Cyprus' Long-term low GHG emission development strategy

2020 update

ΠΡΟΣΧΕΔΙΟ

v.2

Nicosia, February 2021

Department of Environment
Ministry of Agriculture,
Rural Development and Environment

CONTENTS

1. OVERVIEW AND PROCESS FOR DEVELOPING THE STRATEGY

1.1. Executive summary

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

The Government's strategic goal is to participate proportionately in the commitment towards a climate-neutral economy at EU level and to contribute to the new Green Agreement promoted by the European Commission.

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

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

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

The 2030-2040 decade should be a decade of choosing the appropriate technological solutions for adoption that are mature at the time, but also of continuing successful policies and measures that will contribute to achieving the goals of 2050, with even greater intensity and rate of implementation.

New energy technologies or even fuels that will be available on competitive market terms are, in any case, a technical condition for the period after 2030, which will ultimately determine the relative rates of transition to 2050.

Just as the objectives of the year 2030 require monitoring of the performance of the specific priorities and policy measures, which have been designed and will be implemented within the framework of the NECP, for the period 2030-2050 there should be continuous monitoring especially of technological developments to develop the appropriate policies and measures that will contribute most effectively in achieving the objectives of the long-term strategy for 2050.

The expected benefits of transitioning to a climate-neutral economy by 2050 include:

- Reforming of the country’s economy towards clean and modern technologies that strengthen the circular economy, which will utilize a series of advanced solutions and will form new business models.
- Mitigating the effects of climate change and promoting a sustainable economy, by further increasing productivity.
- Enhancing the competitiveness of the economy and industry, through research and innovation, with the aim of creating a digitised, circular economy that ensures high quality jobs and sustainable growth, while creating synergies with other environmental challenges.

In this light, supporting the goal of a climate-neutral economy of the European Union by 2050 is a strategic choice of the country to achieve the central environmental goals for the benefit of society and to ensure a sustainable and sustainable future for all.

In this context, however, appropriate support policies and instruments should be developed at EU level, with a fair distribution of the efforts and resources, highlighting the specificities at Member State level both in terms of production and economy, so that productive, economic and development benefits to be common to all.

The 2050 Long-Term Strategy analyses scenarios for the evolution of the energy system and the pattern of consumption in the final sectors, with the ultimate goal of transition to a climate-neutral economy by 2050. These scenarios will be further discussed and elaborated in the future, in order to select the appropriate policy measures and corresponding technologies that will change the operating model of the consumption and production system.

With a focus on improving energy efficiency, which should be maximized, expanding and ultimately maximising the use of RES, especially in electricity generation, the emphasis on technologies and fuels, alternative technologies in the energy and industrial sector, as well as by changing the overall consumption patterns in the end-use areas, it will be possible to achieve in the best way the climate targets planned under the Long-Term Strategy for 2050.

1.2. Legal and policy context

In accordance with Article 15(3) of the Governance regulation Cyprus’ long-term strategy will contribute to:

(a) fulfilling the Union's and the Member States' commitments under the UNFCCC and the Paris Agreement to reduce anthropogenic greenhouse gas emissions and enhance removals by sinks and to promote increased carbon sequestration;
(b) fulfilling the objective of the Paris Agreement of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1,5 °C above preindustrial levels;
(c) achieving long-term greenhouse gas emission reductions and enhancements of removals by sinks in all sectors. This is in accordance with the Union's objective, in the context of necessary reductions according to the Intergovernmental Panel on Climate Change (IPCC) to reduce the Union's greenhouse gas emissions in a cost-effective manner and

enhance removals by sinks in pursuit of the temperature goals in the Paris Agreement. This is to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases within the Union as early as possible and, as appropriate, achieve negative emissions thereafter;

(d) a highly energy efficient and highly renewables-based energy system within the Union.

In accordance with Article 15(4) of the Governance regulation Cyprus' long-term strategy covers information on:

- total greenhouse gas emission reductions and enhancements of removals by sinks;
- expected progress on transition to a low greenhouse gas emission economy including greenhouse gas intensity, CO_2 intensity of gross domestic product, and strategies for related research, development and innovation;
- information on other national objectives, planning and policies and measures regarding renewable energy and energy efficiency.

In accordance with Article 15(6) of the Governance regulation the information included in this long-term strategy document is consistent with the information contained in Cyprus' integrated national energy and climate plan submitted to the European Commission prior to this document.

Detailed information about projection models, assumptions etc. used for the existing measures and additional measures scenarios (WEM and WAM scenarios respectively) is available in the projections report and in summary in Cyprus' Integrated National Energy and Climate Plan (NECP).

Given the recent developments on climate change mitigation issues (review of the 2030 GHG reduction target) additional policies and measures are under consideration and this long-term strategy document is to be seen as an evolving document, which is expected to be updated at least every 5-10 years intervals required by the Governance Regulation.

1.2.1. EU and 2050 Climate Neutrality[1]

The EU has been at the forefront of addressing the root causes of climate change and strengthening a concerted global response in the framework of the Paris Agreement (COP21, 2015). The Paris Agreement, ratified by 181 parties, requires strong and swift global action to reduce greenhouse gas emissions, with the objective to hold global temperature increase to well below 2°C and to pursue efforts to limit it to 1.5°C. It also has the goal to achieve a balance between emissions by sources and removals by sinks of greenhouse gases on a global scale in the second half of this century. All parties are to present long-term low greenhouse gas emission development strategies by 2020 that deliver on its objectives.

The European Council, in June 2017, strongly reaffirmed the commitment of the EU and its Member States to swiftly and fully implement the Paris Agreement, underlining that the

[1] European Commission, 2018; Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank; A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy; COM(2018) 773 final.

Agreement "*is a key element for the modernisation of the European industry and economy*" and subsequently, in March 2018, invited the European Commission "*to present by the first quarter of 2019 a proposal for a Strategy for long-term EU greenhouse gas emissions reduction in accordance with the Paris Agreement, taking into account the national plans*".

In October 2017 the European Parliament also invited the European Commission "*to prepare by COP24 a mid-century zero emissions strategy for the EU*". Finally, the Regulation on Governance of the Energy Union agreed by the European Parliament and Council calls on the Commission to present an EU long-term strategy by April 2019.

The EU is broadly on track to achieve its 2020 greenhouse gas, renewable energy and energy efficiency targets. However, continued focus is necessary in order to overcome the recent stagnation of energy efficiency improvements and greenhouse gas emission reduction trends. The EU is advancing with its Energy Union Strategy and finalising a modern, advanced and cost-effective regulatory framework to achieve its 2030 greenhouse gas reduction targets and its clean energy transition delivering on the Juncker Commission's objective to put energy efficiency first and become a global leader in renewables. This is an investment in our prosperity and in the sustainability of the European economy. Regulatory stability is an important element for public authorities and private operators alike to achieve full implementation of this framework. Ambitious policies have been agreed at European level, including a reformed EU emissions trading system strengthening the price signal for CO2. For all other sectors, national greenhouse gas emission reduction targets have been set and legislation established to maintain the EU land and forests sink which absorbs more CO2 than it emits. On the side of energy, the targets to improve the EU's energy efficiency by at least 32.5% and to increase renewable energy to at least 32% of the EU's final energy consumption by 2030 are now approved and the proposed legislation to improve the CO2 efficiency of cars, vans and trucks will spur the transition in the transport sector.

Combined, these climate and energy policies will deliver on the EU's contribution under the Paris Agreement to reduce emissions by at least 40% by 2030 compared to 1990. In fact, when the agreed EU legislation is fully implemented, total greenhouse gas emission reductions are estimated to reach around 45% by 2030. The policies put in place today will have a continued impact after 2030 and will therefore already go a long way, with projected emissions reductions of around 60% by 2050. This is, however, not sufficient for the EU to contribute to the Paris Agreement's temperature goals.

The IPCC report confirms that the world needs to limit climate change to 1.5°C to reduce the likelihood of extreme weather events. It also emphasises that emissions need to be reduced with far more urgency than previously anticipated. In order to limit temperature increase to 1.5°C, net-zero CO2 emissions at global level needs to be achieved around 2050 and neutrality for all other greenhouse gases somewhat later in the century. At this point, any remaining greenhouse gas emissions in certain sectors need to be compensated for by absorption in other sectors, with a specific role for the land use sector, agriculture and forests. This provides an opportunity for the EU to step up its action to show leadership and reap the benefits of first mover advantage. This would require the EU to achieve greenhouse gas emissions neutrality by 2050.

1.3. Public consultation

In accordance with Article 15(6) of the Governance regulation this long-term strategy document will be made available to the public. Relevant data such as greenhouse gas inventories as well as data from the latest energy and greenhouse gas emission projections are also available to the public[2].

A draft version of this document was made publicly available for comments through the website of the Department of Environment for a period of 4 weeks (8/2/2021-8/3/2021). During the same period, the LTS was discussed with various stakeholders, while the LTS was also presented to the public on a public hearing in March 2021.

[2] http://www.moa.gov.cy/moa/environment/environmentnew.nsf/All/21395032E3B9BB6CC2257FF0003813DD?OpenDocument

2. CONTENT

2.1. Total GHG emission reductions and enhancements of removals by sinks

2.1.1. Projected emission reductions and enhancement of removals by 2050

Emission reductions have been estimated for different scenarios ranging from the "Business-as-Usual" scenario (BaU) to the "Ambitious" scenario (AMB). The "Ambitious" scenario is one option for future additional policies that could be examined with which carbon neutrality is achieved in 2050. The other two scenarios presented in the plot below are the "existing measures" (WEM) and the "planned policies and measures" scenario, with the latter being the scenario submitted through the NECP as the planned policies for 2030.

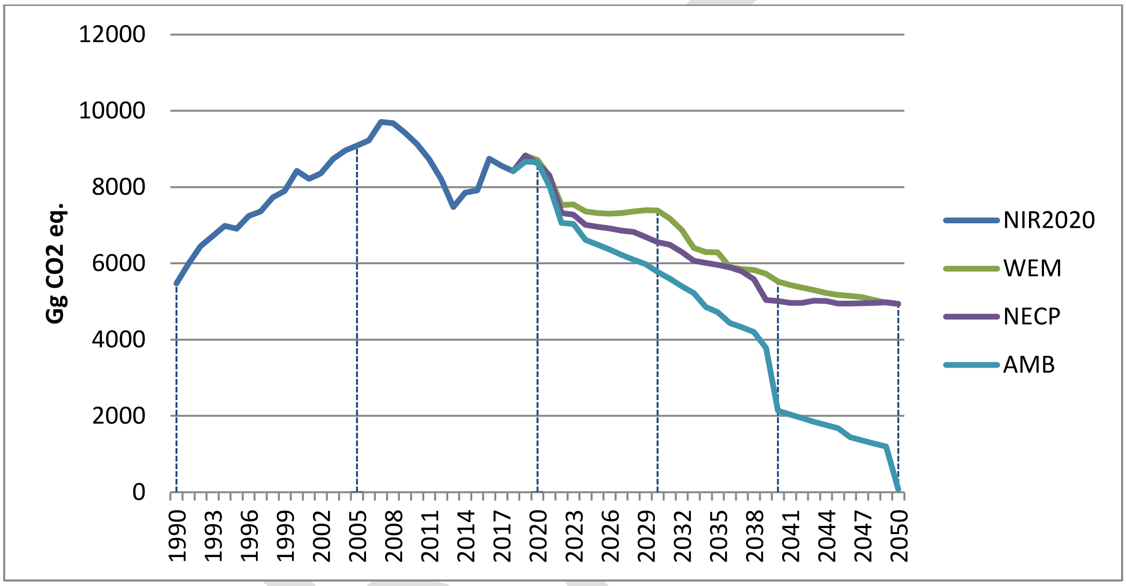


Figure 2.1: Projected emission reductions and enhancement of removals by 2050 with LULUCF, where "NIR2020" are the GHG historical emissions according to the latest GHG inventory report available (May 2020 submission to the UNFCCC secretariat); WEM is the "With existing measures" scenario; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050

The key results for the available scenarios are the following:

- With the WEM and the NECP scenario, emissions in 2050 are expected to reduce by 10% compared to 1990 and 46% compared to 2005;
- With the AMB scenario, Cyprus could reach carbon neutrality by 2050. Large contribution towards this is expected by the use of CCS/CCU[3] technologies, international and local research and technology, education and LULUCF[4] absorptions.

At the moment, the scenario under implementation is the NECP scenario, whereas all additional measures contributing to the "Ambitious" scenario are still under examination. It is considered that with the 2023 review of the NECP additional policies and measures could be agreed that could further increase 2030 ambition. The figure below presents the

[3] CCS: Carbon Capture and Storage; CCU: Carbon Capture and Utilisation
[4] LULUCF: Land Use, Land Use Change and Forestry

contribution of the sectors to the "Ambitious" scenario which is considered one option for achieving carbon neutrality in 2050.

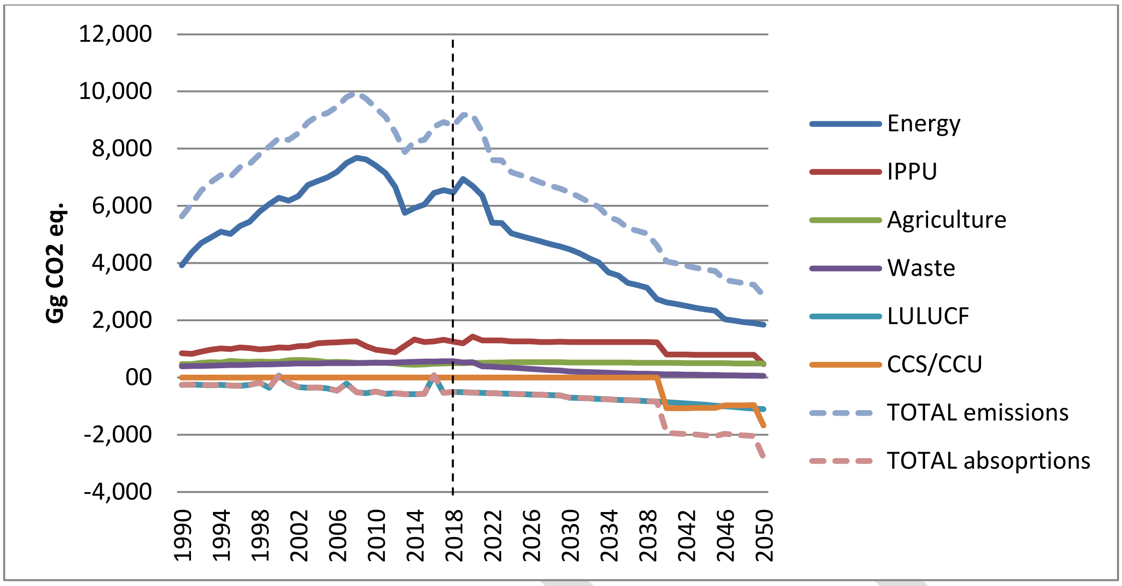


Figure 2.2: Projected emission reductions and enhancement of removals by 2050 by sector for the "Ambitious" scenario where "IPPU" is the Industrial Processes and Other Product Use sector; "LULUCF" is the Land Use Land Use Cover and Forestry sector and "CCS/CCU" stands for the absorptions that could be achieved with the implementation of the technologies Carbon Capture and Storage/ Carbon Capture and Utilisation

2.1.2. National target for 2030 and beyond

In October 2014 the European Council agreed on the 2030 climate and energy framework on objectives regarding greenhouse gas emissions, energy efficiency, renewable energy and interconnections. On greenhouse gas emissions the EU endorses a binding EU target of reducing greenhouse gas emissions by at least 40% by 2030, compared to 1990.

The agreement on the 2030 framework, specifically the EU domestic greenhouse gas reduction target of at least 40%, formed the basis of the EU's contribution to the Paris Agreement. The EU's so-called Intended Nationally Determined Contribution (INDC) was formally approved at an Environment Council meeting in March 2015.

The 40% reduction target is sub-divided into two separate targets for the EU Emission Trade System (ETS) and non-EU ETS sectors elaborated below.

In May 2018 the European Council adopted a regulation on the EU effort sharing of greenhouse gas emission reductions in the non-ETS sectors in the period 2021-2030 – the so-called Effort Sharing Regulation (ESR). Under this regulation Cyprus is committed to a 24 % reduction of greenhouse gas in non-ETS emissions in the period 2021-2030 by 2030 relative to 2005.

Under the Effort Sharing Regulation flexibilities mechanisms ensuring cost-effective reductions include borrowing, banking and transfer of annual emission allowances between years and between member states (cf. Article 5), cancellation of EU ETS Allowances instead – in practice meaning that reductions are made under EU ETS instead of under ESR (cf. Article 6) and use of credits from LULUCF (cf. Article 7).

In May 2018 the European Council also adopted a regulation of emissions by sources and removals by sinks in the land sector – the LULUCF regulation, where LULUCF is “Land-Use, Land-Use Change and Forestry”. Credits obtained under this regulation can be used to reach the target for the non-ETS sector in accordance with the ESR up to a certain limit. The limit for Cyprus is 60 kt CO_2-equivalent credits from LULUCF during the period 2021-2030.

The EU is committed to reducing its ETS emissions by 43 % in 2030 from 2005 to achieve the total greenhouse gas emissions reduction of 40 % below 1990 levels by 2030.The EU has also set itself the target of increasing the share of renewables in energy use to 32 % by 2030.

Achieving climate neutrality

Consistency with Cyprus’ long-term low emission strategy is ensured as Cyprus’ targets under the ESR regulation and the LULUCF Regulation are to be seen as steps in 2021-2030 towards the objective to work towards net zero emissions in accordance with the Paris agreement and for a net-zero-emission target in the EU and Cyprus by 2050.

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

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

The transition will require significant public and private investments. In this context, Cyprus welcomes and supports the announcement by the EIB that it intends to support investment in climate action and environmental sustainability in the period from 2021 to 2030, which will have a significant impact for the post 2030 period. It is underlined that the next MFF will significantly contribute to climate action, since the investments that will occur in 2021-2030 period, will have an impact towards the 2050 decarbonisation targets.

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

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

2.1.3. Adaptation policies and measures

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

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

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

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

The 1st Annual Report on the implementation of the adaptation measures of the National Adaptation Strategy to Climate Change and Action Plan was submitted and approved by the Council of Ministers on 5 December 2018.

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

To this end, and in support of the National Adaptation Strategy and Action Plan, the outcome expected to be produced under Cyprus' Government Initiative for Coordinating Climate Change Actions in the Eastern Mediterranean & Middle East will be utilized. The purpose of this Initiative is to develop a Regional Action Plan to support countries in the Eastern Mediterranean and the Middle East to meet their obligations under the Paris Agreement and to address and / or adapt to the effects of climate change. This Regional

Action Plan will be a dynamic high-level strategic planning document and outline regional climate policy (climate change mitigation and adaptation), taking into account the specificities and challenges of the region.

As shown in figure below, as clearly stated in the “Clean Planet for all, A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy“ study, Cyprus is one of the countries in the Mediterranean that will be affected the most (i.e. 16% of the present Mediterranean climate zone may become arid, outdoor labour productivity may decline by around 10-15%, reductions in projected food availability, undermine security and prosperity, damaging economic, food, water and energy systems, and in turn triggering further conflicts and migratory pressures)[5].

Even though the above aspects are not fully incorporated in the long term strategy scenarios, it is obvious that scaling up electricity from renewables is crucial for the decarbonisation of the Cyprus energy system. Electrification with renewables is seen as a major solution, and the contribution of renewable electricity will be the one of the largest drivers for change Cyprus energy mix transformation.

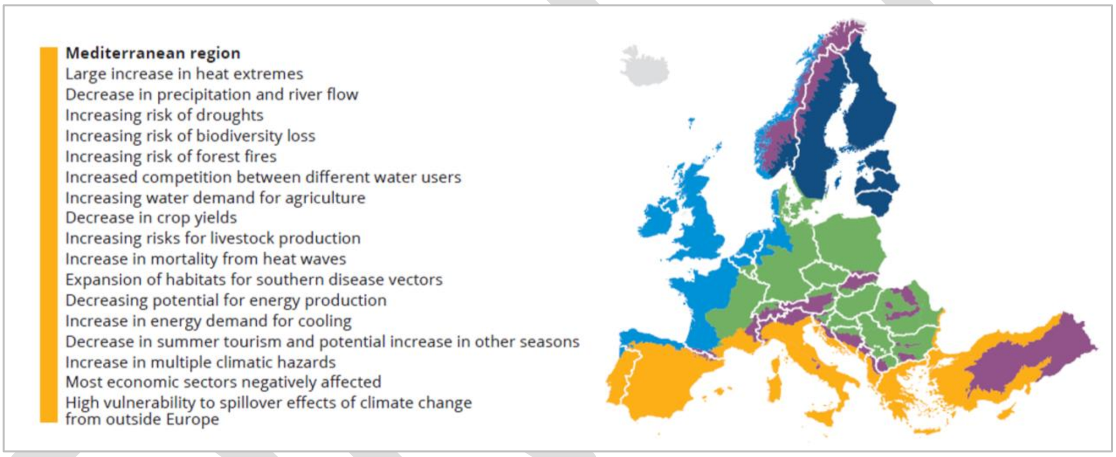


Figure 2.3: Climate Change impacts in Europe[3]

2.2. <u>Renewable energy</u>

The estimated share of renewable energy in final energy consumption by 2050 ranges from 32% (BaU scenario) to 95% (Ambitious scenario). The share renewable energy depends on the implementation rate of the policies and measures described in the NECP as well as the status of the implementation of electricity interconnection with neighbouring countries (Figure 2.4).

Based on the adopted Policies and Measures under implementation (NECP scenario), it is clear that there is a potential to increase the share of RES to 23% by 2030, which increases to 51% in 2050.

[5] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic And Social Committee, The Committee Of The Regions And The European Investment Bank. 28.11.2018. A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy [COM(2018) 773]

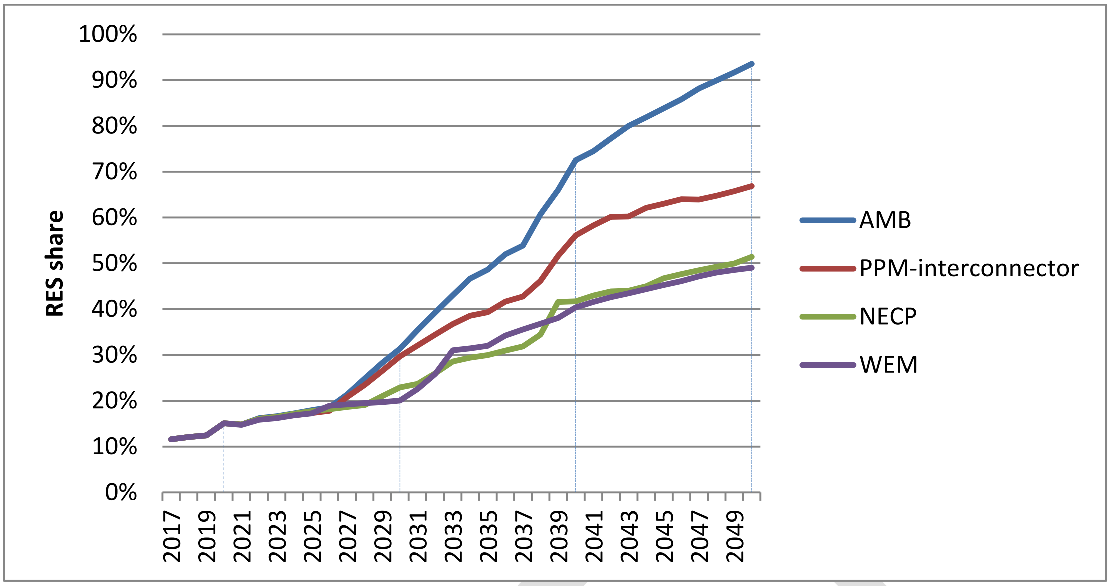


Figure 2.4: Estimated share of renewable energy in final energy consumption by 2050 where WEM is the "With existing measures" scenario; PPM-interconnector is the "Planned Policies and Measures" scenario with the effect of the interconnector; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050

However, it is also clear, from Figure 2.4 and Table 2.1, that the electricity interconnector plays a crucial role in the development in the share of Renewable Energy in an increasingly electrified economy. The electricity interconnector overcomes the Electricity System's technical barriers that hinder the growth of Renewable Energy, while it provides additional opportunities for Export of Electricity, taking advantage of the in-abundance Renewable Energy Potential, especially Solar (Table 2.1). In addition, it will help increase the consumption of electricity from renewable sources since it will facilitate the import of renewable energy produced from wind and solar power plants in the connected countries.

Table 2.1: RE share in final energy demand across all sectors – Ambitious Scenario projections (assuming electricity interconnections)

	2035	2040	2045	2050
All sectors	49%	73%	84%	94%

The incorporation of the EuroAsia Electricity interconnector has a drastic effect on the energy balance of Cyprus in the period up to 2050 since the rate of RES penetration is steeper in that scenario.

However, in the post-2030 period, the possibility of electricity trade enables additional investments in solar photovoltaics, raising the renewable energy share in electricity to 50% by 2030. Deployment of solar photovoltaics aims at exporting electricity, profiting from an assumed electricity price differential between the Cypriot, Greek and Israeli systems. The volume of net electricity exports in 2030 corresponds to a high level of share on RES installations.

Moreover, for larger utility-scale RES projects, steps are already taken to prepare for the opening of the new Electricity Market Trading and Settlement Rules, where all Electricity Sources, Conventional and Renewable are expected to compete on equal footing.

The transition to a highly decentralized power generation system, based on renewable energy sources, will require a more intelligent, smart and flexible system, which will be based on consumer participation, increased interconnectedness, greater involvement of energy storage systems of different sizes and technologies, in the coupling of energy sectors and in the demand-side response and digital management. Also, this energy transition will affect a more extensive set of national policies to achieve a socially and transparent energy and climate transition and a cost-effective way for the economy and society as a whole.

2.3. Energy efficiency

The final and primary energy consumption trajectory under the planned policies and measures scenario (without electricity interconnector) is illustrated in Table 2.2 below.

Table 2.2: Final and primary energy consumption trajectory under the planned policies and measures scenario (without electricity interconnector) [ktoe]

Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Final	1916	1922	1922	1931	1938	1948	1947	1950	1952	1953	1955
Primary	2503	2406	2417	2359	2369	2387	2394	2409	2413	2411	2409
Year	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
Final	1960	1962	1964	1966	1969	1969	1968	1966	1964	1966	1973
Primary	2387	2358	2362	2369	2372	2367	2331	2239	2242	2231	2229
Year	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**			
Final	1979	1984	1987	1990	1993	1996	1998	1996			
Primary	2238	2231	2212	2207	2202	2197	2192	2175			

However, if the planned policies and measures scenario with electricity interconnector will be implemented instead, the primary and final energy consumption will reach 2346 ktoe and 1991 ktoe respectively in 2050. Similarly, if the ambitious scenario will be implemented instead, this includes the electricity interconnector and more energy efficiency measures, such green tax reform. In this case final energy consumption will be further decreased, compared to the other two scenarios. In the planned policies and measures scenario with electricity interconnector and in the ambitious scenario, there is an increase in the projected primary energy consumption for 2050, compared to the planned policies and measures scenario (without electricity interconnector). This is because electricity interconnector enables the export of electrical energy to other countries and thus, the primary energy in these scenarios is increased (the energy will not be used solely to cover national energy needs).

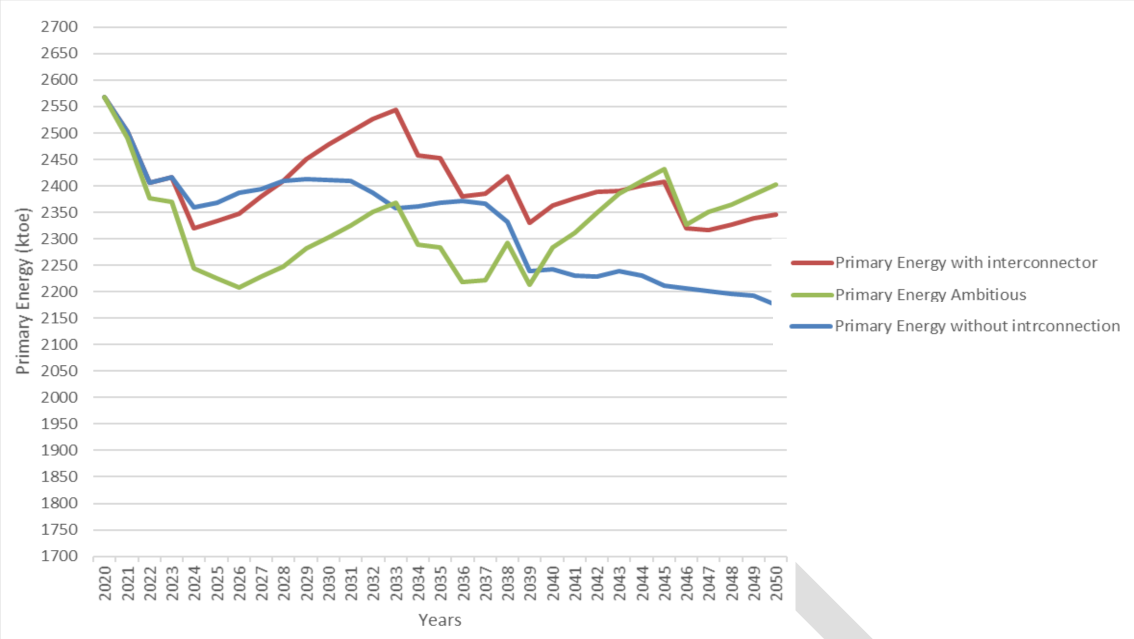


Figure 2.4: Trajectory of the primary energy consumption until 2050

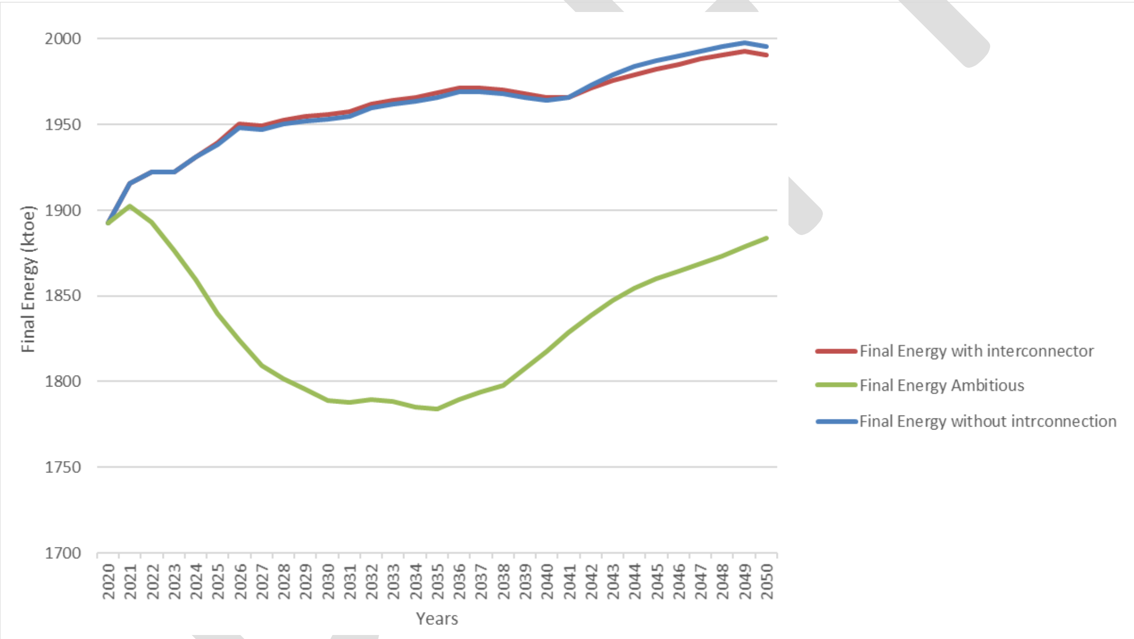


Figure 2.5: Trajectory of the final energy consumption until 2050

2.4. Sector-specific related content

2.4.1. Energy system

In addition to the policies and measures presented in the NECP the following are under examination for the achievement of decarbonisation in 2050:

- Introduction of carbon tax
- Further increase RES after 2030 in all energy
- CCS activities to all ETS installations from 2040 – electricity, cement, ceramics
- Further increase EE after 2030 in all energy except electricity

- Reduction of emissions from implementation of support scheme for agriculture, industry and commercial sectors

2.4.1.1. Possible future emissions trajectories

With further promotion of renewables (which is possible only if the national grid is interconnected), further savings from implementation of energy efficiency measures and utilisation of CCS/CCU technologies the energy sector (excluding transport) could decarbonise further (Figure 2.6).

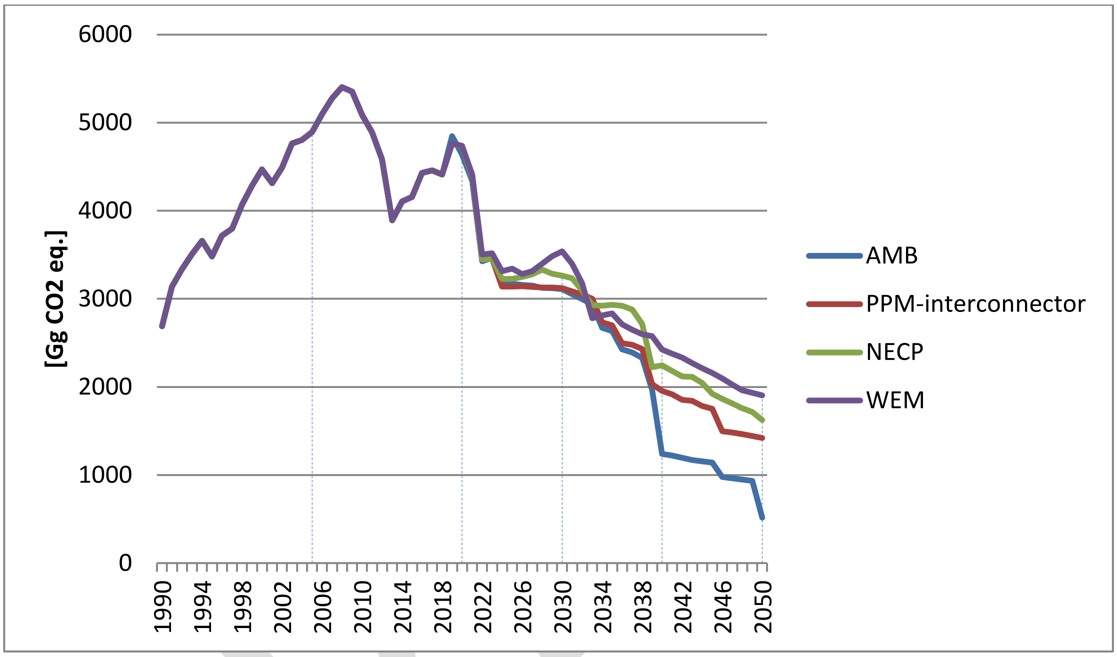


Figure 2.6: Estimated GHG emissions from the energy sector (excluding transport) by 2050 where WEM is the "With existing measures" scenario; PPM-interconnector is the "Planned Policies and Measures" scenario with the effect of the interconnector; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050

2.4.1.2. General description of main drivers for energy efficiency, demand-side flexibility and energy consumption and their evolution from 2021 and beyond

A mixture of policies and measures will be implemented from 2021 and beyond in all sectors of the economy, aiming to reach both indicative and obligatory national energy efficiency targets for 2030. As described in paragraph 3.2.1.1 of the NECP, these will include, inter alia, regulatory and financing measures for households, services and industrial sector, measures in the public buildings, action plan for reducing energy consumption in transport sector as well as cross-cutting measures such as energy and CO2 taxes, energy efficiency obligation schemes, as well as informative and capacity building measures. In general, these policies and measures will continue to be the main drivers for energy efficiency up to 2050.

For the post 2020 period more policies and measures will be examined. Some policies and measures are about to be examined to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models, as described in paragraph 3.2.1.3 of the NECP. Additional policies and measures and further actions to remove specific regulatory and non-regulatory barriers that impede the uptake of energy efficiency investments will also be examined as described in paragraph 3.2.1.4 of the NECP. Also, the green tax reform will be further considered as described in paragraph 5.1.5 of the NECP. The specific measures to be introduced from 2021 and beyond related to the above-mentioned will be included in the next update of the NECP.

2.4.2. Industry

Cyprus Industrial base in mainly operating in light industrial activities. Industry contributes 7.9% to GDP while at the same time employs about 9% of the total employment. The majority of manufacturing units are small and medium-sized enterprises (SMEs), which occupies less than 10 employees. Main growth sectors are, among others, the ICT sector, the pharmaceuticals and food and drink sectors.

The Competitiveness of the industrial sector has still a lot of potentials and is rather low. This is mainly due to low productivity, high production costs and increased supply chain costs resulting from the small size of the market, the insularity of the economy and its geographic and energy "isolation" and its limited resources and low capacity for innovation. At this point Cyprus proceeded with the design and implementation of a new Industrial Policy aiming to develop more high-value-added and innovative products and services that will contribute to the competitiveness of the Cyprus economy over all. At the same time Cyprus is aiming to increase productivity by strengthening the industrial ecosystem and promote the investment in digitalisation, sustainability, innovation and circular economy.

2.4.2.1. Expected emission reductions

Possible emission reductions that could be achieved from the sector of Industrial Product and other Product Use (IPPU) are presented in Figure 2.7.

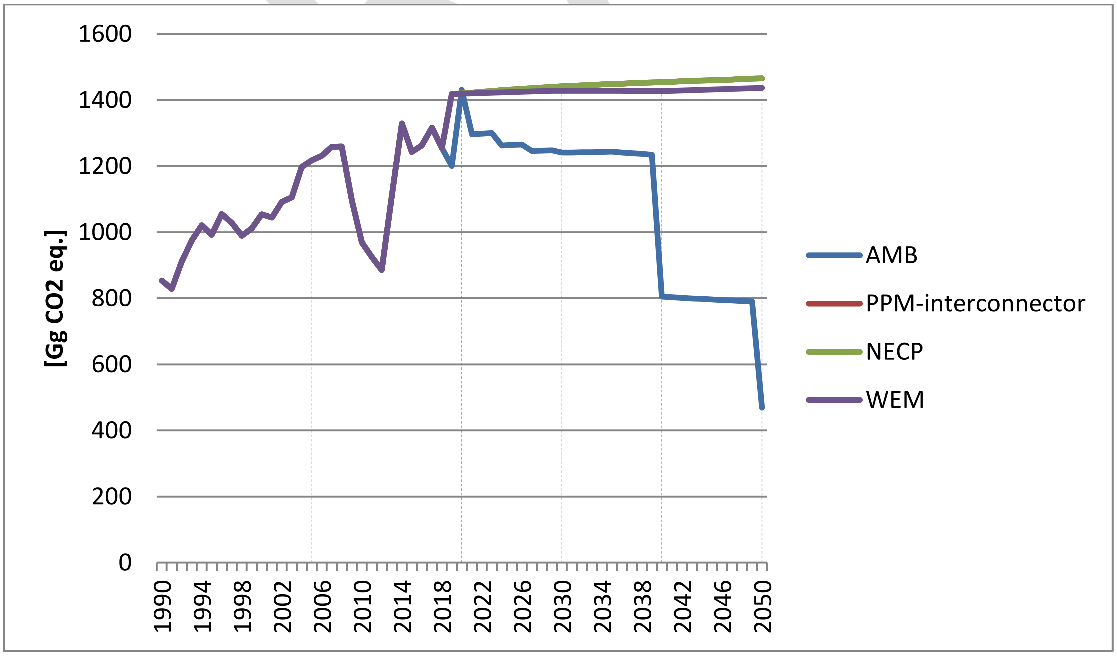


Figure 2.7: Estimated GHG emissions from the sector of Industrial Product and other Product Use (IPPU) by 2050 where WEM is the "With existing measures" scenario; PPM-interconnector is the "Planned Policies and Measures" scenario with the effect of the interconnector; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050

2.4.2.2. General overview of the policies, existing plans and measures for decarbonisation

In addition to the policies and measures presented in the NECP the following are under examination for the achievement of decarbonisation in 2050:

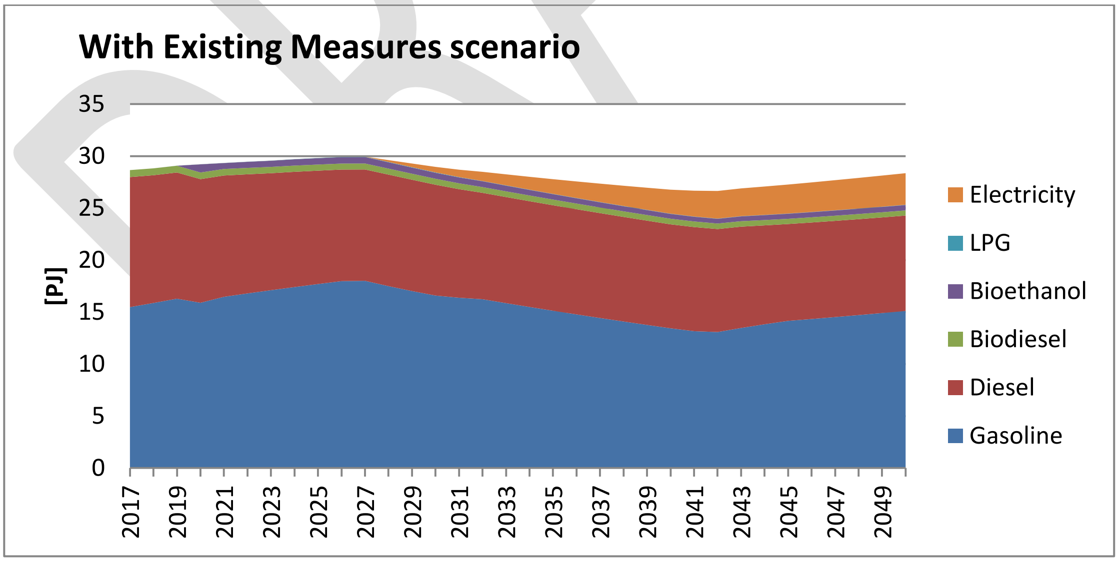
- Introduction of carbon tax
- CCS activities to all ETS installations from 2040 (20% in 2040-2049, 70% in 2050) – electricity, cement, ceramics
- 2015 EU F-Gas Reg. [EU HFC phase down steps] from 2020: 2018-2020 to 93%; 2021-2023 to 45%; 2024-2026 to 31%; 2027-2029 to 24%; 2030-2035 to 21% compared to 2015; AMB 5% by 2050 compared to 2015

2.4.3. Transport

2.4.3.1. Expected emissions and energy sources by transport type

Cyprus has no domestic shipping, aviation and rail services available and these are not expected to be developed until 2050. This section therefore presents information only on road transport.

The projections for the transport sector foresees penetration of alternative fuels and technologies (Figure 2.8). Regarding the passenger car fleet, the number of diesel vehicles are expected to reduce over time, and these are replaced by gasoline, gasoline hybrid and battery electric vehicles. It is worth highlighting that a significant penetration of new electric vehicles appears in the fleet in late 2030's, which brings full electrification of private passenger transport in 2050.



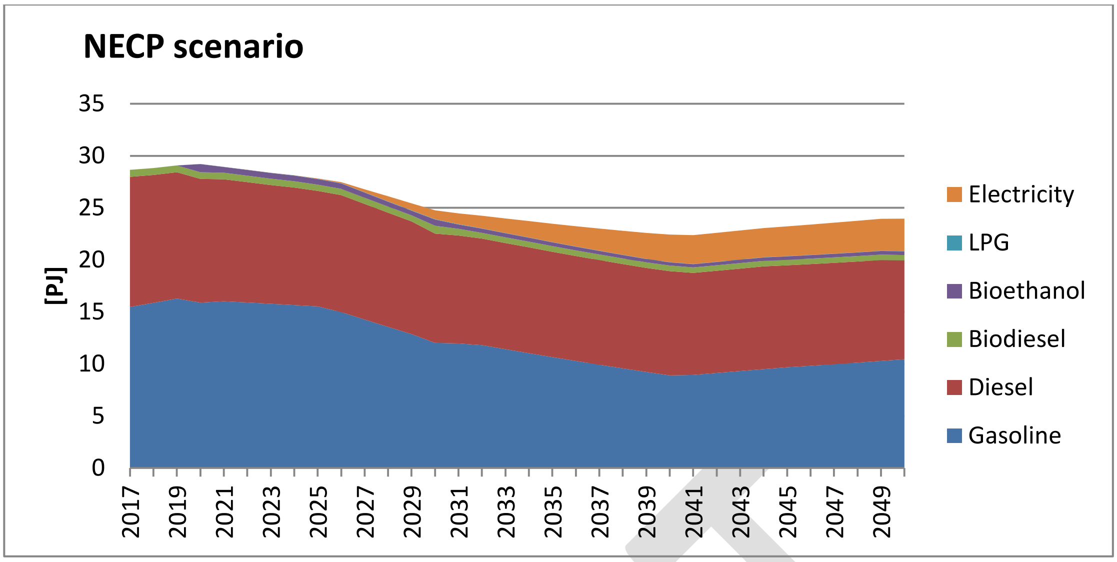


Figure 2.8: Estimated energy consumption by fuel for the transport sector where NECP is the "Planned Policies and Measures" scenario as submitted through the NECP

The projected shift in the road transport fleet results in an equivalent change in the fuel consumption in the transport sector for all scenarios. Electrification of the transport sector is regarded as a key step in the decarbonisation and diversification of fuel supply of this sector. A degree of electrification occurs in the projected scenarios by fully-electric vehicles. Therefore, electricity demand in the transport sector increases proportionally, reaching 3 PJ in 2050 with the most conservative scenario (existing measures) and 7.5 PJ in 2050 with the most ambitious scenario (AMB).

If the electricity demand in the transport sector increases further, it could pose challenges to the grid, but could also offer opportunities. On the one hand, electricity demand rises; this will not happen uniformly as charging will primarily occur at specific hours of the day. It can be expected that the overall load profile will be affected as a consequence. This is something that perhaps is not captured adequately by the current version of the model and may need to be amended in the future. The assumed charging profile can have a significant impact on the results and with increasing penetration of BEVs in the system, more information could become available to assist such an analysis.

Smart charging of vehicles and potential use of vehicle-to-grid systems, in which vehicle batteries can be used as additional supporting infrastructure by the grid operator, can offer demand response services that in turn can add flexibility and have an enabling effect for intermittent renewable energy technologies, subject to wider regulatory and market developments such as the introduction of Time-of-Use or dynamic pricing retail contracts. It has to be noted that changes in the transport sector are subject to the social behaviour of individuals, which is not a trivial matter to address in optimization models. The willingness of consumers to change their behaviour is a factor that may limit the transition of the transport sector to alternative fuels and technologies.

It is important to highlight the drastic reduction in overall energy demand of the transport sector through the promotion of sustainable transport modes. It is estimated that additional cumulative investments in public transport for this scenario amount to 800-900 million EUR2016 to develop a tram line in Nicosia and increase the bus fleet, and an additional 500 million EUR2016 for creating the necessary infrastructure for sustainable transport until 2030. These levels of investment are very large compared to what's foreseen in other sectors, but they also lead to lower private investments in passenger vehicles. It is noted that the materialisation of these projections will necessitate infrastructure investments that will need to be partly financed by EU funds, and an equivalent level of public acceptance and adoption of these modes of transport to make such investments successful.

Given the aforementioned changes foreseen until 2050, the expected impact on the emissions is presented in Figure 2.9. The expected emissions from the road transport sector are expected to range from 0.4 to 1.4 Mt CO2 eq. depending on the policies and measures implemented.

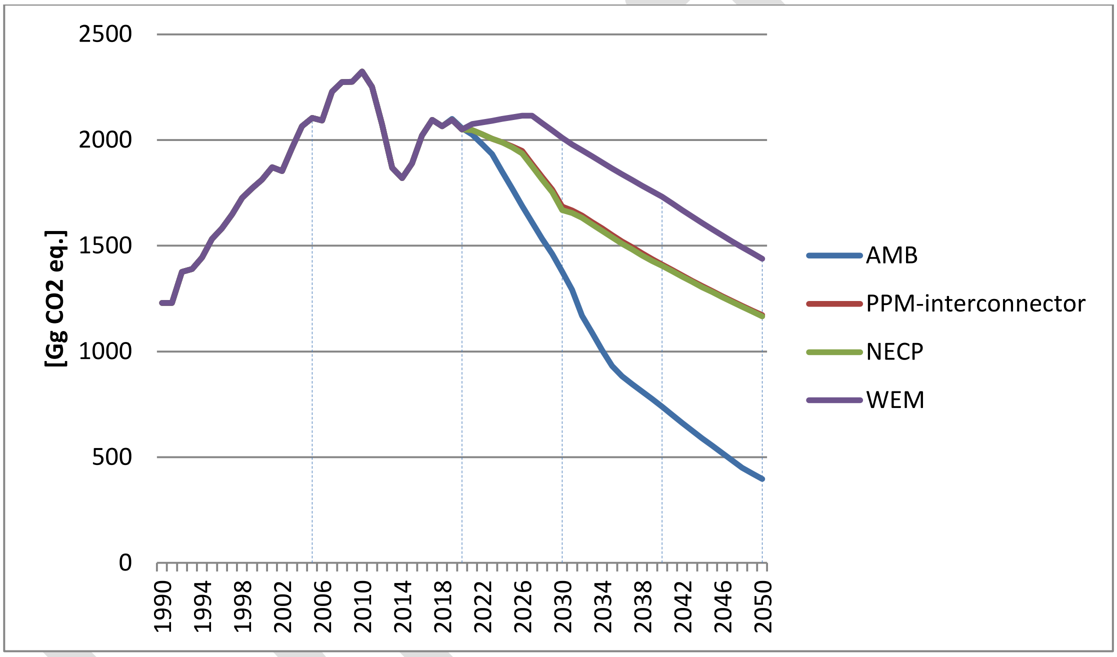


Figure 2.9: Estimated GHG emissions from the transport sector by 2050 where WEM is the "With existing measures" scenario; PPM-interconnector is the "Planned Policies and Measures" scenario with the effect of the interconnector; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050. Electricity emissions and CO2 from biofuels are excluded

2.4.3.2. Decarbonisation options

Decarbonising transport is an enormous challenge and there will be a need to deploy a mix of clean technologies to accelerate the transition to a sustainable system. The forecast for the transport sector foresees penetration of alternative fuels and technologies such as LPG and electric. Electrification of the transport sector is regarded as a key step in the decarbonisation and diversification of fuel supply of this sector. Moreover, a drastic reduction in overall energy demand of the transport sector could be achieved through the promotion of sustainable transport modes.

In addition to the policies and measures presented in the NECP the following are under examination for the achievement of decarbonisation in 2050:

- Introduction of carbon tax
- Further increase EE after 2030
- Further increase RES after 2030
- Fully electrified private transport by 2050; increasing trend starting from 2035

2.4.4. Agriculture and land use, land-use change and forestry (LULUCF)

Agriculture

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

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

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

Anaerobic digestion technology may help to address two congressional concerns that have some measure of interdependence: development of clean energy sources and reduction of greenhouse gas emissions. Anaerobic digestion, as a way of converting biomass to energy, has been practiced for hundreds of years. It is a technology that helps to reduce waste, generate energy and cut down on carbon emissions. The general performance of anaerobic digesters and the diversity of wastes which they can treat have been increasing steadily as a result of new reactor design, operating conditions, or the use of specialised microbial consortia, during the last decades. In Cyprus there are currently operating more than 10 anaerobic digesters, of which the majority is at large animal farms. All available studies show that there is a great potential in Cyprus to further promote anaerobic digestion for the treatment of waste with high organic content.

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

LULUCF

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

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

These are the existing and examined policies for increasing absorption of CO2 from land. However, the general target is to achieve absorptions reaching 1100 Gg in 2050. Towards additional policies and measures will be examined.

2.4.4.1. Expected emissions

Expected emissions from the sector of agriculture are expected to stabilise but not decrease during the coming decades due to the population of the animals (Figure 2.10).

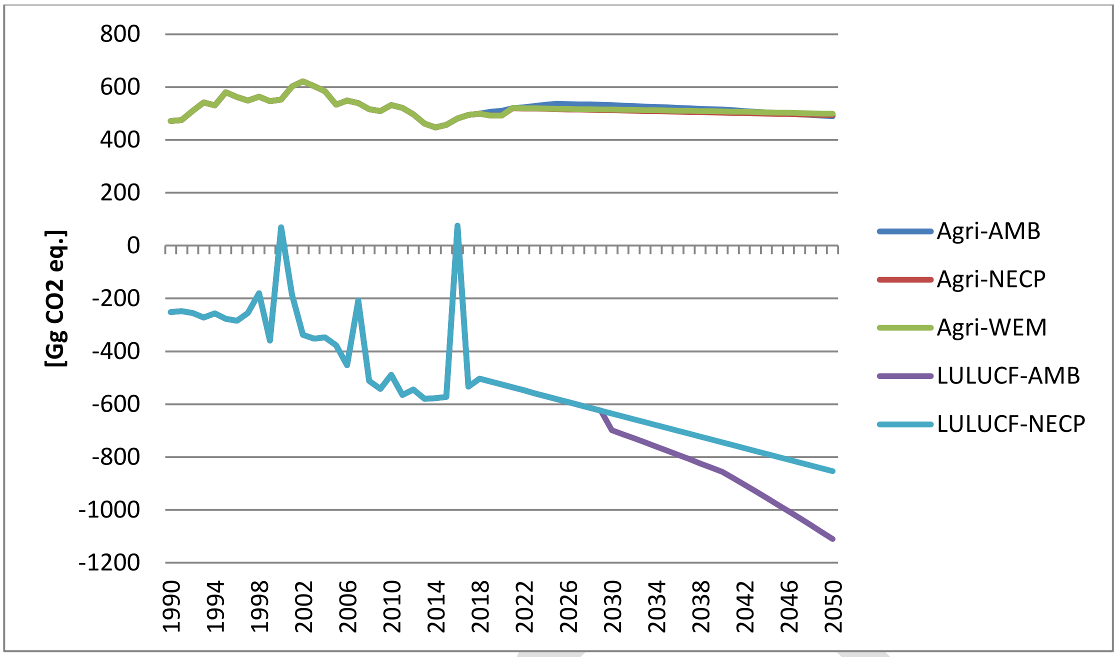


Figure 2.10: Estimated GHG emissions from the sectors of Agriculture (Agri-) and LULUCF (LULUCF-) by 2050 where WEM is the "With existing measures" scenario; PPM-interconnector is the "Planned Policies and Measures" scenario with the effect of the interconnector; NECP is the "Planned Policies and Measures" scenario as submitted through the NECP; AMB is the "Ambitious" scenario towards carbon neutrality in 2050

2.4.4.2. Emission reduction options envisaged

In addition to the policies and measures presented in the NECP the following are under examination for the achievement of decarbonisation in 2050:

- Further increase of AD from 2020 (2020-2030 AD annual increase 0.75%, 2031-2040 AD annual increase 1%, 2041-2050 AD annual increase 1.5% in cattle, pigs and poultry)
- Introduction of AD to sheep, goats, mules and asses, horses from 2031
- Annual decrease of N-fertilizers application by 1% from 2019
- Annual increase of compost and sewage sludge application on soil of 1% from 2019
- Increase absorption by 0.5% annually from 2030 from LULUCF

3. FINANCING

3.1. Estimates of investment needed

The cost for the implementation of the measures included in the strategy has been assessed only until 2030, during the preparation of the NECP. Details on the methodology are available in chapter 5 of the NECP.

The total estimated investments in all sectors are 13.7 Billion Euros for the entire decade 2021-2030, or about 70% of the country's GDP in 2018, for the implementation for the existing and planned measures presented in the NECP. Although aggregate investment levels are similar in both scenarios (with existing and with planned measures), there are considerable differences in the kind of investments foreseen in each scenario. The long-term strategy is consistent with the planned measures scenario, which includes significant additional investments in renewable power generation, for promoting public transport, cycling and walking, and for energy renovations in buildings and industry. Although substantial amounts are required for such investments, the total amount over the decade 2021-2030 is counterbalanced by a strong decline in the expenditures for new cars because of the significant shift towards public and non-motorised transport, and a drop in investments in the power sector due to reduced energy needs thanks to energy efficiency measures.

Additional investment needs to achieve climate neutrality by 2050 have not yet been assessed. Evidently these will involve significant amounts to be devoted to further decarbonisation of the power system, especially after 2040 when most thermal power plants will have been decommissioned and will have to be replaced by renewable sources and electricity storage infrastructure. Additional investments for zero-carbon fuels and engines to be used in road freight transport, shipping and aviation will also be important.

3.2. Policies and measures for related research, development and innovation

Policies and measures for related research, development and innovation are described in paragraph 2.5, 3.5 and 4.6 of NECP.

4. IMPACT ASSESSMENT OF THE SOCIO-ECONOMIC ASPECTS

A comprehensive socio-economic impact assessment of the pathway of Cyprus to climate neutrality does not exist. However, it is possible to provide a preliminary assessment based on knowledge of current market conditions and the policy environment in the country.

As regards social impacts related to changes in the cost of living of low-income households, the Impact Assessment study of the Cyprus NECP has shown negligible effects form implementation of planned policies and measures up to 2030. As regards the longer term, which was not studied in detail, it is reasonable to assume that the cost of the transition to net zero emissions by 2050 can be modest to low and – if properly managed – will not affect disproportionately the most vulnerable parts of the population.

More broadly, and judging by the fact that trade unions and political stakeholders have not expressed serious concerns up to now, it can be stated that the transition to a climate-neutral economy by 2050 can be sufficiently smooth and inclusive, thus avoiding the creation of adverse social effects in the population. It has to be reminded that Cyprus is a service-based economy without many heavy, energy-intensive industries in Cyprus, and without plants using coal.

Economic activities that may experience a gradual decline in employment are a) the operation of thermal power plants and b) the import of fuels and motor vehicles. In power plants, job losses may be modest because the closure of thermal power plants is scheduled to take place in an orderly manner up to 2050, in line with the national NECP, so that some of the personnel of these plants may retire in the meantime; for other power plant employees, some re-training may be necessary so that they obtain skills in renewable energy and smart electricity grids.

In the fuel and motor vehicle import sectors, employment impacts will depend on the pace at which electric cars will enter the market and on whether public transport will replace car mobility. People employed in sectors such as fuel stations and maintenance of vehicles may need to be employed in other similar activities that are expected to grow, such as operation and maintenance of public transport systems and electric vehicles.

The need for alignment of enterprises with the objectives of a climate-neutral economy can create business opportunities in manufacturing and in the provision of consulting services. Construction is also expected to benefit from energy renovations and infrastructure investments in sustainable mobility and smart electricity grids.

Overall, and as long as adequate re-training of parts of the labour force is foreseen, the transition to climate neutrality can yield positive (though modest) employment impacts.

5. ANNEXES

5.1. Details on modelling (including assumptions) and/or analysis, indicators, etc.

Modelling was performed from previously conducted work and Technical assistance received from SRSS using OSeMOSYS model of the Cyprus energy system[6].

It should be highlighted that since this modelling activity aims at indicating the effectiveness of existing and planned policies and measures (PaMs), the objective 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 in regards to specific targets for 2030 were removed from the model, unless backed-up by specific policies. Therefore, no related constraint left in the model for the horizon 2031-2050.

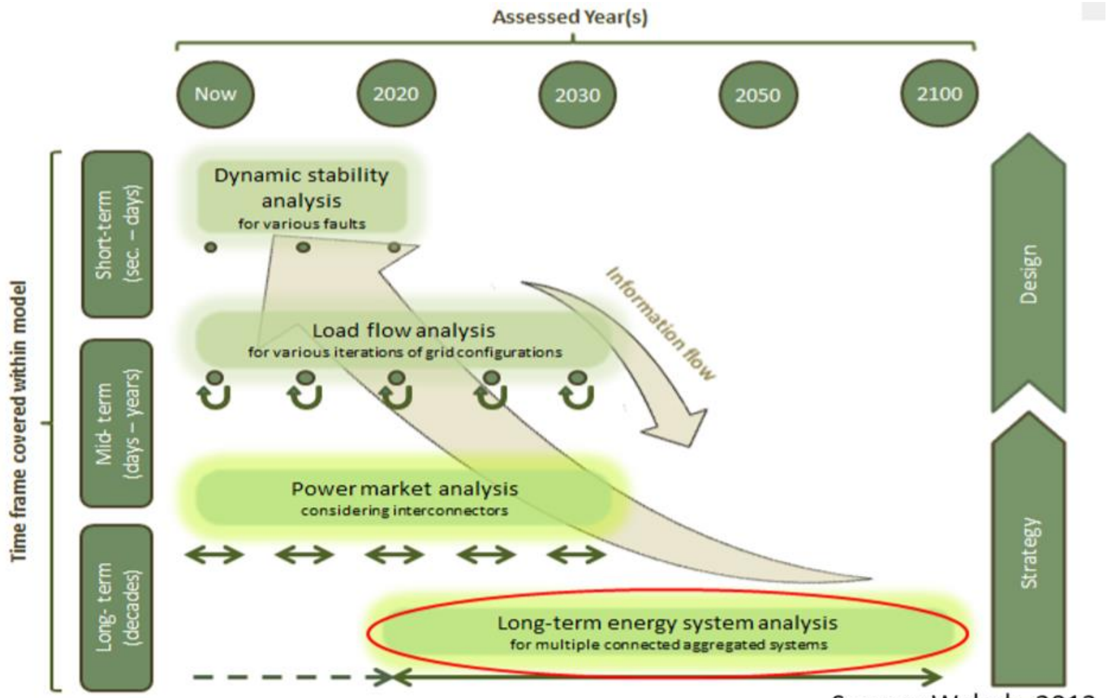
The modelling performed was based on a wide range of technologies, complemented by assumptions regarding the evolution of the investment, operation, maintenance and decommissioning of these technologies.

Various technologies were considered, beside those that are already available. Cost assumptions were drawn from recent historical trends, EU databases and other international databases, while specific studies of these sectors or technologies were taken into account.

However, consideration was not given to technologies that are promising but have not yet been proven in the context of the real economy and the emergence of disruptive technologies between now and 2050, that are completely unknown today, cannot be disregarded (like Hydrogen and Carbon Capture and Storage).

As a way to test the robustness of the RES and emissions trajectories to these uncertainties, some sensitivity analyses were performed for the most critical factors for the evolution of national emissions, revealing the impact of variations in some of the assumptions (for example, natural gas prices, technology costs, different scenarios on demand based on social aspects, etc) on the final modelling results.

[6] Constantinos Taliotis et al., "Cost-Optimal Scenario Analysis for the Cypriot Energy System - Conducted under the European Commission Grant VC/2015/0004" (Stockholm: KTH-dESA, 2017), https://kth.box.com/s/xwzmo2a1epf4ltmwqodk4eeypopsnzjb.



Source: Welsch, 2013

Figure 5.1: Energy system Models, Timescale and Technology

Energy Storage Assumptions:

In the OSeMOSYS model used for Cyprus NECP the Battery Storage was selected based on a number of interlinked benefits:

(1) Battery storage was used to reduce the curtailment of RES in case this was economically viable. i.e. the model chose storage technologies, if the energy stored could participate in the market and receive enough compensation from it, so that investments were deemed to be economically viable (from the entire system point of view).

(2) The batteries were used in the same manner as RES, assisting conventional plants in reducing start-up and shut-down costs (Storage technologies were also capable of providing spinning reserve that was defined as a function of the level of electrical charge on a ratio of 1:1.)

(3) In UCED scenarios, the storage was used to provide additional services to the grid (without taking into account the financial benefits). It was used as a forced investment to cover the energy not served from the intermittency of RES. The results were used in the Long term Planning.

(4) Storage options and conventional thermal plants were allowed to contribute 100% of their rated capacity to the capacity reserve margin, while RET without storage was allocated a lower capacity credit since their availability is intermittent (0% for wind & 20% for PV). (Recent assumptions allow up to 50% for PV, but the scenario was not tested yet)

(5) Thermal Storage for CSP projects was not separated from the CSP plant, but it was assumed as an integrated system (or Hybrid System). This can be further improved in the future development of the model, but it was not expected to improve the results since the LCOE cost of CSP plant (without storage) is higher than PVs (without Storage).

The above methodology followed seems to be slightly different from the method described in the "previous" PRIMES manual:

"Large-scale storage is endogenous in the model (hydro-based pumped storage, air compression, and hydrogen-base storage): depending on economics, storage simultaneously smooth load and accommodates transfer of RES energy from times when RES availability exceeds load to times when RES is insufficiently available".

For behind the meter storage (which can be applied today to prosumers having net-billing support scheme, and later to the market participants – active consumers), it was assumed that: to avoid curtailment of RES production, every additional kWh produced from a RES System (that will not be self-consumed) has to come with storage (if it makes economic sense). Despite the level of curtailment, renewable energy technologies are deemed cost-effective due to their decreasing investment cost.

The behind the meter storage was not able to take advantage of the time-of-use-tariffs since the market is not functional yet in Cyprus. However, based on a previous study performed by SRSS, the intra-day price difference until 2030 is not expected to exceed the LCOE price of the battery storage.

From 2032 onwards the considerable investments in solar technologies and storage technologies substitute the variable costs as the main driver for the cost of electricity.

Discount Rates

Due to the different modelling approach followed in this study, it was important to implement technology-specific discount rates (Table 5.2). 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)[7].

Table 5.2: Technology specific discount rates

Discount Rates in Energy Supply Sectors	
Assumptions for EU Reference Scenario 2016	**Discount Rate**
Regulated monopolies and grids	7.5%
Companies in competitive energy supply markets	8.5%
RES investment under feed-in-tariff	7.5%
Investment under contract for differences	7.5%
RES investment under feed-in premium, RES obligation, quota systems with certificates	8.5%

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

RES investment in competitive markets	8.5%	
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	7.5%	
Non energy intensive industries	9%	
Services sectors	11%	
Public transport (conventional)	7.5%	
Public transport (advanced technologies, e.g. high speed rail)	8.5%	
Business transport sectors (aviation, heavy goods vehicles, maritime)	9.5%	
Country risks	None	
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	13.5%	9.5%

Table 5.3: 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.

Table 5.4: Technoeconomic assumptions for RE technologies for generation

	Investment Cost (EUR2016/kW)			Variable O&M cost (EUR2016/MWh)	Fixed Cost O&M cost (EUR2016/kW)	Capacity Factor	Lifetime (years)
	2030	**2040**	**2050**				
Utility-scale PV	886	611			9	18.5%	20
Wind	1,330	1,266			53	16%	25

Biomass-biogas	2,438	2,415			62	48.5%	30
Rooftop PV	1,241	1,016			12	18.5%	20
EOS 50 MW CSP with 8 hours storage					106	39.3%	30
CSP with 6 hours storage	3,724	3,430		3.1	58.2	50.8%	25

Table 5.5: Average Heating (HDD) and Cooling Degree Days (CDD) in Nicosia, 1984-2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HDD	293.4	261.5	212.1	90.7	15.2	0.2	0.0	0.0	0.0	15.1	118.7	246.1
CDD	0.0	0.0	0.1	4.4	45.4	142.6	237.1	232.4	126.9	35.1	0.5	0.0

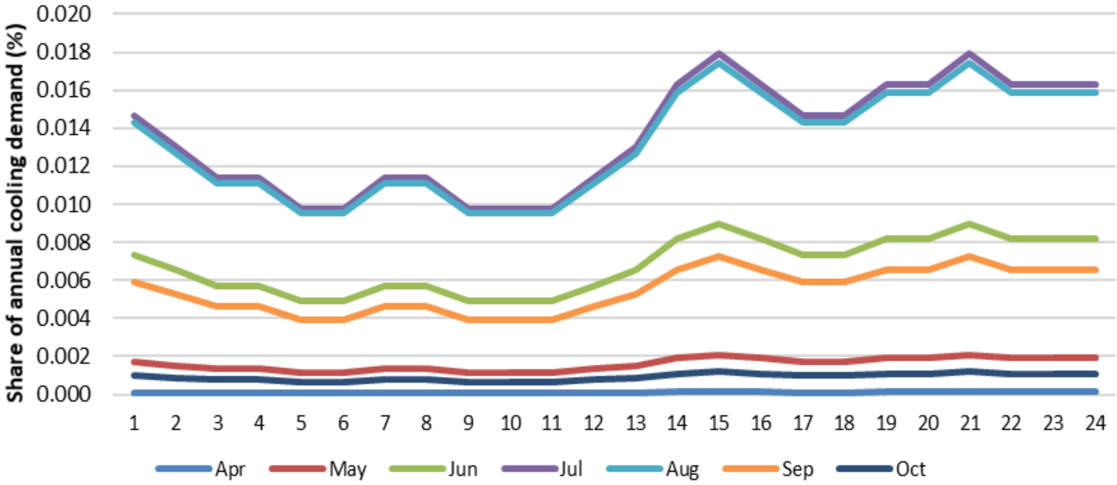


Figure 5.2: Assumed share of annual cooling demand for each hour within each month.

Costs

Due to the considerable investments in the electricity supply sector, the average cost of gross electricity generation increases gradually during the modelling period. Undeniably, this is a function of the assumed fuel price and technology costs adopted in the model. Figure 5.3 provides a breakdown of the different system cost components; these are all undiscounted[8]. 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 2031. From 2032 onwards, the considerable investments in solar PV and storage technologies (Figure 5.4) 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.

[8] 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.

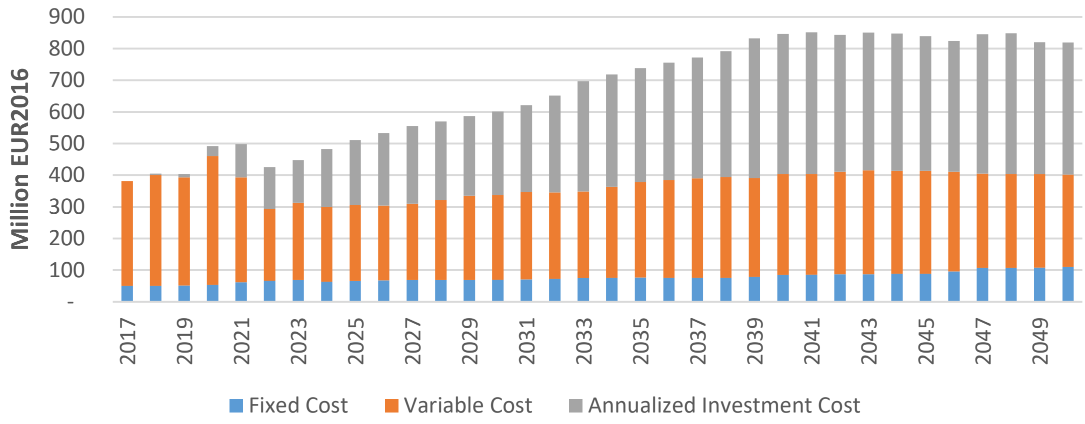


Figure 5.3: Average cost of electricity and breakdown of system cost components – Existing PaMs scenario.

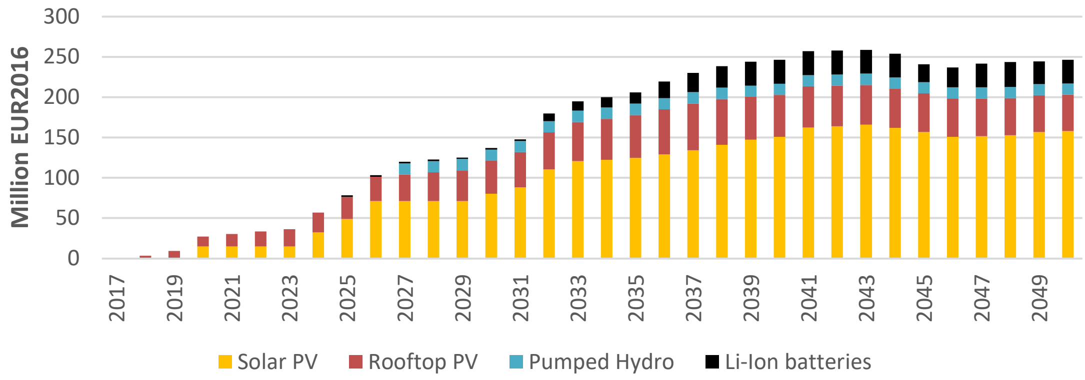


Figure 5.4: Annualized investment costs in solar PV and storage technologies in the period 2020-2050 – Existing PaMs scenario.

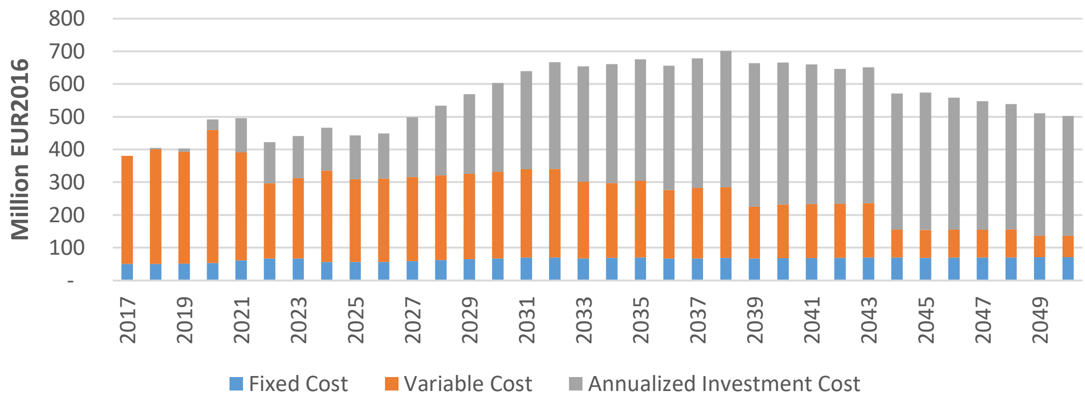


Figure 5.5: Average cost of electricity and breakdown of system cost components – Planned PaMs scenario.