2016)761],

The first estimation shows that the cumulative target of the period 2021-2030 will be between 235,000-238,000 toe. Given that no official data are available at the moment for the national final energy consumption of the years 2017 and 2018, the national cumulative target of the period 2021-2030 will be recalculated in 2019 and will be included in the final national NECP of 2019.

iii. Objectives for the long-term renovation of the national stock of residential and commercial buildings (both public and private)

Most of the existing building stock has a relatively poor energy performance, as the majority (94% for residential sector and 83% for tertiary sector), was built before the implementation of minimum energy performance requirements. Implementation of energy efficiency measures in existing buildings has been mobilized mainly through financial incentives. The Long-term Renovation Strategy (LTRS) which was initially issued 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 building by 2030. LTRS will be revised for second time until April 2020, according to the requirements set by Directive 2018/844/EU. During the development of the new LTRS measurable progress indicators will 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.

iv. The total floor area to be renovated or equivalent annual energy savings to be achieved from 2021 to 2030 under Article 5 on the exemplary role of public bodies' buildings of Directive 2012/27/EU

Article 5 of Directive 2012/27/EU allows Member States, in place of the requirement to renovate annually 3% of the total area of buildings owned and used by central government authorities, to 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 3,316 GWh have to be achieved for the period 2014 – 2020. 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 target might need to be recalculated depending on possible modification of public building stock.

v. If applicable, other national objectives, including long-term targets or strategies and sectorial targets. National objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Not applicable

2.3. Dimension Energy security

i. The elements set out in Article 4(c)

i bis. 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 LNG imports and the development of the necessary infrastructure by the end of 2020, will end the current energy isolation and diversify Cyprus' energy sources.

Most of the imported energy sources are from neighbouring countries, e.g. most of the oil products are imported from Greece and Israel. Due to the small amounts that are imported, the possibility to diversify the energy supply from third countries is very limited.

In the frame of the Government's decision of relocation of the oil products terminals and other facilities from the seafront of Larnaca area and the development of the necessary infrastructure for the import of natural gas, the New Energy and Industrial Area of Vasilikos was established on November of 2014. Oil companies are now building their own terminals at Vasilicos Area, while 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 in order to relocate its own oil stocks in Cyprus, as well as, to reduce the annual storage cost.

Regarding the coping with constrained or interrupted supply of an energy sources, in the case of oil products, KODAP is responsible for the maintenance of the national emergency oil stocks equivalent to 90 days of net imports. 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.

In the case of constrained or interrupted supply of electricity, TSOC submits to CERA whenever it is considered necessary an updated action plan for the restoration of the electrical system after 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. It is expected that in 2019 the TSOC will submit to CERA revised version of the Action Plan. 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 quality and commercial quality, CERA is in the process of taking the decision on preparing such indicators with external assistance.

ii. If 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.

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 section 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 are in discussions to finalize and agree on the Aphrodite Development and Production Plan. Natural gas production from the Aphrodite field is expected to begin in four to five years after the approval of the proposed Development and Production Plan (DPP) and the issue of the Exploitation License. The Aphrodite field gas, according to the proposed DPP, is going to be transmitted to Egypt, mainly to Idku LNG Terminal for liquefaction and re-export as well as for the domestic market. Moreover, in February 2018, the ENI / Total joint venture completed the first exploratory well "Calypso 1" in Block 6, which resulted in a gas discovery. The ExxonMobil/ Qatar Petroleum Consortium proceeds with its plans for two exploration wells in Block 10 in late 2018 -early 2019.

2.4. Dimension Internal energy market

2.4.1. Electricity interconnectivity

i. The level of electricity interconnectivity that the Member State aims for in 2030 in consideration of the electricity interconnection target for 2030 of at least 15%, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10% and the following indicators of the urgency of action:

EuroAsia Interconnector (Project Of Common Interest 3.10.1, 3.10.2, 3.10.3) is considered as an additional measure. It is a cross border interconnector between Greek, 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. This Project of Common Interest is also related to:

- Energy Security Dimension as it promotes diversification of routes and ends the energy isolation of Cyprus.
- Decarbonization Dimension because electricity imports will preferably come from natural gas or renewable sources which contribute to the reduction of greenhouse emissions.

However, the implementation of the project is subjected to underway discussions between the European Commission, the Greek and Cypriot authorities. The final decision will be taken in the near future.

Project 219 - EuroAsia Interconnector

entsoe
Reliable Sustainable Connected

European network of transmission system operators (Entso-e) analysis that Euroasia Interconnector will contribute to social and economic welfare between **€580m and €1.12 billion in each year.**

European network of transmission system operators calculated that expected reduction of **CO2** is between **1.3 million tone to 6.8 million tone** each year or between **21% and 110% of total Cyprus emission**.

Scenario specific CBA indicators	EP2020	Vision 1	Vision 2	Vision 3	Vision 4
B1 SoS (MWh/yr)	N/A	N/A	N/A	N/A	N/A
B2 SEW (MEuros/yr)	360 ±40	660 ±100	580 ±90	1010 ±150	1120 ±170
B3 RES integration (GWh/yr)	750 ±50	4080 ±820	4070 ±810	3260 ±650	3010 ±600
B4 Losses (GWh/yr)	1250 ±125	1100 ±110	1100 ±110	1225 ±122	2050 ±205
B4 Losses (Meuros/yr)	54 ±5	59 ±6	51 ±5	73 ±7	137 ±14
B5 CO2 Emissions (kT/year)	±100	-5600 ±800	-6800 ±	-2300 ±300	-1300 ±200

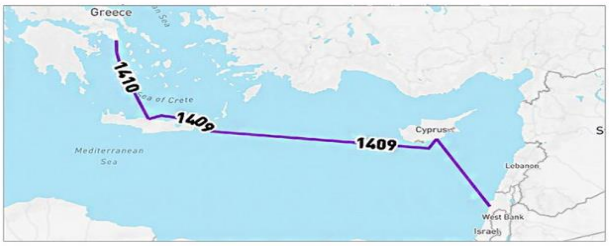


Figure 2.20. EuroAsia Interconnector Cross-Border benefits

2.4.2. Energy transmission infrastructure

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

The T-TYNDP includes the construction of new transmission substations and the upgrading of existing transmission substations to enhance energy security and improve the efficiency of the system operations through remote control and system data acquisition. Thirty-six related projects in a total of a budget of 139.5 million Euros are listed in the T-TYNDP. The financing of these projects will be done through the national budget of the Transmission System Owner (the Electricity Authority of Cyprus).

Similarly, 28 projects are included in the T-TYNDP regarding the construction of new and the upgrading of existing transmission lines (Overhead and Underground Cables). The primary aim of these projects is to increase power transfers between vital energy centres on the island, as well as increase the fault level capacity of the system, therefore increasing system security and resilience. The total budget for these projects is 128 million Euros and will be funded through the national budget of the Transmission System Owner (the Electricity Authority of Cyprus).

The ability of the system to manage and control non-critical loads such as Chillers, Storage Heaters and Water Pumps through tariffs will be upgraded through the replacement of the existing 66kV with a 132 kV Ripple Control System with increased load management and control functionalities. The new Ripple Control System will aid at reducing peak load during

resource scarcity or high system marginal cost conditions (e.g. summer peak, winter peak) by reducing the need to add to the system a high fuel cost (diesel) generation set. Better management of non-critical loads will also reduce the cost of purchasing CO2 emission rights and for maintaining high levels of reserve requirements during peak load conditions. The cost of this project is estimated at 4.2 million Euros and will be financed through the national budget of the Transmission System Owner (the Electricity Authority of Cyprus). Completion date is estimated latest by 2020.

The T-TYNDP foresees the installation of 2x75MVAr 132kV Variable Shunt Reactors to manage increased capacitive reactive power, due to the increasing undergrounding of O/H HV Lines. Installation of reactors (inductors) is expected to reduce system losses and avoid over-voltages caused by capacitive reactance. The cost of this project is estimated at 3.1 million Euros and will be financed through the national budget of the Transmission System Owner (the Electricity Authority of Cyprus). Completion date is estimated end of 2018, early 2019.

Modernization Projects

The commitment of Cyprus to promote the transformation of the traditional vertically and centrally organised electricity system to an electricity system that will be able to accommodate non-dispatchable decentralised generation is reflected in the T-TYNDP financial commitment. A budget of ca. 112 million Euros will be dedicated to investing in modernisation projects up to the year 2027, which is equivalent to an expenditure of 130 Euros per capita. In particular:

1. Installation of Advanced Metering Infrastructure (AMI) and Smart Meters to enable optimization and control of the distribution system, increase the penetration of distributed renewable sources, enable aggregation of RES, demand response and storage, increase direct final customer participation in all market stages (active customers). The deployment of advanced metering infrastructure (AMI) includes the roll-out of 400 000 smart meters. The AMI contributes to increased system observability, load and generation forecasting accuracy, accurate system analysis and planning, load management alternative to ripple control, optimisation of the operation of the distribution system, supervisory control and data acquisition of PV systems and so forth. The major functionality of the AMI is the metering data requisition moreover, control through head end systems (no billing). The total budget of the project is estimated at 75-80 million euros and will be realised in 7 phases, each involving the installation of 57143 smart meters. Each phase ends in January starting from year 2021 (end of phase 1) to January 2027 (end of year 2027). The financing of this project will be through the national budget of the distribution system owner.
2. Installation of a Meter Data Management System (MDMS) to facilitate independent and efficient Meter and Customer Information Management. 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. The total budget of the project is estimated at ca. 19 million Euros and is expected to be completed by 2021. The financing of this project will be through the national budget of the Distribution System Owner.

3. Installation of a Distribution SCADA/ADMS for the automation of the Distribution System Control and Data Acquisition and the Management of the Distribution System at the Medium Voltage Level. 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 Cyprus TSO. The SCADA communicates with 175 RTUs installed at MV Level equipment. The ADMS shall provide, among other things, 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, Power Quality Monitoring. The total budget of the project is estimated at 9.2 million Euros and is expected to be completed by 2022. The financing of this project will be through the national budget of the Distribution System Owner.

Key gas transmission infrastructure projects

Cyprus, has an energy isolated system. Its geographic position and the small market size, make it difficult for investors to invest (for financial reasons). Currently, Cyprus' energy system is heavily depended on conventional fossil fuels, approximately account 90 %.

1. 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. This Project of Common Interest is also related to:

- Energy Security Dimension as it promotes diversification of sources and routes, ends the isolation of Cyprus and Crete, supports new gas production in the E. Mediterranean, including EU indigenous sources, facilitates gas exchanges in S.E. Europe,
- Energy Efficiency Dimension as natural gas is more efficient fuel than the other fossil fuels and
- Decarbonization Dimension because of the import of natural gas in Cyprus fuel market which has lower emissions than conventional fuels.

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.

In 2013, the EastMed pipeline received a CEF grant of 2 million € to cover 50% of the costs for the execution of the Pre-FEED (Front-End-Engineering Design) studies, namely technical feasibility studies, reconnaissance marine survey, as well as economic, financial and competitiveness studies. The objective of the Action was to provide the necessary information to producers and downstream gas market operators, allowing the assessment and possible selection of the project, as preferred export option, for part of the Levantine Basin gas resources, ensuring a new reliable source of supply via a diversified route.

The Action (implementation schedule May 2015 to March 2018) contributed to enhancing the maturity of the project with a detailed and complete technical and economic assessment, enabling the project promoter to provide reliable data to the upstream producers and to downstream operators for the selection of the PCI as preferred export route.

The results of the Action, which clarified that the project was technically feasible and economically viable, allowed the project promoter to proceed to the FEED phase. This is also being supported by CEF with a grant of 34.5 million €. The main objective of the new Action is to carry out the studies required to provide the necessary technical inputs for starting the implementation phase of the PCI. The Action will build on the results of the Pre-FEED analysis and include the main remaining steps, leading to the Final Investment Decision for the PCI. In particular, the Action entails detailed design (FEED) and marine survey activities, including all the engineering details for project implementation, as well as permitting activities in Cyprus and Greece, which are expected to be completed by the 31/12/2020.

Tendering is underway regarding the provision of Front End Engineering Design services related to the offshore and onshore pipeline sections as well as Front End Engineering Design services related to the facilities (Compressor and metering stations) of the EastMed pipeline.

The successful completion of the Action, (implementation schedule May 2018 to December 2021) will lead to the identification of the project routing, the definition of the project costs and the technical specifications required for tendering the construction phase of the project, and will result in the submission of the Environment Impact Assessment (EIA) application to obtain the relevant permits from the competent authorities in Cyprus and Greece, paving the way to start the construction and operation of the EastMed Pipeline.

With regard to the EastMed pipeline's Implementation schedule, following the completion of the FEED phase, FID may be taken during 2021. This would allow construction to start in 2021 and to be completed by end of 2024. Commercial operation could start in 2025. IGI Poseidon will be finalizing the notification of the EastMed project to the national Competent Authority, with regard to establishing the start of the permit granting process, in due course, pursuant to Article 10 of Regulation 347/2013.

Apart from the endorsement of the EastMed as an EU PCI and the afore-mentioned CEF grants, the successful development of the pipeline has also benefitted from the support received from the concerned national governments. In this regard, in December 2017 the governments of Cyprus, Greece, Israel and Italy signed a Memorandum of Understanding underlining their support for the project and mandating a high-level group, composed of senior national officials, to prepare an Intergovernmental Agreement which should be signed by the end of 2018.

The planned budget for this project is around 5 billion Euros.

2. **CyprusGas2EU** (Project of Common Interest no. 7.3.5 former 7.3.2) promoted by Ministry of Energy, Commerce and Industry (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 end of year 2021.

The infrastructure project consists of (a) a Floating Storage and Regasification Unit (FSRU) (b) a jetty 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.

. All necessary technical designs for this activity are secured and are already under execution through the CEF funded CYnergy action (2016-EU-SA-0009).

This Project of Common Interest is also related to:

- 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,
- Energy Efficiency Dimension as natural gas is more efficient fuel than the other fossil fuels and
- Decarbonization Dimension because LNG has lower emissions than conventional fuels.

The capital cost of the Project is estimated to be around €300 million, which will be financed through a combination of a grant from the EU CEF (Connecting Europe Facility) of up to €101 million (project was approved by CEF in January 2018), debt financing (e.g. EIB, etc.) and possibly an equity investment by the Electricity Authority of Cyprus (EAC).

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

1. **EuroAfrica Interconnector** is an interconnector between Greek, Cypriot, and Egypt power grids via submarine power cable. The Interconnector is an energy highway bridging Africa and Europe. It will have a capacity to transmit 2,000 megawatts of electricity in either direction. The indicative cost for the 1,707-km interconnector is 4 billion €.

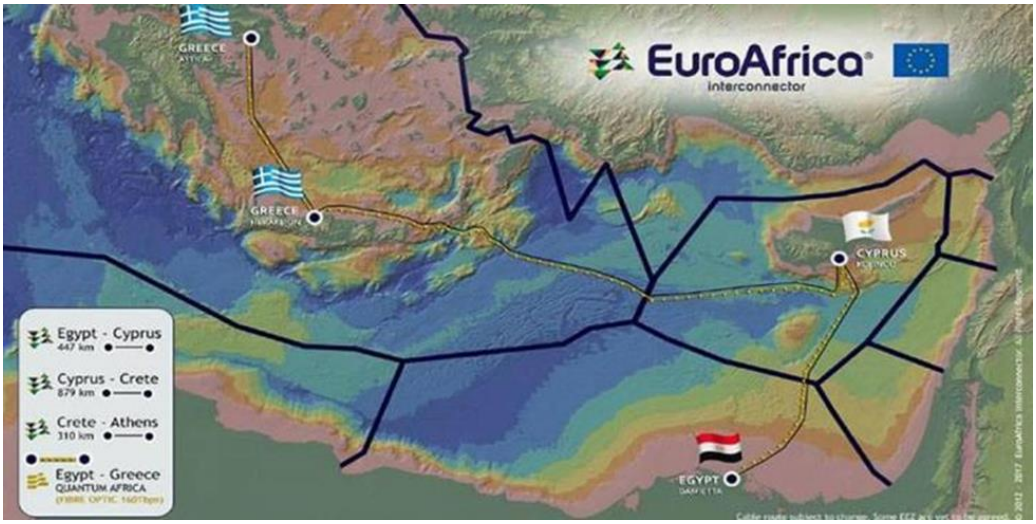


Figure 2.21. EuroAfrica Interconnector Cross-Border benefits

The EuroAfrica Interconnector will link Egypt with Cypriot and Greek power grids through the island of Crete with high-voltage direct current submarine power cable of length around 1,707-kilometre.

Benefits of EuroAfrica Interconnector

- Ensures secure energy supply of Cyprus, Greece and Egypt connecting them with Trans-European Networks of Energy (TEN-E).
- Ends the energy isolation of Cyprus and Crete and connects them with Trans-European Networks of Energy (TEN-E). Cyprus is the last EU Member State fully isolated without energy interconnections.
- For new Egypt and Cyprus gas finding enables path towards new markets in form of electricity. Also enables path for electricity produced from renewable energy sources. Development of renewable energy sources on isolated systems like Cyprus and Crete could compromise islands electrical systems due to chaotic production fluctuations. Electricity interconnection will enable high percentage of renewable sources in such isolated systems.
- Contributes to EU target for 15% of electricity interconnection between Member States.
- Promotes development of renewable energy sources and significantly contributes to the reduction of CO2.
- Offers significant economic and geopolitical benefits to three involved countries. It is expected that socio-economic benefits will be around 10 billion €.

2. **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 24-28". The current base case capacity is 800 mmscfd. 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. The indicative Capex for this pipeline is estimated around 1,1 billion € and the indicative Opex around 10 million € per year.

2.4.3. Market integration

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 legislation, 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;

Promotion of competitively determined electricity prices - Increase system flexibility

1. Revise the regulatory framework to increase the use of flexibility in distribution networks and facilitate the market development of flexibility services with the objective of providing solutions alternative to system expansion. Subject to the final provisions of the recast Electricity Directive, allow the DSO to procure flexibility services, including congestion management in their service area, especially from distributed generation, demand response or storage and 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 Cyprus TSO. The local flexibility markets shall be operated by the Market Operator in close cooperation with the DSO. Preliminary timeframe for this Target is year 2020.

2. Remove market barriers in wholesale and retail markets to demand response and ensure that independent aggregators can compete on a level playing field. Revise the regulatory framework to define the technical modalities for the participation of Demand Response in the electricity market, including the provision of balancing energy and ancillary services. Demand Response should be able to participate in the wholesale electricity markets (Forward and Day Ahead) as well as the Balancing Market and the ancillary services market by their technical requirements for participation in these markets and the capabilities of demand response. The Demand Response service shall be provided via Demand Service Providers and shall include the participation of aggregated loads. The implementation shall be based on "Supplier Compensation", either via the uncorrected or corrected model. Preliminary timeframe for this Target is year 2022.

3. Revise the regulatory framework to expand aggregation. Currently, Market Rules 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. Subject to the final provisions of the recast Electricity Directive, Market Rules will be revised 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). Aggregators shall be able to participate at the wholesale energy market as well as the reserve and balancing markets. Preliminary timeframe for this Target is year 2022.

4. Revise the regulatory framework to enable the participation of storage in the electricity market. The provision of storage services should be market-based and competitive. Storage services shall be critical to the provision of flexibility services. Subject to the final provisions of the recast Electricity Directive, generators, aggregators and (self) consumers will be allowed to own and operate storage systems and, therefore, buy on the Day-Ahead Market

the energy to be stored, as well as to sell the stored energy on the Forward and Day-Ahead Markets. Producers, aggregators and (self) consumers should be allowed to participate with storage systems also to the Balancing Market. These systems may offer to the system dynamic performance which is qualitatively superior to conventional generation. 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. Cyprus TSO to set up products for the participation of energy storage, such as the provision of non-conventional ancillary services (e.g. synthetic inertia, fast primary regulation). Preliminary timeframe for this Target is year 2021.

5. Introduction of dynamic-pricing retail contracts. Subject to the final provisions of the recast Electricity Directive, Dynamic pricing retail contracts will be introduced gradually as the installation of smart meters is roll out and the competitive electricity market becomes operational. 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. Preliminary timeframe for this Target is 2024-2025.

ia. If 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 should be met;

1. Amendment of Priority Dispatch of RES and HECHP. Amendment of the 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. Preliminary timeframe for this Target is year 2019.

2. Technical Biding Limits of RES and HECHP in the Balancing Market. The Regulator to permit the submission of a Negative Priced Downward Offers in the Balancing Market, to provide an incentive to RES to participate in downward balancing. Preliminary timeframe for this Target is year 2019.

ib. If 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;

As mentioned in Section 2.4.2, Cyprus intends to install Advanced Metering Infrastructure (AMI) and Smart Meters to enable optimization and control of the distribution system, increase the penetration of distributed renewable sources, enable aggregation of RES, demand response and storage, increase direct final customer participation in all market stages (active customers). The deployment of advanced metering infrastructure (AMI) includes the roll-out of 400 000 smart meters.

ii. 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 shall be met

Introduce a strategic (contingency) reserve mechanism to address short-term capacity adequacy concerns. Subject to the final provisions of the recast Electricity Regulation, the amended Trade and Settlement Rules introduce a strategic (contingency) reserve mechanism. 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 Cyprus 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. Preliminary timeframe for this Target is year 2020.

iii. If applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

1. Introduction of Independent Comparison Tools including websites for smaller customers to assess the merits of different energy offers available on the market. Subject to the final provisions of the recast Electricity Directive, 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. Preliminary timeframe for this Target is 2020-2021.

2. Right of customers to switch suppliers within a maximum of three weeks. Subject to the final provisions of the recast Electricity Directive, amend national legislation to provide the right to customers with the right of switching suppliers within a maximum of three weeks. By no later than 2027, the technical process of switching supplier shall take no longer than 24 hours and shall be possible on any working day. Preliminary timeframe for this target is 2020-2021.

3. Target regarding introduction of Energy Communities (see Article 16 of proposed recast Electricity Directive). Subject to the final provisions of the recast Electricity Directive, amend national legislation to provide a framework for the activation of 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. Preliminary timeframe for this Target is 2020-2021.

2.4.4. Energy poverty

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 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».

The total number of beneficiaries who fall within the definition of energy poverty is 27000 representing approximately 3,1% of the total population and are eligible to apply and benefit from all the existing measures such as:

(a) reduced prices on electricity tariffs (special electricity tariff 08) which is based on a Ministerial Decision

(b) financial incentives (depending on the available budget) for installing a net-metering Photovoltaic system

(c) financial incentives (depending on the available budget) 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 above-mentioned number of beneficiaries who fall within the definition of energy poverty is not considered significant and thus, no national indicative objective to reduce energy poverty will be included in the Cyprus integrated national energy and climate plan.

It is noted that the number of vulnerable consumers who fall within the definition of energy poverty and have applied and benefited so far (September 2018) from the above measures is 12888 representing 1,5% of the total population.

2.5. Dimension Research, innovation and competitiveness

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

The objective in research and innovation is the best possible production of research work and innovative products and services that will help increase energy efficiency, energy security, and renewable energy and tackle climate change. The research and innovation related to energy and climate should at the same time add value to businesses and provide useful insights for policy makers. In 2016 Cyprus has spent 95m Euros in research and innovation which constitutes 0, 5% of the Gross National Product (GNP). The national target is that investments in research and innovation will rise up to 1,5% of GNP in the near future, which means an annual spending of 285m Euros. 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 energy and climate, for 2020 – 2030, has to be raised to 15m Euros, while currently it doesn't exceed 5m Euros.

The Cabinet of Ministers decision of the 9th of October 2018 (Decision No. 85.833) has set new Governance System of Research and Innovation. Energy and climate issues will be examined and developed in this new framework and is expected to be a priority.

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

The Working Group for Research, Innovation and Competitiveness is operating as a consultation forum between the public sector, the private sector and academia to identify priority areas of research and innovation that simultaneously will respond to the national targets for decarbonization and the market needs. The Working Group is taking into account the Strategic Energy and Technology Plan (SET-Plan), the Cyprus Smart Specialization Strategy the feedback by the other Working Groups in the framework of NECP, and how Cyprus could be positioned in the global market of research and innovation. The priority areas will be set by the end of 2019.

iii. If 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 consumers with adverse social impacts and act as a brake on growth, as it negatively affects the competitiveness of products and services.

Additionally, 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.

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 other sectors will contribute towards this goal.

3. Policies and measures

3.1. Dimension Decarbonisation

3.1.1. GHG emissions and removals

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

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

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

The culmination of the collective efforts that took place in recent years to reduce greenhouse gas emissions and hence to tackle climate change effectively by the global community is the historic agreement reached in Paris in December 2015 at the 21st Session of the Parties to the United Nations Framework Convention on Climate Change. The Paris Agreement entered into force on 4 November 2016. Cyprus completed the ratification process of the Paris Agreement on 4 January 2017.

The effects of climate change are becoming increasingly felt both in Europe and globally. These are expected to be particularly serious for Cyprus, as climate change is already evident; over the last 100 years there has been an increase in average temperature and a decrease in average annual rainfall. The effects of climate change will not only continue but will also increase over the next decades.

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

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

Climate change mitigation is one of the main targets identified in the Cypriot strategy for sustainable development launched by MARDE in 2007[15]. The objective of the strategy is the development of a set of principles for the formulation of an action plan in line with international challenges, and in accordance with EU policy directions and adjusted to the specific national circumstances.

Strategic planning

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

The importance of climate change mitigation (and adaptation) for Cyprus is highlighted through its inclusion as the first target of the strategic plan of the Department of Environment and as one of the strategic goals of the Ministry of Agriculture, Rural Development and Environment[16].

National Policies and measures

Given that Cyprus was a non-Annex I party to the UNFCCC until 2013, national policies and measures for the reduction of greenhouse gas emissions have been developed for the first time in 2007 for the implementation of EU Decision 280/2004[17]. Ever since, policies and measures are reviewed, revised and updated every 2 years. The involved ministries are presented in Table 3.1. The sections that follow present the policies and measures by sector.

Table 3.1. Involved ministries to climate change mitigation policies and measures

Ministry	Issues
Ministry of Agriculture, Rural Development and Environment	Agriculture Forestry Land use Waste

[15] http://www.un.org/esa/agenda21/natlinfo/countr/cyprus/nsds_2007en.pdf

[16] http://www.moa.gov.cy/moa/agriculture.nsf/Stratigikos%20Sxediasmos%202016-2018%20EL%20-%20YpOik%20150901.pdf

[17] Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol

Ministry of Energy, Trade, Industry and Tourism	Energy
Ministry of Transport, Communications and Works	Transport
Ministry of Finance	National budgets
Ministry of Interior	Land use

i. Policies and measures to achieve the target set under Regulation [ESR] as referred to in 2.1.1 and policies and measures to comply with Regulation [LULUCF], covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement

Several policies and measures affecting the abovementioned objectives originate at the EU level, such as the fuel quality directive, emission performance standards for new vehicles, the regulation on fluorinated greenhouse gases, the landfill directive and the common agricultural policy. These are not described further here.

Further, several policies and measures targeting renewable energy and energy efficiency affect the reduction of greenhouse gas emissions in Cyprus. An overview of key policies affecting the national climate target to 2030 is presented in Table 3.2.

Several additional measures are under examination, especially for the transport sector which are anticipated, to have considerable contribution to the reduction of greenhouse gas emissions. These measures will be included in the final submission of the NECP.

Table 3.2. Overview of key policies affecting the national climate target to 2030

Cross sectoral	Information
Energy	Renewable Energy penetration Energy Efficiency (including transport measures) Natural gas in electricity production
Industry	F-gases recovery
Agriculture	Promotion of anaerobic digestion for the treatment of animal waste
Waste	Reduction of waste to solid waste disposal sites from sorting at production level
	Reduction of organics to landfills
	Increase of amount of organic wastes treated by composting
	Promotion of anaerobic digestion for the treatment of the organic fraction of the municipal solid waste
	Biogas recovery from old sold waste disposal sites (deep unmanaged)

ENERGY

Please refer to sections 3.1.2, 3.2, 3.3 and 3.4.

INDUSTRY

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

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

Box 4.8. Key information

Competent authority
Department of Environment, Ministry of Agriculture, Rural Development and Environment
Other involved authorities
-
Type
Legislative, compulsory
National legislation
Fluorinated greenhouse gases Law (No. 62(I)/2016 and 46(I)/2017)
Relevant EU legislation
Regulation on fluorinated greenhouse gases 517/2014
Measures towards attainment
- Implementation of "polluter pays" principle; each producer will have to participate in an appropriate scheme for management of f-gases that have been recovered

AGRICULTURE

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.

WASTE

With the EU Landfill Directive being the main guiding force, in combination to the improvement of the infrastructure of the country, Cyprus has developed and implementing during the recent years the National Municipal Waste Management Plan of 2015-2021 which is currently undergoing a major revision[18]. The implementation of the strategy 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 establishing separate collection systems by local authorities,
- Establishment of extended producer responsibility (EPR) in streams other than packaging waste,
- Establishment of a landfill tax/levy,
- Banning the disposal of certain waste streams from entering into landfills (e.g. green waste, high calorific value waste, etc.)

The adaptations of the strategy that are envisaged:

a) One Sanitary Landfill and one Residual Sanitary Landfill (supplementing MBT unit at Koshi) were constructed and operated (both meet the requirements of directive 99/31/EC). The MBT unit was constructed and operated from 01/04/2010 serving Larnaca - Ammochostos districts. The Plant was designed in a way that a high separation of recycled and biodegradable material is achieved. Another I.W.M.P (Integrated Waste Management Plant) serving Limassol district is expected to be operated by the year 2018.
b) The construction of the Green Point Network (22 collection points for the depositing of various waste streams out of households – bulky waste, green, textile, furniture, WEEE, etc.) is competed. The 4 Green Points, serving Paphos district are operated and the rest expected to be operated by 2018.
c) Separate collection at source was promoted at households, from the existing collective system for the packing waste serving also and all types of paper, created under the packaging directive while the competent authority promotes the separate

[18] The final plan is expected to be available at the end of 2019

collection from other household streams such as other organic waste e.g. food and green waste.

d) The construction works for the rehabilitation/restoration of the old non approved landfills, which are closed at Paphos and Larnaca - Ammochostos districts, were completed. The preparation of studies/documents regarding the rehabilitation/ restoration of the 20 non sanitary landfills of Nicosia district and the 44 sanitary landfills of Limassol district will be completed within 2018 and after that the construction works will begin.

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.

Two (2) landfills are still active in Cyprus but arrangements are made in order to be closed and restored. According to recent data, these two landfills are 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
- Reduction of organics to landfills
- Increase of amount of organic wastes treated by composting
- Promotion of anaerobic digestion for the treatment of the organic fraction of the municipal solid waste

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

Climate Change and Forests

The island has already been affected by climate change and consequently the forests suffer by the prolonged droughts which put the forest ecosystem under serious water stress and high fire risk.

The Department of Forests adopts and applies actions aiming to the adaptation of forest stands (natural and artificial) to climate change. The strategic intention "Protection of the environment and promotion of resource efficiency" is achieved through the protection of forests from fires, overgrazing, human interventions and other biotic and abiotic factors that affect them. Additionally, these actions contribute to the reduction of greenhouse gas emissions and increase carbon sequestration. These actions can be grouped into three main areas as listed in the Statement of Forest Policy:

a) Protecting forests against forest fires,
b) Adaptation of forests to climate change and enhancing the contribution of forests in addressing climate change and improvement of main forests and forested areas,
c) Improvement and expansion of forests.

The above actions include the following measures:

a) Maintenance and improvement of biodiversity in forests. In particular, the conservation of biodiversity is enhanced by the protection of flora and fauna and the protection and restoration of their habitats,
b) Protection of forests from illegal logging: The implementation of Law 139 (I) / 2013 acts as a tool to control most of the available firewood locally and apply criminal penalties for any illegal or uncontrolled logging and / or disposal of the local timber market without authorization,
c) Reforestation of Amiantos (asbestos) Mine as well as restoration of abandoned mines in cooperation with the Competent Authorities (the Department of Geological Survey and the Mines Service),
d) Protection of forests and enhancement of their structure and resistance to climate change through the Rural Development Program 2014 – 2020.

In particular, through the Rural Development Program 2014 - 2020, a number of activities and actions have been promoted under Measure 8 (Investments in forest area development and improvement of the viability of forests). The Action 8.5.3 includes thinning operations in dense forest stands, with the purpose of improving the structure of forests, the adaptation of forest stands to climate change, the reduction of emissions and increase the absorption of greenhouse gases. The implementation of targeted thinning is expected to improve stability and resilience to other disturbances, such as drought, increase of temperature and prolonged heat waves (as a result of climate change).

Additionally the Department of Forests participates in European and International co-funded projects (LIFE+, Interreg etc.) which aim to protect threatened species and ecosystems from the impacts of climate change and succeed their adaptation and sustainable management.

ii. Where relevant, regional cooperation in this area

iii. If applicable, without prejudice to the applicability of State aid rules, financing measures, including EU support and the use of EU funds, in this area at national level

3.1.2. Renewable energy

i. Policies and measures to achieve the national contribution to the binding EU-level 2030 target for renewable energy and trajectories as referred to in Article 4(a)(2), and, if applicable or available, the elements presented in 2.1.2 including sector- and technology-specific measures

Cyprus Government has development various support schemes, incentives and soft measures over the period 2008-2018 in order to further support the Renewable Energy Sources penetration. Especially in the Electricity Sector where the penetration was very low, a lot of support schemes have been developed over the period.

Based on the various incentives the broken down generation, by technologies and the renewable based electricity production over the past 10 years in Cyprus is listed in the table below.

Table 3.3. Electricity Generation per Technology until 2017

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

In the table below, broken down by technologies and how much was the electricity produced from renewable sources sold at a subsidized price over the past 10 years, is shown. The electricity generated for own consumption is not included.

Table 3.4. Renewable electricity sold at a subsidized price (GWh per year) until 2017.

	Solar	Wind	Biogas	Total
2008	1.64	0	7.81	*9.45*
2009	2.91	0	19.85	*22.76*
2010	4.59	31.37	24.8	*60.76*
2011	9.16	114.25	39.71	*163.12*
2012	18.65	185.05	37.63	*241.33*
2013	43.82	230.61	35.83	*310.26*
2014	60.11	182.42	37.46	*279.99*

2015	**85.75**	**221.43**	**37.41**	***344.59***
2016	**94.41**	**226.27**	**36.61**	***357.29***
2017	**111.36**	**211.02**	**36.5**	***358.88***

From 2016 onwards all the new installed RES projects (PV Parks) they are not receiving any subsidy.

Table 3.5, shows the broken down cost, by technologies and the actual subsidy payed to renewable energy producers.

Table 3.5. Subsidy paid to RES Producers in million Euro per Year

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Solar	0.03	0.1	0.055	1.365	2.369	4.402	9.624	11.349	14.005	11.957
Wind	0	0	0	3.607	2.223	5.725	10.433	19.637	24.815	18.299
Biogas*			**0.122**	**0.696**	**0**	**0**	**0.266**	**1.565**	**1.783**	**1.222**

*In 2013-2014 the market Price was higher than FiT Price for Biomass Projects. The excess amount was return to RES and Energy Efficiency fund.

In addition, in the table below there is an analysis broken down by technologies and the specific subsidy of the electricity produced from renewable sources in Cyprus over the past 10 years.

Table 3.6. Subsidy per renewable energy source in Cyprus for the period 2008-2017

Specific subsidy of the renewable electricity (EUR/MWh)	2008	2009	2010	2011	2012	2013	2014-2017
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
Wind		0.166€/kWh 20 years contract			0	0.145€/kWh 20 years contract	
Biomass	0.108€/kWh 20 years contract	0.135€/kWh 20 years contract					
Biogas	0	0.1145€/kWh 20 years contract					
Hydro	0	0	0	0	0	0	0

It should be also noted that as of 2015, all the new support schemes for Electricity production will receive the so-called avoidance cost, which corresponds to an ideal marker price. The scheme will continue until the full liberalization of the market, where the new subsidized electricity and the subsidies paid to producers in provided through avoidance

cost. The current selling price for electricity produced by renewable sources (avoidance cost) is available in the following link: https://www.eac.com.cy/EL/EAC/RenewableEnergySources/Pages/resenergypurcheac.aspx.

Electricity for own Consumption

Support schemes for the production of electricity from renewable energy sources for own use such Net-metering, net-billing and 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 building's 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.

Self-generation / Net billing

With Self-generation and Net-billing schemes, PV generated energy has to be self-consumed within the same 20-min time period it was generated. If local energy demand exceeds PV production, energy is imported from the grid. With Self-generation scheme, excess PV generation is exported to the grid without any economic compensation nor 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). Some existing burdens that exist (i.e. the long procedure needed for town planning or building permit), is expected to be overcome in the following years. This support scheme is the most effective for all industrial and commercial consumers, since the self-consumer is almost excluded for all the taxes for the energy that is self-consumed.

***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 will be developed and provided free of charge to both energy consultants and to the end users. With this tool (that will be monitored and maintain from the government), the end user can have an indication of what size system to install that can make economic sense. On the other hand 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.) .

The operation of the energy system will 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.

Software 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.

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.

Ministry of Energy has requested a Technical Assistance, through SRSS, 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 will need to be indentified and examine, is the dust forecast prediction, which occurs vary often in the Area of Cyprus.

Forecasting 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 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 will help to increase the share of VRE generation that can be safely and economically integrated into an electricity grid.

Alternative fuels – Biofuels in transport

Biofuels are liquid or gaseous transport fuels such as biodiesel and bioethanol which are made from biomass. They serve as a renewable alternative to fossil fuels in the EU's transport sector, contributing to reduction of greenhouse gas emissions and improvement the EU's security of supply. Each member state is obliged to fulfil two obligatory targets by 2020, setting by the relevant EU Directives, 2009/28/EC and 2009/30/EC: 10% of the energy consumption of transport sector comes from renewable sources such as biofuels, and fuel suppliers are required to reduce the greenhouse gas intensity of the transport fuels that they enter in the market by 6% compared with the fuel baseline standard (greenhouse gas emission of EU transport fuels mix in 2010). Currently, the percentage of biofuels to transport fuels is at 2.5% and the greenhouse gas emission reduction is at 1%. These targets will gradually be increased until 2020 in order to meet the obligatory targets.

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

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 high charging stations in high ways and public roads. Although the numbers are still very small, the expectation is that the registration of electric cars will increase considerably over the next five years. New electric car sales are expected to comprise 25%-50% of total vehicles on the road by 2040.

The installation of LPG systems in vehicles and LPG refuelling points in retail stations have also started in 2017 and will reduce the emission of pollutants and fuel consumption in old vehicles.

ii. Where relevant, specific measures for regional cooperation, as well as, optionally, 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 presented in 2.1.2

Cyprus, in the basic reference scenario is remaining isolated (see below all possible scenarios). Even if this might not be the case, at the time being is premature to plan and design specific measures for regional cooperation. Cyprus Authorities, will prepare a scenario for the national contribution and trajectories for exchanging energy with other neighbouring countries like Greece and Israel while with latter is very difficult to obtain information.

After analysing all the possible options for Cyprus and due to various uncertainties and political decisions, as well as various externalities, it was decided that the scenario with existing measures that it will be adopted for the current NECP is as shown below:

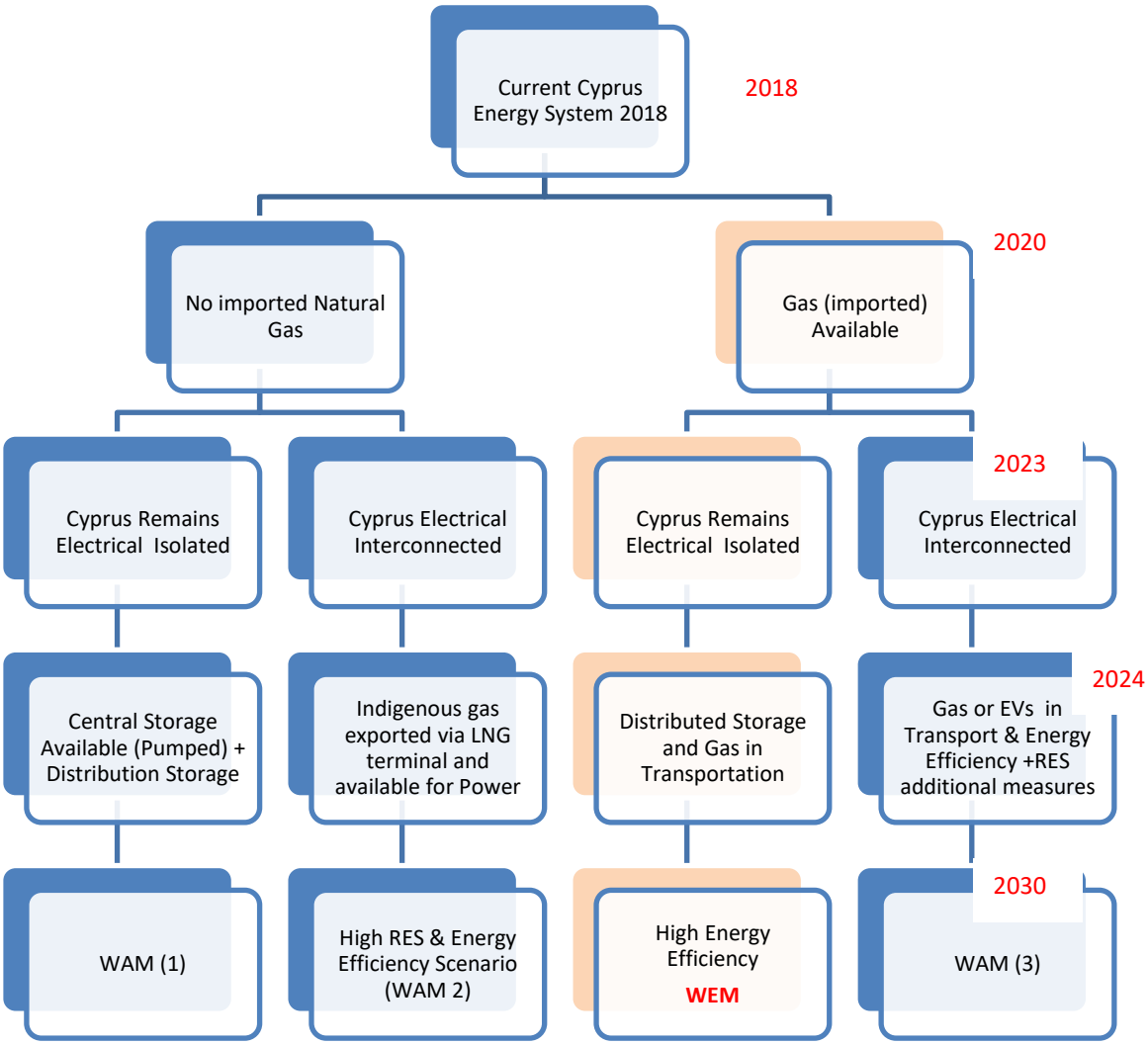


Figure 3.1. Policy Decision Tree and Scenario's With Existing Measures (WEM) and 3 possible pathways With Additional Measures (WAM)

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

iiibis. When applicable, the assessment of the support for electricity from renewable sources that Member States have to carry out pursuant to Article 6 (1b) of the Directive XXXX on the promotion of the use of energy from renewable sources.

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

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

vi. If applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:

3.1.3. Other elements of the dimension

i. If applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

iii. Policies and measures to achieve other national targets, if applicable

iv. Policies and measures to achieve low-emission mobility (including electrification of transport)

iva. If applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

3.2. Dimension Energy efficiency

The existing and additional policies and measures for energy efficiency are described below. It should be clarified that for the draft NECP, policies and measures are not spitted/allocated to points 3.2 i to vii of the Annex I, Part1 of the Governance regulation). Related tables on policies and measures are included in the provided template. A summary table on the existing and additional polices and measures on energy efficiency is attached in Appendix II (in greek).

Existing policies and measures

The energy saving measures planned by 2020 and those that have been implemented in the previous years in each sector and those that will be implemented by 2020 (buildings sector, transport sector, residential sector, tertiary sector, public sector and industrial sector) for achieving the national target, as well as all legislative and non-legislative measures at national level for the promotion of energy efficiency.

The major implemented/ ongoing measures are:

Legislative measures (implemented /ongoing)

- ✓ Minimum energy performance requirements for new buildings, buildings that undergo major renovation and building elements that are 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.
- ✓ 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 promotion of combined heat and power generation systems and high efficiency standards in heating and cooling systems.
- ✓ Legislation for energy efficiency (energy efficiency in public sector, energy efficiency in metering and billing, in transformation, transmission and distribution, energy audits etc)
- ✓ Legislation for regulating the market for energy auditing in buildings, industries and transport and the operation of Energy Service Companies (ESCOs)
- ✓ Legislation for energy labeling and market surveillance
- ✓ Legislations for setting up energy efficiency obligation scheme for energy companies

Information and training measures (implemented/ongoing)

- ✓ 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 s 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 business. The energy manager monitors energy use in a business and promotes the implementation of actions to reduce energy consumption.
- ✓ Promotion of energy management system
- ✓ 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.
- ✓ Annual information campaigns for energy efficiency. The campaign uses the logo “Save energy-Save money”
- ✓ Annual competition for schools for promoting Energy Efficiency, 5 radio spots broadcasted by radio stations all over Cyprus, leaflets, workshops, annual fairs, lectures. Information actions promote energy efficiency investments, energy performance certificates, energy audits and energy performance contacting.

- ✓ More targeted awareness increase actions are implemented in 2018 and 2019 with technical assistance provided by EU (SRSS and Environment Agency Austria and Cyprus Energy Agency), in order to increased awareness of enterprises, industries, citizens, local authorities and journalists of the importance of energy efficiency and of opportunities to save energy and take steps towards saving energy. It will include: an electronic tool (in web-based user-friendly interface) for the calculation of energy savings that will enable households to have a clear view on cost effectiveness of potential energy saving measures, the establishment of the Energy Efficiency Network of enterprises and industries and Event-based awareness campaign for citizens, local authorities and journalists. Performance indicators will be used to evaluate their effectiveness.

Public financing schemes and other financial Measures (implemented/ongoing)

- ✓ 53 million euro has been secured by the European and Structural Funds 2014-2020 for grant schemes and projects for energy efficiency investments in private and public buildings. 33 million euro will be allocated for improving the energy efficiency for buildings used by SMEs and households while, the remaining amount will be allocated for improving the energy efficiency in central government public buildings. Moreover, 1,17 million Euro have been secured from the EU structural and cohesion funds for the period 2014-2020 for pilot projects of combined heat and power generation in public and semi-public buildings. The projects in public sector have started in 2018.
- ✓ The Ministry of Energy, Commerce and Industry (MECI) announced in 2017, the operation of a support scheme for the installation of cogeneration systems fueled 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.
- ✓ A support scheme (Saving – Upgrading) was enacted in 2015 for the energy renovation of existing houses and existing buildings owned or used by small and medium enterprises utilizing European and Structural Funds 2014-2020 (33 million euro). The support scheme provides direct grants for the application of thermal insulation and other energy efficiency measures in buildings that will upgrade their energy class on the building's Energy Performance Certificate to at least B or achieve energy saving of at least 40% or upgrade the building to the nearly zero energy level. A 2nd phase of a scheme was announced in 2018 providing grants for energy efficiency upgrade for households and multifamily buildings (European and Structural Funds 2014-2020)
- ✓ 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 5KW 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 (f national funding).
- ✓ Energy poverty, vulnerable consumers' categories and measures to protect them were defined in a Ministerial Decree which entered into force in 14/9/2015. The Ministerial Decree includes measures such as (a) reduced prices on electricity tariffs, (b) financial incentives for participating in a scheme for installing a net-metering

Photovoltaic system with a capacity of up to 3kW, (c) financial incentives for upgrading the energy efficiency of their houses, and (d) uninterrupted supply of electricity, during critical periods for those vulnerable consumers that continuous power supply is essential for reasons related to their health.

- ✓ Grant Scheme for the insulation of the roofs in the residential sector
- ✓ Grant Scheme for conducting energy audits in SMEs
- ✓ 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 (managed by the EIB, state's financial contribution € 40 million for 2019, funding is 85% from the European Commission and 15% of national participation)..
- ✓ Private financing institutions offer financing for energy efficiency investments, such as the energy loans for thermal insulation, for energy efficiency upgrade of buildings etc.
- ✓ In the framework of two new Interregional European programs between Cyprus and Greece (SYNERGEIN and STRATENERGY), 11 buildings in municipalities and wider public will be energy upgraded in the period 2018-2020.
- ✓ Targeted energy efficiency measures 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 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.
- ✓ Targeted energy efficiency measures at schools
- ✓ Increasing tax on electricity consumption for energy efficiency and renewables
- ✓ For the transport sector: measures to increase the use of a bicycle, to increase the use of public transportation, integrated fleet management system in governmental fleet, training and information on eco-driving etc.
- ✓ Excise duty on vehicles with a view to reducing CO2 emissions. This measure relates to the tax imposed on vehicles with a view to reducing CO2 emissions

Policies and measures for period 2021-2030

An In-Depth Assessment of the Energy Efficiency Potential in Cyprus has been conducted in the framework of a Technical Assistance project for the government of Cyprus and the aim was to assess the maximum theoretical and economically viable energy efficiency potential in Cyprus. A final energy demand forecast model was employed, which was specifically developed for the energy system of Cyprus. 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 computing future final energy consumption by sector and fuel. A large part of the input data used in this top-down forecast model was derived from detailed simulations of building energy demand for a number of representative residential and commercial buildings, using the EnergyPlus model. In this way a reconciliation of engineering with economic calculations was achieved. Three distinct scenarios were designed: a reference scenario, which incorporates all policies adopted until early 2016; a 'realistic scenario', which assumes the implementation of cost-optimal measures in all economic sectors under a modest deployment of financial resources; and a much more ambitious 'maximum technical potential scenario', which assumes an unprecedented mobilisation of financial and human resources that could lead to a deep renovation of all existing buildings and a substantial penetration of alternative fuels in transport. After an interval between 2013-2018, where energy use patterns were affected by the significant economic downturn of years 2013-2015, it is projected that overall energy intensity in Cyprus will continue its downward trend in the coming decades, mainly as a result of improved energy performance of buildings in the residential and tertiary sector. Road transport, which currently accounts for 40% of final energy demand, is expected to demonstrate a decline in energy intensity too, but a slower pace since it exhibits great inertia and thus a shift towards more use of public transport modes will take a long time to materialize. In line with the real-world financial and technical capacity of Cyprus, the Realistic Scenario foresees a small or modest improvement in the intensity of energy use. Under this scenario, an assessment of the cost-effectiveness of the different Energy Efficiency interventions is performed in order to illustrate the optimum mix of these interventions. This is done on the basis of their cost efficiency and affected number of end-users as well as to their attractiveness for the end-users and also from a macroeconomic perspective. Overall, the expected expenditure (capital cost), only for energy efficiency interventions for the household and service sector until 2030, in order to meet the targets resulted out of the realistic scenario which is considered as the energy efficiency scenario (additional measures), amount to at least 1 billion € and this is translated to a mean weighted ratio of annual investments at the level of around 0.33% of the estimated GDP over the 2018-2030 period.

To exploit the considerable potentials in the different sectors the main barriers preventing a broader uptake of energy efficiency measures limited financial support on the one hand and interest of final consumers on the other will be adequately addressed in the post 2020 period.

The regulatory framework will be further adjusted in order to establish a secure, consistent and market-oriented framework for energy efficiency interventions mainly targeting the building sector and to a less extent the transport sector. More emphasis will be put on issues related to standardization of energy services provided, the performance of such services and their procurement and operation in the public sector.

It is evident from the analysis provided in the context of this study, that the existing energy saving potential should be approached on a cost-efficient investment basis and to allow, even incentivize, the best performing interventions and instruments to scale-up.

The existing regulatory provisions with regard to the building code, Energy Performance Certificates, as well as energy audits for non-SMEs will be further enhanced in terms of monitoring processes and increased market value in order to create a sustainable regulatory framework for Energy Efficiency. In this context, the enhancement and extension (both also in time) of an obligation scheme for energy suppliers is proposed in order to increase relevance of the foreseen energy efficiency interventions on the market and to allow for the integration of these measures as new market mechanisms under a competitive framework. Though, the structure of the domestic energy market currently does not leave big room for competition among energy suppliers, considering the anticipated changes especially in the electricity market the introduction of such energy efficiency obligations can be expected to foster and accelerate the establishment of a functioning national energy service market.

The low-hanging fruits in terms of energy efficiency interventions still are not fully exploited and further emphasis will be given to awareness, training and information activities that would allow the fairly easily achievement of some significant energy savings.

A balanced mix of mandatory obligations as well as voluntary targets for the various energy consumers and suppliers will be considered. This needs to be done in a way that while going beyond the minimum mandatory instruments currently foreseen under the EED not to create market failures or uneven burden for some end-users or market participants. The instrument of energy audits especially for non-SMEs should be exploited far more in the future in both the service and industry sector and to be directly linked with any kind of state financial support.

Any regulatory market barrier should be addressed as efficient and as fast as possible in order not to witness market bottlenecks or lock-in effects. For this reason, mainly capacity building measures for various stakeholders groups (e.g. building installers, energy managers, lawyers, bankers) will be timely planned and implemented. The introduction of standardized tools and procedures as well as the development of electronic databases, registries and communication platforms are also considered key instruments for the successful tackling of the existing mainly market-related barriers.

However, the most sever barrier for the achievement of the planned savings is the limited available budget for such kind of interventions. 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. Public support will continue to play a vital and indispensable role in the achievement of the targeted energy savings and as such the appropriate new energy efficiency financing instruments will be deployed and be in operation in due course. 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.

The establishment of a dedicated energy efficiency revolving fund is proposed (soft loans) allowing the sustainable medium-term design of national support schemes for energy efficiency interventions. The success or not of this proposed fund is closely associated with the involvement and cooperation with the domestic banking sector and for this reason the

active and direct participation of the latter sector should be thoroughly discussed and ultimately guaranteed before the launch of support programs under this Fund.

In this context the possibility of additional inflows to this fund will be assessed and considered, mainly in the framework of carbon/green taxes, however without jeopardizing the existence of an initial capital for the medium-term fund operation. The capital for the fund operation is overall proposed to be allocated from the national Cohesion and Structural funds.

Benchmarking assessment and analysis in order to support the efficient planning and distribution of public funds is essential and to this end the current data set of specific energy consumption data for various end-use sectors needs to be systematically broadened and detailed. Market surveys and wider participation of market associations in the various national energy efficiency schemes (e.g. voluntary agreements) and exploitation of data collected by the energy managers of the public buildings and the stock of issued energy building certificates in the framework of dedicated Information System databases and platforms are proposed to be one of the first administrative driven actions.

The Government is examining a fiscally neutral green tax reform, which can significantly contribute towards transition to an economically and environmentally sustainable development. A gradual implementation of environmental taxes to sectors (that are not subject to the EU Emissions Trading System) and at the same the reduction of other expenses related e.g to labor cost, is expected to lead to energy savings and will notable reduce the energy dependency of Cyprus. It is noted that this measure, due to the expected large impact on reducing the national energy consumption, will simultaneously contribute to the achievement of obligations of the country for 2030 regarding energy efficiency, the reduction of the carbon dioxide emissions and the increase of share for renewable energy sources. In general, a fiscally neutral gradual green tax reform can have substantially positive effects both on environmental and economic performance of a country and enable the transition to a more productive, more resource-efficient and less polluting economy.

In the household/residential sector, while not undermining the acceleration of new building requirements (i.e. deep renovations leading to nZEB consumption), any new instrument will be designed to be cost-attractive as well as implementable in market terms. Programmes with a fast market uptake (i.e. roof insulation, heat pumps, solar thermal) allowing both comprehensive and stand-alone interventions shall be priorities. Linking these types of interventions in the household sector to the proposed Energy Efficiency Obligation Schemes will be considered in order to bridge the regulatory and financial gaps and to allow an upscale of the deemed beneficiaries.

In the service sector targeted sub-sectors for tailored initiatives are proposed to be the tourism and the industry food, diary, tobacco sector, while as far as the public sector is concerned emphasis should be given to hospitals and energy efficiency upgrade of street lighting. Since the latter is primarily under the responsibility of municipalities and communes, targeted schemes would need to be designed to empower and/or support local government to programme, procure and implement such measures, while a priority should again be given to the mobilisation of private capital through light energy performance contracting.

Moreover, MECI, with technical assistance from SRSS completed two studies, one by JRC and one by GIZ, that looked into the barriers that hinder the development of the ESCO market in Cyprus. These, given the results of these studies, such as the preparation of template tender

studies provide a list of solutions, measures and actions that can be taken in order to overcome these barriers. Targeted and well-designed actions will be taken documents as standard procedures for procuring ESCO projects in public sector. More actions will include capacity building, targeted trainings, information workshops and events for removing barriers that impede the uptake of energy performance contracting and the implementation of energy efficiency investments in general

Ministry of Energy, Commerce and Industry is working together with the Department of Spatial Planning and Housing to revise the existing requirements that qualify a building to receive an extra 5% building factor. These requirements are examined to go beyond requirements for NZEB at least for new buildings.

The Directive 2018/844/EU amending Directive 2010/31/EU on energy efficiency of buildings has to be transposed to national legislation by March 2020. As a result, new measures will be implemented in the building sector and onwards. The most notable ones are:

a) Setting measurable progress indicators in building renovation
b) Integration of electromobility infrastructure in build environment
c) Smart readiness indicator for buildings
d) Promotion of building automation and control systems in heating and cooling systems

As far as concerns the agricultural sector the focus will be mainly given to higher penetration of RES systems for heating and cooling, achieving relative significant savings in terms of primary energy use and avoided cost of imported fuel, while also the adoption and support of an energy audit scheme could allow the identification of some significant cost efficient energy saving potential that could be addressed under tailored design national programmes either for specific sub-sectors (e.g. wineries) or agricultural process activities (e.g. greenhouses, drying). Given the poor knowledge on RES and energy efficiency potentials and technologies along the agricultural value chain all measures will need to be accompanied by awareness raising and training activities.

The transport sector, while exhibits a reference high potential for savings, due to existing and persistent modal shift patterns and overall infrastructure constraints is expected to perform quite modestly in terms of energy savings in the decade up to 2030. Action will focus on modifying the vehicle taxes to accelerate the penetration of higher efficient cars and light commercial vehicles, soft measures to promote a modal shift towards public, e-mobility and other alternative transport modes. To accelerate the uptake of e-mobility public funding the charging infrastructure and/or other regulatory measures for the set-up of charging infrastructure to enable the development of a free and competitive market will be considered, however only after a certain satisfactory level of cost-efficiency for these infrastructure investments is reached.

Finally, using the European Structural and Investment Funds in the new Programming Period 2020 – 2026, 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 30% of € 225 to € 250 million, should be allocated to the above thematic priority.

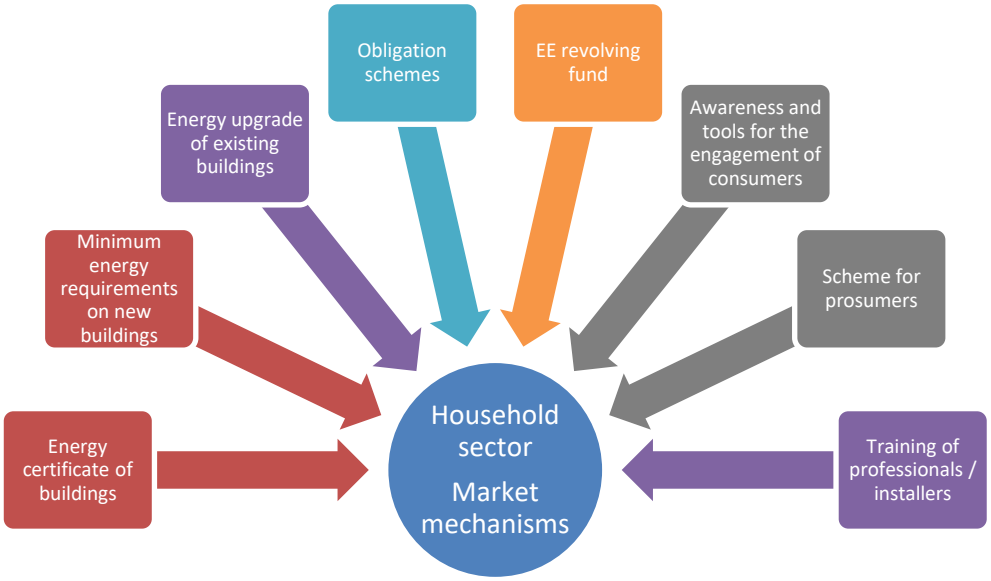


Figure 3.2. Overview of policies for the household sector

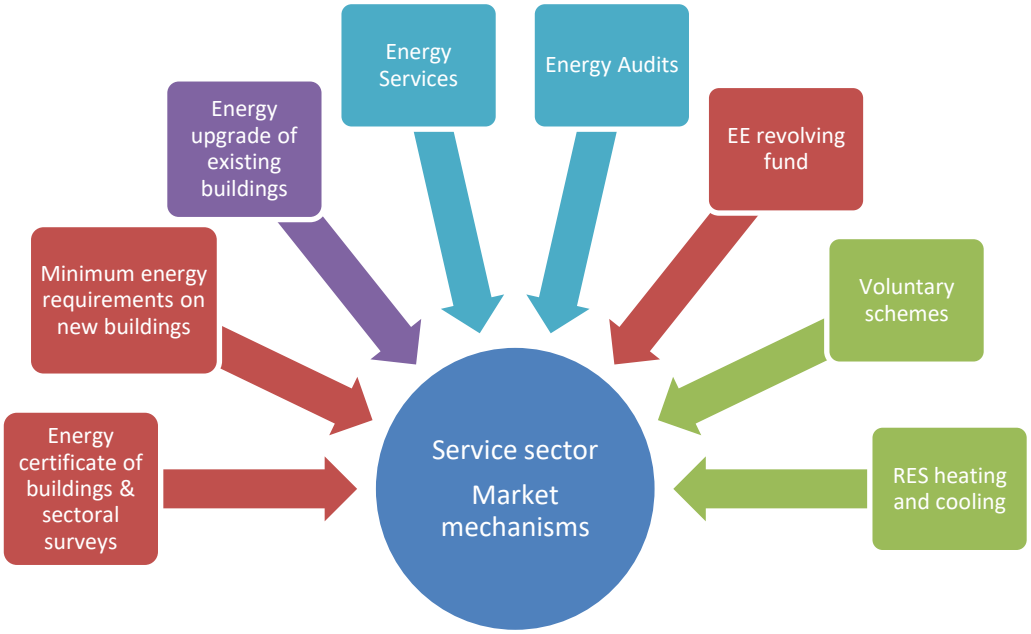


Figure 3.3. Overview of policies for the service sector

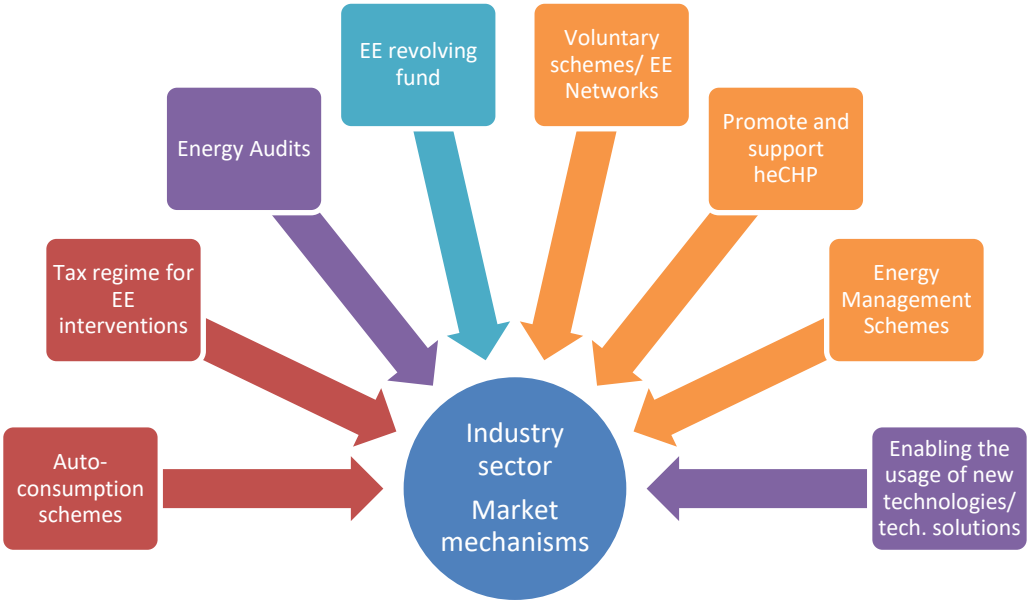


Figure 3.4. Overview of policies for the industry sector

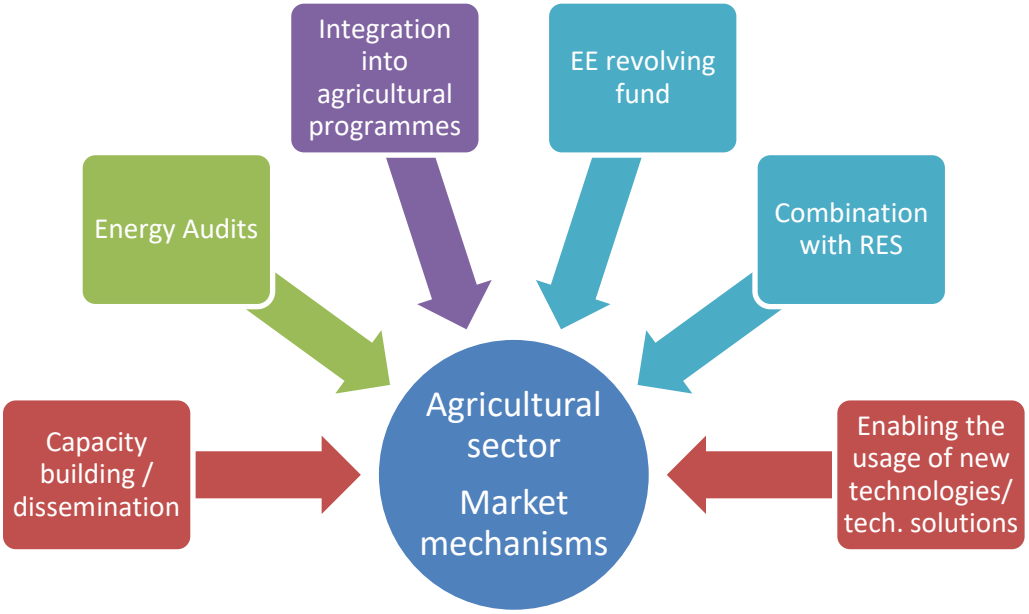


Figure 3.5. Overview of policies for the agricultural sector

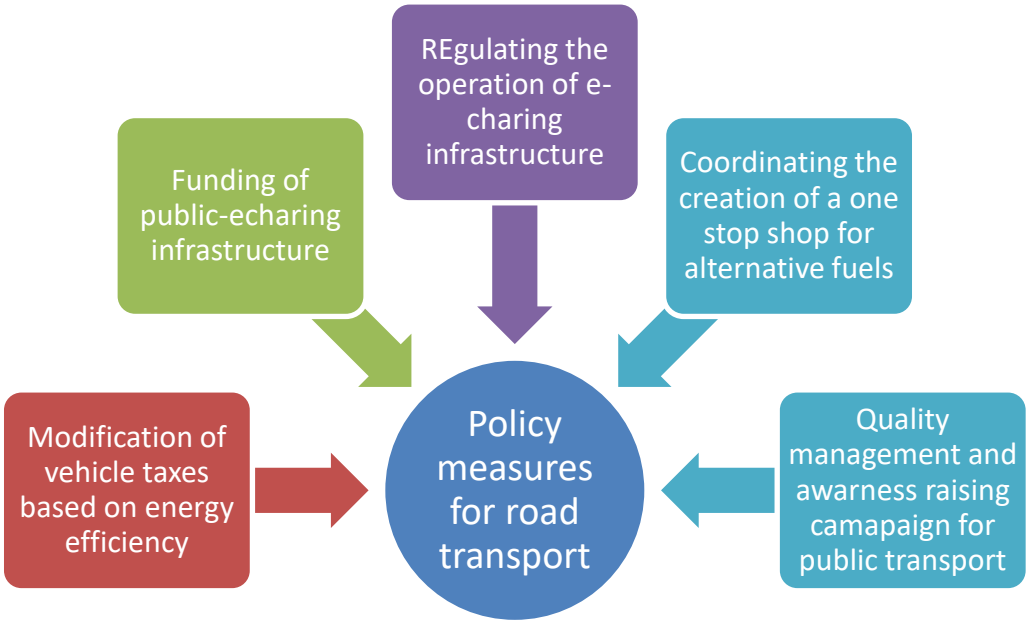


Figure 3.6. Overview of policies for the transport sector

TRANSPORT

In 2016, road transport emissions contributed 23% of the total national emissions excluding LULUCF (Kythreotou and Mesimeris, 2018). The emissions from road transport increased by 68% compared to 1990. According to information from the International Road Federation, Cyprus has the highest car ownership rate in the world with 742 cars per 1,000 people. Other means of transport are very low compared to other countries: 3% public transport and less than 2% bicycle (Ministry of Communications and Public Works, 2010).

In addition to the importance for emissions, transport is an issue of particularly great interest to the society of Cyprus, due to the very large growth of the number of privately owned cars and the associated problems in traffic that are experienced, especially in the capital, Nicosia. Even though many studies have been completed since the 1990s on how to deal with traffic in the urban areas of Cyprus and especially Nicosia, only recently action has been taken and measures are being implemented.

Policies and measures that have already been adopted and are planned aim to reduce the energy consumption of road transport sector contributing to the achievement of the indicative national energy efficiency target and the long-term union greenhouse gas emissions commitments consistent with Paris Agreement. One of the main efforts is to decrease the modal share of vehicles by 30%, increase the modal share for the public transport trips by 20% and of pedestrians and cyclists by 20%, expecting to lead to more than 10% reduction of the consumption of energy from road transport sector by 2030. The adoption of appropriate measures has led to the increase of the use of energy efficient vehicles and vehicles with low or zero GHG emissions, although there is still significant podetial for energy efficiency improvement of the sector. The deployment on alternative fuels infrastructure will contribute to the penetration of alternative fuels in transport sector, especially alternative fuels with low or zero GHG emissions. Another target is the share of renewables to the energy consumption of road transport sector to be at least 10% by 2020,

contributing to the GHG reduction and the diversification of energy mix of the transport sector. This target is continuing after 2020 and becoming stricter for 2030.

Policies and Measures

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

Actions such as improvement of infrastructure for further encouragement of use of public transport, cycling and walking and financial incentives to encourage new vehicles with low or zero emissions and discourage the use of vehicles with high emissions, can reduce the emissions of one of the most important sectors in Cyprus.

In particular, the increase of the modal share for the bus trips to 20% and the modal share of pedestrians and cyclists to 20% by 2030, will be achieved by the development and implementation of measures, such as high quality public transport services, zero or near zero emission zones, improvement of cycling and pedestrian facilities, effective parking policy, measures to promote the use of sustainable modes of transport and discouragement of the use of the passenger car and introduction of a tram system in Nicosia. Furthermore, the possibility of setting up a railway system linking the main urban areas should be further exploited.

According to the 2013 (Amending) Law on Motor Vehicles and Road Traffic, which entered into force on 1 January 2014, the annual circulation tax for each category M1 motor vehicle and the annual circulation tax for each category N1 motor vehicle, resulting from a category M1 motor vehicle and classified under the category of light lorry (VAN type), is calculated on the basis of the carbon dioxide emissions of the vehicle. In addition, as from 1 January 2014, category N2 and N3 vehicles (lorries) and M2 and M3 vehicles (buses) are registered in so far as they have been proven to comply with the 'EURO VI' requirements on the emission of pollutants.

A revision of the vehicle taxes and annual circulation taxes in order to promote the further use of low emission vehicles, including zero emissions vehicles (ZLEVs) has been prepared by amending the Motor Vehicles and Road Traffic Law. The proposed legislation is expected to enter into force in the first quarter of 2019.

The launch of the 4th Old Vehicle Scrapping and Replacement Scheme was announced on 11th of October 2010, whereas the scheme was implemented in 2011. Applications were admitted for a period of 2 months with final date on 13th of December 2010. The 4th Scheme related to the payment of a grant equal to EUR 1 800 and covered the scrapping of M1 category motor vehicles, older than 15 years old, under the condition that a new car with CO2 mass emissions lower or equal to 165gr/km would be purchased.

The new public transportation system was put into force in the second half of 2010. The new bus operators replaced part of their vehicles with new ones that have low fuel consumption and pollutant emissions, as compared to the old vehicles that were replaced. The Ministry of Transport, Communications and Works has recently 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.

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 applying the following:

- Additional Cost for the Tenderer to convert their bus fleet to Compressed Natural Gas (CNG), when such fuel source is available in Cyprus and the prerequisites for doing so exist.
- Additional Cost for the Tenderer to provide Electric Buses (maximum capacity 22 persons) in Historic City Centres of Nicosia, Limassol, Larnaca, Paphos and Famagusta (Paralimni & Agia Napa).
- The tenderer may submit a variant to their standard offer (of 10-year contract period), showing amortisation over a longer period – not exceeding 15years – for supplying a fleet with vehicles (buses) operating with electric energy, which are more expensive than the usual diesel buses, and will require further significant investments on charging stations in depots and key locations, but contribute towards a cleaner environment. To consider such a variant, all vehicles shall be electric and the tenderer will carry out a detailed feasibility study taking into account all costs (including vehicle and infrastructure cost).

The introduction of environmental fees for the use of the road network by 2030 is a revenue generating measure that will discourage the use of cars and also provide a source of funding for implementing the other proposed measures. This measure will be implemented by actions, such as applying congestion charges in the city centres, toll charges applied initially to HGV on Motorways to be extended later to other roads and vehicle types, increasing the taxes for fossil fuels and increasing the parking charges and penalties for illegal parking.

The enhanced planting of trees along streets and strategic road corridors is another measure that reduces the CO2 amount of the atmosphere. Benefits include shading, ambient temperature reduction, CO2 absorption (up to 22 000 tonnes/year), and better conditions for walking and cycling.

In the context of the implementation of EU Regulation (EC) No 1222/2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters, delegated inspectors of the Energy Department perform market surveillance checks in order to identify cases of non-compliance with these provisions. In addition, presentations on energy savings in the transport sector and on eco-driving are made in the context of the seminars addressed to unemployed engineers of all specialisations organised by the Energy Department and the Productivity Centre, with the support of the Human Resources Development Authority of Cyprus.

3.3. Dimension Energy security

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

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 Natural Gas in Cyprus fuel market, by approving the import of Liquefied Natural Gas (LNG) to Cyprus in a manner leading to the commencement of natural gas supply by the year 2020. 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 of Cyprus) in October 2018 for the LNG Import infrastructure in Vasilikos Bay), aiming for a completion by the end of year 2020. 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 pprocurement 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.

The capital cost of the Project is estimated to be €300 million, spread over three years (2018 – 2020). 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 million (project was approved by CEF in January 2018), debt financing (e.g. EIB, etc.) and possibly an investment by the Electricity Authority of Cyprus (EAC). The Operational and Maintenance cost is estimated to be around €200 million and is designed for a period of twenty years.

ii. Regional cooperation in this area

it is not applicable.

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

it is not applicable.

3.4. Dimension Internal energy market

3.4.1. Electricity infrastructure

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

EuroAsia Interconnector is an electricity cross border interconnector between Greek, Cypriot, and Israel power grids via the world's longest submarine HVDC power cable. HVDC onshore converter stations with a total capacity of 2000MW will be located at each connection point. It is a leading Project of Common Interest of the European Union and also 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 secure energy supply (related to dimension energy security). The planned budget of the EuroAsia Interconnector project is approximately 5 billion Euros.

ii. Regional cooperation in this area

See 3.4.1. i

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

It is not applicable

3.4.2. Energy transmission infrastructure

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

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

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 NSI East gas corridor and 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 secure energy supply (related to energy security dimension) and reduce greenhouse emissions due to lower emissions of natural gas than conventional fuels (related to decarbonisation dimension mostly for gas projects). Gas supply transmitted by PCIs will be used for power generation in the island.

A Ministerial decision appointed MECI as the National Competent Authority (NCA) for Projects of Common Interest (PCIs). Some of NCAs' adopted obligations according to EU Regulation 347/2013/EC are the following:

1. The real priority status for PCIs in public sector. Priority status in each Ministry and governmental services of each Member State. A variety of Legislative and Non-legislative measures like One-Stop Shop 4Energy PCIs, Manual of Procedures of PCIs, Environmental manual and legislative measures like Labour Legislation for PCIs, natural gas national quality specifications and excise duties Legislations/Decrees, Environmental Regulations to simplify and to accelerate the permitting granting process. The main objective of the above is the efficient administrative processing of the application files related to PCIs. The policy is related to 3.4.2ii "regional cooperation in this area".
2. Transparency and public participation. These can be achieved through Public Consultation and Participation Plan for PCIs. For this purpose, is essential to i) identify key stakeholder groups related to the PCIs in each MS and Third Country ii) use improved national methodology for public consultation of energy projects to facilitate public acceptance, iii) organise generic and specific consultation with all stakeholder groups, iv) educate public officers dedicated to the permitting for PCIs. All data related to Public Consultation available on One-Stop Shop 4Energy PCIs website. Cooperation with all Project Promoters is needed to create the National Public Consultation Plan for PCIs. The policy is related to 3.4.2 "regional cooperation in this area".
3. The development of the One-Stop Shop 4Energy PCIs E-platform. This platform will increase the efficiency, promote the transparency and help enhance cooperation

among Member States. The MECIT budget of 2019 includes budget provisions 50000€ for the basic design of the interactive E-Platform for Projects of Common Interest (PCIs). The One-Stop Shop 4Energy PCIs provides internal procedures for Energy Investors Hub, Call centre for energy investors and all key stakeholders, interactive Website in English and Greek version. E-Platform will be hosted on www.OneStopShop4EnergyPCIs.gov.cy. The policy is related to 3.4.2ii "regional cooperation in this area" and 3.4.2.iii "financing measures in this area at national level, including EU support and the use of EU funds''.

Furthermore, a MoU was signed between the countries of Cyprus, Greece, Israel and Italy on 5th of December 2017 at Nicosia for the EastMed pipeline project, aiming at the development of this Gas PCI. This MoU is a prerequisite legal measure for the PCI implementation, according to EU Regulation 347/2013/EC. EastMed Pipeline is an offshore/onshore natural gas pipeline, directly connecting East Mediterranean resources to Greece via Cyprus and Crete. The policy is related to 3.4.2ii "regional cooperation in this area".

Other key infrastructure projects

1. Cyprus TSO Ten Year Network Development Plan 2018-2027 according to Article 63 of the Laws for the Regulation of the Electricity Market from 2003 to 2018.

The main objective of this PaM is the development and the secure operation of the Transmission Network in the years 2018-2027. 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 2018 to 2027 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 PaMs template.

2. 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).

The main objective of this PaM is to provide new suppliers with access 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. The MDMS will be used to manage the supplier switching process.

Details regarding this Policy and Measure are included in PaMs template.

3. 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).

The main objective of this PaM is the enhancement of observability, monitoring, data recovery and electrical energy and power measurements at the distribution system level. The

basic quantitative target is the roll out of 400 000 meters by the year 2027. 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 optimisation of the operation of the Distribution System. AMI aids at managing EV Charging, PV System management and generation monitoring, optimisation of RES generation forecasting, maximises RES penetration, enables remote DSO operations (connections/ disconnections, meter reading), aids at the reduction of non-technical losses.

ii. Regional cooperation in this area

One of the NCA of PCIs obligation's (according to EU Regulation 347/2013/EC) is the Cross Border collaboration with other EU Member States and Third Countries. The purpose is to accelerate PCIs' implementation. The precise scope includes Collaboration with Governmental Authorities, National competent Authorities, Transmission System Operators for Gas and Electricity in other countries, Assessment of Investment Opportunities, Assessment of Cross Border Environmental Impact Assessment, Public Consultation and Public surveys in parallel to all impacted countries, Views on studies for Cost Benefit Analysis of each PCI and new policies to lift energy isolation of Cyprus and to highlight the strategic role of Eastern Mediterranean. For the implementation of the above, streamlining of Public Permitting Procedures and bureaucracy is necessary. The policy is related to 3.4.2i "....specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects".

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

Some additional NCAs' obligations according to EU Regulation 347/2013/EC involve financial assistance for PCIs. Actually, some assistance is implemented and some is adopted, as following:

1. Financial assistance for the preparation of the Natural Gas Market in Cyprus. The purpose of this assistance is to import Natural Gas in Cyprus. For example, CEF Grant of 4,5 million Euros was approved for Cynergy programme. For the Cynergy Programme the status is implemented. The technical support is needed for the study for the dedication of TSO Gas, Network codes, the preparation of the new legislation for natural gas and other legislations. The potential EU technical support will also cover the study for the design of an E-Platform for the One Stop Shop 4 Energy PCIs. MECIT requested 1,040,000 euros for EU technical support (SRSP) but approval is still pending. The status for the Technical Support from SRSP is considered as adopted.

2. Financial assistance for PCIs to accelerate Investment in the field of Trans-European Networks -PCIs and to leverage funding from both private and public sectors in order to support PCIs (some adopted and some implemented). Financial Measures include local and European measures for PCIs (e.g. CEF, Invest EU, EIB grants and financial tools etc.). For the category of local financial measures for PCIs and related energy infrastructure, Cyprus Government may decide to develop a national fund for energy transmission infrastructure.

The above 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

i. Policies and measures related to the elements set out in 2.4.3

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

1. Regulatory Decision 01/2017 on the Implementation of a Binding Schedule for the Full Commercial Operation of the New Electricity Market Model.

This PaM aims at introducing a Forward, a Day Ahead, an Intraday and a Balancing Market with a Contingency Reserve to operate a competitive electricity market in Cyprus to increase the share of renewable energy sources to electricity balance. The main quantitative objective is to allow participation of at least (1) 212.5MW of RES Generation, (2) IPPs with a total licensed capacity of ca. 500MW, (3) 4 licensed independent Suppliers. The introduction of Forward and Day-Ahead Markets and at a later stage an Intraday market in order to allow for new RES, IPPs and Suppliers to compete in generating and supplying electricity to final customers. Forward market is based on bilateral over the counter trading between suppliers and generators. The incumbent's bilateral prices will be fixed at its Wholesale Regulated Tariff. Day-Ahead Market will be centrally operated by the TSOC (who is also the Market Operator), obligatory for conventional generators for their available capacity not contracted in the Forward Market or allocated to cover Replacement Reserve. The energy offer cap will be Administratively Defined by the Regulator. The minimum energy offered by the incumbent is equal to its generator's minimum variable cost. Integrated Scheduling Process will be used for preallocating balancing activation instructions to Balancing Responsible Parties (before real time balancing) and procuring frequency ancillary services (FCR, aFRR, mFRR). ISP may modify the Unit Commitment (UCS) schedule. Real time balancing inherits ISP UCS. Dispatch instructions will be issued by the TSOC during real time balancing.

Details regarding this Policy and Measure are included in PaMs template.

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

1. Regulatory Decision on Storage Systems that are installed after the metering point.

The main objective of this PaM is the amendment of the TSRs and TDRs to allow for the participation of storage systems that are installed after the metering point in the electricity markets. The (draft) Regulatory Decision permits the participation in the electricity market of licensed storage systems installed after 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. The TSOC should also define the minimum capacity and technical characteristics of a storage system to be able to participate in the electricity market as a dispatched unit. The (draft) Regulatory Decision also calls the TSOC, in cooperation with the DSO, to take into consideration when drafting the Transmission - TYNDP any developments regarding the provision of services by storage systems in combination with the rate of RES development, the benefits due to loss reduction,

investment avoidance and/or upgrading of the network and/or the Transmission and Distribution Substations. The Transmission TYNDP should also include storage systems after the metering point. The Regulatory Decision calls the TSOC to amend Market and Network Rules in order to allow for the provision of services by storage systems related to the operation of the transmission and distribution systems, to suggest network charges applicable during their charging cycle in the case that such systems offer services to the TSOC and/ or DSO related to the operation of the transmission and/or distribution system.

Details regarding this Policy and Measure are included in PaMs template.

2. Amend the national law to enable operation of the electricity market and make the Market Operator/TSO independent from the vertically integrated electricity company

This PaM aims at enabling the operation of the electricity market and making the MO/TSO independent financially and organizationally (management, human resources) from the incumbent EAC. The amending Bill makes all necessary legislative changes to allow for the operation of the Net-Pool market electricity model. The Net-Pool market model is in compliance to the EU Target Model. The Bill introduces the category of "Aggregators" to allow for the combination of load and energy, including energy from storage systems. It also creates the category of "Storage Systems" and allows for the licensing of aggregators, storage systems and BRPs. The Regulator is authorized to decide on simplified licensing procedures for self-consumption, RES, suppliers and non-connected generation systems. The Bill strengthens clauses related to the Distribution System Owner, Distribution System Operator, foresees for the independence of the Cyprus TSO from the incumbent by providing to the former the necessary resources and autonomy in decision making related to its budget and personnel. It provides for a national certification process for the TSO independence, broadens the duties and responsibilities of the TSOC to include Market Operation and provides to the MO/TSO the authority to enforce Market Rules. The Bill strengthens clauses related to the Transmission-TYNDP. The Bill also concentrates previously scattered clauses on Universal Service under a dedicated Article.

Details regarding this Policy and Measure are included in PaMs template.

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

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

1. Amend Trade and Settlement Rules and Transmission and Distribution Rules to allow for Demand Response in the market according to Art. 15(8) Directive 2009/27/EU.

This PaM aims at creating the necessary conditions for the participation of Demand Response in the Day Ahead Market (directly or via Aggregator) and the Balancing and Ancillary Services Markets (via aggregator). Technical modalities should be defined in order for the national law, as harmonized with Article 15(8) of the Directive, to be applied in practice; in particular, the submission of DR Upward and Downward offers with priority over other participants i.e. should be cleared before offers of other sources with the same price. The DR Aggregator should be engaged in Bilateral Contracts with Suppliers, so as to secure the necessary capacity for participating in the Day Ahead Market and the Balancing Market.

Details regarding this Policy and Measure are included in PaMs template.

3.4.4. Energy Poverty

i. If applicable, policies and measures to achieve the objectives set out in 2.4.4

It is not applicable.

3.5. Dimension Research, innovation and competitiveness

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

Existing policies and measures

1. 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

2. EU Competitive funds i.e. Horizon 2020 and Life

3. European Territorial Cooperation Programs i.e. Cross-Border Cooperation Program Greece - Cyprus 2014-2020 and Transnational Cooperation Program Balkan-Mediterranean 2014-2020

4. Climate-KIC 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.

5. 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.

Planned policies and measures

1. Financing tool providing soft loans for energy efficiency investments

2. Support schemes to promote energy efficiency investments in agricultural sector

3. Fiscally neutral green tax reform by increasing environmental taxes while reducing labor taxation: The Government is examining a fiscally neutral green tax reform, which can significantly contribute towards transition to an economically and environmentally sustainable development. A gradual implementation of environmental taxes to sectors (that are not subject to the EU Emissions Trading System) and at the same the reduction of other expenses related to labor cost, is expected to lead to energy savings and will notable reduce the energy dependency of Cyprus. It is noted that this measure, due to the expected large impact on reducing the national energy consumption, will simultaneously contribute to the achievement of obligations of the country for 2030 regarding energy efficiency, the reduction of the carbon dioxide emissions and the increase of share for renewable energy sources. In general, a fiscally neutral gradual green tax reform can have substantially positive effects both on environmental and economic performance of a country and enable the transition to a more productive, more resource-efficient and less polluting economy.

4. 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.

5. Revision of national funds regarding research and innovation with the aim to boost climate and energy priorities.

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

The European Strategic Energy Technology Plan (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

In national level the Smart Specialization Strategy had highlighted the priority areas in which policy implementation could be based. The priority areas have been selected through the synthesis of quantitative and qualitative data and reflect the areas in which Cyprus has or can have comparative advantages, has significant resources and can present prospects in the near future. An additional parameter for selecting the priority areas was the ability of the research and innovation system to produce significant results in each sector. Cyprus Smart

Specialization Strategy has recognized energy sector as one of the priority areas, and taking into account SET-Plan and national targets for 2020, sets the following topics for research:

a) Development of New or Optimized Technologies for Renewable Energy Sources
b) Innovative Applications of Renewable Energy Sources
c) Exploitation of Hydrocarbons
d) Efficient Use- Energy Saving

Cyprus Smart Specialization Strategy, besides energy sector lists as priority areas:

a) Tourism
b) Agriculture and food industry
c) Build environment and construction industry
d) Transport and shipping
e) Information and communication technologies
f) Health
g) Environment

Subsectors of the abovementioned priority areas, like sustainable tourism and development of innovative and smart construction materials also contribute in energy and climate goals.

The RESTART 2016-2020 program focus on the priority areas that emerged through the Smart Specialization Strategy.

Corporation with other MS is mainly materialized through programs funded by Horizon 2020, Interreg MED.

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

1. 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 99 m Euros from which 45m will be covered by ERDF. RESTART 2016-2020 has been designed and is managed by Research Promotion Institute.

2. 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 18 m Euros.

3. 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 so far 129m Euro EU contribution by participating in 435 projects.

4. 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

5. Out of the total €784 million allocated to Cyprus for the implementation of Cohesion Policy for the programming period 2014-2020, an amount of €32.7 million 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 related to energy and climate projects that have been funded up to now by the abovementioned financing measures

Table 3.7. Energy and climate projects funded up to now by the financing measures in Cyprus

Program	Public funding (million Euros)	Private funding (million Euros)
RESTART 2016-2020	14	-
Grant Scheme to Enhance Business Innovation	1,84	1,84
Horizon 2020	23,71	-
LIFE	-	-
European Territorial Cooperation	2,3	-

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

Part 1
General framework

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

i. Macroeconomic forecasts (GDP and population growth)

The macroeconomic forecasts used for the projections (Table 4.1) are the latest prepared by the Ministry of Finance[19].

Table 4.1. Macroeconomic forecasts (GDP and population growth)

	Real GDP		Population end of year	
	(mln €)	Annual growth (%)	(x 10^3)	Annual growth (%)
2017	19488.7	4.2%	864.2	1.1%
2018	20276.7	4.0%	869.5	0.6%
2019	21051.4	3.8%	874.9	0.6%
2020	21763.1	3.4%	880.6	0.6%
2021	22425.6	3.0%	886.2	0.6%
2022	23031.1	2.7%	891.7	0.6%
2023	23606.9	2.5%	897.2	0.6%
2024	24149.9	2.3%	902.5	0.6%
2025	24632.9	2.0%	907.6	0.6%
2026	25125.5	2.0%	912.6	0.5%
2027	25628.0	2.0%	917.4	0.5%
2028	26140.6	2.0%	921.9	0.5%
2029	26663.4	2.0%	926.2	0.5%
2030	27196.7	2.0%	930.4	0.4%
2031	27740.6	2.0%	934.3	0.4%
2032	28295.4	2.0%	938.0	0.4%
2033	28861.3	2.0%	941.6	0.4%
2034	29438.6	2.0%	945.0	0.4%
2035	30027.3	2.0%	948.3	0.4%
2036	30627.9	2.0%	951.5	0.3%
2037	31240.4	2.0%	954.7	0.3%
2038	31865.2	2.0%	957.8	0.3%
2039	32502.5	2.0%	960.8	0.3%
2040	33152.6	2.0%	963.8	0.3%

ii. Sectorial changes expected to impact the energy system and GHG emissions

F-gases Regulation (no. 517/2014)

[19] Ms. Maria Matsi, Economic Officer, Directorate of Economic Research and EU Affairs, Ministry of Finance, 1439 Nicosia – Cyprus, Tel. no.: +35722601231, Email: mmatsi@mof.gov.cy

Due to the EU legislation importers are allocated with specific quotas of t CO2 eq. that they can import as F-gases. These quotas, according to the relevant EU legislation, are annually decreased. Therefore, there is a reduction of F-gases used in air-conditioning and refrigeration applications, since there are gradually replaced by CO2 and NH3. The impact of these changes has not been taken into account in the projections.

Municipal solid waste management strategy

The municipal solid waste management strategy is currently undergoing a major revision, which is expected to be completed by the end of 2019. This revision in addition to the municipal solid waste management policies and measures to be implemented will also provide a revision of waste production projections.

iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

iv. Technology cost developments

4.2. Dimension Decarbonisation

4.2.1. GHG emissions and removals

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

(a) The change noticed during the recent years in the types of HFCs used is not taken into consideration due to the high uncertainty associated to any prediction of such changes.
(b) The emissions from the possible exploitation of natural gas in the Exclusive Economic Zone are not taken into account due to the high uncertainty associated to any prediction of such changes.
(c) The organic fraction of solid waste not going to the landfill is treated by composting, anaerobic digestion and incinerated for energy. The additional organics for incineration at the cement installation have not been accounted for.

i. Trends in current GHG emissions and removals in the EU ETS, Effort Sharing Regulation and LULUCF sectors and different energy sectors

The Business as Usual (BaU) emissions by sector are presented in Table 4.2 for the period 2005-2040. Emissions for LULUCF have not been estimated. The latest inventory year used as reference is 2016. Total emissions are projected to increase by -4% in 2030 and by -6% in 2040 compared to 2005. ETS emissions (Table 4.3) are projected to decrease by -17% in 2030 and by -12% in 2040 compared to 2005. ESR emissions (Table 4.4) are projected to increase by 13% in 2030 and 2040 compared to 2005. Figure 4.1 presents the expected trends in ETS and ESR emissions for the period 2005-2040. The projections of the energy sectors (distinguished in ETS and ESR) are presented in Table 4.5 and Figure 4.2.

Table 4.2. Total BaU GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	7126	6476	6739	6101	6244
INDUSTRY	1067	1250	1449	1471	1485
AGRICULTURE	535	476	496	535	541
WASTE	486	554	579	718	857
BaU TOTAL (excl. LULUCF)	9213	8756	9263	8824	9127
Change compared to 2005		**-5%**	**1%**	**-4%**	**-1%**

Table 4.3. ETS BaU GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	4377	3899	3892	3284	3564
INDUSTRY	882	894	1082	1082	1082
AGRICULTURE	0	0	0	0	0
WASTE	0	0	0	0	0
ETS TOTAL (excl. LULUCF)	5259	4793	4974	4366	4646
Change compared to 2005		**-9%**	**-5%**	**-17%**	**-12%**

Table 4.4. ESR BaU GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	2749	2577	2848	2817	2681
INDUSTRY	185	356	366	389	402
AGRICULTURE	535	476	496	535	541
WASTE	486	554	579	718	857
ETS TOTAL (excl. LULUCF)	3954	3964	4289	4458	4481
Change compared to 2005		**0%**	**8%**	**13%**	**13%**

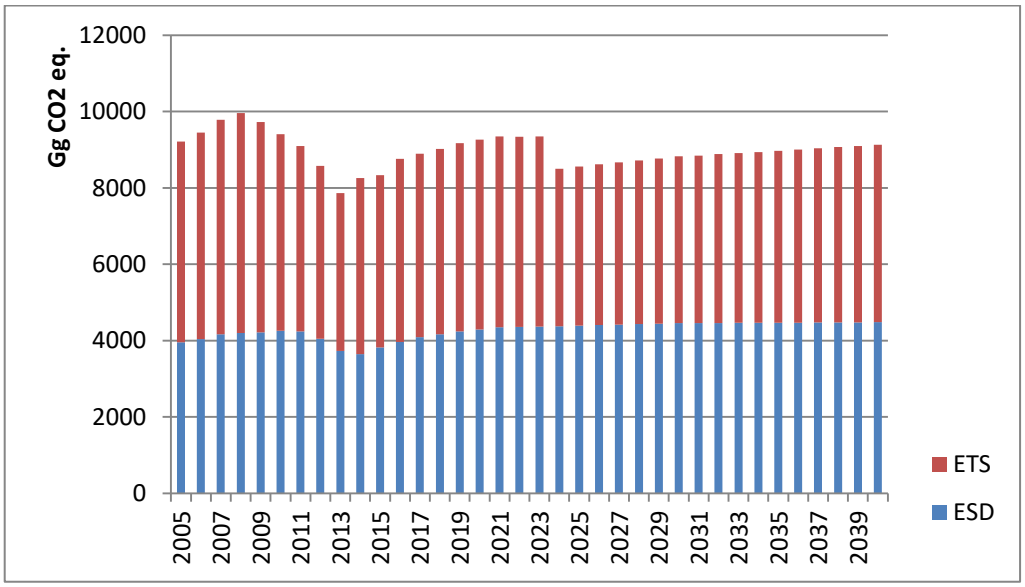


Figure 4.1. ESR, ETS and Total BaU GHG emissions for the period 2005-2040 (Gg CO2 eq.)

Table 4.5. Total BaU GHG emissions for the energy sources (Gg CO2 eq.) 2005-2040

	2005	2016	2020	2030	2040
1A1 Energy Industries	3483	3311	3310	2712	3037
1A2 Manufacturing Industries and Construction	909	603	596	577	533
1A3a ii Domestic Aviation	13	1	1	1	1
1A3b Road Transport	2089	2019	2133	2112	2057
1A3d ii Domestic water-borne navigation	2	2	3	3	4
1A4a Commercial / Institutional	100	82	141	139	116
1A4b Residential	421	360	468	461	397
1A4c Agriculture / Forestry / Fishing / Fish farms	89	80	67	68	67

1A5 Non-Specified	19	19	22	27	33
TOTAL	**7126**	**6476**	**6739**	**6101**	**6244**

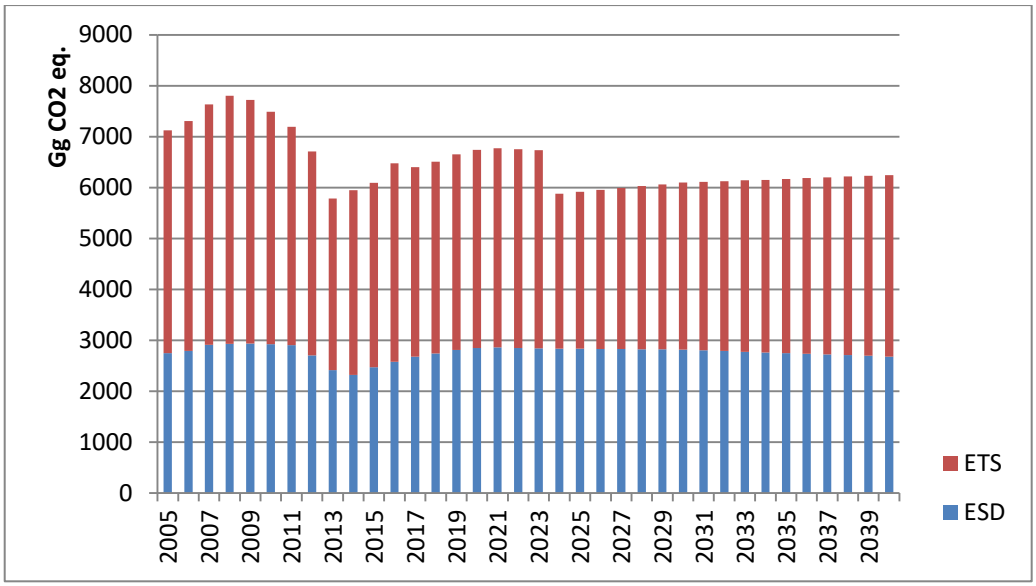


Figure 4.2. ESR, ETS and Total Energy BaU GHG emissions for the period 2005-2040 (Gg CO2 eq.)

ii. Projections of sectorial developments with existing national and EU policies and measures at least until 2040 (including for the year 2030)

The "With existing measures" (WEM) emissions by sector are presented in Table 4.6 for the period 2005-2040. Emissions for LULUCF have not been estimated. The latest inventory year used as reference is 2016. Total emissions are projected to increase by -4% in 2030 and by -6% in 2040 compared to 2005. ETS emissions (Table 4.7) are projected to decrease by -17% in 2030 and by -12% in 2040 compared to 2005. ESR emissions (Table 4.8) are projected to increase by 13% in 2030 and 2040 compared to 2005. Figure 4.3 presents the expected trends in ETS and ESR emissions for the period 2005-2040.

Table 4.6. Total WEM GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	7126	6476	6210	5868	4272
INDUSTRY	1067	1250	1447	1456	1453
AGRICULTURE	535	476	489	508	494
WASTE	486	554	494	361	221
WEM TOTAL (excl. LULUCF)	9213	8756	8640	8193	6441
Change compared to 2005		**-5%**	**-6%**	**-11%**	**-30%**
Change compared to BaU			**-7%**	**-7%**	**-29%**

Table 4.7. ETS WEM GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	4377	3899	3394	3089	1660
INDUSTRY	882	894	1082	1082	1082
AGRICULTURE	0	0	0	0	0
WASTE	0	0	0	0	0
ETS TOTAL (excl. LULUCF)	5259	4793	4476	4171	2742

Change compared to 2005		**-9%**	**-15%**	**-21%**	**-48%**
Change compared to BaU			**-10%**	**-4%**	**-41%**

Table 4.8. ESR WEM GHG emissions aggregated by source category (Gg CO2 eq.) 2005-2040

Gg CO2 eq.	2005	2016	2020	2030	2040
ENERGY	2749	2577	2816	2779	2612
INDUSTRY	185	356	365	374	371
AGRICULTURE	535	476	489	508	494
WASTE	486	554	494	361	221
ETS TOTAL (excl. LULUCF)	3954	3964	4164	4022	3698
Change compared to 2005		**0%**	**5%**	**2%**	**-6%**
Change compared to BaU			**-3%**	**-10%**	**-17%**

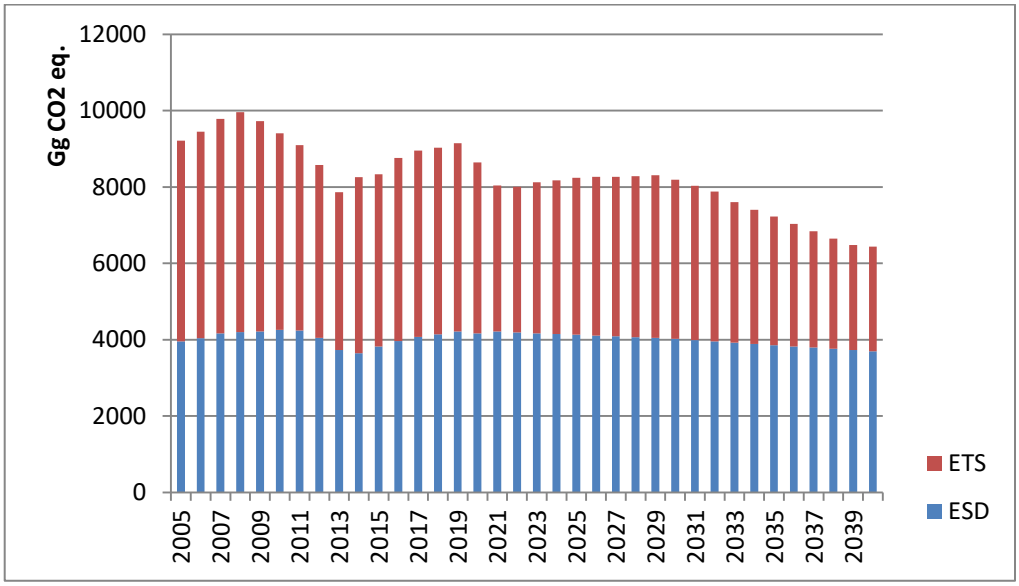


Figure 4.3. ESR, ETS and Total WEM GHG emissions for the period 2005-2040 (Gg CO2 eq.)

4.2.2. Renewable energy

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

iii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

4.3. Dimension Energy efficiency

i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

Table 4.9. Current primary and final energy consumption in the economy and per sector

CYPRUS Eurostat data - 2016 (as available on 28/11/2018)						
Indicator Name	**Value**	**Unit(s)**	**Eurostat Indicator(s)**	**Eurostat database table**	**Eurostat Code**	**Last update (date of the data)**
primary energy consumption	2.4	Mtoe	Primary Energy Consumption	Energy saving - annual data [nrg_ind_334a]	B_100910	2/1/2018
total final energy consumption	1.758	ktoe	Final Energy Consumption	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_101700	31/05/2018
final energy consumption - industry	213.3	ktoe	Final Energy Consumption - Industry	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_101800	31/05/2018
final energy consumption - transport	931.1	ktoe	Final Energy Consumption - Transport	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_101900	31/05/2018
final energy consumption - households	326.3	ktoe	Residential	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_102010	31/05/2018
final energy consumption - services	225.5	ktoe	Services	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_102035	31/05/2018
final energy consumption - agriculture	43.3	ktoe	Agriculture/Forestry	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_102030	31/05/2018
final energy consumption – other sectors	613.6	ktoe	Other sectors	Supply, transformation, consumption - all products - annual data [nrg_100a]	B_102000	31/05/2018

ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

The Comprehensive assessment 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.

iii . Projections considering existing energy efficiency policies, measures and programmes as described under 1.2. ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

Table 4.10. Sectoral energy projections for 2030 With Existing Measures

Sectoral projections for 2030 With Existing Measures *(Mtoe)*	**With Existing Measures**
Primary Energy Consumption	2,8
Total final energy consumption	2,3
Final energy consumption - industry	0,3
Final energy consumption - households	0,5
Final energy consumption - agriculture	0,05
Final energy consumption - transport	1,2
Final energy consumption - services	0,3

iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, according to Article 5 of Directive 2010/31/EU

The cost – optimal levels of minimum energy performance requirements have been calculated for second time in 2018. According, to the results for new building the NZEB are at the cost optimum levels, except hotels. Renovated buildings could achieve higher levels of energy performance, which currently is energy class B in order to achieve cost optimum levels. In general, it is indicated that existing building envelope requirements are much or less at cost optimum level, while more penetration of efficient lighting and PVs could better cost – optimality from the investor's point of view. Based on the results of cost-optimum calculation minimum energy performance requirement will be revised in 2019.

4.4. Dimension Energy security

i. Current energy mix, domestic energy resources, import dependency, including relevant risks

Data for Cyprus energy mix for 2017

	RES MToe	Oil MToe	Other (Industrial waste) MToe
Domestic Sources	0,122	0	0.003
Imports	0.037	2.278	0.018

Current Import dependency is at 95%

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

It is not applicable at the moment.

4.5. Dimension Internal energy market

4.5.1. Electricity interconnectivity

i. Current interconnection level and main interconnectors

0%

ii. Projections of interconnector expansion requirements (including for the year 2030)

It will be set later.

4.5.2. Energy transmission infrastructure

i. Key characteristics of the existing transmission infrastructure for electricity and gas

For electricity transmission infrastructure see Sections 2.4.2, 3.4.1. and 3.4.2.

At the moment there is no gas transmission infrastructure.

ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

See Sections 2.4.2, 3.4.1. and 3.4.2.

4.5.3. Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

See Sections 2.4.3 and 3.4.3.

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

It will be set later.

4.6. Dimension Research, innovation and competitiveness

i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (this analysis should be done on the European and/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 centers 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 centers of excellence in research like RISE are expected to further improve infrastructure.

ii. Current level of public and, if available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

The current level of public finance is estimated to be less than 10m Euro per year.

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

3) Monthly Seasonal Double Use Commercial and Industrial Use Low Voltage Recording (Code 30)

Table 4.11. Monthly Seasonal Double Use 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	-
	Out of peak	7,63	7,25	8,49	8,31	-
Network Cost	**Peak**	3,21	3,21	3,24	3,21	-
	Out of peak	3,21	3,21	3,21	3,21	-
Cost of Ancillary Services	**Peak**	0,67	0,67	0,67	0,67	-
	Out of peak	0,67	0,67	0,67	0,67	-
Cost of Metering	-	-	-	-	-	0,49
Cost of Supply	-	-	--	-	-	2,34

4) Monthly Seasonal Double Use Commercial and Industrial Use Medium Voltage Recording (Code 40)

Table 4.12. Monthly Seasonal Double Use 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	-
	Out of peak	7,49	7,12	8,34	8,15	-
Network	**Peak**	2,03	2,03	2,04	2,03	-

Cost	**Out of peak**	2,03	2,03	2,03	2,03	-
Cost of Ancillary Services	**Peak**	0,66	0,66	0,66	0,66	-
	Out of peak	0,66	0,66	0,66	0,66	-
Cost of Metering	-	-	-	-	-	0,49
Cost of Supply	-	-	--	-	-	2,34

5) Monthly Seasonal Double Use Commercial and Industrial Use High Voltage Recording (Code 50)

Table 4.13. 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	**-**
	Out of peak	7,37	7,00	8,20	8,02	**-**
Network Cost	**Peak**	0,70	0,70	0,70	0,70	**-**
	Out of peak	0,70	0,70	0,70	0,70	-
Cost of Ancillary Services	**Peak**	0,65	0,65	0,65	0,65	-
	Out of peak	0,65	0,65	0,65	0,65	-
Cost of Supply	**-**	-	--	-	-	2,34

For all above tariffs EAC imposes the following additional charges:

1. 0,01€/kWh for the special fund for RES and Energy Conservation (no VAT is imposed on this charge)
2. 0,00065 €/kWh public benefit obligations
3. 19% VAT

iiia. Description of energy subsidies, including for fossil fuels

For vulnerable consumers the tariff with code 08 is applicable. The following categories of customers are eligible provided they are Cypriot citizens or citizens of any other MS or citizens with equal rights to the above, who are legally residing in the areas controlled by the Republic of Cyprus:

1. Large families. For the purpose of this tariff large family is defined as a family that receives Child Benefit from the Welfare Benefits Administration Service of the Ministry of Labour, Welfare and Social Insurance for three or more dependent children and with an annual combined family income of up to €51.258. The annual combined family

income criterion is increased by €5.126 for every additional child over the number of four.

2. Public Assistance recipients from the Social Welfare Services of the Ministry of Labour, Welfare and Social Insurance.

3. Beneficiaries of Guaranteed Minimum Income provided by the Welfare Benefits Administration Service of the Ministry of Labour, Welfare and Social Insurance.

4. Beneficiaries of Severe Motor Disability Allowance from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance.

5. Beneficiaries 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.

6. Beneficiaries 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.

7. Hemodialysis patients who are beneficiaries of the Mobility Allowance from the Department for Social Inclusion of Persons with Disabilities of the Ministry of Labour, Welfare and Social Insurance.

8. People suffering from multiple sclerosis who are registered members of Cyprus Multiple Sclerosis Association.

5. Impact assessment of planned policies and measures

This chapter will be prepared once the draft final submission is ready (end of 2019).

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) Population [million]

	Population [million]
2017	0.8642
2018	0.8695
2019	0.8749
2020	0.8806
2021	0.8862
2022	0.8917
2023	0.8972
2024	0.9025
2025	0.9076
2026	0.9126
2027	0.9174
2028	0.9219
2029	0.9262
2030	0.9304
2031	0.9343
2032	0.9380
2033	0.9416
2034	0.9450
2035	0.9483
2036	0.9515
2037	0.9547
2038	0.9578
2039	0.9608
2040	0.9638

(2) GDP [euro million]

	GDP [euro million]
2017	19488.7
2018	20276.7
2019	21051.4
2020	21763.1
2021	22425.6
2022	23031.1
2023	23606.9
2024	24149.9
2025	24632.9
2026	25125.5

2027	25628.0
2028	26140.6
2029	26663.4
2030	27196.7
2031	27740.6
2032	28295.4
2033	28861.3
2034	29438.6
2035	30027.3
2036	30627.9
2037	31240.4
2038	31865.2
2039	32502.5
2040	33152.6

(3) Sectorial gross value added (including main industrial, construction, services, and agriculture sectors) [euro million]

(4) Number of households [thousands]

(5) Household size [inhabitants/households]

(6) Disposable income of households [euro]

(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]

(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]

(9) International oil, gas and coal fuel import prices [euro/GJ or euro/toe] based on the Commission's recommendations

(10) EU-ETS carbon price [euro/EUA] – based on the Commission's recommendations

(11) Exchange rates to euro and to US Dollar (if applicable) assumptions [euro/currency and USD/currency]

(12) Number of Heating Degree Days (HDD)

(13) Number of Cooling Degree Days (CDD)

(14) Technology cost assumptions used in modelling for main relevant technologies

2. Energy balances and indicators

2.1. Energy supply

(1) Indigenous Production by fuel type (all energy products that are produced in significant quantities) [ktoe]

(2) Net imports by fuel type (including electricity and split into intra- and extra EU net imports) [ktoe]

(3) Import dependency from third countries [%]

(4) Main import sources (countries) for main energy carriers (including gas and electricity)

(5) Gross Inland Consumption by fuel type source (including solids, all energy products: coal, crude oil and petroleum products, natural gas, nuclear energy, electricity, derived heat, renewables, waste) [ktoe]

2.2. Electricity and heat

(1) Gross electricity generation [GWh]

(2) Gross electricity generation by fuel (all energy products) [GWh]

(3) Share of combined heat and power generation in total electricity and heat generation [%]

(4) Capacity electricity generation by source including retirements and new investments [MW]

(5) Heat generation from thermal power generation

(6) Heat generation from combined heat and power plants, including industrial waste heat

(7) Cross-border interconnection capacities for gas and electricity [Definition for electricity in line with outcome of ongoing discussions on basis for 15% interconnection target] and their projected usage rates

2.3. Transformation sector

(1) Fuel inputs to thermal power generation (including solids, oil, gas) [ktoe]

(2) Fuel inputs to other conversion processes [ktoe]

2.4. Energy consumption

(1) Primary and final energy consumption [ktoe]

(2) Final energy consumption by sector (including industry, residential, tertiary, agriculture and transport (including split between passenger and freight transport, when available)) [ktoe]

(3) Final energy consumption by fuel (all energy products) [ktoe]

(4) Final non-energy consumption [ktoe]

(5) Primary energy intensity of the overall economy (primary energy consumption per GDP [toe/euro]

(6) Final energy intensity by sector (including industry, residential, tertiary and transport (including split between passenger and freight transport, when available))

2.5. Prices

(1) Electricity prices by type of using sector (residential, industry, tertiary)

(2) National retail fuel prices (including taxes, per source and sector) [euro/ktoe]

2.6. Investments

Investment costs in energy transformation, supply, transmission and distribution sectors.

2.7. Renewables

(1) Gross final consumption of energy from renewable sources and share of renewable energy in gross final energy consumption and by sector (electricity, heating and cooling, transport) and by technology

(2) Electricity and heat generation from renewable energy in buildings (as defined in Article 2(1) of Directive 2010/31/EU); this shall include, where available, disaggregated data on energy produced, consumed and injected into the grid by solar photovoltaic systems, solar thermal systems, biomass, heat pumps, geothermal systems, as well as all other decentralized renewables systems)

(3) If applicable, other national trajectories, including long-term or sectorial ones (the share of food-based and advanced biofuels, the share of renewable energy in district heating, as well as the renewable energy produced by cities and energy communities as defined by Article 22 of [recast of Directive 2009/28/EC as proposed by COM(2016) 767])

3. GHG emissions and removals related indicators

(1) GHG emissions by policy sector (EU ETS, Effort Sharing Regulation and LULUCF)

LULUCF emissions have not been estimated.

Gg CO2 eq.	BaU			WEM		
	ESD	ETS	TOTAL	ESD	ETS	TOTAL
2021	4350	4993	9343	4212	3826	8038
2022	4358	4984	9343	4189	3820	8009
2023	4369	4974	9343	4167	3955	8122
2024	4377	4126	8503	4150	4020	8169
2025	4392	4167	8559	4131	4110	8241
2026	4406	4209	8615	4110	4157	8267
2027	4420	4247	8667	4089	4179	8268
2028	4433	4286	8719	4067	4213	8281
2029	4446	4325	8771	4045	4260	8305
2030	4458	4366	8824	4022	4171	8193

(2) GHG emissions by IPCC sector and by gas (where relevant split into EU ETS and Effort Sharing sectors) [tCO2eq]

BaU	Gg CO2 eq.	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ESD	Energy	2859	2850	2844	2835	2833	2831	2828	2825	2821	2817
	IPPU	369	371	374	376	378	381	383	385	387	389
	Agriculture	529	530	530	531	531	532	533	533	534	535
	Waste	593	607	621	635	649	662	676	690	704	718
	TOTAL	4350	4358	4369	4377	4392	4406	4420	4433	4446	4458
ETS	Energy	3910	3902	3892	3044	3085	3126	3164	3203	3243	3284
	IPPU	1082	1082	1082	1082	1082	1082	1082	1082	1082	1082
	Agriculture	0	0	0	0	0	0	0	0	0	0
	Waste	0	0	0	0	0	0	0	0	0	0
	TOTAL	4993	4984	4974	4126	4167	4209	4247	4286	4325	4366
TOTAL	Energy	6770	6752	6735	5879	5918	5957	5993	6028	6064	6101
	IPPU	1451	1454	1456	1458	1461	1463	1465	1467	1469	1471
	Agriculture	529	530	530	531	531	532	533	533	534	535
	Waste	593	607	621	635	649	662	676	690	704	718
	TOTAL	9343	9343	9343	8503	8559	8615	8667	8719	8771	8824
WEM											
ESD	Energy	2822	2813	2806	2804	2802	2799	2796	2791	2786	2779
	IPPU	366	367	368	369	370	371	372	373	373	374
	Agriculture	520	519	517	516	515	513	512	511	509	508
	Waste	504	490	476	460	444	426	409	393	377	361
	TOTAL	4212	4189	4167	4150	4131	4110	4089	4067	4045	4022
ETS	Energy	2743	2738	2873	2937	3028	3075	3096	3131	3178	3089
	IPPU	1082	1082	1082	1082	1082	1082	1082	1082	1082	1082
	Agriculture	0	0	0	0	0	0	0	0	0	0
	Waste	0	0	0	0	0	0	0	0	0	0
	TOTAL	3826	3820	3955	4020	4110	4157	4179	4213	4260	4171
TOTAL	Energy	5565	5550	5678	5741	5830	5874	5892	5922	5964	5868
	IPPU	1449	1450	1451	1452	1453	1454	1454	1455	1455	1456
	Agriculture	520	519	517	516	515	513	512	511	509	508
	Waste	504	490	476	460	444	426	409	393	377	361
	TOTAL	8038	8009	8122	8169	8241	8267	8268	8281	8305	8193

(3) Carbon intensity of the overall economy [tCO2eq/GDP]

		BaU		WEM	
	GDP [euro million]	Emissions (Gg CO2 eq.)	C intensity t CO2 eq./ml €	Emissions (Gg CO2 eq.)	C intensity t CO2 eq./ml €
2021	22426	9343	416.6	8038	358.4
2022	23031	9343	405.7	8009	347.8
2023	23607	9343	395.8	8122	344.1
2024	24150	8503	352.1	8169	338.3
2025	24633	8559	347.5	8241	334.6
2026	25126	8615	342.9	8267	329.0
2027	25628	8667	338.2	8268	322.6
2028	26141	8719	333.5	8281	316.8
2029	26663	8771	329.0	8305	311.5
2030	27197	8824	324.5	8193	301.2

(4) CO2 emission related indicators

(a) GHG intensity of domestic power and heat generation [tCO2eq/MWh]

(b) GHG intensity of final energy consumption by sector [tCO2eq/toe]

(5) Non-CO2 emission related parameters

(a) Livestock: dairy cattle [1000 heads], non-dairy cattle [1000 heads], sheep [1000 heads], pig [1000 heads], poultry [1000 heads]

	dairy cattle [1000 heads]	non-dairy cattle [1000 heads]	sheep [1000 heads]	pig [1000 heads]	poultry [1000 heads]
2017	29.8	35.7	313.3	355.7	3326.5
2018	29.8	35.7	316.4	359.2	3359.1
2019	29.8	35.7	319.4	359.2	3391.8
2020	29.8	35.7	319.4	362.7	3424.4
2021	34.2	38.0	334.6	373.3	3522.2
2022	34.2	38.0	334.6	373.3	3522.2
2023	34.2	38.0	334.6	373.3	3522.2
2024	34.2	38.0	334.6	373.3	3522.2
2025	34.2	38.0	334.6	373.3	3522.2
2026	34.2	38.0	334.6	373.3	3522.2
2027	34.2	38.0	334.6	373.3	3522.2
2028	34.2	38.0	334.6	373.3	3522.2
2029	34.2	38.0	334.6	373.3	3522.2
2030	34.2	38.0	334.6	373.3	3522.2
2031	34.2	38.0	334.6	373.3	3522.2
2032	34.2	38.0	334.6	373.3	3522.2
2033	34.2	38.0	334.6	373.3	3522.2
2034	34.2	38.0	334.6	373.3	3522.2
2035	34.2	38.0	334.6	373.3	3522.2
2036	34.2	38.0	334.6	373.3	3522.2

2037	34.2	38.0	334.6	373.3	3522.2
2038	34.2	38.0	334.6	373.3	3522.2
2039	34.2	38.0	334.6	373.3	3522.2
2040	34.2	38.0	334.6	373.3	3522.2

(b) Nitrogen input from application of synthetic fertilizers [kt nitrogen]

Assumed constant as 2016 for the period 2017-2040, i.e. 8.073 kt nitrogen.

(c) Nitrogen input from application of manure [kt nitrogen]

	Nitrogen input from application of manure [kt nitrogen]*
2017	12.357
2018	12.698
2019	12.807
2020	12.897
2021	12.935
2022	13.616
2023	13.620
2024	13.625
2025	13.629
2026	13.633
2027	13.637
2028	13.642
2029	13.646
2030	13.650
2031	13.654
2032	13.659
2033	13.663
2034	13.667
2035	13.671
2036	13.675
2037	13.680
2038	13.684
2039	13.688
2040	13.692

* including volatilisation

(d) Nitrogen fixed by N-fixing crops [kt nitrogen]

Included in Nitrogen in crop residues returned to soils, see next paragraph.

(e) Nitrogen in crop residues returned to soils [kt nitrogen]

	Nitrogen fixed by N-fixing crops [kt nitrogen]
2017	0.248
2018	0.250
2019	0.251
2020	0.253

2021-2040	0.254

(f) Area of cultivated organic soils [hectares]

Cultivation of organic soils does not occur in Cyprus.

(g) Municipal solid waste (MSW) generation

	Total MSW production (1000t) - wet mass
2017	563.8
2018	573.1
2019	581.4
2020	589.5
2021	598.4
2022	607.2
2023	616.3
2024	625.5
2025	634.9
2026	644.7
2027	654.8
2028	665.5
2029	676.7
2030	688.5
2031	693.7
2032	703.2
2033	712.6
2034	722.1
2035	731.5
2036	741.0
2037	750.4
2038	759.9
2039	769.3
2040	778.8

(h) Municipal solid waste (MSW) going to landfills

	Municipal solid waste (MSW) going to landfills		
	Without measures scenario	**With measures scenario**	**With additional measures scenario**
2017	423.78	315.57	315.57
2018	430.75	320.76	320.76
2019	437.03	325.44	325.44
2020	443.12	329.97	329.97
2021	449.77	269.86	269.86
2022	456.40	256.73	256.73
2023	463.25	243.21	243.21
2024	470.18	229.21	229.21
2025	477.23	214.75	214.75

2026	484.58	213.22	213.22
2027	492.16	211.63	211.63
2028	500.20	210.08	210.08
2029	508.63	208.54	208.54
2030	517.54	207.02	207.02
2031	521.44	203.36	203.36
2032	528.55	200.85	200.85
2033	535.65	198.19	198.19
2034	542.75	195.39	195.39
2035	549.85	192.45	192.45
2036	556.95	194.93	194.93
2037	564.05	197.42	197.42
2038	571.15	199.90	199.90
2039	578.25	202.39	202.39
2040	585.35	204.87	204.87

(i) Share of CH4 recovery in total CH4 generation from landfills [%]

Biogas recovery from landfills does not occur in “Without Measures” scenario.

Biogas recovery assumed 20% in “With Existing Measures” scenario.

Biogas recovery assumed 30% in “With Additional Measures” scenario.

References

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Appendices

Appendix I: List of technical assistance projects completed

Description	Grant Agreement or Contractor	Status
Workshop on Electricity Market set-up by providing advice on the planned market model	FSR	Complete 2014
"Energy Efficiency: Technical Assistance in the framework of the directive 2012/27/EU for the assessment of the potential for the application of high efficiency cogeneration and efficient district heating and cooling in Cyprus and identify measures to exploit it a cost effective manner"	JRC	Complete 2015
Conference 'Heating and cooling in the European energy transition'	SRSS	Complete 2015
Impact Assessment regarding the implementation of the proposed Final Detailed Electricity Market Design in Cyprus	E3MLAB	Complete 2015
Workshop "Supporting investments in Smart Grids in 2014-2020 JASPERS Networking Platform"	SRSS	Complete 2015
Workshop "Cost Benefit Analysis of Smart Metering Systems"	SRSS	Complete 2015
ClimaMed2015	SRSS	Complete 2015
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	Complete 10/07/2016
MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impacts) tool	KTH	Complete 05/02/2016
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	Complete 29/07/2016
Development of a cogeneration/trigeneration feasibility tool	Ricardo-AEA	Complete 26/12/2016
"Technical Assistance for energy efficiency and sustainable transport in Cyprus" Technical Assistance in order to assess and formulate recommendations for the promotion and penetration of and alternative fuels in the transport sector	GIZ1	Complete 03/06/2017
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 buildings	GIZ1	Complete 03/06/2017

Description	Grant Agreement or Contractor	Status
Technical assistance in order to make a comprehensive study for assessing the Cypriot energy efficiency potential and propose a strategy to exploit it	GIZ1	Complete 03/06/2017
Technical Assistance in order to design an Energy Efficiency Awareness Campaign in the Republic of Cyprus	GIZ1	Complete 03/06/2017
Support to MECIT Trade and Settlement Electricity Market Rules ('TSRs')	RSE	Complete 03/02/2017
Training on Electricity and Gas Markets	FSR	Complete 09/01/2017
Development of a Heating and Cooling Strategy at Local Level	RICARDO	Complete 24/12/2017
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	Complete 24/03/2018
Development of a code of practice and rules, policies concerning heat network operation	RICARDO	Complete

Appendix II: Summary table on the existing and additional polices and measures on energy efficiency

Σενάριο: «Με μέτρα»[20]

Τομέας	Ενότητα	Χρονοδιάγραμμα υλοποίησης	Εκτίμηση Δαπάνη		Αναμενόμενη συνεισφορά στις εθνικές υποχρεώσεις για την ενεργειακή απόδοση[21]	Σημειώσεις
			Ύψος επενδυτικής δαπάνης (€)	Ύψος συνεισφοράς δημοσίου (€)		
ΕΞΕ	Οικιστικός Τομέας Τομέας Υπηρεσιών, Βιομηχανικός και Γεωργικός Τομέας	2019-2023	40εκ-80εκ εκατομμύρια κόστος νέων επενδύσεων ΕΞΕ		Μερική συμβολή στην επίτευξη του υποχρεωτικού στόχου ΕΞΕ κατά την τελική χρήση της περιόδου 2021-2030, που εκτιμάται προκαταρτικά στα 235,000-238,000 toe (σωρευτικά)	Το ποσό θα παρασχεθεί ως χαμηλότοκα δάνεια μέσω του δανειοδοτικού χρηματοδοτικού εργαλείου της ΓΔ ΕΠΣΑ (Διαρθρωτικά Ταμεία περιόδου 2014-2020). Δεν υπάρχει εκτίμηση για την αναμενομένη απορρόφηση σε επενδύσεις ΕΞΕ.
ΕΞΕ	Τομέας Υπηρεσιών, Βιομηχανικός Τομέας	2018-2030	Δίκτυο επιχειρήσεων για την ενεργειακή απόδοση – Εθελοντικές συμφωνίες/δεσμεύσεις επιχειρήσεων για μείωση στις	Δεν εφαρμόζεται		Δέσμευση περισσότερων από 250 επιχειρήσεων (που δε συμμετέχουν στο σύστημα εμπορίας δικαιωμάτων εκπομπής

[20] Σύμφωνα με τον Κανονισμό για τη Διακυβέρνηση, οι «προβλέψεις με μέτρα» αφορούν μέτρα και πολιτικές που έχουν θεσπιστεί και τεθεί σε εφαρμογή.

[21] Όλα τα μέτρα συμβάλλουν και στον ενδεικτικό στόχο ΕΞΕ που μπορεί να θέσει η Κύπρος και υπολογίζεται ως «μείωση της πρωτογενούς κατανάλωσης ενέργειας κατά 9,5% το 2030, σε σχέση με την αντίστοιχη πρόβλεψη της Ε.Ε για την Κύπρο το 2007 (PRIMES REFERENCE SCENARIO 2007)». Προς την επίτευξη του ενδεικτικού στόχου συνεισφέρουν και οι σχετικές Ευρωπαϊκές Οδηγίες (ενεργειακή απόδοση των κτιρίων, ενεργειακής σήμανσης κλπ). Για το υποχρεωτικό στόχο ΕΞΕ στην τελική χρήση δεν επιτρέπεται να λογίζονται εξοικονομήσεις από εφαρμογή του υποχρεωτικά εφαρμοστέου Ευρωπαϊκού Κεκτημένου.

Τομ	Ενότητα	Χρονοδιάγρα	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
			εκπομπές τους σε αέρια του θερμοκηπίου περισσότερο από 8% μέχρι το 2030, αναλαμβάνοντας δράσεις για μείωση της κατανάλωσης ενέργειας και πόρων, όπως βελτίωση της ενεργειακής απόδοσης, ΑΠΕ κλπ. Το κόστος επενδύσεων δεν έχει ακόμα υπολογιστεί.			αερίων του θερμοκηπίου). Δεν υπάρχει εκτίμηση για την αναμενόμενη υλοποίηση επενδύσεων ΕΞΕ.
ΕΞΕ	Τομέας Υπηρεσιών, Βιομηχανικός Τομέας	2018-2030	€ 20 εκατομμύρια κόστος νέων επενδύσεων για εγκατάσταση μονάδων συμπαραγωγής ηλεκτρισμού και θερμότητας υψηλής απόδοσης	Δεν εφαρμόζεται		Προώθηση μονάδων συμπαραγωγής ηλεκτρισμού και θερμότητας υψηλής απόδοσης με τη μέθοδο συμψηφισμού λογαριασμών
ΕΞΕ	Τομέας Υπηρεσιών	2019-2021	€ 1,2 εκατομμύρια κόστος νέων επενδύσεων για εγκατάσταση μονάδων συμπαραγωγής ηλεκτρισμού και θερμότητας υψηλής απόδοσης	€ 1,2 - Συγχρηματοδοτούμενο από τα διαρθρωτικά ταμεία (Διαρθρωτικά Ταμεία περιόδου 2014-2020).		Πιλοτική Εγκατάσταση 2 μονάδων συμπαραγωγής ηλεκτρισμού και θερμότητας υψηλής απόδοσης
ΕΞΕ	Οικιστικός Τομέας Τομέας Υπηρεσιών,	2019-2030	1,5 εκ για εκστρατείες ενημέρωσης	150,000 ευρώ ετησίως		Διενέργεια ενημερωτικής εκστρατείας ετησίως με

Τομ	Ενότητα	Χρονοδιάγρα	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
	Βιομηχανικός Τομέας, Τομέας Μεταφορών					πόρους από τον προϋπολογισμό του ΥΕΕΒΤ. Μικρή συνεισφορά στους στόχους ΕΞΕ. Λειτουργεί υποστηρικτικά για τα χρηματοδοτικά και άλλα κίνητρα/μέτρα.
ΕΞΕ	Οικιστικός Τομέας, Τομέας Υπηρεσιών	2016-2030	Πρόσθετες επενδύσεις ΕΞΕ κυρίως σε νέα κτίρια πολυκατοικιών και ξενοδοχείων που υπερβαίνουν τις ελάχιστες απαιτήσεις που ορίζει ο Νομός. Το κόστος επενδύσεων δεν έχει ακόμα υπολογιστεί.	Δεν εφαρμόζεται		Πολεοδομικό κίνητρο για αύξηση του συντελεστή δόμησης σε κτίρια, εφόσον ικανοποιήσουν επίπεδο ενεργειακής απόδοσης , υψηλότερο των ελάχιστων απαιτήσεων που ορίζει ο Νόμος.
ΕΞΕ	Οικιστικός Τομέας, Τομέας Υπηρεσιών	2016-2030	Μειωμένος συντελεστής ΦΠΑ για εργασίες ενεργειακής αναβάθμισης σε υφιστάμενα κτίρια. Το κόστος επενδύσεων δεν έχει ακόμα υπολογιστεί.	Δεν εφαρμόζεται		Δεν εκτιμάται μεγάλη συνεισφορά. Κυρίως οι επενδύσεις ενεργειακής αναβάθμισης γίνονται όταν υπάρχει σχέδιο επιδότησης.
ΕΞΕ	Βιομηχανικός Τομέας	2020-2030	Αύξηση της απόδοσης στις μονάδες ηλεκτροπαραγωγής λόγω της χρήσης φυσικού αερίου αντί πετρέλαιο.		Σημαντική συμβολή στη «μείωση της πρωτογενούς κατανάλωσης ενέργειας 9,5% το 2030, σε σχέση με την αντίστοιχη πρόβλεψη της Ε.Ε για την Κύπρο	Δεν συνεισφέρει στον υποχρεωτικό στόχο για εξοικονόμηση ενέργειας κατά την τελική χρήση, αλλά μόνο ενδεικτικό που αφορά μείωση της πρωτογενούς κατανάλωσης ενέργειας.

Τομ	Ενότητα	Χρονοδιάγρα	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
					το 2007 (PRIMES REFERENCE SCENARIO 2007	
ΕΞΕ	Τομέας Μεταφορών- Τέλη κυκλοφορίας οχημάτων -Τροποποίηση παραμέτρων υπολογισμού Τελών Κυκλοφορίας για να ευνοούνται περισσότερο τα χαμηλών εκπομπών οχήματα που θα εγγράφονται για 1η φορά	Εκτίμηση έναρξης – 1ο Τρίμηνο 2019	-	-	Μερική συμβολή στην επίτευξη του υποχρεωτικού στόχου ΕΞΕ κατά την τελική χρήση της περιόδου 2021-2030, που εκτιμάται προκαταρτικά στα 235,000-238,000 toe (σωρευτικά)	

Σενάριο: «Με πρόσθετα μέτρα[22]»

Τομέας)	Ενότητα	Χρονοδιάγραμμα υλοποίησης	Εκτίμηση Δαπάνη		Αναμενόμενη συνεισφορά στις εθνικές υποχρεώσεις για την ενεργειακή απόδοση[27]	Σημειώσεις
			Ύψος επενδυτικής δαπάνης (€)	Ύψος συνεισφοράς δημοσίου (€)		
ΕΞΕ	Οικιστικός Τομέας	2021-2030	**€500** Εκατομμύρια κόστος νέων επενδύσεων (μεμονωμένα μέτρα ΕΞΕ και ενεργειακές αναβαθμίσεις), εάν **υλοποιηθούν μέχρι το 2025.** Το ύψος συνεισφοράς του δημοσίου δεν έχει προσδιοριστεί.		Οι ελάχιστες πρόσθετες οικονομικά αποδοτικές επενδύσεις που υπολογίστηκε ότι απαιτούνται για επίτευξη του υποχρεωτικού στόχου ΕΞΕ κατά την τελική	Οι πολιτικές που θα εφαρμοστούν δεν μπορούν στο παρόν στάδιο να καθοριστούν. Αυτές μπορεί να είναι σχέδια χορηγιών, χαμηλότοκα δάνεια/χρηματοδοτικά εργαλεία, φορολογικά μέτρα κοκ[23]. Πιθανές πολιτικές θα μελετηθούν περαιτέρω εντός του 2019, στα πλαίσια
ΕΞΕ	Τομέας Υπηρεσιών	2021-2030	**€500** Εκατομμύρια κόστος νέων επενδύσεων ΕΞΕ (μεμονωμένα μέτρα ΕΞΕ και ενεργειακές αναβαθμίσεις), εάν **υλοποιηθούν μέχρι το 2025**. Το ύψος συνεισφοράς του δημοσίου δεν έχει προσδιοριστεί.			

22 Σύμφωνα με τον Κανονισμό για τη Διακυβέρνηση, οι «προβλέψεις με πρόσθετα μέτρα» αφορούν τις πολιτικές και μέτρα που έχουν θεσπιστεί και τεθεί σε εφαρμογή για τον μετριασμό της αλλαγής του κλίματος ή την ικανοποίηση των ενεργειακών στόχων καθώς και των προγραμματισμένων πολιτικών και μέτρων και μέτρων υπό εξέταση προς τον σκοπό αυτό.

23 Σύμφωνα με τη ΓΔ ΕΠΣΑ, τη νέα προγραμματική περίοδο 2020-2026 αναμένεται να είναι διαθέσιμοι πόροι από τα Ευρωπαϊκά ταμεία σε ποσό 30% των πόρων (που αναμένονται στα 225-250 εκ) για ΑΠΕ και ΕΞΕ. Η απορρόφηση συνήθως καθυστερεί λόγω διαδικασιών και συνεπώς δεν αναμένεται να συμβάλουν ουσιαστικά στον εθνικό υποχρεωτικό στόχο ΕΞΕ). **Θα χρειαστεί η διασφάλιση και εθνικών πόρων εάν αποφασιστεί ότι θα υλοποιηθούν με Σχέδια Χορηγιών.**

Τομ	Ενότητα	Χρονοδιάγρ	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
					χρήση της περιόδου 2021-2030, υπολογίζεται προκαταρτικά στα 235,000-238,000 toe (σωρευτικά)	τεχνικής βοήθειας που παρέχεται και θα οριστικοποιηθούν κατά την υποβολή του τελικού πρώτου σχεδίου Δράσης
	Όλοι οι τομείς	2019-2030	Επιβολή σε διανομείς ενέργειας υποχρέωση για επίτευξη μέρους του σωρευτικού στόχου εξοικονόμησης ενέργειας στην τελική χρήση . Ανάλογα με το μέρος του σωρευτικού στόχου που θα επιβληθεί στους διανομείς ενέργειας οι αντίστοιχες επενδυτικής δαπάνες θα κατανεμηθούν στους διανομείς ενέργειας.	Δεν εφαρμόζεται	Μερική συμβολή στην επίτευξη του υποχρεωτικού στόχου ΕΞΕ κατά την τελική χρήση της περιόδου 2021-2030, που εκτιμάται προκαταρτικά στα 235,000-238,000 toe (σωρευτικά)	Ο μηχανισμός αποσκοπεί στην ενεργή δραστηριοποίηση των διανομέων ενέργειας με σκοπό την υλοποίηση παρεμβάσεων βελτίωσης της ενεργειακής απόδοσης. Νομοθεσία σε δημόσια διαβούλευση.
ΕΞΕ	Βιομηχανικός Τομέας και Γεωργικός τομέας	2021-2030	Μέτρα προώθησης μεμονωμένων μέτρων ΕΞΕ κατόπιν διενέργειας ενεργειακού ελέγχου. Το ύψος των επενδύσεων και το κόστος συνεισφοράς του δημοσίου δεν έχει	Δεν έχει προσδιοριστεί.		Σε αρχικό στάδιο. [24]

[24] θα μελετηθούν περαιτέρω εντός του 2019, στα πλαίσια τεχνικής βοήθειας που παρέχεται και θα οριστικοποιηθούν ορισμένες (ή συνδυασμός τους) κατά την υποβολή του τελικού σχεδίου Δράσης το 2019

Τομ	Ενότητα	Χρονοδιάγρ	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
			προσδιοριστεί.			
ΕΞΕ	Όλοι οι τομείς	2021-2030	Δημοσιονομικά ουδέτερη πράσινη φορολογική μεταρρύθμιση. Μετατόπιση των φορολογικών επιβαρύνσεων σε ρυπογόνες δραστηριότητες και τα έσοδα που προκύπτουν να επιστρέφονται στους πολίτες π.χ. με μείωση του κόστους εργασίας.	Δεν εφαρμόζεται		Εξετάζεται από το Υπουργείο Οικονομικών. Σε αρχικό στάδιο.
ΕΞΕ	Τομέας Υπηρεσιών	2019-2030	Αντικατάσταση λαμπτήρων οδικού φωτισμού σε Δήμους και Κοινότητες. Το κόστος δεν έχει ακόμα εκτιμηθεί.	Προωθείται δανειοδότηση από την Ευρωπαϊκή Τράπεζα Επενδύσεων		Εξετάζεται από τα Υπουργεία Εσωτερικών και Οικονομικών. Σε αρχικό στάδιο. [5]
ΕΞΕ	Οικιστικός τομέας και τομέας υπηρεσιών	2021-2030	Εγκατάσταση μικρής κλίμακας συστημάτων ΑΠΕ στα κτίρια	Δεν έχει εκτιμηθεί		Υπάρχουν περιορισμοί που απαιτούν να αποδεικνύεται εξοικονόμηση ενέργειας κατά την τελική χρήση, λόγω αλλαγής σε ενεργειακά αποδοτικότερη τεχνολογία.[5]
ΕΞΕ	Οικιστικός τομέας, Τομέας Υπηρεσιών και Βιομηχανικός	2021-2030	Προώθηση μέτρων εξοικονόμησης νερού και ενέργειας κατά την παραγωγή, διανομή αφαλάτωση νερού κλπ.	Δεν έχει εκτιμηθεί		Σε αρχικό στάδιο[5]

Τομ	Ενότητα	Χρονοδιάγρ	Εκτίμηση Δαπάνη		Αναμενόμενη	Σημειώσεις
	Τομέας.					
ΕΞΕ	Τομέας Υπηρεσιών	2021-2030	Ανάπτυξη υποδομών αποδοτικής τηλεθέρμανσης και τηλεψύξης με χρήση RDF και συμπαραγωγής σε τουριστικές περιοχές.	Δεν έχει εκτιμηθεί		Σε αρχικό στάδιο[5]
ΕΞΕ	Τομέας Υπηρεσιών	2021-2030	Λήψη μέτρων εξοικονόμησης ενέργειας στο τομέα της Άμυνας	Δεν έχει εκτιμηθεί		Σε αρχικό στάδιο[5]
ΕΞΕ	Τομέας Υπηρεσιών	2021-2030	Επενδύσεις ενεργειακής απόδοσης στα δημόσια κτίρια για επίτευξη της νέας υποχρέωσης για 3% αναβάθμιση (ή εξοικονόμηση 3.316 GWh) ετησίως ή άλλα ισοδύναμα μέτρα. Ετοιμασία πρότυπων διαδικασιών για χρήση παροχών ενεργειακών υπηρεσιών και άρση των υφιστάμενων εμποδίων	Δεν έχει εκτιμηθεί	εξοικονόμηση 3.316 GWh ετησίως την περίοδο 2021-2030	Σε αρχικό στάδιο[5]
ΕΞΕ	Τομέας Μεταφορών-Δημόσιες συγκοινωνίες	2023-2028	Χρήση λεωφορείων με μειωμένες εκπομπές ρύπων . **€**18 εκ	**€**18 εκ.	Μερική συμβολή στην επίτευξη του υποχρεωτικού στόχου ΕΞΕ κατά την τελική χρήση της περιόδου 2021-2030, που εκτιμάται προκαταρτικά στα 235,000-238,000 toe (σωρευτικά)	
ΕΞΕ	Τομέας Μεταφορών-Περιβαλλοντικοί δασμοί	2021-2030	Εισαγωγή περιβαλλοντικών δασμών για τη χρήση ιδιωτικών οχημάτων	-		
ΕΞΕ	Τομέας Μεταφορών-Περιορισμός της χρήση του ιδιωτικού οχήματος	2020-2030	Αύξηση της πεζής διακίνησης, και της χρήσης του ποδηλάτου και των δημόσιων μεταφορών . **€**2860 εκ.	€930 εκ		

Appendix III: Cumulative expenses needed to achieve the WEM Scenario for the period 2021-2030

Capital Cost (Million USD)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Transport	1055.94	1077.30	1089.51	1125.68	1201.32	1190.87	1192.36	1185.82	1104.04	1093.23
Heating and Cooling	8.73	0.00	47.88	48.05	67.91	41.52	43.44	54.77	67.37	69.97

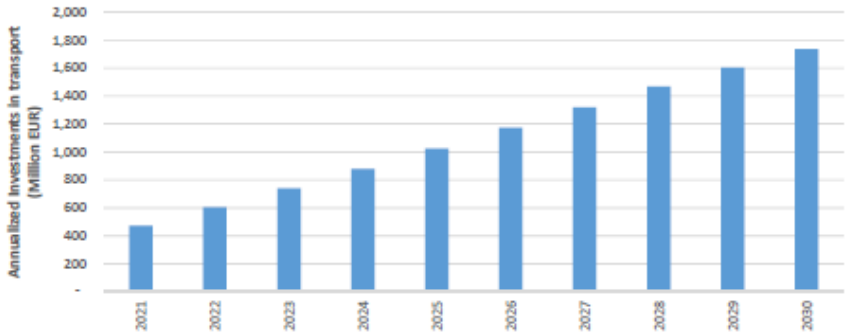
Capital Cost (Million EUR)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Transport	959.945574	979.36192	990.46762	1023.3441	1092.1065	1082.6115	1083.9667	1078.0184	1003.6698	993.84886
Heating and Cooling	7.93669674	0.000166	43.527732	43.680193	61.733199	37.745776	39.495395	49.790142	61.243319	63.606337

Years
Transport
New ICE or GT

Annualized Inv Cost (Million EUR)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Transport	472	605	739	878	1,026	1,173	1,320	1,466	1,602	1,737
Heating and Cooling	53	53	59	65	74	79	84	91	99	108



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Cumulative Ann Inv	5664.5773	7061.0859	8613.793	10322.105	12181.908	14209.722	16413.853	18777.994	21201.733	23615.981

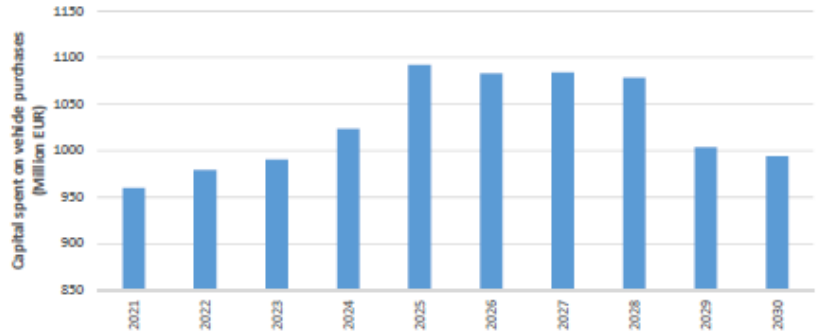
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total System Cost	3,056	3,242	3,415	3,594	3,775	3,938	4,136	4,315	4,351	4,413

Cumulative investments

	2030
Existing PaMs	23,616

Total System Cost

	2030
Existing PaMs	4,413



Appendix IV: 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	Compete4SECAP (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 cities to grow in a sustainable way.	€130000
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	€155798

A/A	Name of the project	Participant	Subject	EU funding
			Blue Economy, and assess corresponding decarbonization and adaptation pathways, thus complementing current available projections for Europe, and nourishing actual economic models with non-market assessment.	
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 (pronounce “Echo”) will use the prodigious potential offered by the ever-growing computing infrastructure to foster and accelerate the European transition to a reliable and low carbon energy supply.	€238000
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	€3499375 (including €2.5 Million from the EC)

A/A	Name of the project	Participant	Subject	EU funding
			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.	
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 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	

A/A	Name of the project	Participant	Subject	EU funding
			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 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)	

A/A	Name of the project	Participant	Subject	EU funding
			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 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 tax by local authorities to finance and promote RES in their territory.	€162813
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 activities will envisage an interregional learning	€143536

			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 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)	€102000

			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 V:

Επιτροπή για μελέτη της Πράσινης Φορολογικής Μεταρρύθμισης

Απόψεις εκπροσώπου ΓΔ Υπουργείου Ενέργειας

1. Μία καλή πράσινη φορολογική μεταρρύθμιση, που να αυξάνει τη φορολογία κατανάλωσης ορυκτών καυσίμων, έναντι μείωσης άλλων φορολογιών, δύναται να εξυπηρετήσει του στόχους του Υπουργείου αυτού για εξοικονόμηση ενέργειας (ΕΞΕ) και αύξηση της διείσδυσης ανανεώσιμων πηγών ενέργειας (ΑΠΕ) καθώς και επιδίωξη των πέντε διαστάσεων της Ευρωπαϊκής ενεργειακής ένωσης:
    i. Ενεργειακή ασφάλεια,
    ii. Ανταγωνιστική αγορά ενέργειας,
    iii. Υψηλή ενεργειακή απόδοση,
    iv. Απαλλαγή από τις ανθρακούχες εκπομπές και
    v. Έρευνα, καινοτομία και ανταγωνιστικότητα.

    Υπό κάποιες προϋποθέσεις ανοικτών αγορών με ελεύθερο ανταγωνισμό, και πάταξης της φοροδιαφυγής, μία καλή φορολογική μεταρρύθμιση θα μπορούσε να αποτελέσει επαρκές και δίκαιο κοινωνικά μέτρο για επίτευξη όλων των στόχων ΕΞΕ και ΑΠΕ.
2. Στην περίπτωση της εξοικονόμησης ενέργειας η πρόταση Ζαχαριάδη για σταδιακή εισαγωγή εισφοράς άνθρακα ύψους €120/ τόνο αναμένεται να είναι από μόνη της επαρκές μέτρο για επίτευξη των εθνικών ευρωπαϊκών υποχρεώσεων για την περίοδο 2021-2030.
3. Στην περίπτωση των ανανεώσιμων πηγών ενέργειας, η πρόταση Ζαχαριάδη για εξαίρεση των οικονομικών δραστηριοτήτων που εμπίπτουν στο Σχέδιο Εμπορίας Δικαιωμάτων Εκπομπών, που περιλαμβάνει την ηλεκτροπαραγωγή από ορυκτά καύσιμα, αναμένεται να έχει σχετικά απροσδιόριστα αποτελέσματα, ή να απαιτήσει. Οι υφιστάμενες τιμές των δικαιωμάτων αυτών βρίσκονται σήμερα στα €20/ τόνο, με την προοπτική του σχεδιασμού της Ε.Επ. για €33/τόνο μέχρι το 2030. Το διαφορετικό ύψος επιβάρυνσης για καύσιμα τελικής χρήσης και αυτών που χρησιμοποιούνται για παραγωγή ηλεκτρισμού, αναμένεται να δημιουργήσει στρέβλωση της αγοράς προς την κατεύθυνση της κατανάλωσης ηλεκτρικής ενέργειας, με περιορισμένο κίνητρο για περιορισμό των εκπομπών ηλεκτροπαραγωγής. **Θα πρέπει να εξεταστεί το ενδεχόμενο περιορισμού του ύψους της εισφοράς άνθρακα στα καύσιμα τελικής χρήσης σε χαμηλότερο επίπεδο και αύξησης της εισφοράς άνθρακα στα καύσιμα ηλεκτροπαραγωγής.** Αυτό θα λειτουργήσει και ως παράγοντας σταθεροποίησης των μακροπρόθεσμων φορολογικών εσόδων, ενόψει της αναμενόμενης μείωσης της κατανάλωσης καυσίμων τελικής χρήσης και αύξησης της κατανάλωσης ηλεκτρισμού. Η επιδιωκόμενη απαλλαγή από τις ανθρακούχες εκπομπές θα πρέπει να οδηγήσει σε κάποιο στάδιο στην αναζήτηση άλλων πηγών για την αντικατάσταση των φορολογικών εσόδων από ορυκτά καύσιμα.
4. Ένα από τα χαρακτηριστικά των αγορών ενέργειας είναι ότι βραχυπρόθεσμα παρουσιάζουν ανελαστικότητα ζήτησης σε σχέση με τις τιμές στην αγορά, πράγμα που αντικατοπτρίζει τις κεφαλαιουχικές επενδύσεις και τον χρόνο που χρειάζονται οι αγορές ώστε να μετακινηθούν σε υποκατάστατα. Για αυτόν τον λόγο είναι επάναγκες **να διατηρηθεί το στοιχείο της σταδιακής εισαγωγής της εισφοράς άνθρακα. Η επέκταση της προτεινόμενης περιόδου από έξι σε δέκα ή και 15 χρόνια θα ταιριάζει στη διάρκεια ζωής υφιστάμενων επενδύσεων**. Οι πρόσφατες ταραχές στο Παρίσι καταδεικνύουν την ευαισθησία των πολιτών σε απότομες αλλαγές τιμών. Ιδιαίτερα όταν η αλλαγή συμπεριφοράς εκ μέρους τους απαιτεί ταλαιπωρία ή υψηλές κεφαλαιουχικές δαπάνες.

5. Η ανακοίνωση του μακροπρόθεσμου πλάνου αύξησης της εισφοράς κρίνεται απαραίτητη για σκοπούς προγραμματισμού και ομαλής προσαρμογής της αγοράς.
6. Οι φορολογικές ελαφρύνσεις ως αντιστάθμισμα της αύξησης της φορολογίας στα ορυκτά καύσιμα θα πρέπει να σχεδιαστούν προσεκτικά μέσα στα πλαίσια ενός κοινωνικού διαλόγου ώστε να τύχουν γενικής αποδοχής, χωρίς να μειώνονται μακροπρόθεσμα τα φορολογικά έσοδα. Η εισφορά άνθρακα είναι δυσνόητη έννοια για το ευρύ κοινό. Η φορολόγηση ορυκτών καυσίμων είναι πλήρως κατανοητή και αποτελεί καλύτερη ορολογία για σκοπούς διαλόγου. Θα πρέπει να αναμένονται αντιδράσεις από τους βαρείς καταναλωτές ορυκτών καυσίμων: Αυτοκινητιστές, επιχειρήσεις μεταφορών, θερμάνσεις πετρελαίου, κάποιες βιομηχανικές δραστηριότητες. Η πρόταση για μείωση των φόρων εργασίας είναι ελκυστική βραχυπρόθεσμα. Επειδή όμως οι φορολογίες κατανάλωσης πλήττουν περισσότερο τους πολίτες με χαμηλά εισοδήματα, είναι σημαντικό η μείωση των φόρων εργασίας να προέλθει περισσότερο με αύξηση του αφορολόγητου εισοδήματος παρά με τη μείωση του ανώτατου συντελεστή φορολόγησης. Μακροπρόθεσμα, η φορολογία εργασίας είναι απαραίτητη ώστε να ικανοποιείται η απαίτηση του συντάγματος για τη συνεισφορά στις κρατικές δαπάνες σύμφωνα με τις δυνατότητες του καθενός. Άλλες φορολογικές ελαφρύνσεις που προσφέρονται καλύτερα είναι περιορισμός των τελών αδειών κυκλοφορίας οχημάτων στο ύψος του κόστους τους, μείωση των τελών μεταβίβασης ακίνητης ιδιοκτησίας, μείωση ή κατάργηση του ΦΠΑ σε είδη πρώτης ανάγκης κοκ.

7. **Η κυβέρνηση θα μπορούσε να υποβοηθήσει την προσαρμογή της αγοράς με τα ακόλουθα πρόσθετα μέτρα:**
    i. **Ευκολίες χρηματοδότησης σε φυσικά πρόσωπα που αντιμετωπίζουν οικονομικά προβλήματα προσαρμογής. Επειδή το κόστος αγοράς του απαραίτητου εξοπλισμού για εξοικονόμηση ενέργειας ή και ιδιο-κατανάλωση από ΑΠΕ αποτελεί επένδυση, η παραχώρηση δανείων αντί χορηγιών θα μπορούσε να αποτελεί καταλληλότερο και πιο καθολικό μέτρο, χωρίς κρατική δαπάνη. Η δόση αποπληρωμής των δανείων με βάση εισοδηματικά κριτήρια θα μπορούσε να αποτελέσει και κατάλληλη κοινωνική ρύθμιση (υπό τη προϋπόθεση ότι θα παταχθεί η φοροδιαφυγή).**
    ii. **Επιταχυνόμενη απόσβεση για επενδύσεις εξοικονόμησης ενέργειας ή ιδιο-κατανάλωσης ΑΠΕ σε επιχειρήσεις.**

Appendix VI

2016					
A/A		CATEGORY OF INVESTMENT	2005	TOTALS (2005-20016)	
			ΑΡ. ΑΙΤΗΣΕ	NO OF APPLICATION	AMOUND
					€
		ENERGY SAVING			
1		ENERGY SAVING IN COMMERSIAL AND INDUSTRIAL UNITS	26	756	8,667,292
2		THERMAL INSULATION IN NON-MOUNTAINOUS REGIONS	157	22,162	28,262,022
3		THERMAL INSULATION IN MOUNTAINOUS REGIONS	0	2,853	5,915,108
				0	0
5		Compact Fluorescent Lamps (CFL)	0	0	2,710,840
			183	25,771	45,555,262
		TRANSPORT		0	0
7		HYBRIC VEHICLE	0	831	997,338
8		ELECTRIC VEHICLE	0	32	22,566
9		VEHICLES WITH CO2 EMISSIONS LESS THAN 120 g CO2/Km	0	2,230	1,594,119
			0	3,093	2,614,023
		RENEWABLE ENERGY SOURCES			
11		GEOTHERMAL HEAT PUMBS	0	134	2,792,384
13		SOLAR THERMAL SYSTEMS HEATERS FOR THE PRODUCTION OF HOT WATER	6	206	1,389,604
14		SOLAR THERMAL SYSTEMS FOR SPACE HEATING	3	1,017	9,520,551
15		DOMESTIC SOLAR WATER HEATERS	258	17,264	10,326,757
16		SOLAR HEATERS FOR THE HEATING OF SWIMMING POOL WATER	4	61	225,014
17		BIOMASS BOILERS AND HEATERS	0	1,226	3,976,108
18		BIOMASS STATIONS FOR HEATING	0	12	136,723
			271	19,920	28,367,142
19		SMALL WIND GENERATORS	0	2	3,826
20		SUBSIDY FOR THE INSTALLATION OF GRID CONNECTED PHOTOVOLTAIC SYSTEMS	21	608	8,297,513
21		PHOTOVOLTAIC SYSTEMS IN HOUSES OF VOLNERABLE CONSUMERS (NET METERING)		2,092	5,625,329
23		STAND ALONE PHOTOVOLTAIC SYSTEMS	18	875	2,741,903
24		STAND ALONE PHOTOVOLTAIC SYSTEMS FOR WATER PUMPS	0	43	229,556
			39	3,620	16,898,127
				0	0
		TOTAL RES	310	23,540	45,265,268
TOTAL			493	52,404	93,434,554

Appendix VII: Input assumptions for the first iteration of the Existing PaMs scenario

1. OVERALL INPUT ASSUMPTIONS

1.1. Modelling Approach

Since this modelling activity aims at indicating the effectiveness of proposed policies and measures (PaMs), the aim was no longer the identification of a cost-optimal solution for a suite of renewable energy and emission targets. As such, all hard constraints defined previously on these were removed from the model, unless backed-up by existing policies. Therefore, the only target related constraint left in the model is associated with the necessity to cut down SOx emission in 2020, once natural gas becomes available.

1.2. Discount Rates

Due to the different modelling approach followed in this study, it was important to implement technology-specific discount rates. The data used in the analysis were drawn from the discount rates employed by the PRIMES model for the EU Reference Scenario 2016 (European Union, 2016)[25].

Table 1 – Technology specific discount rates.

Discount Rates in Energy Supply Sectors	
Assumptions for EU Reference Scenario 2016	**Discount Rate**
Regulated monopolies and grids	7.50%
Companies in competitive energy supply markets	8.50%
RES investment under feed-in-tariff	7.50%
Investment under contract for differences	7.50%
RES investment under feed-in premium, RES obligation, quota systems with certificates	8.50%
RES investment in competitive markets	8.50%
Risk premium specific to immature or less accepted technologies	1-3%
Risk premium specific to investment surrounded by high regulatory or political uncertainty	None
Country-specific risk premiums	None
Discount Rates of Firms in Energy Demand Sectors	
Assumptions for EU Reference Scenario 2016	**Discount Rate**
Energy intensive industries	7.50%
Non energy intensive industries	9%
Services sectors	11%
Public transport (conventional)	7.50%
Public transport (advanced technologies, e.g. high speed rail)	8.50%
Business transport sectors (aviation, heavy goods vehicles, maritime)	9.50%
Country risks	None

[25] European Union, 2016. EU Reference Scenario 2016: Energy, transport and GHG emissions - trends to 2050. Publications Office of the European Union, Luxembourg.

Discount Rates of Individuals in Energy Demand Sectors		
Assumptions for EU Reference Scenario 2016	**Standard Discount Rate**	**Modified Discount Rate due to EE policies**
Private cars and powered two wheelers	11%	11%
Households for renovation of houses and for heating equipment	14.75%	12%
Households for choice of appliances	13.50%	9.50%

1.3. Fossil Fuel Prices and ETS price projections

Following recommendations by MECI, the low fuel price assumptions adopted during the KTH study of 2017 were adopted in this scenario run as well. MECI has consulted with both the Cyprus Gas Company and the Cyprus Hydrocarbons Company before reaching this decision. As such, the prices as provided in Table 2 were used. However, it should be clarified that the ETS price projection recommended by the EC was adopted.

Table 2 – International Fuel prices assumed in the model.

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Oil	**EUR2016/GJ**	5.12	5.40	5.69	5.99	6.30	6.64	6.71	6.79	6.86	6.93	7.00	8.51	9.61
Gas	**EUR2016/GJ**	5.16	5.43	5.73	6.03	6.34	6.68	6.76	6.84	6.91	6.98	7.06	8.57	9.68
Carbon price ETS sectors	**EUR2016/ton CO2**	15.5	17.6	18.6	20.7	21.7	23.3	25.9	27.9	30.0	32.1	34.7	43.5	51.7

2. ELECTRICITY SUPPLY SECTOR

Some overarching assumptions regarding the electricity supply sector include:

a) No Electricity Interconnection or any New Energy Intensive Investment was assumed (such as LNG Terminal, Ethanol Production plant etc).
b) The generation system must have at least two conventional generation points, one at each power station online at all times, for operational security reasons. For this purpose, it was assumed that the installation of the next new CCGT unit (if the installation is deemed cost-optimal) will be at Dhekelia Power Station. Before the installation of the next new CCGT unit at Dhekelia Power Station, two units of ICE (2x17MW) at Dhekelia Power Station and one Steam Unit at Vasilikos Power Station or one Gas Unit of one of the CCGT Units at Vasilikos Power Station will operate as must-run.
c) Natural gas becomes available through an FSRU unit in the last quarter of 2020.
d) From 2020 onwards Low Sulphur HFO will be used instead of 1%S HFO at Dhekelia's ICE and steam units.
e) Only Vasilikos Power Station was allowed to consume natural gas from the existing thermal plants.
f) All new Conventional units, including any new CCGTs at locations other than Vasilikos, were assumed to use Natural Gas as the primary fuel, if this fuel is available. However, it is important to mention that this implies new installations will occur in a location that can be supplied with natural gas. It should be clarified that the cost of gas transmission infrastructure to supply other locations with gas has not been taken into account. This may affect somewhat the optimization

results, depending on whether the gas transmission infrastructure cost will pass to the fuel price or not. The respective policy decisions have to be better clarified by MECI in the next iterations.

2.1. Technology Assumptions

All existing generating options were included in the model (Table 2.3). The units at Vasilikos, Dhekelia and Moni were modelled separately based on the type of technology. Existing renewable energy technologies (RET) were included, while future thermal and RET were allowed for investment as part of the optimal solution. Gas turbines (62 MW), internal combustion engines (17 or 100 MW), steam turbines (57 MW) and combined cycle gas turbines (110 or 220 MW) were modelled as potential available options.

Table 3 – Existing thermal generation capacity.

Facility	Technology Type	Fuel	Rated Capacity (MW)	Retirement date*
Vasilikos Power Plant	Combined Cycle Gas Turbine	Diesel (or gas if available)	440	31/12/2035 – 220 MW 31/12/2038 – 220 MW
	Steam Turbine	HFO (or gas if available)	390	31/12/2032 – 260 MW 31/12/2037 – 130 MW
	Gas Turbine	Diesel	38	31/12/2035
Dhekelia Power Plant	Steam Turbine	HFO	360	31/12/2023
	Internal Combustion Engine	HFO	102	31/12/2035 – 51 MW 31/12/2036 – 51 MW
Moni Power Plant	Gas Turbine	Diesel	150	31/12/2031
		Total	1,480	

*Based on expected outlook provided by EAC.

As in the case of fuel prices, except for certain cases mentioned elsewhere in the document, the same technology costs as used in the KTH study of 2017 were used for the entire suite of energy technologies considered in the model. MECI suggested keeping the same technology assumptions for this set of iterations since the marker in Cyprus is very small comparing with all other EU countries. In addition, the cost of limited land in Cyprus is much higher than the average price of EU. As it was discussed in various fora i.e. Concerted action for RES, POTEnCIA, the average prices assumed in the models does not really reflect the spread of the cost among the various member states. MECI is suggesting that EC should use a standard diviation approach and let each MS choose the appropriate values for the various technology options based on real data (like IRENA costs[26])

As indicated, taking into account the fact that the values used are not consistent with EC's recommendations (Figure 1), these may be revised for the next round of iterations.

[26] https://www.irena.org/costs

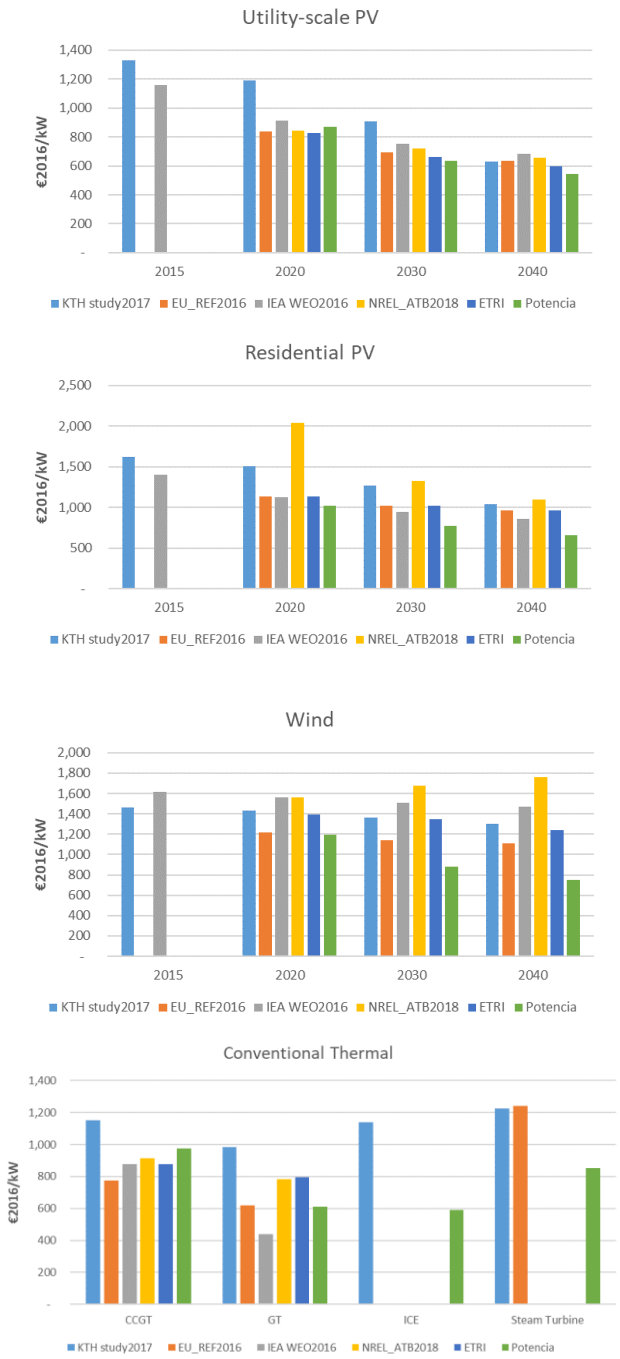


Figure 1 – Investment Cost Comparison of generation technologies considered in the KTH study (and this study) and other literature sources.

Furthermore, MECI will review the techno-economic characteristics for solar thermal technologies, due to the absence of credible figures in time for the scenario run, no change was implemented on these. It is likely that in the next iterations of the two scenarios, new values will be adopted, based on figures to be provided by academics and industry participants that recently attended a CSP-focused conference or from https://www.irena.org/costs/Charts/CSP.

Table 4 – Technoeconomic assumptions for RE technologies for generation.

	Investment Cost (EUR2016/kW)	Fixed Cost O&M cost (EUR2016/kW)	Capacity Factor	Lifetime (years)

	2020	2030	2040			
Utility-scale PV	1,161	886	611	9	18.5%	20
Wind	1,394	1,330	1,266	53	16%	25
Biomass-biogas	2,461	2,438	2,415	62	48.5%	30
Rooftop PV	1,467	1,241	1,016	12	18.5%	20
EOS 50 MW CSP with storage	3,355			106	39.3%	30

In order to prevent complete decommissioning of RET, the model was allowed to repower solar and wind installations, as the new REDII states, thus prolonging their lifetime and keeping these in the system until the end of the model horizon. It was assumed that the repowering cost would correspond to approximately an average of 60% of the cost of a new installation of the same technology, according to MECI's estimations. This approach was adopted at the end of the study, which did not allow for further code improvements regarding repowering. Thus the additional cost was incorporated on the fixed annual cost of each technology instead. In future enhancements of this work, a more detailed analysis of the potential for retrofits can be included, both for renewable energy technologies as well as conventional thermal technologies. Table 4 provides a summary of the main parameters used for renewable energy technologies.

2.2. Final Electricity Demand Projections

MECI after analysing and discussed with TSO-Cy regarding the forecast used, it was agreed not to use the latest forecast by TSO-Cy despite the fact that this one was approved by CERA, as it showed considerable increase in final electricity demand as compared to the previously adopted demand forecasts. After the discussions made it was unearth that TSOCy was using different assumptions for GDP and some policy decision regarding the energy efficiency were not taken into account.

As such, the demand projection provided by Dr. Zachariadis for the previous set of studies (i.e. KTH study 2017 and GIZ study 2017) was once again used (Table 5). The only exception that has to be noted is that the transport electricity demand was allowed to increase or decrease according to the level of electric and plug-in hybrid vehicle penetration. As such, final electricity demand in the transport sector was a result provided by the cost-optimization algorithm.

Table 5 – Final Electricity Demand (GWh) as a total of all sectors (forecast provided by Dr. Zachariades).

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
GWh	4,084	4,227	4,339	4,463	4,593	4,724	4,828	4,913	5,004	5,076	5,130	5,218	5,315
	2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
GWh	5,422	5,518	5,600	5,694	5,798	5,909	6,026	6,150	6,272	6,394	6,515	6,635	6,754

2.3. Storage Options

Two main electricity storage options were considered. The pumped hydro storage facility was maintained as an option, but its deployment was delayed until 2027, as the earliest possible year, according to MECI's suggestions after discussions with the TSOCy. The reasoning for this is that no interest has been shown in such a facility yet and no technical feasibility assessment has been conducted so far. MECI also argues that the cost and performance characteristics assumed for this facility may need to be revised, as the existence of periodic droughts in Cyprus may affect the attractiveness and viability of such a project.

The second option, that of lithium-ion batteries was split into two different categories:

a) A centralized option deployed at the transmission or distribution level – this option was forced to have a minimum ratio of kWh/kWp of 4 hours.
b) A decentralized option deployed at the consumer level – this option was forced to have a minimum ratio of kWh/kWp of 2 hours.

It should be noted that, as recommended by MECI, the latest price forecast from IRENA storage cost-of-service tool were used. As shown in Figure 2, a steep learning rate of up to 7% is foreseen until 2030. For the period after 2030 and until 2050, we assumed that the learning rate would slow down and be limited to 2%. IRENA also projected that by 2030, the round-trip efficiency of Li-ion batteries would improve to 95%, while the lifetime of the technology would be extended to 15 years. These figures were adopted.

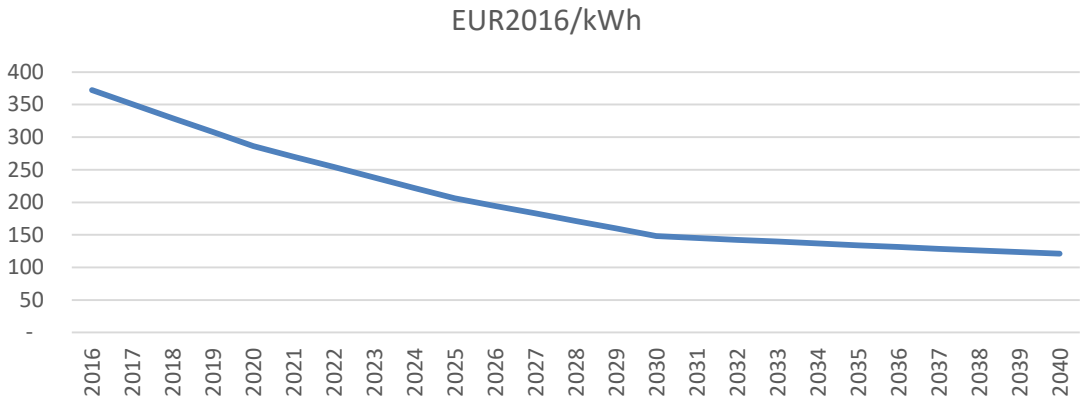
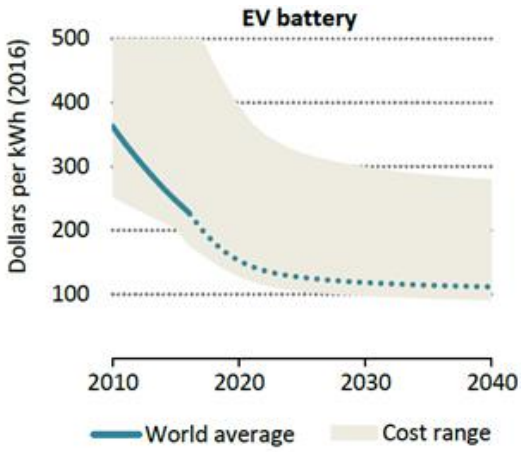


Figure 2 – Investment cost of li-ion battery (nickel manganese cobalt)[27].

It should be noted that a large difference with the above assumptions for batteries exists as compared to those used in the EU Reference Scenario 2016. The latter assumes a constant installation cost of 8250 EUR2016/kWh and annual operation and maintenance cost of 125 EUR/kWh, whereas the present effort assumes the installation cost will drop to 150 EUR2016/kWh by 2030. Taking into account the fact that cost of batteries for mobile applications was already at around 200 EUR2016/kWh (Figure 3) in 2016, as well as the trend and expected trajectory for cost improvements, one could argue that the EU Reference Scenario 2016 is overly pessimistic in regards to the associated battery cost outlook for stationary applications.



[27] Based on IRENA (2017), Electricity Storage and Renewables: Costs and Markets to 2030, International Renewable Energy Agency, Abu Dhabi.

Figure 3 – Historic trend and projection for electric vehicle battery costs, based on the New Policies Scenario of the IEA World Energy Outlook 2017[28].

2.4. Capacity Reserve

A capacity reserve margin of 20% higher than the yearly peak demand, as suggested by CERA, was assumed as the lower limit allowed for the entire model horizon after 2019. Storage options and conventional thermal plants were allowed to contribute 100% of their rated capacity, while RET without storage were allocated a lower capacity credit, since their availability is intermittent (Table 6).

Table 6 – Capacity credit of each technology.

Technology	Capacity credit (% of capacity)
Conventional thermal	100%
Biomass	33%
CSP with storage	100%
Wind	0%
PV	20%
Storage Technologies	100%

2.5. Operational Reserves

The assumption used regarding spinning reserve in IRENA Renewable Energy Roadmap for the Republic of Cyprus was adopted in this analysis as well. The demand for spinning reserve was expressed throughout the model horizon as:

a) A constant 60 MW demand;
b) Plus, an additional 50% of the instantaneous wind generation;
c) Plus, an additional 10% of the instantaneous PV generation.

All thermal conventional technologies were allowed to contribute to this reserve. Additionally, storage options were included, for which the capacity to provide spinning reserve was defined as a function of the level of electricity charge on a ratio of 1:1.

2.6. RES Support Schemes

Certain forced investments or potential investments of renewable energy technologies based on existing support schemes were implemented in the model. Specifically:

- Forced investments in rooftop PV of 60 MW (20 MW in 2018 and 40 MW in 2019), relating to net-metering and net-billing schemes.
- Forced investments in large-scale PV of 120 MW by end of 2019 (i.e. these appear in solution by the first day of 2020). These were forced as MECI foresees that even though applications reached 400 MW, at least the capacity mentioned in the relevant RES support scheme (i.e. 120 MW) will be developed by 2020.
- Forced investments in wind of 12.5 MW by 2020 (instead of 17.5 from 2018 in KTH study). A previously licensed plants of this capacity has not been implemented, but the same capacity has been released in the relevant RES support scheme for inclusion of projects in the competitive electricity market. MECI foresees that this capacity (12.5 MW) will be taken up by interested investors.

[28] IEA, World Energy Outlook 2017, International Energy Agency, Paris.

- Delayed forced investment in CSP 50 MW with storage (EOS) to end of 2021 instead of 2018. According to updates from MECI and the developers themselves, development of this plant is going forward and will be in the system at the latest by year 2021.
- The second CSP plant of 50 MW without storage was not accounted for, as interest in developing this project has been dropped.

3. TRANSPORT SECTOR

In order to be consistent with the government's existing studies on this sector, a list of assumptions were adopted from a relevant Ifeu's study[29]. The main areas in which assumptions were aligned are (separate excel spreadsheet will be provided for these):

i. Fuel efficiency projection for each vehicle technology (Table 8).
ii. The demand was changed from passenger-km and tonne-km to vehicle-km.
iii. A fixed demand projection in terms of vehicle-km for each mode of transport (Table 7) was adopted (i.e. a separate demand for busses, a separate demand for heavy trucks, a separate demand for passenger cars etc.)

Table 7 – Mileage by each mode, as assumed in the Reference case of Ifeu study.

Billion veh-km	2020	2025	2030	2035	2040
Busses	0.1354	0.1361	0.1368	0.1421	0.1475
Light commercial vehicles	1.1746	1.2454	1.3162	1.3598	1.4034
Motorcycles	0.2326	0.2414	0.2503	0.2625	0.2747
Passenger cars	5.9663	6.1941	6.4218	6.7349	7.0480
Heavy duty vehicles	0.2995	0.3176	0.3356	0.3467	0.3578

During preliminary runs of the model, it was noticed that no alternative fuels and vehicles were adopted in the transport sector. In order to address this, following a recommendation by MECI, it was decided to consider the fact that even though the average distance covered by passenger vehicles is around 10,000 km annually, a portion of the fleet travels much more. It was recommended to consider the fact that 10% of the fleet may travel up to 25,000 km/year, while 20% of the fleet may travel up to 20,000 km/year. This was implemented in the model, so as to make potential investments in plug-in hybrid, hybrid and electric vehicles more attractive. The same approach was adopted for light commercial vehicles as well.

Table 8 – Fuel efficiency of road transport vehicle technologies (MJ/veh-km); based on Ifeu, 2017.

		2020	2025	2030	2035	2040
Busses	Diesel	11.92	11.56	11.27	10.70	10.12
Light commercial vehicles	Diesel plug-in hybrid	2.76	2.69	2.60	2.47	2.34
	BEV	1.22	1.20	1.16	1.11	1.06
	Diesel	3.19	2.94	2.75	2.61	2.48
Motorcycles	Gasoline	1.20	1.20	1.21	1.20	1.20
Passenger cars	Diesel plug-in hybrid	2.76	2.69	2.60	2.47	2.34
	BEV	0.94	0.89	0.89	0.87	0.86
	Gasoline plug-in hybrid	2.20	2.15	2.17	2.14	2.12
	Diesel	3.06	2.87	2.71	2.58	2.46
	Gasoline hybrid	2.15	2.15	2.11	2.06	2.01
	Gasoline	2.99	2.87	2.74	2.60	2.46

[29] Ifeu, 2017. Penetration of alternative fuels in Cyprus road and maritime sectors

	LPG	2.52	2.48	2.44	2.39	2.35
	Natural gas	2.54	2.49	2.50	2.47	2.43
Trucks	BEV	3.40	3.27	3.14	3.05	2.96
	Diesel	9.37	9.30	9.05	8.53	8.01
	Natural gas	12.63	11.64	10.80	9.48	8.01

The potential deployment of electric and plug-in hybrid vehicles will have an effect on the load profile of the electricity sector. As such, so as to account for this, a charging profile had to be adopted. Since there is limited penetration of these technologies in Cyprus, local information on the charging behaviour is lacking. Therefore, information from a relevant academic article was adopted[30], as shown in Figure 4 below. The same profile was assumed to be applicable for the entire year throughout the modelling horizon.

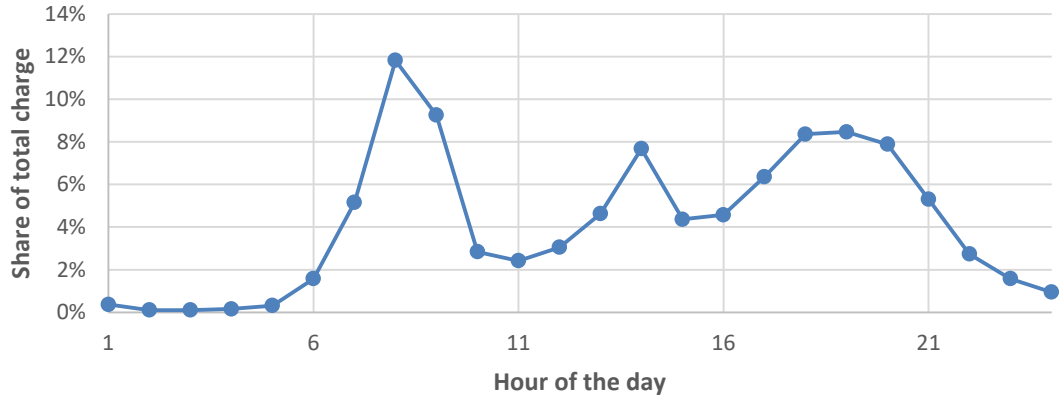


Figure 4 – Share of hourly charging rate as compared to daily total charging volume for electric and plug-in hybrid vehicles.

4. HEATING AND COOLING SECTOR

In order to conform with the results and assumptions adopted in the Energy Efficiency studies of the government, it was decided that the results pertaining to the Existing Policies and Measures scenario from these studies would be adopted on an as-is basis. In this sense, the final energy demand projections for the industrial, agricultural, residential and commercial sectors were directly taken from the latest demand projections of Prof. Zachariadis (Cyprus University of Technology – CUT), provided to the Cyprus Institute in October 2018 (Table 9). The main reason for this decision is that the latest PaMs in this sector were taken into account by CUT, whereas these were not easily captured by a cost-optimization conducted by the OSeMOSYS model; a quantitative provision of data which would enable this was difficult in the time available. However, in the future iterations of the model an effort will be made to retrieve the required information from MECI, so as to allow a full optimization of this sector as well, rather than predefining the results.

Table 9 – Forced final energy demand in the Heating and Cooling sector (PJ).

	2020	2025	2030	2035	2040
Gas Oil/Diesel/Gasoline/Light Fuel Oil/	9.009	8.887	8.510	7.598	6.667

[30] Anglani, Norma & Fattori, Fabrizio & Muliere, Giuseppe. (2014). Combining Photovoltaic Energy with Electric Vehicles, Smart Charging and Vehicle-to-Grid. Solar Energy. 10.1016/j.solener.2014.09.034.

Heavy Fuel Oil					
LPG	3.381	3.379	3.482	3.352	3.186
Pet coke	4.3196	4.0445	3.6873	3.4153	3.1630
Biomass	1.4195	1.5517	1.7849	1.8637	1.9016
Solar Thermal	4.1454	4.3051	5.1507	6.4694	7.8105
Electricity	8.2933	8.3740	9.2593	10.1851	10.9272

The seasonal variation in demand for heating and cooling was estimated based on historical measurements of heating and cooling degree days, provided by MECI. 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 (Figure 5). However, analysis providing a more accurate demand profile may be needed for future enhancements of the model.

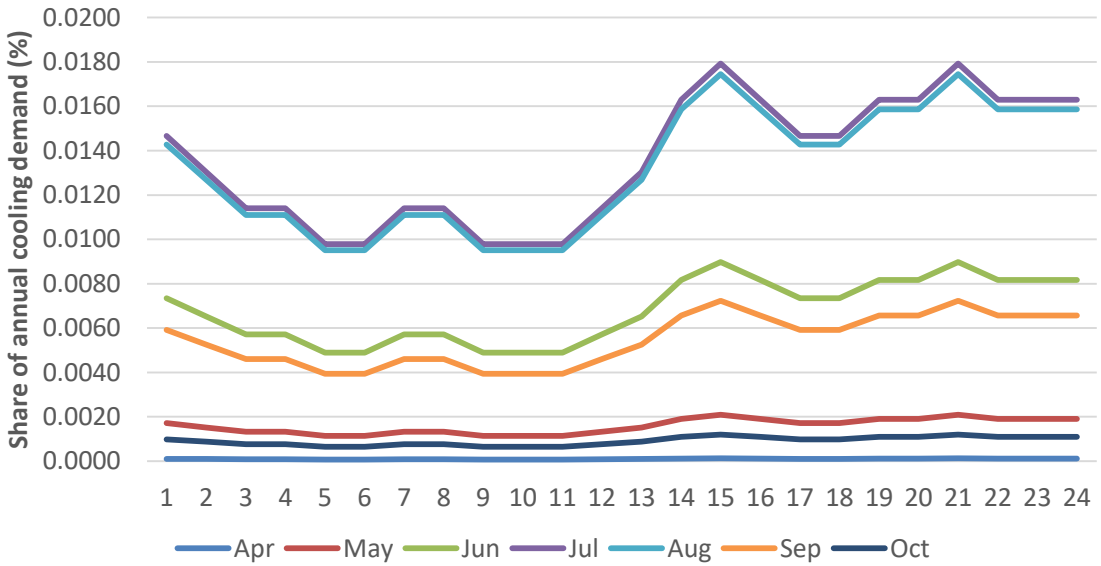


Figure 5 – Assumed share of annual cooling demand for each hour within each month.

The technoeconomic assumptions for the technologies used in this sector (Tables 10 and 11) were taken from a separate JRC study focusing on this sector [31]. In order to ensure enough capacity of technologies able to provide high heat would be present, a high heat requirement was inserted in the model. This requirement was set at 0.62 PJ in 2020 and increased gradually to 0.75 PJ by 2040. Only boilers and CHP technologies were allowed to satisfy this demand.

Table 10 – Technoeconomic characteristics of technologies in the industrial, commercial and agricultural sectors.

Resource	Technology	Investment cost (EUR2016/kW)	Fix O&M (EUR2016/kW)	Lifetime (years)	Heat efficiency	Electric efficiency	Cooling efficiency
Electricity	Heat pumps	838	16.8	20	3	--	4
Electricity	Resistance	101	1.1	15	0.9	--	0.63

[31] JRC, 2016. Cost-benefit analysis for the potential of high-efficiency cogeneration in Cyprus.

	heaters						
Gas oil, kerosene, light fuel oil	Boilers	80	4.0	20	0.77	--	0.54
Gas oil, light fuel oil, livestock/ industrial waste, LPG	CHP	1241	16.7	20	0.47	0.34	0.33
Gas oil, kerosene, light fuel oil	Efficient Boilers	325	16.2	20	0.9	--	0.63
LPG	Boilers	188	9.4	20	0.66	--	0.46
Municipal waste, biomass	CHP	1448	19.7	20	0. 47	0.34	0.33
Livestock/industrial waste, LPG	Efficient Boilers	327	22.9	20	0.96	--	0.67
Biomass	Boilers	350	17.5	20	0.77	--	0.54
Municipal waste, biomass	Efficient Boilers	726	8.2	20	0.81	--	0.57
Solar	Solar panels	893	17.9	20	6.54	--	4.58

Table 11 – Technoeconomic characteristics of technologies in the residential sector.

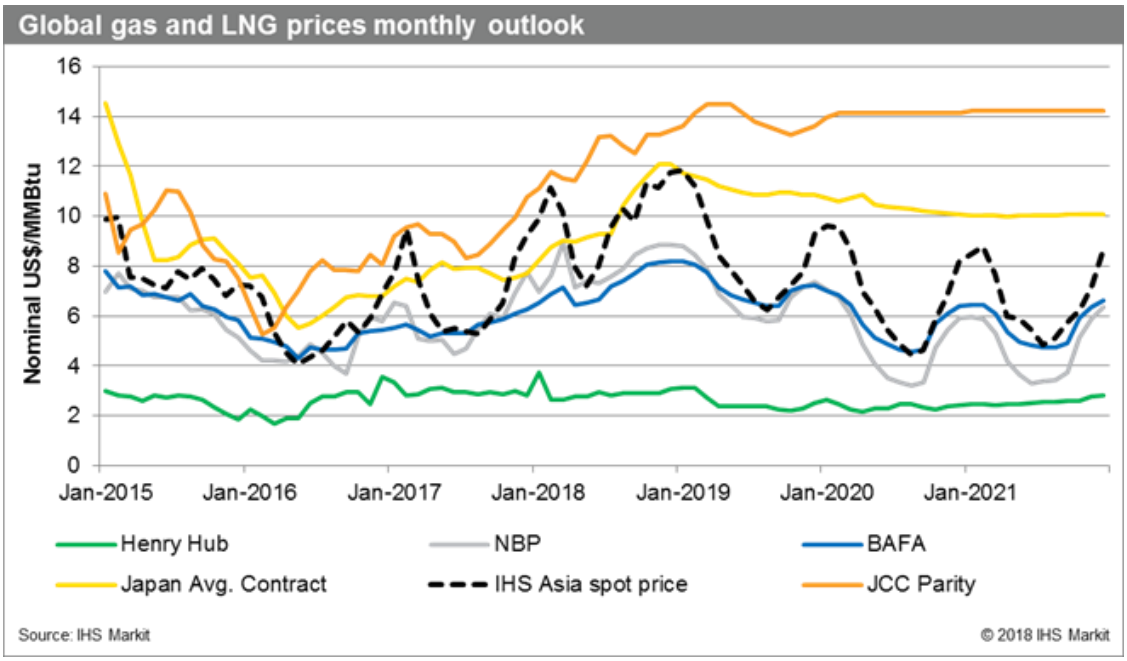
Resource	Technology	Investment cost (EUR2016/ kW)	Fix O&M (EUR2016/ kW)	Lifetime (years)	Heat efficiency	Electric efficiency	Cooling efficiency
Electricity	Heat pumps	1263	9.3	20	3.79	--	2.65
Electricity	Resistance heaters	182	2.0	15	0.9	--	1
Gas oil, kerosene, light fuel oil	Boilers	216	10.9	20	0.77	--	1
Gas oil, light fuel oil, LPG	CHP	1552	22.1	10	0.5	0.4	0.35
Gas oil, kerosene, light fuel oil	Efficient Boilers	325	16.2	20	0.96	--	1
LPG	Boilers	188	9.4	20	0.77	--	1
LPG	Efficient Boilers	432	21.6	20	0.96	--	1
Biomass	Boilers	504	25.2	20	0.77	--	1
Biomass	CHP	1759	27.9	10	0.5	0.4	0.35
Biomass	Efficient Boilers	958	24.1	20	0.85	--	1

Solar	Solar panels	1191	23.8	20	6.54	--	1

Appendix VIII: Forecasting of Energy Prices for Cyprus Government in coordination with Cyprus Hydrocarbon Company

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 below graph along with other details on gas prices can be found on the attached document IHS Market LNG and Gas Prices



1. The prices of futures

Future prices run up to 2026, 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.

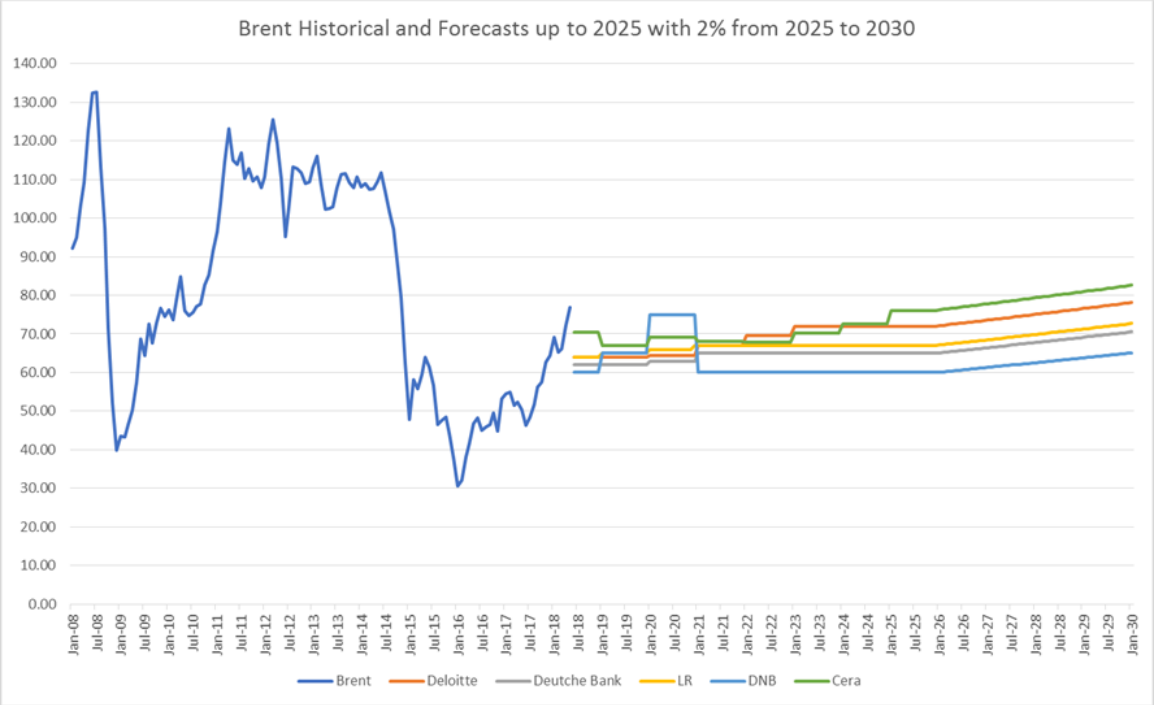
2025	64.00
2026	65.28
2027	66.59
2028	67.92
2029	69.28
2030	70.66
2031	72.07

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.



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 attached McKinsey report page 28: «New normal case, new crude production is expected to come at lower cost breaking even at 65-75/bbl»

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

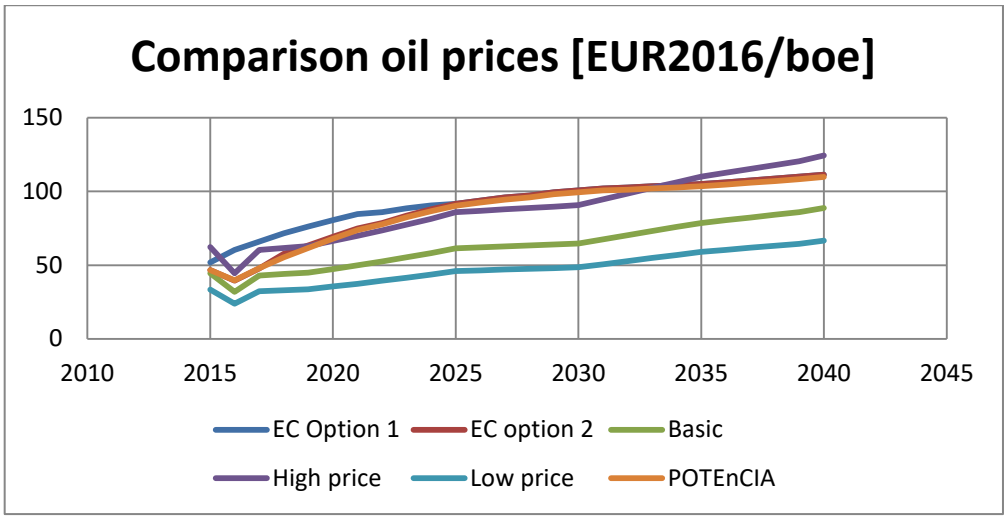
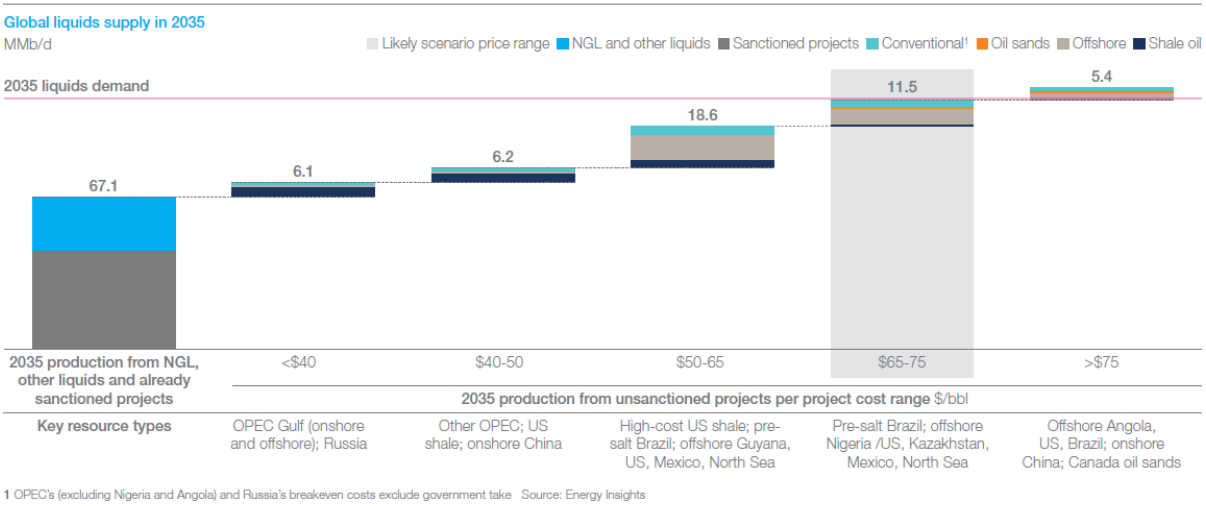


Figure 16. Oil cost projections (prices in €$_{2016}$/boe)

McKinsey report page 28:

In our 'new normal' case, new crude production is expected to come at a lower cost, with marginal supply breaking-even at USD 65-75/bbl

NEW NORMAL CASE



1 OPEC's (excluding Nigeria and Angola) and Russia's breakeven costs exclude government take Source: Energy Insights

Table 17: Oil cost projections (prices in €$_{2016}$/boe)

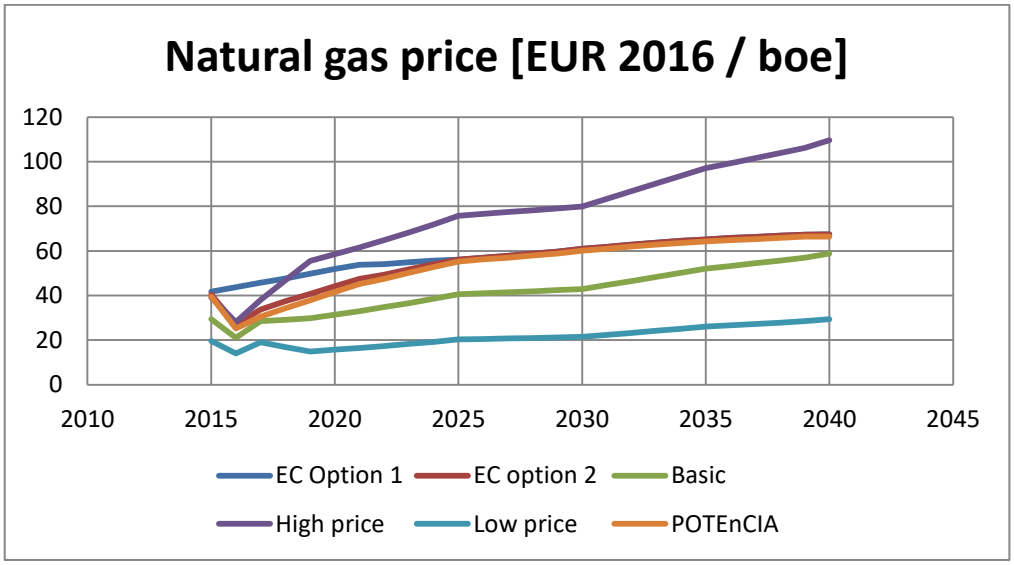
Year	EC Option 1	EC option 2	Basic	High price	Low price	POTEnCIA
2021	84.57	74.92	49.85	69.80	37.39	73.72
2022	85.95	78.53	52.54	73.55	39.40	77.64

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 2: 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



Appendix IX: DRAFT - JRC/IPR/2018/C.3/0034/NC - Technical support on long-term energy modelling (LTEM) - Analysis of future scenarios for the Cyprus energy system - Existing PaMs scenario

Authored by: The Cyprus Institute

v.4 – 14th December 2018

1. BACKGROUND

Building on the EU's 2030 Framework for Climate and Energy and the European Energy Security Strategy, the Energy Union aims at providing more secure, affordable and sustainable energy to all European citizens. On 30 November 2016, the European Commission proposed a Regulation on the Governance of the Energy Union, whose aims include ensuring the achievement of the EU's 2030 energy and climate targets. The proposed Regulation highlights that EU countries and the Commission should work together and emphasises the importance of cooperation between Member States. It takes into account the fact that different countries may contribute to the Energy Union in different ways and degrees. Member States will be required to prepare and submit integrated National Energy and Climate Plans that address the five dimensions of the Energy Union for the period 2021-2030, according to a common template, and will have to report on their progress on a biennial basis.

The five dimensions of the Energy Union to be addressed in the submitted Energy and Climate Plans are:

- Security, solidarity and trust – the EU's energy and supply mix should be diversified to ensure energy security. Cooperation between Member States can assist in this.
- Integrated Internal Energy Market to allow exchange of energy across the EU, thus promoting competition between suppliers. Adequate technological and regulatory infrastructure is required for this point.
- Energy Efficiency improvements to reduce dependence on energy imports, emissions and boost economic growth.
- Decarbonisation of the economy to conform with the Paris Agreement. Reduction of greenhouse gas emissions should occur in both the ETS and non-ETS sectors.
- Research, Innovation and Competitiveness to promote advancements in low-carbon and clean energy technologies that will assist in the transition to a decarbonised energy system.

The objective of the conducted work is to provide technical support on Long-Term Energy modelling for one of the Member States; the Republic of Cyprus. The modelling work will help assess the impact of the Cyprus energy system on the five dimensions of the Energy Union. The work is conducted using an existing OSeMOSYS model of the Cyprus energy system. OSeMOSYS is an open-source demand-driven cost-optimisation model, which identifies the cost-optimal solution for satisfying an externally defined demand for energy[32]. The choice of technologies and energy mix is based on techno-economic data inserted in the model, such as fuel costs, technology costs, availability of resources, as

[32] Mark Howells et al., "OSeMOSYS: The Open Source Energy Modeling System: An Introduction to Its Ethos, Structure and Development," *Energy Policy* 39, no. 10 (October 2011): 5850–70, https://doi.org/10.1016/j.enpol.2011.06.033.

well as constraints such as emission limits and renewable energy share targets. The model for Cyprus consists of three modules: electricity supply, road transport and heating and cooling. Scenarios will be developed that cut across the three sectors, taking into account local specificities. The model has been updated to an extent using recently provided data by the Cypriot Ministry of Energy, Commerce and Industry (MECI), but further updates and enhancements are planned.

Once fully updated and calibrated, two separate scenarios will be evaluated – an Existing Policies and Measures scenario and an Additional Policies and Measures scenario. This document provides an overview of the key results provided by the first iteration of the Existing Policies and Measures (PaMs) scenario for the Cyprus energy system. Due to the short timeframe provided to conduct this run, the results should be considered as provisional. Certain assumptions will be revisited in the next iterations of the model. Further, a thorough analysis and potentially additional studies are still required to verify the technical feasibility of the provided results; especially so in the electricity supply sector.

The results shown in this report focus till 2040, in line with the reporting template provided by the European Commission, but it should be clarified that the results provided by the model are available on an annual basis till 2050. The detailed model results can be accessed in separate spreadsheets given as supplementary material to this report.

5. EXISTING PAMS SCENARIO RESULTS

The results description of this section has been broken down by sector (i.e. electricity, transport, heating and cooling). Additionally, results on 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. A short comparison with the results of the EU Reference Scenario 2016 is included in each section.

5.1. Electricity Supply Sector

2.1.1. Capacity

The projection offered by the model in the electricity supply sector is quite interesting and can be regarded as optimistic. Following the expected deployment of renewable energy technologies till 2020 as promoted by the existing support schemes and the development of the planned 50 MW CSP plant by 2021, only an additional 320 MW of solar PV and 20 MW of biomass-fired facilities are deployed till 2030. Nonetheless, even though penetration of renewables is relatively modest till 2030, an aggressive deployment of solar PV occurs in the period 2031-2040 (Table 1). This deployment is driven and enabled by an equally aggressive deployment of Li-ion batteries during the same period, as these reach 657 MW in 2040. It should be noted that based on a relevant IRENA publication[33], 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 be higher than 95% at an installation cost of approximately 150 EUR2016/kWh. All Li-ion batteries deployed are in-front-of-the-meter facilities and have 4 hours of storage; this results in 288 MWh of battery storage in 2030 and 2628 MWh in 2040. No behind-the-meter battery storage is deployed as this is not deemed cost-optimum under the current assumptions followed. Furthermore, at the latter part of the modelling period, a 130 MW (1040 MWh) pumped-hydro facility is also developed.

Table 1 – Capacity projections in the electricity supply sector (MW).

	2020	2025	2030	2035	2040
Vasilikos	868	868	868	608	0
Dhekelia	460	102	102	0	0
Moni	150	150	150	0	0
New CCGT	0	216	216	216	216
New ICE	0	0	0	0	0
New ST	0	0	0	0	57
New GT	0	0	0	0	0
Light fuel oil CHP	0	85	96	97	110
Solar PV	292	292	614	2114	3408
Solar Thermal	0	50	50	50	50
Wind	175	175	175	175	175
Biomass	10	25	29	70	70
Pumped Hydro	0	0	0	0	130
Li-Ion Batteries	0	0	72	307	657

The aggressive deployment of batteries and solar PV can be attributed to the reduction in capital cost assumed over time for both of these technologies. 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

[33] IRENA, 2017. Electricity Storage and Renewables: Costs and Markets to 2030, International Renewable Energy Agency, Abu Dhabi.

curtailment may be observed. This curtailment is not easily captured by a long-term energy systems model, as employed here. Hence, a separate detailed analysis focusing on a single year in a much finer temporal resolution may be needed to assess this proposed outlook.

Another aspect that should be raised is that of the deployment of small CHP facilities at the final end-user level. This CHP capacity, which reaches 96 MWe in 2030 and 110 MWe in 2040, is deployed due to the direct adoption in the model of the final energy demand projections in the Heating and Cooling sector as provided by the Cyprus University of Technology. The model simply deems that this is the most efficient way of consuming the fuel forcibly allocated to the system. It is expected that if the limits on fuel use for the Heating and Cooling sector are lifted from the model, this option will not appear to this high degree in the optimal solution. To do this, updated demands for Heating and Cooling will need to be expressed in terms of useful energy demand.

EU Reference Scenario 2016 is more optimistic for the year 2020 than the present results. It projects that solar capacity will reach 338 MW and wind capacity will reach 216 MW. In contrast, the present effort estimates 292 MW and 175 MW respectively.

In respect to 2030, the electricity capacity results are quite comparable between the two models. Specifically, the EU's Reference Scenario 2016 projects a thermal capacity of 1455 MW, whereas the present scenario projects 1432 MW. Renewable energy capacity as a whole is also similar, albeit with some differences. Solar capacity reaches 529 MW in EU Reference Scenario and 664 MW (PV and CSP) in the present effort, while wind capacity is 229 MW in the former and 175 MW in the latter case. Finally, biomass-fired facilities are limited to 11 MW in EU Reference Scenario, but increase to 29 MW in the present effort.

A big difference can be noticed in 2040, mainly due to the increased penetration of solar PV in the present effort. The EU Reference scenario projects that only a further 50 MW solar PV will be added to the system between 2030 and 2040, whereas this effort projects nearly 2.8 GW.

It is worth noting that no information is given regarding penetration of any storage technologies in the EU Reference Scenario 2016. As such, no comparison regarding this aspect can be made.

2.1.2. Generation

The above technology deployment provides the generation mix shown in Figure 1. The substitution in the latter part of 2020 (i.e. in the period October-December) of oil-fired generation with gas-fired generation results in a transitional period as indicated below. Renewable energy contribution as a share of the final electricity consumption reaches 15.6% in 2020, falling just short of the 16% target. In the post-2020 period, gas-fired generation dominates the electricity mix till 2030. The RE share in 2030 reaches 26%, as more solar PV is introduced in the system.

The rapid deployment of solar PV discussed above slowly displaces natural gas from the generation mix, which occurs gradually over the decade 2030-2040. The RE share reaches as high as 78% in the latter years of the modeling horizon. Another enabler of solar PV is the electrification of the transport sector, as this raises the demand for electricity throughout the year. Specifically, in 2030 about 700 GWh are consumed in the transport sector, while for the period 2032-2040 annual consumption rises to approximately 950 GWh. This aspect is elaborated further in the relevant section later on in the report.

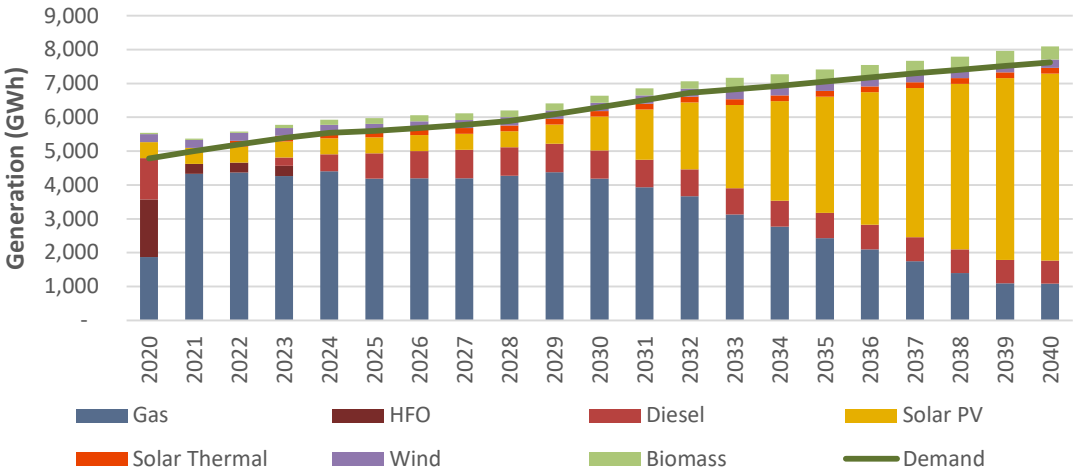


Figure 1 – Projected generation mix till 2040.

In terms of generation, similar observations as in the capacity results apply when conducting a comparison with EU Reference Scenario 2016. The RES shares in generation are 21.5%, 29.4% and 28% in 2020, 2030 and 2040 respectively in the EU Reference Scenario 2016. Even though in that scenario a mild increase in renewable energy generation is foreseen between 2030 and 2040 in absolute terms, this is overshadowed by the foreseen increase in fossil-fired generation. In contrast, the results shown here indicate 13.5%, 24.4% and 78% in 2020, 2030 and 2040 respectively.

Further, inconsistencies exist in regards to electricity demand, as well. Gross generation reaches approximately 4,900 GWh in 2020, 5,500 GWh in 2030 and 6,200 GWh in 2040 in the EU Reference Scenario 2016. However, the present effort projects gross generation will reach 4,800 GWh in 2020, 6,300 GWh in 2030 and 7,600 GWh in 2040. As such, even though the demand projection is comparable in the two scenarios for 2020, it is much greater in the present effort.

2.1.3. Costs

Despite the considerable investments in the electricity supply sector, the average cost of gross electricity generation stays relatively stable throughout the modelling period. Undeniably, this is a function of the assumed fuel price and technology costs adopted in the model. Figure 2 provides a breakdown of the different system cost components; these are all undiscounted[34]. As illustrated, a reduction in cost is achieved when the system shifts fully towards gas-fired generation in 2021. It can be noticed that variable costs (i.e. fuel costs) are the main driver of the electricity cost till 2036. From 2037 onwards, the considerable investments in solar PV and storage technologies (Figure 3) substitute these variable costs as the main driver for the cost of electricity. The rate at which these investments occur is considerably high in the period 2030-2040 and raises the question of adequate funding to finance all this infrastructure.

[34] 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 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.

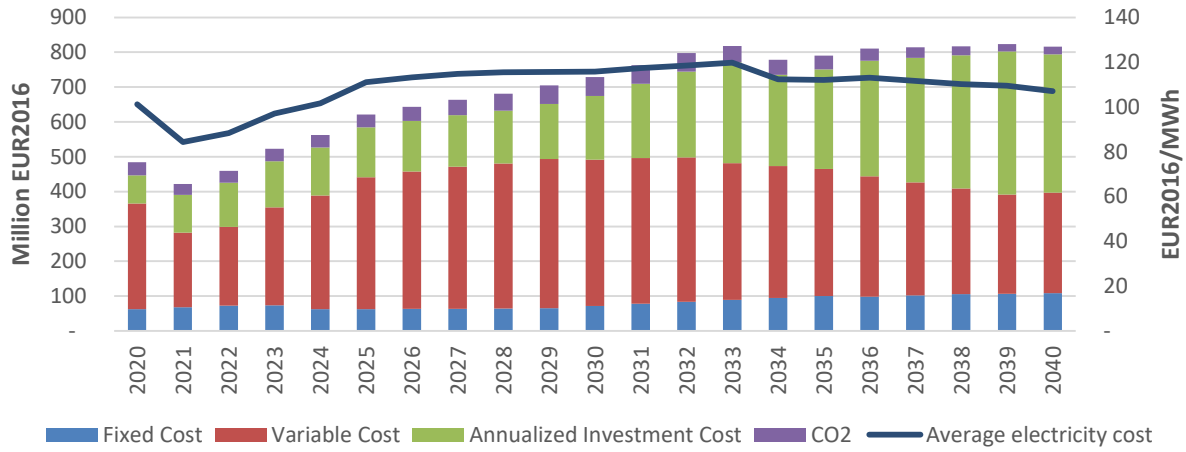


Figure 2 – Average cost of electricity and breakdown of system cost components.

In comparison to EU Reference Scenario 2016, the average cost of electricity generation is slightly lower in the present scenario. The former projects a cost of around 110-120 EUR2016/MWh for the entire period between 2020-2040, whereas the present scenario projects the cost between 100-120 EUR2016/MWh. A potential reason for this difference is that technology and fuel cost assumptions were not aligned between the two models; the present effort assumes considerably lower fuel price projections. Similarly, the assumptions regarding photovoltaics and battery storage have significant discrepancies. For instance, utility-scale PV assumed here has an investment cost of 1160 EUR2016/kW in 2020 and 890 EUR2016/kW in 2030, whereas the EU Reference Scenario 2016 assumes 840 EUR/kW in 2020 and 700 EUR/kW in 2030. On the other hand, the present effort assumes battery storage cost will drop to 150 EUR2016/kWh by 2030, while the EU Reference Scenario 2016 assumes a constant cost of 8250 EUR2016/kWh until 2050.

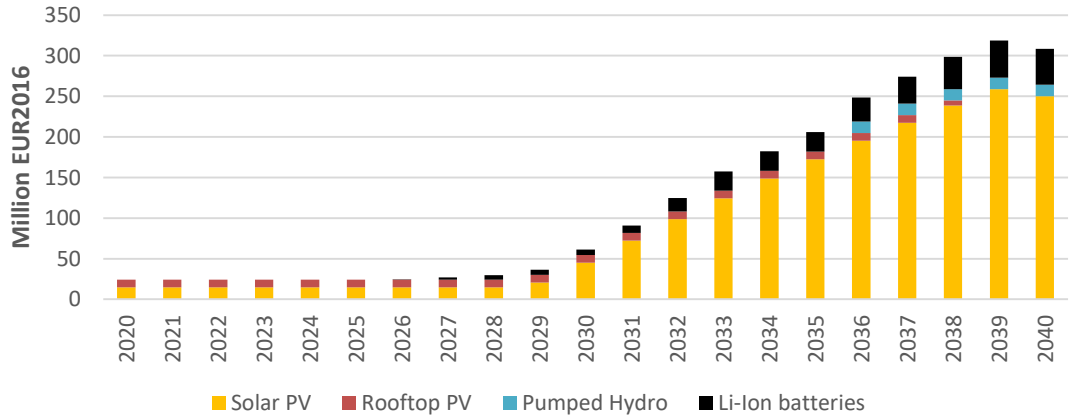


Figure 3 – Annualized investment costs in solar PV and storage technologies in the period 2020-2040.

5.2. Transport Sector

The forecast for the transport sector foresees penetration of alternative fuels and technologies. Due to the assumed higher mileage allowed for certain vehicle categories, alternative technologies are deemed cost-competitive by the model and as such enter the market in significant numbers (Table 2). In the passenger car fleet, the number of gasoline and diesel vehicles are reduced over time; these are replaced by hybrid and plug-in hybrid vehicles. It is worth highlighting that even though a significant penetration of plug-in hybrid vehicles is achieved, no new electric vehicles appear in the

fleet[35]. Furthermore, a considerable penetration of LPG-fired vehicles is observed – the rate at which this occurs may be considered unrealistic, given the current limited adoption of this technology in Cyprus.

Table 2 – Projected vehicle fleet (total number of vehicles).

		2020	2025	2030	2035	2040
Passenger cars	Diesel	73,788	43,042	12,296	-	-
	Diesel hybrid	-	-	-	-	-
	Diesel PHV	-	-	31,228	64,279	69,185
	Gasoline	363,854	216,172	157,893	117,345	153,027
	Gasoline Hybrid	56,502	60,844	62,807	66,241	69,185
	Gasoline PHV	-	60,844	62,807	65,927	69,185
	BEV	39	39	39	27	12
	LPG	34,430	103,925	143,769	147,725	122,670
	Natural gas	-	-	-	-	-
	Hydrogen	-	-	-	-	-
		2020	2025	2030	2035	2040
Busses	Diesel	5,518	5,546	5,575	5,791	6,011
	Diesel hybrid	-	-	-	-	-
	BEV	-	-	-	-	-
	Hydrogen	-	-	-	-	-
		2020	2025	2030	2035	2040
MCs	Gasoline	56,887	61,248	66,382	70,341	68,097
	BEV	-	-	-	-	-
		2020	2025	2030	2035	2040
Trucks	Diesel	18,097	19,190	20,278	20,948	21,619
	BEV	-	-	-	-	-
	Natural gas	-	-	-	-	-
		2020	2025	2030	2035	2040
Light Trucks	Diesel	107,689	106,303	112,797	116,385	119,973
	BEV	-	-	-	-	-
	PHEV Diesel	8,877	13,351	13,885	14,419	14,953
	Hybrid diesel	-	-	-	-	-

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 3, gasoline remains as the main fuel consumed in road transportation up to 2040. However, gasoline consumption is reduced from 433 million litres in 2020 to 266 million litres in 2040. The use of diesel remains relatively stable throughout the period dropping only slightly from 270 million litres in 2020 to 240 million litres by 2040. Similarly, the 1st generation biodiesel used for blending follows a similar trend, as the current blending mix is kept constant throughout the whole period. Bioethanol is not mixed with gasoline at the moment and

[35] Zero penetration of BEV can be attributed to assumed costs. It has to be mentioned that costs in the transport sector were not changed from the KTH study of 2017. In that, vehicle technology costs were taken primarily from IEA-ETSAP technology briefs, which admittedly can now be considered as outdated. This is an important area for improvement in the next set of iterations, where perhaps a mixture of EU Reference Scenario 2016 and Ifeu transport study assumptions can be adopted to tackle this.

there is no indication that this will occur in the future. Therefore, bioethanol use remains at zero levels throughout the modelling horizon. Similarly, no forced blending was implemented for 2nd generation biofuels, hence these do not appear in the solution.

Table 3 – Evolution of fuel consumption in the transport sector till 2040.

		2020	2025	2030	2035	2040
Biodiesel 1st gen	**Litres**	15,719,713	13,982,785	13,886,518	14,340,552	14,102,662
Biodiesel 2nd gen	**Litres**	-	-	-	-	-
Bioethanol 1st gen	**Litres**	-	-	-	-	-
Bioethanol 2nd gen	**Litres**	-	-	-	-	-
Diesel	**Litres**	268,134,121	238,507,006	236,864,974	244,609,521	240,551,780
Gasoline	**Litres**	432,589,622	333,353,280	278,301,631	265,789,608	266,379,848
LPG	**Litres**	37,972,943	112,674,263	153,162,007	125,333,557	126,247,291
Natural gas (STP)	**m3**	-	-	-	-	-
Electricity	**MWh**	63,882	463,782	709,896	943,194	965,321

As aforementioned, the model results show a considerable increase in the use of LPG for transport, as it increases gradually to 153 million litres in 2030 and 126 million litres by 2040. Considering the fact that the current use of this fuel is minimal, the realistic nature of the results has to be assessed.

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, albeit not by fully-electric vehicles, but by plug-in hybrid vehicles. Nonetheless, the electricity demand in the transport sector increases significantly, reaching 710 GWh in 2030 and 965 GWh in 2040; corresponding to 11% and 13% of the total final electricity demand respectively. This poses several challenges to the grid, but also offers 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 is perhaps not captured adequately by the current version of the model and may need to be amended in the next set of iterations.

At the same time, 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. 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.

Detailed results regarding the transport sector are not provided by the EU Reference Scenario 2016, thus a detailed direct comparison cannot be made. Furthermore, demand in this scenario is expressed in vehicle-kilometres, whereas EU Reference Scenario 2016 breaks this down into passenger-kilometres and tonne-kilometres. Since the assumptions on occupancy and load rate of vehicles are not shared, a comparison regarding demand cannot be reached either. Nonetheless, the rate of electrification between the two scenarios can be compared. The share of electricity in the transport sector increases slowly to 0.6% and 1.3% by 2030 and 2040 respectively in the EU Reference Scenario 2016. However, the corresponding figures in the present scenario are 11.9% by 2030 and 16.9% by 2040. Similarly, EU Reference Scenario project the RES share in the transport sector to fluctuate around 10% throughout the period from 2020 to 2040, whereas this effort indicates that it will

gradually increase from roughly 3% in 2020 to 9.6% in 2040. This inconsistency may be attributed to different assumptions regarding biofuel blending between the two scenarios[36].

5.3. Heating And Cooling Sector

Concrete conclusions on this sector cannot be made, since the final energy demand was specified as a hard constraint. Nonetheless, it is worth noting the significant RE share projected till 2050, which will be mainly driven by solar thermal technologies in buildings, as well as the higher share of RES in the electricity consumed by this sector. The projected final energy demand of the Heating and Cooling sector is provided in Table 4. The RES share foreseen in the Heating and Cooling sector is comparable to that of the EU Reference Scenario up to 2030, as it reaches 24.1% in 2020 and 29.7% in 2030. However, it is limited to 37.6% in 2040, whereas this scenario projects it to 55%. The main reason for this difference is the higher share of RES projected in the electricity sector.

Table 4 - Final energy demand in the Heating and Cooling sector (PJ).

PJ	2020	2025	2030	2035	2040
Electricity	8.29	8.37	9.26	10.19	10.93
Heating oil/light fuel oil/Gas Oil	9.01	8.89	8.51	7.60	6.67
Pet Coke	4.32	4.04	3.69	3.42	3.16
LPG	3.38	3.38	3.48	3.35	3.19
Biomass	1.42	1.55	1.78	1.86	1.90
Solar	4.15	4.31	5.15	6.47	7.81
RES share	**22.4%**	**24.3%**	**29.2%**	**43.9%**	**55.8%**

5.4. Primary Energy Supply and Final Energy Demand

A moderate decrease in the primary energy supply can be observed across the time horizon (Table 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 2020 heavy fuel oil is still used to a considerable extent until the introduction of less carbon-intensives natural gas in the power sector in the last quarter of the same year.

Table 5 – Primary Energy Supply evolution till 2040 (ktoe).

	2020	2025	2030	2035	2040
Diesel	449	205	204	210	207
Gasoline	331	255	213	203	204
Heavy Fuel Oil	362	-	-	-	-
LPG	102	143	168	150	146
Heating Oil/light fuel oil/Gas oil	215	212	203	181	159
Pet coke	103	97	88	82	76
Natural gas	333	747	748	434	202
Hydrogen	-	-	-	-	-
Electricity	-	-	-	-	-
Biomass (includes biofuels)	57	59	65	112	113

[36] The future level of blending as well as potential shift of some of the public fleet (e.g. public busses) into fully biofuel-fired is something that needs to be clarified from MECIT. Similarly, whether bioethanol can be blended with gasoline in Cyprus remains unclear. Petrol companies in Cyprus argue that due to the high temperatures experienced in Cyprus, the blended fuel's vapor pressure will not conform with the fuel quality directive.

Solar thermal	99	117	138	169	201
Solar PV	41	41	86	295	476
Wind	20	20	21	21	21
Total	***2,112***	***1,896***	***1,932***	***1,858***	***1,804***

Despite the reduction in primary energy supply, final energy demand is projected to increase over time (Table 6). The main driver in this case is the increased electricity demand. Continued electrification of the heating and cooling sector, as well as the considerable volumes of electricity consumed in the transportation sector have a significant role in this. The contribution of fossil fuels decreases with time, with the exception of LPG, which increases due to its adoption in the transport sector. Furthermore, the contribution of solar thermal in the heating and cooling sector is projected to nearly double from 2020 to 2040.

In comparison to EU Reference Scenario 2016, the final energy demand in the present effort is higher. When aviation is excluded, since it is not reported here either, the EU Reference Scenario 2016 projects final energy demand at 1452 ktoe, 1396 ktoe and 1454 ktoe for 2020, 2030 and 2040 respectively. Thus, the demand reported here is higher by 150 ktoe in 2020, 220 ktoe in 2030 and 280 ktoe in 2040. As mentioned above, a major reason for this discrepancy is related to the final electricity demand; a difference of 85 ktoe exists for 2020, 130 ktoe for 2030 and nearly 200 ktoe for 2040.

Table 6 – Final Energy Demand evolution till 2040 (ktoe).

	2020	**2025**	**2030**	**2035**	**2040**
Diesel	231	205	204	210	207
Gasoline	331	255	213	203	204
LPG	102	143	168	150	146
Heating Oil/light fuel oil	215	212	203	181	159
Natural gas	-	-	-	-	-
Pet Coke	103	97	88	82	76
Hydrogen	-	-	-	-	-
Electricity	476	514	571	637	696
Biomass (includes biofuels)	46	48	54	56	57
Solar thermal	99	103	123	155	187
Total	**1,603**	**1,577**	**1,624**	**1,674**	**1,731**

As shown in Table 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 achieved, while this increases further to 19.5% by 2030 and 45.5% by 2040. In contrast, the EU Reference Scenario 2016 projects a RES share in final energy demand of 14.8% in 2020, 18.4% in 2030 and 20.3% in 2040.

Table – RE share across the energy system.

	2020	**2025**	**2030**	**2035**	**2040**
All sectors	**13.1%**	**15.3%**	**19.5%**	**34.3%**	**45.5%**
Electricity	15.6%	18.7%	25.7%	60.0%	83.1%
Heating and cooling	22.4%	24.3%	29.2%	43.9%	55.8%
Transport (Directive 2009/28/EC methodology)	3.7%				
Transport (Directive (EU) 2015/1513 methodology)		5.1%	7.4%	9.1%	9.6%

5.5. Carbon Dioxide Emissions

Drawing directly from the model outputs, a carbon dioxide emission trajectory is extracted (Figure 4). A significant decarbonisation is achieved first by gas-fired generation and later by solar PV deployment in the ETS sector in this scenario; total CO_2 emissions in the ETS sector drop from 2,500 ktons in 2020 to 1,575 ktons in 2030 and 430 ktons in 2040. However, the reduction in CO_2 emissions in the non-ETS sector is not as impressive. Emissions in the non-ETS sector decrease from 2,480 ktons in 2020 to 2,200 ktons in 2030 and 2,000 ktons in 2040. The main driver for this is the continued dependence of the transport sector on oil products.

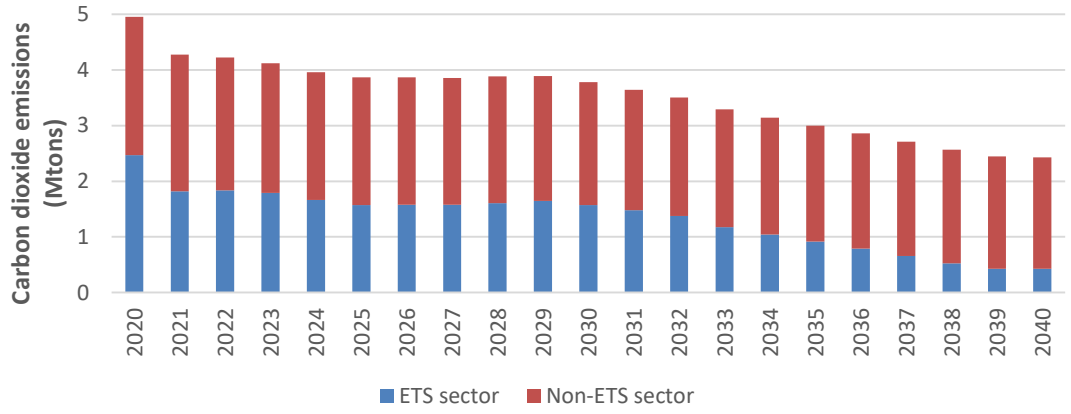


Figure 4 – Trajectory of carbon dioxide emissions in the ETS and non-ETS sectors.

The above results are not consistent with those of EU Reference scenario 2016. Specifically, the total energy related CO_2 emissions in that report are projected to reach 5.4 Mtons in 2020, whereas here only 5 Mtons are estimated. Similarly, the EU Reference scenario's projection indicates 4.9 Mtons in 2030 and 5.2 Mtons in 2040, whereas the scenario provided here indicates 3.8 Mtons by 2030 and 2.4 Mtons by 2040. The reason for this considerable difference is twofold; on one hand a greater penetration of solar PV is projected in the present scenario, while on the other hand the carbon intensity of the transport sector is much higher in the EU Reference Scenario 2016. Whereas the present scenario foresees total non-ETS CO_2 emissions at 2.2 and 2 Mtons respectively in 2030 and 2040, transport-related CO2 emissions alone in the EU Reference scenario reach 2.9 Mtons in 2030 and 3 Mtons in 2040.

6. ANNEXES

The following files are provided as supplementary material to this report:

A. Input assumptions document – file named "Segment of D2 - Input assumptions for Existing PaMs scenario_v4.doc".
B. OSeMOSYS results template – file named "E_PaMs_291118_1500_v121218.xls".
C. Results inserted in the voluntary reporting template provided by the EC – file named "Annex I part 2 template_Existing PaMs 291118_1500_v131218.xls".