# Malta Low Carbon Development Strategy

October 2021

GOVERNMENT OF MALTA
MINISTRY FOR THE ENVIRONMENT,
CLIMATE CHANGE AND PLANNING


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# Foreword - Minister for the Environment, Climate Change and Planning

As we come to grips with the COVID-19 pandemic and move towards a post pandemic context, we cannot lose the opportunity to look back at the lessons learned from the pandemic. We need to ensure that as we strive to revitalize our lives we don't just work to build back to our old ways of doing things but we must focus on building back better. We are still facing what can be called a global climate crisis - accelerating climate change and unprecedented loss of natural resources and biodiversity. The situation is exacerbated by anthropogenic activities and lifestyles that continue to fuel GHG emissions and cause extreme ripple effects on the world's livelihoods.

Our transport systems, infrastructure, energy use, construction, manufacturing, and agriculture sectors are starting to suffer and endure the manifestations of climate change. Whilst Malta has already been seeing a reduction in carbon emissions, further efforts are required to reduce emissions levels that push our small island state towards a safer operational balance within this context.

As the economy progresses to a new normal in a post-COVID scenario, consumption and energy demand are expected to progress accordingly. Hence, instilling behavioural changes towards more climate friendly and sustainable practices is paramount in driving Malta towards a carbon-neutral and resilient island in the face of increasing climate change pressures. Government has already taken a stance on this by making carbon neutrality a strong pillar for economic growth and recovery from the COVID-19 pandemic – it is already striving towards a more proactive Malta that brings a real change, as evidenced by recently announced initiatives as ClimateOn, Seedgreen, Ecobuild, and Saving our Blue campaign.

With this Low Carbon Development Strategy, Government wants to continue gaining ground and set a strategic direction for the next 30 years, with a set of measures where economic growth is decoupled from natural resource use and environmental pressures. The strategy, in combination with other national strategies and plans such as the National Energy and Climate Plan (NECP), the Long Term Renovation Strategy (LTRS), and the Long Term Waste Management Plan, will ensure carbon emissions reductions across the main sectors of the Maltese economy, in line with the EU climate neutrality ambition set by the European Green Deal and in line with our Paris Agreement goals. Conserving energy and reducing emissions from transport, buildings, industry, waste disposal, water generation, and the sector of agriculture and land-use, land-use change and forestry (LULUCF) represents a winning conflict resolution to climate change mitigation - decreasing the demand for energy generation and unsustainable resources and methods will pay end-consumers and beneficiaries, whilst also resulting in a reduction in carbon emissions.

This strategy, indeed, addresses Malta's decarbonisation journey by prioritising the most cost-effective measures to improve energy efficiency and promoting renewable energy sources, whilst taking into account their socio-economic impacts. It aims at promoting green investment over 30 years, whilst improving the quality of our building stock, the way we work, our mobility patterns, our health and lifestyles.

Unbeknownst to the majority of us, climate change is also revealing itself on our shores through higher

temperatures, change in precipitation patterns, sea level rise, and ocean acidification and warming. This strategy addresses the impacts of these risks and consequences through measures that teach us how we can adapt to these phenomena – ranging from a cross-sectoral level, to a micro approach that considers water resources, infrastructure and transport, land use and buildings, natural ecosystems, agriculture and fisheries, health and civil protection, and tourism sectors.

This is the framework and anatomy within which the Maltese Government will be operating and applying to the Maltese economy over a 30-year period leading up to 2050. It is purposely designed to address the pathways for Malta to achieve carbon neutrality by 2050 across all sectors. The policy mix on both mitigation and adaptation fronts focuses on different levers to ensure public spending and leverage for private investment - information, incentives, regulation, enforcement, and working with stakeholders to overcome financial and technical barriers. With the United Nation's Climate Change Conference of the Parties (COP26) on the horizon (in November 2021), Government is committed to rise to the challenge of honouring the Paris Agreement and its goals. The transition to a greener and carbon neutral economy for Malta will pump new life into our future, where government will invest substantially in the process to ensure all are and remain onboard.

Together we can reverse the impending calamities of climate change and environmental degradation. We can do that by building back better, by changing our production and consumption patterns to ones that respect life. Let's take control. Let us build back better.

**Aaron Farrugia**
Minister for the Environment, Climate Change and Planning

# List of Abbreviations

| | |
|---|---|
| **AD** | Anaerobic Digestor |
| **Bln** | Billion |
| **CC** | Climate Change |
| **CCGT** | Combined Cycle Gas Turbines |
| **CFCs** | Chlorofluorocarbons |
| **$CO_2$** | Carbon Dioxide |
| **$CO_2$eq** | Carbon Dioxide Equivalent |
| **CPD** | Civil Protection Department |
| **DR** | Discount Rate |
| **EC** | European Commission |
| **EE** | Energy Efficiency/ Efficient |
| **EfW** | Energy-from-Waste |
| **ERA** | Environment and Resource Authority |
| **ETS** | Emission Trading Schemes |
| **EU** | European Union |
| **EV** | Electric Vehicle |
| **EWA** | Energy and Water Agency |
| **FDI** | Foreign Direct Investment |
| **GHG** | Greenhouse Gas |
| **GHGE** | Greenhouse Gas Emission |
| **GwH** | Gigawatt Hour |
| **HFCs** | Hydrofluorocarbons |
| **ICE** | Internal Combustion Engine |
| **IM** | Infrastructure Malta |
| **Kt** | Kiloton |
| **Ktoe** | Kilotonnes of Oil Equivalent |
| **kWh** | Kilowatt-hour |

| | |
|---|---|
| **LCDS** | Low Carbon Development Strategy |
| **LCDV** | Low Carbon Development Vision (2017) |
| **LED** | Light-emitting diode |
| **LTRS** | Long Term Renovation Strategy |
| **LULUCF** | Agriculture and land-use, land-use change and forestry |
| **MACC** | Marginal Abatement Cost Curve |
| **MCST** | Malta Council for Science and Technology |
| **MECP** | Ministry for Environment, Climate Change and Planning (previously Ministry for the Environment, Sustainable Development and Climate Change) |
| **MFF** | The EU's Multiannual Financial Framework 2021-2027 |
| **MFH** | Ministry for Health |
| **Mln** | Million |
| **MS** | Member States |
| **MT** | Million Tons |
| **MTIP** | Ministry for Transport, Infrastructure and Capital Projects |
| **MW** | Megawatts |
| **MW(e)** | Megawatt electrical, a unit of electric power |
| **MWh** | Megawatt hour |
| **NECP** | National Energy and Climate Plan(s) |
| **NFRP** | National Flood Relief Project |
| **Nm** | Nautical Miles |
| **NPV** | Net Present Value |
| **NREAP** | National Renewable Energy Action Plan |
| **NSO** | National Statistics Office |
| **OFW** | Offshore floating wind turbines |
| **OFSPV** | Offshore floating solar PVs |
| **OHS** | Occupational Health and Safety |

| | |
|---|---|
| **OHSA** | Occupational Health & Safety Authority |
| **pa** | Per annum |
| **PV** | Photovoltaic |
| **R&D** | Research & Development |
| **R&I** | Research and Innovation |
| **RDD** | Rural Development Department, Ministry for Agriculture, Fisheries, Food and Animal Rights |
| **RDI** | Research, Development & Innovation |
| **RE/ RES** | Renewable Energy/ RE sources |
| **REWS** | Regulator for Energy and Water Services |
| **SDG** | Sustainable Development Goal |
| **SEA** | Strategic Environmental Assessment |
| **SWH** | Solar Water Heaters |
| **SWHP** | Solar Water Heat Pumps |
| **TM** | Transport Malta |
| **ton** | A short ton, equal to 2,000 U.S. pounds |
| **tonne** | A metric ton, equal to 1,000 kilograms (2,204.6 pounds) |
| **UM** | University of Malta |
| **UNFCC** | United Nations Framework Convention on Climate Change |
| **US** | United States |
| **W** | Watts |
| **WCMP** | 2nd Water Catchment Management Plan |
| **WMP** | Waste Management Plan for the Maltese Islands |
| **Wp** | Watt Peak |

# Executive Summary

Climate Change (CC) is a global phenomenon which is posing enormous and growing threats and challenges on a daily basis, especially on small island states like Malta[1]. It is no longer a matter of 'if' CC will happen, but rather of 'when', 'at which intensity' and 'where it will hit worst'. It is therefore with utmost urgency that countries need to accelerate the implementation of mitigation measures, to reduce carbon emissions and curb the destructive CC patterns which are developing globally. This primarily entails dealing with greenhouse gases (GHGs) that trap heat and make the planet warmer (this does not include all air pollutants[2]), and which largely emanate from carbon dioxide ($CO_2$), but also methane ($CH_4$), nitrous oxide ($N_2O$), and other industrial (fluorinated) gases as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$), and nitrogen trifluoride ($NF_3$). In the meantime, all countries need to ensure resilience and adaptation by preparing for the inevitable CC.

Driven by evidence that calls for immediate action and a number of international obligations, the Maltese Government has embarked on the development of a Low Carbon Development Strategy (LCDS or "Strategy") that maps out the country's decarbonisation journey up to 2050, following the publication of a Low Carbon Development Vision (LCDV) in 2017. The LCDS is being spearheaded by the Ministry for the Environment, Climate Change and Planning (MECP), with considerable inter-ministerial collaboration involved, including input from the Ministry for Energy and Sustainable Development, and the Ministry for Transport, Infrastructure and Capital Projects. CC ubiquitously impacts all sectors of an economy and hence collaboration from all parties, including private individuals and households, civil society and the private sector, will be required to make sure that both mitigation and adaptation measures are adopted effectively.

This Strategy is the result of a three-year process initiated by MECP, whereby mitigation measures have been researched and short-listed, possible abatement levels quantified through Marginal Abatement Cost Curve (MACC) modelling (i.e. ratio of abatement potential against incremental cost of measure), and stakeholders consulted, leading to a list of realistic and cost-effective measures which are to be implemented in the years to come. The use of MACC modelling allows government to predict the likely economic impacts and benefits of reducing GHG emissions, including overall economic investment costs and operational cost/ savings over the baseline (i.e. a situation without LCDS measures). The social and environmental effects and the cost to society from taking such measures are considered in specific assessments and thus allow policy to be designed in a way that is beneficial to society in economic and environmental terms. This three-year process was initiated in 2018 and its output and considerations have been inevitably impacted by the COVID-19 pandemic which hit Malta as from March 2020.

1 World Health Organisation (2018). Climate Change increasingly affects small countries. Retrieved from: http://www.euro.who.int/en/countries/malta/news/news/2018/06/climate-change-increasingly-affects-small-countries

2 Air pollutants relate to those pollutants which can harm the environment and health, can cause property damage, but do not necessarily cause an increase in global temperatures. Key primary air pollutants include particulate matter (PM), black carbon (BC), sulphur oxides (SOX), nitrogen oxides (NOX) (which includes both nitrogen monoxide, NO, and nitrogen dioxide, $NO_2$), ammonia ($NH_3$), carbon monoxide (CO), methane ($CH_4$), non-methane volatile organic compounds (NMVOCs), including benzene ($C_6H_6$), and certain metals and polycyclic aromatic hydrocarbons (PAHs), including benzo[a]pyrene (BaP). This Strategy focuses on GHGs, i.e. carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and other industrial (fluorinated) gases as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride ($NF_3$).

Malta is already subject to GHG mitigation commitments under the EU climate action regulation. Under this set of regulations, the EU has set efforts to reduce its overall 1990 emission levels by 20% up to the year 2020, by 55%[3] by 2030 and be climate neutral[4] by the year 2050. More specifically, Malta also has its own targets in terms of the Effort Sharing Decision (Decision No 406/2009/EC of 23 April 2009; ESD), committing to control GHG emission growth to no more than 5% of 2005 levels by 2020, and the Effort Sharing Regulation (Regulation (EU) 2018/842 of the 30 May 2018; ESR). This Strategy will help in reaching the latter target and fulfilling our obligations in terms of the EU and Paris Agreement. A Climate Action Act was also enacted in local law in 2015[5], setting the national governance framework for Climate Action and covering both Adaptation and Mitigation.

Government has already committed to becoming carbon neutral by 2050, as part of its pillars of economic growth and recovery from the COVID-19 pandemic. At the same time, Malta understands that its effort will only contribute a very small (in absolute terms) part to the required global effort, with larger and more developed countries having to carry large reductions to their footprint. In this regard, Malta can still take a key role in the global war against CC – by assisting in the piloting of carbon efforts and new technologies (carbontech).

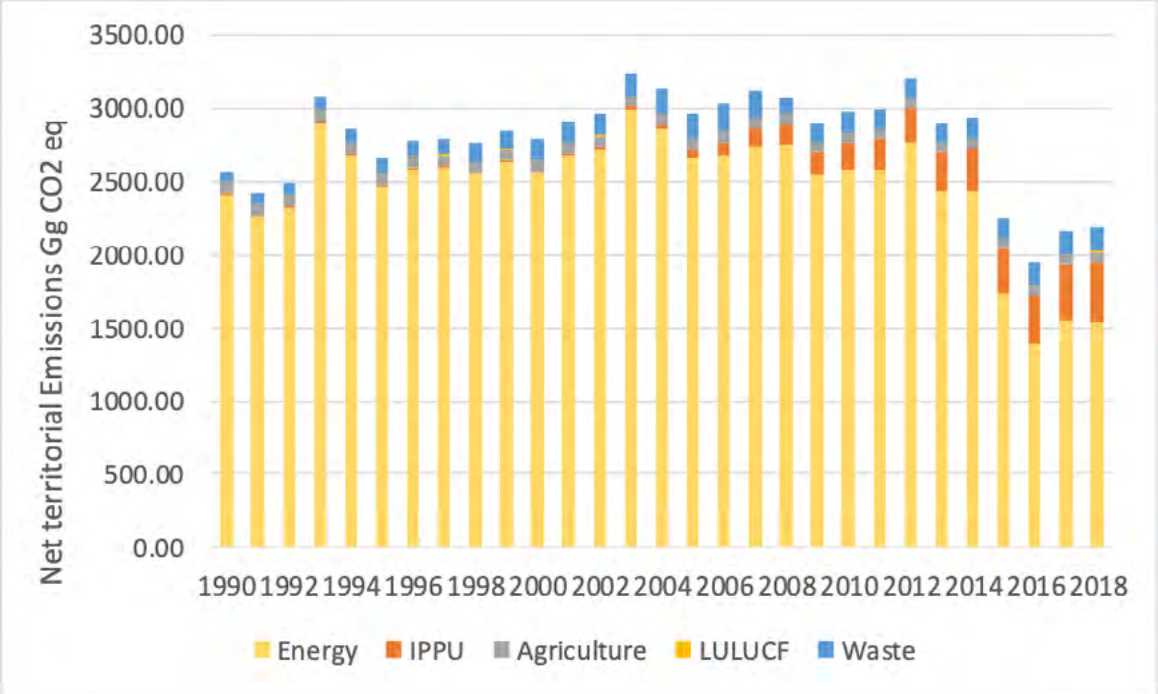



*Figure 1: Historic Net Territorial GHGEs by Inventory Sector (Source: Malta Resources Authority (2020), National Inventory)*

3 Updated from -40% through EU Council Conclusions in December 2020 (https://www.consilium.europa.eu/media/47296/1011-12-20-euco-conclusions-en.pdf)

4 Carbon neutrality refers to the state of achieving net zero carbon emissions (i.e. all carbon emissions are offset by carbon removal technologies and/ or renewable energy); carbon negative is a state where offsetting exceeds carbon emissions; net zero refers to zero carbon dioxide emissions.

5 The Climate Action Act was published as Chapter 543 of the Laws of Malta in 2015 and is Malta's main law on climate change. This enabling Act specifies that it aims to contribute to the mitigation of CC by limiting anthropogenic emissions of GHGs and to protect and enhance greenhouse gas sinks and reservoirs.

The recent public announcements that the island of Gozo can become carbon neutral before Malta's 2050 target confirm government's commitment. Government also welcomes the local private sector's efforts to follow in these steps, with various local companies having already announced plans towards carbon neutrality.

Over the past years, Malta has already been seeing a reduction in carbon emissions, especially due to the shift of power generation using gas rather than heavy fuel oil (Figure 1).

This trajectory is still not enough for Malta to reach its 2030 targets under the ESR and will not be conducive to the EU's new goal of climate neutrality by 2050. For this reason, this LCDS outlines a feasible set of measures in seven different sectors, namely: **Energy, Transport, Buildings, Industry, Waste, Water and Agriculture and land-use, land-use change and forestry (LULUCF)**, aimed to achieve target reductions in GHG emissions by 2050 and also enabling Malta to reach its ESR targets by 2030, as indicated in Figure 2 and Figure 3.

The measures leading to such abatement have been short-listed from a long list of possible measures derived through research and stakeholder discussions. The LCDS operates on a four-year policy cycle as mandated in the amended Climate Action Act – which will provide further opportunities to update such measures as new information becomes available, and as technologies (and their costs) develop.

This Strategy also assesses the social and economic impacts of each measure (a separate Strategic Environmental Assessment has also been commissioned by the Ministry). The impact assessment outlines the potential effects of the individual and sectoral measures on different players in the economy, to make sure that any negative effects are managed, and positive impacts materialise.

Additionally, this Strategy also includes adaptation measures, proposing initiatives which will help the country be resilient in the face of CC impacts which are already hitting our islands. The adaptation measures aim to address the specific risks and vulnerabilities which Malta faces given its nature as a small island state and given its Mediterranean climate.

This LCDS therefore brings together Malta's efforts in combatting CC and its effects, both through mitigation measures which will decrease the future emissions of our activities, as well as through adaptation measures, which will prepare our islands to be resilient in the face of increased risks and effects.

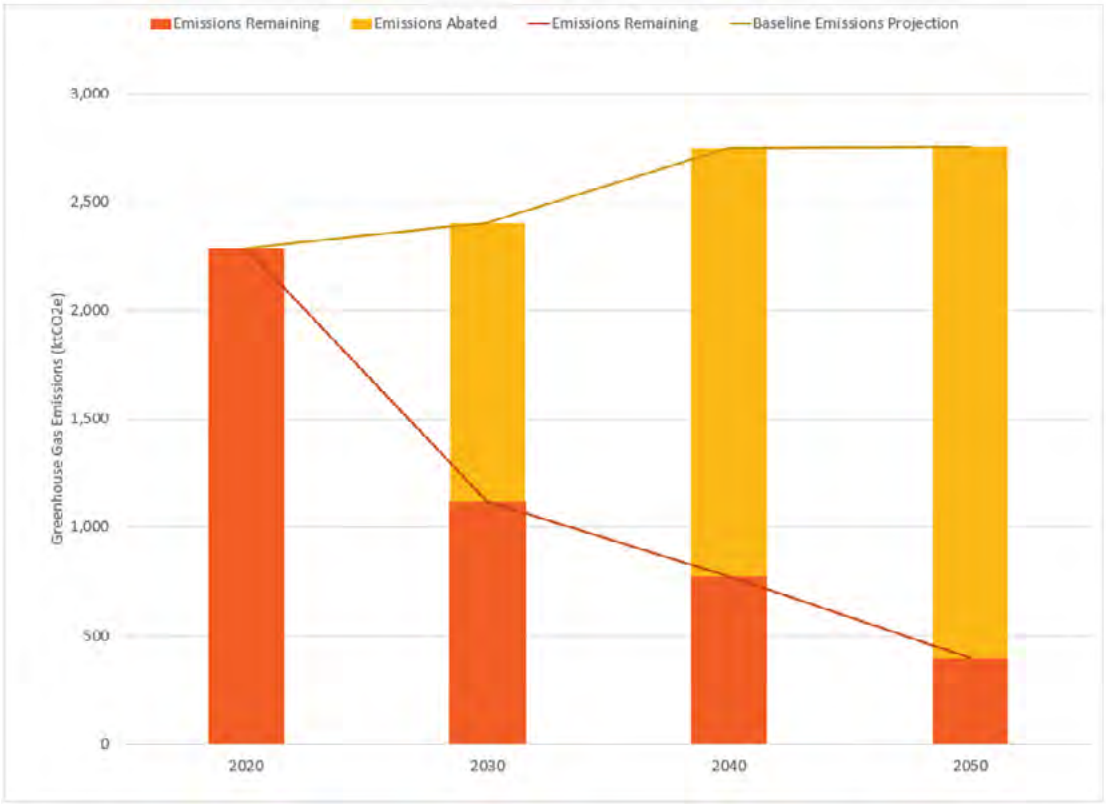



*Figure 2: Total GHG Emission Reductions*

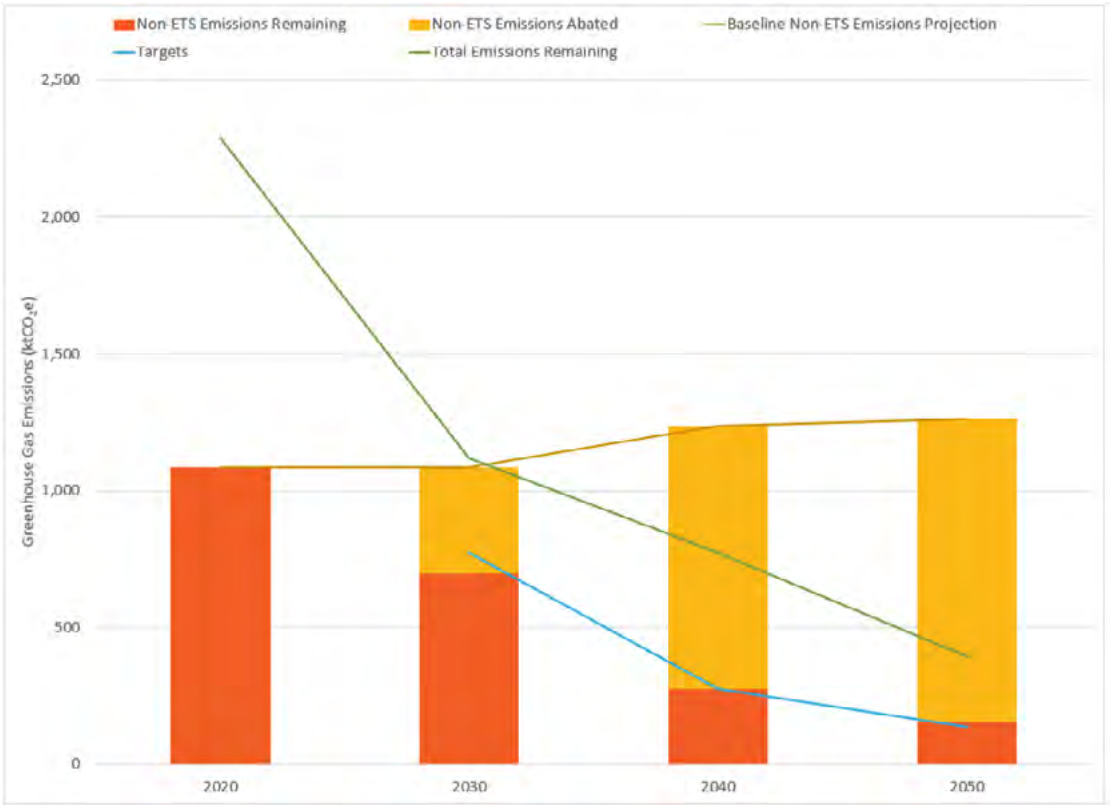



*Figure 3: GHG Emission Reductions – Contribution under ESR vs Target / Proposed Targets*

# 1

# Overview And Process For Developing Strategies

### 1.1. Introduction

Climate change (CC) is real and happening globally. Mitigation through lower carbon emissions is a must for the world if we are to stall this intense destructive pattern; however, the reduction in greenhouse gas (GHG) emissions will not happen organically. These climate forcers are pressuring planetary boundaries through the seven main GHG as outlined in the Kyoto Protocol[6], namely: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and other industrial (fluorinated) gases as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$), and nitrogen trifluoride ($NF_3$). Also, as GHG emissions lead to higher temperature intensity, some increased air pollution results via increased smog, rise in mold, and more pollen (which are intensified via rising global temperatures). Hence, though this Strategy focuses only on GHG emissions, their reduction might have benefits for reduction of other air pollutants[7].

Carbon emissions need to be reduced and eventually netted, via extensive globally committed and concerted actions that are put together and translated into realistic and implementable plans, whilst still allowing for economic development to be maintained, and countries and citizens to continue thriving. Malta is no exception in terms of actions that needs to be taken and is hereby presenting its Low Carbon Development Strategy (LCDS or "Strategy") which sets a direction for the years to come, mapping a trajectory of how the country aims to reduce its GHG emissions and contribute to CC mitigation. The LCDS is being spearheaded by the Ministry for the Environment, Climate Change and Planning (MECP) and is the result of a three-year process initiated by Government and the MECP, whereby mitigation measures have been researched and short-listed, possible abatement levels quantified through Marginal Abatement Cost Curve (MACC) modelling (i.e. the ratio of abatement potential against incremental cost of measure), and stakeholders consulted, leading to a list of realistic and cost-effective measures which are to be implemented in the years to come.

The Strategy aims to move towards climate neutrality by 2050 in line with Malta's contribution to EU-wide goals. Carbon neutrality is also one of Malta's pillars for economic growth and recovery from the COVID-19 pandemic. This three-year process was initiated in 2018 and its output and considerations have been inevitably impacted by the COVID-19 pandemic which hit Malta as from March 2020. Within this context, this Strategy seeks to align economic development with measures that reduce and offset GHG emissions through interim targets for 2030. Longer-term targets can only be achieved as smaller interim goals are obtained. It acts as a direct response to several international and national legal vehicles which require different nation states, including Malta, to act and be ambitious on CC, decrease carbon emissions and address vulnerabilities.

This Strategy lays out a number of proposed measures, spanning over seven sectors, namely: **Energy, Transport, Buildings, Industry, Waste, Water and Agriculture and land-use, land-use change and forestry**

6 United Nations (1998). Kyoto Protocol, Annex A

7 The European Environment Agency (2020) Air quality in Europe Report refers to the following air pollutants: particulate matter (PM), black carbon (BC), sulphur oxides (SOX), nitrogen oxides (NOX), ammonia (NH3), carbon monoxide (CO), methane (CH4), non-methane volatile organic compounds (NMVOCs), and certain metals and polycyclic aromatic hydrocarbons (PAHs). This LCDS focuses on GHG emissions only, while the Malta Environmental & Resources Authority's (ERA) National Air Pollution Control Programme (2019) covers NOx, sulphur dioxide (SO2), NMVOCs, NH3, and fine PM (PM2.5).

**(LULUCF)**. These measures represent steps that must be taken in order to achieve the necessary goals, in the said timeframes. The measures chosen have been primarily analysed using MACC modelling, to ensure cost effectiveness and a balance between carbon abatement and economic cost. Social and environmental impact assessments of these measures have also been carried out.

The Strategy will not be implemented in a vacuum, and is underprinned by the geophysical and economic context of the Maltese islands. This in itself makes it very unique when compared to any other LCDS, since some of the characteristics of the islands limit the type of measures which can be recommended in order to reduce carbon emissions.

- Firstly, Malta is physically separated from mainland Europe; this insularity means that connections with Europe are only possible via air or sea. While both aviation and marine emissions fall outside the scope of the LCDS (due to their international footprint), domestic navigation emissions fall within the scope of the targets addressed in this LCDS However, transport measures linked to other countries are not included in the Strategy, unlike for other countries who target emissions resulting from trains, buses or private vehicles moving across borders.
- Secondly, due to Malta's small size and related economies of scale issues, as well as its very limited natural resources, it is greatly dependent on imports, whose emissions are accounted for in the country of origin (in line with the methodology used to account for GHG inventories). Small size also leads to cost diseconomies, as certain technologies require a high-level minimum efficient scale which a country like Malta might not be able to attain. These cost considerations also affect the adoption of new technologies at an early stage; however, Malta remains best placed to act as a test bed for new technologies, in partnership with larger countries/ private partners, and emerging carbon technologies (carbontech) are one such opportunity for Malta.
- Thirdly, our limited land availability limits the possibility of woodlands which could be used for natural carbon sequestration, whilst also limiting certain mitigation measures such as the deployment of large renewable energy batteries or extensive onshore renewable 'farms' which would require large land areas.
- Fourthly, Malta is also characterised by very hot summers and mild winters, hence heating is only used for relatively short periods in Maltese buildings, meaning that lower emission reductions can be obtained from this sector compared to other colder countries. The key economic areas are mostly service oriented or low carbon intense manufacturing, which also limit the carbon reductions possibilities from this end.

These characteristics make Malta one of the lowest emitters of GHGs per capita and per unit GDP in Europe but also points towards the fact that many of the low lying fruits which can easily be tapped into by other larger, more carbon intense countries, are not present in Malta. These limitations mean that benefits and carbon savings from the measures hereby proposed might take longer than other measures implemented in other counterpart countries, or are marginally costlier. Moreover, Malta's size does not allow it to be a technology enabler but rather an adopter, such that any carbon saving technologies might take longer to be adopted locally. Malta understands that its effort will only contribute a very small (in absolute terms) part to

the required global effort, with all other countries having to carry reductions to their footprint according to their common but differentiated responsabilities and respective capabilities.

Malta could act as a test bed to pilot carbon efforts and new technologies (carbontech). The recent public announcements that the island of Gozo can become carbon neutral before Malta's 2050 target confirm government's vision in this area. Government also welcomes the local private sector's efforts to follow in these steps, with various local companies having already announced plans towards carbon neutrality, and more to follow in the coming months.

CC is already happening, and any measures taken now will only reduce and/ or postpone future negative impacts, but are unlikely to completely eliminate them given the global damage done to date. Negative impacts and risks are already occurring and impacting our daily lives and environment. For this reason, it is important that countries also adopt adaptive measures to reduce these impacts. Malta is thus presenting a set of adaptation measures as part of this LCDS, to make sure that the country remains responsive and resilient in the face of environmental changes brought about by CC.

### 1.2. Legal and policy context

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the 2015 Paris Climate Agreement, Malta has international commitments towards action on CC, and as a Member State of the European Union, Malta contributes to the EU's Nationally Determined Contribution. In order to fulfil this Malta is bound by EU legally binding targets. Malta also adopted its Climate Action Act (2015) and a Climate Emergency Resolution (2019) which provide nationally binding legal obligations for coherent and coordinated governance to deal with the climate crisis.

The Paris Agreement is the first-ever universal, legally binding global CC agreement. It sets out a global framework to avoid dangerous CC by limiting global heating to well below 2°C and to actively pursue the ambition to limit the increase to below 1.5 degrees Celsius. It does this by planning for low carbon development, increasing resilience and ability to adapt, improving ability to live with the adverse impacts of CC, and by making financial flows consistent with resilient and low carbon development trajectories. A requirement of the Paris Agreement is that all parties to the Agreement must prepare and communicate their Nationally Determined Contributions to the global effort to reduce GHG emissions.

In line with this, the EU has a long-term strategy to achieve climate neutrality by 2050, under which each Member State is required to plan and communicate an LCDS up to 2050. This document is Malta's LCDS, and has been prepared in line with the process outlined in the Regulation on the governance of the energy union and climate action (EU/2018/1999)[8]. Aligning with the EU's long-term strategy, the LCDS is consistent with Malta's National Energy & Climate Plan (NECP - 2020), which aims to ensure the achievement of the

8 Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action.

EU's 2030 objectives and targets in line with the Paris Agreement commitments. The LCDS and Long Term Renovation Strategy (LTRS - 2021) are also aligned; the LTRS supports the renovation of the national building stock into a highly energy efficient and decarbonised building stock by 2050 and is in line with the EU Energy Performance of Buildings Directive. The LCDS is also aligned with other strategies or policies in place or which are currently being finalised, including: the Green Public Procurement Action Plan, the National Strategy for the Environment, the National Biodiversity Strategy Action Plan to 2030, the National Post-Pandemic Strategy, and Malta's Economic Vision for 2021-2031. In particular, the National Biodiversity Action Plan to 2030 contains targets and measures on the management and protection of ecosystems and biodiversity, which in turn would lead to the achievement of long-term strategic goals for carbon neutrality and climate adaptation and mitigation through the protection of natural carbon sinks, the restoration of habitats, the implementation of nature-based solutions and green infrastructure, amongst others.

Recently, the EU has further reaffirmed its commitment to decarbonisation with the launch of the European Green Deal - a new growth strategy for the EU that commits to no net emissions of GHG by 2050, endorsing the Commission's ambition to make Europe the first climate neutral continent by 2050. The Green Deal aims to set a pathway to net neutrality and to establish legislation and funding that provides the confidence that business, investors, workers and consumers require for strategic long-term change.

Within the EU, the headline target (previously set at -40%) has been increased to a 55% reduction by 2030 (over 1990 levels), while the long-term objective of climate neutrality by 2050 has also been adopted. EU negotiations in 2018 resulted in legislation relating to the Effort Sharing Regulation (ESR) that has led to Malta's bespoke targets. The ESR targets relate to emissions not covered by the scope of the EU Emissions Trading Scheme (ETS) emissions. For Malta, the target is to achieve a 19% reduction in net territorial non-ETS GHGEs (relative to 2005) by 2030.

In 2021, the European commission issued the Fit for 55 Package which is linked with the European Green Deal and outlines a list of proposals that aim to achieve the EU's target in terms of climate action by 2030 including those referring to energy efficiency and renewables.

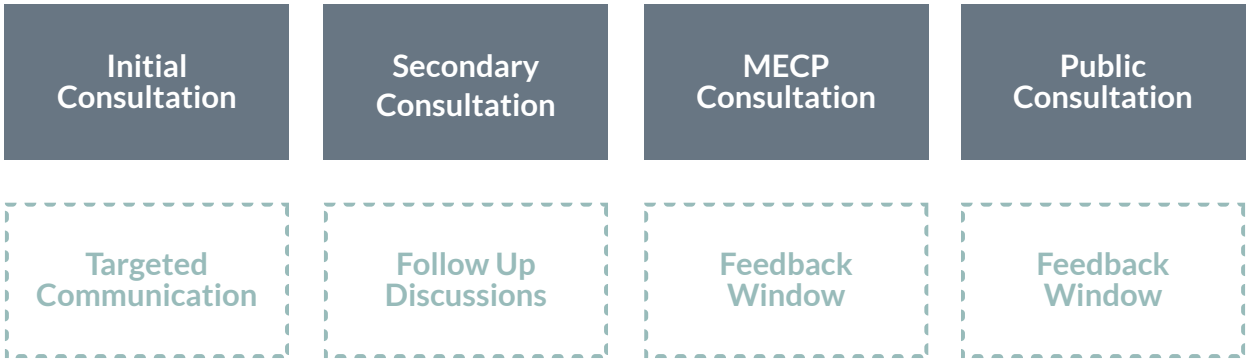
Malta has recently taken a further step in strengthening its commitment to a sustainable, low-carbon future, with government's announcement that carbon neutrality will be one of the main pillars of government economic policy. As mentioned above, Malta's Climate Act enshrines the above international requirements into national law, and alongside other key planning and policy documents, this LCDS plays a key part in delivering on these requirements.

### 1.3. Public consultation and stakeholder engagement

Given the cross-cutting nature of the Strategy both in terms of mitigation and adaptation measures, an extensive stakeholder engagement exercise was undertaken throughout the LCDS process. This consultation process was important on various grounds. Firstly, it enabled the input of professionals working in their specific field, therefore ensuring that any measures put forward were realistic and feasible from a sectoral perspective. Secondly, it enabled the collection of data which might not have been publicly available, hence allowing for better quantification. Finally, the inclusion of various stakeholders, including experts and entities/ agencies, ensures that the Strategy is developed through a bottom-up approach. This should help in

securing a high degree of ownership across the community and implementation buy-in.

The consultation process was made up of the following steps:




Upon inception of the project, a number of 'key' stakeholders were identified for a first wave of consultation. Initial stakeholders involved in the phase of identification and quantification of the measures included Ministries, government entities, agencies and authorities. A list of stakeholders consulted is presented in Annex 6.1 to this report. These meetings were set up to discuss a long list of mitigation measures relevant to each entity. The meetings were carried out between August 2018 and January 2019, with stakeholders provided preliminary feedback as well as additional data when available. Most of the initial consultations were carried out through face-to-face meetings, with feedback and other follow ups carried out lasting up to June 2019.

In the period between February and August 2019, a fresh consultation process was carried out to collect further insights from other stakeholders. Starting from August 2019, a number of consultation sessions were carried out on adaptation measures.

This process allowed for the selection of the most viable, feasible and cost-effective measures to be chosen at that point in time, thus moving from a long list to a more concentrated short list. Following the collection of feedback from these two rounds of consultation, the measures started being modelled and the LCDS drafted. During January and February 2020, the Ministry undertook further consultations with stakeholders, allowing for further feedback and discussions to be included in the draft.

During May 2020, the preliminary mitigation and adaptation measures were presented to the Climate Action Board. The finalised short-list of measures was then presented to a number of stakeholder groups, so as to have their preliminary views prior to this public consultation process. These included separate meetings with representatives of the regional committees and local councils, a selection of academics, business representatives from the Chamber of Commerce and from the Chamber of SMEs (transport section), as well as various members of civil society.

A public consultation document was then shared in June 2021 to allow all interested stakeholders and the general public to provide feedback on its contents. Feedback was submitted till August 2021, followed by an analysis of such feedback and the finalisation of this LCDS.

Transitioning to a low carbon (and eventually carbon neutral) economy and society will require effort and a change in behaviour from all – government, employers, employees, civil society and citizens. It is only through a collective effort that we can aim to achieve these ambitions.

### 1.4. Other Considerations

The Strategy has been developed based on the information available at the time of undertaking the analysis. The Strategy will inevitably be impacted by a range of future policy decisions taken across the EU and government - information on these potential future changes is necessarily incomplete. This includes European policy as well as decisions being developed within each of the sectors considered within the analysis.

As far as possible, impacts are considered for Malta, but data was not always available for the specific Maltese situation (i.e. measures not having been previously considered and researched locally; measure being looked into, but considered too early in the stage to use for policy setting). As a result, the analysis behind some of the measures is based on data from a range of other (mostly European) countries. Work is currently ongoing in many areas to increase local knowledge. Information on the performance of future technologies is also incomplete - it is highly challenging to consider how technology will evolve over a future 30-year period. Nonetheless, it is to be underlined that the Strategy is to be updated on a four-year cycle as per the Climate Action Act, and hence technological evolutions will be taken in consideration with each update.

Another key consideration is that the LCDS is a complex and lengthy process that was initiated in 2018, with various stakeholder consultations and modelling done over 2018-2019. In this regard, the baseline and measures are based on a pre-COVID scenario. Emission reduction targets set by the EU are also based on pre-COVID years. There is considerable uncertainty on the possible medium-to-long term repercussions of the COVID pandemic, including on baseline changes, impact on measures and impact on the country's fiscal flexibility.

The MACC modelling is also a complex scientific-based process, in that one needs to build a model that provides an approximation of real life. In this regard, with all the uncertainties and unknowns, such approximation is subject to various assumptions. Additionally, feedback loops, tipping points and ecosystem impacts could not be considered in this first version of a local MACC model.

Finally, a number of assumptions are inherent in the modelling underlying this LCDS, given the very nature of long-term projections being considered here (i.e. till 2050). Various other developments in the coming years could impact (negatively or positively) the achievement of this LCDS. In this regard, as noted, the LCDS operates on a four-year policy cycle which will provide further opportunities to update with additional data as it becomes available in some of the faster moving areas, and as new situations emerge, including in a post-pandemic world.

# 2

# Abatement Of Greenhouse Gases

This section presents the mitigation measures, as short listed through the discussions with stakeholders and as modelled through the MACC approach. This section first provides context on Malta's GHG emissions baseline, explains the overarching themes for this Strategy, and presents the key policy initiatives. Given its key role, energy demand (including consumption), energy requirements, and the role of renewable energy are presented, before delving into the LCDS sectors. These include the energy system (with some of the initiatives already explained in the sub-section on energy demand), transport, buildings, industry, waste, water and LULUCF.

### 2.1. Total GHG Emission reductions and enhancement of removals by sinks

The recent focus of energy and climate policy in Malta has been to move away from reliance on high carbon fuel oil electricity generation and to increase the efficiency in power generation. This has had a positive impact on territorial emissions, with overall emissions reducing significantly from 2014. Historic GHG emissions by inventory sector are shown below in Figure 4.

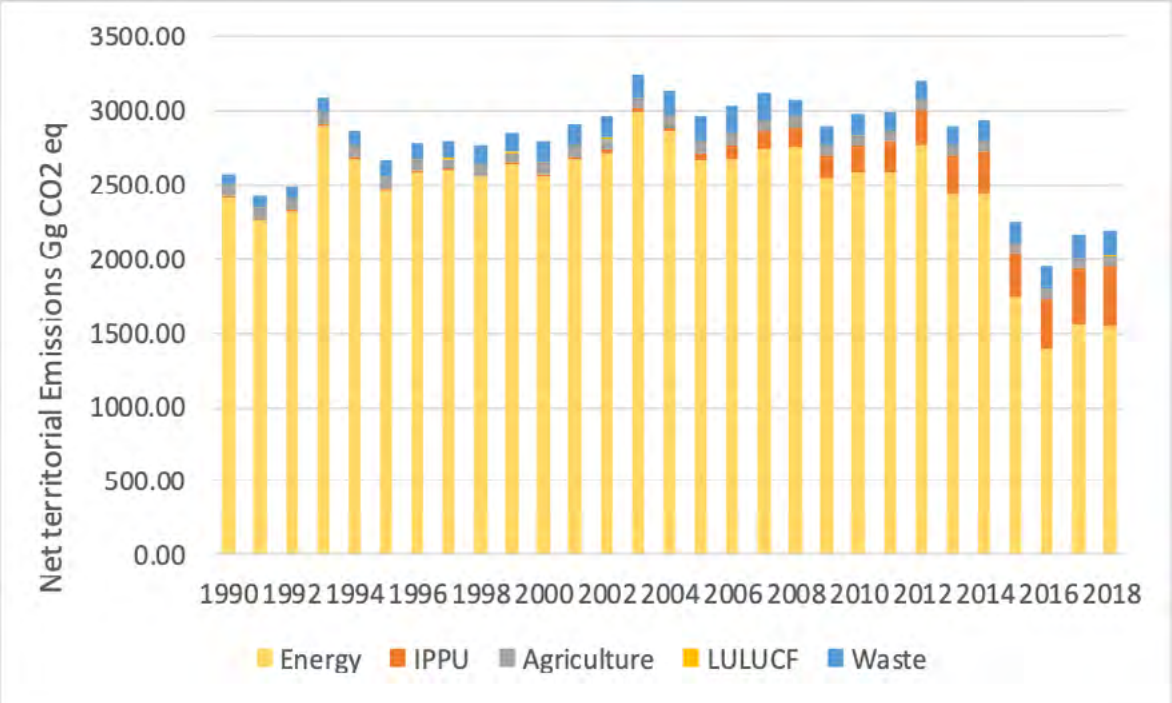
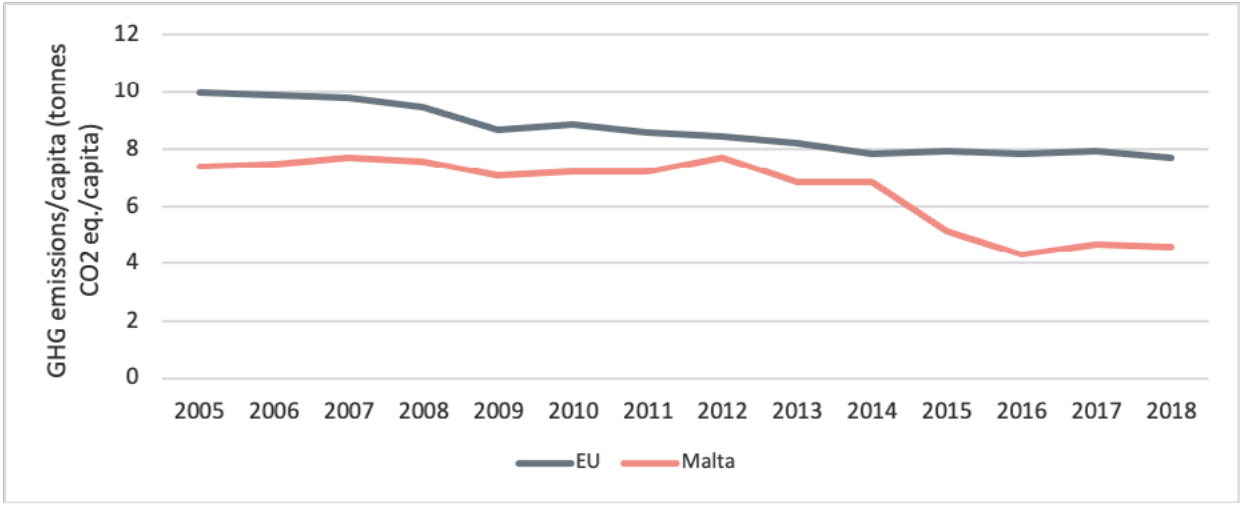



*Figure 4: Historic Net Territorial GHGEs by Inventory Sector (Source: Malta Resources Authority (2020), National Inventory)*

GHG emissions per capita and GHG emissions per unit of GDP (the latter showing the carbon intensity of an economy) have also been decreasing in the local context, as shown below in Figure 5. Malta also stands below the EU average in terms of GHG emissions per capita.



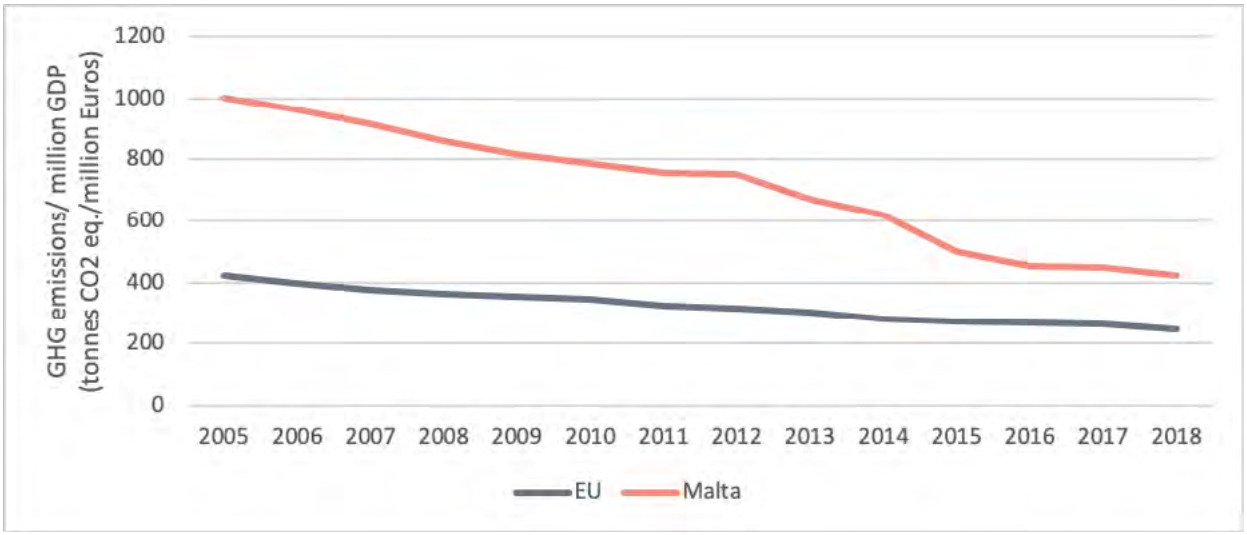




*Figure 5: GHG emissions per capita and GHG intensity – MT vs EU (Source: Eurostat)*

However, further GHG reductions are necessary to not only meet the 2030 targets under the ESR, but also to align Malta's de-carbonisation trajectory with that adopted by the EU – that is, climate neutrality by 2050. Some of the challenges of Malta achieving such a trajectory are set out below in Section 2.2. Nevertheless, this LCDS clearly sets out a feasible and attainable set of measures, designed with Malta's specificities in mind, that achieve significant reductions in GHG emissions by 2050, as well as meeting the current ESR target in 2030. The anticipated GHG emission reductions from the LCDS are presented in Figure 6 and Figure 7 below. 2020 emissions have been modelled on the basis of the 2018 level, whilst being projected to decrease significantly out to 2050.

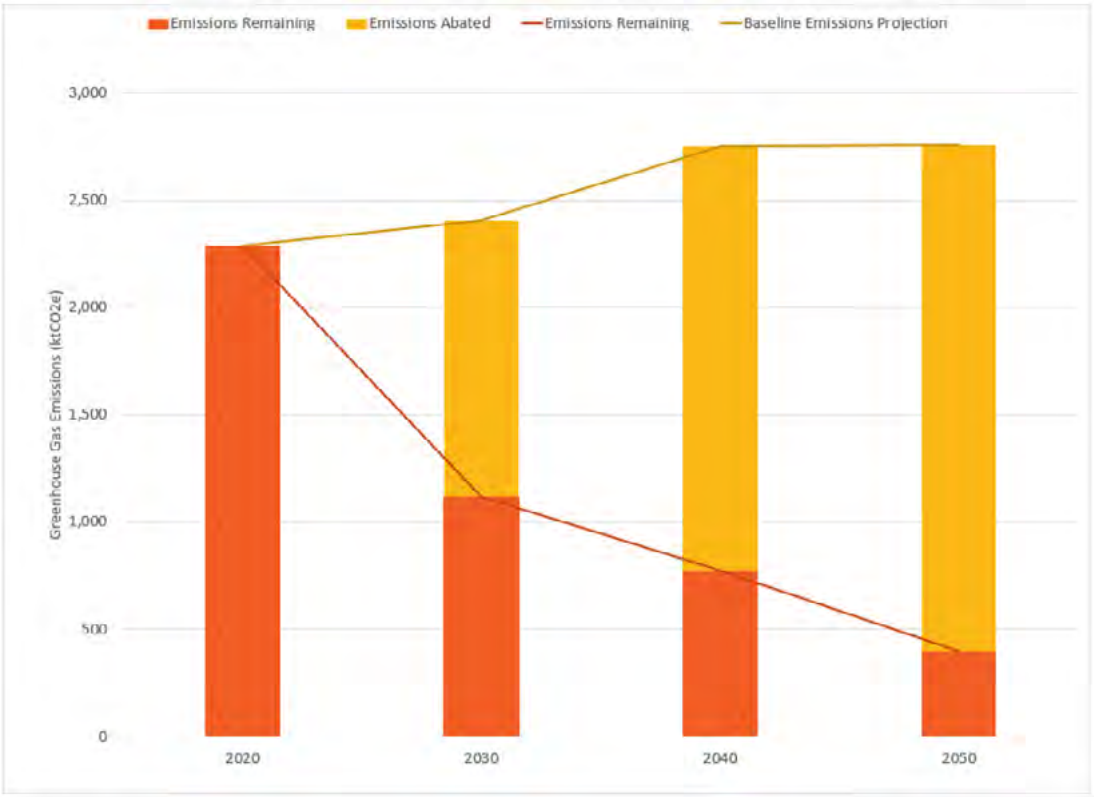



*Figure 6: Total GHG Emission Reductions*

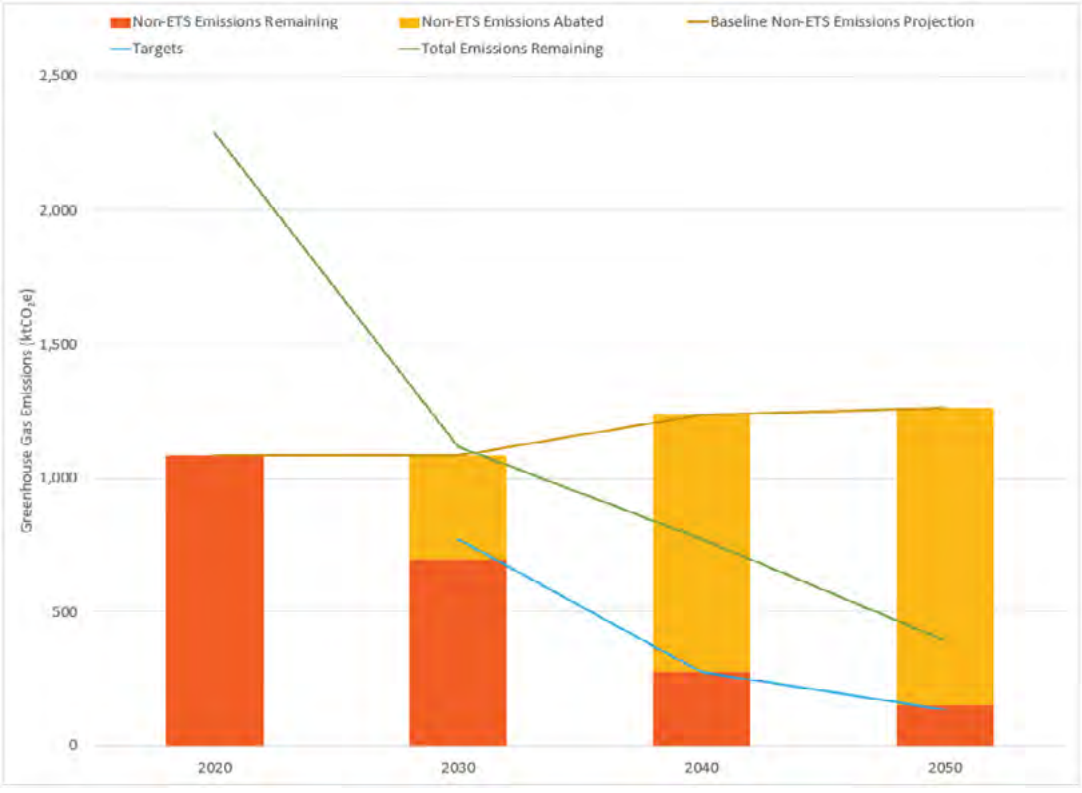



*Figure 7: GHG Emission Reductions – Contribution under ESR vs Target / Proposed Targets*

The national target under the ESR in 2030 is currently set at 826,687 tonnes $CO_2$e (reflecting a 19% reduction in emissions over 2005 levels), and the measures and set of initiatives have been designed to meet this target. Indicative milestones in 2040 and 2050 reflect 60% and 80% reductions over 1990 levels respectively.

The breakdown of the emissions by sector are shown below in Figure 8. Note that this represents the breakdown by sector where the emissions are generated, and not where the upstream actions may occur. Hence, for instance, electrical efficiency measures (e.g. buildings, industry and water) are accounted for under the energy sector where emissions from electricity supply are accounted for.

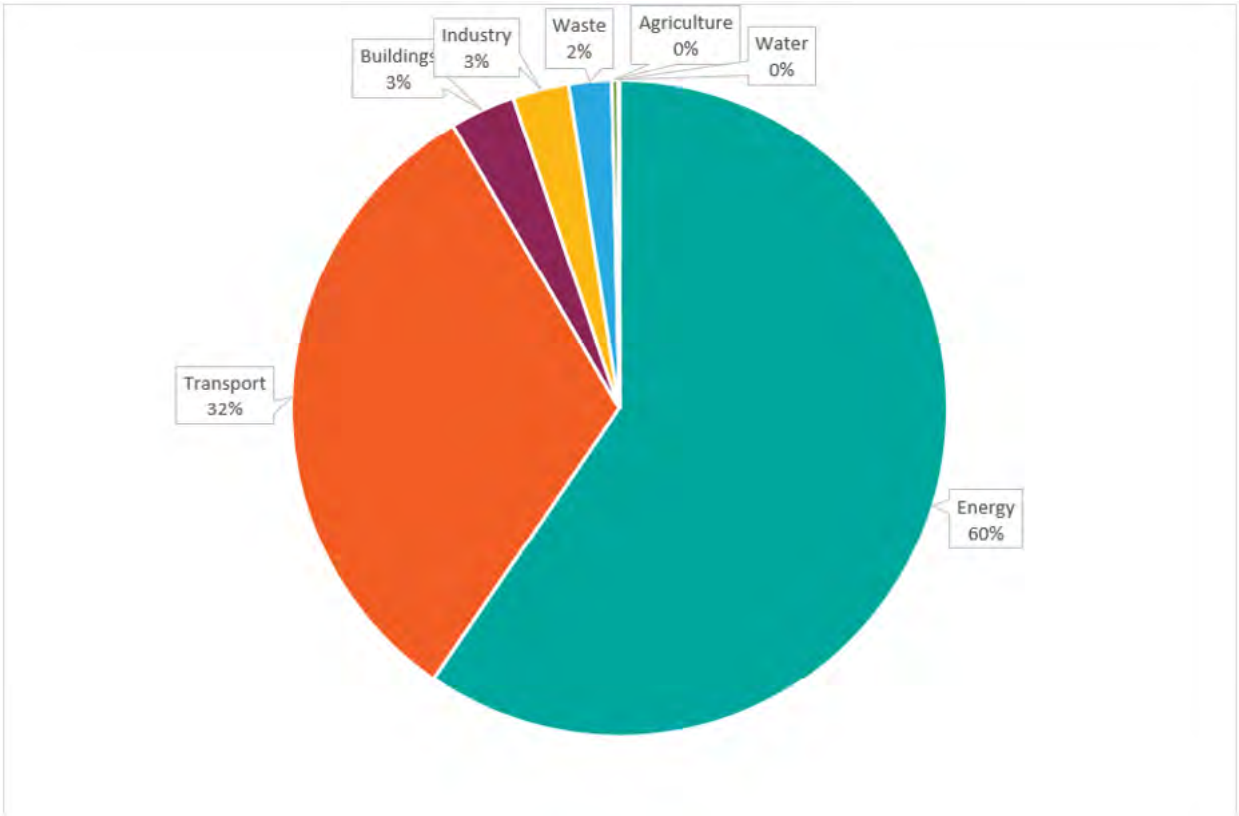



*Figure 8: Share of Abatement Potential in 2050*

The sectoral breakdown is further detailed through the Marginal Abatement Cost Curves (MACCs) that were developed to support the assessment of measures under the LCDS. These MACC figures are shown in Figure 9 and Figure 10. In 2030 the energy efficiency (EE) related measures feature more prominently as the carbon intensity of the grid is still predominantly based upon gas. However, by 2050, when the carbon intensity is minimised, GHG savings from electrical EE measures are significantly reduced.

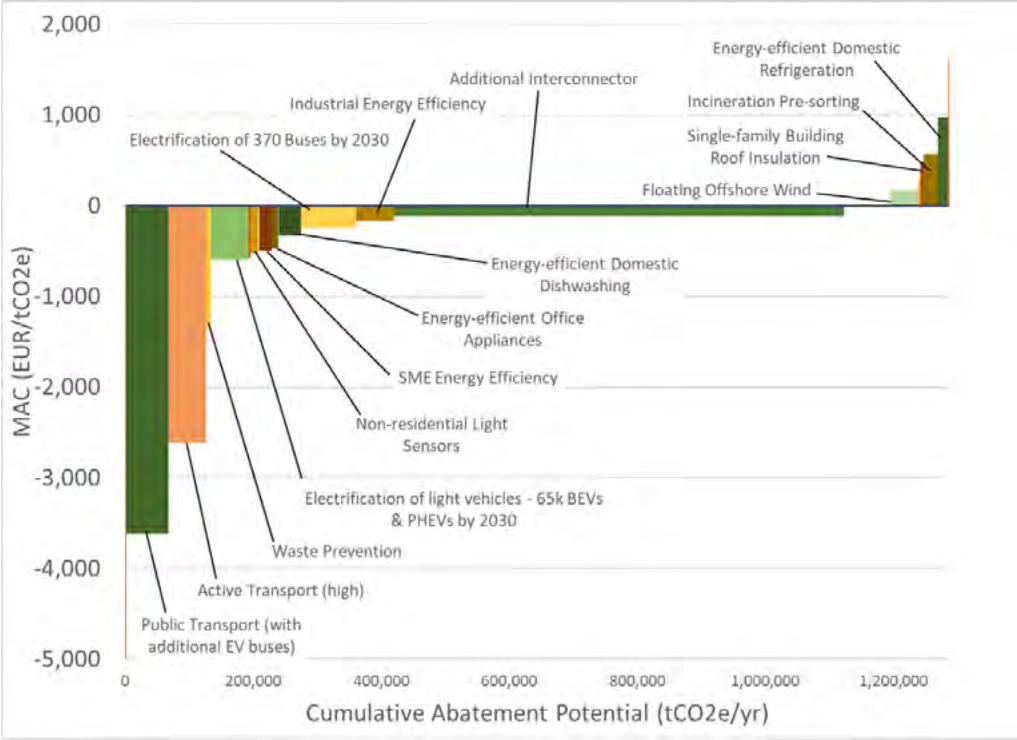



*Figure 9: Marginal Abatement Cost Curve in 2030*

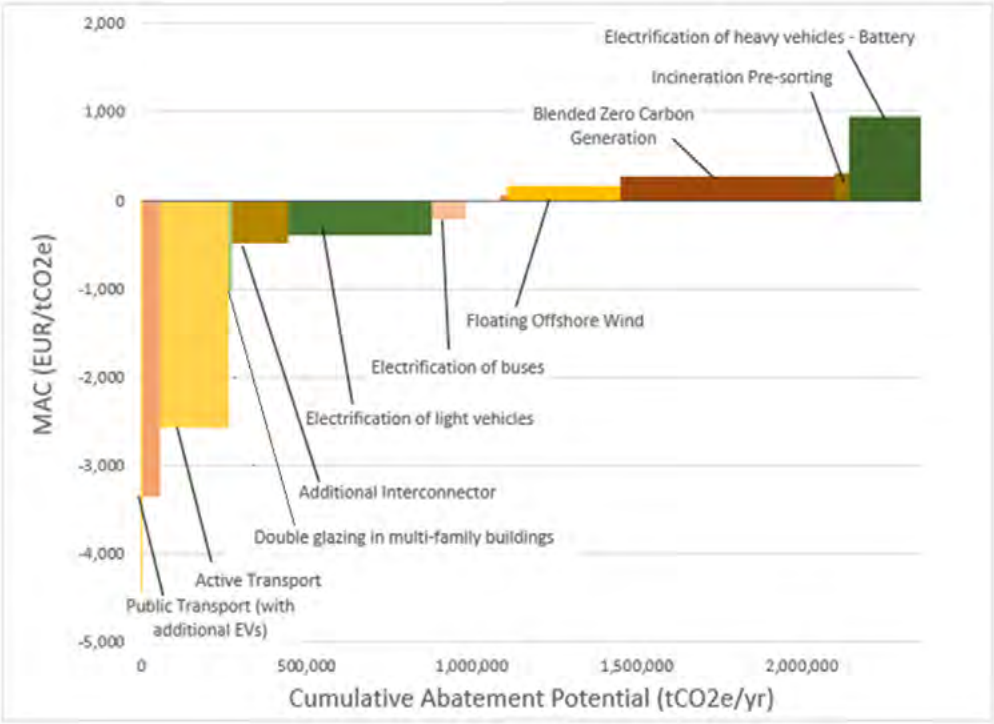



*Figure 10: Marginal Abatement Cost Curve in 2050*

Therefore, the number of key measures falls, and so the overall emissions savings are narrowed to either those in the transport sector or those which provide alternative low carbon sources of electricity.

Carbon sinks or removals are currently very limited in Malta. The potential for afforestation is low due to the limited land size, the nature of the climate and topography, and pressure on land use vis-à-vis farming and other uses. However, this does not limit the value that such efforts do provide in terms of adaptation. See Section 2.6.7.1 for more details.

### 2.2. Overarching themes for the Strategy

The ambition of the policies and measures set out in this LCDS are targeted at meeting our EU 2030 and 2050 targets and align with those already set out in the NECP. The challenges that Malta faces in reducing its CC emissions outlined in its NECP remain present and relevant for this LCDS. These include:

- the specific characteristics of Malta's energy system and market, such as its small nature, the existence of a single electricity distributor/supplier, the absence of natural gas and district heating and cooling networks, and the small size and number of suppliers and market players – which, taken together, limit the range of measures available to meet energy savings obligations;
- marked growth in pre-Covid population and GDP, which at the time made it difficult to restrain energy consumption. Similar to the LCDS, analysis undertaken on the NECP was mostly undertaken pre-COVID;
- its specific geographic, environmental and spatial constraints (limited land area and high population density) together with its rich but fragile natural environment and climatic conditions, which lead it to not having an array of options for modal shifts to reduce carbon emissions, whilst diseconomies of scale also hinder resorting to alternative technologies;
- its limited mitigation potential, arising from Malta's service-based economy, specifically in the transport and agricultural sectors as well as the legacy effect in solid waste disposal, have resultant high mitigation costs coupled with significant socio-economic considerations. A thriving economy that would have partially decoupled GDP from emissions would still have residual level-off coupling, which in turn drives up emissions.

In addition, Malta has only just developed its LNG power plant which will continue to run throughout the duration of the NECP, and which will make the achievement of the deeper level of emissions reductions required for the latter part of the LCDS more challenging to deliver (due to lack of potential to reduce even further).

Alongside this, the NECP notes that "temperate climatic conditions and lack of energy-intensive industries mean that Malta has the second lowest final energy consumption per capita across all EU Member States." At the same time, technological advances may result in additional opportunities for Malta to reduce its emissions becoming available in the period 2031-2050, which are not explored in the NECP.

The sectoral policies set out in subsequent chapters will exist within a framework of European policy which

is similarly aimed at reducing carbon emissions. This includes the EU-ETS – phase 4 of which will continue through the duration of the NECP. Beyond this, the future of the ETS and the general structure of the policy framework is under review and therefore, the LCDS builds upon the NECP adopted by Malta in 2019, thus using this policy scenario as a baseline for additional measures that further enhance decarbonisation.

### 2.3. Overview of key policy initiatives

The timeline below summarises the key policy initiatives of the LCDS. It is broken down by each 10-year period out to 2050, and those initiatives that are a higher priority – with regards to the potential for abating GHG emissions – are positioned towards the top of the diagram, with the lower priority ones towards the bottom. These key policy initiatives are described further in Section 2.6.

The positions on the timeline broadly reflect when the first concerted efforts relating to the initiative are expected. For many initiatives, sustained effort and action will be required over much of the period out to 2050 to ensure they are implemented effectively, and the necessary outcomes are achieved over the timeframe. The initiatives that are highlighted in green are those that primarily help meet the targets under the ESR (i.e. non-ETS related emissions).

The proposed projects may be reviewed in terms of capacity, nature and timelines following more detailed studies carried out by the competent Ministry. Additionally, plans for the power sector will ensure that, apart from guaranteeing security of supply and affordable prices, they fulfil the planned reduction in GHG emissions outlined in the LCDS.

Furthermore, the LCDS is a long-term strategy that will extend up to 2050. Whilst modelling has been based on existing technologies and studies, the LCDS operates on a five-year review cycle which means it will be updated to reflect new technologies, and hence updated/ new measures as these become cost-effective tools to further reduce emissions on a national level.

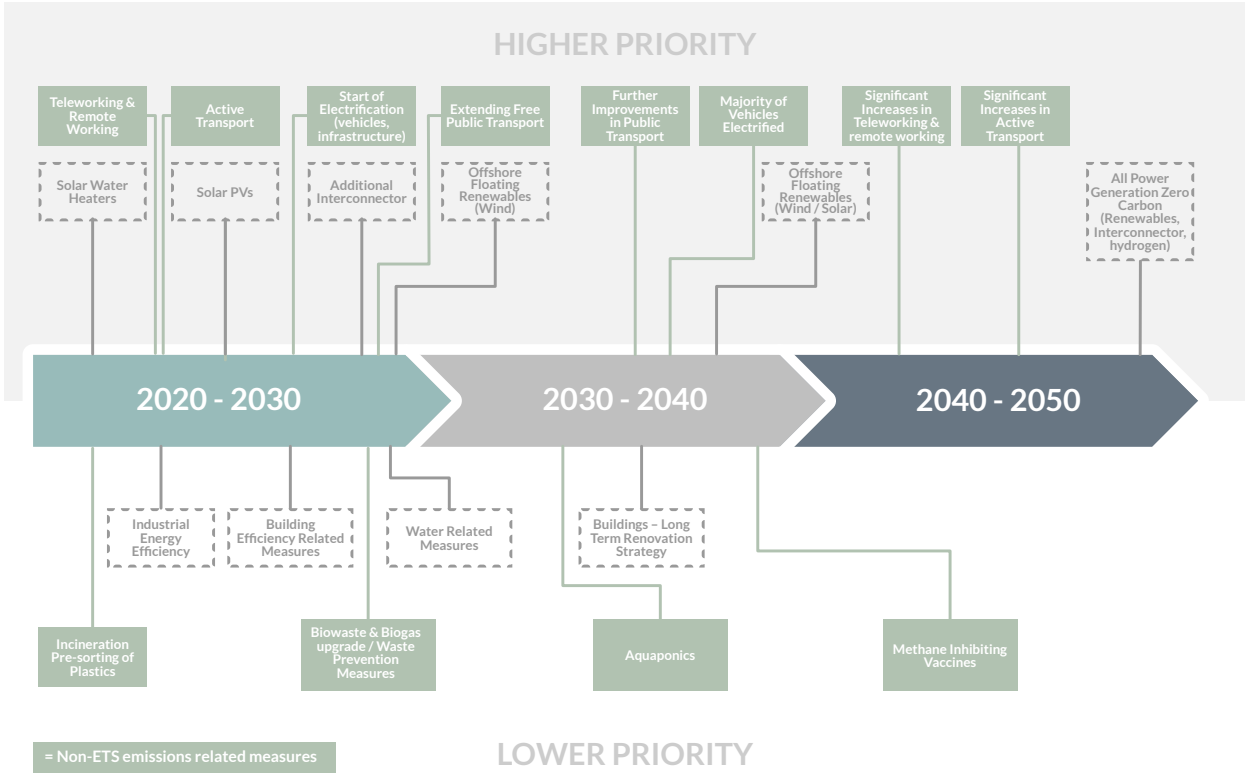



*Figure 11: Overview of key policy initiatives*

## 2.4. Energy demand

For MACC modelling purposes, a key consideration is the energy model (demand and supply) to be utilised in the baseline, and to be amended through NECP/LCDS initiatives. The estimated energy demand and supply for Malta was estimated for the period up to 2050 [9]. The approach taken for the LCDS MACC model was based on the baseline energy demand figures reported under the NECP for Malta (see Annex 6.2 for further information on the MACC methodology)[10].

### 2.4.1. Assumptions for the estimated energy consumption by 2050

Energy consumption has been based on a number of principles. The narrative below makes reference to various measures which are either explained in the NECP and/ or will be explained in this Strategy document, Section 2.6 onwards.

- An increase in renewables from 2021 to 2030 is attributed to the increase in PVs (which are expected to reach maximum capacity by 2030 due to local roof space limitations) as well as solar water heaters.

9 The estimations are based on modelling and assumptions and do not consider the matching of demand and supply in the period.

10 Since the NECP baseline projects were out to 2040 only, it was conservatively assumed that the energy demand in 2050 in the baseline was the same as the 2040 figures.

Further growth would be attributable to repowering using more efficient panels. The supply of electricity from renewables increases steadily over time, as first the roll out of solar PV continues to 2030, together with the installation of Offshore Floating Wind (OFW) turbines when feasible.

- Gas consumption increases slightly in the short term as overall electricity demand increases, in part driven by the switch to electric vehicles (EVs). However, a new electricity interconnector is planned to be constructed, heavily reducing the further use of gas for electricity generation. In practice, the Combined Cycle Gas Turbine (CCGT) plants might be utilised for grid balancing or backup in case of constraints on the use of the interconnectors.
- Oil products are mainly associated with vehicle fuels and heating. The use of these fuels decreases over time, particularly from 2030 to 2050, when there is a wholesale shift away from internal combustion engines. Some fuels may be required for some vehicles that are more challenging to switch to EVs e.g. construction, farming.
- Continued utilisation of the existing electricity interconnector, with a new interconnector being built in the near future. This would offset the reduction in gas usage by the CCGTs.
- Some energy is supplied through the energy from the waste plant; however, this is lower than in the baseline, as the removal of fossil-based plastics prior to incineration will not only reduce GHG emissions from the plant but also reduce the amount of energy supplied.
- Overall, as energy efficiency (demand reduction) measures are implemented, and the supply of energy moves to more efficient and lower carbon forms, the overall supply of energy decreases out to 2050. However, the overall supply in the form of electricity increases, again primarily because of the shift to EVs.

### 2.4.2. Total estimated energy required out to 2050

The estimated energy required is based on the following considerations:

- Around one third of the required energy is associated with transportation. Total demand falls out to 2050 as the supply of energy switches from oil-based vehicle fuels to electricity.
- Most of the remaining energy required relates to demand from buildings, of which the majority is from commercial enterprises, hospitality and the public sector. Despite some EE measures being implemented, energy demand continues to grow out to 2040, due to increased economic activity and the development of new buildings; following this, it remains stable until 2050.
- A fraction of the energy demand derives from agriculture, fisheries and forestry.
- In terms of the demand for electricity, by 2050 a further ~3,000 GWh of electricity is required to meet the requirement for powering EVS - making this the highest sectoral demand. Significant demands are still required from industry, with reduced demand from residential buildings due to household EE measures being implemented. Slight reductions in electricity demand from water efficiency measures are also likely to be realised.

## 2.5. Renewable Energy

Renewable Energy (RE) affects final energy consumption and electricity generation emissions and is hence a component in the LCDS MACC modelling. Policy-wise, it is governed by a specific national RE strategy which is aligned with the NECP and LCDS. The LCDS review process (and other structures in place within other governance frameworks) will ensure that the developments in Malta's RE strategy are fully aligned with LCDS objectives.

## 2.6. Sectors

### 2.6.1. Energy system

This sub-section provides an overview of the LCDS measures for Malta's energy system. The main measures falling under this sector, include the following:

- Before 2030, continued uptake of solar PVs, together with initiatives related to offshore PVs.
- Continued update of Solar Water Heaters (SWHs) and other renewable heating technologies, before and after 2030 (also included as part of the EE measures within the building sector).
- Continued use of the existing interconnector, and additional use of interconnectors in the future. Installation of offshore floating wind (OFW) turbines or solar when feasible.
- Use of hydrogen fuel to operate CCGT power plants.

#### 2.6.1.1. Intended or likely future emissions trajectory

It is expected that emissions from the CCGT plants will grow from 2020 to 2030 as plant utilisation increases. In this LCDS, in line with government announcements, the development of an additional electricity interconnector to Italy is being considered. The current estimation is that this would be sized at around 200 MW. This would enable the generation of electricity to be switched away from the CCGT and lead to a significant reduction of territorial emissions associated with the generation of electricity.

Some fossil fuels may still need to be supplied to Malta for heating purposes in industrial plants, manufacturing processes and welding, amongst others. These are not expected to be a significant proportion of the total emissions from the sector or for the country. No specific figures were modelled in the MACC model for these other fuels.

In terms of the abatement potential from the energy related measures, this is set out in Table 1. The package of measures also includes "Blended Zero Carbon Generation" which brings together the three methods for delivering low carbon energy for Malta by 2050, these being offshore floating wind, a third interconnector, and hydrogen power. The measure reflects the amount of remaining low carbon energy required to ensure the Maltese grid achieves zero carbon.

| Measures | Abatement Potential, tonnes $CO_2e$ / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **825,033** | **1,158,546** | **1,262,117** |

*Table 1: Energy Measures Abatement Potential*

Based on the outlined assumptions, by 2030, the most significant contributor to GHG emissions abatement is the interconnector. In addition, further installation of Solar PV and SWHs - and other renewable heating technologies - contribute to further abatement potential. As previously explained, this scenario foresees the addition of another electricity interconnector. Based on the projected price developments of the Italian electricity market, it is expected that a larger share of electricity demand is met by electricity imports over the interconnectors. This is complimented by additional RE sources such as OFWs and an expected lower loading of CCGT plants. The reduced use of the CCGT plants leads to significant reductions in GHG emissions. The modelled scenario projects ~4,000 GWh of electricity imports from the interconnector and a contribution of over 1,000 GWh electricity from renewables by 2050. To achieve RE source targets, a combined approach of grants, technology breakthroughs (in offshore marine renewables) and a solid regulatory framework, including in spatial planning, will be required.

Whilst some overall savings are projected from further installation of solar PV and SWHs, the majority of the savings are expected to arise from from the use of additional interconnectors in the long term versus CCGT. While net cost savings materialise over the long-term horizon, investment is required at the beginning of the LCDS time horizon.

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

EE and attaining EE is a key policy across the EU and globally. The transition towards greener, more sustainable and low carbon technologies will play a critical role in addressing the CC crisis. The production and consumption of energy is a key source of global emissions and thus a central target of national, regional and international policy in this regard. Putting in place targeted actions to improve the efficiency of the production and use of energy is therefore critical. Understanding, however, the energy profiles of various sectors (and thus the potential for implementing efficiencies in these sectors) will improve the efficacy of any actions. To this end, the main sectors where EE is most relevant are buildings and industry. While accounting for a small proportion of energy demand, the LCDS also takes the water sector into account.

Whilst the fuel efficiency of vehicles is also of importance, this is not straightforward for Malta to address as all vehicles are imported. It is considered that EE of vehicles would change according to wider European regulations, norms and market forces within the automotive sector.

Where buildings are concerned, there are several key drivers for EE. Firstly, the increasing population and number of buildings will drive up energy demand, making EE measures important to ensure the minimum generating capacity required is installed. Secondly, cost savings to households and businesses are important.

Also, for industry, one of the main drivers for efficiency will be cost savings. If costs can be reduced, the financial standing of the company could be increased, and/or competitiveness could be improved through producing products at a lower price.

Finally, the key driver for efficiency in the water sector is the constraints on the supply of fresh water in Malta, as de-salination plants need to be used to produce a large amount of local water needs. This efficiency is driven also through tariff mechanisms which are aimed at encouraging users to remain within the lower 'efficient water use' tariff band. Fresh water supply and aquifer management remain challenging. Any increases in the efficiency of supplying water would benefit the sector as well as reducing energy requirements, and as a result contribute to GHG emission reduction.

From a carbon abatement perspective, the most important timeframe for implementation and effect for EE initiatives is the period during which the majority of electricity is still being supplied locally using the CCGT plants (as these are powered through gas, a fossil fuel). This mode of generation makes the most significant contribution to total generation until a new interconnector is built, and further renewables (e.g. OFW) are installed. Beyond this, the carbon abatement of EE measures reduces significantly as the grid decarbonises. However, such measures are still important to ensure that the scale of necessary infrastructure is kept to the minimum necessary to meet demand. Therefore, EE measures are of particular importance in the period up to 2030. Such EE measures have been considered as a package under the Buildings sector, as described in Section 2.6.3.

Further detail on the proposed strategy and related policies for these key sectors is set out below in the respective sections.

#### 2.6.1.3. General overview of policies, existing plans and measures for decarbonisation

As mentioned above, recent energy and climate policy has focused on reducing the use of fuel oil for the generation of electricity. With the building of modern CCGT plants, GHG emissions from electricity supply in Malta have reduced significantly (see Figure 4). However, to contribute to the EU's objective of climate neutrality by 2050, all Member States will need to shift their existing fossil fuel-based energy supplies to other forms. The below explanation will firstly set out the existing policies in the NECP (which covers till 2030), and then consideration is given to the longer-term period out to 2050.

**Policy developed - National Energy and Climate Plan**

*Solar PV (terrestrial)*

- According to the NECP, the technical limitation on the roll out of solar PV will be reached by 2030 – c. 9,127 new PV systems by 2030 will enable Malta to reach the 11.5% target share of RES in gross final energy consumption (by 2030) . The NECP also points out that this technical limitation should be reviewed on a 5 yearly basis to assess further potential expansion of solar PV as technologies and/or understanding of the technical limitations evolve.

*Renewable Water Heating Technologies*

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

*Offshore floating renewables (wind/solar/wave)*

The physical constraints of Malta's territory and potential barriers to standard renewable technologies were fully reviewed during the NECP assessment. Furthermore, novel technologies were considered in the LCDS given its 2050 timeframe. These include technologies where pilot-scale installations have been developed and where the market is expected to develop in an accelerated manner by 2030 and beyond. In addition to some additional capacity of land-based solar PV – on buildings where SWHs have not been installed – consideration was given to offshore floating technologies (offshore floating wind (OFW) and offshore floating solar PV (OFSPV)). Moving offshore for renewable power generation has many advantages, but there are also challenges to ensure that such is not detrimental to the marine environment. Indeed, Malta's marine Natura 2000 network encompasses 18 sites and covers over 4100 km², equivalent to more than 35% of Malta's Fisheries Management Zone. Such areas are designated for the protection of marine habitats and species pursuant to the EU Nature Directive. Moreover, there are also expected additional costs to arise from the need to stabilise platforms and bring grid connections onshore. Indeed, with technology breakthrough in offshore marine renewables (coupled with other instruments and measures), Malta could aim to target higher RE shares beyond 2030.

During the LCDS process, the various geological, depth, navigational and environmental constraints for offshore generation were plotted and some potentially feasible areas in Malta's territorial waters were identified. While certain assumptions were made in the LCDS in order to establish some possible parameters for offshore generation sites, further scientific assessments of the impacts, including on wildlife (e.g. endangered, migratory bird species), would be required to provide greater certainty of the potential maximum area of the installations. For the purposes of estimating abatement potential from the measures, a limited area to the south of Malta of around 15 square nautical miles (~25% of the total identified) was considered viable for siting OFWs. OFSPVs could be co-located in between the turbines to maximise efficiency of use of

shore power connectors and mooring infrastructure; however, as this is at an earlier stage of research and development than OFW, no offshore solar generating capacity was actually included under the scenario.

In addition, government will be committing to closely monitor technological developments in the RE sector that could possibly make it cost effective to install further RE systems at sea (i.e. deep sea wind/solar farms, wave technology).

*Backup for intermittent renewables/ battery storage*

Both Solar and Wind energy are intermittent in nature, hence some backup supply is required. Backup possibilities are that the existing interconnector (or an additional one) could be used, the existing CCGT plants could have their operating lifetimes extended if their capacity factors are reduced, and/or battery storage technology could be used. Regarding the latter, the storage period is still not particularly long and so currently would be better suited for daily / weekly fluctuations in solar resource, rather than monthly or seasonal fluctuations in wind resource. However, battery technologies are improving consistently and at a fast pace, and so longer storage times that may suit the specific RE systems could be implemented in future.

Although achievement of a 100% RE mix is not possible for Malta at this point in time, technologies will evolve significantly by 2050, giving a plausible low-cost renewable solution to help Malta meet its power supply requirements along with significantly reducing carbon emissions.

As indicated above, the existing support for battery storage technology is unlikely to yield large-scale roll-out of battery storage systems, and Malta shall be seeking EU funds to bridge the gap.

*Additional electricity interconnector*

Given the assumed increase in energy demand over time, for the energy grid to decarbonise by gradually moving away from the use of gas, the proposed scenario considers the installation of additional interconnectors as an alternative source of supply. Separate measures consider the installation of up to two additional interconnectors. These are envisaged to be installed to cater for electricity generation, as the energy grid decarbonises by moving away from the use of gas over time. Grid decarbonisation is achieved because the emissions associated with power generation take place outside of the territory of Malta, so are not counted in the national emissions inventory; nonetheless the cost of emissions is included in the cost of the purchased electricity. In addition, the source countries have greater potential to obtain a higher RES percentage in their supply.

Under the modelling of emissions for the LCDS, added installation was assumed to provide the required electricity on top of the additional renewable generation from the technologies outlined above. The trajectory of emissions reductions - for 2030 and 2040 - is highly dependent on how much of the interconnector capacity is used on an annual basis. This, in turn, is linked to the rate of the decline in the use of existing CCGTs, which, in turn, is likely to be dependent on relative pricing.

*Energy security and balance*

Additional interconnections will need to have sufficient on-shore backup power generation facilities, to guarantee security of supply for Malta. Risks are associated with physical damage to infrastructure and subsequent power outages. Subsea damage is often difficult and complex to repair. The increased development of renewable sources of electricity could reduce reliance on thermal generation and/or the interconnector, thereby maximising security of supply, and potentially reducing costs as the price of renewable technology falls in the future.

Grid balancing methods are likely to be beneficial and required as Malta transitions to a low carbon economy with greater use of renewables and the interconnector. The use of CCGT plants for grid balancing is one method, but in addition to this, smart grid technologies may eventually be considered to improve the utilisation efficiency of the power system by detecting and reacting to local changes in usage.

*Use of Green Hydrogen in the Energy mix*

In addition, contingent upon a suitable supply from mainland Europe (e.g. a European supply network included in the EU's hydrogen strategy 2020 [11]), a potential future source of energy - both electricity and fuel - could be hydrogen. In theory, Malta could build a supply pipeline to the mainland, akin to the proposed pipeline for natural gas, to power hydrogen power stations on the island – or, indeed, as is currently being proposed by government, the proposed gas pipeline would be built hydrogen-ready, to enable the switch from gas to hydrogen at the time any EU supply network is commissioned. The hydrogen power station could be based upon retrofit of the current CCGT power stations. This would provide a carbon neutral source of power for Malta as long as it runs on 100% green hydrogen. However, the supply of hydrogen would still be contingent upon import from other countries, thereby potentially posing a risk to security or to cost of supply. Alongside this, any hydrogen power station could also act as a back-up to intermittent renewables if battery storage were not in place, or able to store charge over longer periods of time to smooth supply from wind resources. Furthermore, the use of alternative fuels such as biofuels and synthetic fuels will be looked into as a potential source of energy supply beyond 2030.

**Timing of measures**

The proposed timing of the energy and EE measures is shown in Figure 12. Whilst this LCDS scenario is proposing this specific timeline, government will continue performing more detailed studies which will determine whether specific projects are developed earlier then indicated herein.

11 https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

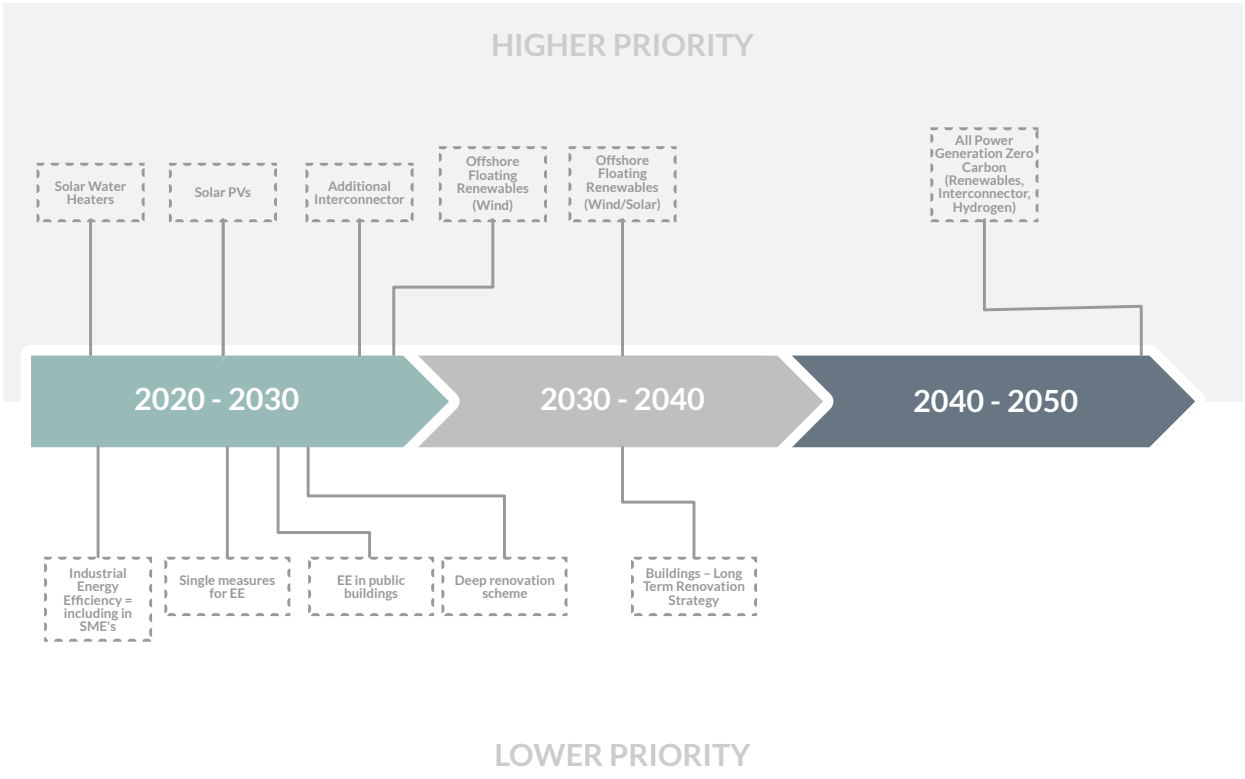



*Figure 12: Implementation timeline for energy measures*

### 2.6.2. Transport

Pollution stands out among the main environmental impacts of transport. In particular, road transport is the main source of PM and noise, and represents important shares in the emissions of a number of other air pollutants, including nitrogen oxides (NOX), volatile organic compounds (VOCs), ozone ($O_3$), sulphur dioxide ($SO_2$), metallic compounds and benzene ($C_6H_6$). These effects are especially severe in Malta due to the high car dependency and relatively old car fleet. Additionally, the transport sector is responsible for 21.1% of GHG emissions generated in Malta, becoming the biggest single sector surpassing electricity generation in 2019.

#### 2.6.2.1. Estimated emission reductions

Under the LCDS, a package of measures is assumed to be put in place to support a more significant shift away from private car use in Malta, alongside further measures to support a faster transition to electric vehicles (EVs). The LCDS, in line with the NECP and transport strategies currently in place, considers the following measures:

- Support for the electrification transition: this is further supported by strengthening the grant scheme currently in place to incentivise the purchase of EVs and plug-in hybrid vehicles
- The installation of an extended network of EV charging points
- Electrification of government fleet, with government leading by example

- Electrification of scheduled public transport buses
- Support to drive a significant further increase in public transport usage: this is assumed to arise from a suite of measures, including the extension of free public transport services, and improvements in public transport services..
- Support for active transport: sustained investment taking place throughout the strategy period in infrastructure to support cycling (e.g. bikes, e-bikes, pedelecs) and walking.
- Encouraging teleworking, and remote working and further promotion of Government online services to reduce and avoid the need to travel, especially to and from specific 'traffic hotspots', and especially during peak hours.

Table 2 sets out the abatement potential calculated to arise as a result of putting in place the package of measures in the LCDS.

Implementation of this package of measures results in a net cost saving over the long-term LCDS time horizon. This is a result of the avoided costs from car use and road maintenance outweighing the investment in infrastructure for active travel and support for public transport, as well as the savings from transitioning to EVs. While net cost savings materialise over the long-term horizon, investment is required to start in the immediate.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **270,241** | **711,458** | **1,016,788** |

*Table 2: Transport Measures Abatement Potential*

There is further scope for emissions reductions through considering the potential for reducing the impacts associated with marine/ maritime transport, on a domestic level. Malta's emissions inventory suggests impacts of 69 thousand tonnes CO2 associated with domestic marine navigation, equating to a 12% of the transport total (and 3% of total emissions for Malta). This includes both ferries and some fuel use by fishing vessels.

In this area, the NECP also indicates a plan to develop a tunnel between Malta and Gozo which is assumed to reduce the requirement for gasoil used in internal navigation by around 50%.

#### 2.6.2.2. General overview of policies, existing plans and measures for decarbonisation

**Policy developed - National Energy and Climate Plan**

Under a business-as-usual scenario, it is anticipated that transport in Malta will continue to be dominated by private car use in the absence of alternatives such as mass transit as well as coupled to the travel patterns and needs of the population. In this regard, the LCDS is aimed to build on the NECP and existing transport strategies, to bring about a more significant shift away from private car use. Additional abatement from these activities is not included within the results, but is anticipated to help offset some of the cost of transitioning to EVs as outlined above. Further anticipated economic savings resulting from improvements in public health (from the increased activity levels) and a reduction in congestion have not been included in these cost calculations.

*Electrification - Supporting instruments*

A number of European countries have already announced bans on Internal Combustion Engines (ICE). Malta has also announced an intention to impose a full ICE ban/ ICE cut-off date, with a Clean Vehicles Commission being set up to advise on the nature and timing of such a decision. For this strategy, an ICE cut-off date for beyond 2030 is being considered.

In addition to a ban on petrol and diesel cars, the implementation of measures that ensure attitude changes favourably towards EVs are needed for the required level of uptake to be achieved. This can be done through grants and other instruments that bridge the cost differential between technologies as well as ensuring infrastructure is adapted to the uptake of EVs. In this respect, a draft national strategy for EV charging infrastructure has been launched which looks at the installation of charging facilities at multiple venues - publically, at home, en route and at the final destination. Education and information on the technology and its use (e.g. on battery lifetime and battery-end-of-life disposal/replacement), as well as incentive schemes (for

purchase of EVs, purchase of equipment by large fleet operators to repair EVs, and electricity charging tariffs), will be essential to further ensure the targeted uptake is met - ad hoc policy initiatives may subsequently be applied in this regard. Furthermore, upskilling the workforce and collaborations/ partnerships with educational institutions and automotive companies are being looked into to push further this electrification transition in our local markets (e.g. readiness to repair and maintain EVs). Malta aspires to have introduced c. 65,000 EVs, including plug-in hybrid EVs (PHEV), by 2030.

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

At the time of writing, in the local context it is recognised further that there could be supply issues for right-hand drive vehicles, and efforts with international producers will need to be undertaken to secure supply in the near future.

*Electrification of government fleet*

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

*Public transport*

Further efforts on decarbonisation relate to measures to increase public transport uptake. The LCDS measures take into account further improvements to the overall public transport service through the introduction of more bus services, dedicated bus lanes and the introduction of traffic priority measures as well as further leveraging of technology designed to improve journey times and service reliability (e.g. app-driven services). In addition to this improved logistical framework, the extension of free public transport services would provide a further incentive to increase take-up. At the same time, research shows that some form of disincentive needs to be put in place in order to lead to a sufficiently high change in behaviour.

At the time of writing, Transport Malta is undertaking a National Household Travel Survey (NHTS). This will provide vital information on current travel patterns and behaviour, as well as changes in transport trends that have emerged over the last 30 years. The NHTS is also designed to quantify public opinion and views on any new potential transport policies and measures being explored by government. This survey data would guide Transport Malta in finding the optimal policy mix to achieve improved mobility through modal shift towards greener and more sustainable means of transport. The collected data will later be used to update Malta's National Transport Model (four-stage macro model) for a more detailed technical assessment of

future policies and measures and their impacts on traffic congestion and any related externalities, as well as future update cycles of this LCDS.

In order to further support the national electrification drive and reduce national emissions, the electrification of the current public transport bus fleet (a total of 370 buses) to electric ones is assumed to occur by 2030. Similar to the exercise involving the electrification of private EVs and the government fleet, this exercise would be complemented by the installation of the necessary charging infrastructure.

*Active transport*

Evidence from other countries (such as Denmark) confirms that the provision of support to both active transport and public transport is likely to result in a larger shift from car use than supporting only one of these areas. Cycling in Malta is assumed to increase as a result of sustained investment in active travel infrastructure taking place over the next 30 years, alongside a large increase in the use of e-bikes and pedelecs (which are deemed key in such a measure given Malta's hilly topography and warm climate). Infrastructure includes cycle tracks and lanes, bike parking facilities, bike charging points, footpaths, pedestrianised areas, widened sidewalks and investment in traffic management systems (and associated signage) to give bikes/pedestrians priority - where practicable - on existing roads. In addition, the promotion of active modes of transport will also be incentivised through the use of marketing tools and the launch of further specific programmes, incentives/grants or schemes[12] (including with and for industry) to sustain a cultural and social shift that would spur citizens away from private car use. These efforts will build on some Government's recent efforts, including the use of smaller vehicles for urban mobility, such as pedelecs and category L vehicles (e.g. mopeds, motorcycles, tricycles and quadricycles), aimed at a lower environmental impact from transport. Active commuting such as walking will also be incentivised, such as implementation of safe routes for students.

*Electrification of Heavy Goods Vehicles*

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

*Teleworking and remote working*

Additional to modes of active transport (that shift movement to a less carbon intensive mode of transport), government will continue to consider initiatives that avoid altogether the need to move. One of the few positive outcomes of the COVID-19 pandemic is that it forced employers, including government, to implement infrastructure that supports teleworking/ remote working, thus decoupling the need to commute from the ability to produce. During COVID-19, it is estimated that around 33% of the local workforce worked

12 A scheme for the purchase of Pedelecs and Category L Vehicles (e.g. Mopeds, Motorcycles, Tricycles and Quadricycles) is already in place, with the aim of promote the use of small vehicles for urban mobility, with a special focus on EVs, in order to reduce congestion and emissions.

remotely, and it is expected that post-COVID-19, half of the time worked will continue be carried out in this way. Studies covering foreign countries show an enormous appetite for remote working from the part of both employers and employees.

Government policy has been underlining the need to ensure the possibility of teleworking as a family-friendly measure for decades. This strategy considers the teleworking/remote working possibility as a GHG reduction measure, addressing the dependency of productivity and transport. In order to support this further, government will be looking into: (i) promoting and incentivising further remote working amongst the workforce, including through remote workspaces for public officials across Malta and Gozo; and (ii) improved provision of online services.

*Mass Transport system*

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

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

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

**The timing of measures**

As previously mentioned, the intention to impose a full ICE ban/ ICE cut-off date has been proposed by government, which has set up a special Clean Vehicles Commission to advise on such matters. The ICE cut-off date has not been determined yet; however, studies carried out so far indicate a date beyond 2030. In this regard, and in line with th NECP, Malta aspires to have more than 65,000 electric vehicles (including PHEV) by 2030. The LCDS considered three scenarios:

- an optimistic scenario where the ICE cut-off is set to 2030;
- a pessimistic scenario where the cut-off date is set to 2034;
- and a central scenario which is an average of these two outputs.

Data suggests cars in Malta have a long lifetime, and hence there will be a time lag between putting the policy in place and seeing the change. Even if the ICE cut-off date is set at 2030, the full impact of this policy is likely to be seen in later years. Within this measure, there could be different variants, such as the application of the ICE cut off initially to specific types of vehicles (e.g. company cars, which typically have a shorter lifespan).

The shift to active travel is anticipated to require consistent investment in infrastructure and behaviour change occurring over many years. These policies will therefore not bring about change in a short enough time frame to assist in significant emissions reductions. This might therefore require some of the investment in public transport to be brought forward. The extension of free public transport schemes is, for instance, envisaged to bring a modal shift between 2026 and 2030, whilst the electrification of the same fleet is expected to take place before 2030.

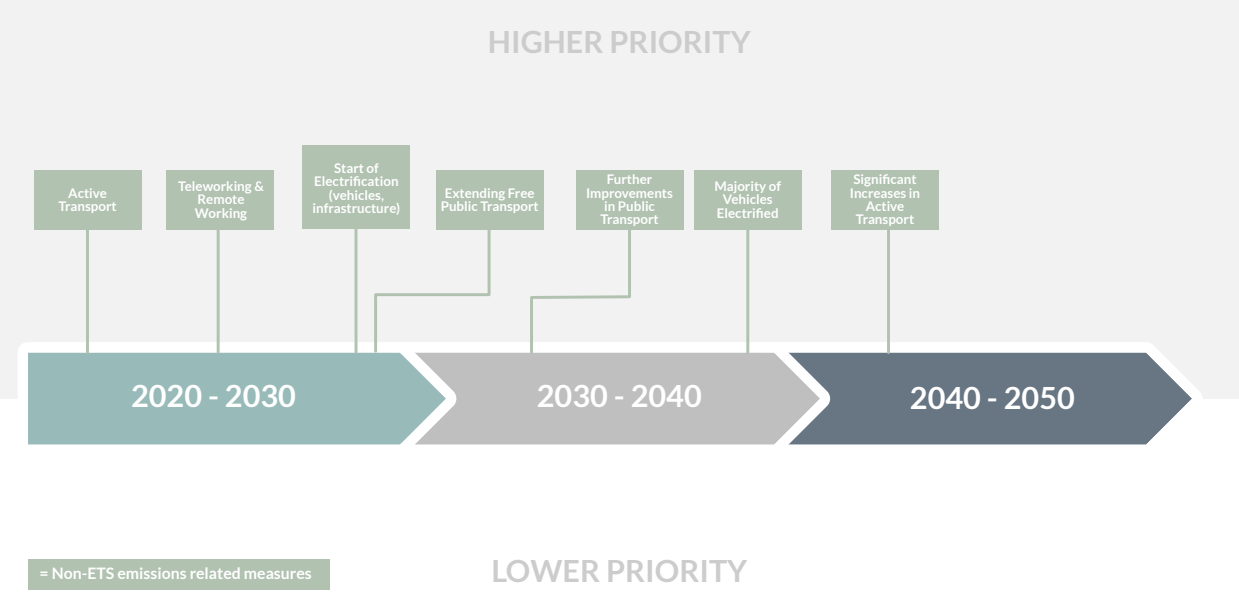



*Figure 13: Implementation timeline for transport measures*

### 2.6.3. Buildings

The LCDS measures on buildings are in line with Malta's Long Term Renovation Strategy (LTRS), which is was also launched in 2021. The implementation of the LTRS will be driving the actions planned under this sector.

Buildings in Malta generally utilise electricity for lighting, space heating and cooling, water heating, and for powering appliances and equipment. Unlike other European states, in Malta there is no gas supply network passing through towns and villages. Additionally, the design of a building affects the levels of heating and cooling that are required to be produced through different appliances. Modelling energy demand from building design changes, achieved either via retrofit or by marginal changes to future building stock, was not carried out under this study but referred to through work undertaken for the LTRS [13].

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

It is important to note that there are several technologies that require roof space in Malta, and therefore are "competing" for the same space resource. Different technologies are suitable depending on the requirement of the building, and hence cannot be predicted at this stage[14]. The modelling has sought to ensure that the maximum roof space available is not exceeded.

Assumptions regarding roof space are presented in Table 3. The MACC approach looked into an estimated number of households and offices, and the floorspace of single and multi-family housing, and offices, under a baseline scenario, from 2020 to 2050.

| Year | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| Households | 183,996 | 213,393 | 220,589 | 223,329 |
| Offices | 2,890 | 3,228 | 3,336 | 3,378 |
| Single-family Housing ($m^2$) | 13,860,605 | 15,479,732 | 16,001,714 | 16,200,462 |
| Multi-family Housing ($m^2$) | 7,254,985 | 8,102,477 | 8,375,695 | 8,479,725 |
| Office Floorspace ($m^2$) | 814,870 | 910,059 | 940,746 | 952,431 |

*Table 3: Baseline projected number, and floorspace ($m^2$) of household buildings office buildings*

The figures suggest that the building stock will increase by approximately 20% by 2050. Whilst equipment is

13 It should also be noted that there are significant challenges associated with Malta's built environment data. There is therefore a requirement to use data from other countries or use expert assumptions in some instances.

14 Through subsequent cycles of the LCDS and LTRS, government will undertake more detailed study into building types to provide more granularity on the building type and likelihood of which type of technology is most suitable.

easier to replace, changes to fixed infrastructure – such as insulation or shading – is more costly, and those costs increase when changes are made through retrofits rather than designed into new buildings. Therefore, the LCDS assumes new buildings are targeted so that further costs are not burdened on future generations.

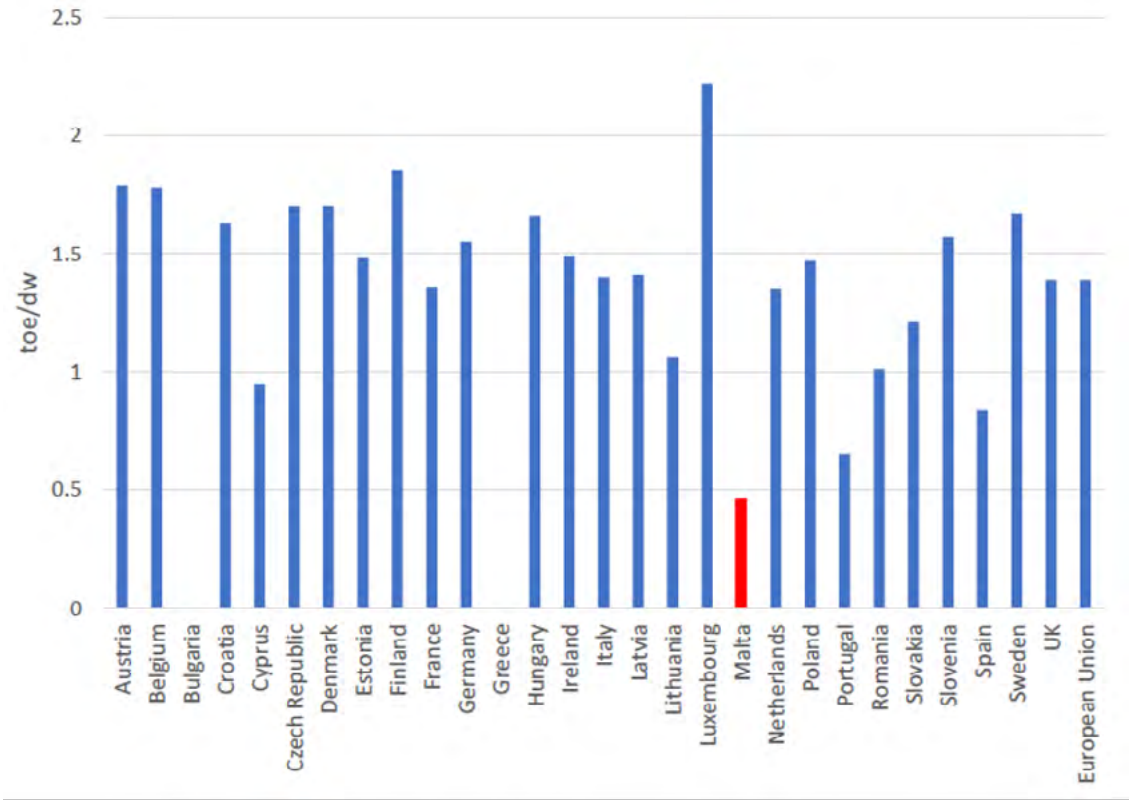



*Figure 14: Average energy consumption per dwelling (adjusted to EU climate) in 2016, toe/dw (Source: Malta NECP 2030)*

Finally, a key consideration regarding the degree to which measures can be implemented in the residential buildings sector is that Malta's average energy consumption per dwelling is the lowest among all EU Member States (see Figure 14). This is likely to be a combination of the warmer climate compared to other EU countries, reducing the need for space heating, as well as Malta's development path towards EU GDP per capita convergence. Thus, whilst the buildings sector has a key part to play in Malta's LCDS, the relative magnitude of savings from the sector will be lower than other countries across the EU, as there is relatively less to save.

#### 2.6.3.1. Estimated emission reductions and energy demands

The policy initiatives being considered, in line with the LTRS, include:

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

The above policy initiatives capture various measures, including EE domestic appliances, EE office equipment, installation of light sensors, roof and wall insulation, and LED lighting uptake, amongst others.

Table 4 presents the anticipated abatement potential for measures relating to buildings. The most significant level of abatement from the measures modelled in 2030 is expected to come from ensuring domestic appliances have a high energy performance rating and are therefore very energy efficient. In addition, the use of EE office equipment and the installation of light sensors (mainly in non-residential buildings) to optimise lighting usage would be expected to generate further abatement. Some additional abatement could be achieved through greater usage of roof and wall insulation to ensure buildings stay cool and air-conditioning use is minimised during summer months, as well as maximising any heating required during winter months; this was not specifically modelled but would represent some additional abatement - as the grid decarbonises this becomes less impactful in emission terms. Measures to drive a full switch to LED lighting could provide some additional abatement; however, the levels are not significant as other types of EE bulbs are highly pervasive in the market by 2030, and the savings from a switch of such bulbs to LEDs are not as significant as they would be where the switch is made from incandescent bulbs. Other changes to building design – as well as the building's integral energy-using equipment - will also contribute to abatement over and above the measures listed.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **82,025** | **33,769** | **2,215** |

*Table 4: Buildings Measures Abatement Potential*

### 2.6.3.2. General overview of policies, existing plans and measures for decarbonisation

**Policy developed - National Energy and Climate Plan**

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

- Residential:
  - Improved EE appliances
  - Installing roof insulation
  - Increased use of LED lighting
- Non-residential (offices, government buildings, other non-residential):
  - Installing roof insulation

- Increased use of LED lighting
- Increased use of automated lighting
- Increased EE office/ IT equipment

The nature of the changes required under these measures are mostly captured, to varying extents, by the policy initiatives set out in the NECP and the LTRS. The update of these measures, and hence the ambition, can be increased further by increasing the scope of the specific policy instruments - for example, by increasing the overall grant allocation available in a given year or by adjusting the threshold to cover a larger number of consumers. The effects of the various policies should be monitored closely out to 2030 and policy parameters changed as required. EE measures improperly implemented may give rise to energy poverty in circumstances where lower income bands of society are locked out of EE technology, thus driven to be higher consumers to meet basic needs. Government will be tackling this vicious circle that widens the difference between higher and lower income households, and will ensure that vulnerable classes of society are well taken care off so they can reap the benefit of higher efficiency, lower consumption and hence lower cost.

*Policy initiatives relating to residential buildings*

- Energy efficiency of household appliances

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

- Insulation and double glazing

  Under this measure, government will consider providing small installation cost grants for different types of residential property. Maximum grant levels can be set and increased over time if further uptake is required.

- Lighting Efficiency

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

- Air conditioning

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

- Deep renovation of buildings

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

- EE single measures and retrofitting to achieve NZEB level

  Several of these single EE and retrofitting initiatives, together with initiatives mentioned under the section on Energy systems, can be collated into one package of measures that are aimed at achieving NZEB levels. These measures include roof and wall insulation (LTRS assumes 14,000 units by 2030); SWHs and heat pumps (LTRS assumes 24,000 units by 2030); and window double glazing. The inclusion of sustainable building materials is also being recommended within such package. It is deemed difficult to achieve the targeted uptake without regulatory measures complimenting such package.

- Design – existing and new buildings

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

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

houses e.g. in the form of reduced property taxes (e.g. stamp duty, sales tax), or help-to-buy housing schemes.

- Education and awareness

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

*Policy initiatives relating to non-residential buildings*

- The set of measures outlined above will also be incentivised by the policy initiatives set out in the NECP. For example:
  - Providing greater access to financial support schemes for those disclosing verified energy savings;
  - A requirement that non-SMEs with an annual consumption exceeding 800 tonnes of oil equivalent (toe) to implement an ISO certified management system;
  - Regulation 10 of LN 196 of 2014 makes it mandatory for, and the responsibility of, non-SMEs registered and doing business in Malta to carry out energy audits to the established quality level and frequency;
  - Financial support for business clusters on EE;
  - Grants to help SMEs carry out energy audits of their premises/ processes/ plants/ transport fleet; and
  - Regular training sessions and seminars.
- The private sector is already actively participating in the country's move towards decarbonisation, but further effort is still needed. The Government intends to continue promoting investment towards further uptake of energy efficiency measures in buildings and equipment used for industrial and services operations in Malta.
- Policy measures such as EE certificates for some categories of buildings (e.g. offices and hotels) will be further assessed, to further improve their energy performance. The use of ambitious criteria within these certificates is particularly important where the construction of new buildings is concerned, given the relatively high cost of retrofitting EE measures. In relation to hospitality, government is aware of the current hardships caused by the COVID-19 pandemic, and is therefore aware of the need to carefully assess the impact of such measures.
- As also indicated in the NECP and LTRS, government and public bodies are aware of their key role in promoting EE. In this regard, central government will continue to lead by example through its continued commitments towards the ongoing programme of implementing EE and renovation measures in public buildings. Government will continue looking into measures such as: EE lighting systems, use of LEDs; smart meter installations & energy management systems; replacement of ACs to inverter integrated

ACs; sustainable procurement of appliances and equipment; and roof and wall insulation/double glazing or glass tinting. Measures to instil behavioural changes will also be considered.

**The timing of measures**

As discussed in Section 2.6.1.2, the most important period for the implementation of EE measures from an emissions abatement perspective, is whilst electricity is still being supplied locally. A particular focus should be on those measures relating to EE standards for the construction of new buildings. This will help to ensure that expensive renovation is not required from 2030 to 2050. Whilst it may hold true that the carbon abatement effect of EE measures diminishes as the grid decarbonises, the ability of higher EE in buildings would still ensure more affordable energy use for basic households needs (e.g. heating and cooking). This ensures that the proportion of household income spent on energy in the dwelling is reduced, allowing a lower income band to move away from the risk of (energy) poverty.

### 2.6.4. Industry

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

Such manufacturing operations mostly consume energy in the form of electricity[15], thus generating emissions indirectly from energy consumption. According to the NECP, this consumption amounted to around 10% of the island's total energy consumption in 2015. Opportunities for improving industrial EE are therefore of interest in the pursuit of territorial GHGEs reductions.

In Malta, the main energy-consuming industrial processes are:

- refrigeration / cooling for machinery;
- injection / blow moulding;
- compressed air;
- motors and drives; and
- water heaters/ boilers.

15 Interviews with a selection of local industry confirmed that the vast majority of energy consumption for the industrial processes was in the form of electricity, including water heating. Consumption of other fuels does occur but is negligible in the context of this measure. Fuel consumption for the transport needs of these facilities is out of scope.

Overall, the industrial sector in Malta already has a fair understanding of available efficiency measures and has made efforts to implement some of them. This is helped by the fact that many of the larger manufacturing sites are Maltese subsidiaries of large international companies and are therefore required to comply with company-wide environmental management systems and policies. Nonetheless, a large number of SMEs, due to their small size, find it not cost-effective to invest in such technologies (including EE measures) or may find difficulties with the initial funding outlay required.

Within this sector, examples of positive efficiency actions include:

- implementing switch-off routines for machinery;
- replacing moulds with state-of-the-art designs;
- introducing variable speed drives on motors;
- utilising waste heat from air compression processes; and
- use of LED lighting.

The available technology for each of these processes is improving every year. For example, the base load consumption of electric injection equipment is a fraction of that of the hydraulic alternative, providing significant overall energy savings[16]. In addition to these technological improvements, some site-specific ideas arose during consultation with local industry. This included an idea for providing an industrial park with a shared seawater cooling facility which would cut the energy needs for all facilities in the park. Government, through entities such as Malta Enterprise and Indis Malta, are committed to work with industry to find decarbonisation solutions.

#### 2.6.4.1. Estimated emission reductions and energy demands

The EE measure related to industrial processes in Malta modelled for the LCDS encompasses a variety of possible technologies, as described above. This measure also allows for some conservative consideration of future technological improvements that are, as yet, unknown.

The greatest level of abatement will be achieved in the period when electricity is mostly being generated locally. As imports or alternative sources of energy supplies come into effect, the territorial emissions saved from further reductions in electricity consumption are limited. However, the measures are anticipated to make an economic saving over the 30 -year period due to reduced electricity usage outweighing the investment in new, more energy efficient equipment. However, it is pertinent to note that investment is required in the immediate, while savings will materialise over the long-term LCDS horizon. In addition, electricity supply can be reduced by ~232 GWh in 2030, rising to ~345 GWh by 2050. Whilst the GHG emission reductions are lower in the longer term, these savings can ensure that the scale of any additional infrastructure needed to

16 An Energy Saving Guide for Plastic Injection Moulding Machines, Mobil. Accessed 3rd May 2019 from: www.mobil.com/en/industrial/podcast/~/media/C19701CE80A046DD8D1073C545C262E7.ashx

meet electricity demand (as explained in the sub-section on Energy) can be limited, which saves costs and, in the case of offshore renewables, the amount of area needing to be taken up by related infrastructure.

The abatement potential of measures that are aimed at tackling emissions from the industrial sector is shown inTable 5. As with the other energy efficiency measures, the impact is greatest in the earlier years, when the carbon emissions from electricity generation are higher.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **74,848** | **35,344** | **2,706** |

*Table 5: Industry Measures Abatement Potential*

### 2.6.4.2. General overview of policies, existing plans and measures for decarbonisation

The NECP (which includes measures up to 2030) refers to various policies and plans:

- Energy Management Systems backed up through ISO standards;
- Supporting energy audits - planned to continue into the future as issues and solutions change over time; and
- Information dissemination programmes.

Malta Enterprise has recently announced a support scheme for SMEs, aimed at helping such enterprises to purchase and invest in EE equipment. Government will evaluate the uptake of such a scheme, and consider extending/ strengthening such a scheme to ensure that small enterprises are assisted in reducing their energy consumption. The engagement with local industrial stakeholders during this LCDS process confirms this scope for further efficiency gains in Malta's industrial operations. The majority of stakeholders interviewed mentioned ideas of efficiency improvements as well as giving examples of barriers they faced in implementing them. Such barriers included access to capital, long payback times, and access to information.

Apart from the initiatives in the NECP, government will also consider further initiatives such as green bonds, revolving loan funds and loan guarantees. As financial savings are expected, policies will focus on adequate access to capital for the necessary investments to be made.

**The timing of measures**

Given that many of the industrial EE measures are expected to result in financial savings over time from reduced electricity payments, the LCDS assumes a prioritisation of this measure before 2030 (see Figure 12).

### 2.6.4.3. Refrigerants (F-gases)

Hydrofluorocarbon (HFC) refrigerants are mainly fluorine containing synthetic substances, generally

found as gases although some are liquid at room temperature. The main uses are in refrigeration and air conditioning in stationary and mobile applications, including domestic, commercial and industrial use. Some special uses include the use of specific gases such as Sulphur hexafluoride (SF6) in insulation of high voltage switchgear and the use of specific application in the semiconductor industry. Most F-gases in use are replacing the previously used chlorofluorocarbons (CFCs). In fact, the NECP confirms that HFC emissions started to increase significantly in Malta from 1999, largely as a result of the shift away from the use of CFCs in equipment for refrigeration and cooling. European legislation resulted in the phasing out of the use of CFCs as these were having a detrimental effect on the ozone layer. However, an increase in CC emissions has occurred as a result of the shift towards HFCs. All emissions of these gases fall within the sector 'Industrial Processes and Product Use' (IPPU). The NECP notes that emissions of HFCs in 2017 accounted for around 99% of total IPPU emissions.

Subsequent European legislation has been implemented which aims to tackle HFC emissions. This includes the current F-gas Regulation which is focused on[17]:

- Limiting the amount of the most important F-gases that can be sold in equipment;
- Banning the use of F-gases where less harmful alternatives exist;
- Preventing emissions of F-gases from existing equipment.

The aim of the legislation is to cut emissions of HFCs by two-thirds from 2014 levels by 2030. These emissions should therefore be tackled through Malta's implementation of this legislation. Stringent implementation of this regulation should in part, if not completely, achieve the set targets for this sector. Noting also that, climatically speaking, Malta requires a level of use of refrigerants, and as already highlighted Malta is a technology adopter, further reduction of GHGs from this sector will only come through a wider approach at a European level.

### 2.6.5. Waste

#### 2.6.5.1. Estimated emission reductions

Waste disposal in landfills contributes to CC by releasing methane into the atmosphere. Methane is a harmful GHG which is 20 times more potent than carbon dioxide in terms of 'Global Warming Potential'. The waste management sector accounts for less than 10% of GHGEs in Malta.

Under the LCDS, and in line with the Waste Management Plan (WMP) for the Maltese Islands (2021 to 2030; mandated under the EU Waste Framework Directive Article 9(1) as provided for in the revised Waste Framework Directive (2018/851)), a package of measures is being put in place, especially in the areas of recycling and waste prevention. The LCDS covers the following measures:

17 Details of the legislation can be found at: https://ec.europa.eu/clima/policies/f-gas_en

- **High biowaste capture:** this measure assumes that 80% of municipal biowaste is captured for recycling, which takes place via an anaerobic digestion (AD) facility. Since locally there is little in the way of garden waste, the captured material consists largely of food waste – assumed to be collected from both households and commercial facilities.
- **Incineration pre-sorting:** this measure assumes that additional sorting equipment is put in place to ensure the efficient removal of a wide range of recyclables from residual waste, thereby further improving the municipal recycling rate. In this way, the recycling rate for plastic film – which makes a reasonably significant contribution to the impacts of incinerating residual waste – is improved substantially. This will also indirectly allow for a more streamlined collection system on a national scale.
- **Waste prevention:** measures will continue to be put in place to support waste reduction, in particular reducing food waste, junk mail, and support a switch to reusable nappies.

Though still important, the table below confirms that waste measures make a relatively modest contribution to abatement potential compared to other sectors such as transport and buildings. The most significant contributor is the measure to improve the sorting of waste prior to it being sent to the incinerator.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **31,832** | **32,779** | **68,083** |

*Table 6: Waste Measure Abatement Potential*

Investment costs for the new infrastructure are anticipated to be offset to a significant extent by the financial benefits arising from the waste prevention measures. There is a net cost across all three waste sector measures by 2050, which represents a net cost over the long-term LCDS horizon; any capital investment would still need to be incurred upfront. In addition, as will be discussed in Section 4, a significant proportion of the financial cost of these measures is potentially available through the use of European funding. In this regard, the above waste measures are part of government's wider waste management investment plans through the ECOHIVE Project. Investment includes a waste-to-energy plant (EfW) which will in itself significantly limit Malta's landfilling volumes, a new plant for the management of dry recyclables, a plant to treat organic waste to extract energy and produce compost for use in agriculture, as well as the replacement of the clinical and abattoir waste incinerator.

#### 2.6.5.2. General overview of policies, existing plans and measures for decarbonisation

The policies proposed here build on those measures and actions already included in the NECP, which include a waste-to-energy facility to be commissioned in 2024 to enable increased diversion of residual waste from landfill to further lead to compliance with European legislation. The policies mentioned below are also aligned with the WMP. Many actions will take place in the period 2021-2030, leading to relatively early emissions reductions, including the commissioning of new infrastructure.

*Increased biowaste capture sent to anaerobic digestion*

Over the period 2011-2018, Malta has seen an overall increasing trend in food waste generation. Households in Malta generate approximately 135kg of food waste per capita each year. The majority of the food waste generated over this period in Malta was landfilled, while the organic waste collected from households following the nationwide rollout of separate organic waste collection was processed via AD into RE. In light of this, efforts to achieve further reduction of the emissions arising from the treatment of food waste (that would otherwise occur via the residual waste stream) consider the need to capture more separately collected food waste which would be treated in the new infrastructure and its biogas captured for RE production. This can be done in parallel with the application of circular economy principles that can minimise food waste in the first place.

*Waste prevention*

The WMP sets out a series of waste prevention measures which aim to facilitate the prevention of waste and the reuse of materials by industry, government, citizens and tourists. The objectives of these measures are to:

- Foster a culture of resource efficiency by encouraging alternative choices that contribute towards sustainable consumption, changing attitudes towards preventing unnecessary use, and encouraging the repair and reuse of items rather than discarding them early in their economic lifetime
- Create new business opportunities for greener products, repair services and secondary markets
- Provide economic incentives to support society in transitioning towards voluntary prevention and reuse initiatives. A Waste Prevention Programme is set out, seeking the enactment of measures which prevent the generation of waste. This Programme promotes the minimisation of waste generated through the adoption of various measures which incentivise greener business processes, and prompt societal change towards smarter consumption patterns.

The target waste streams will be tackled through measures that include awareness-raising campaigns, implementing economic incentives, new legislation to support waste minimisation initiatives and various other tools to incentivise waste prevention.

Key measures considered in the WMP include:

- Establishing re-use and repair centres.
- Economic incentives to promote repair and reuse activities.
- Setting up a waste prevention budget line to incentivise waste prevention initiatives.
- Digitising office procedures.
- Encouraging retailers to promote initiatives for customers who bring their own containers.

- Providing economic incentives to support packaging-free initiatives and products with less packaging.
- Exploring economic incentives targeting recycled materials in construction.
- Establishing a set of waste prevention guidelines for all Government events.
- Developing legislation for the diversion of food waste from landfill.
- Limiting retail and distribution outlets from discarding unsold food.
- Overcoming barriers imposed by current legislation restricting the redistribution of food.
- Developing a regulatory framework to enable people to unsubscribe from unsolicited mail.
- Supporting the creation of an online alternative to unaddressed mail.
- Introducing legislation to prohibit the use of single-use plastics in public events. This measure can be introduced for single-use plastic items that are not already banned under the Single-Use Plastics Directive.
- Piloting a smoking ban on several local beaches.
- Amending the Building Regulations to mandate a minimum of 15% recycled materials in buildings.
- Removing barriers to the export of reconstituted stone products or powdered stone from construction and demolition waste where feasible

*Mandatory pre-sorting of plastics at Waste to Energy Facility*

The NECP notes the intention to consider pre-treatment for the proposed waste-to-energy facility. Under the LCDS, pre-sorting of plastics in the input waste stream would be mandatory. Implementation of this measure therefore requires the plant specification to be developed such that it ensures the facility is able to efficiently sort (for recycling) all plastics, including plastic film.

**The timing of measures**

Although waste is anticipated to make a relatively small contribution to overall abatement achievements (compared to other sectors), emission reductions start to be made earlier than in the case for some other sector measures due to the investment in infrastructure which is likely to occur prior to 2030 (see Figure 15).

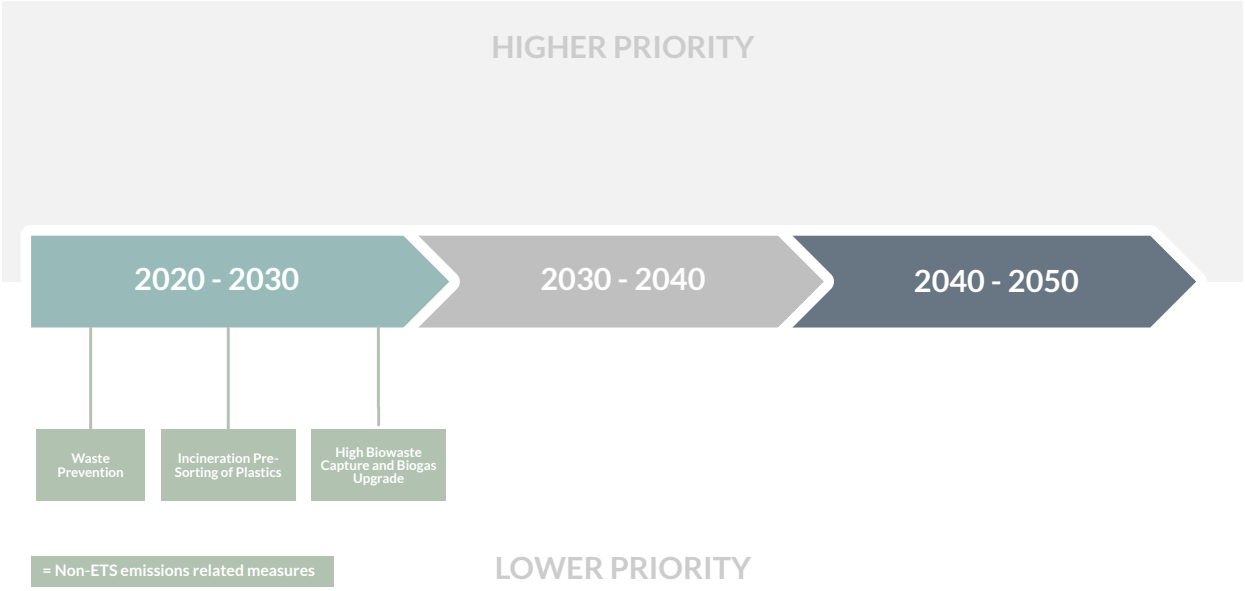



*Figure 15: Implementation timeline for waste measures*

### 2.6.6. Water

#### 2.6.6.1. Estimated emission reductions and energy demands

Under the LCDS, four measures targeting the water use of different sectors are implemented. These measures seek to either reduce the demand for water or move away from extraction of groundwater. These are:

- the storage and use of rainwater on Malta's industrial parks;
- the treatment and re-use of greywaters in hotels;
- a reduction in water use through a behaviour change campaign; and
- investment in technology to improve irrigation efficiency.

Table 7 details the abatement potential calculated to arise as a result of putting in place the package of measures under the LCDS. The data shows that the potential abatement is very modest compared to other sectors. Nevertheless, implementation of this package of measures results in a net cost saving in 2050.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **1644** | **827** | **121** |

*Table 7: Water Measures Abatement Potential*

### 2.6.6.2. General overview of policies, existing plans and measures for decarbonisation

**Policy developed - National Energy and Climate Plan**

*Reduction in water use from behaviour change*

The 2nd Water Catchment Management Plan (WCMP), which covers the period from 2015 – 2021[18], includes an educational project measure involving the development of a long-term national water conservation campaign. This campaign aims for a reduction of 5% of municipal demand, equal to a water saving of 1 million $m^3$[19]. The plan also includes a supporting measure involving a specific campaign targeting education activities at schools. In September 2019, EWA launched this national water conservation campaign titled Water – Be the Change[20]. The proposed measure out to 2030 and beyond represents a long-term extension of this campaign beyond 2022, involving:

18 Sustainable Energy and Water Conservation Unit (2015) The 2nd Water Catchment Management Plan for the Malta Water Catchment District 2015 - 2021, 2015

19 Sustainable Energy and Water Conservation Unit (2015) The 2nd Water Catchment Management Plan for the Malta Water Catchment District 2015 - 2021, 2015

20 About us | Water - Be The Change

- frequent messaging;
- targeted and, where possible, personalised, messaging for specific customer cohorts including high-consumers and those mostly likely to change behaviour;
- use of behavioural science insights to help 'nudge' large numbers of consumers towards behaviour change;
- consideration given to the credibility of the information source, the narrative style of the message, and the information channel in designing messaging; and
- a long-term focus in an effort to avoid the rebounding increases in demand following initial messaging typical of water-saving campaigns.

A recent review of international efforts to promote water conservation concluded that efforts to increase public awareness such as through media campaigns could result in reductions in municipal demand of between 2 and 20%[21]. GGiven that the proposed campaign would have a long-term focus, and taking into account the range of impact of previous campaigns, the awareness raising campaigns are expected to remain of value.

*Storage and use of rainwater in industrial sector*

The 2nd WCMP includes a demand management measure involving support schemes for the development of rainwater runoff harvesting facilities in the agricultural and other commercial sectors, and forecasts that this could result in an increase in harvested rainwater of 25,000 $m^3$ per year. Within this measure, passive low-methods for rainwater collection can also be considered.

*Treatment and re-use of greywaters in the hotel sector*

In March 2014 the EU Life+ Investing in Water project recommended that the 2nd WCMP includes measures to support the uptake of greywater recycling systems in the hotel sector only, acknowledging that Malta has no other particularly large water-consuming industries[22]. The Malta Tourism Authority administers the Eco-Certification scheme for hotels in Malta, made up of 51 mandatory criteria and 38 voluntary criteria. To be certified, hotels must satisfy all mandatory criteria and 50% of the voluntary criteria. One such voluntary criteria is that a wastewater treatment plant is installed and operational and treated grey water is re-used.

Further incentives, including through the Eco-certification scheme, could be explored by the government to ensure more energy-efficient water use in this important industry.

21 Moglia, M., Cook, S., and Tapsuwan, S. (2018) Promoting Water Conservation: Where to from here?, Water, Vol.10, No.11, p.1510

22 Malta Business Bureau (2014) Recommendations – National Water Management Plan - EU LIFE+ Investing in Water Project

The 2nd WCMP includes a supplementary measure involving support mechanisms for research initiatives on greywater recycling systems for the domestic and commercial sectors.

*Investment in technology to improve irrigation efficiency*

The National Agricultural Policy for the Maltese Islands 2018-2028 noted that there is already wide use of efficient irrigation systems, including drip irrigation. Indeed, the most recent estimate available is that 52% of holdings apply drip irrigation, with 29% applying sprinkler irrigation and 19% using surface irrigation[23]. The data available to date indicates that there is still significant scope for investment in water efficiency in the agricultural sector. Hence, government is committed to further support farmers in transitioning to more efficient means of irrigation, in line with the Agricultural Policy measure to 'promote the development and financing of smart irrigation systems'.

Additionally, the Agricultural Policy identifies "sustaining water & key resources" as a strategic policy objective for the agricultural sector[24]. The policy defines the following measures which would support the LCDS referred to above:

- Consult, train, educate and inform farmers on a set of instruments aimed at improving crop selection, water use and its conservation and non-conventional sources of water;
- Promote the development and financing of smart irrigation system; and
- Conduct an economic and financial feasibility study on the introduction of irrigation systems that minimise evaporation and collect dew moisture through deficit irrigation strategies

It should be noted that, as Malta's grid carbon intensity decreases over time, the GHG emission abatement benefit of this measure associated with reduced energy demand for electric-powered pumps and new water production diminishes. However, the benefit of the investment in efficient irrigation in terms of resilience to water scarcity will remain relevant.

Regarding the timing of these measures it is assumed that all can be implemented before 2030.

23 Eurostat (2010) Share of holdings applying different irrigation methods 2010, accessed 22 May 2019, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Share_of_holdings_applying_different_irrigation_methods,_EU-28,_NO_and_CH_2010,_(%25).png&oldid=284096

24 Atriga Consult (2018) National Agricultural Policy for the Maltese Islands 2018 - 2028

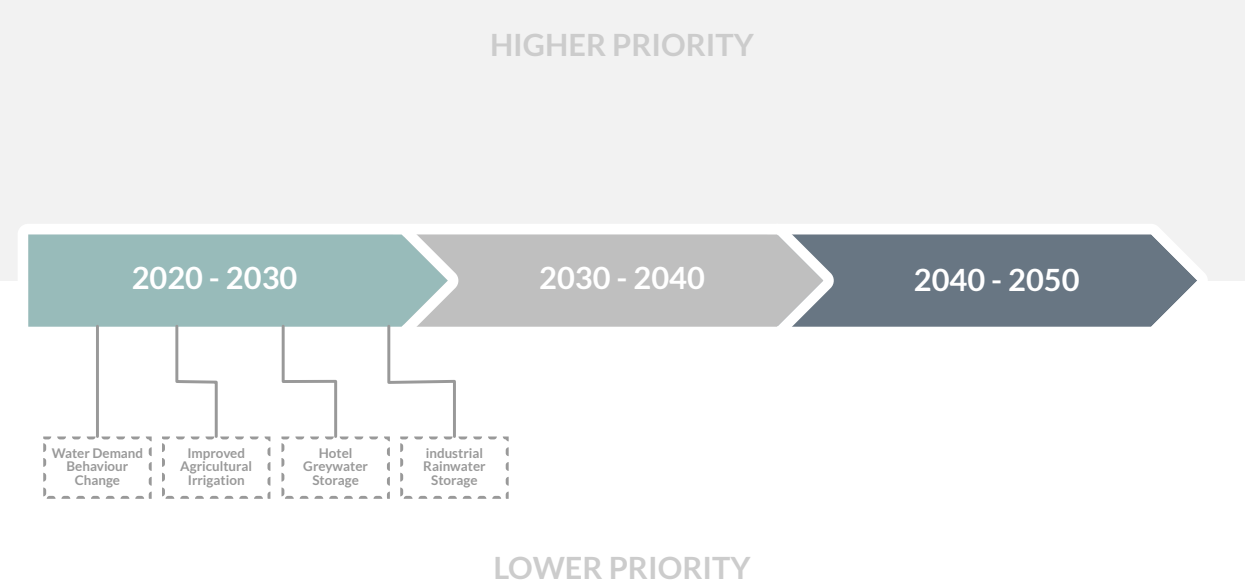



*Figure 16: Implementation timeline for water measures*

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

#### 2.6.7.1. Land use, land-use change and forestry

The LULUCF Regulation includes the removal and emissions of GHG from land use, land use change and forestry, requiring Malta to ensure that emissions from certain land uses are offset by at least an equivalent removal of CO2. This is known as the 'no debit' rule. Malta's specific circumstances create a challenging backdrop to the removal of emissions in the LULUCF sector.

High population density and limited land availability, combined with low rainfall, limit the potential of sequestration in new vegetation. The National Forestry Accounting Plan 2019 reported on Malta's planned levels of afforestation as well as the likely levels of sequestration achieved by these new forests as well as existing, still-growing forests[25]. The total sequestration potential was in the order of 10 ktCO2e/yr, which is an immaterial amount when considering the total territorial emissions orders of c. 1,000 ktCO2e/yr.

Given the competition for land use in the Maltese archipelago, additional land on the required scale is deemed unrealistic, and therefore no such mitigation/ offsetting measure was included in this LCDS. This does not, however, take away from the value that such efforts do provide in terms of ecological and adaptation value, as ecosystem restoration will be important in bolstering and strengthening the islands' ecology.

25 Malta Resources Authority (2019) National Forestry Accounting Plan Containing Malta's Forest Reference Level, Report for Ministry for Environment, Sustainable Development and Climate Change, 2019

### 2.6.7.2. Agriculture - Estimated emissions reductions and Implementation timeline

Data indicates that the potential abatement in this sector is small compared to other sectors. Nevertheless, two measures were still considered in this LCDS. The potential future use of a vaccine which targets methane-producing microorganisms in the rumen of livestock is considered as a long term measure. In addition, a diversification measure involving the commercial scale use of aquaponics-based food production in place of conventional agricultural production of 36% of fruit and vegetable produced in Malta.

Table 8 details the abatement potential calculated to arise as a result of putting in place the package of measures being proposed. The data shows that the potential abatement is modest compared with other sectors. Implementation of this package of measures will come at a net cost in 2050, that is, over the long-term time horizon of the LCDS. Investment costs would also need to be incurred at the start of the measures' implementation.

| | Abatement Potential, tonnes CO2e / year | | |
|---|---|---|---|
| | 2030 | 2040 | 2050 |
| **Total** | **0** | **4,933** | **6,762** |

*Table 8: Agriculture Measures Abatement Potential*

### 2.6.7.3. Agriculture - General overview of policies, existing plans and measures for decarbonisation

**Policy developed - National Energy and Climate Plan**

*Modification of ruminant diets*

There are other additional measures which could be considered beyond 2030 to further reduce emissions from enteric fermentation. One such measure is the modification of ruminant diets in the dairy and beef sectors, including through:

- improving the digestibility of forage;
- using high-fat diets; and
- using nitrate as a feed additive.

Of these three approaches, the use of a nitrate feed additive is anticipated to have the greatest potential impact upon enteric fermentation emissions. This measure involves the dosing of nitrate into the rumen of livestock which can then act as a sink for excess hydrogen, through conversion to ammonia, which would otherwise be available for production of methane. Nitrate is administered as a feed additive in the form of calcium nitrate. Thorough mixing with the rest of the feed intake is required, and so this measure is only

suitable for livestock fed a total mixed ration[26, 27 ,28]. Implementation might involve the creation of minimum standards for animal feed in terms of the nitrate content.

Improving the digestibility of forage and higher-fat diets should also be considered. There are already some efforts underway locally by the sole supplier of dairy cattle feed in Malta to optimise the fat content of cattle diets, considering the impact that fat content has on the milk produced[29]. In addition, progressive farms are exploring opportunities to improve the quality of forage in order to improve cows' average daily gain and reduce enteric methane emissions. Government will continue to monitor the progress of these efforts and facilitate knowledge sharing between farmers and feed producers to increase uptake of these measures.

*Methane-inhibiting vaccines*

Beyond the modification of ruminant diets, a potential future option which may be implementable after 2040 is the use of a methane-inhibiting vaccine which targets methane-producing microorganisms in the rumen of livestock (methanogens). Such vaccines are currently in the early stages of development, and a fully developed vaccine is not expected before 2030[30, 31]. However, it should be noted that the emergence of such a technology is, however, not guaranteed. If a vaccine is to be developed and obtain the necessary regulatory approval, it will need to overcome practical challenges such as ensuring the vaccine has no unintended adverse effects (e.g. reduced productivity, different product taste, compromised food safety). Additionally, in the EU, the European Medicines Agency regulates the use of veterinary vaccines, reviewing applications for market authorisation approval. Any prospective vaccine would need to clear this authorisation process. Regarding implementation, the cost to farmers is expected to be low - given that farmers already vaccinate livestock to prevent disease, adding another vaccine would be simple and cheap to administer.

*Manure and slurry management*

In terms of emissions arisings from manure and slurry, the Maltese Agency for the Governance of Agricultural Bio-Resources is updating and further developing its Agricultural Waste Management Strategy, to better manage livestock farms that generate slurry. A treatment option is to dewater the slurries and process the resulting liquid fraction and the solid fraction separately. The main emission reduction resulting from this measure will be through the stabilisation of the solid fraction while the liquid fraction will undergo further

26 Veneman, J.B., Saetnan, E.R., Clare, A.J., and Newbold, C.J. (2016) MitiGate; an online meta-analysis database for quantification of mitigation strategies for enteric methane emissions, Science of The Total Environment, Vol.572, pp.1166–1174

27 van Zijderveld, S.M., Gerrits, W.J.J., Apajalahti, J.A., Newbold, J.R., Dijkstra, J., Leng, R.A., and Perdok, H.B. (2010) Nitrate and sulfate: Effective alternative hydrogen sinks for mitigation of ruminal methane production in sheep, Journal of Dairy Science, Vol.93, No.12, pp.5856–5866

28 Eory et al (2015) Review and Update of the UK Agriculture Marginal Abatement Cost Curves

29 Personal communication with KPH Feed Mill

30 Subharat, S., Shu, D., Zheng, T., Buddle, B.M., Janssen, P.H., Luo, D., and Wedlock, D.N. (2015) Vaccination of cattle with a methanogen protein produces specific antibodies in the saliva which are stable in the rumen, Veterinary Immunology and Immunopathology, Vol.164, No.3, pp.201–207

31 New Zealand Productivity Commission(2018) Low-emissions Economy

treatment technologies.

*Aquaponics*

There are opportunities for Malta's agricultural sector to reduce its emissions through diversification of food production methods, shifting towards forms of agricultural production which require reduced inputs including fertilisers, water resources and energy relative to conventional agriculture. One such method is the use of aquaponics, a portmanteau of aquaculture and hydroponics, which combines these two agricultural techniques. An aquaponic agricultural system involves the recirculation of water from fish tanks through filtration units and into soil-less hydroponic beds in which crops are grown. Locally, the current aquaculture activity will be leveraged in order to feed into aquaponics activities. Features of aquaponics which lead to lower GHG impact per unit yield of fruit and vegetable include:

- no soil loss which might lead to emissions through loss of soil-organic carbon;
- heavily reduced synthetic fertiliser input; and
- reduced water use.

One area where aquaponics is more energy intensive than conventional agriculture is in the use of electricity due to lighting, aeration and pumping requirements. However, it should be noted that as Malta's grid carbon intensity decreases over time, the impact of this difference will be negated.

At present, the Maltese Diversification and Competitiveness Directorate is participating in an EU PRIMA Project called Self-sufficient Integrated Multi-Trophic AquaPonics (SIMTAP). The main goal of the project is to define, design, set up and test aquaponics systems that reduce fish feed inputs and other resource consumption including water and energy. The project intends to undertake a Life Cycle Assessment (LCA) to quantify the environmental impacts with greater certainty.

Once a system has been defined which can operate successfully in Malta, and with confirmed emissions abatement benefits, then government will provide support. The Diversification and Competitiveness Directorate might consider seeking funding to provide grants or loans for equipment and training programmes for those in horticultural and aqua cultural sectors to upskill so as to consider the use of aquaponics.

**The timing of measures**

Methane-inhibiting vaccines are currently in the early stages of development and so it is not anticipated that they would be implemented beyond 2030. It is also assumed that aquaponics systems would take some time to set up and for farmers to retrain, and so production is expected beyond 2030.

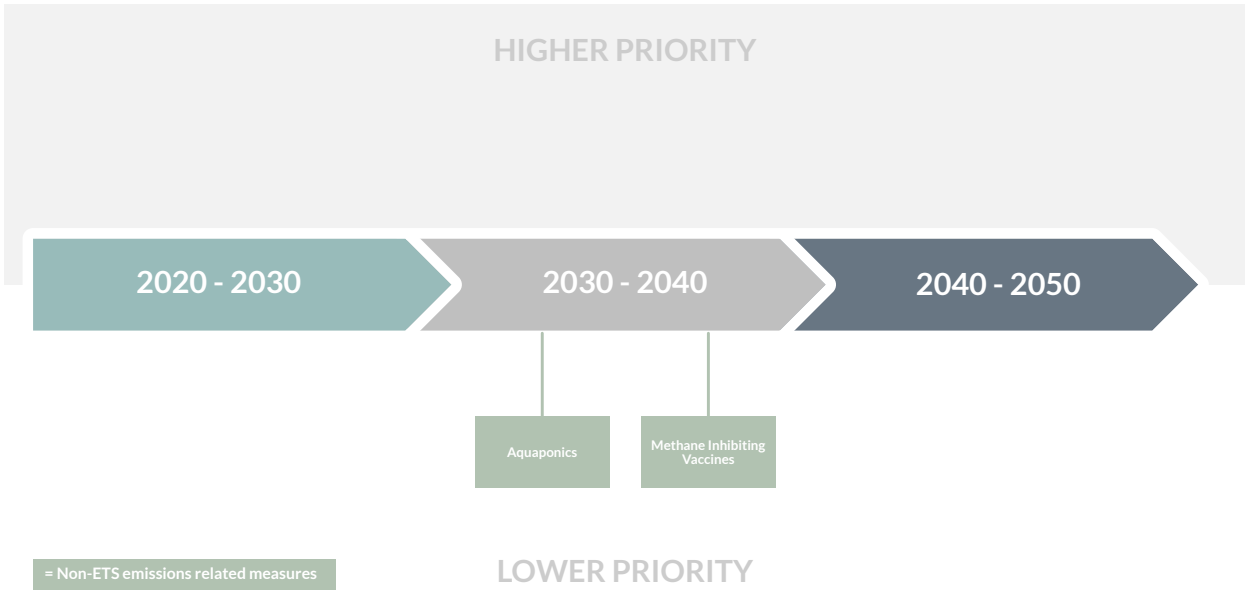



*Figure 17: Implementation timelines for agriculture and LULUCF measures*

# 3

# Adaptation

This section of the LCDS presents the adaptation measures for Malta, plotting out adaptation action needed in line with vulnerabilities identified.

CC is being witnessed globally and is posing new threats and challenges to all countries, especially small island states like Malta[32]. It is no longer a matter of 'if' or 'when' CC will happen, but rather 'at which intensity' and 'where it will hit worst'. In addition to the mitigation measures aimed at reducing carbon emissions discussed in previous sections of this LCDS, adequate adaptation measures to limit the effects and impacts of CC need to be strengthened and built upon. Even if GHG emissions had to be hypothetically stopped today, CC will continue for several years ahead, and its effects, on various sectors of the economy, will be further exacerbated. Adapting to such changes in weather and climate as a result of CC (such as change in temperatures, precipitation, and wind forces) have thus become indispensable if we are to sustain a good quality of life. Assessments have been carried out which explore the vulnerability of the Mediterranean region to CC, including one carried out by the Mediterranean Experts on Climate and Environmental Change (MedEC), and another which was published in the International Journal of Disaster Risk Reduction. The MECP is also currently carrying out a climate risk and vulnerability assessment for Malta.

The Climate Action Act enacted as part of the Maltese legislation in 2015 also puts forward the obligation on the country to adopt, and update periodically (at least every 4 years), a national adaptation strategy. Malta published a National Climate Change Adaptation Strategy in 2012, putting forward various measures. The strategy summarised the impacts of CC on specific areas and presented a set of actions. It covered risks and financial impacts; identifying the requisite legal framework; sustainability; water, agriculture; human health; tourism; communication and education. A review of the strategy's measures has been undertaken by MECP as part of this LCDS process, to take stock of progress, lessons learnt, and updates needed.

### 3.1. Adaptation priorities

Scientific evidence points towards a changing climatic scene[33], on a global, regional (including the Mediterranean region), as well as local level. In line with global and regional forecasting models and trends of CC, various studies point towards four major general effects on countries, including our islands:

- Higher temperatures;
- Change in precipitation patterns;
- Sea level rise; and
- Ocean acidification and warming.

Based on a vulnerability assessment referred to in the latest national communication of Malta under the

32 World Health Organisation (2018). Climate Change increasingly affects small countries. Retrieved from: http://www.euro.who.int/en/countries/malta/news/news/2018/06/climate-change-increasingly-affects-small-countries

33 Stocker, T. et al. (2013). Technical Summary. Climate Change 2013 - The Physical Science Basis: Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. s.l. Cambridge University Press

UNFCCC (i.e. the Seventh National Communication of Malta prepared in 2017), a number of sectors were identified as being of priority in terms of the current status of resources and activities. These sectors, shown below, were deemed as requiring the most attention when devising adaptation measures due to their current vulnerability and likely proneness to suffer from the effects from CC:

A. Water Resources
B. Infrastructure and Transport
C. Land Use and Buildings
D. Natural Ecosystems, Agriculture and Fisheries
E. Health issues and Civil Protection
F. Tourism
G. Cross-sectoral[34]

Based on research and stakeholder discussions, the major risks and vulnerabilities have been identified, for each sector, through an impact-likelihood matrix. The use of an impact-likelihood matrix allowed for the assessment of the importance of CC risks based on the gravity of their impact and the likelihood of them happening. This enabled the identification of the risks which should be addressed first, in terms of priorities. Such adaptation priorities per sector are hereby outlined.

**A. Water resources**

The Maltese islands, with their semi-arid Mediterranean climate, suffer from a general lack of rainfall in summer and a lack of exploitable surface waters. Groundwater is the only natural freshwater source which is available all year round, and this has increasingly suffered from a degradation in quality due to nitrate pollution and sea water intrusion. Since the 1980s, Malta has had to utilise desalination of sea water to supplement its supply of potable water. Due to water scarcity, CC effects on water resources are a big concern for the country. CC can impact the hydrological cycle[35]. Specifically, as extreme storm events increase, and flash floods become more common, the ground will become saturated more quickly, reducing the time for water to percolate to the water table. This lack of absorption, unless properly managed, could also inevitably lead to greater run-off, leading to floods (and damage to infrastructure and property).

*Changing rainfall patterns resulting in flooding, decrease in aquifer recharge and increase in rainwater runoff*

34 This additional category was added to account for risks/vulnerabilities and measures which would have a cross-cutting nature amongst different sectors.

35 Ministry for Resources and Rural Affairs (2010). The Second National Communication of Malta to the United Nations Framework Convention on Climate Change.

**B. Infrastructure and Transport**

More intense and frequent extreme weather events, such as storms, high winds, and choppier waters, could **disrupt air and sea transport activities**. Being a small island with no land connections with other countries, Malta is entirely reliant on supplies – including food - being transported by air and sea from its trading partners. The effects of CC on this aspect are likely to lead to: increased maintenance to aircraft, airport systems and air navigation systems and landside areas; greater downtime for cargo ships and operations, port operations, cruise liners, and smaller vessels; and increased energy cooling costs for aircraft and airport transfer vehicles.

Intense rains and floods are likely to cause **transport re-routing** and congestions. In addition, increased temperatures might make transportation (including active modes of transportation) uncomfortable, whilst also leading to increasing costs of cooling for passenger and commercial vehicles delivering goods.

CC is also likely to lead to **damages to road and maritime infrastructure** due to torrential rains, floods, wind velocity, sea level rise and extreme heat. This could lead to increased maintenance and replacement costs, increased inconvenience, and road safety hazards to the public (e.g. power cuts, increased accidents, road closures and reduced mobility as well as increased pressure on alternative roads, deformation of bridges as well as damage to marina pontoons and buoys, amongst others). **Current adaptive infrastructure** might be insufficient or inadequate as intense storms become more frequent.


**C. Land Use and Buildings**

**Coastal erosion, leading to more hazardous rocky coastal zones**, is a key CC effect. Malta's land area is extremely limited – a situation which is worsened by the island's very high population density. The natural processes of erosion will be quickened due to CC, making the coastal zones more dangerous as rocks will loosen (with the risk of falling and injuring the public).

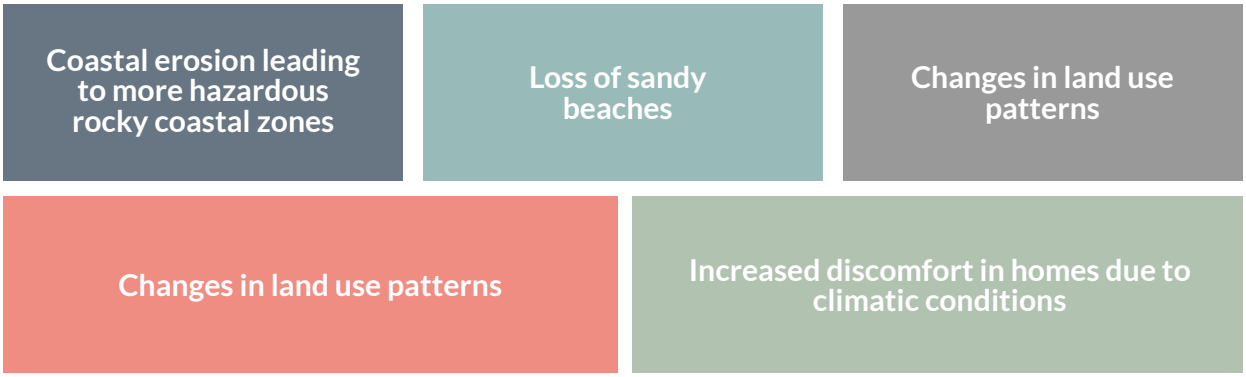
Another risk is that of the **loss of sandy beaches**. Mean sea level rise, other adverse weather conditions and the fact that the island is tilted to the east, all contribute to the fact that low-lying zones will be adversely hit and that sandy beaches might end up being (partly) lost.

A third risk is that **low-lying coastal areas will be affected by sea level rise and storm surges** impacting man-made structures (e.g. recreational establishments, tourist attractions, domestic residences, promenades etc.).

Increase in temperatures, drought, salinization of soil and the loss of soil (due to increased run-offs due to

flash floods or wind) will all lead to inevitable **changes in land use patterns**. Fields could become smaller and fertile land could decrease, reducing its ability to absorb rainwater.

Finally, the **possibility of increased discomfort in homes due to climatic conditions** will increase. Such discomforts could include excessive heat; easier and more frequent flooding of underground and ground floor levels; risk of damp walls and increased mould; and humidity, amongst others.




**D. Natural Ecosystems, Agriculture and Fisheries**

CC will lead to a number of risks related to agriculture and ecosystems. As witnessed by recent extreme weather events in Malta (e.g. February 2019), CC can cause significant damages to **production resources such as farming equipment, glasshouses, and buildings**, impacting operations and livelihoods of workers in the industry.

As sea levels rise, low-lying coastal areas are increasingly being inundated with saltwater, gradually **increasing soil salinisation and impacting negatively most soil parameters** (e.g. reduced nutrient level, reduced soil organic matter, soil potassium (fertility), soil biodiversity, soil moisture). This affects production in crops, pastures and trees, interfering with nitrogen uptake, reducing growth, and stopping plant reproduction.

CC can lead to **soil erosion, reducing carbon stocks or carbon sequestration in soil**. Previous sections of the LCDS already highlighted that Malta has inherent limitations in its offsetting potential, and CC further exacerbates this situation. Soil erosion reduces the effectiveness of soil to capture carbon and provide a solution for long-term storage of atmospheric $CO_2$.

**Deterioration and loss of biodiversity, native species, ecosystem, and habitats** can also be magnified by the introduction of new invasive species, lack of rainfall, increased temperature and drought, increased wind, and extreme weather events. Therefore, while CC will exacerbate the natural loss in land area due to natural factors, in the case of natural ecosystems, CC will worsen negative effects of anthropogenic origin.

Extreme heat could also lead to thermal stress of livestock, whereby animals are unable to maintain an ideal

body temperature due to ambient temperatures, leading to illnesses and/ or death. This will decrease yields for farmers or lead to higher financial costs needed to keep livestock refreshed.

Such changes in weather could also impact the post-production and post-harvest processes such as drying, storing, and transporting of produce (especially of perishable items, which also impacts the profitability of the system). This is because higher ambient temperatures make it harder to keep produce at the required safe temperatures whilst they are prepared, stored and transported.

Farming will also be made more difficult due to **difficulties in pollination**, because of early germination/ budding and a longer growing period. The warming of the earth's climate causes plants to bloom earlier, which results in some plants not getting pollinated. Decreased pollination will also lead to decreased flora.

Considering the limited water resources, higher temperatures and longer periods of drought will inevitably lead to greater demand for water and hence, will lead to **increased competition for water use** and greater pressures on the water supply.

Harsher weather conditions might lead to more **farmers abandoning their land since profitable farming becomes more arduous and less attainable**. The above-mentioned complications to the farming industry might not make it worthwhile for farmers to continue to work their land.

| | | |
|---|---|---|
| Damage to production resources caused by hail, storm or lightening | Increased soil salinization and negative impact on most parameters | Soil erosion leading to reduced carbon stocks/ carbon sequestration in soil |
| Deterioration /loss of biodiversity native species, ecosystem and habits | Thermal stress for livestock | Impacts on post-production and post-harvest processes and profitability |
| Increase in abandoned land by farmers | Projected difficulties in pollination | Increased water use for agriculture |

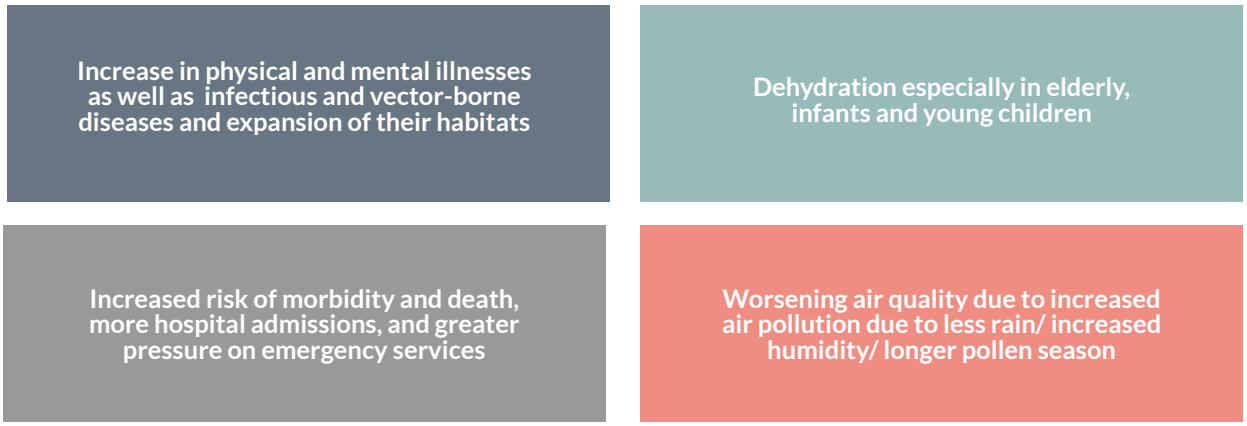
### E. Health and Civil Protection

CC is also bound to have an impact on health; the negative effects of CC on human change are well-documented[36, 37, 38]. **Illnesses are bound to increase**. These could be physical ailments such as respiratory diseases, increased risk of developing cancer and direct diseases such as cardiovascular diseases, mental health illnesses (e.g. trauma from extreme weather events) as well as infectious and vector-borne diseases (increasing due to warmer climates).

As temperatures rise and the frequency of heatwaves increase, the **risk of dehydration, especially in elderly, infants and young children** is likely to rise. The increase in water demand and greater stressors on water resources might lead to price pressures.

CC might lead to **increased morbidities and mortalities, more hospital admissions, and greater pressure on emergency services**, especially amongst vulnerable individuals, increasing pressures both on patients and their families. The adverse effects of CC on morbidity and mortality can be both direct, and indirect. Financial and human resource pressures will also increase in terms of health public services (e.g. hospitals) and emergency operators (e.g. Civil Protection Department (CPD)).

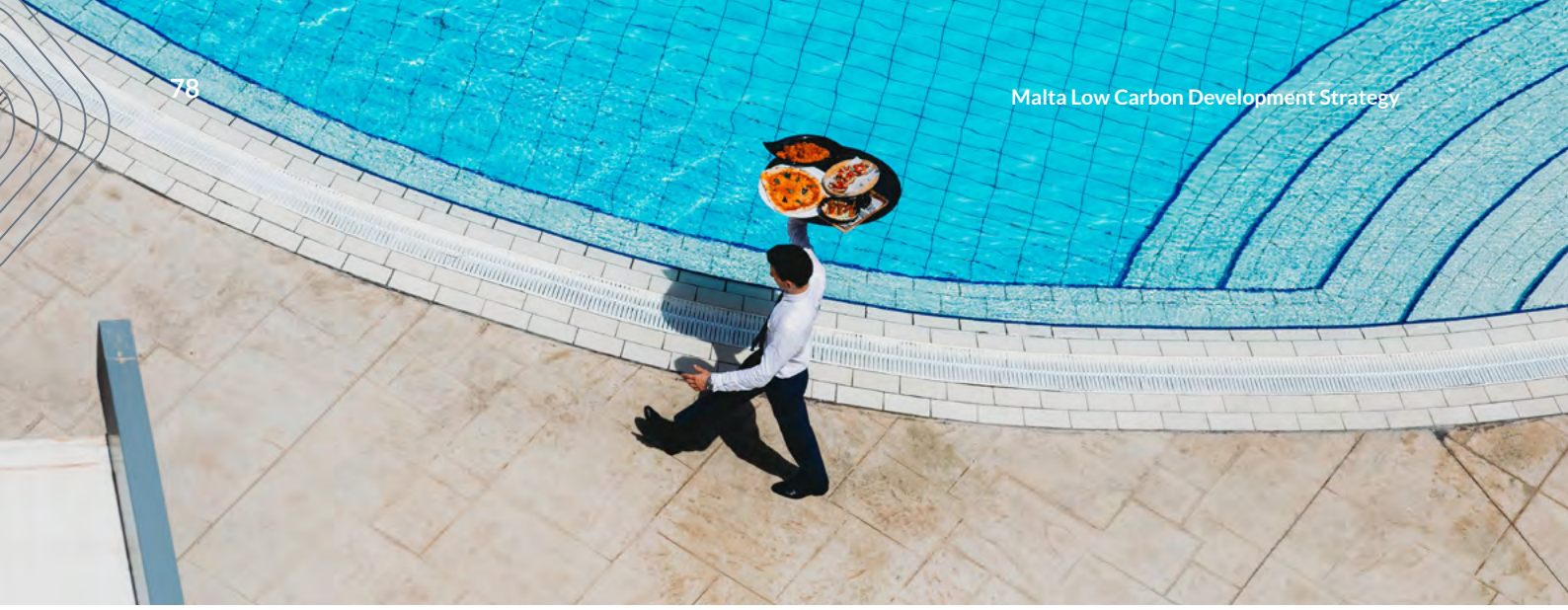
CC will also lead to **worsened air quality due to increased air pollution from less rain/ increased humidity and longer pollen seasons**. This will impact people suffering from allergies and other respiratory diseases, whilst also decreasing productivity.




36 Scientific American (2017): Doctors Warn Climate Change Threatens Public Health, accessed 6 January 2021, https://www.scientificamerican.com/article/doctors-warn-climate-change-threatens-public-health/

37 The Guardian (2019): Australian Medical Association declares climate change a health emergency, accessed 6 January 2021, https://www.theguardian.com/australia-news/2019/sep/03/australian-medical-association-declares-climate-change-a-health-emergency

38 The New York Times (2016): Global Warming Linked to Public Health Risks, White House Says, accessed 6 January 2021, https://www.nytimes.com/2016/04/05/us/politics/climate-change-health-risks.html



### F. Tourism

The increased temperatures, increased probability of heat waves, and the possible accompanying drought during the summer months (June-August), could lead to a **shift of tourists northbound of Malta during the summer months and the lengthening of shoulder months**.

Additionally, **hardship for individuals working in the industry will increase due to greater exposure to higher temperatures**. Individuals working outdoors such as drivers, tour guides and ferry operators will be faced with harsher weather conditions, impinging on their productivity and health.

CC will also **change tourists' behaviour during their stay**. They might start to demand more indoor and/or night-time activities, leading to businesses to have to adapt their products and services accordingly.

| | | |
|---|---|---|
| Shift of tourists northbound during the summer months and lengthening of shoulder months | Hardship for individuals working in the industry (e.g due to greater exposure to higher temperatures) | Change in tourists' behaviour during their stay |

### G. Cross sectoral

CC is likely to lead to **increased regulations and related costs to counteract its effects**, for both the public and private sector.

| |
|---|
| Increase in regulations and costs to counteract CC effects |

In summary, the following are the risks which should be prioritised when looking at the relevant adaptation measures to be implemented.

| | |
|---|---|
| **Water Resources** | ■ Changing rainfall patterns resulting in flooding, decrease in aquifer recharge and increase in rainwater runoff |
| **Infrastructure and transport** | ■ Disruption to air and sea transport and maritime activities<br>■ Damaged infrastructure<br>■ Discomfort during road transportation<br>■ Inadequate current infrastructure |
| **Land use and buildings** | ■ Coastal erosion leading to more hazardous rocky coastal zones<br>■ Loss of sandy beaches<br>■ Low-lying coastal areas affected by sea level rise and storm surges<br>■ Changes in land use patterns<br>■ Increased discomfort in homes due to climatic conditions |
| **Natural Ecosystems, Agriculture and Fisheries** | ■ Damage to production resources such as farming equipment, glasshouses and buildings<br>■ Increased soil salinisation, and negative impact on most soil parameters<br>■ Soil erosion leading to reduced carbon stocks or carbon sequestration in soil<br>■ Deterioration/loss of biodiversity, native species, ecosystem and habitats<br>■ Thermal stress for livestock<br>■ Impacts on post-production and post-harvest processes and profitability<br>■ Increase in abandoned land by farmers as higher temperatures makes farming unattractive<br>■ Difficulties in pollination<br>■ Increased water use for agriculture |

| | |
|---|---|
| **Health and Civil Protection** | ■ Increase in illnesses (including mental health illnesses) / infectious and vector-borne diseases and expansion of their habitats<br>■ Increase in physical ailments such as respiratory diseases, increased risk of developing cancer and chronic diseases such as cardiovascular diseases<br>■ Dehydration risks, especially in elderly, infants and young children<br>■ Increased risk of morbidity and death, more hospital admissions, and greater pressure on emergency services<br>■ Worsening air quality due to increased air pollution from less rain/ increased humidity/ longer pollen season |
| **Tourism** | ■ Shift of tourists northbound during the summer months and lengthening of shoulder months<br>■ Hardship for individuals working in the industry due to greater exposure to higher temperatures<br>■ Changes in tourists' behaviour during their stay |
| **Cross Sectoral** | ■ Increase in regulations and related costs to counteract CC effects |

*Table 9: High priority risks and vulnerabilities*

The above risks and priorities outline the most pressing issues which are already present and/or will materialise through CC. The adaptation measures being proposed in this LCDS are measures which seek to directly address such issues.

### 3.2. Challenges, Gaps and Barriers to adaptation

Before delving into the actual adaptation measures being proposed, it is worth nothing that there are a number of challenges and barriers which act as limitations when designing and implementing adaptation strategies. Some of these limitations are common globally, whilst others are more specific to Malta.

One of the major challenges when it comes to designing adaptation strategies is the uncertainty and insufficient knowledge in terms of the spatial (where) and temporal (when) patterns of CC impacts. Not knowing where and when the impacts will materialise often limits the accurate design of effective adaptation

measures. MECP has commissioned a vulnerability and risk assessment to identify the climate vulnerabilities of the country and sectors, filling the gaps of knowledge in spatial and temporal patterns and their effect on society and economic activities.

The lack of reliable CC forecasts is exacerbated in the case of Malta. This is because the European and South Mediterranean forecasts available are too high level to be able to extrapolate relevant data for such a small island state. Moreover, this research area remains highly understudied locally, exposing a lacuna in data and information required for effective policy making.

Adaptation measures are not to be implemented in a vacuum, but rather in a dynamic and ever- changing community. Hence, uncertainties with regards to future socio-economic trends as well as policy responses will inevitably lead to a difficulty in drawing up effective adaptation measures. This means that once the strategy is drawn up, constant monitoring and updating will be needed in line with the changes in the socio-economic state of the country.

Moreover, the benefits of measures are dependent on their actual implementation and uptake. Not knowing the policy response makes it difficult to outline future benefits vis-à-vis the costs of a measure, metrics which are usually indispensable when proposing a policy.

Adaptation measures are often characterised by immediate costs of implementation, while benefits only materialise in the long run. This means that adaptation measures cannot be approached through a short-term view or a short legislative time period. Rather, a long-term approach is being considered. Government will work with scientists and academics to ensure such a long-term approach is adopted. At the same time, short-term responses will also be needed given the immediate CC impacts already being felt.

Measures will also have to be implemented across various sectors, since CC will impact a variety of economic activities. However, different sectors might have conflicting agendas in terms of which policies should be implemented and in which order. Government will look at mainstreaming CC adaptation measures across all governmental policies, in order to benefit from synergies.

### 3.3. Adaptation measures

Within the context of the aforementioned risks and challenges, setting an adaptation strategy is vital to ensure that CC impacts do not impinge on the quality of life of Malta's citizens. Moreover, the cost of inaction will be much higher than preventive action today; therefore, it becomes imperative to outline a number of necessary adaptation measures.

In order to make sure that adaptation measures are relevant for Malta, a review of past and current policy documents was carried out. The subsequent bottom-up stakeholder consultation process with Line Ministries and other relevant stakeholders has informed this Strategy with realistic measures which are already being

implemented or can be considered for future implementation[39]. Adaptation measures were chosen on the basis of their benefits/impacts, implementation processes and financial considerations.

The final measures being proposed range from studies and awareness campaigns to infrastructural investment. This approach will ensure that the knowledge gap in terms of CC is bridged, whilst at the same time undertaking direct and more immediate measures to minimise the negative CC effects on our islands. The next tables describe the adaptation measures proposed to address the aforementioned prioritised risks. Some of these measures are already being undertaken as they fall under other sectoral strategies and action plans that are in their implementation phase.

**A. Water Resources**

| Title of Measure | Description |
|---|---|
| Surveying and managing existing rainwater harvesting infrastructure | Surveys of the status of existing relevant infrastructure (e.g. public reservoirs, wells), including the identification of the potential users of such rainwater. |
| Monitoring of borehole water usage | Continue monitoring of boreholes and water abstraction. |
| Further enforcement of legislation mandating rainwater capture reservoirs or wells | Ensure that all new developments are provided with a water reservoir which is to be connected to a pump to connect to second class distribution system, enabling each dwelling to store and re-use its rainwater run-off from its own built-up area. |
| Extend the Domestic Cisterns Restoration Scheme | This scheme, originally put in place in 2013, is to be further extended. Government will also consider support to cover for costs of households who hold a cistern but need to redirect the water for use. |
| Incentive schemes to construct/ rehabilitate existing reservoirs to capture rainwater for re-use (irrigation and other appropriate uses) | Increasing incentives to help farmers and landowners to increase the presence and use of reservoirs. |
| A comprehensive study of the current hydrological cycle monitoring capacity and new hydrological data modelling and management | Study to better understand the hydrological cycle (e.g. rainfall, run-off, evaporation) and review whether gaps in data collection exist. |

39 A list of such stakeholder consultations is provided within Annex 6.1 - 1.4 Adaptation Assessment.

| | |
|---|---|
| Studies to identify new areas for water catchment infrastructure | Studies to identify new areas where reservoirs and retention systems can be developed (preferably located within the urban context and within existing committed road network infrastructure) to increase the local water storage capacity, collect water run-off and decrease flooding, whilst creating an additional water supply. These studies will possibly include the identification of the best-suited sustainable urban drainage systems for the Maltese Islands, more specifically infrastructure developments that employ design techniques to reduce water run-off as much as possible. |

*Table 10: Adaptation measures – water resources*

**B. Infrastructure and Transport**

| Title of Measure | Description |
|---|---|
| Energy Efficiency Standards (infrastructure) | Support EE standards for infrastructure, through both legislation and economic incentives. EE measures relate to both mitigation and adaptation. |

| | |
|---|---|
| Study on green infrastructure in Malta | A study to identify a list of different possible green features (e.g. added trees on the sidewalk to provide shade, parks, community gardens, green benches, and green roofs on bus-stops) as well as integration of green infrastructure (including at ports) and further introduction of green urbanisation (projects and areas) [40], their cost (capital cost as well as ongoing costs, including maintenance) and the potential benefits for each. Scenarios where such green features, and integration of green infrastructure were considered a success, would also be included. This will tally with the work of the Intelligent Planning Consultative Forum, a platform wherein stakeholders in the development, planning and environment areas are brought together to identify proposals for key areas which necessitate action in terms of intelligent planning. The Forum has recently prepared a study on green walls and green roofs, which indicated that these could be of benefit to Malta. |
| Review of Storm Water Master Plan; including updated list of areas prone to flooding | Reviewing and updating of current measures in 2008 Masterplan, including lists of vulnerable areas to link up with list being drawn up by EWA in terms of flood prone zones. The update should also seek to evaluate the impact of infrastructure on future scenarios, such as population growth and increased construction. |
| Ongoing assessment to optimise flooding pathways and "emergency water ways" | Updated assessment and studies to identify new flooding pathways and water ways and integrate reservoirs into the road landscaping to act as a water catchment area which would cushion and avoid urban flooding, whilst allowing for more seepage into the aquifer. |
| Modify standards for road materials to be able to cope with higher temperatures and extreme precipitation events | Amend standards on materials used for roads, including those used for pavements and embankments, to ensure that these endure high temperatures whilst also being able to increasingly soak in more precipitation. |
| Modify technical standards for capacity of flood infrastructure | Explore new ways of expanding the capacity of current flood-relief infrastructure, such as higher flood barriers as well as wider flood relief tunnels or additional tunnels. |

40 Recently, government has pushed on soft urbanisation (greening of roundabouts), and is moving towards green urbanisation projects such as the carbon-neutral park at Kalkara's Rinella Garden, and a green open space for families at Mosta (previously scheduled for development).

| | |
|---|---|
| Identify and screen critical risks and concerns for i) the aviation sector and airports; ii) maritime sector and ports | Identify and screen major critical risks and concerns for the aviation sector and airports (e.g. surface access to airports) as well as the maritime sector. |
| Introduce maritime weather stations in ports to record trends of major parameters | Develop port weather stations and data collection buoys to collect information in relation to the major sea climate parameters, such as sea temperature, sea level rise and wave strength. |
| Improvement of Harbour Wave Climate | Harbour Wave Climate refers to wave parameters (e.g. height, strength) over a period, within a harbour. Such climate can be improved through measures such as breakwaters (new and upgrades) and installing rip rap breakwaters, amongst others, to make operation of ports more viable. |

*Table 11: Adaptation measures – Infrastructure and Transport*

**C. Land use and buildings**

| Title of Measure | Description |
|---|---|
| Joint MSWU, PA and TM initiatives | Entities such as the Planning Authority (PA), Transport Malta (TM), Infrastructure Malta (IM) and the Marine, Storm Water and Valley Management Unit (MSWU) to continue coordinating operations, especially in the design of new roads and new developments. |
| Identify high risk/vulnerability areas in Malta and apply appropriate treatment | Project to identify major vulnerable areas with regards to the most important CC indicators (e.g. sea level rise, floods, coastal erosion). |
| Integrated policy framework for coastal zones and beaches | A national policy framework to address the coastal quality, ecology, access, beach activities and beach replenishments will be undertaken as one integrated plan. |
| Raise awareness to reduce trampling and compaction of land | Carrying out an awareness program to reduce the trampling and compaction of vegetation, soil and wetlands locally. |
| Research examining the climate status of public buildings | Identify climate proofing retrofitting measures for public buildings. |

| | |
|---|---|
| Study on green buildings in Malta | The study should highlight various features of green buildings such as materials to be used (e.g. permeable and insulating surfaces), techniques and designs. It will also highlight the benefits derived from such new ways of building. |
| Update building regulations and codes to ensure climate proof buildings | Following a consideration of cost-effectiveness, update building codes and regulations to ensure that new developments have enough cushion for CC and extreme events such as heat waves, storms and/or floods, thus guiding developers to follow minimum building standards to ensure CC adaptation. |
| Create incentives to incorporate green features and measures in buildings | Incentives to ensure that green features are included in both existing and new buildings such as fiscal incentives to incentivise green roofs and rooftop gardens, controlled ventilation, grey water usage and rainwater catchment, amongst others – without replacing existing soft landscaping, such as front gardens, in the urban environment. |
| Quality Seal (Considerate Construction Scheme) for building contractors | 'Considerate Construction Scheme' represents a quality seal to encourage construction processes that are considerate of the surrounding households and environment and that they are acknowledged for this (e.g. adequate site hoarding; emission prevention techniques). |
| Land use management to be adapted to the changing climate | Any land use management plan should take into account the need for agricultural areas, as well as bare land to soak in water from floods. |

*Table 12: Adaptation measures – Land use and Buildings*

**D. Natural Ecosystems, Agriculture and Fisheries**

| Title of Measure | Description |
|---|---|
| Strengthened ties between the ERA, RDD, AM and UM's Institute of Earth Systems | The RDD, together with ERA and AM, shall continue building upon the current institutional links with the UM Institute of Earth Systems to spur further research on how CC affects Maltese agriculture and how agriculture can suitably adapt to and mitigate these effects. |

| | |
|---|---|
| Encourage the use of EU funds for adoption of technologies | Encouraging the use of EU funds, especially those under the RDP, as a complement to national and private funding and initiatives, for the adoption of innovative technologies (e.g. hydroponics) and greater R&I that can increase farm competitiveness (and at the same time responding to CC). |
| Study and implementation of maintaining Maltese agro-ecosystems through the management of agricultural landscapes | Undertake further research into Maltese agro-ecosystems, whilst investing further into the maintenance of current ones – by transforming current unsustainable practices into ones carried out with an ecosystem approach to lower GHG emissions and enhance the health of the surrounding biodiversity, while obtaining better produce. This involves managing agricultural landscapes, for instance, by preserving ecological integrity and the scenic value of landscapes. |
| Following the completion of the National Agricultural Policy 2018-2028, devise more detailed action plans for each high-level CC-related measure | To further ease the implementation of those measures that could have a CC element, government will ensure that coherent action plans addressing these measures are implemented. |

| | |
|---|---|
| Implement good sustainable farming practices (e.g. wind curbing, soil conservation techniques, cultivation methods) | Implementation (through research and experimentation) of wind curbing and soil conservation techniques (e.g. rubble walls) that are suitable for local climatic conditions, including the protection of green water. Also, carry out research and experimentation on new crops that require less water and fertilizer requirements, and which have a higher economic return. Study (and support) the introduction of innovative) cultivation methods and facilities to avoid heat damage. |
| Implementation of the National Strategy on Invasive Alien Species and promotion of complementing, sector-specific Codes of Best Practice | Adopt and implement the national strategy and appropriate contingency plans, as well as Codes of Best Practice, to deal with the threat posed by alien and invasive species, which could also have significant health and economic implications – primarily in avoiding the introduction of invasive alien species in order to protect and conserve local biodiversity, habitats and ecosystems. |

*Table 13: Adaptation measures – Natural Ecosystems, Agriculture and Fisheries*

**E. Health and Civil Protection**

| Title of Measure | Description |
|---|---|
| Strengthen the continuous and rigorous surveillance of infectious diseases, including through additional expertise | To continue to assess and identify measures required to strengthen the ongoing rigorous surveillance of infectious diseases and their vectors, so as to prevent any possible outbreaks of CC related vector-borne diseases, by identifying early risk signs. Such measure will also help to identify early-control systems and contingency plans, as well as additional expertise required. |
| Maintain and strengthen education programmes relating to food safety and the climate scenario | The MFH Food Safety Commission and the Environment Health Directorate will continue to maintain and, where appropriate, strengthen programmes directed at reducing potential risks on food safety. This is especially relevant given that the projected climatic scenario for the Maltese islands shows a potential adverse effect on food safety, with the subsequent risk of food-borne illness. |

| | |
|---|---|
| Allow additional breaks for people working outdoors | For people working outdoors, such as those in the construction industry, the MFH, in collaboration with the OHSA, can raise awareness/ promote (and potentially enforce regulations on) the need for appropriate attire/ protection and possibly additional breaks for people working outdoors. As heatwaves increase, this measure will have positive impacts by reducing health issues such as dehydration, skin diseases, and heat strokes, while contributing to increasing productivity of employees in the remaining working hours. |
| Improve health information and knowledge for the development of environmental health information systems | This measure relates to the augmentation of the already existing 'local health information system', collecting information and data such as urban air pollution, reactions during heat waves, and onset of flower pollen distribution which might lead to allergies. This could assist relevant authorities to come up with, for instance, guidelines of how to keep the home cooler (e.g. increase external shading, electric fan, mobile evaporation coolers), recommendations for public health response to heatwaves, as well as how to anticipate health issues such as allergies and asthma. |
| Strengthen the entire public health infrastructure to prevent illnesses and health issues | Public health infrastructure to continue to be strengthened to make sure that the overall public sector is able to decrease illnesses and health issues derived from CC (including mental issues e.g. climate anxiety), whilst decreasing hospital admissions, and pressure on emergency systems – whilst also having potential knock-on effects on worker productivity. This can be done by:<br><br>(i) upholding standards in homes and residences for older persons<br>(ii) enable the possibility of residents to enjoy living in their family home for as long as possible through more community services |
| Develop a National Contingency Plan which outlines processes and best practices of what will occur when extreme weather events hit the islands | A national plan, drafted with the help of emergency units such as the CPD, and guided by results of studies that identify hotspots and best emergency routes, will outline the plans and courses of action that will need to be followed in case an emergency, such as heatwave of extreme floods, occurs. |

| | |
|---|---|
| Drinking water fountains | This measure refers to the distribution of drinking water fountains in public areas, including touristic areas. |
| Vaccinations for new CC-related diseases | According to the WHO, vaccine hesitancy, and CC, are amongst the top 10 threats to global health in 2019[41]. In this regard, the MFH will always be open to the possibility of eventually providing vaccinations related to any new CC-related diseases. |

*Table 14: Adaptation measures – Health and Civil Protection*

**F. Tourism**

| Title of Measure | Description |
|---|---|
| Increase awareness of CC effects within the hospitality industry | Carry out a tailored awareness program, directed specifically at informing industry operators, on the potential CC effects on operations and solutions to the problem (e.g. sustainable/ eco-tourism practices). Through this knowledge sharing, the market will be better equipped to respond to such changes. |

*Table 15: Adaptation measures – Tourism*

**G. Cross sectoral**

| Title of Measure | Description |
|---|---|
| Update policies with CC considerations | Any new strategies/ policies/ updates to existing government documents will reflect CC considerations, where applicable. |
| Promote self-sufficiency skills to increase resilience against CC | Programs to help individuals develop self-sufficiency skills and be more resilient and autonomous (e.g. growing one's own crops, learning how to bike, getting off the grid). |

41 Winsor, M. (2019). Vaccine hesitancy, climate change, Ebola among top 10 'threats to global health' this year, WHO says. Retrieved from: https://abcnews.go.com/International/vaccine-opponents-climate-change-ebola-top-10-threats/story?id=60438329

| | |
|---|---|
| Survey to gauge level of CC understanding in Malta | Study to understand the current CC knowledge and awareness amongst the local population, including willingness to accept adaptation measures. |
| Joint initiatives between MCST and MECP | Joint initiatives to assist RDI initiatives focused on CC adaptation measures. |
| Create an 'online community' where entities can share their knowledge on CC as well as possible adaptation measures | Setting up/ expanding the current digital workspace whereby any government entity can join an online community to contribute and share knowledge with regards to CC adaptation measures best practices. |
| Ensure that maintenance regimes in different sectors consider CC | Any maintenance carried out on any vulnerable assets (including infrastructure such as roads and bridges as well as machinery) which are possibly impacted by CC should consider maintenance agreements/ arrangements that take into account such CC impacts. |
| Improve weather forecast and early warning systems for extreme weather events | New technologies and assistance to improve forecasts and early identification of extreme weather events. New warning systems to allow for easier and quicker dissemination of alert signs to the public will be considered. |
| Carry out vulnerability assessments to identify where the greatest efforts should be made in terms of adaptation | Vulnerability assessments to identify the most vulnerable areas and economic sectors which will be impacted, to focus adaptation efforts right where they are needed. |
| Awareness campaigns regarding CC and changing risk situations, supporting climate-conscious choices | Continue to raise awareness amongst the population with regards to CC and how this impacts our daily lives, through initiatives such as social media campaigns, radio-tv adverts and other means of communication. Citizens and businesses also need to be supported to make climate-conscious choices through capacity building, certification, education, green marketing, behavioural nudging, etc. |

*Table 16: Adaptation measures – cross-sectoral*

# 4

# Financing

This section provides an overview of the estimates of investment needed, as calculated through the MACC modelling and discussions with various government stakeholders, as well as providing an overview of potential sources of funding, mitigating approaches aimed at low to middle income families, and policies and measures for related research, development and innovation (RDI), to ensure a just transition which leaves nobody behind.

The section also explores how EU funding, including the 2021-2027 Multi-annual Financial Framework, the Next Generation EU and the Recovery and Resilience Facility, amongst others, will be key sources of decarbonisation funding for the economy. Such EU funding will also be completed by local funding. In terms of RDI funding, the section highlights how Malta Enterprise and MCST are amongst the agencies offering/ who will offer funding schemes on CC.

While this section provides a general overview, government will continue to monitor potential support schemes on an individual measure basis once project details and funding regulations become available.

### 4.1. Estimates of investment needed

Table 17 below sets out the estimated investment needs for the LCDS, taken from the point of view of the whole economy (i.e. private and public sector). The split between private and public funding would be analysed in more detail in action plans implementing such a Strategy. The figures are presented as net present values (NPV) over the period 2020 to 2050. The Total Net marginal investment m EUR provides the total marginal investment needed (I.e. total for both private and public sectors), for each measure in million Euros[42].

**NPV Total capital investment of measures, m EUR/ NPV Net total capital investment, m EUR**

| Measure | Primary Type | Sectors | Total Net Marginal investment m EUR 2020-2050 |
|---|---|---|---|
| EVs - Charging Infrastructure | ESR | Transport | 3,700.43 |
| EVs - Personal Vehicles | ESR | Transport | 2,406.91 |
| Floating Offshore Wind | ETS | Energy | 1,026.55 |

42 The MACC model also provides (a) the NPV of Total capital investment of measures, i.e. the total new investment needed for each measure in million Euros, so each figure is net positive – i.e. a cost; (b) the NPV Net of total capital investment which provides the net capital investment position. In this case, the capital investment includes what would be saved from avoiding infrastructure or equipment that would have been installed in the baseline. For example, for some of the transport measures the switch away from personal vehicles to public transport and active transport reduces the road development and maintenance costs more than the additional costs of the new vehicles, so the net position is negative – i.e. a saving (c) the NPV of Net total annualised cost, which reflects the net total annualised costs – including both annualised capital and the annual operating costs. There are several measures, particularly those relating to energy efficiency, that will deliver overall cost savings despite capital investment being required – in other words, the savings in operational costs outweigh the payback in capital investment over time.

| | | | |
|---|---|---|---|
| EVs - Commercial Vehicles | ESR | Transport | 2,781.42 |
| Additional Interconnector | ETS | Energy | 807.63 |
| Domestic Non-solar AWHPs | ETS | Buildings | 882.55 |
| Energy-efficient Domestic Refrigeration | ETS | Buildings | 591.13 |
| Solar Water Heaters | ETS | Energy | 809.76 |
| Energy-efficient Domestic Dishwashing | ETS | Buildings | 240.65 |
| Energy-efficient Office Appliances | ETS | Buildings | 29.92 |
| Single-family Building ASHP | ETS | Buildings | 370.97 |
| Industrial Energy Efficiency | ETS | Industry | 547.21 |
| Multi-family Building ASHP | ETS | Buildings | 234.93 |
| Active Transport (high) | ESR | Transport | 477.42 |
| Domestic Rainwater Storage | ETS | Water | 196.54 |
| Solar PV | ETS | Energy | 292.87 |
| Public Transport (Free, LEZ, Parking Toll, Upgraded) | ESR | Transport | - 332.54 |
| Single-family Building Roof Insulation | ETS | Buildings | 99.35 |
| Office Building ASHP | ETS | Buildings | 65.97 |
| High Biowaste Capture and Biogas Upgrade | ESR | Waste | 15.12 |
| Domestic LEDs | ETS | Buildings | 14.85 |
| Improved Agricultural Irrigation | ETS | Water | 36.10 |
| Incineration Pre-sorting | ESR | Waste | 7.20 |
| Non-residential Light Sensors | ETS | Buildings | 16.84 |
| Hotel Greywater Storage | ETS | Water | 12.70 |
| Industrial Rainwater Storage | ETS | Water | 7.91 |
| Multi-family Building Roof Insulation | ETS | Buildings | 4.71 |
| Office Building Roof Insulation | ETS | Buildings | 1.35 |

*Table 17: Estimated investment needs for the LCDS*

### 4.2. Mitigating the financial burdens on low to middle income families

Keeping in mind the financial outlay required, Table 18 below provides a short summary of mitigation approaches government will consider to minimise the financial burden of some of the key abatement measures on low to middle income families.

In terms of the burden on families from measures related to transport – namely due to the cost of purchasing EVs (and to a lesser extent ebikes) – these will be mitigated through methods including grants, exemptions based on income and subsidies.

The burden from measures connected with EE for residential buildings and the use of RE devices will be also be mitigated through grants and subsidies.

| Measure | Burden mitigation |
|---|---|
| Public Transport | Extending free public transport itself mitigates impact |
| Electric Vehicles | Staggered/ delayed cut-off date for households / exemptions based on income |
| Extension and strengthening of current EV grant schemes. EV prices expected to continue to decrease/ converge as more manufacturers enter the market | Capital funded at national Government level. The active transport (mainly cycling) infrastructure (which carries a small cost) has already been considered in Government's €700mln roads upgrade programme, initiated in 2019.<br><br>Extension of current subsidies for purchasing bikes, electric bikes. |
| Active Transport | Capital funded at national Government level. The active transport (mainly cycling) infrastructure (which carries a small cost) has already been considered in Government's €700mln roads upgrade programme, initiated in 2019. |
| Extension of current subsidies for purchasing bikes, electric bikes | Capital funded at national Government level. |
| Incineration Pre-sorting | Capital funded at national Government level |
| High Biowaste Capture and Biogas Upgrade | Capital funded at national Government level |
| Waste Prevention | Campaigns funded at national Government Level. Consumers will also save from changes in behaviour |
| Residential buildings - energy efficiency | Grants / subsidies based upon household income brackets |
| Solar water heaters / solar PV / heat pumps | Grants / subsidies based upon household income brackets |

*Table 18: Financial burden mitigation for selected measures*

### 4.3. Sources of Funding

As with any national strategy, funding is crucial to achieve successful implementation and uptake. This is especially the case in the current situation where countries grapple with the impacts of the COVID-19 pandemic. Funding takes an even more central role for the country to achieve its decarbonisation goals, given the starting point and ambition involved. To this end, it is necessary to ensure that climate policy is financed in a sustainable manner and that it is implemented efficiently, equitably and in line with the country's long-term objectives, avoiding financing investments that are not in line with these objectives. It is therefore important to foster the development of a favourable environment for sustainable financing and greater involvement of the financial system, ensuring that climate policy is financed fairly and in a way that leaves no one behind.

The LCDS requires funding in terms of capital expenditure (initial and replacement) and recurring expenditure. The latter could be partly offset through savings (i.e. baseline expenditure being more costly than the expenditure required for the proposed new process/ measure), such that these measures would still require an initial outlay in terms of capital expenditure but would pay off during their lifetime as savings are reaped. Funding sources can be split into two categories:

- Public funding, which can itself take various forms, including local and EU/ international funding, and comprise of various implementing mechanisms (e.g. grants, loans and green bonds, loan guarantees, (tax) credits)
- Private funding, which can also take various forms, from use of own funds to equity investment, mezzanine and debt funding (e.g. bank loans; bonds issued through capital markets).

It is worth noting that there are limited sources of private funding in Malta, due to the small size of the market (which leads to diseconomies of scale) as well as the high opportunity costs. This challenge can be partially mitigated through the creation of hybrid mechanisms and blended financial instruments which bring private and public funding sources together, with public funding crowding-in private initiative.

The following sub-sections explore funding instruments relevant to the specific themes within the LCDS, on a regional and national level. These instruments can apply to both mitigation and adaptation measures, keeping in mind that primarily mitigation costs outweigh those related to adaptation.

#### 4.3.1. European financing instruments

The financing of climate policy is supported by several European Community funds, which comes to no surprise given the EC's commitment to decarbonisation goals and climate neutrality by 2050. The EU has taken the steps to secure these financial means. The European Parliament and Member States, including Malta, reached an agreement on an improved EU budget for 2021-2027 and on an extraordinary recovery instrument, NextGenerationEU. This package of more than €1.8 trillion will enable the EU to tackle both today's crisis and tomorrow's challenges. Thirty per cent of all EU funds, and 37 per cent of the €672.5 billion of new grants and loans from NextGenerationEU's Recovery and Resilience Facility, will be dedicated to fighting CC. The "twin transitions" (green and digital) will also be at the heart of NextGenerationEU.

These funds will allow Member States including Malta to invest in green jobs and sustainable economic growth. These funds will finance clean technologies, boost the share of renewables in the energy mix, improve the EE of buildings (supporting the EU's Renovation Wave), and accelerate the rollout of sustainable green transport and infrastructure. The Just Transition Mechanism will also mobilise over €100 billion of public and private investment to support those regions most vulnerable to potential negative socio-economic impacts of the transition. In more detail:

- The **2021-2027 Multi-annual Financial Framework (MFF)** will be one of the main sources of financing for the decarbonisation of the economy in the next decade. As proposed by the EC, 25% of the overall expenditure budget will be devoted to climate action, which could mean an allocation to this area of around EUR 320 billion in the period in question. Out of the €2.25 billion in EU funding negotiated for Malta, €1.9 billion was allocated to the MFF.
- The EU budget will provide €503 billion to the **European Green Deal Investment Plan**, which incorporates the Just Transition Fund (to help carbon intensive countries, including Malta, to make the fossil-fuel shift - although it must be noted that the funds available under this funding component are not sufficient to fulfil the investment needs of the LCDS); InvestEU (EU instrument for mobilising public and private financing for strategic investments towards sustainable investment) as well public sector loan facilities.
- The new **Recovery and Resilience Facility (RRF)**, the key recovery instrument at the heart of NextGenerationEU, will provide large-scale financial support (grants, top-ups via loans) to reforms and investments of a long-term nature, with the aims of mitigating the economic and social impact of the coronavirus pandemic and of making the EU economies more sustainable, resilient and better prepared for the challenges posed by the green and digital transitions. From the latest EU budget, Malta was allocated €327 million from the grants within RFF (excluding loan amounts).

- **ReactEU** will target shorter-term crisis repair actions related to various thematic including essential investments for the green and digital transitions, and for which Malta has been allocated €50 million.
- In relation to supporting R&I in the digital industry area and for innovative low carbon technology demonstration projects, there are several programs covering the next decade at a European level. These include the **Horizon Europe Program** (€100 billion Research and Innovation Framework Programme), **the LIFE Program - Program for the Environment and Climate Action**, and the **Innovation Fund - NER 450** (c. €10 billion, financed from the EU Emissions Trading Scheme, to support innovation in: energy intensive industries; renewables; energy storage; carbon capture, use and storage).
- The **European Institute of Innovation and Technology (EIT)**, an EU body created to strengthen Europe's ability to innovate, and part of the EU's Framework Programme for Research and Innovation, will invest EUR 500 million in knowledge and innovation communities across Europe, driving European innovation in the areas of climate.
- Another EU funding instrument is the **Connecting Europe Facility (CEF)**, which will enable the funding of energy, transport and digital infrastructure projects, of which 40% will contribute. The **European Regional Development Fund (ERDF)** within the MFF shall invest between 30% to 50% in innovation-related projects, and at least 30% in projects that combat CC and contribute to the circular economy (some of the measures envisaged in this LCDS also contribute to this goal), and between 6% to 10% shall be allocated to the area of sustainable urban development.

#### 4.3.2. National financing instruments

Both recent and the current Government Budget put specific emphasis on CC as a key government priority, and as previously mentioned, government has recently announced carbon neutrality as one of its main pillars for economic development and recovery.

Additionally, the Paris Agreement (article 2(1)c) talks about making finance flows consistent with a pathway towards low GHGE and climate-resilient development. Government shall, through various means, enable the raising of funds to implement these LCDS measures. Such funds can be raised through existing or innovative funding solutions and through various mechanisms.

As stated in the 2017 Low Carbon Development Vision, Government will be investing directly in a decarbonisation infrastructure to facilitate the transition to a low-carbon economy, while at the same time also influencing private investment through its policy and regulation, and incentives designed to support such a vision. Additionally, the LCDV envisions the adoption of new financial instruments (e.g. green bonds, referred to in the 2021 Budget) aimed at facilitating the transition to a low carbon economy. The Malta Stock Exchange has also recently launched a Green Market.

### 4.4. Policies and measures for related research, development and innovation

Research, development and innovation (RDI) are key to the process of defining sound policies for mitigation and adapting to CC. This sub-section delves into RDI-specific funding, and policies and measures.

*Policy framework on RDI*

In the context of an RDI policy framework that can enable Malta's pathway towards becoming a low carbon

economy, Government has already put in place national strategy and policy documents that tackle the subject. The importance of RDI in the Maltese economy, as well as measures that push forward such RDI, as outlined in Malta's main RDI strategy and policy documents, are presented in the table below:

| Policy Document | Salient points/ measures arising from Policy document |
|---|---|
| MCST, Public consultation document: Towards a smart specialisation strategy 2021-2027 for Malta, 2020 | This document provides an outline of the potential RDI areas for 2021-2027. Malta has identified 5 potential smart specialisation areas for the period 2021-2027. One of them is "Sustainable Use of Resources for Climate Change Mitigation and Adaptation", which focuses on four sub-categories namely; i) towards Zero Carbon Buildings, ii) Renewable Energy Generation and Energy Storage Solutions, iii) Resource Efficiency in Industry, and iv) Turning Waste into Resource. |
| MCST, National R&I Strategy 2014-2020, 2014 | This R&I Strategy (updated by the 2021-2027 Strategy referred to above) is aimed at embedding R&I at the heart of the Maltese economy to spur knowledge-driven and value-added growth and to sustain improvements in the quality of life. The mission of the strategy revolves around the goals of comprehensive R&I support ecosystem; Investing in a stronger knowledge base; and smart, flexible specialisation. This strategy tackles CC by addressing the need for capacity building in the field, especially in relation to CC adaptation, to be able to guide policy and business decisions. |
| MCST, National Research and Innovation Action Plan 2015-2020, 2014 | This document acts as the implementing arm of the National R&I Strategy and refers to various projects being implemented across the 3 pillars or goals of the Strategy mentioned above. For instance, projects related to investment in buildings and equipment for research (research infrastructures or cluster structures as centers of excellence in different disciplines, including some which could have a CC impact) in the public sector are highlighted. Capacity building for excellence in CC adaptation is also mentioned as one of the actions. |

| | |
|---|---|
| MCST, National European Research Area (ERA) Roadmap 2016-2020, 2016 | Malta's National ERA Roadmap is a complementary document to the National R&I Strategy and Action Plan referred to above, with reference to priorities that have been translated into action. This document reiterates Malta's commitment to the achievement of a well-functioning European Research Area. Priorities are linked to international cooperation in science, technology, and regional initiatives such as PRIMA (previously mentioned; tackles food systems and water resources, touching on health, CC, energy, biodiversity, coastal sea management and agriculture). |
| National Strategy for Research and Innovation in Energy and Water for 2021-2030 | The strategy identifies a number of priority areas with potential to contribute to the decarbonisation of water supply and use, including;<br>■ water use efficiency;<br>■ desalination processes; and<br>■ water and wastewater treatment and reclamation. |

*Table 19: Main RDI policy documents*

With respect to local sources of RDI funding, a number of programmes and schemes have been made available through local government agencies:

- **Malta Enterprise:** Malta's investment promotion agency, tasked with attracting new foreign direct investment (FDI) as well as facilitating the growth of existing operations including through the provision of supporting measures. FDI related to RDI is one key area of focus. Malta Enterprise also administers schemes related to measures that could support SMEs in their contribution towards lower emissions, including EE measures. This is also being done with a view to assisting local firms recover and regenerate after the pandemic.
- **MCST:** the governmental body responsible for Research and Innovation (R&I), space, science and technology manages national funds for R&I. The environment, and CC, are areas of focus, as seen in the RDI strategies referred to above. For instance, the table above makes reference to "Sustainable Use of Resources for Climate Change Mitigation" as one of 5 key smart specialisation areas identified.

The University of Malta is also embarking on two infrastructural projects that could have impacts on CC research. These include:

- Sustainable Living Complex, whose primary objective is to achieve a model resource-efficient building, labelled as a "live laboratory" to monitor a range of resource-efficient technologies in a real-life context. This project will:

- provide a basis for policymaking on sustainable development issues;
- create an infrastructure for indigenous innovation in the construction industry; and
- provide a best-practice model.

- Transdisciplinary Research and Knowledge Exchange (TRAKE) project, which:
  - seeks to create a modern research facility aimed at enabling and supporting technology transfer, entrepreneurship and knowledge exchange with industry, including EE and CC;
  - focuses on the valorisation of ongoing research

Various entities, including the MCST and the University of Malta, also participate in cross-border RDI-related funding programmes. Examples of such programmes include:

- *Blue Bioeconomy ERA-NET Co-fund:* A joint call (ending in 2023) supported by 16 countries, including Malta (through MCST), funding projects that explore innovative, sustainable and climate-friendly utilisation of aquaculture production systems;
- *Partnership for Research and Innovation in the Mediterranean Area (PRIMA) programmes:* launched in 2018 and supported by Horizon 2020, it provides a €220 million fund running over a span of ten years. Malta will be contributing €5 million over the ten-year period, allocating €500,000 per annum to fund research and innovation actions dealing with the thematic areas of sustainable water management, sustainable and effective farming systems and agro-food value chains in the Mediterranean.

In addition, whilst the fight against CC focuses mostly on carbon emissions reduction, carbon capture and carbon capture technologies (carbon tech) are making their way to the market as a way to reverse CC. Carbontech represents a new economic niche area which feeds into the policy framework on RDI in the context of CC. A new category of companies is indeed coming to market, whereby such players are using technological innovation to turn excess $CO_2$ into useful, marketable products. Examples include concrete, fuels, plastics, and textiles, amongst others. The process utilized to turn carbon into value includes electrochemical, photochemical, thermochemical, bio-catalysed, and photosynthetic technology. According to a market report published by the Circular Carbon Network (CCN)[43], the pace of activity in this sphere picked up dramatically in the past decade, with around 330 innovators working on carbon removal or turning carbon into value, 107 of which are already generating revenue. As previously mentioned, Malta can play a role as a test bed for such new technologies, in partnership with larger countries/ private partners.

43 Circular Carbon Network (2020). CIRCULAR CARBON MARKET REPORT. Available at https://circularcarbon.org/market-report/

# 5

# Environmental And Socio-Economic Impacts

The LCDS measures being proposed will be implemented in a developed economy with a thriving society – both are, however, coming to grips with the effects of the COVID-19 pandemic. Government will support areas, groups and individuals who may face socio-economic challenges in providing their contribution to the implementation of these measures, to ensure a fair transition to a carbon neutral economy in a way that no one is left behind.

The targeted reduction in GHG emissions, as well as the adaptation measures, are intended to provide overall benefits to all members of society. However, the Strategy will also impact different stakeholders to varying degrees and at different timeframes. This section provides an overview of the potential non-GHG effects of these mitigation measures.

The LCDS will be employed in a system bounded by financial constraints. Certain measures might impact the markets for goods and services, the labour market and how they operate. They might entail additional financial and administration burden on both the private and public sector and also impact international trade (to a lesser extent given the size of the local economy).

The measures will also impact the individuals and the social aspects of the country. Measures might impact the inclusion/exclusion of vulnerable groups, the aesthetics of cultural buildings and the personal and family life, amongst others.

In general, social and economic consequences of the implementation of the measures will be positive, including on both public health and general living conditions. A key effect on vulnerable sections of society could relate to initial capital costs of certain measures, as consumers. Government plans to support these vulnerable groups through ad-hoc support.

Hence, whilst acknowledging the LCDS's great potential in decreasing emissions and enabling Malta to reach its GHGE reduction targets for 2030 and 2050, government is aware of the positive and negative side effects of such LCDS measures. This necessitates steps to be taken in order to maximise benefits whilst minimising the negative impacts.

This section focuses on these socio-economic impacts of the Strategy, based on the EC's Impact Assessment guidelines (which provides both social and economic impact categories). The Strategy will also have effects in terms of the environment, over and above the reduction of GHG emissions, such as on ecosystems or air pollution. These other environmental impacts were tackled specifically in a Strategic Environmental Assessment (SEA) commissioned by government.

The following sub-sections provides an overview of the main social and economic impacts envisaged under the identified sector-related measures.

## 5.1. Agriculture

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ Commercial scale Aquaponics- based food production<br>■ Methane inhibiting vaccines | Social<br>■ New entrepreneurship/ employment opportunities<br>■ Potential for exports<br>■ Improved public health<br>Economic<br>■ Niche area of economic growth through innovation (aquaponics)<br>■ Increased product offering in the market (aquaponics)<br>■ Lower dependency on imports<br>■ FDI opportunities | Social<br>■ Food safety issues (including impact on health of animals/ humans)<br>■ Change to farming practices<br>■ Increased regulation by public authorities<br>■ Need to tackle the negative perception of produce quality<br>Economic<br>■ Import flows<br>■ High capital and operating costs (aquaponics)<br>■ Affordability issues if any increase in costs is passed onto consumers |

*Table 20: Impact Assessment for the Agricultural sector*

### 5.2. Buildings

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ EE single measures and retrofitting to achieve NZEB level<br>■ Measures, supported by schemes, for deep renovation<br>■ EE measures in public buildings<br><br>The above policy initiatives will lead to the following measures/ technologies:<br><br>■ LED lighting, in the residential and non-residential building sector<br>■ Automated lighting in non-residential buildings<br>■ EE water heating/ heat pumps<br>■ EE appliances<br>■ EE office/ IT equipment<br>■ Wall/roof insulation and double-glazing | Social<br><br>■ Convenience to family life (EE appliances)<br>■ Better indoor room temperatures/living conditions (wall/roof insulation)<br>■ Improved employee productivity (automation; better conditions)<br>■ Positive impact on safety issues and prevention of accidents (LEDs compared to halogen bulbs; automation)<br>■ Improved public health<br>■ Public participation from installations in public buildings/ provision of grants or subsidy schemes<br>■ Contribution to SDG 11 – sustainable cities and communities<br><br>Economic<br><br>■ Improved business competitiveness and household purchasing power<br>■ Increased sales for EE equipment/ services<br>■ Lower maintenance/ replacement costs | Social<br><br>■ Exclusion of vulnerable individuals/ households who cannot afford higher spend - government to provide support<br>■ OHS concerns for installation of external condenser unit on roofs<br>■ Disruption to family life/ business operations during installations<br>■ Aesthetical value of installations close-by heritage sites (roof insulation)<br><br>Economic<br><br>■ Administration burden for applicants and administrators of grant/ subsidy schemes<br>■ Administrative burden |

*Table 21: Impact Assessment for the Building sector*

### 5.3. Energy

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ Solar PV installations<br>■ Installation of SWHs/ SWHPs<br>■ Additional electricity interconnector(s)<br>■ Offshore floating wind turbines | Social<br>■ Increased labour opportunities in maintenance and installation<br>■ Self-sufficiency of consumers<br>■ Participation of civil society<br>■ Improved health<br>■ Measures that address several SDGs<br><br>Economic<br>■ Greater innovation and research<br>■ With RES, less dependence on foreign energy sources | Social<br>■ Affordability issues<br>■ Potential financial gap for operator<br>■ Risks during installations/ maintenance<br>■ Reduced available roof space<br>■ Limited access to RES installed on roofs for apartment holders<br>■ Negative visual impacts on cultural sites<br><br>Economic<br>■ Increased imports<br>■ Increased dependence on foreign energy sources for non-RES (interconnector)<br>■ Administrative burden on public authorities (e.g. schemes administration; compliance and enforcement)<br>■ Initial capital outlay<br>■ Increased maintenance costs<br>■ Rooftop property right issues<br>■ Solar rights issues<br>■ Expropriated land |

*Table 22: Impact Assessment for the Energy sector*

### 5.4. Industry

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ EE industrial measures for large firms and SMEs | Social<br>■ Greater efficiency and lower energy bills<br>■ Satisfying green consumers<br>■ Decoupling energy and industry, bringing more macro-economic stability<br>■ Improved air quality, public health and quality of life (residents and workers).<br>■ Measures addressing various SDGs<br><br>Economic<br>■ Increased product offering through competition<br>■ Increased innovation and research | Social<br>■ n/a<br><br>Economic<br>■ Initial capital outlay<br>■ Shifting additional costs to customers via increased prices<br>■ Increased administration burden for public authorities |

*Table 23: Impact Assessment for the Industry*

### 5.5. Water

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ Storage and use of rainwater in industrial parks<br>■ Treatment and re-use of greywaters in hotels<br>■ Reduction in water use through a consumer behaviour change campaign<br>■ Investment in technology to improve irrigation efficiency | Social<br>■ More sustainable lifestyles and water consumption patterns<br>■ Greater water accessibility for vulnerable families<br>■ Satisfying green consumers<br>■ Improved public health<br>■ Measures tackling various SDGs<br>■ Improved quality of life for farmers and their families<br><br>Economic<br>■ Empowerment by companies and individuals to reduce their demand for primary water<br>■ Increased offering in the provision of water through competition<br>■ Increased R&I<br>■ Improved competitiveness for businesses and purchasing power for consumers/ individuals<br>■ Decreased dependency of industry and households on primary water services<br>■ Increased revenues from higher and better crop yields<br>■ Lower dependency on imports for agricultural product | Social<br>■ Health risk if greywater is not adequately treated<br>■ Negative visual impact on cultural sites<br><br>Economic<br>■ Change in demand for water utilities operator<br>■ Initial capital outlay<br>■ Increased administration burden for public<br>■ Initial maintenance of efficient technologies<br>■ Property rights (e.g. ownership of wells and cisterns) |

*Table 24: Impact Assessment for the Water sector*

### 5.6. Waste

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ Sorting of Residual Waste at incinerators<br>■ 80% Capture of Municipal Biowaste and Biogas Upgrade<br>■ Household waste prevention measures | Social<br>■ Creation of additional green jobs<br>■ Increased public awareness on waste management issues and facilitated responsible participation. Increased awareness in homes enables food cost savings<br>■ Improved public health<br>■ Improved security for incinerator workers & neighborhoods<br>■ Better job conditions for EfW plant workers<br>■ Lower nuisance effects on individuals residing near the EfW facility<br><br>Economic<br>■ Cost savings for commercial businesses and more customer profile insights for tailored offerings<br>■ Potential reduction in costs, capacity issues and adverse externalities experienced in the sector<br>■ Economic efficiency and resiliency gains from a more circular economy<br>■ Creation of additional raw material input into secondary economic markets<br>■ R&I in connection with change in biogas use and development of efficient waste sorting management processes<br>■ Indirect contribution to lowering food insecurity and malnutrition goals<br>■ Positive impacts on reaching national recycling targets | Social<br>■ Change in household behavior requires more attention and effort, against time and space constraints<br>■ Potential disincentive for households to sort recyclable waste at source (from semi-mixed waste separation measure)<br><br>Economic<br>■ Higher administrative burden on Local Councils<br>■ Higher cost of collection<br>■ Administrative burden<br>■ Change in demand for printing houses<br>■ Macroeconomic impacts from household behavior changes (e.g. purchases, savings) |

*Table 25: Impact Assessment for the Waste sector*

### 5.7. Transport

| Measures | Positive Impacts | Negative Impacts |
|---|---|---|
| ■ Electrification measures<br>■ Public Transport measures<br>■ Active Transport measures<br>■ Teleworking/ remote working | Social<br>■ Health benefits from reduced air and noise pollution, potentially lower traffic accidents and more regular exercising<br>■ Increased flexibility for employees<br>■ Travel time reductions for individuals and businesses<br>■ Improved travel for non-vehicle owners, enabling social and economic participation<br>■ Enhancing the efficiency of local components of the TEN-T network<br>■ Facilitated access to cultural sites and improved preservation as a result of lower traffic emissions<br><br>Economic<br>■ Incremental investment in the EV market<br>■ Reduced traffic congestion contributing to economic productivity and competitiveness, investment/ employment/ job attractiveness and facilitating trade logistics<br>■ New R&I spurred in connection with EV transition implementation and efficient/ safe active transport infrastructure<br>■ Facilitation of labour geographical mobility and labour market matching efficiency<br>■ Possible reduced costs of operating and managing offices | Social<br>■ High upfront EV capital cost/ use might exclude some individuals from the personal vehicle ownership market<br>■ Risks for public safety in EV accidents<br>■ Waste management of EVs/ batteries<br>■ Security of supply issues for electricity and batteries (EVs)<br>■ Reduced social interaction (and linked mental/physical health effects and work engagement) resulting from TW/ RW<br>■ Higher costs for employees, and potential increased digital divide.<br><br>Economic<br>■ Business costs in connection with EV transition adjustments<br>■ Potentially lower market competition in EV market and competitive distortions from public transport subsidisation<br>■ Negative knock-on effects on economic activity and employment in traditional personal car travel sectors<br>■ Additional tax/ charges burden on businesses and individuals, which can result to be of a regressive nature<br>■ Administrative requirements for management of any mechanism to disincentivise undesirable usage<br>■ Free public transport may disincentivise innovation/ competition in this market<br>■ Negative/ displacement effects on commercial activity of any location-specific disincentive scheme |

*Table 26: Impact Assessment for the Transport sector*

# 6

# Annexes

### 6.1. Stakeholder Consultation List

| Initial Consultation | Second round of consultations | MECP Consultation | Public Consultation |
|---|---|---|---|
| 2018<br>■ Planning Authority<br>■ Agriculture and Fisheries<br>■ ERA<br>■ Ministry for Energy and Water Management<br>■ EWA<br>■ Wasteserv<br>■ Building Industry Consultative Council (BICC)<br>■ Ministry for Transport, Infrastructure and Capital Projects (MTIP)<br>■ Transport Malta (TM)<br>■ MRA<br><br>2019<br>■ Enemalta | 2019-2021<br>■ Ministry for Finance<br>■ EWA<br>■ Agricultural Directorate<br>■ ERA<br>■ Planning Authority<br>■ Water Services Corporation<br>■ Marine and Storm Water Management Unit (MSWU)<br>■ Meteorological Office (MET)<br>■ Malta Tourism Authority<br>■ Ministry for Family, Children's Rights and Social Solidarity<br>■ Ministry for Gozo<br><br>Other correspondence:<br>■ Fisheries Department<br>■ Regulator for Energy & Water Services (REWS)<br>■ Ambjent Malta<br>■ Plant Protection Directorate (PPD)<br>■ Agriculture Department<br>■ Veterinary Regulation Directorate (VRD)<br>■ MTIP/TM<br>■ BICC/ Building Regulations Office (BRO) | 2020<br>■ Climate Action Board<br>■ Kunsill Regjonali/ Local Council Association<br>■ The Malta Chamber<br>■ Academics<br>■ Civil society (including various constituted bodies, NGOs and other VOs and entities)<br>■ Malta Chamber for SMEs | 2021 |

| Initial Consultation | Second round of consultations | MECP Consultation | Public Consultation |
|---|---|---|---|
| Feedback received (apart from feedback provided directly during consultation meetings) | | | |
| | ■ Ministry for Energy and Water/ Management<br>■ EWA<br>■ REWS<br>■ Ambjent Malta<br>■ Department of Fisheries<br>■ MSWU<br>■ ERA<br>■ PPD<br>■ VRD<br>■ Aviation Sector (TM), Transport and Marine Infrastructure, Infrastructure Malta (IM)<br>■ MSWU (WID/MTIP)<br>■ Economic and Policy Division<br>■ Ministry for Agriculture<br>■ Ministry for Economy | ■ The Malta Chamber<br>■ Malta Chamber of SMEs | ■ Various entities and individuals as part of public consultation process |

*Table 27: Entities consulted throughout the LCDS stakeholder consultation process*

### 6.2. Details on modelling

A Marginal Abatement Cost Curve (MACC) is a tool which allows a country to progress towards decarbonisation in a politically and economically efficient manner. This is achieved by ranking a range of GHG-abating measures in order of cost-effectiveness. A MACC model is intended to establish the possible routes to decarbonisation and is used alongside socio-economic assessments to assess the implications of these routes. Used together, a MACC and socio-economic impact assessments allow governments to strategically plan activities across all sectors of society, futureproofing for CC requirements and developing effective mitigation strategies.

The metric of cost-effectiveness is called the marginal abatement cost (MAC). Each measure's MAC is calculated from two other values: its economic and financial cost and its abatement potential. The lower

the MAC, the more cost-effective the measure, and therefore the MACC itself is a visually intuitive way of displaying this information.

The MACC developed for the LCDS is a detailed bottom-up MACC relying on the principle that each measure seeks to replace one process with another process. Often, this will involve the phasing out of a carbon-intensive process in favour of a low(er)-carbon process. A measure can be thought of as a combination of two processes – where the net difference describes the impact of the measure. For the cost figures, this is described economically as the opportunity cost, but a similar logic applies to emissions and utility consumption calculations. For example, if 1 kWh of electricity generated by a combined cycle gas turbine plant (CCGT; a process) emits 400 gCO2e, but 1 kWh of electricity generated by solar photovoltaics (PV; another process) is zero-carbon, then the net impact of replacing CCGT with PV (a measure) is 400 gCO2e/kWh. In reality, the calculations are often more complicated than this example, mainly in order to more adequately account for inter-measure dynamics.

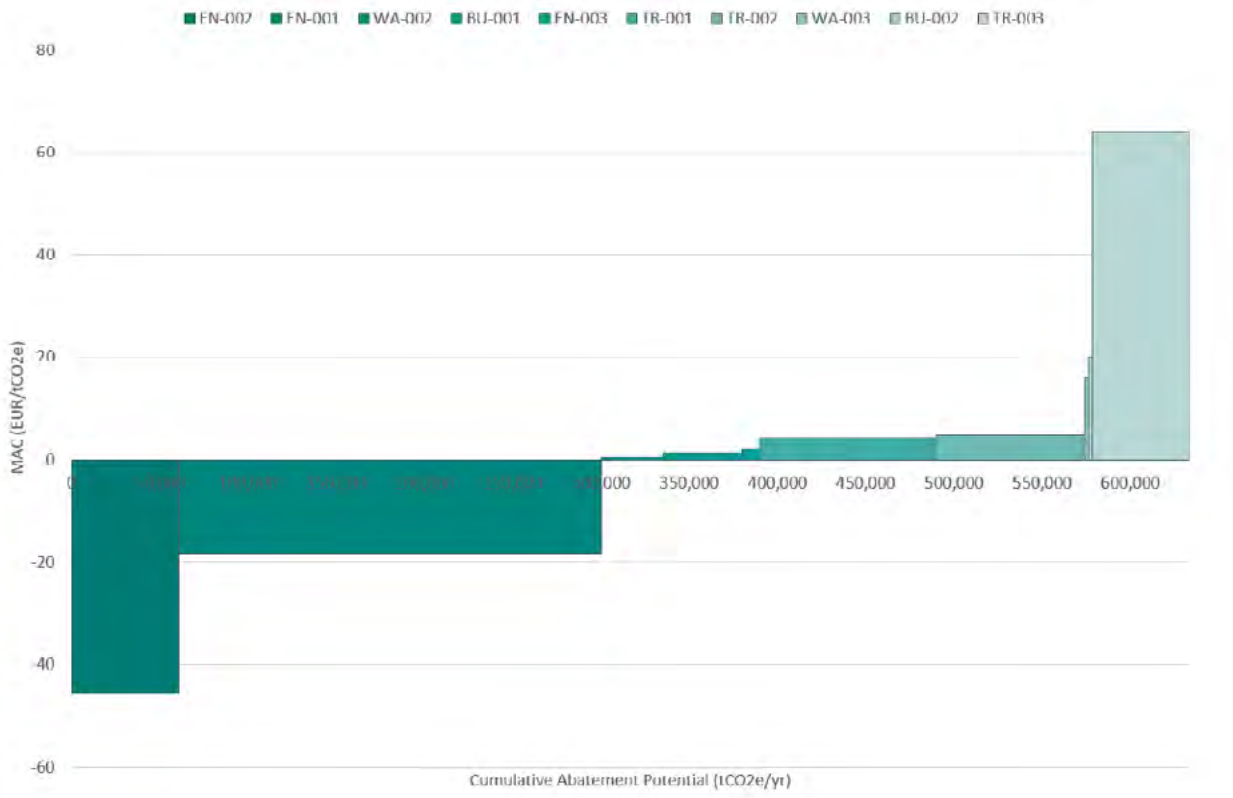
A MACC model includes various inputs/ outputs, with the following structure being followed for this LCDS:

- Process consumption (electricity, water, gas, etc.),
- Process generation (electricity, water, gas, etc.),
- Process direct emissions (fossil, non-fossil), and
- Process cost (allowing for technology learning over time).

These values are recorded on a per unit basis; for energy this operational unit may be per GWh (electricity generated) or for transport it may be per Gt.km (transported). In addition to these inputs, the MACC model records:

- the (high-carbon) processes being replaced and the (low-carbon) processes that take their place: whether the process relates to supply or demand of the given operational unit;
- the low-carbon processes: the maximum technical potential that the processes can achieve over time, accounting for technical constraints such as availability of space or demand levels. Again, this is recorded in terms of the given operational unit for that process. Optimistic, central, and pessimistic estimates of the technical potential are derived. Local considerations regarding acceptance and likely rates of market penetration are also considered in the technical potential.

The MACC for Malta's LCDS, for 2030 and 2050, were presented in Figure 9 and Figure 10 of this report, while the example shown below is based on mock data. However, it has been generated by the MACC model and serves as a useful illustration of the information presented on the chart.




The x-axis represents cumulative abatement potential. The example above shows that, if each of these mock measures were implemented, 630 $ktCO_2e$ could be saved each year. This would represent a cut of almost a third of Malta's net territorial GHGEs in 2016. A vertical line can be placed on this axis to represent the GHGE abatement required by EU targets.

The y-axis represents marginal abatement costs (MACs). Measures with the lowest MACs are ranked first and so are found to the left. In this example, two measures generate negative economic costs (or savings to society) upon implementation. This is a relatively common finding in climate change MACCs; the reason why these measures are not already happening are unlikely to be strictly financial. They may instead relate to issues with imperfect or distorted markets such as lack of awareness or issues over conflicting agency[44]. These broader issues were considered independently of the MACC model.

44 Kesicki, F., and Ekins, P. (2012) Marginal abatement cost curves: a call for caution, Climate Policy, Vol.12, No.2, pp.219–236

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