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MALTA COUNCIL FOR ECONOMIC & SOCIAL DEVELOPMENT

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# Technical Report on the Reduction of Greenhouse Gases

## Research Report

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## Malta Council for Economic and Social Development

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## Executive Summary

The reduction of the carbon footprint and greenhouse gas emissions of Malta through improved efficiency in generation capacity, and through the replacement of heavy fuel oil with natural gas and renewable sources is a key policy objective that guides Malta's recent energy policy decisions. This research paper assesses the current policy context by drawing from local and EU policy documents of legislative instruments on the subject, assesses the current state of play of greenhouse gas emission reductions with respect to Malta's targets, draws out various international success stories that are of relevance to the local context, and presents research from consultative interviews with key stakeholders, and based on these identifies recommendations for greenhouse gas emission reductions in Malta.

Malta's Climate Action Act, the main law on climate change and the foundation of Maltese national climate policy, aims to contribute to the mitigation of climate change by limiting anthropogenic emissions of greenhouse gasses and protect and enhance GHG sinks and reservoirs. As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Malta has various legally binding targets to meet, mostly contained in its National Energy and Climate Plan (NECP). The NECP serves as a strategic planning framework and policy document that guides Malta's contribution to achieving the Energy Union's 2030 objectives and targets, whilst identifying those measures necessary for their achievement during the period until 2030. These targets include a 19% reduction in net territorial non-Emissions Trading System (ETS) greenhouse gas emissions (relative to 2005). Malta's Low Carbon Development Strategy (LCDS) maps out the country's decarbonisation journey up to 2050. The LCDS recognises that Malta's trajectory is still not enough to reach its 2030 targets of a 19% greenhouse gas reduction and will not be conducive to the goal of climate neutrality by 2050. The LCDS outlines a feasible set of measures in seven sectors, namely, Energy, Transport, Buildings, Industry, Waste, Water and Agriculture and land-use, land-use change and forestry (LULUCF) to achieve the greenhouse gas reductions that would enable Malta to reach its targets.

Malta's greenhouse gas emissions are reviewed. The Energy sector, consisting of the energy generation and transport sectors, is identified as being the highest overall contributor to the national greenhouse gas emissions (75.6%). Road transport accounts for 91% of the overall transport sector emissions, and these emissions have continued to increase with the increase in Malta's car fleet. Industrial processes and product use (IPPU) emissions, amounted to 13.19% of Malta's emissions in 2020 and are dominated by the

increasing emission trend of hydrofluorocarbons (HFCs), particularly from the category refrigeration and air conditioning. The overall share of greenhouse gas emissions from the waste sector is equivalent to 7.52% of the gross national greenhouse gas emissions, with the main gas emitted being methane, mainly from the disposal of solid waste to land.

Lowering greenhouse gas emissions is a socio-technical transition and an uncertain process that requires the participation of different actors and institutions, and is influenced by existing infrastructure, and existing policies and legislative tools at national, regional, and global scales. Through a literature review conducted as part of this research paper, case studies and international success stories were identified through systematic literature searches. Ten success stories of greenhouse gas reductions from island environments or from similar climatic conditions are presented. These success stories focused on increasing the uptake of renewable energy, electrification of land transport, shared mobility, the use of green building materials to improve energy efficiency in buildings, and energy education.

Interviews were also conducted with policy and business stakeholders. Given the complexity of this socio-technical transition, the Transition Model Canvas was used to structure the data collection and analysis. Increased policy focus on greenhouse gas reduction, and investment in new generation capacity, fuel switching, alternative sourcing of electricity and uptake of solar photovoltaics were identified as being the main gradual factors favouring the establishment of the niche system with lower greenhouse gas emissions and accelerating the green transition. Exogenous shocks associated with the COVID19 pandemic, but more importantly Russia's invasion of Ukraine, have accelerated the green transition, and are expected to improve the feasibility of renewables and innovative technologies. Public and private sources of funding, with various implementing mechanisms, are expected to contribute to this transition. However, key limitations associated with Malta's environmental characteristics, the land and sea use, and demographics, pose limitations to the uptake of renewables. Additionally, gaps in existing strategies, reactive policymaking and weak implementation of existing strategies were identified as limiting the potential and efficacy of existing schemes and measures in achieving significant greenhouse gas emissions abatement. Uncertainties were also associated with the availability of technologies, such as offshore photovoltaics and wind, and hydrogen, which are expected to become more feasible sources of energy for Malta, but this depends on external forces. The interviewees identified the need for improved

communication with the public and stakeholder engagement, and investment in innovation to address climate change mitigation and adaptation challenges.

# 1. Introduction

The reduction of the carbon footprint and greenhouse gas emissions of Malta through improved efficiency in generation capacity, and through the replacement of heavy fuel oil with natural gas and renewable sources is a key policy objective that guides Malta's recent energy policy decisions.

This research paper presents the current policy context by drawing in from local and EU policy documents of legislative instruments on the subject, assesses the current state of play of greenhouse gas emission reductions with respect to Malta's targets, draws out various international success stories that are of relevance to the local context, presents research from consultative interviews with key stakeholders in Malta, and analyses and presents results and recommendations based on the review of literature and success stories, and the stakeholder interviews.

# 2. Assessment of the policy context

Malta's 2004 accession to the European Union (EU) acted as a catalyst for social, economic, and political transformation while Malta is also part of several multilateral environmental agreements, thus playing a dynamic role in this climate change reality despite its small size. As a member state of the European Union, Malta was a party to the 2015 Paris Agreement, described as the first-ever universal legally binding global climate change agreement, and to which the EU and its member states are among the nearly 190 parties[1]. The first outcome, produced in the same year, was the Climate Action Act, the main law on climate change and the foundation of Maltese national climate policy. It aims to contribute to the mitigation of climate change by limiting anthropogenic emissions of greenhouse gasses (GHGs) and to protect and enhance GHG sinks and reservoirs[2]. The Act also established a Climate Action Board (CAB) as a body which ensures representation of all sectors of Maltese society in the fight against climate change.

[1] Paris Agreement. Available from: https://ec.europa.eu/clima/eu-action/international-action-climate-change/climate-negotiations/paris-agreement_en. Accessed: 19 May 2022.

[2] Climate Acton Act. Available from: https://environment.gov.mt/en/decc/Pages/climateActionAct.aspx. Accessed: 19 May 2022.

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC)[3] Malta has various legally binding targets to meet, mostly contained in its National Energy and Climate Plan (NECP)[4]. The NECP serves as a strategic planning framework and policy document that guides Malta's contribution to achieving the Energy Union's 2030 objectives and targets, whilst identifying those measures necessary for their achievement during the period until 2030. The NECP provides a plan for Malta to attain a sustainable, affordable, and secure energy system by following a decarbonisation trajectory, whilst recognising the inherent challenges and opportunities brought about by the specificities of Malta and focuses on five dimensions, namely decarbonisation, energy efficiency, energy security, internal energy market and research and innovation competitiveness. The decarbonisation targets of the NECP are to achieve a 19% reduction in net territorial GHGEs (relative to 2005) by 2030, contribute to the EU greenhouse gas emission reduction target while fulfilling the obligations of the Paris Agreement. Malta also aims to increase the share of renewable energy to 11.5% in the gross final energy consumption in 2030 and achieve 14% renewable energy sources (RES) in the transport sector in line with the Renewable Energy Directive.

In the context of the 2020 European Semester[5], the Commission had conducted a comprehensive analysis of Malta's economic policy and published it in the 2020 Country Report, stating that Malta's transformation to a climate neutral economy will require sizeable private and public investment over a sustained period. Investment in greenhouse gas emissions reductions, particularly in sectors like construction and transport, can help achieve the dual objectives of economic recovery and sustainability. Investments in the green and digital transition, and particularly on clean and efficient production and use of energy, sustainable transport, waste management, research and innovation were recommended by the Commission.

[3] United Nations Framework Convention on Climate Change. Available from: https://unfccc.int/. Accessed: 18 May 2022.

[4] Malta's 2030 National Energy and Climate Plan. Available from: https://www.energywateragency.gov.mt/wp-content/uploads/2021/10/MT-NECP-FINAL-2020-10-05_Corrigendum.pdf. Accessed: 20th May 2022.

[5] Council Recommendation on the 2020 National Reform Programme of Malta and delivering a Council opinion on the 2020 Stability Programme of Malta. Available from: https://ec.europa.eu/info/sites/default/files/2020-european-semester-csr-comm-recommendation-malta_en.pdf. Accessed: 20th May 2022.

Driven by calls for immediate action and international obligations, Malta has developed a Low Carbon Development Strategy (LCDS)[6] that maps out the country's decarbonisation journey up to 2050. The LCDS recognises that despite the recent reduction in greenhouse gas emissions, Malta's trajectory is still not enough to reach its 2030 targets of a 19% reduction in net territorial non-Emissions Trading System (ETS) greenhouse gas emissions (relative to 2005) and will not be conducive to the goal of climate neutrality by 2050. For this reason, the LCDS outlines a feasible set of measures in seven sectors, namely, Energy, Transport, Buildings, Industry, Waste, Water and Agriculture and land-use, land-use change and forestry (LULUCF) to achieve the greenhouse gas reductions that would enable Malta to reach its targets.

In the latest Council Recommendation on the 2022 National Reform Programme of Malta and delivering a Council opinion on the 2022 Stability Programme of Malta[7], Malta is described as lagging in achieving its 2030 target of reducing, by 19%, from 2005 levels, greenhouse gas emissions not covered by the EU ETS, falling under the Effort-Sharing Regulation. One of the Council recommendations and given that renewables only account for 8% of the energy mix, is to reduce reliance on fossil fuels by further exploiting Malta's solar and wind potential, including floating offshore energy. Improvements in the electricity transmission and distribution grids, and investments in electricity storage are recommended to supply firm, flexible and fast responding energy while the improved energy efficiency of buildings, particularly residential buildings, including by rolling out heat pumps and other green solutions, would help reduce energy demand. Road transport emissions are steadily growing, forming the largest source of non-ETS greenhouse gas emissions. The Council Recommendation identifies the need for transport emission reductions through improved quality of public transport, deployment of intelligent transport systems, and investments in soft mobility infrastructure, such as pavements and cycling lanes, for a safe alternative to private car use

[6] Malta Low Carbon Development Strategy. Available from: https://environment.gov.mt/en/Documents/main/maltaLowCarbonDevelopmentStrategyFinalDocumentOct2021.pdf. Accessed: 20th May 2022.

[7] Council Recommendation on the 2022 National Reform Programme of Malta and delivering a Council opinion on the 2022 Stability Programme of Malta. Available from: https://ec.europa.eu/info/system/files/2022-european-semester-csr-malta_en.pdf. Accessed 20th May 2022.

# 3. Assessment of the current state of play

As Party of the UNFCCC, and a Member State of the European Union, Malta is required to report on historic trends of GHG emissions from anthropogenic activities, and on the impact of measures (ERA, 2018). Inventories provide a crucial starting point for policymaking in respect of mitigation of climate change. By evaluating the historic emissions trend, it is possible to assess the effectiveness of actions and measures taken in the past and a starting point towards assessing what actions need to be taken by Malta in future. Malta's National Inventory on Greenhouse Gas Emissions and Removals, covers the following seven categories of such gases, namely:

- Carbon dioxide ($CO_2$)
- Methane ($CH_4$)
- Nitrous oxide ($N_2O$)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride ($SF_6$)
- Nitrogen trifluoride ($NF_3$) (MRA, 2022).

The quantities of greenhouse gasses quoted are presented here in terms of $CO_2$ equivalents (CO2 eq.), where estimated absolute amounts are multiplied by the Global Warming Potential (the radiative forcing effect, GWP) of the respective gas, giving a quantity which makes the comparisons easier.

Anthropogenic activities for which GHG emissions are estimated and reported in national inventories are usually grouped into five main sectors, namely:

- Energy (including transport)
- Industrial Processes and Product Use (IPPU)
- Agriculture
- Land Use, Land-use Change and Forestry (LULUCF)
- Waste

Malta's annual national greenhouse gas emissions are presented in detail in Malta's National Inventory on Greenhouse Gas Emissions and Removals (MRA, 2022), and are shown in in Figure 1. From 1990 to 2012, an overall increasing emissions trend is observed, but this is followed by a decrease in emissions from 2012 to 2016 at high rates (24.22% reduction between 2014 and 2015 emissions in particular) which are a consequence of

investment in new generation capacity, fuel switching and alternative sourcing of electricity. A significant increase of 16.29% is observed between 2016 and 2019 as there was a shift back towards local electricity generation as opposed to the previous use of the interconnector with mainland Europe's electricity grid. The Energy sector, which is the energy generation and transport category contributors, is the highest overall contributor to the national greenhouse gas emissions (Table 1). Carbon dioxide forms the bulk of the emissions while nitrous oxide and methane accounted for 9.88% and 1.22% of the sectoral emissions, respectively. The transport sector is the second largest contributor to greenhouse gas emissions, and accounted for 21.1% of the total in 2019 (MECP, 2021), of which road transport accounts for 91% of the overall transport sector emissions, and which have increased proportionally with the increase in Malta's car fleet (MRA, 2022), while national marine transport accounts for around 8%, and domestic aviation account for just 0.6% of total sector emissions (MRA, 2021).

Industrial processes and product use (IPPU) emissions, amounted to 13.19% of Malta's emissions in 2020 and, are clearly dominated by the increasing emission trend of hydrofluorocarbons (HFCs), particularly from the category Refrigeration and Air Conditioning (94.46% of all greenhouse gas emissions from the IPPU sector). Agriculture is not a major contributor towards total emissions, and it has seen a decrease of emissions of around 33% over the 1990-2020 period. Enteric fermentation amounted to 43% of the agricultural emissions, while manure management accounted for 27% and agricultural soils accounted for 30% of total emissions. Methane emissions accounted for 49% of the total agriculture emissions, while nitrous oxide accounted for 51% respectively. Malta's LULUCF sector is a negligible source of emissions, with annual net emissions below five thousand tonnes $CO_2$eq over the 2005-2019 period (EPRS, 2021). In 2020, the overall share of GHG emissions from the waste sector is equivalent to 7.52% of the gross national greenhouse gas emissions, with the main gas emitted being methane, mainly from disposal of solid waste to land (MRA, 2022).

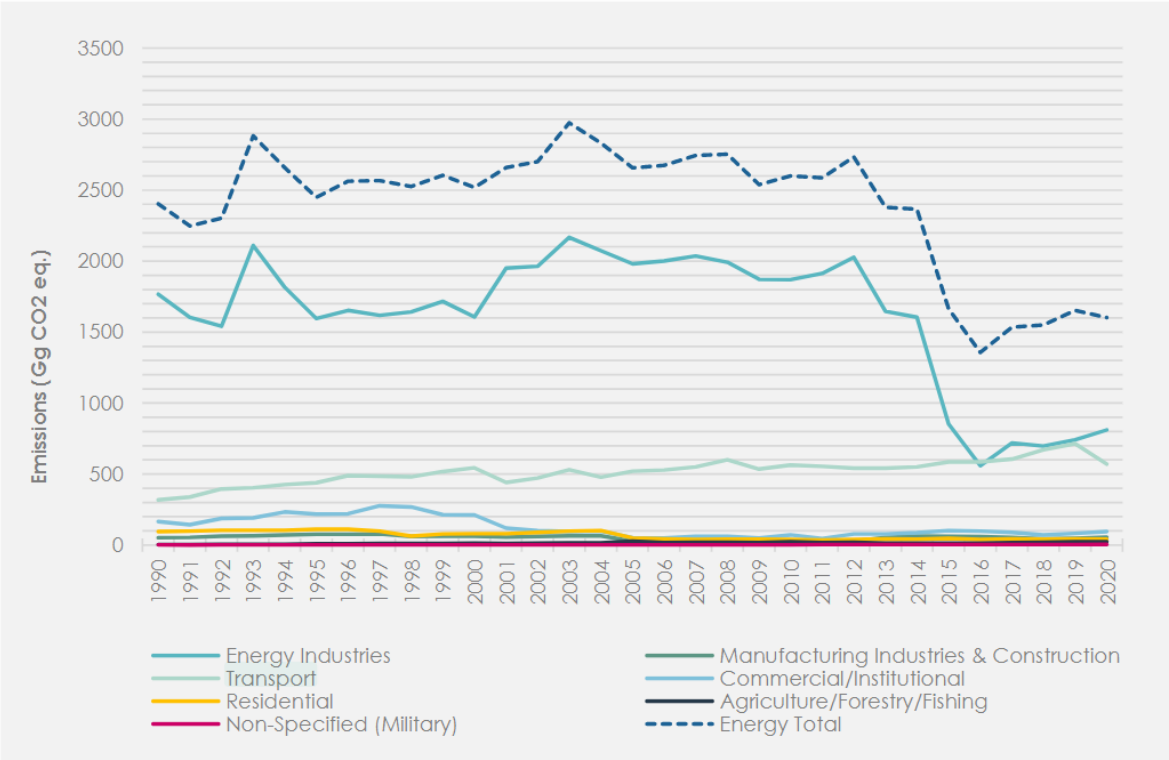


*Figure 1 – Total emissions and emissions by sector for Malta* (Source: MRA, 2022)

GHG emissions per capita also present a general increasing trend from 1990 until 2012, which is then reversed after 2012, even though population growth continued its path. A decoupling occurred between emissions and Maltese population trends. For the period after 2012, substantial emission reductions due to important technical developments in the electricity generation sector, have counteracted any increase expected due to continued population growth (Figure 2). Similar observations can be made on the association between the Gross Domestic Product (GDP) and greenhouse gas emissions, where a decoupling of economic growth from greenhouse gasses emissions occurred and emissions did not increase at the same rate as GDP, implying that an economic shift from energy intensive activities to ones with a relatively lower energy demand resulted in successful development and increased efficiency (Figure 3). Transport was never decoupled from growth and has remained highly correlated with GDP (and with population) over the considered period. The same goes for IPPU emissions, which show an even higher correlation with GDP (MRA, 2022).

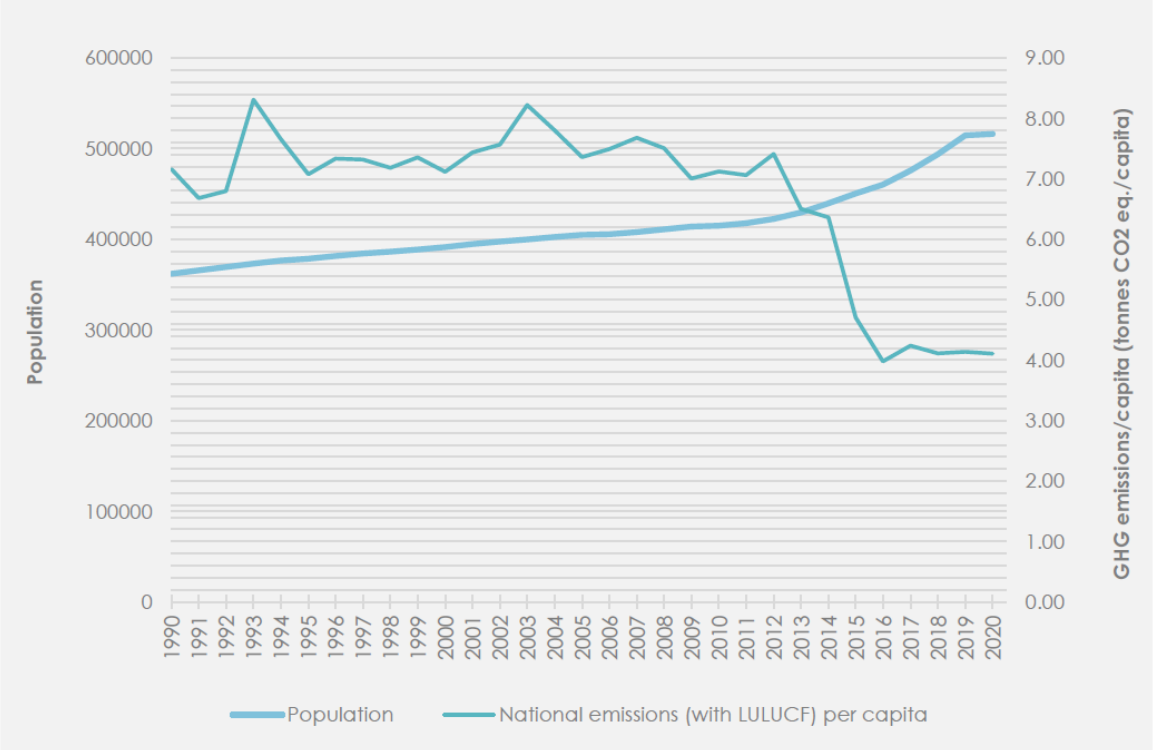


*Figure 2 - Trend in emissions per capita compared to population trend* (Source: MRA, 2022)

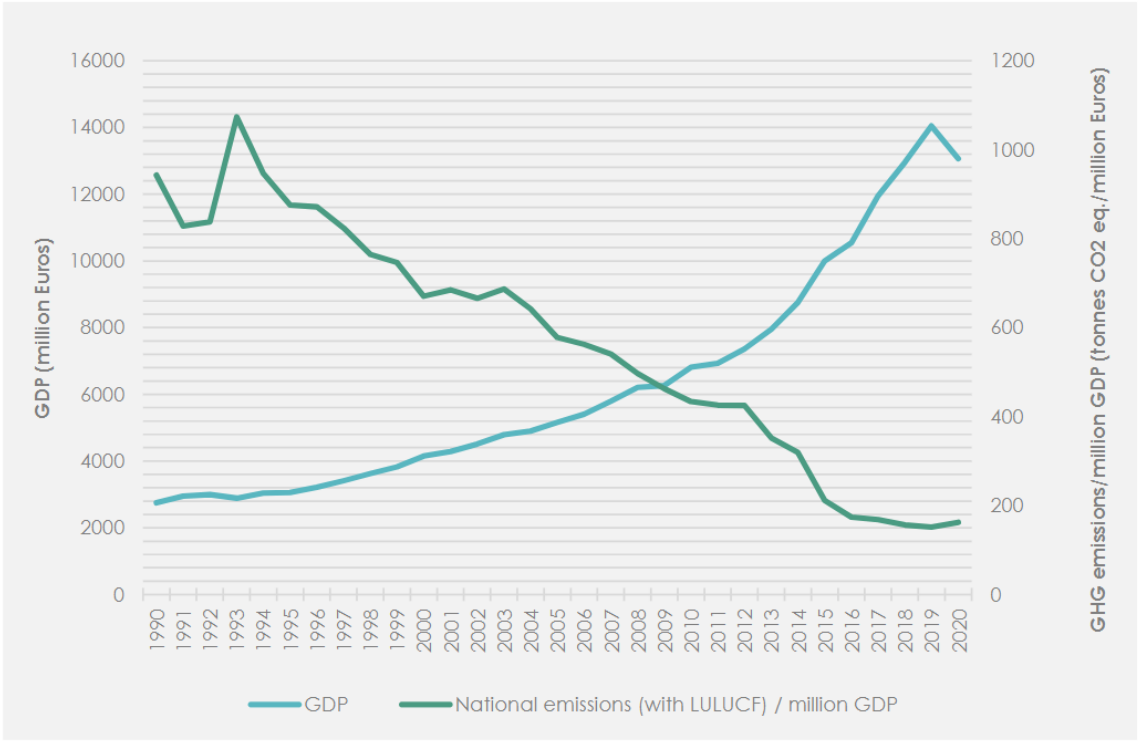


*Figure 3 - Trend in emission per GDP compared to GDP trend* (MRA, 2022).

*Table 1 – The contribution (%) to Malta's total and greenhouse gas emissions by sector* (MRA, 2022).

| SECTOR | % TOTAL GHG EMISSIONS | GHG EMISSIONS (%) | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_20$ | F-Gases |
| **ENERGY** | 75.6 | 99.82 | 1.22 | 9.88 | NO |
| **IPPU** | 13.19 | 0.28 | NO | 4.36 | 97.4 |
| **AGRICULTURE** | 3.79 | NO | 20.39 | 73.25 | NO |
| **LULUCF** | -0.10 | -0.14 | NO | 0.20 | NO |
| **WASTE** | 7.52 | 78.39 | 12.31 | NO | |

The national target greenhouse gas reduction target by 2030 is currently set at 826,687 tonnes CO2eq (reflecting a 19% reduction in emissions since 2005), and the indicative milestones in 2040 and 2050 reflect 60% and 80% reductions from 1990 levels respectively (MECP, 2021). Several initiatives to fulfil these targets have been undertaken, however, further GHG reductions are necessary to meet these targets and align Malta's decarbonisation trajectory, along with the long-term European commitments. Several challenges are faced by Malta in reducing greenhouse gas emissions, as outlined in the NECP and LCDS, and include the following:

- the specific characteristics of Malta's energy system and market, namely the existence of a single electricity supplier, the absence of natural gas and heating/cooling networks, and the dependency on imports and exports, and the small size and number of suppliers and market players;
- market pre-Covid population and GDP growth which at the time made it difficult to restrain energy consumption;
- its specific geographic constraints, namely limited land area, rich but fragile natural environment and climatic conditions, which lead it to not having an array of 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, agricultural and waste disposal sectors as well as the legacy effect in solid waste disposal, have resultant high mitigation costs coupled with significant socio-economic considerations (MECP, 2021).

Malta's Report on Policies and Measures and Projection, 2021 prepared by the Malta Resources Authority, pursuant to the Regulation (EU) No 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action Article 18, provides an overview of the implemented policies and measures, and associated projections in greenhouse gas emissions (MRA, 2021). While the policy context has already been summarised in the previous section, the following list summarises the main measures implemented by Malta, but a more detailed account is provided by the MRA report (March 2021):

1. Energy Sourcing – the quantified measures for the energy sectors are listed in Table 2.
    1.1. Electricity generation: Electricity supply in the Maltese Islands in recent years has been maintained through three main sources: the local electricity generation plants, electricity imported through the interconnector, and electricity generated by distributed renewable energy plants, a mix of residential and commercial solar energy installations being the main contributors. Conventional fossil fuel generation of electricity is concentrated in four installations with a combined generation capacity of 548 MW.
    1.2. Submarine electrical interconnection to the European network: While until recently Malta was isolated from the European grid, such isolation has been tackled through a 200MW 220kV HVAC interconnector with mainland Europe via Italy and started being used in 2015.
    1.3. Gas Interconnection: the Maltese Government has started work on the development and implementation of a gas pipeline between Malta and Italy, which would allow the transportation of gas from the Italian gas network to Malta both to meet Malta's energy generation needs and to provide a basis possibly also for the development of an inland gas distribution network.
    1.4. Renewable energy sources in electricity: solar photovoltaics (PV) continue to be the most viable and robust form of indigenous source of renewable energy and has been able to successfully penetrate most sectors. An assessment of Malta's technical potential for solar PV conducted by the Energy & Water Agency (EWA) indicates that after 2020, there will be potential for further deployment of solar PV particularly on rooftops and brownfield sites. The Maltese Government thus intends to extend its current policy framework up to at least 2030, and adopt new measures where appropriate, with the goal of incentivizing the increase in solar PV capacity. PV systems not larger than 16 Amps per phase are fast tracked through a

notification process, while systems larger than 16 Amps require an authorisation and licence to operate, from the regulator, prior to construction and connection to the grid. The grid connection study is performed free of charge for systems below 60A/phase or having a capacity not exceeding 40kW. Recent schemes also included battery storage with PV systems[8]. Projections of renewable electricity and/or heat generated by waste-to-energy plants from biodegradable waste content are based on projections of waste generation and are projected to remain largely constant or the foreseeable future.

1.5. Renewable energy sources in heating and cooling: Three new schemes were launched in 2021 to assist consumers to switch from the conventional to more efficient water heaters. These newly launched schemes focus on solar water heaters, and for those without roof access, air to water heat pumps. The existing solar water heater scheme, Thermal Basic Scheme gives a €700 grant for a system with 5 years warranty. To this, another solar water heater scheme has been added, the Thermal Premium Scheme for stainless steel systems exceeding the 100-litre capacity, whereby a maximum of €1,400 will be given as a grant, covering 75% of the total investment. Under the Premium scheme, an additional €500 grant will be given to cover a 10-year warranty. These solar water heater technologies save an average of around 1,800 electrical units annually per household. The air to water heat pump technology gives the opportunity to those not having roof access to invest and install a clean energy technology in their household. This grant, Heat Pump Starter will give a grant of a maximum of €1,000, which covers 50% of the investment[9].

1.6. Renewable Energy Sources in Transport: Malta has in place a substitution obligation on importers of petrol and diesel to blend an increasing share of biofuels in their mix with the aim of meeting the target of a 10% share of RES in transport in 2020 as per Article 3(4) of Directive 2009/28/EC. Local importers and wholesalers of petrol and diesel will likely meet their post-2020 substitution obligation by blending EN 590 diesel with Fatty Acid Methyl Esters (FAME) biodiesel (EN 14214) and hydrotreated vegetable oil (HVO) (EN 15940), as is the current practice.

[8] Energy and Water Agency. New schemes and grants for PV panels launched. Available from: https://www.energywateragency.gov.mt/news/new-schemes-and-grants-for-pv-panels-launched-2/. Accessed 24 June 2022

[9] Energy and Water Agency. New Solar Water Heaters and Heat Pumps schemes launched. Available from: https://www.energywateragency.gov.mt/news/new-solar-water-heaters-and-heat-pumps-schemes-launched/. Accessed 20 June 2022

2. Energy Efficiency - the quantified measures for the energy sectors are listed in Table 2.
    2.1. Enemalta, the only Distribution System Operator, has embarked on an extensive program to ensure efficient distribution that minimises loss. It has also equipped 99.6% of its consumers with smart meters and has adopted a tariff system that favours prudent energy use and energy efficiency, with the aim of fostering such behaviour in its final consumers.
    2.2. The industry's share of final energy consumption in Malta is significantly low as Malta is not an industry-based economy and there are no energy intensive industries. The sector is also contributing significantly in terms of energy efficiency with an 8% growth in economic activity corresponding only to an increase of 1.5% in energy consumption during 2017. Enterprises are actively encouraged to undertake energy efficiency projects which shall be supported by investment aid. Local legislation also makes it mandatory for non-SMEs registered and doing business in Malta to carry out energy audits to the established quality level and frequency. The Government shall require non-SMEs with an annual consumption exceeding 800 toe to implement an ISO certified Management system (EN ISO 50001, or EN ISO 14001 if an energy audit is included). SMEs can benefit from grants to assist them in the performance of energy audits of their premises, processes, equipment, and vehicle fleets.
    2.3. The 2025 Transport Master Plan identifies measures to achieve low-emission mobility while the vehicle scrappage scheme is incentivising owners to replace old, less-efficient, vehicles.
    2.4. Due to the temperate climate and the general preference to use natural ventilation, when possible, households have typically low energy bills and EU data shows that Malta already has the lowest energy use per capita in Europe in 2016 (Figure 4). This could result in difficulties to justify investment in the renovation of their building. The government has recently published a long-term renovation strategy[10] for the renovation of the national building stock. This strategy identifies policy and actions to drive the renovation of the Malta's building stock, including through cross-cutting initiative, information campaigns and voluntary schemes, working with stakeholders, regulation and enforcement and financial incentives in the short to medium term. The establishment of energy communities and promotion of smart

[10] Malta Long-Term Renovation Strategy 2050. Available from: https://environmentcms.gov.mt/en/Documents/closedMinisterialConsultations/longTermRenovationStrategy2050.pdf. Accessed 21 June 2022.

technologies are considered as long-term actions that will be developed in the post-2030.

2.5. Government has embarked on a continued roll-out of energy efficient street lighting and overall, this is expected to lead to the replacement of over 33,000 lamps from the present lighting luminaries to LED technology.

2.6. In 2021, the provision of water services accounts for 6% of the total national electricity demand. This is mainly used for water production, particularly due to the use of sea-water desalination plants which account for around 60% of the total production of potable water. Leakage management in Malta by the Water Services Corporation has resulted in a reduction of around 40% of municipal water demand over a 15-year period. Domestic water consumption in Malta stands at around 17 million $m^3$ per year which amounts to an average daily consumption per person of around 115 litres. Government has embarked on a nation-wide campaign to help raise awareness on optimal use of water, with the aim of instilling a cultural shift in people's behaviour towards water conservation.

3. Energy – Transport – Malta's National Transport Strategy, 2050 and Transport Master Plan, 2025 have been developed to cover all relevant transport modes (land, public transport, sea, and air) for the short, medium, and long term for Malta. the quantified measures for the energy sectors, including transport, are listed in Table 2.

3.1. Infrastructural developments to improve traffic flows and reduce emissions: several major road infrastructure improvement projects have been carried out to improve road traffic flow, which is expected to lead to a reduction in greenhouse gas emissions. The 'MODUS - Encouraging a modal shift in land transportation' project looked at intelligent system approaches to transport management, as a means to address infrastructural limitations on efficient traffic flows.

3.2. Electromobility: National statistics show that by the end of 2019, the stock of electric vehicles amounted to 2293, with an additional 2200 hybrid vehicles (electric/petrol or diesel). Several schemes for sustainable transport have been launched as part of the 2022 Budgetary Measures, including the purchase of new electric vehicles in Category L, M and N and pedelecs, and include a scrappage scheme intended to provide further financial support[11].

[11] Transport Malta. Purchase of New Electric Vehicles. Available from: https://www.transport.gov.mt/land/sustainable-transport/financial-incentives-2022/new-electric-vehicles-5439. Accessed 20 June 2022.

3.3. Sustainable Urban Mobility measures including hubs to provide multi-modal transport services for transport users, urban mobility planning, and testing electric buses. A teleworking policy has been established by the Government to reduce the need for travel.

3.4. Vehicle circulation fees for more efficient vehicles: circulation fees are calculated depending on the year of registration, based on engine size, year of make, CO2 emissions, particulate matter (PM) emissions and fuel type.

3.5. Vehicle Registration Tax System Reform (2009): licensing of vehicle now calculated on carbon emissions, the length of the vehicle, Euro standard and its value. From April 2013, hybrid cars (M1 vehicles) are subject to the registration tax, but the CO2 value included in the Certificate of Conformity is lowered by 30%.

4. Industrial Processes and Product Use (IPPU)

4.1. Implementation of the F-gas Regulation: the current F-gas Regulation has been implemented locally by Legal Notice 143 of 201834. The new F-gas Regulation strengthens the original F-gas Regulation and introduces a phase-down of the consumption of HFCs through the allocation of quotas, which take into consideration the global warming potentials of the respective HFCs. It is expected that this shall result in a transition to refrigerants with a lower GWP, leading to a reduction in HFC consumption and, consequently, in the emissions of F-gas, in the EU.

5. Agriculture: while agriculture makes relatively minor contributions to greenhouse gas emissions, several policies and programmes include mitigation actions, including the:

5.1. National Agricultural Policy for the Maltese Islands (2018-2028)

5.2. Agricultural Waste Management Plan for the Maltese Islands

5.3. Nitrates Action Programme

5.4. Rural Development Programme (2014-2020)

6. Land Use, Land Use Change and Forestry (LULUCF): The potential of LULUCF activities aimed to mitigate climate change and enhance or preserve the sinks include:

6.1. Afforestation projects and Forest Management of existing woodlands

6.2. Sustainable activity and management of land.

7. Waste Management: Malta's Long Term Waste Management Plan for Malta 2021-2030[12] aims to maximise the resource value in waste through different management options;

[12] Long Term Waste Management Plan 2021-2030. Available from: https://era.org.mt/wp-content/uploads/2022/02/Long-Term-Waste-Management-Plan-v1.4.3-Spreads-Digital-Version.pdf. Accessed: 19 June 2022.

innovate by designing waste prevention initiatives to lower Malta's per capita generation rate; reform the collection system to increase economies of scale, harmonise collection practices and modernise the collection fleet; build the necessary waste management facilities to treat recyclable, organic and residual waste to achieve Malta's targets; study the feasibility of an enhanced producer responsibility framework to complement Malta's transition to a circular economy and reflect further on the true cost of waste management; and promote further the involvement of the private sector in waste management.

7.1. Reduction of Emissions from open and closed landfill sites through waste management, gas extraction, treatment of methane or possibly combustion for energy generation.

7.2. Diversion of biological waste from landfills: The Sant' Antnin Waste Treatment Plant includes a biological treatment plant for the production of biogas through the anaerobic digestion of biodegradable municipal solid waste. The biogas produced is to be used for the generation of electricity by combustion in a Combined Heat and Power (CHP) plant, and any excess electricity will be fed to the grid. Furthermore, the excess heat is directed to heat a nearby therapeutical pool. The setting up of new Mechanical Biological Treatment (MBT) Plants in the North of Malta will continue to reduce the amount of waste deposited in landfills and to utilise waste through energy from waste projects.

7.3. Organic Waste Collection nationwide, started in October 2018, enables the reduction of landfilled degradable organic carbon while reducing greenhouse gas emissions.

7.4. Wastewater management through the operation of urban wastewater treatment plants and wastewater sludge treatment.

8. Cross-cutting measures, including policies, vision documents and strategies, including:

8.1. Sustainable Development Strategy for the Maltese Islands 2007-2016, and subsequently the Sustainable Development Vision for 2050

8.2. Green Public Procurement – National Action Plan (2019-2025)

8.3. The Water Catchment Management Plan for the Maltese Islands, including the formulation of the 3rd Water Catchment Management Plan for the Maltese Islands (2022)

8.4. National Environment Policy (2012)

8.5. National Biodiversity Strategy and Action Plan (2012-2020)

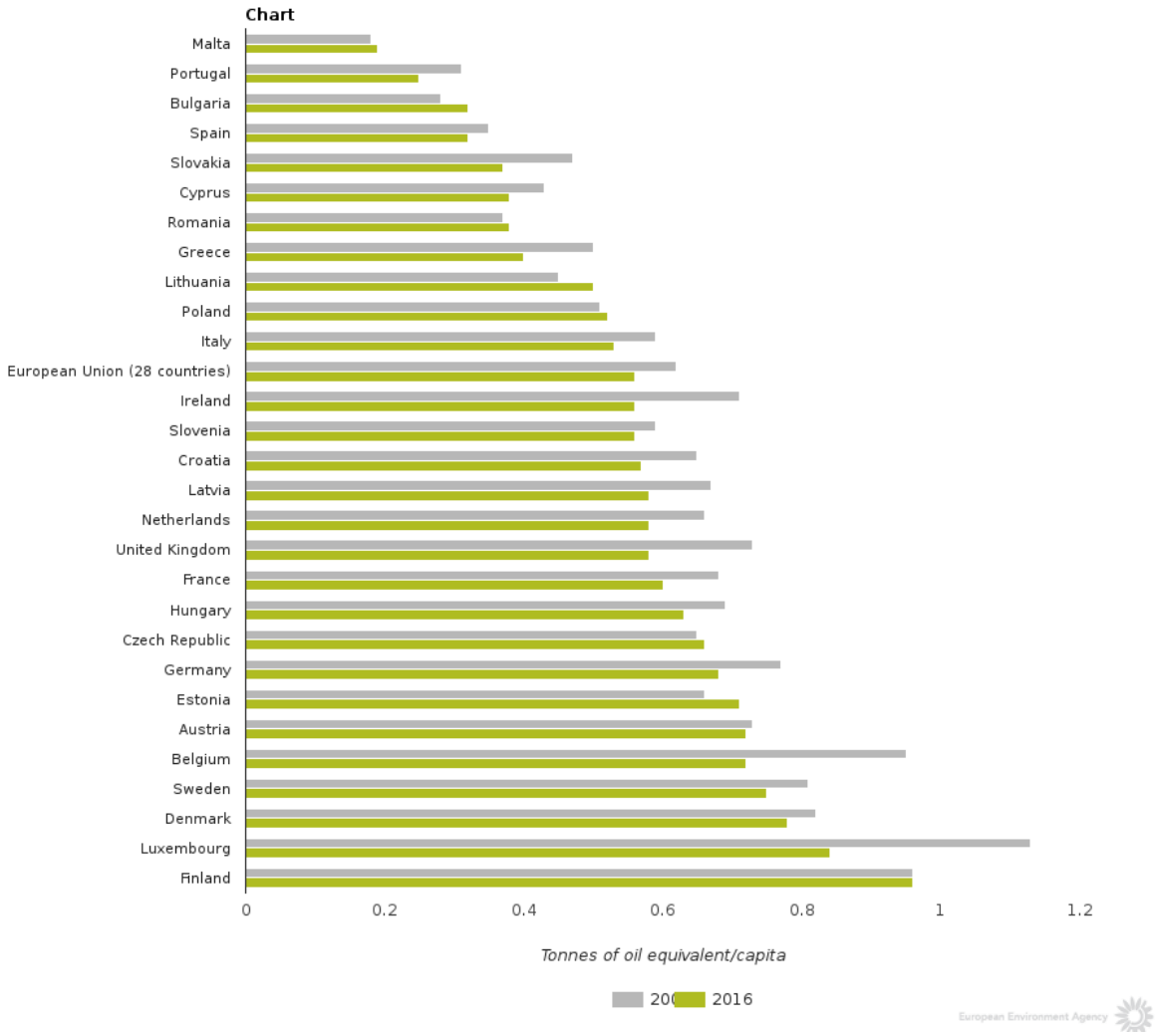


*Figure 4 - Per capita final energy consumption of the households sector, by country (Source: EEA)*

The MRA (2021) report presents a 'projections with existing measures' (WEM) scenario, which considers policies and measures that have been adopted and implemented. The aggregated effect of the policies and measures is illustrated in Figure 5, which shows how Malta has not been able to limit its Effort Sharing Decision emissions to a level equal or below the annual emission allocation and thus had to resort to buying extra Annual Emissions Allocations (AEAs) from other Member States, which situation is expected to remain until the end of the Effort Sharing Decision compliance period.

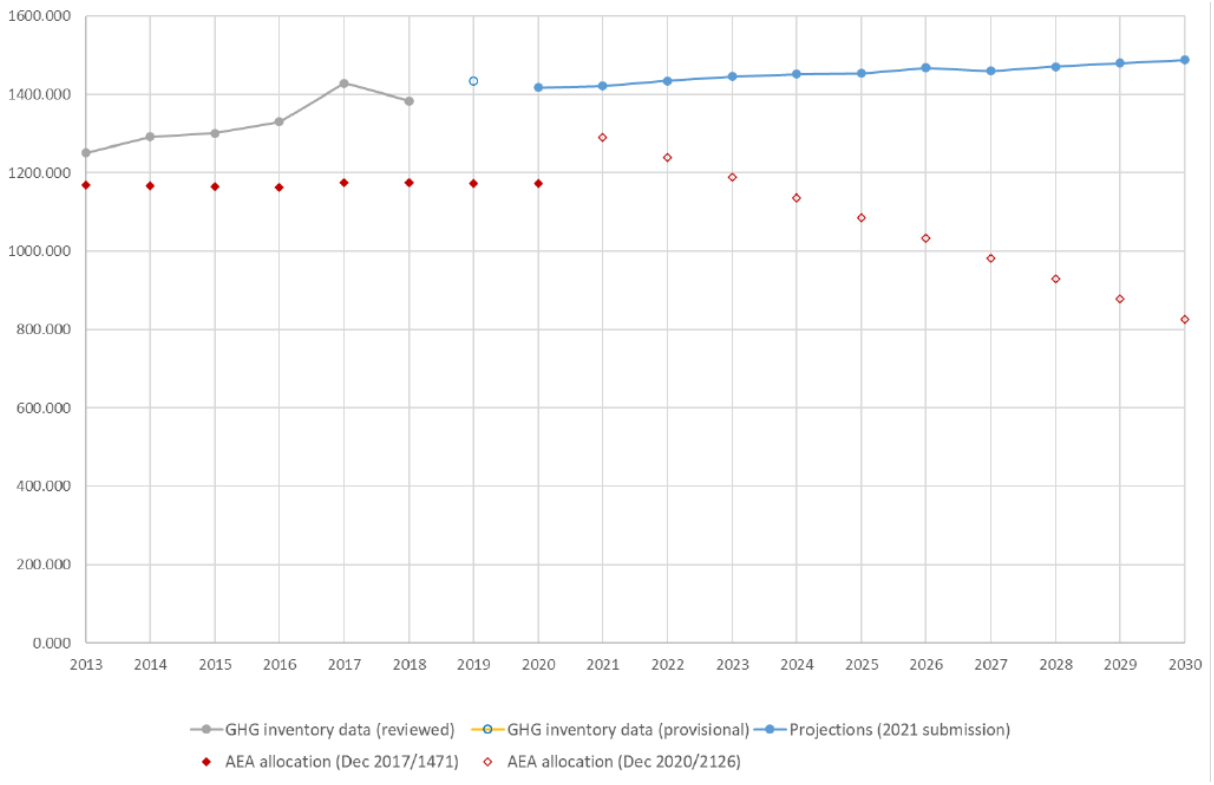


*Figure 5 - Indicative comparison of historic (2013-2018), provisional (2019) and WEM projected (2020-2030) emissions with ESD (2013-2020) and ESR (2021-2030) targets (Source: MRA, 2021)*

Further greenhouse gas reductions are necessary to meet the 2030 targets under the ESR and to align Malta's de-carbonisation trajectory with that adopted by the EU and achieve climate neutrality by 2050. Within this context, the LCDS identifies measures to achieve these targets, with anticipated sectoral greenhouse gas emission reduction from the LCDS being presented in Figure 6. The sectoral breakdown is further detailed through the Marginal Abatement Cost Curves (MACCs) presented within the LCDS and shown in Figure 7 and Figure 8. In 2030 the energy efficiency related measures feature more prominently as the carbon intensity of the grid is still predominantly based upon gas but by 2050, when the carbon intensity is minimised, greenhouse gas savings from electrical energy efficiency measures are significantly reduced.

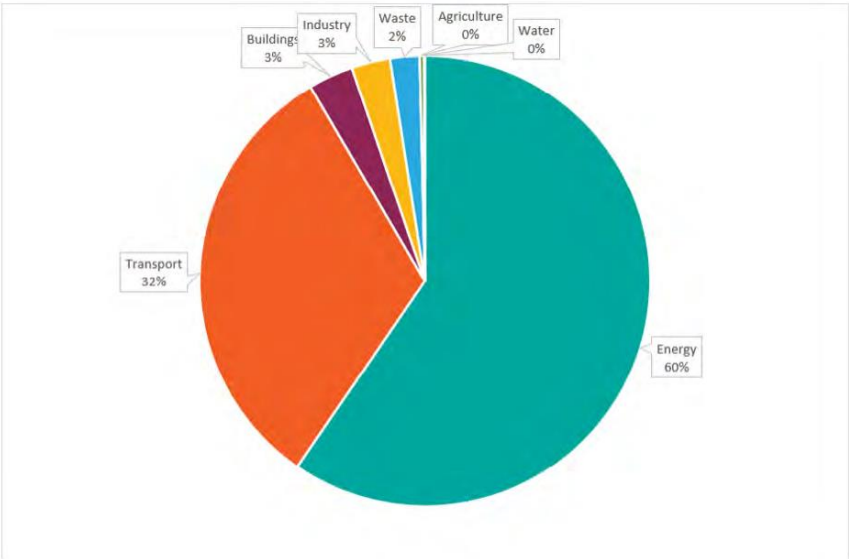


*Figure 6 - Share of Abatement Potential in 2050 (Source: LCDS 2021)*

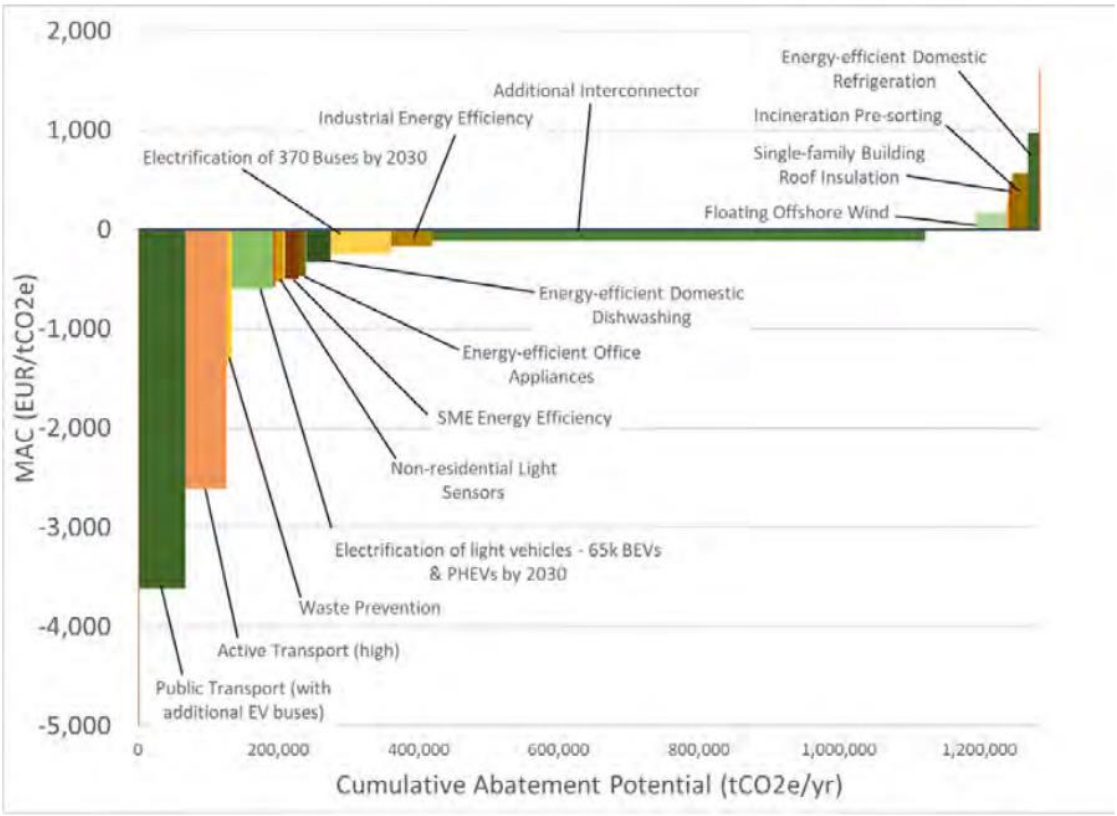


*Figure 7 - Marginal Abatement Cost Curve in 2030 (Source: LCDS 2021)*

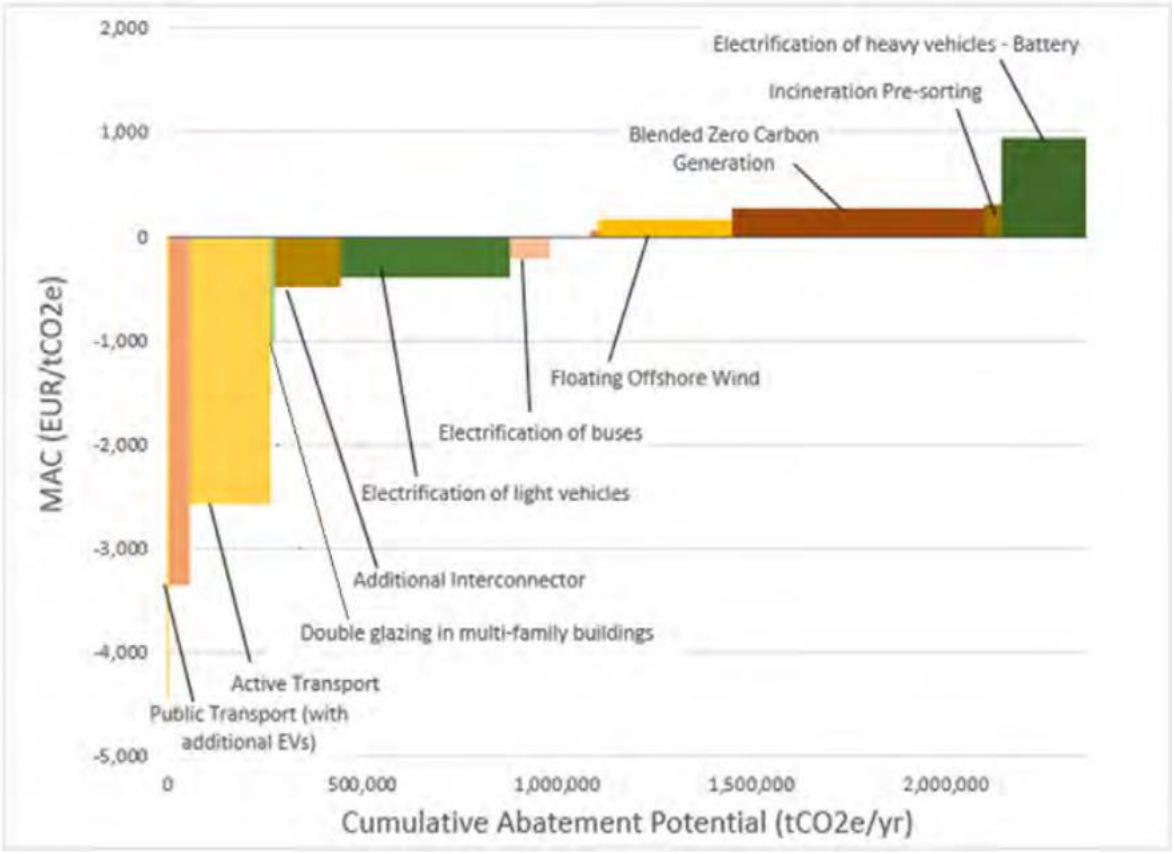


*Figure 8 - Marginal Abatement Cost Curve in 2050 (Source: LCDS 2021)*

*Table 2 - Summary of quantified policies and measures for the Energy Sectors (Source: MRA, 2021)*

| POLICY OR MEASURE | MAIN OBJECTIVE | QUANTIFIED OBJECTIVE | SECTOR(S) AFFECTED | GHG AFFECTED | PLANNED BUDGET | EXPECTED IMPACT | TYPE OF POLICY INSTRUMENT | RELEVANT UNION POLICY | IMPLEMENTATION PERIOD |
|---|---|---|---|---|---|---|---|---|---|
| FINANCIAL SUPPORT SCHEMES FOR SOLAR PV | Reach 2030 RES contribution | Reach 2030 RES contribution | Energy production | CO2 | Grants for PV worth 2.5 mil. EUR annually; Feed in tariff 12 mil. EUR in 2030 | 73.7 GWh of cumulative energy savings by 2030; Solar PV capacity of 262 MW by 2030 | Regulatory | RES Directive Recast<br>Governance Regulation | 2021-2030 |
| ENGAGEMENT OF STAKEHOLDERS FOR INCREASED DEPLOYMENT OF RES | Reach 2030 RES contribution | Reach 2030 RES contribution | Energy production | CO2 | | | Other | RES Directive Recast<br>Governance Regulation | 2021-2030 |
| SOLAR WATER HEATERS SCHEME | Reach 2030 RES contribution | Reach 2030 RES contribution | Energy production | CO2 | 2 mil. EUR/year | 151 GWh of cumulative energy savings by 2030 | Economic | Energy Efficiency Directive Recast<br>Governance Regulation | 2021-2030 |
| ENERGY EFFICIENCY: ELECTRICITY TARIFFS INCENTIVISING END USERS TO REDUCE CONSUMPTION | Addressing Article 7 of the EED | Reach 2030 EE contribution | Energy consumption: residential | CO2 | | 40 GWh cumulative savings by 2030 | Regulatory | Energy Efficiency Directive Recast<br>Governance Regulation | 2021-2030 |
| SUPPORT SCHEME FOR SERVICES AND INDUSTRY TO PROMOTE ENERGY INVESTMENT EFFICIENCY BY | Addressing Article 7 of the EED | Reach 2030 EE contribution | Energy consumption: services, industry | CO2 | 2.5 mil EUR annually | 279 GWh of cumulative energy savings by 2030; 40 mil EUR of investment in | Economic | Energy Efficiency Directive Recast | 2022-2030 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MAKING AVAILABLE INVESTMENT AID LINKED TO THE AMOUNT OF SAVINGS ACHIEVED | | | | | | Energy Efficiency | | Governance Regulation | |
| ENERGY EFFICIENT STREET LIGHTING | Addressing Article 7 of the EED | Reach 2030 EE contribution | Energy consumption: public sector | CO2 | | 117 GWh cumulative energy savings to be achieved y 2030 | Planning | Energy Efficiency Directive Recast<br><br>Governance Regulation | 2018-2021 |
| PROJECTS IN THE PRIMARY WATER NETWORK AND WASTEWATER TREATMENT PLANT | Addressing Article 7 of the EED | Reach 2030 EE contribution | Energy consumption: public sector | CO2 | c. 52 mil EUR | 53 GWh cumulative energy savings by 2030 | Planning | | 2021-2030 |
| BIOFUELS SUBSTITUTION OBLIGATION (2021-2030) – INCREASED SUBSTATION OBLIGATION OF AT LEAST 14% SHARE OF RES SUPPLIED FOR FINAL CONSUMPTION IN THE ROAD TRANSPORT SECTOR, WITH ADVANCED BIOFUELS CONTRIBUTING AT LEAST 3.5% OF THE SHARE BY 2030 | Reach 2030 RES contribution | Reach 2030 RES Transport contribution | Energy consumption: transport | CO2 | | 14% share of RES in road transport | Regulatory | RES Directive Recast<br><br>Governance Regulation | 2021-2030 |
| ACQUISITION OF RENEWABLE ENERGY CREDITS FROM OTHER MEMBER STATES | Reach 2020 RES targets | Reach 2020 RES overall target | | | | Achieve 10% RES share in 2020 | Other | RES Directive 2009/28 | |
| ESTABLISHMENT OF CRITICAL | Strengthen and secure the resilience | | Energy supply | | | | Regulatory | Directive 2008/114/EC | 2011- |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| INFRASTRUCTURE PROTECTION UNIT (CIP) | of Malta's critical infrastructure and national emergency services | | | | | | | |
| NATIONAL RISK ASSESSMENT – GAS SECURITY OF SUPPLY | Implement national risk assessment on security of gas supply | | Energy supply | | | | Regulatory | Regulation 2017/1938 | 2019- |
| NATIONAL PREVENTIVE ACTION PLAN – GAS SECURITY OF SUPPLY | Develop a national preventive action plan in line with Gas Security of Supply Regulation | | Energy Supply | | | | Regulatory | Regulation 2017/1939 | 2019- |
| NATIONAL EMERGENCY PLAN – GAS SECURITY OF SUPPLY | Develop a national Emergency plan in line with the Gas Security of Supply Regulation | | Energy Supply | | | | Regulatory | Regulation 2017/1940 | 2019 |
| MALTA – ITALY GAS PIPELINE PROJECT | Connection to the Trans-European Natural Gas Network | | Energy Supply | CO2 | | | Planning | Regulation 347/2013 | 2024- |
| ENERGY BENEFIT SCHEME | Reduction of energy poverty in Malta | | Energy consumption: households | | Direct reduction of utility bills for vulnerable households | | Economic | | Implemented |
| PROVISION OF PROFESSIONAL ADVICE TO VULNERABLE HOUSEHOLDS | Reduction of energy poverty in Malta | | Energy consumption: households | | Knowledge sharing | | Information | | Implemented |
| REPLACEMENT OF APPLIANCES IN HOUSEHOLDS SCHEME | Reduction of energy poverty in Malta | | Energy consumption: households | CO2 | Improved standard of living and lowering energy bills while offsetting 20t of CO2 emissions through energy savings | | Economic | | Implemented |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DEVELOPMENT OF R&I STRATEGY FOR ENERGY AND WATER | | | | | | | | 2020-2030 |
| REMOVING TRAVEL BOTTLENECKS AND REDUCING SEVERANCE BETWEEN URBAN COMMUNITIES – MARSA ROAD PROJECT | Modal shift toward Public Transport/ensuring high level service on the TEN-T Core and Comprehensive network | Decrease private vehicle travelled distance (vkm); increase public transport passenger travelled distance (pkm); reduction of lost time per passenger; reduction in congestion | Energy consumption: transport | CO2 | 77 mil EUR | 15 mil pkm savings compared to ref scenario for private cars; 10 mil pkm increase in Public Transport in peak hour; cost reduction of external impacts 58 mil/year; CO2 emission of 2741 tons/year | Planning | 2021-2025 |
| REMOVE TRAFFIC BOTTLENECK AT ADDOLORATA JUNCTION, MARSA | | | | | 82 mil EUR | CO2 reductions of 7,000 tons per year from 2020 | Planning | 2017-2021 |
| REMOVE TRAFFIC BOTTLENECK AND UPGRADE OF REGIONAL ROAD – KAPPARA JUNCTION | | | | | 35 mil EUR | | Planning | 2016-2018 |
| VARIOUS ROAD AND INFRASTRUCTURE PROJECTS | | | Energy consumption: transport | CO2 | | | Planning | 2018-2030 |
| IMPLEMENT PUBLIC TRANSIT QUALITY CORRIDORS | Modal shift toward Public Transport | Improve reliability and reduced perceived waiting time to increase bus patronage and public transport modal share | Energy consumption: transport | CO2 | 7 mil EUR | | Planning | Completion date: 2025 |
| IMPROVEMENT OF FERRY LANDING PLACES | Modal shift toward Public Transport/Develop transport hubs to | Increase frequency from 1 service every 30 min to 1 service every 15 | Energy consumption: transport | CO2 | 2.3 mil EUR | | Planning | 2019-2025 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | encourage intermodality | minutes and increase capacity | | | | | | |
| IMPLEMENTATION OF A CYCLING CORRIDOR | Provide alternative to private vehicles/encourage sustainable travel patterns and reduce private vehicular demand | Reach 42Km of bicycle lands. Increase the share of transport by bicycle to 3% | Energy consumption: transport | CO2 | 10 mil EUR | | Planning | 2019-2020 |
| INTRODUCTION OF A LOW EMISSION ZONE (LEZ) IN THE 'HUB' | Reduce the impact of high-polluting vehicles in inner congested urban areas and TEN-T network | | Energy consumption: transport | CO2 | | | Regulatory | Completion: 2025 |
| INTRODUCTION OF ELECTRIC BUSES IN GOZO | Impact reduction of vehicles in urban areas | Replacement of 8-12 diesel buses by electric buses | Energy consumption: transport | CO2 | 8 mil. EUR | Reduce 475.8 ton of CO2 emissions/year amounting to a total of 67,038 Eur of savings in air pollution and climate change per year | Planning | 2019-2020 |
| EXPRESS PASSENGER FERRY LINK BETWEEN MALTA AND GOZO | Removal of bottlenecks at TEN-T comprehensive ports | Improve community times between Gozo and the more inner harbour and central areas of Malta | Energy consumption: transport | CO2 | 6.3 mil EUR | | Planning | 2020-2025 |
| FREE TRANSPORT FOR YOUTHS, STUDENTS, AND SCHOOL CHILDREN | Modal shift towards public transport | | Energy consumption: transport | CO2 | | Reduction of c. 6300 passenger car trips | Economic | 2018-2020 |
| CAR-SHARING SCHEME | Providing an alternative to private vehicles/encourage sustainable travel patterns and reduce | Promotion of multiple occupancy vehicles | Energy consumption: transport | CO2 | | | Voluntary | 2018-2020 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | private car vehicular demand | | | | | | |
| LAST-MILE DELIVERY FOR VALLETTA | Testing the concept of sustainable last mile delivery in a Valletta pilot project | Reduce air pollution; incidence of traffic infringements and road congestion | Energy consumption: transport | CO2 | | Planning | 2019-2020 |
| DEVELOP A NATIONAL BICYCLE STRATEGY | Increase the modal share of cycling; strategy promoting cycling not only as a leisure activity but also credible, safe, alternative mode of transport | Identified routes mapped out and developed into a smart route planner and offered on mobile devices; upgrade a select number of routes into physically safe cycling routes | Energy consumption: transport | CO2 | | Planning | 2018-2020 |
| INCREASE USE OF INTELLIGENT TRANSPORT SYSTEMS IN TRAFFIC MANAGEMENT | Additional traffic control centre to become operational; installation of CCTS with ITS capabilities | Realtime reactions to traffic conditions and accidents; leading to improvements in travel time, pollution reduction and improved safety | Energy consumption: transport | CO2 | | Information | 2020 |
| SMART PARKING SYSTEM FOR VALLETTA | Improving the efficiency of parking in Valletta thereby reducing travel time and traffic congestion | | Energy consumption: transport | CO2 | | Information | 2020 |

# 4. Methodology

## Review of literature, international success stories and best-case examples

A review of the existing policy and legislative landscape has been carried out and presented in the first section of the report. Relevant policy and legislative literature have been reviewed using official documents by the Government of Malta and the European Commission (EC) websites.

This report also presents case studies and international success stories, identified through systematic literature searches using academic search engines (Google Scholar and Scopus), and the CORDIS section of the EC website. Literature searches have been carried out using the following keywords:

- greenhouse gasses or GHG
- emission reduction
- Mediterranean
- nature-based solutions or NBS
- air pollution
- renewable energies

Different combinations of such terms were entered as well. These inputs resulted in many available materials, therefore the first selection of articles was conducted based on title and abstract, to verify their connection to the theme advocated by this report. Subsequently, in a second review of the papers the following inclusion criteria were considered:

a) relevance to the theme of reducing greenhouse gas emissions;
b) Mediterranean climate conditions;
c) the nature of being an island, therefore possessing a limited space of land;
d) be completed projects, whose term or most recent update dates back a maximum of 5 years (2018-2022), and
e) compares conditions before and after implementation of the technology or solution.

We considered studies that met at least 3 of criteria a-e (above). Finally, as part of a snowball sampling strategy, other links and literature were consulted to identify other case-studies and literature that may have not been included in our initial literature searches. The snowball sampling led the researcher to various atlases and databases that have been

created as outcomes of various EU-funded projects and initiatives. These were checked to find the most suitable examples that are relevant for the purpose of this study.

## Stakeholder interviews

Research interviews were conducted with key public sector stakeholders involved in setting key policies for the energy and climate change sectors and with representatives of the private sector. Several authorities and business organisations with an interest in greenhouse gases emissions reductions were contacted and invited for an interview. The dialogue with representatives of three major Maltese authorities namely The Energy and Water Agency (EWA), Malta Resources Authority (MRA) and the Ministry for Environment, Climate Change and Planning, and subsequently The Malta Chamber as business representative, consolidated the literature review previously performed. The interviews were semi-structured with questions (Annex I) used to prompt an open discussion leading to a deeper understanding of the landscape, incumbent system and niche system as defined by the Transition Model Canvas (TMC). The interview questions focused on the current Maltese standpoint along this 2030 decarbonization pathway, analysing the possible interventions to be implemented in the sectors of greatest concern at the level of greenhouse gas emissions and the possible obstacles foreseen in this regard. The share of renewable energy harnessed in Malta and the possible breakthrough in this sector due to the current global situation were also given prominence. Finally, the electrification of transport, nature-based solutions and the behavioural contribution of citizens were discussed through open-ended questions addressed to the stakeholders. As outcomes, besides having the perspectives of prominent figures in the Maltese landscape, it was possible to have insight into how Malta's progress towards limiting greenhouse gas emissions, the efforts and actions implemented on the territory so far, and the various mitigation measures that could concretely contribute to a reduction in greenhouse gas emissions.

# 5. Review of literature, international success stories and best-case examples

## Literature review themes

During a literature review conducted as part of this research paper, case studies and international success stories were identified through systematic literature searches using, predominantly, academic search engines and the EC CORDIS which acts as primary source of results from the projects funded by the EU's framework programmes for research and innovation.

Based on the key sector contributing to Malta's greenhouse gas emissions, the following key themes of international research success stories were identified for the scientific literature review:

a. renewable energy sources;
b. diversification of energy sources (including, waste to energy, biomass, biomethane, etc.);
c. public transport efficiency;
d. electric vehicles;
e. car sharing;
f. nature-based solutions, and
g. building efficiency.

Literature focusing on participation of local communities that is more likely to contribute to the reduction of greenhouse gases was considered as a crosscutting theme in this review.

## Literature and success stories

The literature search yielded a total of 20 publications, mostly articles in scientific journals but also project outcomes and grey literature. More than a half of the literature focused on renewable energies and different energy sources while the remaining ones were distributed under building efficiency and nature-based solutions. In addition to this systematic literature search, additional success stories were identified from literature relating to nature-based solutions and urban mobility.

A total of ten success stories of significant greenhouse gas reductions from island environments or from similar climatic conditions are presented in this section in view of their relevance to Malta's context or the polices and measures identified within the LCDS.

## Success Story 1: Scenarios of future greenhouse gas emissions in Tenerife

Tenerife has a surface area of 2,034Km$^2$ and has a high population density, and an important tourism sector. This paper evaluates 3 scenarios based on the present situation (2018), a future baseline (2050) with a reduced implementation of renewables, and one for a future (2050) ecology-aware scenario with 100% exploitation of renewable resources. By analysing the variation in greenhouse gas emissions among the scenarios important emission declines are noted for both future scenarios because of the higher renewable energy penetration in the mix, combined with the electrification of land transportation, which is one of the largest emitters in the base case scenario. A greater electrification of the energy demand will lead to the use of more efficient devices with lower energy needs. It was also found that as the availability of groundwater sources diminishes, the energy cost of supplying water demand will increase sharply due to the higher specific consumption of desalination plants. The highest reduction in greenhouse gas emissions was recorded in the 'ecology-aware scenario', in which solar photovoltaics and wind power were the only electricity generators while groundwater abstraction is not allowed leading to a system that is entirely reliant on desalinated sea water and recycling of wastewater, mainly for irrigation purposes. This reduction in greenhouse gas emissions, a consequence of higher renewable energy penetration in the mix, and the optimization of energy–water networks in island territories as presented in this research could provide important key messages for insular environments, like Malta, on how to reduce electricity consumption, improving water system efficiency, and avoid the dependence on external resources. Additionally, similar to Malta, limitations in land availability, along with other characteristics of the electric infrastructure and the saturation of electrical substations are identified for Tenerife, which need to be considered in the application of the results from this high-level study. Similar to what is proposed in Malta's LCDS, the article identifies offshore wind and photovoltaics installations as an opportunity to decrease the pressure for land uptake (Rodríguez-Urrego et al., 2022).

## Success Story 2: the Smart Island Energy Systems (SMILE) project

The Horizon 2020 project SMILE[13] has proposed a set of technological and non-technological solutions to make more agile and competitive the distribution in an electricity grid based on renewable sources and storage systems. For this purpose, three demonstrator islands (Samso, Orkney, Madeira) have been selected and have evaluated different combinations of technological solutions according to local specificities and conditions and the existing infrastructure and are involving all value chain actors needed to efficiently implement projects system-wide. The technological solutions vary from integration of different battery technologies, power to heat, power to fuel, pumped hydro, electric vehicles, electricity stored on board of boats, aggregator approach to demand side management (DSM) and predictive algorithms. The 3 case studies are characterised by high penetration of renewable energy sources in the electricity grid or have planned increased shares thereof in the forthcoming years. Each pilot aims to demonstrate stable and secure grid operation in the context of the implementation of solutions enabling demand response and the intelligent control and automation of distribution networks to provide for smart management of the grid, as well as in the context of the adoption of energy storage solutions and/or the connection between the electricity network and other energy networks as well as of the smart integration of grid users from transport and mobility. Moreover, cross-cutting activities among the pilots are devoted to solving common technical, organizational, legal, regulatory, and market-related issues as well as to evaluate the solutions from the economic and business points of view. Each of the demonstrators is bringing a specific set of challenges, technology options and most importantly, energy market conditions. The sites are therefore effectively representative of most of the EU energy markets and offer excellent demonstration settings which will deliver maximum impact in terms of replicability.

The use of smart grid technologies to improve the utilisation efficiency of the power system by detecting and reacting to local changes in usage is identified in the LCDS as beneficial. Through experimentation in the case-studies and collaborations between stakeholders in different island environments, this project shows how through smart grids, peak demand can be reduced, and the energy grid can be stabilized. Smart grids can also help enhance

[13] Smart Island Energy System Horizon 2020 project. Available from: https://cordis.europa.eu/project/id/731249/reporting. Accessed: 25 May 2022.

energy efficiency and are expected to have a fundamental role in decarbonizing the economy.

## Success Story 3: Offshore renewables in the Asturias

The potential of renewable energy sources is sometimes hampered by their dependence on specific weather conditions, while in in insular systems their potential uptake is also affected by the lack of land space. The coastal area of Asturias, Spain, is used as an example to prove the potential of combining offshore wind and solar power but for which assessments are generally lacking as recognised also by Malta's LCDS which considers a limited area to the south of Malta, of around 15 square nautical miles, as viable for siting offshore floating wind but no offshore solar generating capacity was included as this technology is at an earlier stage of research and development than offshore floating wind.

In the Asturias, floating solutions are the only option for marine renewables due to the lack of shallow water areas, which renders bottom-fixed wind turbines inviable. Results showed advantages both for wind and solar energy in terms of efficiency compared to the single source onshore farms. The main advantage of floating photovoltaic panels is the water cooling on the solar cells, therefore higher conversion efficiency, followed by abundant water for cleaning the panels, scalability of the systems from microwatt to megawatt, and reduction in the growth of algae by the shading effect of the panels. Conventional offshore wind farms require large empty marine surface areas in between the turbines, which in combined systems, may be occupied by floating photovoltaics therefore increasing the capacity density and optimizing marine space (López et al., 2020)

## Success Story 4: Diversification of energy sources in SIDS

Small Island Developing States (SIDSs) are faced with challenges such as reducing the share of fossil energy and waste landfilling. To compare and explore the potentials of different Waste-to-Energy (WtE) strategies in such insular systems, 53 SIDSs were considered, comprising three main geographic regions in this study: Caribbean (24 islands), Pacific (20), and Atlantic, Indian Ocean, Mediterranean, and South China (9). The findings show that WtE technologies can be an alternative to increase the penetration of renewable energy, reduce energy cost, and increase reliability, reduce the amount of waste disposal, and so

increase the lifetime of landfills, and reduce the carbon and ecological footprints of population growth. WtE was found to be cost-effective in SIDSs because of small travel distances to power plants and landfills. A more urgent need to replace landfilling practices with WtE technologies was identified for SIDS exhibiting higher population densities and having a high share of fossil fuel in their electricity mix. Furthermore, only 3%of the landfill area is necessary for buildings and landscaping associated with a WtE plant able to treat 1 million tons of municipal solid waste, considering a 30-year lifespan while additional incineration provides energy recovery benefits (Mata-Lima et al., 2021). Malta's LCDS mentions investment in a WtE plant which is expected to significantly reduce Malta's landfilling volumes, and a new 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.

## Success Story 5: Geothermal energy in Dominica

The selection of viable technologies for harnessing renewable energy sources is dependent upon several factors, with the most critical being geographical and geological factors. This case-study presents the case of Dominica, which is geographically located in the Caribbean, and is endowed with many forms of renewable energy such as wind, solar and hydroelectric power. These systems are, however, largely intermittent in supply and are affected by seasonal and daily fluctuations, and thus need to be fully consolidated with other dispatchable power systems to maintain reliability. Geologically, the region is situated in an active region around the Caribbean plate, creating ideal geological situations for the use of geothermal energy. Geothermal energy is independent of weather and climatic situations and most suitable for scale-up. While geothermal energy is less relevant to the case of Malta, the study presents the use of multiple decision criteria to support evidence-based decision making. It explores future scenarios, including the achievement of 100% geothermal integration which reduces the national life cycle GHG emissions by 99.5%, allowing the island to meet its commitments under the Paris Agreement and providing 70% cheaper energy by 2030 (Bhagaloo et al., 2022).

## Success Story 6: Use of Green Building Materials in Taiwan

The service and residential sectors have become significant sources for reducing greenhouse gas emissions arising from the demand for heating, ventilation, and air conditioning (HVAC) in buildings. For new buildings, Malta's government will consider implementing energy efficiency standards to drive up performance in household buildings. Here, the case study of Taiwan is considered. In Taiwan, the energy efficiency in buildings is considered as being very important since the service and residential sectors, in a climate characterised by hot temperatures and high humidity, are the primary sources of greenhouse gas emissions. The electricity consumption for this sector presents a decreasing trend over the period of 2005–2020, a consequence of existing policies that promote green building materials which include materials having high thermal insulation performance. It is expected that the energy consumption and GHG emissions of the service and residential sectors will be further reduced because the new and/or retrofitted buildings will adopt the certified green building materials by 2030 (Tsai & Tsai, 2022).

## Success Story 7: Renewable-fed Power-to-Power systems for small French islands

For this study, 21 small French islands based in Europe were used as examples to prove how electrical energy storage systems and hydrogen can ensure an appreciable match between electrical load and supply without concerns about intermittency. For each island, three distinct energy storage options were explored and discussed: hydrogen storage, battery storage and a hybrid one with hydrogen plus battery combined storage. Especially in insular locations, renewable energy sources-based hybrid configurations have proven economically superior to the diesel generators, with a considerable reduction of greenhouse emissions. More than 99 thousand tons of $CO_2$ emissions can be prevented by avoiding consumption of more than 34 million litres of diesel per year (Shahid et al., 2022).

## Success Story 8: Building efficiency case-study in Madrid

The building of the energy department of the Madrid Institute for Advanced Studies (IMDEA)[14] incorporates different climate change adaptation solutions from similar climatic conditions to Malta. The building has been designed according to the criteria of bioclimatic architecture, therefore including energy efficient systems, renewable energy, reduced energy use, efficient water systems, efficient resource use and green areas around the building. Moreover, roof areas exposed to direct sun have been covered with a special white material reflecting radiation, which reduces the amount of energy needed for cooling and the contribution to the urban heat island effect. Finally, climate change mitigating measures are also implemented via behavioural measures: electric cars and carpooling are encouraged by the reservation of special places in the parking area. The construction lasted 2 years and cost around 9 million euros, but provided that the building is well maintained, its useful life is estimated to be over 50 years. The new building did not just cost money, but it is meant to save money during the period of use. The high energy and water efficiency of the building can result in lower future costs for energy and water consumption compared to conventional buildings. Today, IMDEA has successfully acquired funding for research and development from national and EU calls, in the magnitude of millions of euros, also improving the research and innovation capacity in this sector.

## Success Story 9: Shared Mobility in Elba (Italy)

The research carried out on the Tuscan Island of Elba was developed under Horizon 2020 project CIVITAS DESTINATIONS[15] project and is based first on the implementation of the concept of Shared-Use Mobility Agency (SUMA) and Mobility as a Service (MaaS), and then moves on to how the co-creation of a Sustainable Urban Mobility Plan (SUMP) can respond to the demands of both resident citizens and tourists, clearly needs of a different nature. SUMA provided answers to the island's needs, such as a coordinated mobility offer

[14] Climate ADAPT - White roof, innovative solar shadings and bioclimatic design in Madrid. Available from: https://climate-adapt.eea.europa.eu/metadata/case-studies/white-roof-innovative-solar-shadings-and-bioclimatic-design-in-madrid. Accessed: 25 May 2021.

[15] CIVITAS Destinations Horizon 2020 project. Available from: https://civitas.eu/projects/destinations. Accessed: 25 May 2021.

managed by a unique agency to optimize the available resources and to create a suitable offer to be integrated with public transport. Similar to Malta's transportation objectives in the LCDS to more active and sustainable transport, the MaaS concept in this case-study is used to foster the transition from a dominant car ownership model of mobility, to one of paying for mobility "on account" using more sustainable modes of transport as an alternative to private car use. Eventually, the co-creation of the SUMP, implemented through a series of citizen and stakeholders Laboratories in which all participants could express their point of view and formulate proposals, allowed the development of a future-thinking approach: elaborating actions for the present having a critical view of the past and strategic-long term goals (Gini & Ambrosino, 2022).

## Success Story 10: Empowering Energy Education

The eTEACHER Horizon 2020 project aims to empower building end-users to achieve energy savings and improve comfort for the sake of health and wellbeing[16]. The project has developed intervention strategies according to cultural and demographic indicators and is implemented in 12 different demo sites located in three European countries with different climatic conditions. In this project, a user-friendly app was developed to obtain information about the environmental conditions using sensors, and evaluate the users comfort levels, and then based on these two inputs identify recommendations to reduce carbon emissions while also improving well-being. E-teacher raises energy awareness of building users through tailored methods and strategies that are deployed through ICT solutions, and which are expected to reduce energy consumption by 10% and is of direct relevance to the implementation of Malta's LCDS which identifies support for education and awareness-raising initiatives on energy usage in households but remains rather generic in its approach.

[16] eTeacher Horizon 2020 project. Available from: http://www.eteacher-project.eu/. Accessed: 25 May 2021.

# 6. Stakeholder interviews

Interviews were conducted with key stakeholders from the following entities:

- Malta Resources Authority,
- Ministry for the Environment, Energy and Enterprise, and the
- Energy and Water Agency.

In a subsequent step, a meeting was held with The Malta Chamber and in addition to representatives from the Chamber included businesses from the following sectors:

- Airline sector;
- Environmental and planning;
- Industrial gas and energy industry;
- Packaging;
- Mobility and road transport sector, and
- Energy efficiency.

The Malta Chamber also provided written comments, which are presented in Appendix 2 of this report.

The interviews were analysed qualitative using the Transition Model Canvas (TMC), to map the most important elements of the socio-technical transition of greenhouse emission reduction while identifying systemic strengths and vulnerabilities and use them to identify, design, or adapt change strategies (van Rijnsoever & Leendertse, 2020).

Lowering greenhouse gas emissions is a socio-technical transition and an uncertain process that requires the participation of different actors and institutions, is influenced by existing infrastructure, and existing policies and legislative tools at national, regional, and global scales. Socio-technical transitions are therefore complex processes that are difficult to understand and even more so manage. The TMC has been identified as a reference tool used to structure the data collection, analysis, and presentation of socio-technical transitions. The TMC is an adaptive tool based on the multi-level perspective (Geels, 2011; van Rijnsoever & Leendertse, 2020) and is also used to structure qualitative data collection carried out through interviews with key stakeholders and subsequent data analysis (Figure 5).

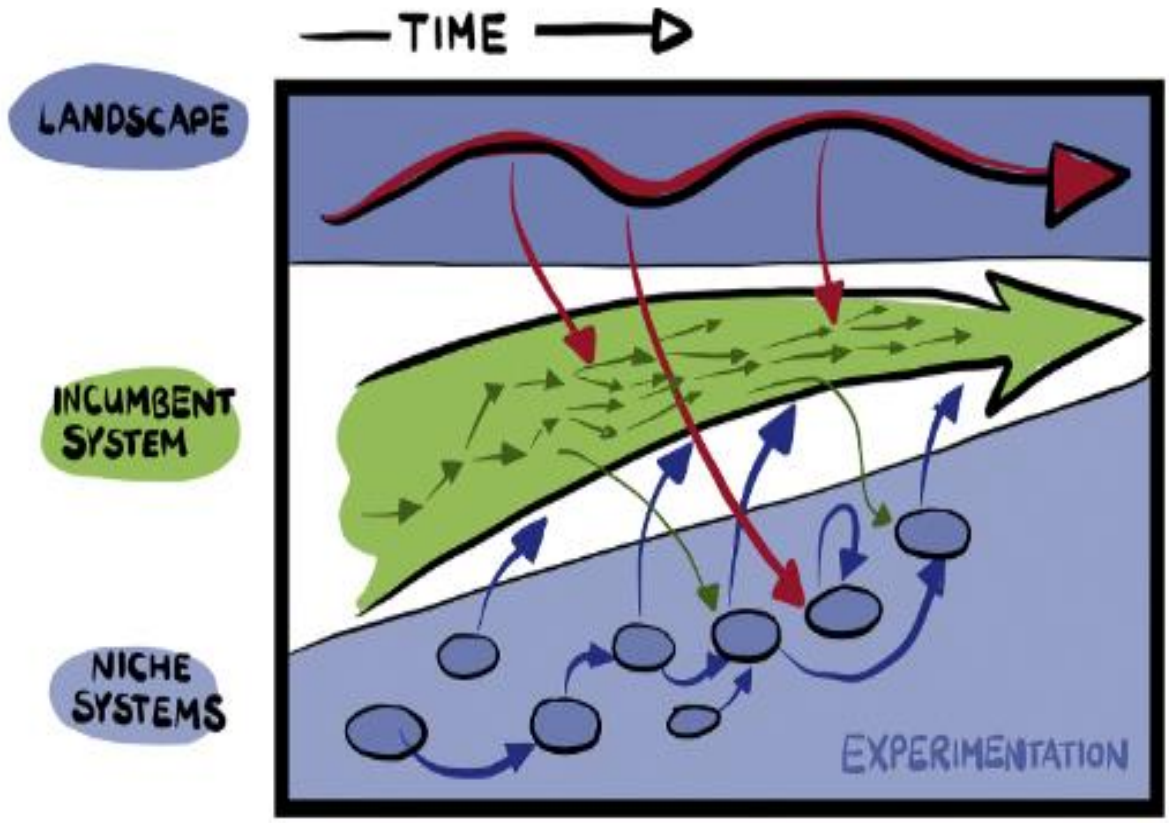


*Figure 9 – The interaction of the three elements forming part of the Transition Model Canvas.*

Figure 9 identifies the three elements forming the TMC conceptual framework, based on the multi-level perspective, namely the:

1. **landscape**: the wider context that influences niche and incumbent dynamics, including trends, values, ideologies and macro-economic patterns;
2. **incumbent system**: the structure of established rules and systems that stabilize current practice, and are shaped by technological, scientific, policy, socio-cultural and market forces, and
3. **niche system**: the locus for innovation and ideas, as radical as they can be.

The difference between an incumbent system and a niche system lies in their degree of structuration and stability. Interacting elements in the incumbent system are characterised by stable and self-reinforcing configuration of rules and actor behaviours. (Geels, 2011; van Rijnsoever & Leendertse, 2020).

The stakeholders' responses have been categorised into the different components of the TMC as shown in Figure 10.

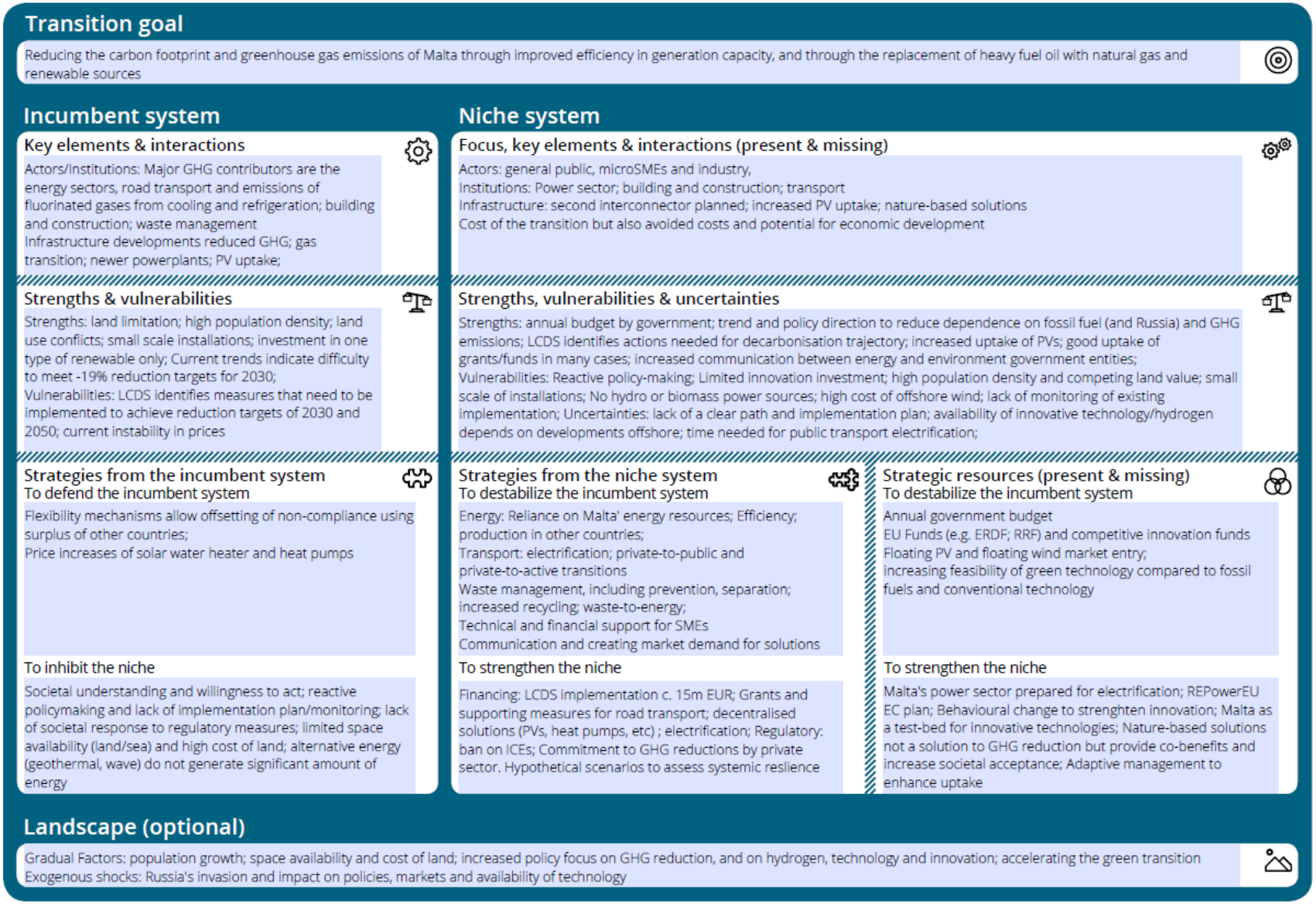


*Figure 10 - Transition Model Canvas with the interviewee responses.*

## Transition Goal

The identified transition goal is the reduction of greenhouse gas emissions, according to the stated NECP objective show below:

- To reduce the carbon footprint and greenhouse gas emissions of Malta through improved efficiency in generation capacity, and through the replacement of heavy fuel oil with natural gas and renewable sources.

## Landscape

Insularity, and the associated dependence on external markets, space limitation across the inland-coastal-sea gradient and arising spatial conflicts, population dynamics, are a key defining feature for Malta's greenhouse gas emission reduction targets. Malta's energy market is the main contributor to such emissions (Table 1), followed by the road transport sector, the industrial Processes and Product Use (IPPU) and waste sectors. Agriculture contributed just 3.79% of Malta's total greenhouse gas emissions (MRA, 2022). Despite annual increases from 2009 onwards, the gross final energy consumption from renewable energy sources (RES) in 2020 was at 10.7%, the lowest in the EU member states [17].

The interviewees identified an increased policy focus on greenhouse gas reduction and the uptake of alternative fuel sources as being the main gradual factor favour the establishment of the niche system and accelerating the green transition. Exogeneous shocks associated with the COVID19 pandemic, but more importantly Russia's invasion of Ukraine, have accelerated the green transition. It was commented by one interviewee that the latter *"has brought closer to everyone the dependence on source from outside the EU at political level"* and is expected to lead to key *"policies but at the end of the day it all depends on how much the general public accepts that we need to move away from fossil fuels"*. Another interviewee explained that before these exogenous shock *"we were talking more philosophically and now there is an issue of accelerating the green transition. We [Malta] cannot be insulated from what is happening. The legislation will push for this transition … The indigenous capacity to produce energy needs to be increased and we* [Malta] *need to focus on supply security."* This event has also led to changes in technology feasibility, as the recent increases in oil prices have made renewable energy sources more feasible. However, concerns were raised by business interviewees about the costs of energy changes, how this

[17] Eurostat Renewable Energy Statistics. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics. Accessed: 27 May 2022.

will change in the future and the time needed by industry to plan for this change: "*industry and the commercial sector need to know if and when energy costs are going to be increased locally, they need to plan for it now. We have no visibility and no idea when this is going to happen … suddenly find[ing] an increase in energy would be severely detrimental.*"

## Incumbent System

### Key elements and interactions

In line with previous observations (Assessment of the current state of play), the major greenhouse gas contributors are identified as the energy sector, road transport, emissions of fluorinated gases from cooling and refrigeration from IPPU and waste management. While different entities have contributed to the NECP, which was led by the Energy and Water Agency, stakeholders from other sectors were also identified as being important for the transition to low greenhouse gas emissions. All interviewees explained that important reductions in greenhouse gas emissions have been achieved by newer power plants, the interconnector, the transition to liquified natural gas, and increased uptake of photovoltaics. During the interviews, the important role of the newly established Building and Construction Authority in improving the energy performance of buildings was identified. Similarly, in the sector of road transport, which is identified as being the most important contributor to greenhouse gas emissions from the transport sector, Transport Malta has established a National Transport Strategy for 2050[18]. One interviewee explained that road transport has become one of the most important greenhouse gas emitters, and that *"we are in a situation where in normal years emissions from road transport area almost as hight as power generation."*

### Strengths and vulnerabilities

Within the TMC, strengths comprise internal and socio-technical landscape stable key elements and interactions in the system, as well as the factors that give a socio-technical system its stability (van Rijnsoever & Leendertse, 2020). **Strengths** of the incumbent system identified by the interviewees include existing space limitations, high population density of

[18] Transport Malta Strategies, Policies & Actions. Available from: https://www.transport.gov.mt/strategies/strategies-policies-actions-1342. Accessed: 27 May 2022.

Malta, and environmental characteristics which limit uptake of renewable energy sources due, for example, to conflicting uses of land and coastal areas or because of the high cost associated with deep offshore wind energy sources or the limited potential to significantly generate energy through geothermal and wave energy.

**Vulnerabilities** are the points that can be targeted to destabilize the system and may be the least stable key elements or interactions, but also supportive factors (van Rijnsoever & Leendertse, 2020). The main vulnerability of the system is the political willingness for decarbonisation, and the LCDS already identifies the measures needed to implement and achieve the greenhouse gas emissions reduction targets for 2030 and 2050. The current instability associated with Russia's invasion of Ukraine has led to an increased awareness of our (Malta/EU) dependence on external sources, increases in the cost of energy, and for the need to improve the indigenous capacity of energy production to ensure the security of the supply. Similarly, the recent instability coupled with a reduction in the market prices of new technologies, such as floating photovoltaics and floating wind, is leading to increased opportunities for the uptake of these technologies.

## Strategies from the incumbent system

**Short-term feasibility of the incumbent system:** The strategy from the incumbent system entails identifying the actors' strategies that are currently deployed or likely to be deployed in the future to defend the incumbent system and inhibit the niche system (van Rijnsoever & Leendertse, 2020). Strategies from the incumbent system that defend or inhibit the niche system identified by the public sector interviewees included elevated costs of some renewable energy sources, such as floating photovoltaics and floating winds, the increasing costs of solar water heaters and heat pump water heaters, and limitations associated with the use of some renewable energy sources such as geothermal and wave energy which were identified as having lower energy production capacity. The latter are a consequence of the environmental characteristics (e.g., sea depth) but also of arising conflicts with other land uses and the use of the coastal and marine environment.

**Reactive policymaking:** On the other hand, the interviewed business stakeholders mainly identified policy-making inhibitors. It was mentioned that Malta is reactive, rather than proactive, in its sustainability-related EU policy as, more often than not, its policies often follow those of the European Commission. One of the business stakeholders explained how

in the case of the 'Fit for 55 package[19]', *"most countries went into the negotiations at EU level with their plan in hand and compared. In Malta, we do it differently. We wait what comes out of the EU, then we start planning because we are forced to following what is set by other countries."* Another business stakeholder commented *"our policy cycle has been reversed. Rather than the country having a policy orientation and according to the developments that are happening in the EU uses those developments to tap into funding that will help implement its vision, we do it the other way round … we see what funds we can apply for, we create a scheme in the spot and … in the meantime something else comes up in the EU and we forget about that scheme and create another one, and nobody quite knows where we are heading because what we cannot measure by default we will never achieve, let's be clear."*

In written feedback (Appendix 2), the Malta Chamber commented that existing strategies tend to be in the form of visions rather than concrete plans than concrete plans which effectively demonstrate how to close the gap between the present reality and the country's targets, which plans are not convincing or effective as advertised as these lack detail regarding their implementation and the study of the obstacles on the ground. A business stakeholder working in the energy efficiency sector commented "*there are certain deadlines but there is no roadmap on how to achieve those deadlines. There's a plan … we don't know when we are going to arrive. We need to see more clarity on what the plans are because on buildings we are decades behind*" and added that *"what is being done in terms of grants from Malta Enterprise and other entities is good, but a lot of improvement can be done … we are not seeing enough acceleration to reach those deadlines."* A business stakeholder from the packaging sector commented that *"we don't have a market in Malta so basically our policies are driven by anything but Malta … I think there is a chance that industries like our will no longer be able to operate in Malta"* because of the inability to make commitments in terms of energy emission reductions.

**Gaps in existing strategies:** The business community commented that there are entire gaps in some areas, as, for example, explained during the interview with business stakeholders in which the lack of strategy on how to procure sustainable aviation fuels while there is an additional cost for transporting these fuels to Malta was lamented. A representative from the airline industry explained the commitment of the airline to achieve

[19] Fit for 55. European Commission. Available from: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/. Accessed 20 June 2022.

net zero emissions by 2050, and how the airline is currently offsetting its emissions, but the cost of offsetting emissions has increased substantially. The lack of relevant policy for the procurement of sustainable aviation fuels would require further offsetting in the future. Another example is Malta's targets to electrify the vehicle fleet, which lacks a coherent roadmap on how to get there. Between today and 2030, to meet EV targets, as identified in the LCDS and also featured prominently in the media, Malta would need to have 65,000 EVs, including plug-in hybrid EVs, on the road[20]. *"This means that practically all new cars on the road would need to be electric, rather than the small percentage today. This reality is not acknowledged in policy and hence the government target of 65,000 EVs lacks credibility."* National statistics show that in 2020 the stock of electric vehicles was 2533 electric and 2700 hybrid vehicles, which is not significantly different from the 2019 data, when the stock of electric vehicles amounted to 2293 with an additional 2200 hybrid vehicles. A report presenting a study for a cut-off date for the importation and registration of Internal Combustion Engine (ICE) vehicles in Malta has determined that both the fleet targets and road emission targets set for 2030 are unattainable in the absence of complimentary policy actions, while Malta will fall short of its 2050 fleet target for 100% of the fleet to be non-internal combustion engine vehicles by this date, further supporting the need for complimentary policy action (PWC, 2019).
On the issue of credibility, a representative of The Malta Chamber *"if we say that we have a target of 19% [reduction in greenhouse gas emissions] and we don't say how we're going to get there, then the credibility around that 19% is very low… the plan gives you the confidence not the targets."*

## Niche System

### Focus, key elements, and interactions

In line with the transition goal of reducing greenhouse gas emissions, the same sectors as those already identified in the incumbent system were identified for the niche system. Of relevance here, given the sectoral contributions to the national greenhouse gas emissions, is the important role of the regulators and policies relating to the power sector, building

[20] [WATCH] Government targets 65,000 electric cars on the road by 2030. MaltaToday, 22 November 2021. Available from: https://www.maltatoday.com.mt/news/xtra/113419/government_targets_65000_electric_cars_on_the_road_by_2030. Accessed: 22 June 2022.

and construction, transport, and waste. The interviewees identified increased uptake of photovoltaics and the establishment of a second electricity interconnector to Sicily as key initiatives forming part of the niche system.

The response of the public, SMEs and industry was also identified as being particularly important to foster acceptance of measures focusing on renewable energy, increased efficiency and achieving behavioural change (e.g., increased public/active transport; increased waste separation) necessary to reduce greenhouse gas emissions according to the national targets. Here, the role of nature-based solutions was also discussed, with the interviewees considered these as having limited capacity to achieve significant reduction in greenhouse gas emissions but also provide an opportunity to achieve "citizen and industry buy-in" of an alternative future particularly because they give rise to improved aesthetics whilst also generating other co-benefits, such as flood mitigation, grey water treatment, local climate regulation and improved health. They are part of the solution and allow *"to convince people that things can change for the better"* while also providing a nature-based solutions toward adaptation, which is itself an *"underexplored area when it comes to climate action, and admittingly we need to do more … from all points of view"*.

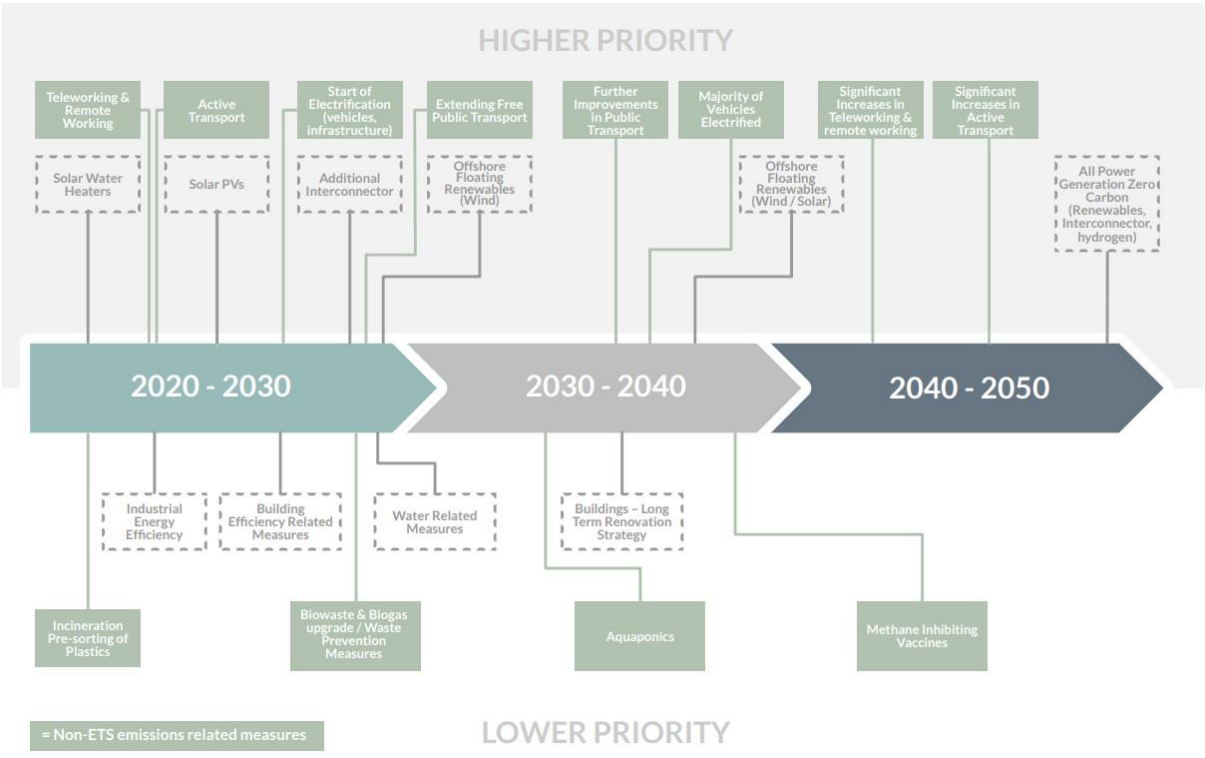


*Figure 11 - Overview of the key policy initiatives identified in Malta's LCDS* (Source: MECP, 2021).

A key element of the transition is the important role of the LCDS which outlines measures in seven different sectors, that is Energy, Transport, Buildings, Industry, Waste, Water and Agriculture and land-use, land-use change and forestry (LULUCF), to achieve target reductions in GHG emissions by 2050 and enabling Malta to reach its Effort-Sharing Regulation (ESR) targets by 2030 (Figure 11). For many initiatives, sustained effort and action is 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 LCDS recognises that the projects may be reviewed in terms of capacity, nature and timelines following more detailed studies by the competent authorities, while the LCDS operates on a five-year review cycle to reflect update in technology and its cost-effectiveness, and hence, potentially, leading to the identification of updated/new measures. This section of the TMC framework provides an overview of some of the main measures, and associated data, as presented in Malta's LCDS with the latter including further details on these measures.

**Energy**: The highest abatement potential of measures within the LCDS is the energy and transport sectors, followed by buildings and the industry, and waste management (Figures 6, 7 and 8), but the relative contributions to greenhouse gas emissions reductions is expected to vary with the target period. By 2030, and based on assumptions outlined in the LCDS and according to the modelled price developments of the Italian electricity market, the most significant contributor to GHG emissions abatement is the interconnector while additional installation of Solar PV and SWHs, and other renewable heating technologies, are expected to contribute to further abatement potential (Figures 12 and 13) while the expected reduced use of combined cycle gas turbine plants is expected to lead to significant reduction in greenhouse gas emissions. It is not clear whether consideration of steep energy costs from the Italian electricity market, for example as a consequence of the recent Ukraine's invasion by Russia in February 2022, have been considered within the models used for the LCDS preparation. More generally, the installation of an additional electricity interconnector, fosters the energy grid decarbonisation 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, but the cost of emissions is included in the cost of the purchased electricity whilst the source countries would also have greater potential to obtain a higher renewable energy source percentage in their supply. On the other hand, to achieve the renewable energy 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. Renewable sources of electricity could reduce reliance on fossil fuels and the interconnector, and therefore maximising security of supply while potentially reducing the costs as the price of renewable technology falls in the future. The LCDS has considered a limited area to the south of Malta, of around 15 square nautical miles, as viable for siting offshore floating wind and is included in the estimation of the abatement potential while no offshore solar generating capacity was included as this technology is at an earlier stage of research and development than offshore floating wind. Upon contingent supply from mainland Europe, hydrogen could be used as a source of energy, in line with the government proposal for a gas pipeline that is built hydrogen-ready, to enable the switch from gas to hydrogen at the time any EU supply network is commissioned. Retrofitting current Combined Cycle Gas Turbine plants to use hydrogen would make Malta carbon neutral but there is a potential risk to security or to cost of supply since this is dependent on import from other countries.

**Transport**: Within the transport sector, greenhouse gas abatement is considered within the LCDS through further support for the electrification transition, by strengthening the grant scheme currently in place for the purchase of EVs and plug-in hybrid vehicles, the installation of an extended network of EV charging points, and the electrification of the government fleets and public transport buses. Malta aspires to have introduced c. 65,000 EVs, including plug-in hybrid EVs, and c. 6,500 charging points are expected to be introduced by 2030.

Further support to drive an increase in public transport usage, including through the extension of free public transport services and improvement of the transport services, and support for active transport (cycling, and walking), the latter is assumed to increase over the next 30 years as a consequence of improvement in the soft mobility infrastructure and increased availability of ebikes and pedelecs. Teleworking and remote working are also seen as a greenhouse gas reduction measure and for addressing the dependency of productivity and transport.

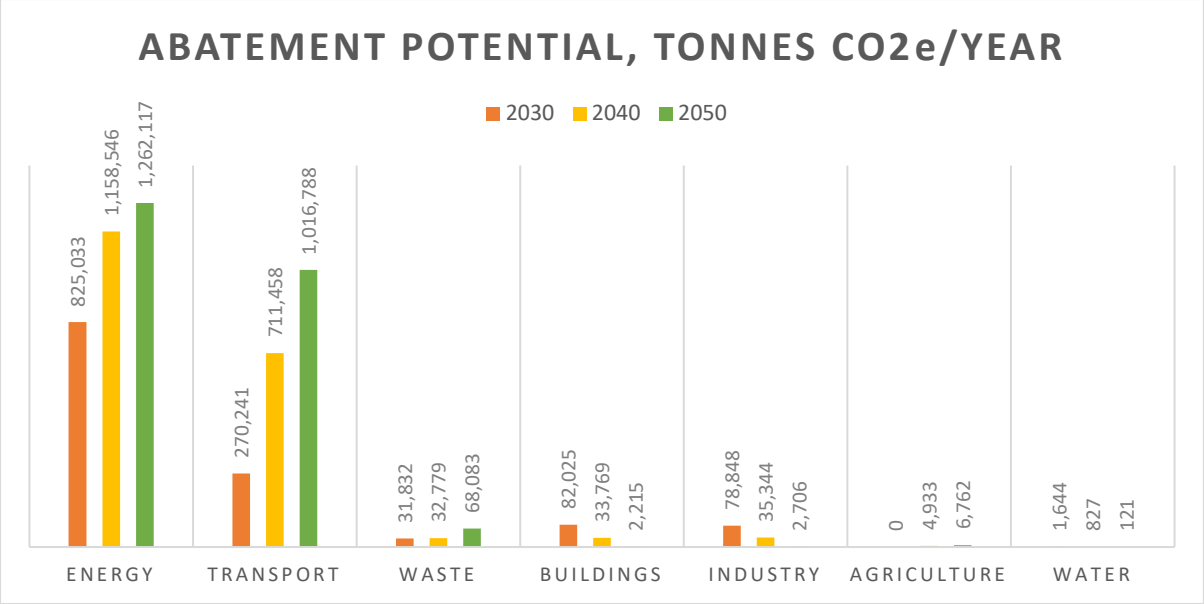


*Figure 12 – Sectoral abatement potential in tonnes CO2e/year (based on data presented in Malta's LCDS 2021)*

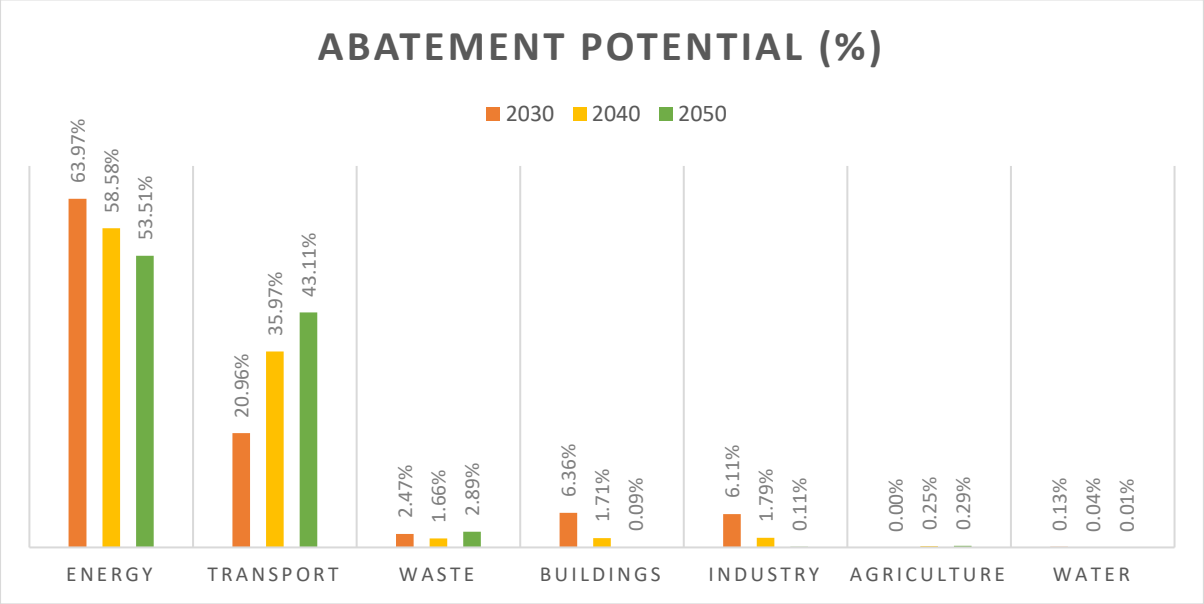


*Figure 13 - Sectoral abatement potential as a fraction of the total abatement for the respective period (based on data presented in Malta's LCDS 2021).*

**Buildings**: The LCDS measures on buildings are in line with Malta's Long Term Renovation Strategy (LTRS), launched in 2021, and which implementation is expected to drive the actions within this sector. Figure 14 presents the estimated floorspace of single and multi-family housing, and offices, under a baseline scenario, from 2020 to 2050, which figures suggest that the building stock will increase by approximately 20% by 2050. The policy initiatives considered by the LCDS include energy efficiency single measures and retrofitting to achieve Nearly Zero Energy Building (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. Measure, supported by schemes, for deep renovation (e.g., the 'Irrestawra Darek' scheme) that includes retrofitting green and enhancing energy efficiency initiatives of 12,000 units of building stock by 2030, and energy efficiency measures in buildings are included in the LCDS. Most significant abatement will be achieved from ensuring domestic appliances having a high energy performance rating and are therefore very energy efficient. Additionally, the use of energy efficient office equipment and the installation of light sensors, predominantly in non-residential buildings, to optimise lighting usage would be expected to generate further abatement. Additional abatement from roof and wall insulation, and other changes in building design and the building's integral energy-using equipment, and improved enhanced and awareness, were not specifically modelled in the LCDS but would be expected to lead to some additional abatement.

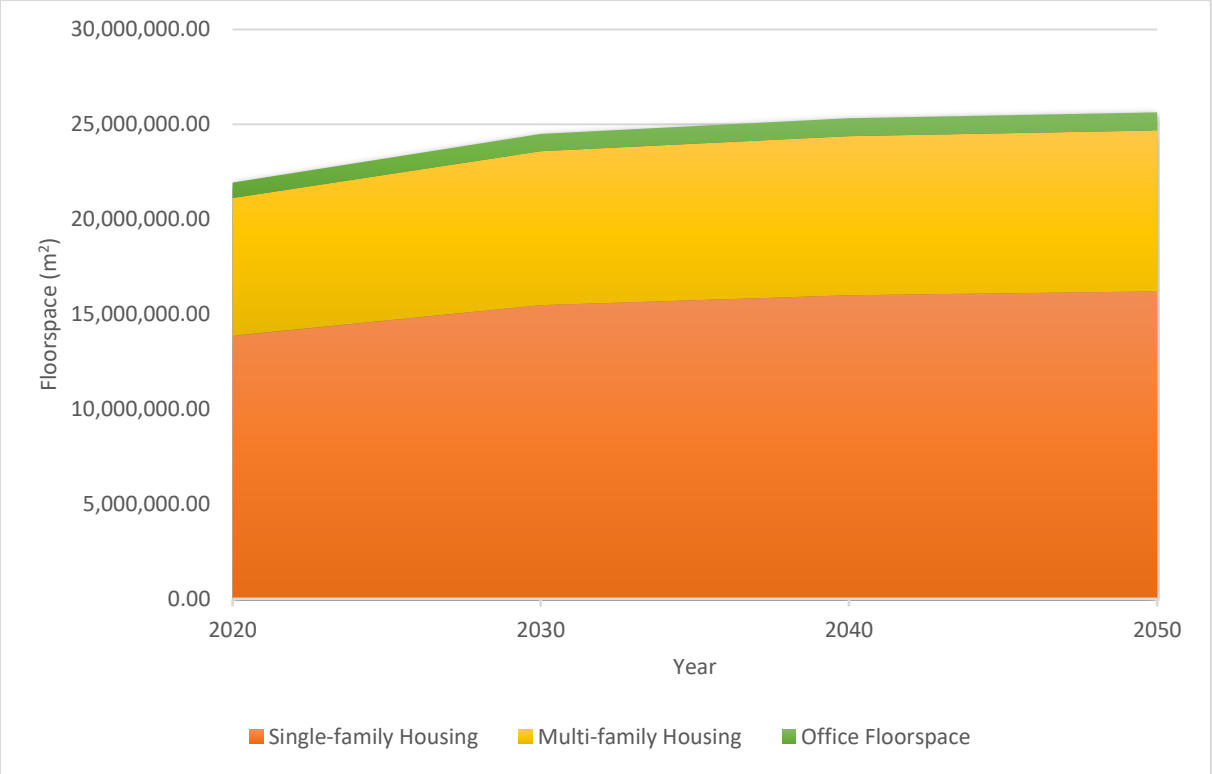


*Figure 14 – Baseline and projected floorspace (m2) of household and office building (Data Source: LCDS, 2021)*

**Industry:** Malta lacks carbon intensive industries and industrial emissions make up only a minimal part of the greenhouse gas portfolio. Manufacturing operations mostly consume energy in the form of electricity, thus generating emissions indirectly from energy consumption, which according to the NECP amounted to around 10% of the island's total

energy consumption in 2015. The LCDS recognises that, overall, the industrial sector in Malta already has a fair understanding of available efficiency measures and has made efforts to implement some of them. It also identifies examples of positive efficiency actions, such as implementing switch-off routines for machinery; replacing moulds with state-of-the-art-design, introducing variable speed drivers on motors; utilising waste heat from air compressed processes and the use of LED lighting. The greatest greenhouse gas abatement will be achieved in the period where electricity is mostly being generated locally. The measures modelled in the LCDS are anticipated to make an economic saving over the 30-year period due to reduced electricity usage and outweighing the investment in acquiring new more energy efficient equipment.

**Waste:** In line with the Waste Management Plan (WMP) for the Maltese Islands (2021 to 2030), the LCDS covers measures for high (80%) municipal biowaste capture for recycling taking place via anaerobic digestion facility, increased material recovery from the proposed waste-to-energy facility leading to an improvement in recycling rates and waste prevention. These measures are expected to make a modest contribution to the abatement potential compared to the energy and transport sectors (Figure 12 and Figure 13).

**Water:** under the LCDS, four measures targeting water use of different sectors are implemented with modest abatement potential: 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.

**Agriculture and land-use, land-use change and forestry (LULUCF):** Given the competition for land use in the Maltese archipelago, additional land on the required scale for carbon sequestration is deemed unrealistic, and therefore no such mitigation/offsetting measure was included in this LCDS. The abatement potential of agriculture using a vaccine targeting methane-producing microorganisms in the rumen of livestock and 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 are considered in the LCDES but the abatement potential of this sector is small compared to other sectors.

## Strengths, vulnerabilities, and uncertainties

**Positive policy direction but gaps in implementation:** Strengths of the niche system are associated with the national and regional EU policy direction towards decarbonisation, and more recently to reduce the dependence on fossil fuels from Russia. In the latest Council Recommendation on the 2022 National Reform Programme of Malta and delivering a Council opinion on the 2022 Stability Programme of Malta, increases in public investment for the green and digital transition, and for energy security, are recommended. Similarly, the Council's Recommendations include a reduction in the overall reliance in fossil fuels, an accelerated deployment of renewables, including floating and offshore energy, further upgrading Malta's electricity transmission and distribution grids, and creating incentives for electricity storage to supply firm, flexible and fastresponding energy. Reductions in energy demand through improved building energy efficiency and in emissions from road transport are also recommended. However, a key uncertainty is whether recent trends of greenhouse gas emission reduction can be reversed in line with the proposed implementation of measures identified by the LCDS, without which Malta would not be expected to reach its 19% reduction target for 2030 and decarbonisation journey up to 2050. This is also particularly important within the context of recent changes in energy prices (Figure 15), a consequence Russia's invasion of Ukraine and, which change in prices, and associated long-term consequences, being unlikely to be considered by the LCDS since this was published in 2021. The most significant contributor to greenhouse gas emissions abatement by 2030, as planned within the LCDS, is the interconnector but there is an uncertainty associated to the increasing costs of purchasing electricity from the Italian electricity market[21,22] which have also shown significant increases in March 2022 (Figure 16).

The LCDS requires funding in terms of capital expenditure and recurring expenditure, with the latter partly being offset through savings such that these measures would still require an initial outlay of capital expenditure but would be expected to pay off during their lifetime as savings are reaped (MECP, 2021). Public sources of funding are identified within the LCDS and include local and EU/international funding comprising various implementing mechanisms (e.g., grants, loans and green bonds, loan guarantees and (tax) credits).

[21] Energia elettrica: un aggiornamento delle tariffe. Available from: https://www.pricepedia.it/it/magazine/article/2022/03/16/energia-elettrica-un-aggiornamento-delle-tariffe/. Accessed 26 June 2022.

[22] Prezzi ARERA 2022: stangata nei rincari in bolletta per gas e luce! Available from: https://energia-luce.it/news/primo-trimestre-2022-prezzi-arera/. Accessed 26 June 2022.

Various public sources of funding that are also outlined in the LCDS, including the ERDF, Resilience Recovery Fund (RRF), REPowerEU and competitive innovation funds, were identified during the interviews. It was explained that public funding is expected to leverage private financing, and that *"if the LCDS is implemented properly, it [public funding] creates an economic gain."* To this extent, the positive cases of increase photovoltaic implementation, and good uptake of grants and funding associated with the electrification of transport, and increased efficiency were mentioned as examples.

However, there are multiple uncertainties associated with Malta's implementation plan which as commented, particularly by the business stakeholders, during the interviews often lacks sufficient detail and therefore credibility (see Strategies from the incumbent system). While Malta's National Energy and Climate Plan for the period 2021-2030 was published in December 2019, recent greenhouse gas emission trends do not indicate consistent reductions in emissions (Assessment of the current state of play). The public sector interviewees explained that even though the Government of Malta dedicates an annual budget to the implementation of measures identified the LCDS strategy, recent data indicates that Malta is not line with this target. In addition to limited implementation planning for some of the existing measures (e.g. electric vehicles 2030 target; adequate focus on shared mobility in current implementation), a number of gaps in existing strategies were identified by the business sector, including the need for an improved regulatory framework for minimum standards relating to energy efficiency in buildings, the taxing of vehicles using the polluter-pays-principle, sufficient availability of electric vehicle charging infrastructure and disposal of electric vehicle batteries at the end of life. The interviewees identified multiple co-benefits arising from nature-based solutions implementation, which go beyond greenhouse gas emission reductions and improved energy efficiency but identified uncertainties about their impacts as few studies have been carried out to evaluate these.

Uncertainties are also linked to the availability of innovative technologies and solutions, such as offshore photovoltaics and wind, and hydrogen, which are expected to become more feasible sources of energy for Malta, but this depends on external forces, while the timeframe for change is relatively short as commented by a business stakeholder: "*industry has been making steps … throughout our existence but now what we are being asked to do a quantum leap, and this is what we need to refocus. Now we are being asked to do it in a very short timeline … the solutions aren't off the shelf, they're not yet ready.*" Similarly, for the road transport sector, a key uncertainty arises from the constraints in establishing an

electrified mass transport system, and in achieving behavioural change in shifting towards public, active and sustainable transport, and the time needed for the implementation of these project.

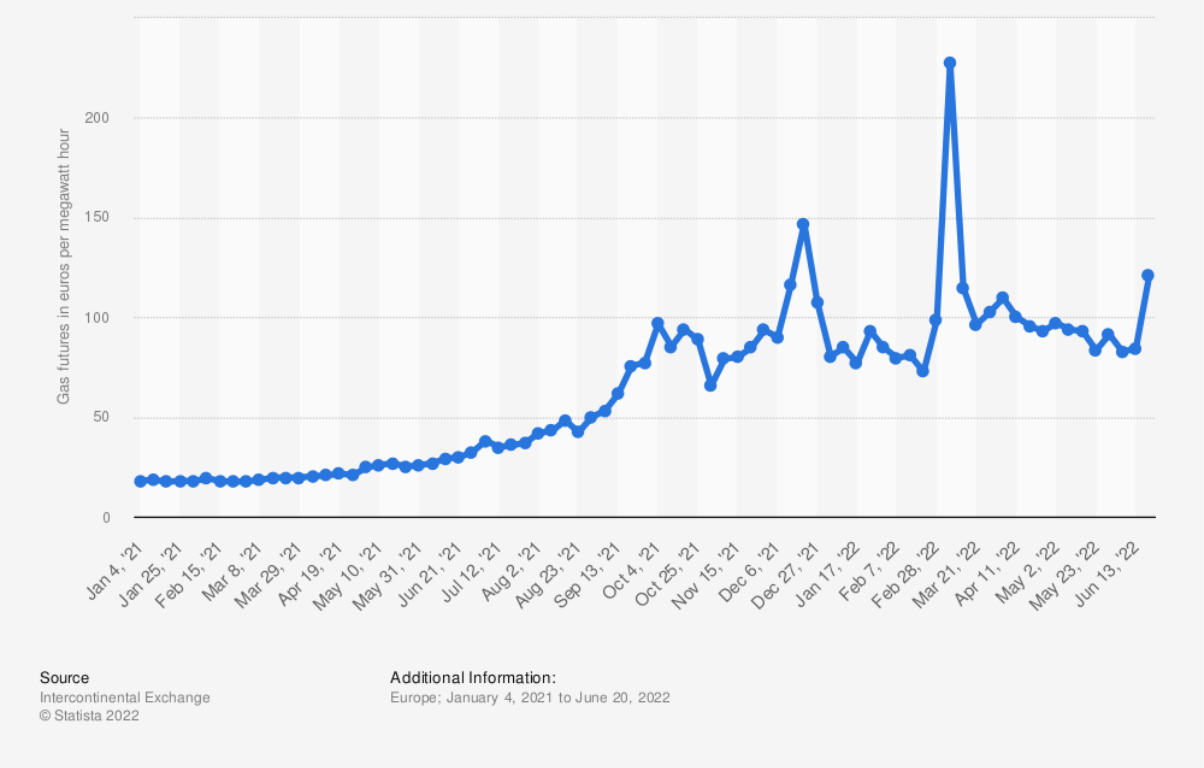


*Figure 15 – Dutch TTF gas futures at the beginning of each week from January 4, 2021, to June 20, 2022 (in EUR per megawatt hour; Source: Statista, 2022).*

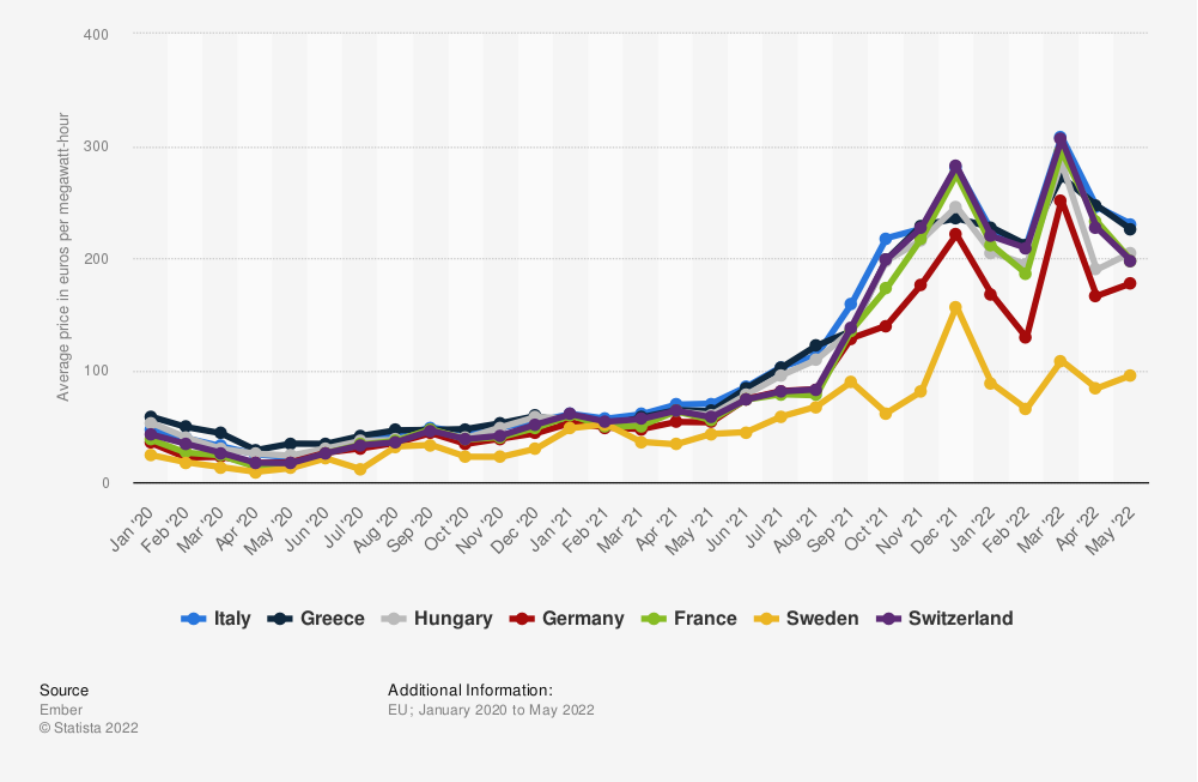


*Figure 16 - Average monthly electricity wholesale prices in selected countries in the European Union (EU) from January 2020 to May 2022 (in EUR per megawatt-hour; Source: Statista, 2022)*

**Limited innovation investment for context-adapted solutions:** In addition to existing limitations associated with the environmental characteristics of the Maltese territory (land area, conflicting land and marine uses, sea depth around Malta, climate) and the population dynamics (e.g. high density, increasing population size), which have already been described in previous sections and which limit the scale of renewable energy source installations, or the availability of particular energy sources (e.g. hydro, tide, biomass and offshore wind), a key vulnerability identified by all interviewees was the limited innovation investment of both the public and private sector, which is consistently one of the lowest in Europe (Figure 17). Public sector interviewees identified the need to "*further take up innovative solutions particularly in the context of where we want to be, as for example, identified by the LCDS"* but explained that this also requires a behavioural change as *"both industry and government prefer to buy in existing technologies and practices"* which give the lowest risk but may not have the highest return on investment.

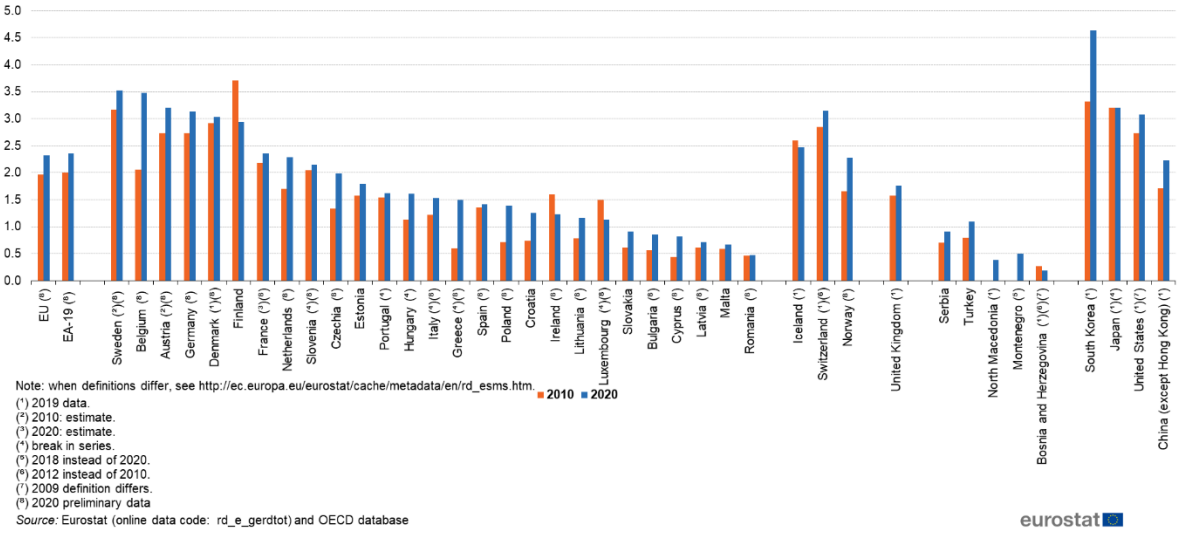


*Figure 17 – Gross domestic expenditure (in % relative to the GDP) on R&D in 2010 and 2020 in the EU (Source: Eurostat, 2022)*

## Strategies from the niche system

**Existing strategies from the niche system** were identified by the interviewees to address greenhouse gas emissions from the major emitting sectors. Within the energy production sector, recent technological developments have reduced greenhouse gas emissions by around half. But this was followed by recent increases in greenhouse gas emissions due to increases in demand following this achievement of technological development saturation

in energy production. Increases in photovoltaics and the establishment of a second electricity interconnector to Sicily are expected to contribute further to the goal of greenhouse gas reductions.

An important transition for greenhouse gas emission reductions is that of improving energy efficiency. The Energy and Water Agency is offering audit schemes and support schemes to industry to become more competitive and greener. The support is financial and technical, and includes in-house free audits to microSMEs, and financial support to non-SMEs for energy audits, and to identify what type of investment is needed while providing technical support to identify financial schemes to carry out investments that lead to increased efficiency. Decentralised solutions, such as solar and heat pump water heaters, were also identified as being important to increase efficiency. Despite current uptake being rather low and recent price increases, the schemes for heat pump water heater and solar water heaters have been revised and now offer increased support.

The Transport Strategy for 2050 recognises that contributions of transport to climate change through greenhouse gas emissions and identifies the need for transport systems that are resilient to the climate impacts. Relevant actions identified in the National Transport Strategy for 2050 include the promotion of renewable energy sources and zero carbon modes for transport and improving public and collective transport. In line with this strategy, the interviewees explained that in the transport sector, the transition is focusing on 3 main pillars:

a. the electrification of the fleet and, therefore, linking transport to the transition in the energy sector;
b. shifting from private to public transport, and which includes the electrification of mass transport, and
c. shifting from private to active transport.

**Establishing meaningful stakeholder and consumer engagement** is an essential part of the strategy to destabilise the incumbent and stabilise the niche system, as explained by one of the interviewees who noted through communication it is possible to *"induce people to ask for them [decentralised energy solutions] and, therefore, also influence the market"*. All interviewees described the importance of communicating key messages to improve the acceptance of greener solutions with lower greenhouse gas emissions, and this, amongst others, applied to transport, and electrification and the use of active and collective

transport, waste management, except for all other sectors and measures that depend entirely on the government (e.g. having a second interconnector with Sicily). One interviewee explained that as EU member states *"we have measures that may be very effective on paper but there is concern about how much citizens may take up such initiatives … You need citizens but also industry to buy in the idea that something has to be done. In that case, you either convince them or command them. Convincing takes more initial effort but hopefully the system becomes autonomous".* The same interviewee explained that regulatory measures have in some cases led to counterproductive measures in other countries and there is concern about the reaction of citizens to such initiatives.

Communication goes beyond simple informing and educating, as explained by the same public sector interviewee who discussed the importance of establishing feedback processes on current initiatives and their uptake as part of an adaptive management approach. The interviewee explained how recently support schemes and grants have been revised as part of an adaptive management approach to improve the attractiveness of support schemes and increase their uptake whilst also stimulating the market and, potentially, lowering prices to an increased demand.

Interviewees from the private sector explained how *"schemes aren't continuous, they start and stop… we waste a lot of time and time when things change continuously,"* but also identified the need for *"more openness at early stages of planning bringing in stakeholders from the private sector to help, not to hinder, … put together a strategy that can work … Why should a scheme come out in a particular way, although we recommended it in one way, and then they have to rewrite it because there's hardly any take up. Look at the time and effort wasted, and this has happened more than once."* Another business stakeholder identified the need for improved participation of the private sector and for evidence-based decision making through stakeholder engagement and impact assessment of relevant schemes and policies: *"if the government is going to propose something, first there is a call for evidence, after the call for evidence there is a public consultation, during the period of public consultation there is stakeholder meetings, government arrives at an impact assessment, following that impact assessment there is a draft. That is how things are made in other countries…even for the public sector they gain more confidence in issuing something which has been consulted with the private sector rather than the doing their own thing and then you have to face the music after … if something is not working."* Communication needs to be enhanced not merely its frequency, but its quality and depth

to foster acceptance, ownership of decision-making and contribution to the greenhouse gas abatement goal.

## Strategic Resources

**Public funding:** Key strategic resources were associated with government support and public funding for decarbonisation, and the guidance provided by the LCDS through the identification of specific measures in the different sectors. Stakeholder support and interest in existing measures, such as photovoltaics uptake, improved energy efficiency and transport electrification, by the public and industry are also considered as being important to further strengthen the niche. Driven by the market, some renewable energy sources (e.g., floating photovoltaics, wind) are also become more feasible and are expected to make a market entry. This transition is also supported by the "REPowerEU: Joint European action for more affordable, secure and sustainable energy" initiative of the European Commission which proposes and outline of a plan to make Europe independent from Russian fossil fuels well before 2030, starting with gas, in light of Russia's invasion of Ukraine. To do so, the REPowerEU plan is based on two pillars, namely *"diversifying gas supplies, via higher Liquefied Natural Gas (LNG) and pipeline imports from non-Russian suppliers, and larger volumes of biomethane and renewable hydrogen production and imports; and, reducing faster the use of fossil fuels in homes, buildings, industry, and power system, by boosting energy efficiency, increasing renewables and electrification, and addressing infrastructure bottlenecks*[23]*."*

**Innovation** was considered as being critical to address knowledge gaps and identify context-adapted solutions to this transition goal. Concerns were raised about the innovativeness of Malta's public and private sectors, with two of the interviewees explaining that often organisations prefer to buy in existing technologies or practices as this gives lower risk. Here, the need to tap into existing research happening within the EU block was identified, and for Malta to act as a testbed for innovative technologies.

[23] REPowerEU: Joint European action for more affordable, secure and sustainable energy. Available from: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_1511. Accessed: 27 May 2022.

# 7. Conclusions and Recommendations

This research paper has assessed the current policy context and the current state of play of greenhouse gas emission reductions with respect to Malta's policy targets. This research identifies the LCDS as an important guiding policy for achieving the country's decarbonisation journey up to 2050, particularly within the context of trajectories showing that that despite recent reductions in greenhouse gas emissions due to technological enhancements, Malta's trajectory is still not enough to reach its 2030 targets of a 19% reduction in net territorial non-ETS greenhouse gas emissions (relative to 2005) and will not be conducive to the goal of climate neutrality by 2050. By referring to recent greenhouse gas emission inventories, the sectoral greenhouse gas emissions have been reviewed in this paper, relevant sectorial measures identified, and the recent trend in greenhouse gas emissions is described. A key element of the transition is the important role of the LCDS which outlines measures in seven different sectors, that is energy, transport, buildings, industry, waste, water, and agriculture and LULUCF, to achieve target reductions in GHG emissions by 2050 and enabling Malta to reach its ESR targets by 2030. Measures for each of these sectors are briefly presented in this report together with relevant data. Interviews were conducted with stakeholders from key public entities responsible for climate change and energy policy and stakeholders from the business sector. The Transition Model Canvas was then used to structure the qualitative data collection and to map the most essential elements of the socio-technical transition of greenhouse emission reduction while identifying systemic strengths and vulnerabilities and use them to identify strategies and recommendations for the uptake a niche system leading to lower greenhouse gas emissions. This research has also drawn on various international success stories that are of relevance to the local context and for relevant themes identified based on the assessment of the state of play and during the interviews with stakeholders.

Exogeneous shocks arising from Russia's invasion of Ukraine, which has revealed the dependence on external energy sources, led to increased energy costs and accelerated the green transition, are expected to improve the feasibility of renewables and innovative technologies, and increased uptake of innovative technologies, such as offshore wind and solar photovoltaics, and hydrogen availability are expected to contribute to the socio-technical transition of achieving lower greenhouse gas emissions. However, recent changes in energy costs are also a source of uncertainty as businesses are unaware of how electricity prices will change. Additionally, in view of the target of achieving energy grid

decarbonisation by moving away from the use of gas over time through a second interconnector, there is uncertainty associated to the increasing costs of purchasing electricity from the Italian electricity market.

The government plays a leading role in this socio-technical transition by setting the strategy and through investment in technology and energy sources that lead to lower emissions but key initiatives for greenhouse gas reductions also require uptake by the public and industry. This report has identified concerns by the interviewees regarding the current progress in achieving the targets set in the NECP and LCDS. It has identified the need for improved communication between the public and private sector, and for a continued efforts in deploying of more innovative and sustainable technologies, for example associated with the electrification of road transport and energy efficiency in buildings, while communicating with stakeholders and the public to foster necessary behavioural changes (e.g., waste separation, the shift towards public and active transport). Various support measures, for example relating to energy efficiency, electrification of transport, and innovation, exist in the form of grants and other financial tools, and technical assistance, to support and facilitate this socio-technical transition. These already have high uptake and are expected to contribute to generating private investment and a greener economy, with lower greenhouse gas emission. However, gaps in existing strategies and reactive policymaking, which is responding to EU policies, funding availability and international developments, rather than being based on a sound strategic policy that is developed by national authorities based on data-driven approaches and with the social partners, limit the potential and efficacy of existing schemes and measures in achieving greenhouse gas emissions abatement. Social partners emphasised the need for evidence-based policymaking and meaningful participation of stakeholders. Weaknesses and gaps in the implementation of measures identified in the NECP and LCDS, and the associated limited progress in achieving Malta's greenhouse gas reductions so far, limit the credibility of existing targets and plans. Several relevant examples were identified by stakeholders during the interviews conducted in this research, and include Malta's currently unattainable 2030 target for electric vehicles, the lack of ambitious standards for building efficiency to reduce greenhouse gas emissions, and of procurement strategies for sustainable aviation fuels.

Innovation can address existing gaps in knowledge and implementation and identify context-adapted solutions to this transition goal. Here, the need to improve the current innovation capacity in the public and private sector was identified together with the need to tap into existing research happening within the EU block, and access EU-wide

competitive funding for improved innovation capacity and for Malta to function as a testbed for innovative technologies was discussed. Within this context, this research paper has also identified success stories from EU-funded research and innovation programmes as applied to island environments and similar climatic conditions. The presented success stories demonstrate how increased uptake of renewable energy sources in the energy mix, electrification of road transport, the creation of communication platforms and tools, and more broadly education and awareness raising in demonstrative projects can bring together stakeholders while achieving lower greenhouse gas emissions.

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## Annex 1 – Interview questions

1. As reported in its NECP, Malta has to reduce its GHG emissions by 19% by 2030. What is the current situation and is Malta on track to achieve this goal?
2. The sectors identified as major contributors to GHG emissions are energy (production and consumption), transport and residential heating/cooling. In your opinion, is there a particular sector that has been moving towards lower GHG emissions?
3. Could you identify the main transitions that are needed for these sectors to be able to reduce GHG emissions?
4. Are dedicated funds already available for this purpose?
5. Reasonably, financing may be one of the first hurdles encountered during this transition toward GHG emissions reduction. What do you think might be other obstacles, perhaps already encountered in past experiences, maybe still present, or perhaps foreseen for the future? What could further slow down this race to 2030 decarbonization?
6. Currently, what are the types of renewable sources exploited to produce energy besides the use of solar panels? Apart from the ones you mentioned, which are already in use, which others could be implemented in the area and exploited in order to contribute consistently to the reduction of greenhouse gasses?
7. Can this transition towards carbon neutrality be part of the economic recovery following the Covid-19 pandemic?
8. Do you think that the current situation involving Ukraine and Russia will be a turning point to invest more in renewable energies and incentivize their use?
9. Considering the current possibilities and future plans, is a 100% electrification of public transport feasible and how can the transport sector reduce its GHG emissions?
10. Malta is embarking on a number of greening and nature-based solutions projects, including living walls and facades, and green roofs in cities. Do you think that these initiatives contribute toward the overall goal of reducing GHG emissions and the decarbonisation of the economy?
11. The reduction of GHG emissions also depends on individuals' choices. What are the thoughts of the Maltese people? Have you had the opportunity to understand the ideas, interests and concerns of the locals regarding this delicate subject? What

might be a way to engage even those who don't care about the issue at the moment?

## Annex 2 – Written feedback provided by The Malta Chamber

- Malta is reactive, not proactive, when it comes to sustainability-related EU policy. Malta does take a position on its particular situation, but more often than not, this is after the Commission Proposal has already been issued, at which point it would be too late.
- Malta's strategies tend to be visions, rather than concrete plans which effectively demonstrate how to close the gap between the present reality and the country's targets. The impact of measures listed in strategies may be unclear, and implementation may deliver different results. Therefore, plans are not convincing and not as effective as advertised. Not enough focus is dedicated to implementation and the study of obstacles on the ground, especially those encountered by the business community.
- While existing strategies are lacking, there is a gap entirely in some areas. Malta's targets to electrify the vehicle fleet, for example, lack any coherent roadmap on how to get there. Between today and 2030, to meet EV targets, Malta would need to have 65,000 EVs on the road. This means that practically all new cars on the road would need to be electric, rather than the small percentage today. This reality is not acknowledged in policy and hence the government target of 65,000 EVs lacks credibility.
- Vehicles should be taxed on the polluter pays principle; hence taxed based on usage, not mere ownership.
- Shared mobility needs to be incentivized as it is a realistic, scalable solution which can deliver on reduced congestion and emissions.
- For buildings to meet European targets and standards, there must be a significant legislative overhaul and increased minimum standards.
- Government communication with stakeholders and the private sector must improve. Currently, public consultations tend to be tokenistic, and only present documents once they are already largely finished and inflexible to serious revisions. The private sector also has data it may share with the government.

- Open consultation should take place before schemes and policies are launched, to reduce the need for changes to schemes or policies after they are launched and ensure that schemes and policies are more effective, and that there is good uptake by the private sector.

Some common principles:

- Communication with the Private Sector: Not merely its frequency, but its quality and depth. Such dialogue cannot be merely tokenistic, as a box-ticking exercise.
- Enforcement of Standards & Regulations: Change can easily be undermined if there is not a level playing field, and if rules are broken whenever convenient.
- From Reactive to Proactive: Malta needs to work closely with private enterprise to anticipate European standards & regulations, and lobby where necessary. The country cannot end up in a situation where paying fines is inevitable because change is too unpopular in the short-term. Furthermore, strategies need to be well communicated and adaptable to revised European targets, as such changes are continuous, and Maltese strategies are already out of date.
- Bridge the Gap with Implementation: Strategies lay out visions, but are often not concrete enough & are not credible enough. They lack a step-by-step roadmap from the short, to medium, to long-term, to demonstrate how the country may achieve its targets. Policies and schemes may often leave a lot to be desired at implementation stage. Strategies need to be more quantitative than qualitative.

## Annex 3 – Simplified Summary

The reduction of greenhouse gases is a key policy objective for Malta. The National Energy and Climate Plan (NECP), which serves as a strategic planning framework and policy document that guides Malta's contribution to achieving the Energy Union's 2030 objectives and targets, identifies a 19% reduction in net territorial non-Emissions Trading System greenhouse gas emissions (relative to 2005) by 2030. Malta's Low Carbon Development Strategy maps out the country's decarbonisation journey up to 2050. Power generation and transportation (mainly road transport) are the sectors with the highest greenhouse gas emissions, followed by industrial processes and product use emissions, and the waste sector.

Lowering greenhouse gas emissions from these sectors is a complex process that requires the participation of different stakeholders and is influenced by the existing infrastructure, and policy and legislations at national, regional, and global scales. This report has identified success stories from island environments and similar climatic conditions which focused on increasing the uptake of renewable energy, electrification of land transport, shared mobility, the use of green building materials to improve energy efficiency in buildings, and energy education. Through interviews with policy and business stakeholders this report evaluates recent trends, and measures for the reduction of greenhouse gas emissions. An increased policy focus on greenhouse gas reduction and investment in new generation capacity, fuel switching, alternative sourcing of electricity and uptake of solar photovoltaics were identified as the main gradual factors favouring the transition to lower greenhouse gas emissions. External shocks were associated with the COVID19 pandemic and Russia's invasion of Ukraine, which have accelerated the green transition and are expected to improve the feasibility of renewables. Public and private sources of funding are expected to contribute to this transition, but key limitations associated with Malta's demographics, use of the land and sea, and environmental conditions remain. Uncertainties are associated with the feasibility of technologies and renewables, such as offshore photovoltaics and wind, and hydrogen, and the uptake of measures by stakeholders. The need for communication with the public, more meaningful stakeholder engagement in decision-making, and investment in innovation to address these challenges and uncertainties were identified to address climate change mitigation and adaptation.

## Annex 4 – Press Brief

Greenhouse gas emission reduction is a key policy objective for Malta. This research paper identifies various international success stories and presents results from stakeholder consultation. Increased policy focus on greenhouse gas reduction, fuel switching and alternative sourcing of electricity, and uptake of solar photovoltaics, were identified as the main gradual factors favouring this transition to improved greenhouse gas abatement but gaps in implementation remain. The need for communication with the public, meaningful stakeholder engagement in decision-making, and investment in innovation to address these challenges and uncertainties are identified.