Malta's
4th Biennial Report

2020

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The Fourth Biennial Report of Malta
under the
United Nations Framework Convention on Climate Change

January 2020

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Title	Fourth Biennial Report of Malta, 2020
Report pursuant to	Decision 2/CP.17 'Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention'
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Prepared by the
Malta Resources Authority

on behalf of the
Ministry for Environment, Sustainable Development and Climate Change

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Introduction

At the 16th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) held in Cancun, Mexico, in 2010, it was decided that "*Developed countries should submit* [...] *biennial reports on their progress in achieving emission reductions, including information on mitigation actions to achieve their quantified economy-wide emission targets and emission reductions achieved, projected emissions and the provision of financial, technology and capacity-building support to developing country Parties*"[1].

At the subsequent Conference of the Parties held in Durban, South Africa, in 2011, a decision was taken for Annex I Parties to submit these biennial reports prepared in accordance with guidelines established under Decision 2/CP.17[2]. Developed country Parties are required to submit their fourth biennial report by 1 January 2020.

This is the fourth biennial report of Malta. This written report is accompanied by data and information submitted electronically in Common Tabular Format (CTF) tables.

[1] Decision 1/CP.16 'The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention', FCCC/CP/2010/7/Add.1.
[2] Decision 2/CP.17 'Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention', FCCC/CP/2011/9/Add.1.

Chapter 1: National context

OVERVIEW OF RELEVANT GEOGRAPHIC, CLIMATIC, DEMOGRAPHIC AND ECONOMIC PARAMETERS OF MALTA.

Malta is an archipelago made up of three inhabited islands, namely Malta, Gozo and Comino, and several small uninhabited islands (Cominotto, Filfla, St Paul's Islands) and islets situated close to the coastline of the main islands.

The Maltese archipelago is situated in the middle of the Mediterranean Sea (Figure 1), approximately 90 kilometres to the south of Sicily, Italy, and 290 kilometres from the North African mainland. Towards the East, the Straits of Gibraltar are at a distance of almost 1,850 kilometres, while the Suez Canal is around 1,500 kilometres to the Southwest.

The total combined area of the Maltese islands (Figure 2) is 316 square kilometres, with a total shoreline of 271 kilometres. Topographically, the coastline facing the African mainland, is dominated by cliffs, with the land sloping down to a low-lying shoreline on the northern coast. The northern areas of Malta, and Gozo, are marked by low hills, with plains predominant towards the southern parts of the island of Malta. There are no mountains and no rivers; seasonal water courses may appear after heavy rainfall.

The climate of the Maltese islands can be described as typically Mediterranean, with hot, dry summers and relatively mild winters. Average yearly temperatures range from approximately 23oCelsius during the day and 16oCelsius during the night, with overall annual average hours of daylight ranging between 10 hours in the months of December and January to more than 14 hours in from May to July. Relative humidity is often high while annual rainfall is relatively low, at around 600mm, and with the highest rainfall rates usually occurring in the months of November, December and January.

Natural resources are very limited. Limestone is the main mineral resource that Malta can boast of, used primarily in the local construction industry. Sea salt production as an artisanal activity also occurs. Sourcing of water is constrained by the fact that permanent above-ground freshwater bodies are absent, and rainfall is rather limited. Most of the naturally occurring freshwater is found in underground aquifers, accessible by extraction via pumping stations and boreholes. In the early 1980's desalination of seawater was introduced, through the investment in reverse osmosis plants, now accounting for more than half of the production of potable water in the country.

The population of the Maltese islands has seen a steady growth over the years. End-of-year population in 2017 was 475,701, an increase of almost 31.5% over the 1990 figure (361,908). Malta's population represents a very high population density, in 2017 this standing at 1,505 persons per square kilometre. Population growth rates have increased in recent years due primarily to immigration. The population is also becoming increasingly an ageing one.

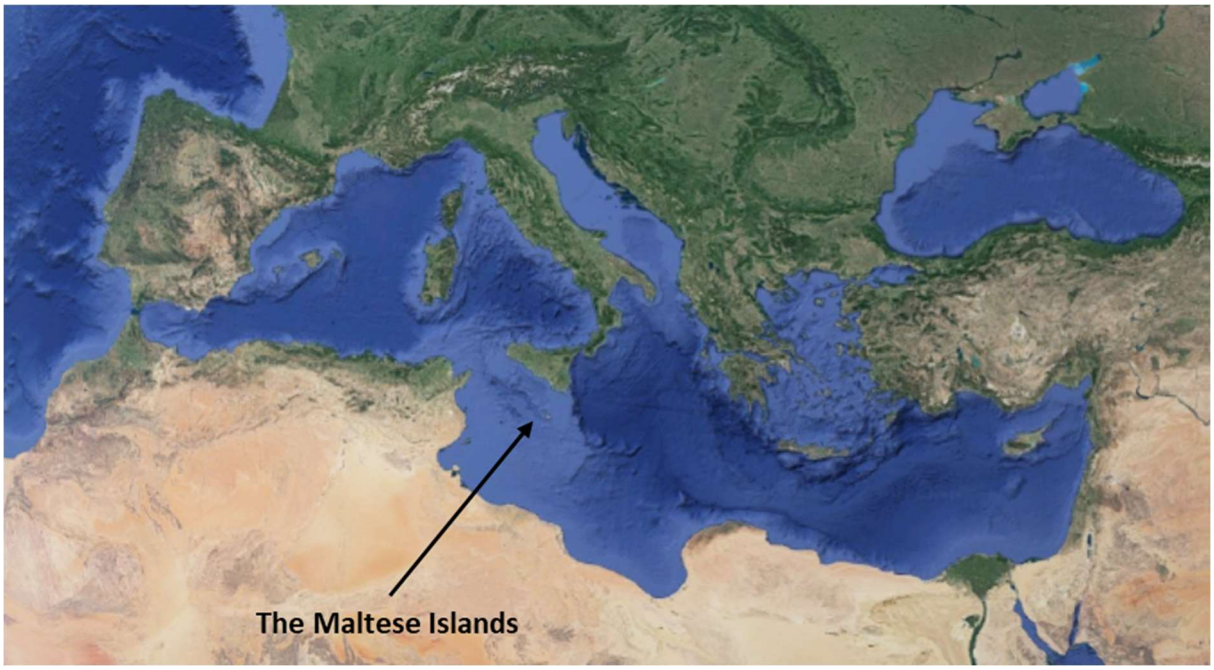

Figure 1 Map of the Mediterranean Sea showing the geographical location of Malta

(adapted from Google Maps).

Figure 2 Map of the Maltese islands

(source: NASA Earth Observatory).

Distribution of the population across the islands varies. Malta is by far the most populated, with more than 90% of the total population resident on that island. The Northern Harbour district (the area to the west of the capital city of Valletta) and the Southern Harbour district (the area lying to the east and southeast of Valletta, including also the capital city) together form a population agglomeration that accounts for almost half the total population of the country. As might be expected, the population density in these areas is very high in contrast to the density in more rural areas of the island of Malta and compared to the other inhabited islands, Gozo and Comino.

Almost a third of the area of the country is urban, mainly of a residential nature, but also incorporating other developments such as the airport, ports, and industrial and commercial sites. Agricultural land accounts for approximately half of the land area with the rest being natural vegetated land. In the housing sector, there is a growing trend in favour of concentrating residential units in blocks of two units or more on the same site, shifting away from the more traditional terraced house construction practices earlier.

Forest coverage in Malta is very low, with the only remaining forest remnants occurring in localized pockets. The two main such areas are Buskett and Miżieb, both of which are the result of afforestation, Buskett going back as far as the presence of the Knights of St. John, and Miżieb at a much later stage. Maquis and garigue habitats are also present.

Historically, agriculture was a very important economic activity in Malta, though an important element of services-oriented activity was also prevalent, especially due to the presence of established British forces on the islands until the late 1970's, which necessitated a number of ancillary services. The present mainstays of the country's economy are manufacturing and services. The manufacturing sector has largely developed into high value areas, such as microelectronics and pharmaceuticals. Apart from traditional activities such as tourism, education, health, retailing and banking, the services industry has in recent years diverged towards other activities such as financial services, specialised forms of tourism, including, in particular, language schools and diving centres, maritime and aviation services, information technology and gaming. Large scale industrial establishments are few, the largest of which, and the most relevant from a greenhouse gas emissions perspective, being the electricity generation plants.

Malta's economy has strong trade links to the European Union, the economic bloc of which Malta became a full member State in 2004. Imports and exports of goods is completely dependent on maritime and air transport, in the absence of other direct links to surrounding mainland regions.

Economic growth has been sustained over the past decades, as evidenced by Gross Domestic Product. GDP has grown from €2,749.4 million (ESA 2010) in 1990 to €11,206.0 million in 2017. Per capita GDP in 2017 stood at more than €23,000.

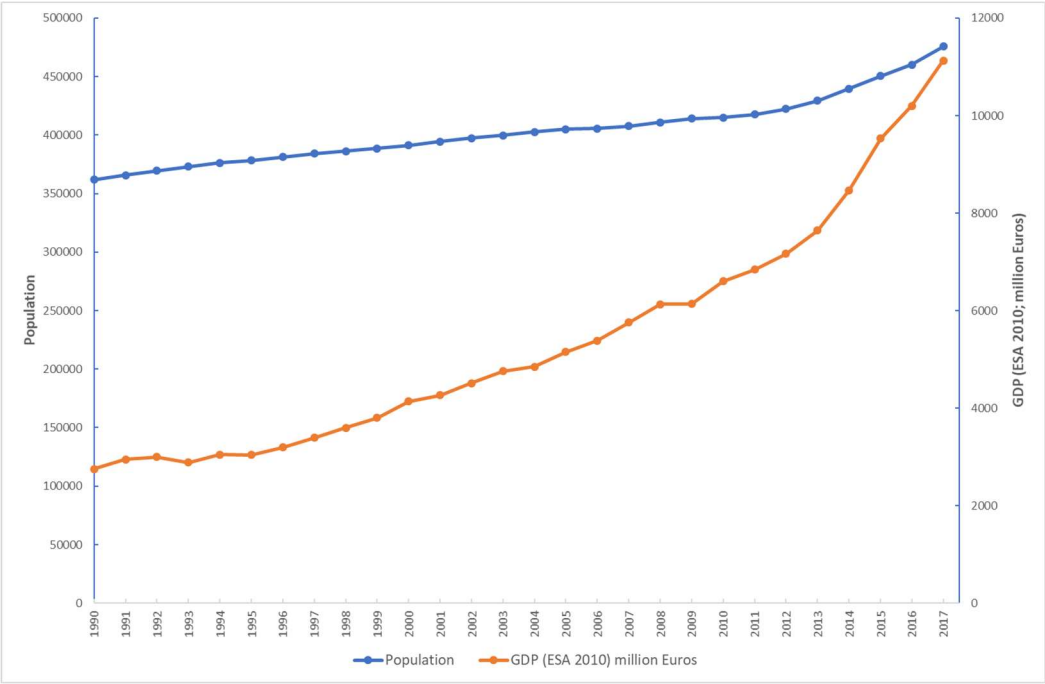

Figure 3 Population and GDP trends 1990 – 2017

(data adapted from EUROSTAT and the National Statistics Office websites, accessed October 2019).

MALTA'S STATUS UNDER INTERNATIONAL CLIMATE TREATIES

Malta ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994, and the Kyoto Protocol in 2001. Malta ratified these instruments as a non-Annex I Party at the time, thus without immediately taking on any quantified emissions limitation or reduction obligations.

Malta's accession to the European Union in 2004 meant that Union legislation related to climate action became immediately applicable to Malta. Malta's 2009 request to become an Annex I Party to the UNFCCC was approved by the Conference of the Parties to the UNFCCC in 2010. While remaining with a quantified target for the remainder of the first commitment period of the Kyoto Protocol, Malta became an integral part of the collective commitments of the European Union for the second commitment period under the Doha Amendments to the Kyoto Protocol.

Chapter 2: Greenhouse Gas Emissions and Trends

This chapter gives an overview of the approach taken by Malta with regards to the elaboration of annual national inventories of greenhouse gas emissions from sources and removals by sinks, and a discussion of the main trends in emissions. Data on emissions and removals discussed here are derived from the latest available national greenhouse gas inventory submitted in accordance with UNFCCC requirements in 2019[3], covering the period 1990 to 2017.

The estimation of emissions by sources and removals by sinks of greenhouse gases (GHG) contained in Malta's inventory submission covers the following greenhouse gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous Oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6); and,
- Nitrogen trifluoride (NF_3)[4].

The sectors for which estimation of emissions or removals is carried out are:

- Energy;
- Industrial Processes and Product Use (IPPU);
- Agriculture;
- Land Use, Land-Use Change and Forestry (LULUCF); and,
- Waste.

NATIONAL INVENTORY ARRANGEMENTS

Any Annex I Party to the UNFCCC has an obligation to establish a National Greenhouse Gas Inventory System, defined by decision 19/CMP.1 'Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol' as:

> "*all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information*."

The legal requirements for Malta's national inventory system are established through the 'National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removal by Sinks Regulations, 2015'[5].

This legal notice formally identifies the Minister responsible for climate change (via the Ministry for the Environment, Sustainable Development and Climate Change, MESDC) as

[3] Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019.
[4] Emission of nitrogen trifluoride do not actually occur in Malta.
[5] Legal Notice 259 of 2015 (Subsidiary Legislation 543.01), National System for the Estimation of Anthropogenic Greenhouse Gas Emissions by Sources and Removal by Sinks Regulations, 2015; http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12393&l=1.

the Single National Entity (SNE) with overall responsibility for the national inventory system and a mandate to ensure that the national system operates in accordance with relevant decisions of the UNFCCC bodies and with applicable European Union legislation. Official approval of greenhouse gas inventory submission is issued by the SNE.

The same legal notice provides also for the designation of an Inventory Agency, with specific responsibility for the preparation of annual inventories. The Malta Resources Authority (MRA) is at present the body designated as inventory agency.

The legal notice also established rules for the relationship between the Single National Entity and the Inventory Agency on one hand, and data providers on the other.

As the national Inventory Agency, the MRA is responsible for planning, preparation and management of the national GHG inventory. Sector inventory compilers within the Climate Change Unit of the MRA carry out the various stages of the inventory cycle, starting from gathering of data from relevant data providers, to estimating emissions or removals of greenhouse gases, inputting of data, and generation of, Common Reporting Formal (CRF) tables, compilation of the National Inventory Report (NIR), and final submission to the UNFCCC Secretariat, in accordance with respective EU and UNFCCC requirements.

Data collection involves liaising with various data providers, including public entities, such as the National Statistics Office, Ministries, and government departments, authorities and agencies, and, in a number of, instances private establishments, according to the nature of the data associated with specific activity category calculation methodologies.

An important development within the context of the national inventory system is the recent adoption, by the MRA, of a documented quality management system (QMS), based on the ISO 9001:2015 'Quality Management Systems – Requirements' approach. All business processes required for the preparation and submission of national GHG inventories by the MRA have been established, mapped and documented as part of this QMS. ISO certification of this QMS was obtained in 2018.

Furthermore, national greenhouse gas inventories are subject to two important peer review processes: the first being the annual review under the EU Monitoring Mechanism[6], focussing particularly on those emissions subject to the Effort-sharing Decision of the EU[7]; the second being the review under UNFCCC rules, which takes place almost annually and which covers all aspects of the inventory process and the entire scope of the inventory.

A more detailed discussion of the national inventory system, the planning, preparation and management of national inventories, additional information on institutional, legal and procedural arrangements in Malta for estimating anthropogenic greenhouse gas emissions by sources and removals by sinks, and further description of the MRA's QMS, may be found in chapter 1 of the national inventory report submitted as part of annual inventory submissions. Sector specific chapters of the NIR provide detailed information on methodologies for the estimation of emissions and removals for activity categories and sub-categories, sourcing of data, and quality assurance and control activities undertaken in the compilation of national inventories.

[6] Regulation (EU) 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.
[7] Refer to chapter 3 of this report for more details on the Effort-sharing Decision of the European Union.

RELEVANT CONTACT DETAILS

Single National Entity:

Office of the Permanent Secretary - Ministry for the Environment, Sustainable Development and Climate Change,

Postal Address: 6, Triq Ħal Qormi, Santa Venera SVR 1301, Malta

Website: https://msdec.gov.mt

Inventory Agency:

Malta Resources Authority,

Postal Address: Millennia Building, Aldo Moro Road, Marsa, MRS 9065, Malta

Website: www.mra.org.mt

DISCUSSION OF EMISSION TRENDS FOR AGGREGATED GREENHOUSE GAS EMISSIONS[8]

The overall profile of total national emissions over the time-series 1990 to 2017 (Figure 4) shows a general increase in national emissions from 1990 (2106.14 Gg CO_2 eq. with LULUCF; 2103.18 Gg CO_2 eq. without LULUCF) up to year 2012, when emissions peaked (3189.86 Gg CO_2 eq.; 3187.40Gg CO_2 eq.), and a subsequent rapid decrease until 2016 (1899.10 Gg CO_2 eq.; 1895.68 Gg CO_2 eq.). Total national emissions increased again between 2016 and 2017 (2155.24 Gg CO_2 eq.; 2151.59 Gg CO_2 eq.).

The same trend profile is observed both for with-LULUCF and without-LULUCF emission estimations. The LULUCF sector reports net positive emissions, thus resulting in total emissions 'with LULUCF' being higher than 'without LULUCF' albeit by a marginal amount. The values of total national emissions are presented in Table 1.

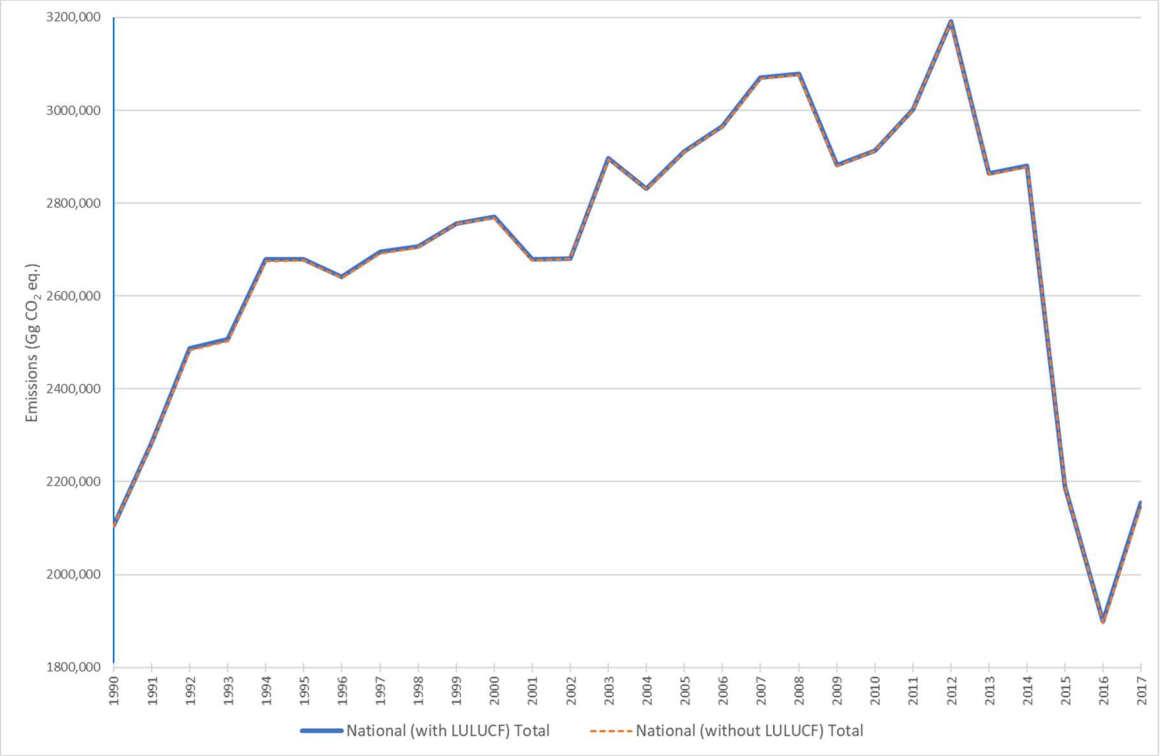

Figure 4 National total greenhouse gas emissions (with/without LULUCF)

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

As will be discussed later, the trend profile of total national greenhouse gas emissions follows closely that of the Energy sector. The Energy sector is the highest overall contributor to greenhouse gas emissions in Malta, by a significant margin over other sectors, for most of the time-series; thus, its influence on the total emissions profile. In turn, the Energy sector is strongly influenced by emissions from the two main category contributors, energy generation and transport. Both contribute towards the increase up to 2012. Investment in new generation capacity, fuel switching, and alternative sourcing of electricity contribute towards the rapid decrease in emissions observed for the years after 2012. This trend is

[8] For the purposes of this report, the period 1990 – 2017 is considered. Data quoted is sourced from Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019 (accessed at: https://unfccc.int/documents/194903 (NIR), https://unfccc.int/documents/195425 (CRF tables)).

reversed between 2016 and 2017, as there was a shift back towards local electricity generation as opposed to previous use of the interconnector with mainland Europe's electricity grid.

Table 1 Total national greenhouse gas emissions (with/without LULUCF) for the years 1990 – 2017

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

	Total national emissions with LULUCF	Total national emissions without LULUCF
	Gg CO_2 eq.	
1990	2106.14	2103.18
1991	2285.01	2280.26
1992	2487.37	2483.01
1993	2506.75	2503.48
1994	2680.17	2676.49
1995	2678.94	2675.87
1996	2641.34	2638.33
1997	2694.89	2691.96
1998	2706.63	2704.09
1999	2756.57	2754.65
2000	2770.83	2767.68
2001	2678.47	2676.36
2002	2681.23	2679.97
2003	2896.08	2894.69
2004	2831.18	2829.64
2005	2911.33	2909.62
2006	2964.85	2962.97
2007	3068.13	3066.11
2008	3076.41	3074.30
2009	2880.64	2878.40
2010	2911.94	2909.94
2011	2999.70	2997.46
2012	3189.86	3187.40
2013	2862.74	2860.04
2014	2877.87	2874.93
2015	2191.34	2188.16
2016	1899.10	1895.68
2017	2155.24	2151.59

Figure 5 shows the correlation between the trend in total national emissions and the population trend of the Maltese Islands, in terms of GHG emissions per capita. Historical data shows that there was a clear correlation between population growth and national total greenhouse gas emissions until 2012, following which a decoupling of these two parameters can be observed.

Population has grown steadily over the years. Similar to the trend of total national emissions, GHG emissions per capita also show a general increasing trend from 1990 until 2012; this trend is then reversed after 2012, at a significant rate, the result of the general

decrease in emissions suppled with continued population growth, which itself shows an upsurge in the rate of growth. Emissions per capita in 1990 stood at 5.82 tonnes CO_2 eq. per capita, reaching their highest level in 2007 at 7.53 tonnes CO_2 eq. per capita and a low of 4.13tonnes CO_2 per capita in 2016, with 4.53 tonnes CO_2 eq. per capita in 2017.

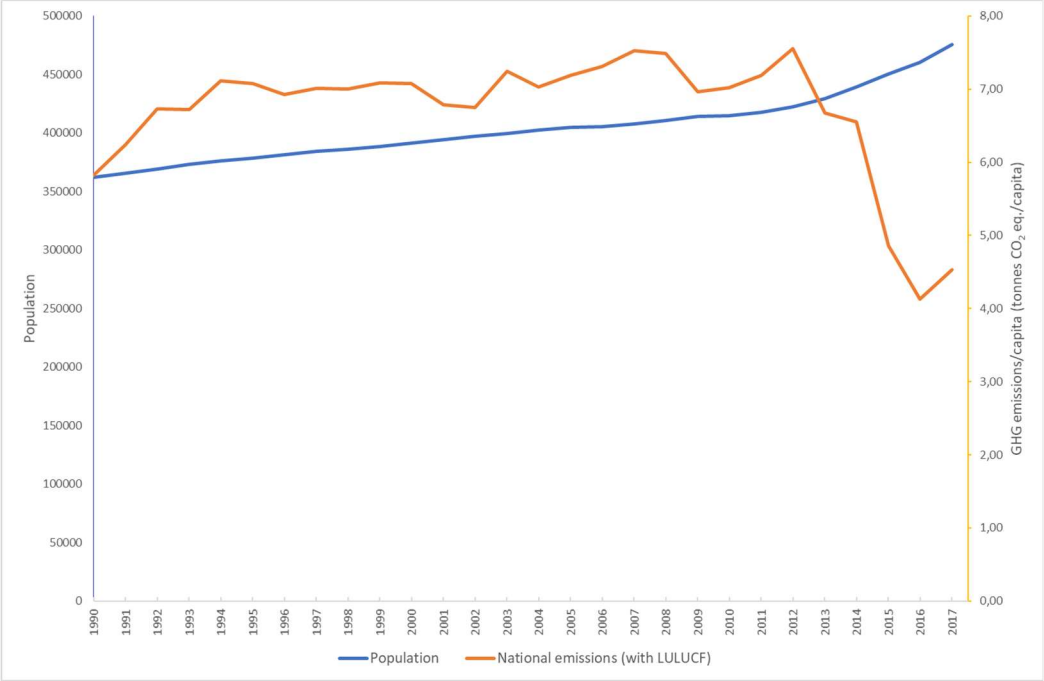

Figure 5 Trend of emissions per capita

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

The decoupling between GHG emission trends and population trends for Malta in the latter years implies that population statistics alone cannot directly explain the changes in GHG emissions over the whole period under consideration.

Indeed, one could consider that greater demand for major emitting activities in Malta, particularly energy (and therefore, energy generation) and mobility (i.e. road transport) as population grew, could explain the increasing emissions at least until 2012, as these activities have been the major contributors to overall national total emissions in absolute terms.

After 2012, substantial emission reductions due to major technical developments in the electricity generation sector have counteracted any increase that one may have expected would occur due to continued increase in demand as a result of population growth. Targeted measures even in one sector or activity category could have a major impact on overall emissions, despite continued population growth, and presumably, growth in demand, even more so, if that one sector or category has a significant share in total national emissions, as is the case for electricity generation.

On the other hand, the overall increase in emissions in 2017 compared to 2016, including the relatively substantial increase in energy emissions, resulted in per capita emissions reverting to an upward trend.

The emissions intensity of Malta's economic development can be described in terms of the correlation between the trend in national GHG emissions and the trend in Gross Domestic Product (GDP).

Figure 6 shows how GHG emissions per unit million GDP changes over the 1990-2017 time-series. Overall, apart from the years 1990 to 1995, the overall trend is of a continuous decrease in the emissions intensity of Malta's economy: that is a decoupling of economic growth from greenhouse gas emissions. Between 1990 and 2017, Malta's GDP saw an overall increase of 304.7% between 1990 and 2017, GHG emissions per unit million GDP in 2017 were 74.7% lower than in 1990.

An important factor related to economic growth is certainly energy demand, translating primarily into electricity generation, the main contributor to total national greenhouse gas emissions. The decoupling observed here implies that an economic shift from energy intensive activities to a bigger economic contribution by activities with a relatively lower energy demand (e.g. shift in manufacturing towards high value-added products and shift to services industries) is resulting in economic development becoming increasingly efficient emissions-wise.

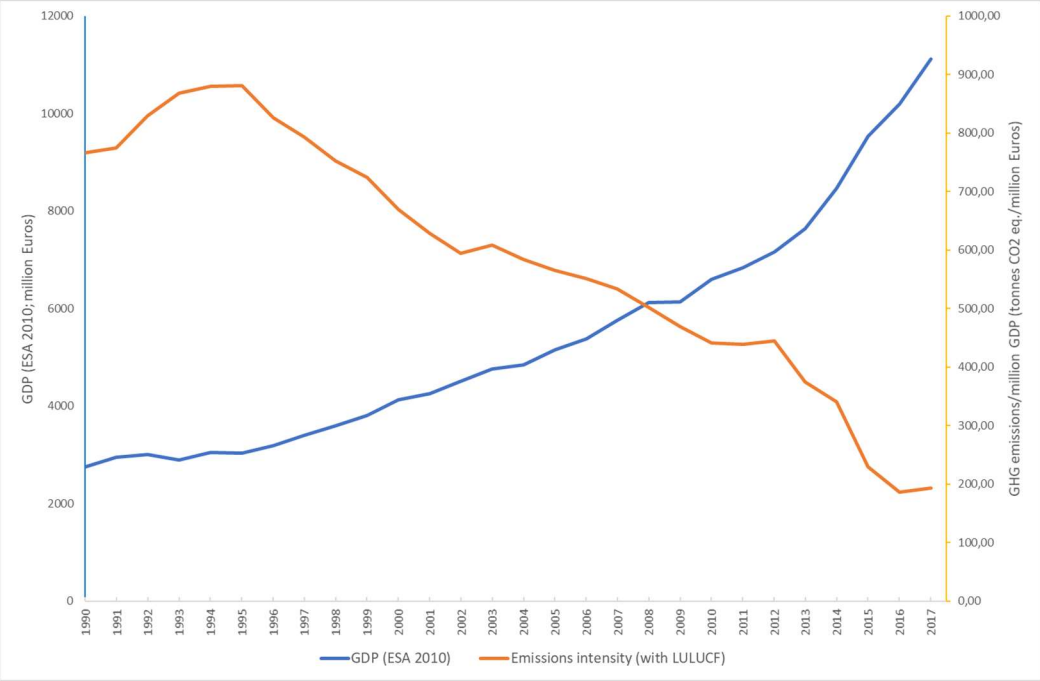

Figure 6 Greenhouse gas emission intensity of Malta's economy (GHG emissions per unit GDP)

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY GAS

Emission estimates for each greenhouse gas for the years 1990 - 2017 are presented in Table 2. This table highlights the major contribution that carbon dioxide has in total national emissions. The status of this greenhouse gas as the highest contributor has been maintained throughout the years.

The trend profile for each greenhouse gas can be better observed in Figure 7 and Figures Figure **9** toFigure **12**. The relative contribution of CO_2 emissions to total national emissions represents the strong influence that this gas has on the national emissions trends, to the extent that the trend profile for national emissions runs almost parallel to the trend for CO_2 emissions. This is similar to what has already been mentioned with regards to the trend profile for the Energy sector; indeed, activity categories in the sector Energy are the major contributors of national carbon dioxide emissions (Figure 9).

It is however to be noted that the relative contribution of CO_2 is decreasing with time, as may be seen, in particular, for the more recent years (Figure 8). The relative share of other gases is increasing, particularly the substantial increase in the share of emissions of HFCs. This is due to two main factors: a) the decrease in absolute amounts of carbon dioxide emissions with time, as a consequence primarily of the decrease in emissions from the Energy sector; b) the increase in absolute emissions of other greenhouse gases, especially of HFCs consequential to the increase observed in emissions from the activity category Refrigeration and air-conditioning under sector IPPU (as will be discussed later; Figure 12). HFCs accounted for almost 19.3% of total national greenhouse gas emissions in 2017. The relatively high global warming potentials of HFCs, compared to carbon dioxide in particular, have a multiplier effect on the impact of HFCs into the atmosphere.

Methane emissions have also seen an increase in their relative share of total national emissions over the years, for the same reasons mentioned above. This share increased from 5.4% in 1990 to 11.6% in 2017 (peaking in 2016 at almost 13.0%). In absolute terms, CH_4 emissions experienced continued growth until 2007, followed by a somewhat erratic trend profile for subsequent years. The main contributors of methane emissions are Waste management activities (accounted for more than three-fourths of total national CH_4 emissions in 2017; solid waste disposal as the major emitter) and Agriculture (19.3% in 2017; enteric fermentation being the main agriculture activity contributing to CH_4 emissions), with a minimal contribution by the Energy sector (3.5% in 2017).

Agricultural activities are the main source of nitrous oxide emissions (66.6% of total N_2O emissions in 2017), which in themselves represent a substantially small share of total national greenhouse gas emissions (2.7% in 2017). Smaller contributions are made by waste and energy activities.

Table 2 Greenhouse gas emissions, by gas

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

Note to Table 2: Values denoted '0.00' indicate that emissions have been estimated but the value is of an order of magnitude that cannot be represented at two decimal places.

	CO_2 with LULUCF	CO_2 without LULUCF	CH_4	N_2O	HFC	PFC	SF_6	NF_3	Total with LULUCF	Total without LULUCF
	Gg CO_2 eq.									
1990	1943.29	1946.25	105.27	54.61	NO,NE,IE,NA	NO,NA	0.01	NO	2106.14	2103.18
1991	2112.20	2116.95	112.10	55.95	NO,NE,IE,NA	NO,NA	0.01	NO	2285.01	2280.26
1992	2305.37	2309.73	119.22	56.99	NO,NE,IE,NA	NO,NA	1.43	NO	2487.37	2483.01
1993	2318.09	2321.37	126.12	57.83	NO,NE,IE,NA	NO,NA	1.43	NO	2506.75	2503.48
1994	2484.08	2487.76	132.33	58.65	0.00	NO,NA	1.43	NO	2680.17	2676.49
1995	2476.81	2479.88	137.28	60.34	0.00	NO,NA	1.44	NO	2678.94	2675.87
1996	2435.85	2438.86	144.12	56.91	0.00	NO,NA	1.45	NO	2641.34	2638.33
1997	2481.56	2484.49	151.01	57.94	0.00	NO,NA	1.45	NO	2694.89	2691.96
1998	2485.14	2487.68	157.52	59.95	0.01	NO,NA	1.47	NO	2706.63	2704.09
1999	2531.41	2533.33	164.41	57.35	0.01	NO,NA	1.47	NO	2756.57	2754.65
2000	2525.72	2528.87	174.91	58.88	6.70	NO,NA	1.47	NO	2770.83	2767.68
2001	2426.41	2428.51	179.56	57.65	11.26	NO,NA	1.49	NO	2678.47	2676.36
2002	2420.94	2422.21	186.23	56.31	14.99	NO,NA	1.50	NO	2681.23	2679.97
2003	2627.23	2628.62	193.05	55.90	16.45	NO,NA	2.06	NO	2896.08	2894.69
2004	2539.90	2541.44	202.80	55.92	29.48	NO,NA	1.54	NO	2831.18	2829.64
2005	2596.38	2598.08	214.22	55.68	41.78	NO,NA	1.56	NO	2911.33	2909.62
2006	2604.21	2606.09	221.90	56.34	78.86	NO,NA	1.67	NO	2964.85	2962.97
2007	2682.95	2684.96	228.06	56.69	96.74	0.00	1.67	NO	3068.13	3066.11
2008	2758.79	2760.90	147.61	53.69	112.37	0.00	1.84	NO	3076.41	3074.30
2009	2530.73	2532.97	162.55	50.39	133.13	0.00	1.59	NO	2880.64	2878.40
2010	2532.35	2534.34	180.26	50.06	145.49	0.00	1.79	NO	2911.94	2909.94
2011	2611.54	2613.77	168.63	43.59	169.02	0.00	4.69	NO	2999.70	2997.46
2012	2771.33	2773.80	169.59	44.91	201.03	0.00	0.54	NO	3189.86	3187.40
2013	2438.18	2440.88	158.90	43.88	216.32	0.00	2.77	NO	2862.74	2860.04
2014	2426.13	2429.07	173.86	43.49	230.77	0.00	0.68	NO	2877.87	2874.93
2015	1717.60	1720.78	181.65	42.26	246.37	0.00	0.28	NO	2191.34	2188.16
2016	1413.36	1416.77	183.87	41.73	256.58	0.00	0.14	NO	1899.10	1895.68
2017	1608.67	1612.31	187.49	43.51	310.93	0.00	0.99	NO	2155.24	2151.59

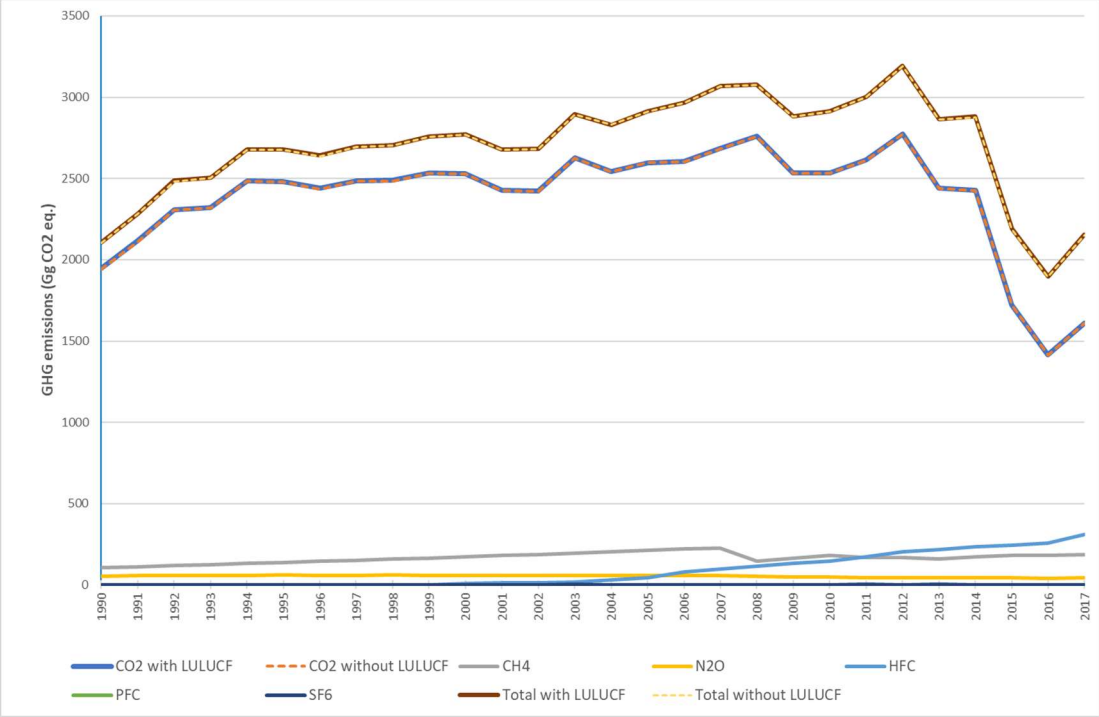

Figure 7 Emissions of greenhouse gases, differentiated by gas

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

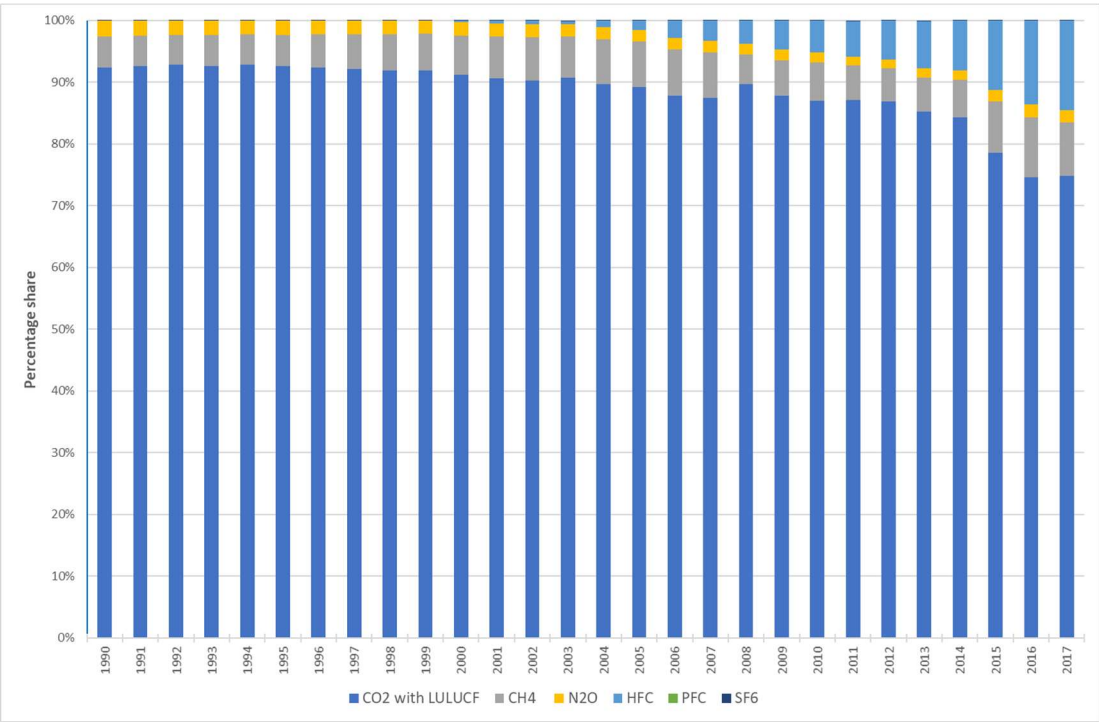

Figure 8 Percentage share of each greenhouse gas in total national emissions

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

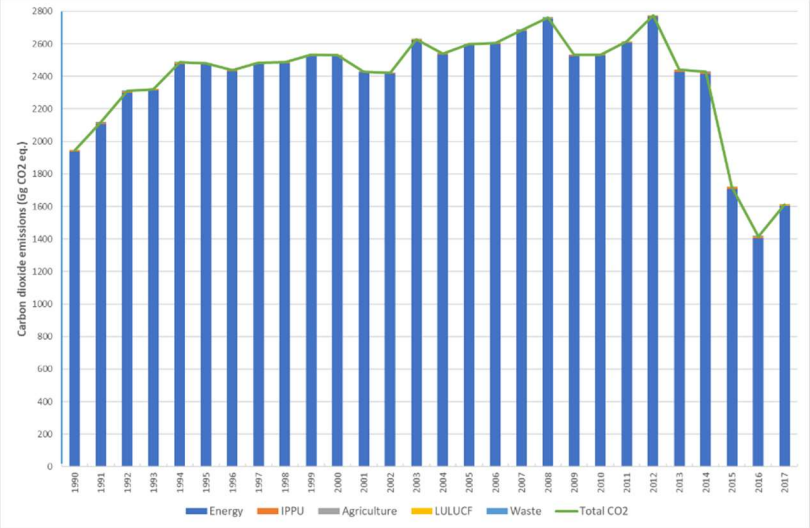

Figure 9 Carbon dioxide emissions, sectoral contributions

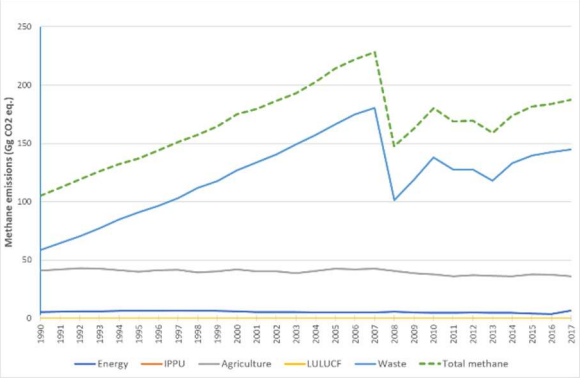

Figure 10 Methane emissions, sectoral contributions

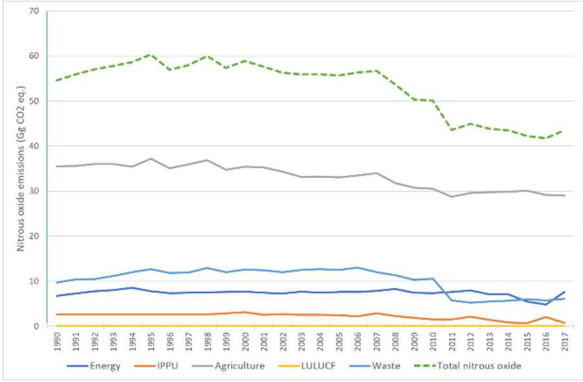

Figure 11: Nitrous oxide emissions, sectoral contributions

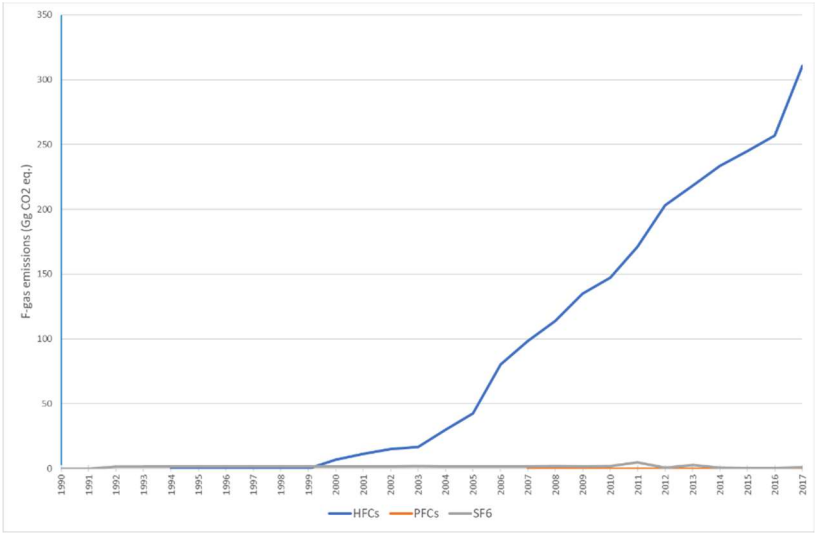

Figure 12 Emissions of fluorinated greenhouse gases

(all charts adapted from Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

DESCRIPTION AND INTERPRETATION OF EMISSION TRENDS BY SECTOR

Table 3 presents Malta's greenhouse gas emissions disaggregated at the level of sectors (see also Figure 13). The predominance of emissions from Energy sector activities is evident. Waste and Agriculture were also significant contributors until the mid-2000's, being surpassed then by sector IPPU as the sector with the second highest share of total national emissions. Key inventory figures are also presented in Table 4 at the end of this section.

Table 3 Greenhouse gas emissions, by sector

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

	Energy	IPPU	Agriculture	LULUCF	Waste	Total with LULUCF	Total without LULUCF
	Gg CO_2 eq.						
1990	1950.00	7.78	76.60	2.96	68.79	2106.14	2103.18
1991	2119.48	8.01	77.65	4.75	75.12	2285.01	2280.26
1992	2313.91	9.02	78.95	4.36	81.13	2487.37	2483.01
1993	2326.96	9.04	78.73	3.27	88.75	2506.75	2503.48
1994	2493.39	9.32	76.74	3.68	97.03	2680.17	2676.49
1995	2485.50	9.29	77.08	3.07	104.00	2678.94	2675.87
1996	2444.38	9.09	76.28	3.00	108.59	2641.34	2638.33
1997	2490.05	9.30	77.49	2.93	115.13	2694.89	2691.96
1998	2494.06	8.73	76.16	2.55	125.14	2706.63	2704.09
1999	2541.15	8.15	75.24	1.92	130.11	2756.57	2754.65
2000	2535.50	14.99	77.38	3.15	139.81	2770.83	2767.68
2001	2435.18	19.10	75.67	2.11	146.41	2678.47	2676.36
2002	2429.41	22.97	74.57	1.26	153.02	2681.23	2679.97
2003	2636.40	24.71	71.85	1.39	161.73	2896.08	2894.69
2004	2548.79	37.07	73.73	1.54	170.05	2831.18	2829.64
2005	2605.25	49.46	75.83	1.71	179.09	2911.33	2909.62
2006	2612.45	86.96	75.56	1.88	188.00	2964.85	2962.97
2007	2692.30	104.66	76.57	2.01	192.58	3068.13	3066.11
2008	2768.70	120.09	72.43	2.11	113.08	3076.41	3074.30
2009	2538.72	140.47	69.48	2.25	129.73	2880.64	2878.40
2010	2540.26	152.37	68.10	2.00	149.21	2911.94	2909.94
2011	2619.24	179.23	64.96	2.23	134.04	2999.70	2997.46
2012	2778.69	208.82	66.56	2.47	133.32	3189.86	3187.40
2013	2438.58	231.59	66.08	2.71	123.78	2862.74	2860.04
2014	2426.55	243.20	65.79	2.94	139.39	2877.87	2874.93
2015	1717.33	256.73	67.86	3.18	146.24	2191.34	2188.16
2016	1414.24	266.00	66.64	3.41	148.80	1899.10	1895.68
2017	1617.86	317.31	65.13	3.65	151.29	2155.24	2151.59

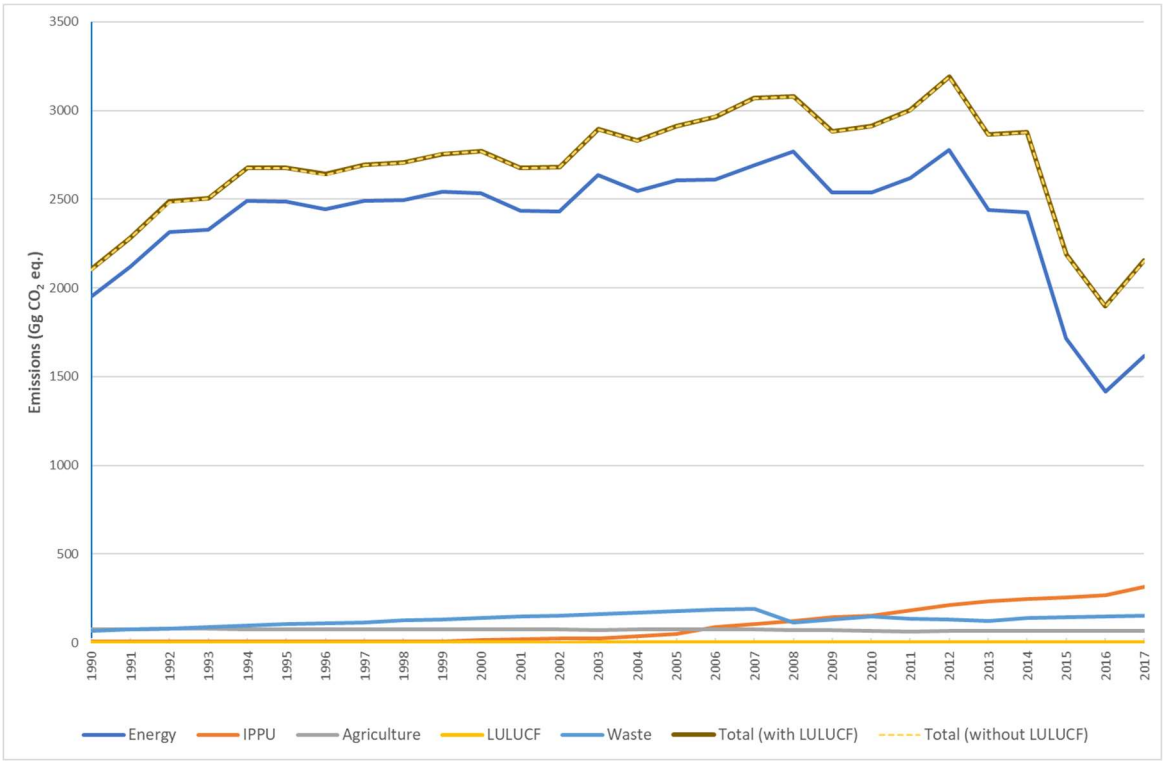

Figure 13 Emissions of greenhouse gases, differentiated by sector

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

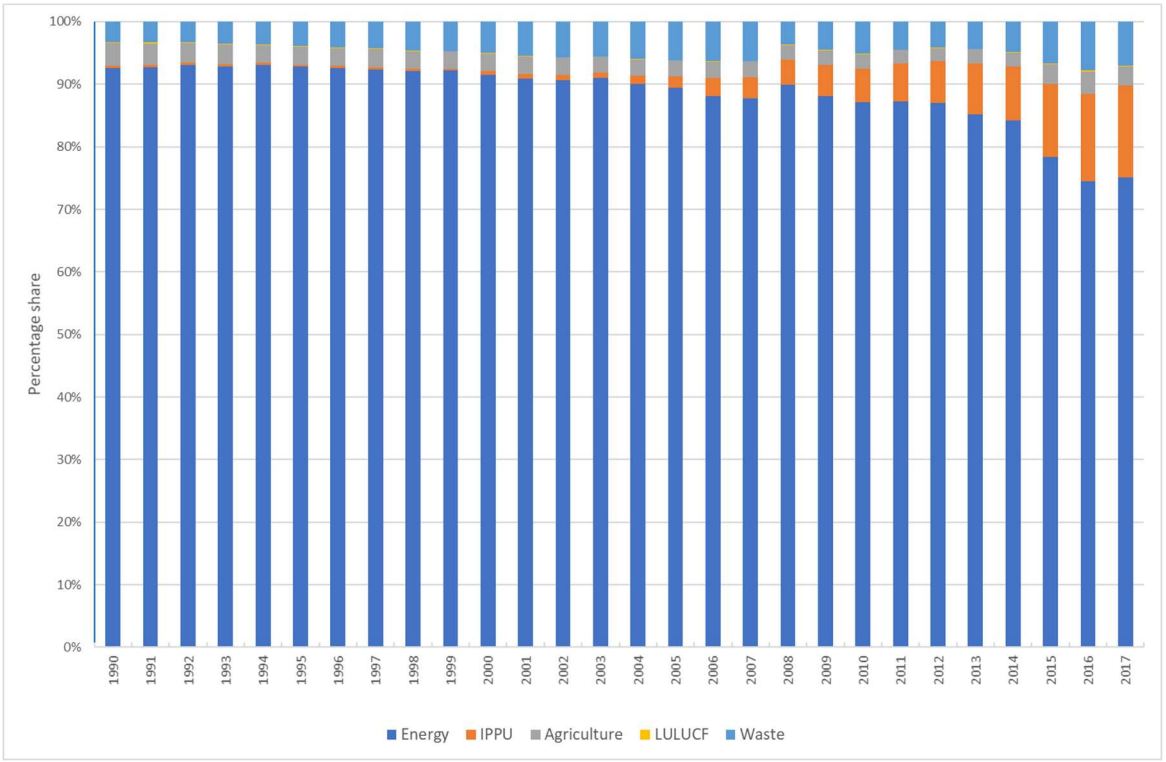

Figure 14 Percentage contribution of each sector to total national emissions

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

The **Energy** sector has had a strong influence on the trend profile for total national emissions throughout the period 1990-2017, as can be seen in Figure 13, with a dominant share of national emissions (Figure 14). Emissions from the main activity categories forming part of the Energy sector (for inventory reporting purposes) are presented in Figure 15.

For most of the time-series, emissions from **Energy Industries** (electricity generation) were the highest among all category activities in Malta's inventory. From the early 1980's until 1995, coal was the main fuel for the generation of electricity at the sole generation plant (Marsa Power Station) existing at the time. New plant (Delimara Power Station) was brought into operation in the mid 1990's and all electricity generation was converted to oil-fired technology, using a mix of heavy fuel oil and diesel oil. An increase in electricity demand, may have served as a counteracting factor to gains that would have been achieved with the change from coal to oil-based generation and the commissioning of the new plant in the mid-1990's, thus serving an important driver for the general increase in emissions that may be observed up to 2012.

Post-2012, new developments in the local electricity generation sector played a crucial part in the reversal of the emissions trend for energy industries. Marsa Power Station was largely decommissioned (one operational unit remaining solely for emergency stand-by purposes still in place), investment was made in an interconnector with mainland Europe, thus allowing for the possibility to source electricity from the European grid, and the construction and bringing into operation of a gas-fired plant. These investments together have led to the drastic reduction in greenhouse gas emissions that may be observed after 2012, coupled by significant improvements in the overall emissions intensity of indigenous electricity generation. It is to note that all existing public electricity generation plants mentioned here fall within the scope of the European Union's Emissions Trading System (EU ETS) and are subject to monitoring, reporting and emissions accounting obligations under the EU ETS. Historical CO_2 emissions, electricity generated in Malta and electricity sources through the interconnector, since 2005 (the first year of implementation of the EU ETS) are shown in Figure 16. Furthermore, progress is being achieved with regards to sourcing of a share of local energy demand from renewable energy sources. The share of renewable energy in relation to gross final electricity consumption is estimated to have reached 6.6% by 2017.

The sharp change in the trend for emissions for the Energy Industries category shows the potentially high impact of focussed policies and measures targeted towards an activity which is defined by a relatively small number of clearly identifiable point sources, especially in the context of a small country such as Malta.

Another activity with a substantial share in Energy sector, and thus, in national, greenhouse gas emissions is **Transport**. Overall transport greenhouse gas emissions have seen a general increase throughout the years, largely linked to the growth in road transport, the predominant option for internal transport. While an extensive bus system services the two main islands, ownership and use of private vehicles are high. At the end of December 2017, the stock of licensed motor vehicles stood at 372,061[9]. Of these, 78.4% of the total stock of licensed vehicles were passenger cars, 13.6% were commercial vehicles, 6.9 per cent were mainly motorcycle, quadricycles and all-terrain vehicles, while buses and minibuses accounted for less than one per cent, equating to a rate of more than 780

[9] News Release 015/2018; National Statistics Office, 2018 (accessed at: https://nso.gov.mt/en/News_Releases/View_by_Unit/Unit_B3/Environment_Energy_Transport_and_Agriculture_Statistics/Documents/2018/News2018_015.pdf.

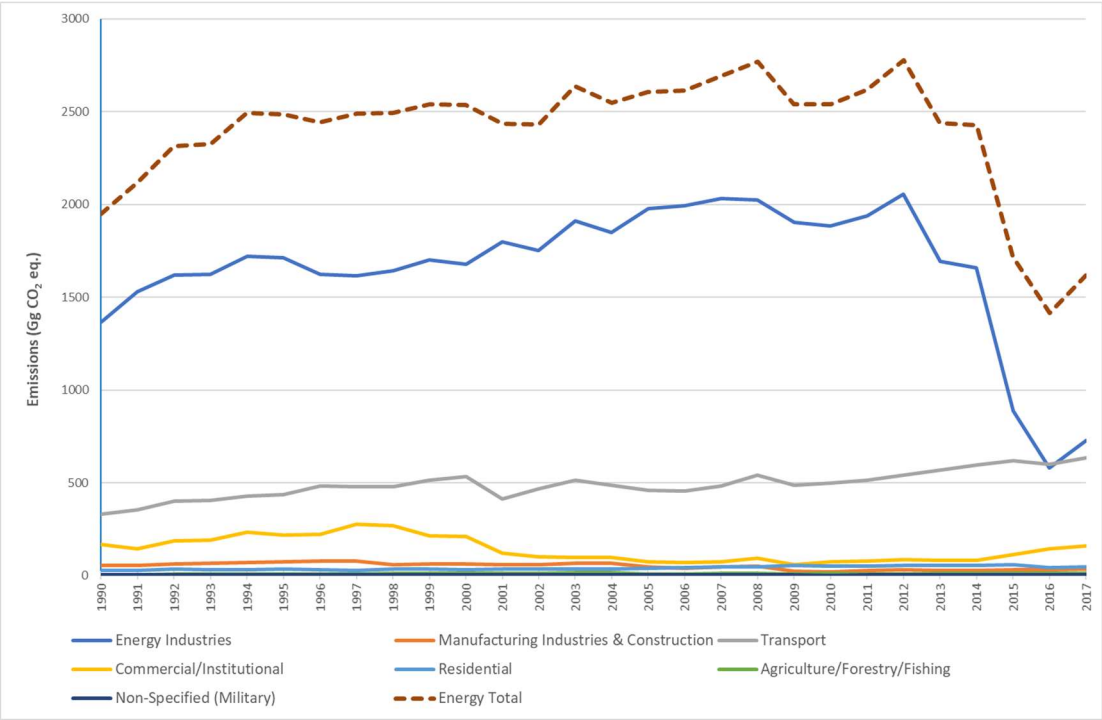

Figure 15 Emissions of sector Energy, disaggregated by activity category

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

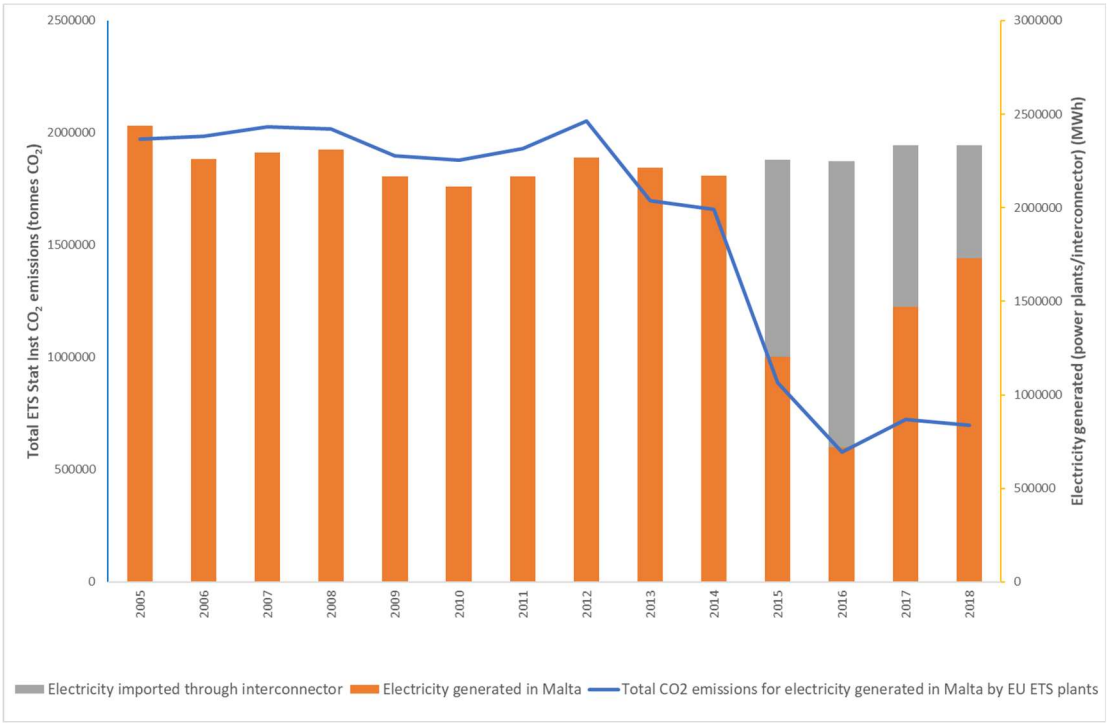

Figure 16 Cumulative CO_2 emissions from local EU ETS electricity generation plants, quantity of electricity generation in Malta from these plants and electricity sourced via the interconnector, trends since 2005

(adapted from data submitted by operators of electricity generation plants in accordance with reporting requirements pursuant to the EU ETS Directive).

licenced vehicles per 1,000 inhabitants (or around 610 passenger cars per 1,000 inhabitants).

Emissions from other modes of internal transport, that is internal navigation and domestic aviation are minimal in comparison to road transport. A scheduled ferry service provides a year-round link between the islands of Malta and Gozo, while domestic aviation is mainly limited to intermittent trans-island services provided from time to time by helicopter or light aircraft, training flights provided by local aviation schools and recreational aviation, particularly by micro-lights.

It is also worth noting that for one year, 2016, total national transport emissions (road, internal navigation and domestic aviation) surpassed the total greenhouse gas emissions of the energy industries sector for that same years.

Other activity categories (manufacturing and construction; commercial, institutional and residential; agriculture and fisheries) also contribute towards sector Energy emissions, albeit at relatively small amounts. Indeed, there is a high dependence on electricity for many energy-related requirements within the industrial, commercial and residential sectors; thus, direct emissions from fuel consumption in these activities would not be expected to be substantial when compared to those of energy industries and road transport.

Being an island state, Malta depends hugely on international maritime and aviation transport. Emissions from these activities are not considered as 'national' emissions for the purposes of greenhouse gas inventories. It is interesting to note however the level of emissions from these activities for Malta. Greenhouse gas emissions from international maritime bunkers reached 6,963.1 kilotonnes CO_2 equivalent in 2017, an amount more than three times total national emissions. Emissions from international flights to or from Malta amounted to 431.1 kilotonnes CO_2 equivalent in the same year, comparable with emission levels for road transport.

The **IPPU** sector has, over the last two decades, seen a major increase in emissions, both in absolute terms and in terms of its relative share of total national greenhouse gas emissions. Emissions of HFCs (Figure 12), entering the market as of the mid 1990's to replace ozone depleting substances, from activity sub-category Refrigeration and Air-conditioning account, by a large margin, for the bulk of emissions of this sector (greater than 96% in 2017; Figure 17). This activity sub-category is growing as more refrigeration and air-conditioning systems are installed in the residential and commercial sectors, as an adaptive means to minimize the effect of climatic conditions particularly in the hot summer season and driven by increased affluence of the population and growth in tourism.

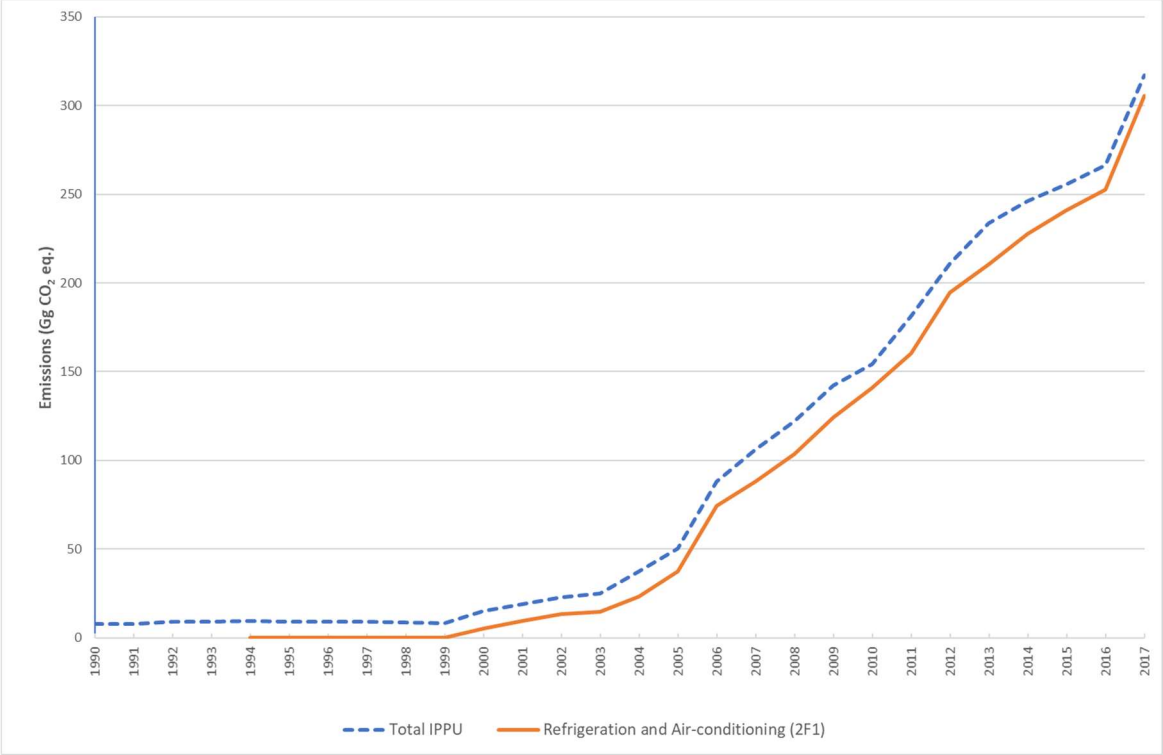

Figure 17 Emissions of sub-category Refrigeration and air-conditioning compared to total emissions of sector IPPU

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

The **Agricultural** sector shows a gradual decrease in total greenhouse gas emissions over the time-series 1990 – 2007. Activity category Enteric Fermentation accounts for almost half of total sector emissions, with categories Managed Soils and Manure Management accounting for the remainder. The sector has never been a major contributor to overall national emissions in its own right; this is to be expected, considering the nature of this economic sector in Malta, dominated, in terms of use of agricultural land, by small holdings of less than 2 hectares of utilised agricultural area each. The main cultivated crops are potatoes, tomatoes, other vegetables such as cauliflower, grapes, wheat, barley, olives and citrus fruits, mostly destined for domestic consumption. Livestock rearing in mainly focussed on cattle, pigs, poultry and rabbits, with small numbers of sheep and goats, with cattle, sheep and goats grown particularly for milk and the production of milk products while swine, poultry and rabbits and some cattle for local meat consumption.

From the perspective of emitted gases, emissions of methane and nitrous oxide are reported for this sector. All Enteric Fermentation emissions are of methane. Both gases are emitted by activities under category Manure Management: more than two thirds of category Manure Management emissions being nitrous oxide. Direct and indirect nitrous oxide emissions are reported under category Managed Soils.

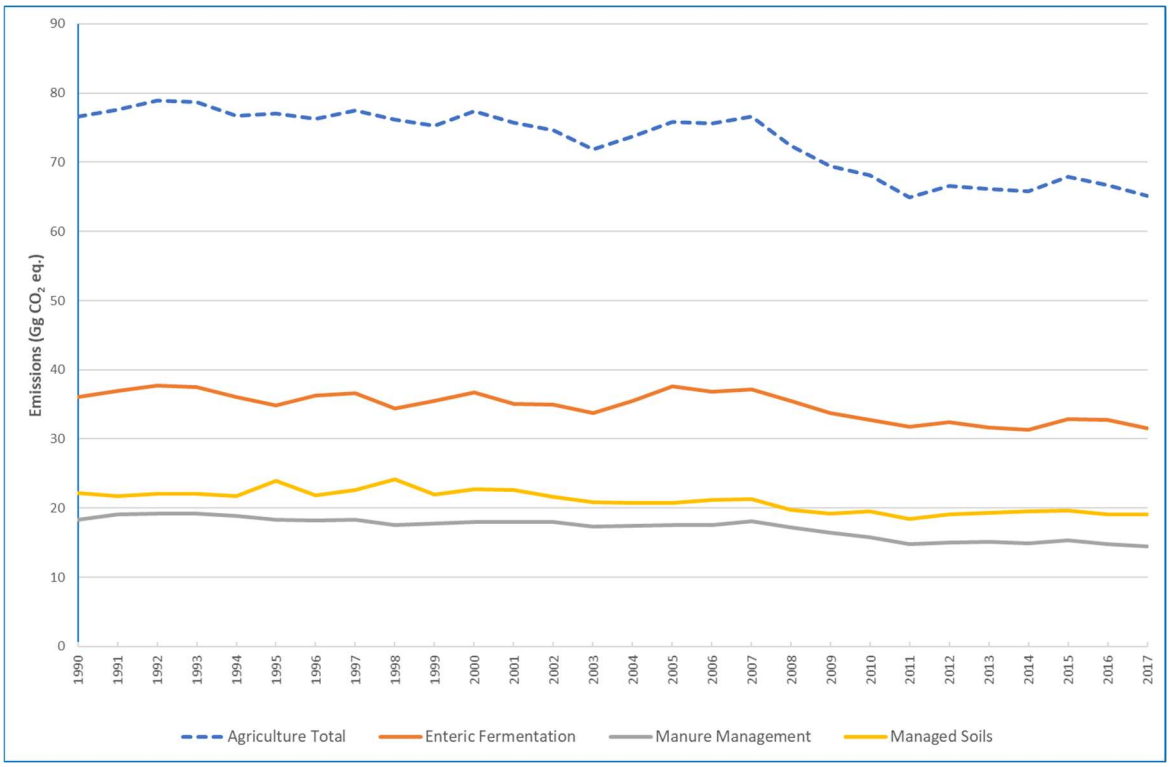

Figure 18 Emissions of sector Agriculture, disaggregated by activity category

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

Sector **LULUCF** shows a small net emissions contribution towards national greenhouse gas emissions. Net negative emissions (i.e. net removals) are estimated for category Grassland, while the other activity categories for which estimates are currently available, Cropland, Settlements and Other Land, have been determined to be net positive (i.e. net emissions) contributors.

The general profile of the trend of emissions from sector **Waste** is evidently greatly influenced by the profile of emissions for activity category Solid Waste Disposal, this being the category with the highest share of emissions in this sector (Figure 19). Until the upsurge in IPPU emissions in recent years, the Waste sector was the second highest contributing sector towards total national emissions in Malta.

Until 1996, solid waste (both municipal and industrial) was deposited into one of three unmanaged landfills: Magħtab and Wied Fulija in Malta and Qortin in Gozo. In 1997, waste stopped being deposited at Wied Fulija and all the waste generated between the years 1997 to 2004 was deposited at Magħtab and Qortin, with the vast majority entering Magħtab. From 2004, waste deposition in unmanaged landfills was stopped and solid waste started to be deposited in a newly opened managed landfill (Ta' Żwejra, an engineered landfill). Subsequently, another managed landfill (Għallis) took over, and remains operations till the present. Rehabilitation, including landfill gas extraction, works have been taking place in the closed landfills.

In 2017, 93% of all sector Waste emissions were generated by the category Solid Waste Disposal. Methane emissions from this category are also the predominantly emitted

greenhouse gas in this sector (emissions of nitrous oxide and carbon dioxide have relatively small shares of total sector emissions).

Other solid waste management approaches have also been utilised, at least for a share of generated waste, including separation and composting at the Sant' Antnin. This composting plant stopped operating in early 2007 and was replaced by a mechanical biological anaerobic treatment plant some years afterwards.

Basic incineration facilities existed for in Malta until 2007. The facilities in operation at the time were basic and without combustion control. In early 2008 the commissioning of a central thermal treatment facility allowed for the decommissioning of old incinerators, and is currently used for municipal, industrial and clinical incineration needs.

Three plants are available for the treatment of sewage, between them accounting for the treatment of around 90% of all sewage generated, the remaining 10% having to be disposed of in its untreated form. Indeed, the coming into operation of the second plant in 2008 and the largest treatment plant in 2011 explains the trend in wastewater emissions observed after 2007 (Figure 19). The third plant, with the smallest treatment of capacity, was constructed in the early 1980's and in at present undergoing retrofitting.

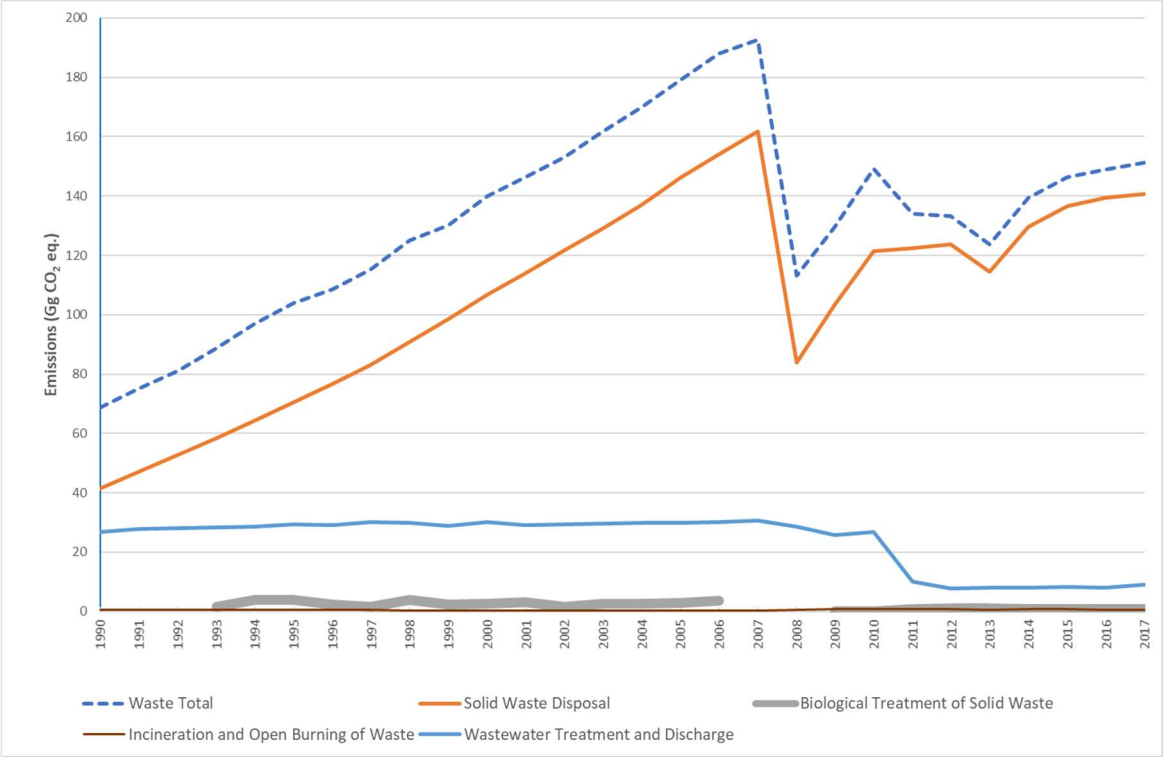

Figure 19 Emissions of sector Waste, disaggregated by activity category

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

Table 4 Key greenhouse gas inventory figures

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

	Emissions, 1990 Gg CO_2 eq.	% share of total emissions, 1990	Emissions, 2017 Gg CO_2 eq.	% share of total emissions, 2017	% change 1990-2017
Energy	1950.00	92.6	1617.86	75.1	-17.0
IPPU	7.78	0.4	317.31	14.7	3975.9
Agriculture	76.60	3.6	65.13	3.0	-15.0
LULUCF	2.96	0.1	3.65	0.2	23.1
Waste	68.79	3.3	151.29	7.0	119.9
Total-with LULUCF	2106.14	---	2155.24	---	2.32
Total-without LULUCF	2103.18	---	2151.59	---	2.29

Table 5 Key categories (level assessment, with LULUCF)

(source: Malta's inventory of greenhouse gas emissions and removals, 2019; Malta Resources Authority, 2019).

Note to Table 5: For 1990, there is no difference in level key category list whether assessing with or without LULUCF. For 2017, the only difference between with and without LULUCF is that category Enteric Fermentation is not a key category for the without LULUCF assessment.

1990			2017		
Energy Industries	Liquid Fuels	CO_2	Road Transportation	Fossil fuels	CO_2
Energy Industries	Solid Fuels	CO_2	Energy Industries	Gaseous Fuels	CO_2
Road Transportation	Fossil fuels	CO_2	Refrigeration and Air conditioning	no classification	Aggregate F-gases
Other Sectors	Liquid Fuels	CO_2	Other Sectors	Liquid Fuels	CO_2
Manufacturing Industries and Construction	Liquid Fuels	CO_2	Energy Industries	Liquid Fuels	CO_2
Solid Waste Disposal	Waste	CH_4	Solid Waste Disposal	Waste	CH_4
Enteric Fermentation	Farming	CH_4	Domestic Navigation	Liquid Fuels	CO_2
Domestic Navigation	Liquid Fuels	CO_2	Manufacturing Industries and Construction	Liquid Fuels	CO_2
			Enteric Fermentation	Farming	CH_4

Chapter 3: Quantified Economy-wide Emission Reduction Target

THE EU TARGET UNDER THE UNFCCC

A Party to the UNFCCC and a Member State of the European Union, Malta is committed towards contributing to the achievement of the joint EU economy-wide emissions reduction target of 20% compared to 1990 emission levels, by 2020 (Table 6).

The EU has also offered to increase this target to 30% reduction, by 2020, provided that other developed countries also commit to achieving comparable emission reduction levels, and that developing countries contribute adequately, according to their responsibilities and respective capabilities. At present, the EU considered that the conditions for increasing its 2020 target are not in place.

Table 6 Key facts of the joint Convention target of the European Union for 2020

Parameters	Objective
Base year	1990
Target year	2020
Emission reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	AR4
Sectors covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
Land Use, Land-Use Change, and Forests (LULUCF)	Accounted under the Kyoto Protocol, reported in EU inventories under the Convention.
Use of international credits (JI and CDM)	Possible, but subject to quantitative and qualitative limits.
Other elements	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

The following assumptions and conditions apply to the EU's 20% target under the UNFCCC:

- The EU Convention pledge does not include emissions/removals from LULUCF, but it is estimated to be a net sink over the relevant period. EU inventories include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol.
- The target refers to 1990 as the single base year for all gases and all Member States.
- Emissions from international aviation, to the extent that they are included in the EU Emissions Trading System (EU ETS) are included in the target.

- A limited number of international credits (Certified Emission Reduction (CER) units; Emission Reduction Units (ERUs); temporary CERs (tCERs) or long-term CERs (lCERs) from afforestation or reforestation projects) and units from new market-based mechanisms may be used to achieve the target. In the EU ETS, the use of international credits is capped (up to 50 % of the reduction required from EU ETS sectors by 2020). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. For emissions under the Effort Sharing Decision (ESD), the annual use of international credits is limited to up to 3% of each Member State's ESD emissions in 2005, with a limited number of Member States being permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.
- The Global Warming Potentials (GWPs) used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the IPCC when the target was submitted. In its submission to clarify the 2020 target from 20 March 2012, the EU announced that the implications of the CMP Decision to revise the GWPs to those from the IPCC Fourth Assessment Report (AR4) are under review. This review has been completed and revised GWPs from AR4 were adopted for the EU ETS. For the revision of ESD targets the revised GWPs were taken into account. For the implementation until 2020, GWPs from AR4 will be used consistently with the UNFCCC reporting guidelines for GHG inventories.
- The target covers the gases CO2, CH4, N2O, HFCs, PFCs and SF6.

THE EU'S COMPLIANCE ARCHITECTURE FOR 2020

In 2009, the EU established internal rules under its "2020 climate and energy package"[10]. These rules underpin the EU implementation of the target under the Convention.

The package introduced a clear approach to achieving the 20% reduction of total GHG emissions from 1990 levels, with year 2005 chosen as the base year for the internal compliance approach. The 20% target based on 1990 levels translates to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between two sub-targets, separately covering emissions within the scope of the EU's Emissions Trading System and emissions falling within the scope of the Effort Sharing Decision (Figure 20). These two sub-targets are:

- a 21 % reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10 % reduction target compared to 2005 for ESD sectors, shared between the 28 EU Member States through individual national GHG targets.

Other targets forming part of the overall package relate to the share of renewable energy (20% of EU energy from renewables) and energy efficiency (20% improvement in energy efficiency). All the targets forming part of the 2020 climate and energy package were adopted by the Heads of Government of the EU Member States in 2007, giving them a solid policy basis.

[10] More information on the 2020 climate and energy package may be found at: https://ec.europa.eu/clima/policies/strategies/2020_en.

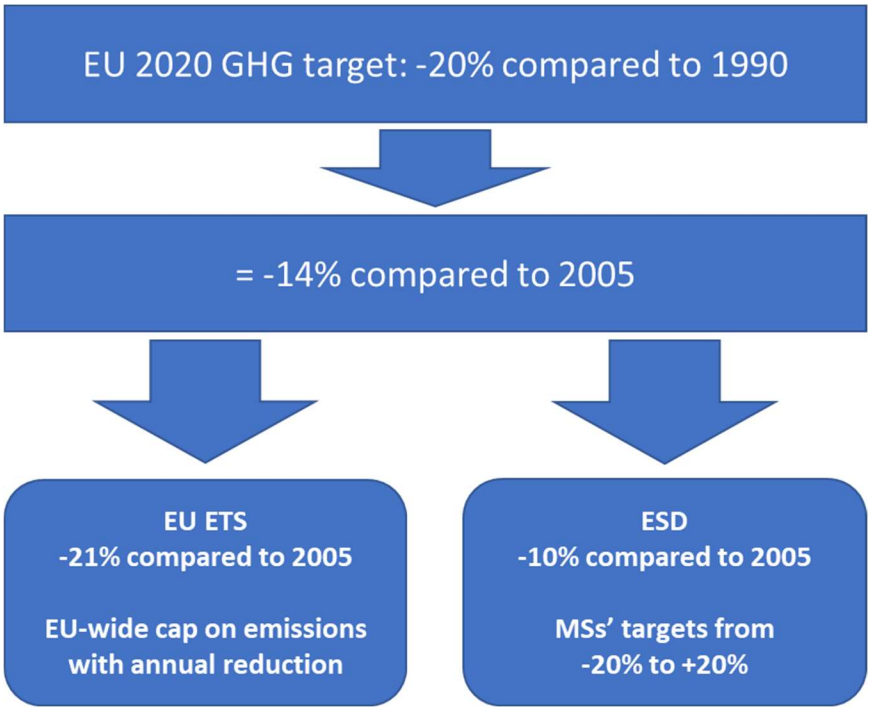

Figure 20 Achieving the EU 2020 GHG objectives

In the context of the overall goals of the package, the EU ETS Directive[11] was amended[12] with a view to achieving a highly harmonized approach. A single cap on the total allowances to be made available for all the stationary installations participating in the system is set, covering all the EU Member States and the three additional participating non-EU Member States, Norway, Iceland and Liechtenstein. For the period 2013 to 2020, the cap decreases by 1.74% annually (starting from the average level of allowances issued by Member States for the EU ETS period 2008-2012), thus serving as the principal means of ensuring that these installations reduce their collective emissions. The allowances are made available to operators of installations either through auctioning according to purposely established auctioning rules, or, for eligible sectors and sub-sectors, by free allocation based on harmonized EU-wide rules and criteria. Operators of installations are required to annually monitor, and report verified emissions, and to surrender sufficient allowances to account for all reported emissions. Operators may buy allowances if they have a shortfall of allowances, or, if they have a surplus, sell allowances. A limited quantity of international credits may also be utilized, subject to the credits used meeting the applicable quality criteria.

Emissions from domestic and international aviation activities, to or from, or within EU countries had been incorporated into the EU ETS by a previous amendment to the EU ETS Directive. In this manner, aviation is also giving a fair and tangible contribution towards

[11] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC; OJ L 275, 25.10.2003.

[12] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve ad extend the greenhouse gas emission allowance trading scheme of the Community; OJ L 140, 5.6.2009.

mitigation of climate change. In order to facilitate subsequent negotiations that started within the International Civil Aviation Organization (ICAO), leading to the adoption of rules on a global market-based system for international aviation, the EU later decided to limit the monitoring, reporting, verification and accounting obligations only flights within the European Economic Area

The EU ETS is estimated to cover around 45% of European Union greenhouse gas emissions. The remaining 55% of domestic emissions fall within the scope of the Effort Sharing Decision[13] (that is, all non-ETS emissions, not including emissions from domestic aviation and emissions and removals from land use, land-use change and forestry. The ESD thus covers a diverse range of emitters: transport (road, national navigation), buildings, small industrial installations, fugitive emissions from the energy sector, fluorinated gases, agriculture and waste.

The ESD emissions reduction objective requires national-level reduction or limitation efforts in accordance with targets set for individual Member States. These targets are expressed are percentage changes by 2020 compared to Member State's respective 2005 emission levels, translated into binding quantified annual emission trajectories for the years 2013 to 2020, and quantified into absolute Annual Emission Allocations (AEAs)[14] [15]. The percentage 2020 targets of Member States range from the most stringent 20% reduction obligation for Luxembourg, Denmark and Ireland to the least stringent 20% limit on the increase in emissions for Bulgaria. The targets were determined as a correlation with the economic situation of each Member State, with GDP/capita as a proxy criterion, with the more prosperous States having the more negative (i.e. reduction) targets and those Member States with a less developed economic status having the positive (i.e. limited increase) targets (Figure 21).

Achieving the ESD targets is mainly expected to come from domestic action by the individual Member States. Where this is not possible, a number of flexibility mechanisms facilitate compliance with the targets: these mechanisms include the possibility to acquire additional AEAs from States with a surplus (emission in a year being lower than the annual emission allocation for that year) and use these to account for those emission exceeding the target, or the limited use of international credits (up to 3% of the Member States' ESD emission in 2005; in total, around 750 million credits may be used by all Member States throughout the 2013-2020 period).

[13] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas reduction commitments up to 2020; OJ L 140, 5.6.2009.

[14] Commission Decision 2013/162/EU of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council; OJ L 90, 28.3.2013.

[15] The AEAs set in Commission Decision 2013/162/EU were subsequently adjusted, in accordance with Decision 406/2009/EC, as published in Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period 2017 to 2020; OJ L 209, 12.8.2017.

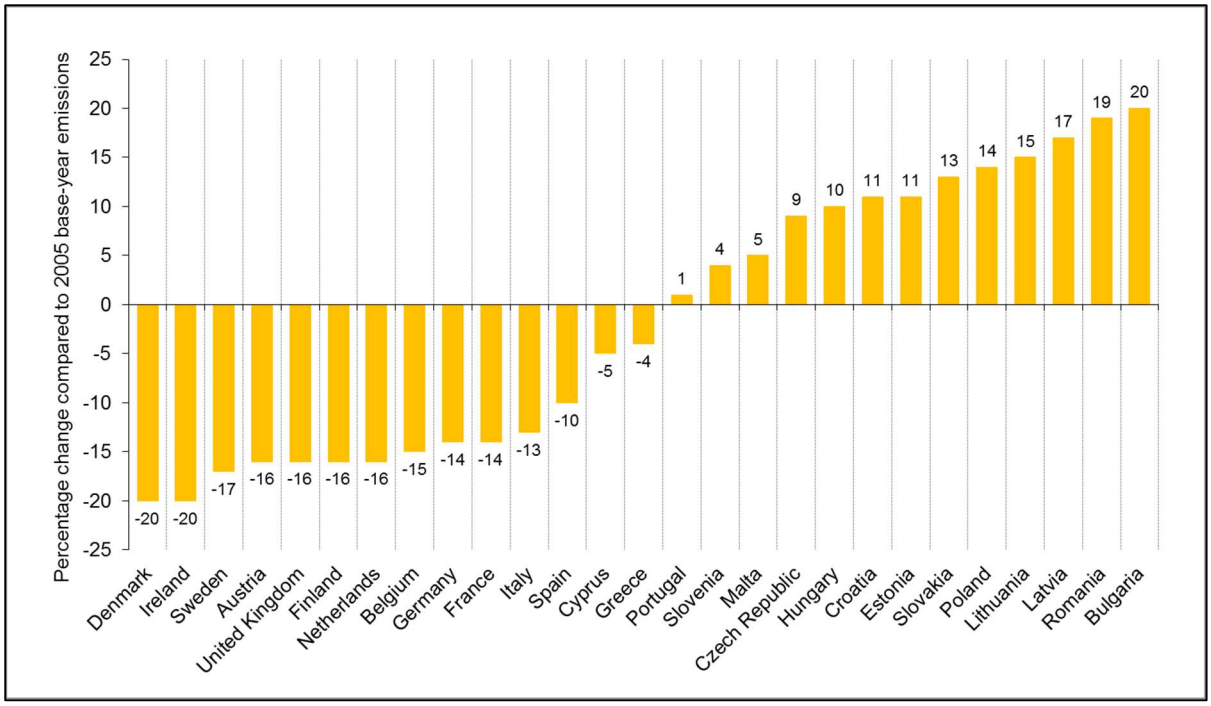

Figure 21 National 2020 GHG emission limits under the ESD, relative to 2005 emissions levels

(adapted from Decision 406/2009/EC).

MONITORING OF PROGRESS TOWARDS THE 2020 GHG TARGETS

The monitoring and assessment of progress towards the overall 2020 greenhouse gas emission targets are underpinned by the monitoring mechanisms established by EU law.

Robust monitoring of emissions is an inherent part of the EU ETS process. Operators of stationary installations and aircraft operators are required to monitoring their EU ETS emissions in accordance with approved monitoring plans, meeting the requirements set out in law[16]. Reports must be verified by independent, competent verification bodies holding a formal accreditation from the accreditation body of an EU Member State.

Assessment of progress towards Member States' respective targets is based on a comprehensive reporting system, including annual inventories of greenhouse gas emissions and removals and biennial reporting on policies and measures and on projections. Legal requirements for such reporting are established through the Monitoring Mechanism Regulation[17] and related subsidiary legislation. Compliance with annual ESD targets is established through the annual greenhouse gas inventory submissions, subject to a European peer review procedure. The European Commission also assesses, on an annual basis, the progress being made by the Union collectively, and by the member

[16] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emission pursuant to Directive 2003/87/EC of the European Parliament and of the Council; OJ L 181, 12.7.2012). Verification and accreditation requirements under the EU ETS are established by Commission Regulation (EU) 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council; OJ L 181, 12.7.2012.

[17] Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to the climate change and repealing Decision NO 280/2004/EC; OJ L 165, 18.6.2013.

States, with a view to determining the progress being made in respect of international commitments.

MALTA AND THE 2020 GHG TARGETS

As already noted above, Malta is also participating in the collective European Union efforts to achieve the joint EU economy-wide emissions reduction target of 20% compared to 1990 emission levels, by 2020.

The existing energy industry plants fall within the scope of the EU Emissions Trading System and are thus subject to the monitoring and reporting and emission accounting obligations of the EU ETS, in respect of carbon dioxide emissions. There are no other industrial activities in Malta that are in the EU ETS. These plants are the same electricity generation installations that account for the emissions reported under activity category Energy Industries in Malta's greenhouse gas inventory.

Aviation emissions to or from the Maltese airport are also subject to the requirements of the EU ETS Directive as applied to aviation activities. Other than activities that are exempted from the EU ETS by virtue of exemptions set out in the EU ETS Directive, flights to or from Malta operated on intra-EEA routes are monitored and reported to the relevant State administering respective operators.

Under the Effort Sharing Decision, Malta's target is to limit its emissions growth to not more than 5% over 2005 emission levels by 2020. As already discussed above, this target applies to national emissions not covered by the EU ETS, except for carbon dioxide emissions from domestic aviation and emissions or removals relating to LULUCF. The 2020 ESD target translates into a linear trajectory of binding quantified annual emission allocations for the years from 2013 to 2020, the trajectory starting from 2009 on the average of (ESD) greenhouse gas emissions during 2008, 2009 and 2020 and ending in 2020 on the 5% limit. The quantified AEAs for Malta are presented in Table 7[18]. The method for the determination of the linear trajectory and the annual emission allocations for Malta is pictorially represented in Figure 22.

The flexibility mechanisms available to Malta for meeting its annual ESD targets, in case emissions cannot be domestically maintained within the limits set by the annual emission allocations, include:

- utilisation of AEAs acquired from other Member States;
- annual use of international credits from project activities up to a quantity equal to 3% of the (ESD) greenhouse gas emissions figure for 2005, which would be equivalent to a total of around 264 kilotonnes CO2 equivalent over the entire period.

It is envisaged that shortfalls in compliance with the ESD targets will be offset by AEAs purchased from other Member States.

[18] AEA values sourced from Commission Decision 2013/162/EU and, as adjusted for years 2017 to 2020 in accordance with Decision 406/2009/EC, from Commission Decision (EU) 2017/1471 of 10 August 2017.

Table 7 Annual emission allocations of Malta, under the Effort Sharing Decision

Annual emission allocation (tonnes CO_2 eq.)							
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
1 168 514	1 166 788	1 165 061	1 163 334	1 174 524	1 173 666	1 172 808	1 171 950

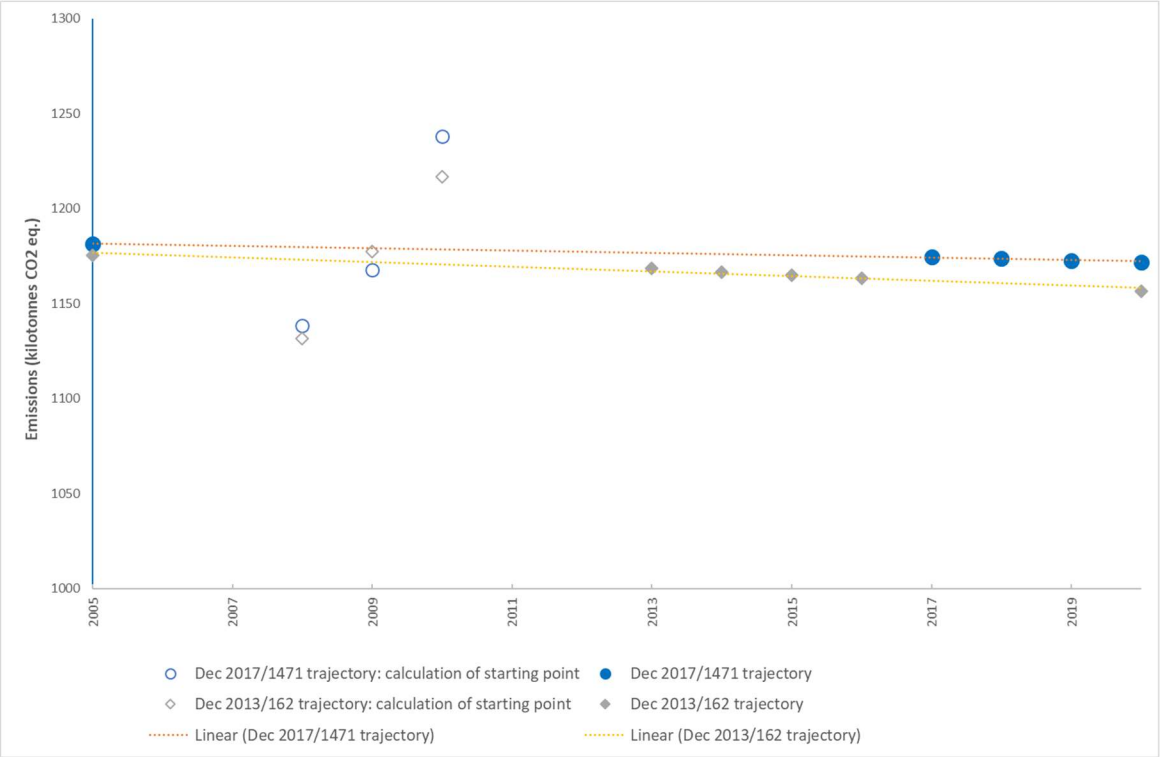

Figure 22 Determination of linear trajectory and annual emission allocations for Malta, under the Effort Sharing Decision, including adjustments for years 2017-2020 pursuant to Decision (EU) 2017/1471

Chapter 4: Progress in achieving quantified economy-wide emission limitation/reduction targets

Climate change mitigation policy in Malta is largely driven by the country's participation in, and contribution to, objectives established at European Union level, including in particular those already discussed in the previous chapter (EU commitments under international climate action treaties; EU legislation, such as the EU Emissions Trading System Directive and the Effort Sharing Decision).

Policymaking in this area, in general, is centralized through structures within the central government. Climate change policy is a theme specifically indicated as a Ministerial portfolio; at present, climate change policy falls within the portfolio of the Minister for the Environment, Sustainable Development and Climate Change. Two main policymaking approaches are prevalent: i) top-down, overarching (and often, cross-sectoral) national policies and strategies (e.g. low carbon development strategy); and, ii) sectoral actions either as targeted stand-alone measures (e.g. government grants for renewable energy sources in the residential sector), or a combination of measures set out in action plans (e.g. national transport action plan), usually developed in response to overarching policy decisions or national strategies. More often than not, one will notice that policies and measures may not specifically be adopted to directly address greenhouse gas emissions; rather, it is often the case that the reduction or limitation of greenhouse gas emissions from the sector or sectors covered by a particular policy, strategy, action plan or measure is one of a number of co-benefits of that particular policy, strategy, action plan or measure, albeit an important benefit.

POLICY CONTEXT IN MALTA – THE CLIMATE ACTION ACT

In 2015, the Maltese House of Representatives reached bipartisan agreement for the adoption of a Climate Change Act[19], which sets the fundamental basis for climate action in Malta:

> "*It shall be the duty of every person together with the Government to protect the climate and to assist in the taking of preventive and remedial measures to protect the climate*."[20]

The Act goes on to define the duties and obligations of the Government of Malta with respect to climate action, and presents guiding principles for the fulfilment of such duties and obligations:

> " *[t]he Government shall, in fulfilling its duties and obligations under this Act:*
>
> *(a) take climate change considerations into account, to the extent possible, in relevant social, economic and environmental policies and actions;*
>
> *(b) take into account its obligations and commitments pursuant to international treaties and its obligations as a Member State of the European Union;*

[19] Climate Action Act (Cap. 543), 2015 (accessed at: http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12336&l=1).
[20] Article 4 of the Climate Action Act (Cap. 543).

(c) take into account the geophysical, social and economic circumstances of Malta;

(d) ensure that actions taken are, to the extent possible, the most cost-effective, using best available technologies and best practices as appropriate to Malta;

(e) ensure that it takes into account the best available scientific, technological, technical and socio-economic information;

(f) ensure that all sectors of society and the economy participate in national climate action, including in relevant decisions;

(g) ensure that climate change, environment, conventional and alternative energy policies and measures are designed, developed, coordinated and implemented in the best interests of the environment, the economy, international and European Union obligations;

(h) ensure that climate action taken respects the interests of all sections of society, is non-discriminatory and, where relevant, promotes gender equality;

(i) ensure that data is collected, processed and interpreted in cognizance of data related to achieving overall international and European Union obligations in other areas;

(j) respect and, to the extent possible, safeguard the interests of vulnerable sectors of society, including by taking climate actions that support the eradication of poverty;

(k) ensure that climate action taken should promote and enhance the competitiveness of Malta's economy;

(l) ensure, to the extent possible, that no conflict exists between policies and measures adopted in respect of climate action and other policies and measures;

(m) ensure that it takes precautionary measures to anticipate, prevent or minimize the causes of climate change and to mitigate its adverse effects and that where there are threats of serious or irreversible damage, the lack of full scientific certainty should not be a reason for postponing such measures;

(n) ensure that climate action taken contributes to sustainable development;

(o) ensure that, where relevant, any beneficial impacts of climate change are harnessed to the benefit of society, the economy and the environment, to the extent that such beneficial impacts can reduce vulnerability and enhance resilience to other adverse impacts of climate change;

(p) ensure that, prior to taking any decision, all the consequences of the outcome of that decision throughout the whole life cycle of that outcome are taken into consideration; and

(q) ensure adequate information is made available to the public, to facilitate public participation in respect of certain plans and programmes relating to the climate system and ensure adequate access to justice."[21]

The Act requires the Government to prepare a low-carbon development strategy and a national adaptation strategy, providing also for their periodic (at least every four years)

[21] Article 6 of the Climate Action Act (Cap. 543).

review and updating. The Act also establishes a Climate Action Board whose functions include supervising the implementation of the provisions of the Act and advising the Minister responsible for climate policy on the implementation of the Act, monitoring that Malta fulfils its climate-related obligations under the UNFCCC and obligations arising from its membership of the European Union, facilitating adherence to national climate change policies and strategies and reporting on the progress made by Malta in the field of climate change. The Act also provides for the establishment of a Climate Action Fund, as a funding channel to support climate action in Malta. The Act also gives powers to the Minister responsible for climate change policy to enact regulations under the act.

POLICY CONTEXT IN MALTA – NATIONAL STRATEGIES

Malta's first comprehensive national policy document related to climate action was published in 2009, in the form of the 'National Strategy for Policy and Abatement Measures Relating to the Reduction of Greenhouse Gas Emissions'[22]. This strategy considered a number of strategic themes: securing civil society and citizen participation; establishing an institutional framework for climate change and building the appropriate human capital; integrating the economics of climate change in policy design and the identification of abatement measures; and, abatement measures identified in a number of key sectors, namely energy, waste and agriculture, water and transport. This strategy was subsequently followed, in 2010, by a 'National Climate Change Adaptation Strategy'[23].

These strategies were not the only, or first, policy documents that gave climate change due consideration. Already in 2006, 'A Sustainable Development Strategy for the Maltese Islands'[24] had identified the reduction of greenhouse gas emissions as a priority area that warrants attention for the attainment of sustainable development goals in Malta. In 2012, the 'National Environment Policy'[25] highlighted the reduction of national greenhouse gas emissions as an important element of national environmental policy. The 'Malta's Sustainable Development Vision for 2050'[26] also states that "[t]*he transition to a low-carbon economy is central to our future economic development model*."

Sectoral policy documents have also included climate action within the respective sector's policymaking. Thus, the 'National Energy Policy'[27] of 2012 mainstreamed climate change mitigation within the then-framework for planning the country's energy policy.

[22] National Strategy for Policy and Abatement Measures Relating to the Reduction of Greenhouse Gas Emissions; Ministry for Resources and Rural Affairs, 2009 (accessed at: https://msdec.gov.mt/en/Document%20Repository/Malta%20Climate%20Change%20Adaptation%20Strategy/National%20Climate%20Change%20MITIGATION%20Strategy.pdf).
[23] National Climate Change Adaptation Strategy; Climate Change Committee for Adaptation, 2010 (accessed at: https://msdec.gov.mt/en/Document%20Repository/Malta%20Climate%20Change%20Adaptation%20Strategy/National%20Adaptation%20Strategy.pdf).
[24] A Sustainable Development Strategy for the Maltese Islands; National Commission for Sustainable Development, 2006 (accessed at: https://msdec.gov.mt/en/sustainabledevelopment/Pages/natstratsusdev.aspx).
[25] National Environment Policy; Ministry for Tourism, Environment and Culture, 2012 (accessed at: https://msdec.gov.mt/en/decc/Documents/environment/National%20Environment%20Policy.pdf).
[26] Malta's Sustainable Development Vision for 2050; Ministry for the Environment, Sustainable Development and Climate Change, 2018 (accessed at: https://meae.gov.mt/en/Public_Consultations/MSDEC/Documents/Malta%27s%20Sustainable%20Development%20Vision%20for%202050.pdf).
[27] National Energy Policy; Ministry for Resources and Rural Affairs, 2012.

The reduction of greenhouse gas emissions by different modes of transport is identified as one of the goals of the 'National Transport Strategy – 2050'[28].

NATIONAL ENERGY AND CLIMATE PLAN

An important development in policy planning in the last three years has been the extensive work undertaken in the preparation of Malta's first National Energy and Climate Plan (NECP). This is an obligation under the EU's Energy Union Governance Regulation[29] of 2018. The main objective of the governance mechanism established by this regulation is to enable the achievement of the objectives of the European Union's Energy Union, and in particular the targets of the 2030 Framework for Climate and Energy, in the field of greenhouse gas emission reductions, energy from renewable sources and energy efficiency. The Governance Regulation requires Member States to prepare, by the end of 2019, and every ten years thereafter, integrated national energy and climate plans, based on five key dimensions: decarbonisation; energy efficiency; energy security; internal energy market; and, research, innovation and competitiveness. The first plan is expected to cover the period 2021 to 2030; yet it should also take into account the longer-term perspective.

The preparation of Malta's NECP is being coordinated by an Inter-Ministerial Steering Committee (IMSC-NECP) established through a decision of the Cabinet of Ministers. The IMSC-NECP has been set up to ensure that all national stakeholders contribute effectively towards the NECP, in recognition of the crucial importance of coordination and contributions from several entities. A high-level political representative from each Ministry forming part of the IMSC-NECP sits on the Committee. Under the IMSC-NECP, two Technical Working Groups were established, one on energy modelling and another on non-energy, climate-related modelling; these working groups are tasked with the relevant quantitative assessments and to provide technical input to the IMSC-NECP.

The main role of the IMSC-NECP is that of aligning diverse Ministerial priorities so as to develop a holistic and integrated NECP, with the immediate priority being the completion of the final NECP by the end of 2019. There is a possibility that the IMSC-NECP structure will remain in place post-2019 to overlook the implementation of policies and measures which have been established as part of the NECP; indeed, the IMSC-NECP, can serve as the main framework for the coordination of policy-making, and implementation, for energy and climate action in Malta, potentially complementing the Climate Action Board established by the Climate Action Act in a comprehensive national climate action framework covering all aspect of policy planning, implementation and oversight.

The Ministry for Energy and Water Management is the leading ministry in the development of the NECP. Other Ministries considered to be important contributors to the preparation of the Plan, represented on the IMSC-NECP, and tasked with providing input in areas falling under their remit, include: the Office of the Prime Minister; Ministry for the Environment,

[28] National Transport Strategy – 2050; Transport Malta, 2016 (accessed at: https://www.transport.gov.mt/strategies/strategies-policies-actions/national-transport-strategy-and-transport-master-plan-1343).

[29] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council; OJ L 328, 21.12.2018.

Sustainable Development and Climate Change; Ministry for Transport, Infrastructure and Capital Projects; Ministry for the Economy, Investment and Small Business; Ministry for Finance; Ministry for European Affairs and Equality; Ministry for Education and Employment; Ministry for Justice, Culture and Local Government; and, the Parliamentary Secretary for Financial Services, Digital Economy and Innovation.

Apart from the individual Ministries sitting on the IMSC-NECP, other national governmental entities are key stakeholders responsible for the implementation of specific sections of national energy and climate policies falling under their remit and provide important technical contributions towards the NECP through the work of the two technical working groups.

The NECP has been approved by the Cabinet of Ministers and submitted to the European Commission in accordance with the Governance Regulation.

LOW-CARBON DEVELOPMENT STRATEGY

A second crucial policy development process that is also currently ongoing is the elaboration of a Low-Carbon Development Strategy (LCDS) for Malta, which looks beyond the 2030 perspective and towards 2050. The LCDS looks at both mitigation and adaptation aspects, and as such serves as a review, and update of the existing mitigation and adaptation strategies already mentioned above. The work on the LCDS is being led by the Ministry for the Environment, Sustainable Development and Climate Change.

The first phase of the work on the LCDS was a preparatory scoping phase to identify all possible relevant information and assess the current situation of the country from a socio-economic and environmental (with particular emphasis on climate-related) perspective. This scoping phase led to recommendations for a LCDS vision document[30], published in 2017. The vision document sets out the Maltese Government's key aspiration:

> "*Government aspires for Malta's social and economic development to occur in a low-carbon and climate resilient manner. In this context, the vision for Malta's Low Carbon Development Strategy is to transform Malta into a low-carbon and climate resilient country through symbiotic societal and economic collective actions by 2050. In this way Malta will be in a position to mitigate against greenhouse gas emissions thereby reducing its vulnerability, and increasing its adaptive capacity, to climate change*."

Areas for action are identified in the vision document: enterprise; energy; transport; waste; water; agriculture; tourism; information and communication technologies; finance; and, expert knowledge.

The LCDS process has now entered the second main phase: the preparation of the strategy itself. This phase includes the establishment of a mechanism for the setting of sectoral emissions mitigation targets, the preparation of recommendations for sector-specific adaptation, and the elaboration of an integrated LCDS for the eventual consideration and adoption by the Cabinet of Ministers. The conclusion of this phase, and thus the availability of a final LCDS, is expected towards late 2020 or early 2021.

[30] Malta's Low Carbon Development Strategy – Our Vision; Ministry for Sustainable Development, the Environment and Climate Change, 2017 (accessed at: https://meae.gov.mt/en/Public_Consultations/MSDEC/Documents/MSDEC%20LCDS%20Vision.PDF).

NATIONAL POLICIES AND MEASURES

The following sections aim at providing a succinct overview of policies and measures implemented, adopted or planned that may have an impact on greenhouse gas emissions from activities in Malta. It is not meant to be an exhaustive presentation of actions being taken by Malta, or to be a detailed policy-by-policy or measure-by-measure discussion, but rather it is intended to show the type of actions that are being taken in all relevant sectors. Appendix 1 provides summary qualitative information on individual policies and measures. More detailed information may be found in CTF table 3.

As was already noted previously, it may not necessarily be the case that such policies or measures are put in place specifically and primarily for the limitation or reduction of emissions; rather, actions taken are usually intended to address situations or circumstances that require that such action is taken, with an important co-benefit being the effect on greenhouse gas emissions from the targeted activities.

POLICIES AND MEASURES – ENERGY

The Energy sector is the largest contributor to total national greenhouse gas emissions, with emissions from energy industries and transport being the activity categories with the highest share of sector and national emissions.

Malta has no indigenous fossil-based energy resources and depends on imported fuels and electricity, and any indigenous generation from renewable resources, for all its energy needs. Petroleum exploration efforts, started in the 1950's continue to the present, mainly offshore. To-date, no commercially viable discoveries have been made, though good drillable prospects have been identified, yet remain untested. The discovery of commercially viable fossil-fuel deposits around Malta would provide an opportunity for reducing the country's dependence on foreign sources for such energy resources, though reliance on refinery facilities in other countries would remain.

Electricity generation and sourcing

Until recent years, the sourcing of electricity was fully dependent on local generation capacity, primarily based on coal (in the seventies, eighties and early nineties), then oil. Since 2017, natural gas-fired plant has come into operation and now meets a substantial part of electricity demand of the country. Meanwhile, what used to be a system completely isolated from any mainland electricity grid, has now been connected to the European grid via an interconnector with Italy. Renewable energy sources have seen a steady growth.

Figure 23 presents an overview of the trends of consumption of different fossil fuels in the local electricity generation plants since 2005. Heavy fuel oil was the main energy source until 2016, complemented by smaller quantities of diesel. Generation until 2016 was dependent on two installations, Marsa Power Station and Delimara Power Station. Since then, Marsa Power Station has been largely decommissioned and only one generation unit remains operational, kept on stand-by in case of emergency. The older parts (known as Delimara 1) of the then-Delimara Power Station have also been decommissioned, and the remaining plant split into two distinct commercial entities, Delimara (2) Power Station

and D3 Power Plant (D3PP) in 2017. Another generation plant, Delimara 4 CCGT Power Plant and LNG Terminal (D4PP) was commissioned and started operations in 2017, with natural gas as its fuel, and including a floating storage unit to meet the natural gas demands of Delimara 4 and Delimara 3.

The present make-up of local public generation capacity is thus:

- Marsa Power Station: 1 open cycle gas turbine, diesel-fired, total rated thermal input (MW(th)): 121;
- Delimara 2 Power Station: 2 open cycle gas turbines and 2 combined cycle gas turbines, all diesel-fired, total 484 MW(th);
- Delimara 3 Power Plant: 4 combined cycle diesel engines operating on diesel only, 4 dual fuel (diesel or gas) combined cycle diesel engines, total 330 MW(th);
- Delimara 4 Power Plant: 3 combined cycle gas turbines, gas-fired, total 432 MW(th).

Energy generation and carbon dioxide emissions by plant for the years since 2005 are presented in Figure 24. Total electricity generation from conventional sources in Malta for the same period may be observed in Figure 16.

The existing conventional power generation capacity is complemented by a 200MW (220kV HVAC) submarine cable laid between Malta and Sicily (Italy), providing greater flexibility in the sourcing of electricity within the context of security of supplies. The first sourcing of electricity through this interconnector was in 2015, peaking in 2016, and then decreasing somewhat as the new local generation plants came into operation.

The combination of new generation plant and utilisation of the interconnector has seen the emissions intensity of electricity generated in Malta (without accounting for electricity generated through renewables) decrease from 0.81 $kgCO_2$/kWh in 2005 to 0.40 $kgCO_2$/kWh in 2018.

An important future development in energy generation in Malta would be the laying of a gas pipeline connecting Malta with the European gas network via importation of gas from Italy. This 'Project of Common Interest' has already been the subject of preparatory studies into its technical and financial viability, high-level environmental and risk assessment, and technical studies to define the route and terminal point at both ends and the design of the infrastructure. Subject to ongoing detailed preparatory work and permitting procedures, the pipeline is expected to be in place by 2024.

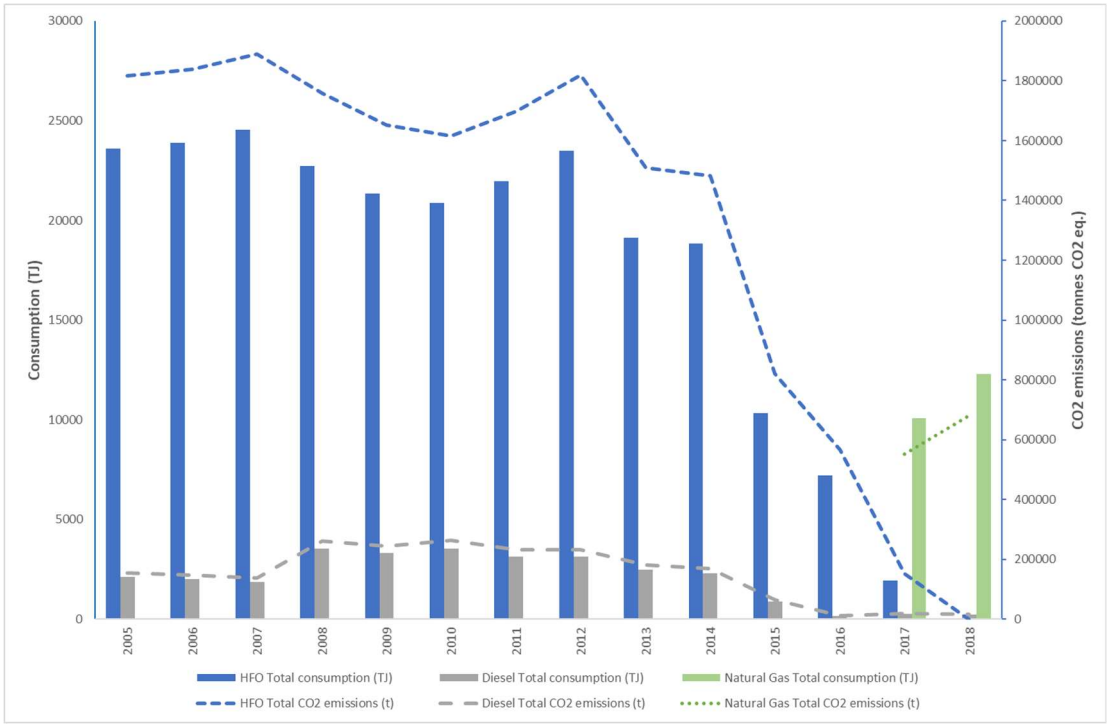

Figure 23 Trends in consumption and CO_2 emissions for Heavy Fuel Oil (HFO), Diesel and Natural Gas used in conventional electricity generation in Malta's power stations, for the years from 2005 to 2018

(adapted from data submitted by operators of electricity generation plants in accordance with reporting requirements pursuant to the EU ETS Directive).

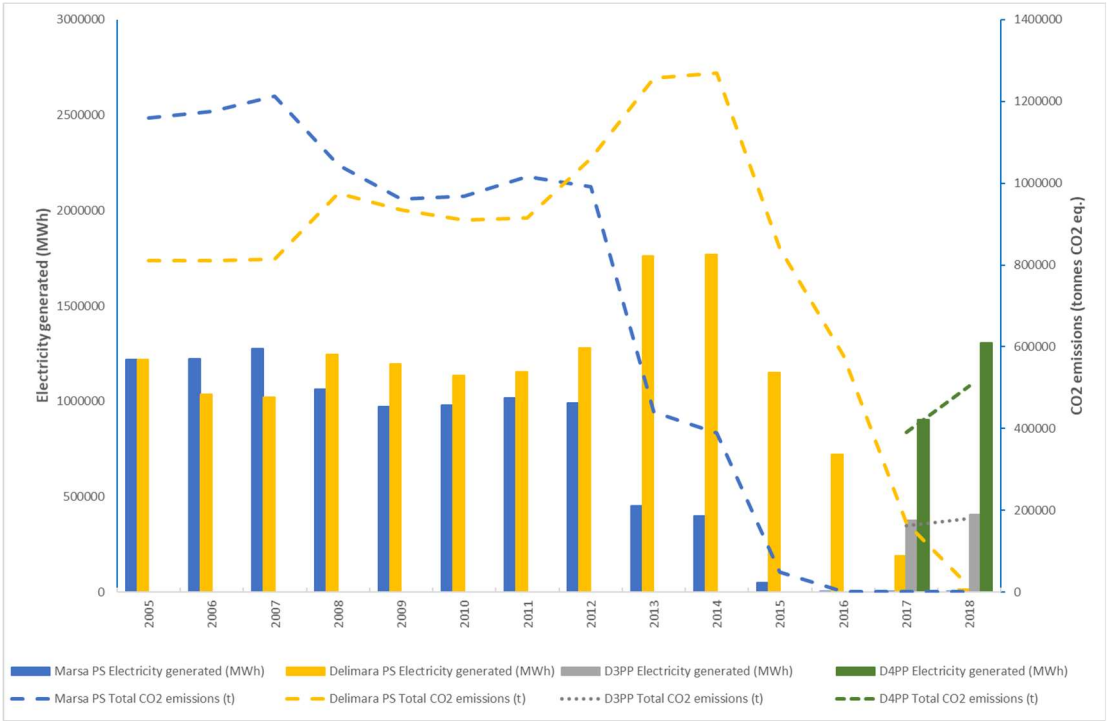

Figure 24 Trends in electricity generation and CO_2 emissions for the four public electricity generation plants in Malta, for the years from 2005 to 2018

(adapted from data submitted by operators of electricity generation plants in accordance with reporting requirements pursuant to the EU ETS Directive).

Renewable energy sources

Sourcing of energy from indigenous renewable energy sources (RES) is mainly via electricity generation by solar photovoltaics and the replacement of grid electricity for water heating in solar water heaters. In line with Directive 2009/28/EC[31], Malta is required to meet a 10% renewable energy share in gross final consumption of energy by 2020. Malta is expected to meet its target mainly through indigenous sources and through the use of statistical transfers. A higher-than-envisaged increase observed in electricity and energy demand in the very short term reflects the overall increase in population and economic and tourist activity. Efforts to increase the renewable energy share are ongoing: the share of renewable energy in relation to gross final electricity consumption is estimated to have reached 6.6% by 2017. The full exploitation of RES within the technical and geographical limitations of a small country with a high population density is however not enough to keep up with the steep increase in demand, due to the increase in population, increased tourism activity and relatively high economic growth.

The National Renewable Energy Action Plan of 2017[32] sets out the RES mix that is expected to deliver the 10% target by 2020, the trajectory towards 2020 and the measures to reach the target. A number of underlying principles have been defined, including, among others:

- RES obligations to be honoured;
- Energy efficiency to be a priority;
- RES can contribute to a green economy through the creation of green jobs;
- A holistic approach should be taken when considering RES and conventional energy sources;
- Aiming towards full exploitation of a mix of indigenous RESs;
- Cooperating with other countries and use of flexibility mechanisms provided for in EU law to address any shortfalls in reaching the 2020 RES target;
- Improving the knowledge base and supporting research and innovation; and,
- Incentivizing investment in renewable energy technologies.

Solar photovoltaics (PV) are deemed to be the most viable and robust indigenous form of renewable energy. Uptake of this technology has been high in all sectors: industry, commercial and residential. Financial support by central government is currently provided through grants towards the capital investment involved. Further initiatives part of loans for the installation of solar PV (and solar water heating) as part of loans, providing access to communal PV farms to consumers who cannot themselves directly invest in PV technology, and working with stakeholders in the construction and real estate sectors to incentivize the inclusion of PVs in new or newly refurbished buildings.

Solar water heaters offer another opportunity for investment in RES. In fact, a number of grant schemes facilitated a high rate of installations of solar water heaters every year, though this has seen a gradual increase in recent years, primarily due to increased preference for PVs and market saturation.

Wind energy is another potentially significant source of energy. Large wind farm installations could have a significant contribution towards meeting Malta's renewable

[31] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC; OJ L 140, 5.6.2009.

[32] The National Renewable Energy Action Plan 2015-2020; The Energy and Water Agency, 2017 (accessed at: https://ec.europa.eu/energy/en/topics/renewable-energy/national-renewable-energy-action-plans-2020).

energy targets; however, proposals made to-date have been shown to not be financially or environmentally feasible. Uptake of micro or medium sized win turbine technology has been limited mainly to a number of installations for research purposes, with further uptake constrained by uncertainties about energy yields, relatively high installation costs and planning permitting issues.

Waste is also considered as a potential source of energy, with several initiatives already in place or planned to be in place shortly, including the generation of energy from biogas produced in waste treatment facilities. Planning is also currently in hand for a major waste incineration facility which will also be capable of generating electricity.

Energy efficiency

The National Energy Efficiency Action Plan of 2017 (NREAP-2017)[33], determines the energy efficiency savings projected for 2020, to be met via four main policy approaches:

- energy efficiency obligation on the national electricity supplier, to apply a progressive (rising block) residential tariff system which would incentivize efficient use of electricity, facilitated by nation-wide smart metering, which is nearing completion;
- financial support and fiscal incentives for economic (industrial, commercial, residential and transport) sectors to adopt energy efficient technologies;
- regulatory action and voluntary agreements with high energy consumers, encouraging them towards energy efficient technologies and practices; and,
- the public sector leading by example with government and public entities practicing energy efficiency.

The energy efficiency measures discussed in the NREAP-2017 are estimated to lead to a cumulative end-use energy saving in 2020 of 934.7 GWh.

Transport

While it is an activity category with a relatively high share of total national greenhouse gas, transport may potentially offer a substantial contribution towards the reduction of emissions.

The National Transport Strategy sets out the vision for transport in Malta, with a view towards 2050. A number of key strategic goals are identified:

- transport to support economic development;
- transport to promote environmental and urban sustainability;
- transport to provide accessibility and mobility;
- transport to support social development and inclusion;
- transport to remain safe and secure; and,
- transport to work towards improved public health.

The goals of the Transport Strategy are further developed, for the short to medium term, through the 'Transport Master Plan 2025'[34]. The Master Plan sets operational objectives for

[33] Malta's National Energy Efficiency Action Plan; Office of the Prime Minister (Energy & Projects), 2017 (accessed at: https://ec.europa.eu/energy/sites/ener/files/documents/mt_neeap_2017.pdf).

[34] Transport Master Plan – 2025; Transport Malta, 2016 (accessed at: https://www.transport.gov.mt/strategies/strategies-policies-actions/national-transport-strategy-and-transport-master-plan-1343.

different modes of transport for the period up to 2025 guided by principles such as: efficient utilisation of the existing transport system; creating modal shift; integrated approach to planning and design; encouraging use of greener fuels and vehicles; modernisation and development of the transport network; investing in education, information, human resources, research and innovation; and, ensuring sustainable financing. Among the measures identified, which are already being implemented or are planned for implementation in the near future, the following may be mentioned:

- free school transport for primary and secondary school students, free use of public transport for youths and students between 16 and 20 years old, and extension of free public transport services for the elderly;
- infrastructural improvements to the existing road network, including a number of projects in key areas as part of the TEN-T network that will ensure smoother vehicle passage and, among others, lead to a reduction in emissions;
- support to car sharing and transport on demand schemes;
- incentivizing cycling through infrastructural improvements in the road network (e.g. integrating dedicated cycle lanes in road improvement projects) and financial support for the acquisition of bicycles;
- provision of ferry services between towns located around the major harbours (e.g. Valletta to Sliema) and improvements in ferry services provided between Malta and Gozo.

A potentially significant development in the road transport sector will be the decision, due in the forthcoming future, on a date after which internal combustion engine cars will no longer be placed on the Maltese market. The necessary studies and consultations are currently ongoing to come to a final decision. This may be expected to, among others, drive the shift to electrification, complemented by other actions already being taken, such as financial grants and fiscal support measures by the government in favour of the purchase of electric vehicles and infrastructural works to install charging points. Complementary actions include government grants for the scrapping of conventional internal combustion engines and purchase of electric vehicles, reduced circulation tax rates for electric vehicles compared to conventional vehicles, reduced registration fees, priority parking near charging points and preferential incentives with respect to controlled vehicular access areas and use of bus lanes.

The use of biofuels in road transport is supported by the introduction, in 2011, of a substitution obligation on importers and wholesalers of automotive fuels, with a 10% share of biofuels in road transport fuels expected by 2020. The approach being used at present in the blending of biodiesel and hydrotreated vegetable oil (HVO) with diesel. On the other hand, bioethanol is currently not used, due to the warm Maltese climate which creates technical difficulties for the blending of bioethanol with petrol. The addition of bioethanol to petrol in low percentages increases the vapour pressure of the fuel blend and therefore increases the possibility of emissions of benzene and volatile organic compounds, particularly in high ambient temperatures. Therefore, unless petrol with a sufficiently low Reid Vapour Pressure (RVP) is readily available in relatively small volumes and competitive prices, the warm climate in Malta would drive the vapour pressure of bioethanol-petrol blends above the limit determined by EN 228.

The use of Autogas as a fuel in vehicles is underpinned by legislative instruments regulating the retrofitting of conventional vehicle engines to Autogas use, complements by codes of practice for installers. A number of service stations have also installed Autogas storage

and dispensing facilities while owners of petrol vehicles who wish to convert to Autogas may benefit from rebates on the cost of conversion.

Information technology is an important element in supporting efficient mobility. A number of initiatives are being taken or are planned, including:

- intelligent transport system, encompassing a number of independent systems such as closed-circuit television network covering a number of key areas, dynamic message sign network, electronic parking guidance systems, urban traffic management and control systems and flood alert systems in flood-prone urban areas;
- deployment of a national traffic control centre to manage transport across all the country and facilitate transit of buses;
- controlled vehicular access system put in place in the capital city (Valletta), which is very prone to traffic congestion due to being a major administrative and commercial hub.

In addition, the promotion of e-working and teleworking, initiatives established towards incentivizing a modal shift, particularly towards mass public transport modes and initiatives taken by individual organisations and entities, such as green travel plans implemented by the University of Malta (a major educational institution in Malta with a large student population concentrated in one localized campus), further complement the measures already mentioned above.

Domestic aviation in Malta is limited mainly to irregular flights between Malta and Gozo, flight schools and private flying for leisure and recreative purposes, in all instances using small aircraft. Overall emissions from domestic aviation are minimal.

International aviation, on the other hand, is a crucial means of transport from and to the Maltese Islands, being a mainstay of the local tourism industry, business-related travel, carriage of goods and having an important social dimension as it allows the Maltese population easy and ready access to the world. From a policy perspective, it is to note that many international flights to or from Malta's sole international airport would fall within the scope of the EU's Emissions Trading System as applied to aviation activities. Indeed, several aircraft operators based in Malta and providing international aviation services are subject to the obligations (monitoring and reporting of annual verified emissions; surrender of allowances to account for reported emissions) of the EU ETS. Similarly, flights to or from Malta performed by other operators who fall within the scope of the EU ETS are subject to the same obligations, these obligations being incumbent on the operators performing such services and as attributed to Member States for administrative purposes in accordance with attribution criteria set out in the EU ETS Directive.

Malta has, together with the other EU Member States, declared a commitment to start implementing ICAO's Carbon Offsetting and Reduction System for International Aviation (CORSIA) as of the start of this global market-based measure in 2021. CORSIA will require aeroplane operators performing international flights to monitor and report annual verified emissions and to offset emissions, above a pre-determined baseline, with the overall aim being of limiting international aviation emissions to a level not higher than 2020 levels. Implementation preparatory work for CORSIA are already in hand, underpinned by the legislative framework set out at EU level. Again, several local aeroplane operators will fall within the scope of CORSIA and will have obligations accordingly. Most international

flights to and from Malta will be within the scope of CORSIA and thus subject to monitoring, reporting and offsetting obligations.

The maritime sector is another important economic activity which has a long historical association with Malta and provides a critical economic and social service to the country. The maritime sector is dominated by international activities relating largely to the transport of goods and fuel bunkering services. The tourism sector also benefits, with Malta serving as an important hub, or stop-over, place in the Mediterranean for a number of major cruise line companies.

As of 1 January 2018, large ships over 5 000 gross tonnage loading or unloading cargo or passengers at ports in the European Economic Area were required to monitor and report their related carbon dioxide emissions and other relevant information. The relevant obligations are set out in Regulation (EU) 2015/757[35] (Shipping MRV Regulation). The Shipping MRV Regulation provides for three main implementation steps:

- Monitoring: From 1 January 2018, shipping companies monitor, for each of their ships undertaking maritime transport activities to or from port in the European Economic Area: CO_2 emissions, fuel consumption and other parameters, such as distance travelled, time at sea and cargo carried on a per voyage basis;, so as to gather annual data into an emissions report submitted to an accredited MRV shipping verifier.
- Emissions reporting: From 2019, and each year, companies submit an annual emission report to an accredited shipping MRV verifier, and subsequently report to the European Commission and to the State in which each ship is registered (the flag State) verified data from their maritime activities covered by the Regulation's geographical scope;
- Document of compliance: From 2019, companies are to ensure that all their ships that have performed activities to or from ports in the European Economic Area carry on board a document of compliance, with Member States' authorities checking fulfilment of this obligation by inspections on ships.

The MRV Regulation in itself may not directly lead to reductions in emissions from maritime activities; however, it will provide a crucial basis for future policy making in this area, as it will provide the data necessary for the European Union to decide whether, and if so, to what extent, tangible objectives may be set out for the maritime sector. In fact, the MRV Regulation is but the first step in the three-step strategy for the maritime sector that the EU is contemplating: MRV; greenhouse gas reduction targets for the shipping sector; further measures, including market-based measures in the medium to longer term.

There are important synergies between the EU strategy on maritime transport activities and recent development at the international level. The International Maritime Organization (IMO) has established an IMO Data Collection System. This system requires owners of large ships, engaged in international shipping, to report information on fuel consumption of their ships to the respective ship flag State. The flag States then report aggregated data to the IMO, which shall produce an annual summary report to the IMO

[35] Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC; OJ L 123 19.5.2015.

Marine Environment Protection Committee (MEPC). This system started operating in 2019, with the first annual monitoring cycle. So as to take into account these international developments, the EU's Shipping MRV Regulation is currently undergoing a revision to align it to the international system.

POLICIES AND MEASURES – INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)

A justification of action in the IPPU sector is two-fold: this sector has an important share overall total national greenhouse gas emissions; and, emissions from this sector see a high rate of increase year-to-year. Trends in this sector are dominated to a very high extent by emissions of fluorinated gases, especially HFCs from refrigeration and air conditioning equipment. Refrigeration and air conditioning are crucial for the type of climate that Malta experiences, and such equipment is ubiquitous in industrial, commercial and residential sectors.

The measure that would be expected to contribute most to the limitation and reduction of emissions of fluorinated gases is the EU's F-gas Regulation: Regulation (EU) No 517/2014[36]. The Regulation aims at transitioning the market towards untilisation of F-gases with lower global warming potentials, while setting end-dates for the placing on the market of gases with high global warming potential. It also establishes a pan-EU ssystem of quotas for the production and importation of F-gases, while also sets out mimum qualification requirements for technical personnel involved in the handling of such gases (e.g. for technicians involved in the servicing of refrigeration and air-conditioning equipment). The F-gas Regulation have been implemented locally by Legal Notice 143 of 2018[37].

POLICIES AND MEASURES – AGRICULTURE

Future GHG emission trends in the agriculture sector may be influenced both by measures taken to directly address emissions or measures that indirectly contribute towards decreasing emissions, and by inherent trends in activity in the sector. The restructuring of the animal husbandry sector to conform to animal welfare, food safety, veterinary and waste management requirements, will lead to both direct and indirect reductions in emissions, in particular with more efficient practices.

Addressing Malta's obligations under EU legislation, particularly the Nitrates Directive (91/676/EC)[38], N_2O emissions from the use of fertiliser is expected to decrease over time as improved cultivation practices are adopted, mainly through the Nitrates Action Programme (more information is provided below). Furthermore, Malta benefited from the European Agricultural Fund for Rural Development, a financial instrument under the reform of the Common Agricultural Policy with the aim of strengthening the EU's rural development policy and simplifying its implementation.

36 Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation EC) No 842/2006;
37 Fluorinated Greenhouse Gases (Implementing) Regulations (Subsidiary Legislation 427.94): http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12826&l=1.
38 Directive 91/676/EC on the protection of waters against pollution caused by nitrates from agricultural sources.

The Agricultural Policy for the Maltese Islands 2018-2028[39], published in 2018, identifies six strategic policy objectives which form the basis for the development of policy measures in the short to medium term. These strategic policy objectives are:

- Food presentation, labelling and traceability;
- Consolidation of land holdings;
- Sustaining water and key resources;
- Competitiveness and diversification;
- Adaptation to and mitigation of geo-climatic conditions; and
- Research and development.

Most of these strategic objectives have an important climate dimension, not least the objectives 'sustaining water and key resources' and 'adaptation to, and mitigation of, geo-climatic conditions'.

The policy also includes seventy policy measures organised in four sets of operational objectives, namely economic objectives, social regeneration, resources and governance. The quantification of the effect of these policy measures has yet to be developed and at this stage it is not possible to quantify directly the impact on greenhouse gas emissions of these measures.

Farm waste management in Malta is governed by the requirements of several EU Directives, in particular the Nitrates Directive as transposed into national law. The relevant national legal instruments provide for the designation of the entire territory of Malta and Gozo as Nitrate Vulnerable Zones, the formulation of Code(s) of Good Agricultural Practice and the preparation of Action Programmes in respect of the designated vulnerable zones. The Waste Framework Directive 2008/98/EC, as transposed by the Waste Regulations, 2011 (L.N. 184 of 2011), is also to be complied with.

National agriculture waste management planning requires the development of a national system for manure management which will address a number of market failures, including the insufficient availability of cultivated land where manure can be applied, the vulnerability of the entire territory to nitrates contamination and the practical difficulties faced in terms of appropriate manure management by the typically small and fragmented farm holdings in Malta. Several research studies are also currently being conducted by the recently established Governance of Agricultural Bio-resources Agency to analyse possible ways of managing manure. An amount of liquid manure from cattle farms and dry manure from poultry farms is also treated in the Malta North Mechanical Biological Treatment (MBT) facility which started operations in 2016.

This Malta Nitrates Action Programme [40] addresses the protection of waters against pollution caused by nitrates from agricultural sources. This may also contribute towards the limitation of emissions of nitrous oxide from agriculture activities. The drawing up of a Code of Good Agriculture Practice (CoGAP) for Malta [41] is an important action towards controlling nitrates from the agriculture sector in accordance with the EU's Nitrates Directive. Further complementary measures include the formulation of fertilizer plans, an

[39] Agriculture Policy for the Maltese Islands 2018-2028; Parliamentary Secretariat for Agriculture, Fisheries and Animal Rights, 2018; https://agriculture.gov.mt/en/agric/Pages/nationalAgriPolicy.aspx.

40 Nitrates Action Programme – Malta; 2011; https://agriculture.gov.mt/en/agricultural_directorate/Pages/nitratesActionProg.aspx

[41] The Maltese Code of Good Agricultural Practices; Agricultural Services and Rural Development Division, 2003; https://agriculture.gov.mt/en/agricultural_directorate/Documents/nitratesActionProgrammeRegulations/ntr001.pdf

information and communication campaign (InfoNitrates LIFE+ Project) on the good use and management of nitrates in crop cultivation and livestock husbandry in Malta, training to and ongoing monitoring of farmers to ensure that the application of fertilisers is in compliance with relevant provisions, and the setting up of a Nitrates Database for the registration of farm holdings and better control of nitrates in the sector.

The Rural Development Programme (RDP) 2014-2020 [42] has climate mitigation and adaptation actions as one of the main cross-cutting objectives. The RDP 2014-2020 identified five 'themes':

- Theme 1: Water, wastes and energy: improving sustainable use and generating renewable energy;
- Theme 2: Maltese quality produce: improving quality, traceability, strategic marketing, adding value, branding and promotion;
- Theme 3: Sustainable livestock: improving resource efficiency, competitiveness and productivity, and welfare;
- Theme 4: Landscape and environment: managing habitats and features; and,
- Theme 5: Wider rural economy and quality of life: developing rural tourism, rural skills and promoting social inclusion;

themes 1, 3 and 4 of which have a direct, or at least indirect, relationship with climate action policy. Under these themes a number of measures relating to climate change were developed:

- Measure 2 - advisory services, farm management and farm relief services: this covers advisory services and training to farmers on such topics as water management, nutrients budgeting and management of fertiliser application, organic waste, improving soil management and the relationship with the wider biodiversity;
- Measure 4 – investments in physical assets: provides support for more efficient water-saving devices and systems in farms, improving water and waste storage and better waste handling and collection facilities and processes;
- Measure 11 - organic farming: provides support to farmers already practicing or interested in starting organic farming, taking into consideration the specific context of the Maltese agriculture sector, such as the small size of fields and fragmentation of cultivated land, the risk of cross-contamination from agricultural practices in neighbouring holdings and the climatic conditions which may make it more difficult to control and contain certain pests and diseases in an organic manner;
- Measure 16 – Cooperation: supporting joint action between different actors in the agricultural sector in such areas as climate change and bioenergy.

42 https://eufunds.gov.mt/en/EU%20Funds%20Programmes/European%20Agricultural%20Fund/Documents/RDP%202014-2020/Malta%27s%20Rural%20Development%20Programme%202014-2020.pdf

POLICIES AND MEASURES – LAND USE, LAND USE CHANGE AND FORESTRY

The LULUCF sector's contribution towards the EU's overall greenhouse gas mitigation effort is governed primarily by Decision No 529/2013/EU[43] and Regulation (EU) 2018/841[44].

Regulation (EU) 2018/841 in particular, requires EU Member States to ensure that any greenhouse gas emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO_2 from the atmosphere, the so-called 'no debit' rule, in the period 2021 to 2030. Accounting under the LULUCF Regulation is split over two compliance periods, 2021 to 2025 and 2026 to 2030, with Member States being required to show that over each of these compliance periods, they are abiding by the no debit rule. If this cannot be achieved by actions in the sector, the Regulation also provides for flexibility mechanisms by which Member States can close any gaps that it may have in respect of the no debit rule: the use of respective annual emission allowances allocated to the Member States under the Effort Sharing Regulation or buying net removals from other Member States who have successfully increased their rate of net removals beyond their respective commitment. This Regulation should incentivize Malta to enhance removals or reduce emissions in the LULUCF sector.

In view of the high population density of the Maltese Islands and the limited land availability, and to a certain extent the local climatic conditions (such as limited rainfall), the potential for further reduction of CO_2 emissions through carbon sequestration in vegetation is envisaged to be minimal. The woodland areas of the Maltese Islands total about 200 hectares. Native forest is all but extinct, cut down by early colonisers for wood and to clear the land for agriculture and building. Residual woodland areas are now protected by legislation. In recent years, afforestation projects have been undertaken, and have had an effect on the area covered by permanent vegetation, particularly trees; however, the CO_2 removals have not been estimated, given that data availability is, to-date, sparse.

Action in this sector is primarily targeted towards enhancing tree coverage on the Maltese Islands and safeguarding the integrity of the existing, albeit limited, forested areas by good management.

A number of afforestation efforts are undertaken by a number of entities, two such being the 34U Campaign, whose objectives are the planting of indigenous trees in various areas of the Maltese islands, thus increasing the surface area covered by permanent vegetation and recreating tracts of Mediterranean woodland, and efforts by the Ministry of Gozo to plant trees and shrubs (from 2010, over 6,103 trees and over 60,714 shrubs/climbers/perennials have been planted) in various areas of the island of Gozo. Recent declarations have been made by central government regarding future plans to extend existing tree plantations, and to include tree planting activities as part of major infrastructural projects.

The Foresta 2000 afforestation project involves the restoration of an area of natural habitat to a Mediterranean woodland. This long-term project, sited in the North of the island of Malta, commenced in 2003 and is a collaboration between a number of local non-

[43] Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities; OJ L 165, 18.6.2013.
[44] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU; OJ L 156, 19.6.2018.

governmental organizations and the government, which at present amounts to a total of 44 hectares of afforested land.

Management plans for existing woodland areas aim towards conserving existing woodland habitats and, to the extent possible extend their coverage. Management plans often involve the close collaboration of public and private entities and non-governmental organisations. A typical example is the il-Buskett, one of a handful of extensive woodland areas remaining in Malta. This area is managed by the central government through the recently established Ambjent Malta agency, with parts of the woodland managed directly by a private entity under a public-private partnership. Among the actions undertaken are works relating to soil stabilization, cleaning, site surveillance, restoration and rebuilding of rubble walls, regeneration of exposed ground and re-afforestation by re-cultivation from seeds of indigenous species found in the area.

The RDP 2014-2020 includes several measures that relate to LULUCF, in the context of restoring, preserving and enhancing ecosystems. Among relevant measures, one may note the following:

- Measure 8 - Investments in forest area development and improvement of the viability of forests: providing support for the creation and sustainable management of woodlands so as to contribute towards climate change mitigation, improve biodiversity, ensure woodland sustainability and enhance carbon sequestration; and,
- Measure 10 – Agri-environment-climate: includes a number of sub-measures that contribute to a number of key objectives including, among others, enhancing soil conservation and soil quality. Increasing tree coverage and greening of denuded landscapes, supporting biological and mechanism pest control and promoting biodiversity conservation of indigenous species of plants.

Where such measures result in an increase in above-ground biomass or soil depth and carbon content, they will thus be contributing to climate mitigation via enhanced carbon storage and sequestration

POLICIES AND MEASURES – WASTE

Until early 2004, solid waste was deposited in unmanaged landfills. One of three such landfills (Wied Fulija) was closed in 1996, and the other two landfills, Magħtab (in Malta) and Qortin (in Gozo) were closed in 2004.

Between 2004 and 2007, municipal solid waste was disposed of in a managed landfill at Ta' Żwejra, and subsequently in the Għallis managed landfill which started operating in the beginning of 2007. These landfills are operated by WasteServ Malta Ltd., a company set up by the Government of Malta in 2002 to organise, manage and operate national waste management systems.

Malta's waste-water handling infrastructure consists of two main networks that collect both domestic and industrial wastewater as well as some storm water runoff. The sewerage system has been upgraded with the building of three new sewage treatment plants, which process started in 2006 and ended in 2011. Two of the plants came into operation in 2008, while the third became fully operational in 2011. The bulk of sewage is now treated.

Solid waste management

The Waste Management Plan for the Maltese Islands – A Resource Management Approach 2014 – 2020[45] provides a roadmap that Malta is envisaging to follow to move waste management in Malta towards increased prevention, re-use, recycling and recovery. The waste management plan addresses a number of key issues and challenges: low rates of recycling; high landfilling rates; unsustainable waste management; breaking the link between economic growth and waste generation, moving towards sustainable waste management through prevention of waste generation, and diverting waste management away from landfilling and towards reuse, recycling and recovery.

A number of measures have been put into action to directly address emissions from landfilling sites. Though closed for a long time, the Magħtab and Qortin landfills remain a source of methane emissions due to the decaying of the biological waste placed there over the years. Landfill gas extraction infrastructure was installed to treat odour and noxious gas emissions from these closed sites in a regenerative thermal oxidiser. This is coupled with re-contouring works to improve the stability of the waste mass, better control emissions and rehabilitate the sites for eventual future alternative use. Landfill gas extraction is expected to continue for around another 10 years. The managed landfill of Ta' Żwejra and Għallis incorporate landfill gas management measures in accordance with the permitted conditions of operation. Waste cells are capped, and gases extracted.

The diversion of waste from landfilling to other waste management options is a crucial step in Malta's waste management plan as a whole. The Sant' Antnin Waste Treatment Plant includes a biological treatment plant for the anaerobic digestion of biodegradable municipal solid waste, resulting in the production of biogas. The biogas produced is used for the generation of electricity by combustion in a Combined Heat and Power (CHP) plant, for own use by the plant, with heat generated used directly for the heating of a therapeutical pool in the vicinity used in the care of disabled persons, with any excess electricity fed to the national electricity grid.

A Mechanical Biological Treatment plant has started operations in 2016 in the North of Malta for the treatment of municipal solid waste (MSW). This facility extracts the organic fraction and the Refuse Derived Fuel (RDF) from delivered waste, with the residual waste then disposed of in the landfill. This facility has the potential of also treating animal manure.

A crucial development achieved in the past few years is the separate of waste at source, the Maltese households. A pilot project was launched in July 2015, with 9 localities taking part initially; the scheme was then extended to all localities in the Maltese islands as of October 2018. In this way, a substantial fraction of food waste and other organic waste is separated from other municipal waste and directed to existing anaerobic treatment facilities. It is worth noting that the entire country is covered by system for the collection, not only of separated organic waste, but also the collection of mixed recyclables. This is further complemented by bring-in-sites across all localities and within easy reach of households and centralized civil amenity sites for the deposition of various types of wastes.

45Waste Management Plan for the Maltese Islands – A Resource Management Approach 2014 – 2020; Ministry for Sustainable Development, the Environment and Climate Change, 2014; http://environment.gov.mt/en/document%20repository/waste%20management%20plan%202014%20-%202020%20-%20final%20document.pdf

Wastewater management

Wastewater management is dependent on the existing network for the collection of sewage and treatment of the bulk of sewage in three wastewater treatment plants, which have come into operation since 2008. 80% of all sewage undergoes aerobic treatment in these plants, with the resultant clean water either distributed for agricultural use or discharged into the sea. Work continues on improving the infrastructure to reduce further the share of untreated sewage, often the result of exceptional disruptions to the operations of the plants or unintentional bypassing. The Malta South Urban Wastewater Treatment Plant (Malta South UWWTP) is the largest of the three sewage treatment plants and features anaerobic sludge digestion with biogas production. The biogas is combusted for energy recovery, meeting a share of the plant's own operating demand. Waste heat is also used in internal operations, to maintain the optimal sludge digestion temperature.

Waste-to-Energy

The future of waste management in Malta may lie with the commissioning of a waste-to-energy facility that would be able to treat a substantial part of local solid waste while generating energy. Studies carried out to-date have identified a plant with the capacity of processing, through incineration, more than 100 000 tonnes of waste and recover almost 70 000 MWh of energy every year. The commissioning of such a plant will not mean that other waste minimisation solutions will not be required; indeed, the operation of such a facility will have to be complemented by recovery and recycling measures.

ASSESSMENT OF THE ECONOMIC AND SOCIAL CONSEQUENCES OF RESPONSE MEASURES

As a small country, Malta's policy action would not, in itself, be expected to have major adverse impacts on third counties, including developing countries. Notwithstanding, Malta takes a proactive approach through actions that offset, to the highest extent possible, any adverse impacts that may occur.

Malta is a fully committed participant in the global action on climate mitigation. The Kyoto Protocol, in its very nature, aims at addressing in tangible terms the anthropogenic causes of observed climate change, through emission reduction or limitation efforts that contribute towards alleviating the harmful consequences of climate change for, among others, developing countries. Malta is an Annex I Party to the UNFCCC and thus has taken on emission limitation obligations under the Protocol as part of the joint fulfilment of the European Union's overall commitments. Though not a Party inscribed into Annex II of the Convention, still, Malta provides financial support to developing countries through both bilateral and multilateral channels (refer to chapter 'Provision of Financial, Technological and Capacity-building Support to Developing Country Parties' below for more details).

One may also reflect on the fact that Malta's contribution towards international climate action started at the very beginning of the international political process that eventually led to the adoption of the UNFCCC, the Kyoto Protocol and the more recent Paris Agreement. In 1988, Malta had introduced an item on the agenda of the General Assembly of the United Nations entitled '*Conservation of Climate as part of the Common Heritage of Mankind*', eventually leading to the adoption of Resolution 43/53 on the '*Protection of Global Climate for Present and Future Generations of Mankind*'. The

resolution requested that action be taken that would eventually lead to recommendations on elements for inclusion in a future international convention on climate; the Framework Convention on Climate Change was eventually adopted in 1992.

As already noted in a previous chapter, Malta's climate policy and legislative framework reflects, to a large extent, and builds on, policy and legislation enacted within the European Union. Any legislation proposed at EU level is subject to a formal process of impact assessment, that also looks at economic and social impacts of the proposed legislation. EU climate policy provides for emission mitigation action across all economic activities. All classes of Kyoto Protocol greenhouse gases are addressed.

Apart from the overarching policy framework at EU level ensuring the proper assessment of impacts of policy decisions, there are also important examples of sector-specific legislation that incorporate requirements that directly or indirectly may safeguard against adverse impacts to third countries. One such example is that for biofuels to count towards mandatory national renewable energy targets under EU law, they must comply with sustainability criteria that include that biofuels cannot be grown in areas converted from land with previously high carbon stock such as wetlands or forests and cannot be produced from raw materials obtained from land with high biodiversity such as primary forests or highly biodiverse grasslands. These conditions are, among other, aimed at protecting these important ecosystems, including in developing countries.

Further to its participation in international and EU efforts that already strive to be in line with the principle in Article 3, paragraph 4, of the Kyoto Protocol, Malta also undertakes direct action with developing third countries in areas of capacity building and transfer of technology and knowledge. Such action includes financial support for the implementation of alternative technologies, adaptation and capacity building and education, the latter including the provision of post-graduate scholarships in climate action at a major Maltese tertiary education institution (refer to chapter 'Provision of Financial, Technological and Capacity-building Support to Developing Country Parties').

Chapter 5: Projections

This Chapter provides an overview of the projected emissions up to 2030, split by sector and by gas, as well as the methodologies used in developing said projections.

The projections presented and discussed here reflect the outcome of modelling exercise carried out in the context of the preparation of Malta's first National Energy and Climate Plan under the EU's Energy Union Governance Regulation. As such, this modelling exercise represents a subsequent step to the Climate Action Results Evaluation (CLARE) modelling system used by the Malta Resources Authority for previous reporting on projections; as part of the ongoing development of the country's capacity for assessing the impact of policies and measures and projecting greenhouse gas emissions and removals.

The modelling of projections for the sector Energy is now being carried out by the Energy and Water Agency, using a suite of bespoke modelling tools developed through assistance under a European Commission capacity building project. Similarly, the Malta Resources Authority is undergoing capacity building support under this same project to enhance its projections capabilities for the sectors IPPU, Agriculture, LULUCF and Waste. It is acknowledged that Malta's capacity in projections has yet to reach full maturity, and the changes made in the approaches used for projections should be kept in mind if any comparison is made with projections reported in previous Biennial Report of Malta.

For the purpose of this submission, historic data presented in the 2018 National Greenhouse Gas Inventory feeds into the sectoral models for the estimation of GHG emissions projections. Two main policy scenarios have been projected, namely (1) the Business-as-Usual (BAU) or 'without measures' (WOM) scenario, which assumes that no further measures are implemented after the reference or base year (taken as 2016 for all sectors) and (2) the 'with existing measures' (WEM) scenario, which takes into account currently implemented and adopted policies and measures as at end 2016. It is necessarily the case that all policies and measures mentioned and discussed in the previous chapter have been modelled. Indeed, there may be actions which by their very nature are difficult to quantify, from an emission-saving perspective: this is often the case, for example, with regards to awareness raising and training programmes.

A 'with additional measures' (WAM) scenario is not presented in this submission. Policies and measures that have been taken into account in the projections modelling performed so far has focussed on those action that are already being implemented. In the context of the ongoing preparations of Malta's National Energy and Climate Plan and Malta's first comprehensive Low Carbon Development Strategy, new policies and measures will be proposed, analysed and where applicable, brought into effect in the future. It is hoped that future submissions of the Biennial Report of Malta will be able to present projections taking into account such additional measures.

DESCRIPTION OF THE MODELLING FRAMEWORK

This section provides a description of the modelling framework used to project future emissions by sector and by type of greenhouse gas involved. A secondary function is to estimate the impact of policies and measures aimed at reducing the emissions, relative to a BAU scenario.

Projections modelling – Energy

Over the course of 2018, eleven models were developed by the Energy and Water Agency and Transport Malta, for the projection of emissions from the Energy sector; seven of which are non-transport models. Projections on power generation were generated through an electricity dispatch model, which is driven by Gross Domestic Product (GDP) and affects Natural Gas. For the Manufacturing industries subsector, Commercial and Institutional services, Residential services and Agriculture, Forestry and Fisheries subsectors, non-transport fuel consumption models were used. These were driven by Gross Value Added (GVA), with the exception of the Residential Sector Model which was driven by population. A PhotoVoltaics production model was also developed, which estimated the potential of residential and non-residential PVs using past trends, cost projections, feed-in tariffs and an independent study carried out by EWA on investigating PV technical potential. Another model was also developed projecting the number of heat pumps. This was driven by the number of households, past trends and GDP. With regards to transport, 2 road transport models were developed. One modelled the consumption of biofuels, driven by a substitution obligation of -14% to be reached by 2030. The second road transport model projected the consumption of diesel and petrol, using population and GVA as drivers. In conclusion, a model for inland navigations (excluding fishing vessels) and another model for aviation were developed. Emissions resulting from gasoil, diesel and petrol used in national navigation were modelled on the basis of GDP taking into consideration the changes due to fast ferry and Gozo tunnel being proposed. For the aviation sector, emissions from Jet A1 were projected on the basis of the number of departures (departure projections developed by the Malta International Airport).

It is to be noted that forecasts of macroeconomic indicators used in the energy models were developed by the Economic Policy Division within the Ministry for Finance in collaboration with Cambridge Econometric, using a short-term quarterly forecasting econometric model specifically for Malta (STEMM). This model is basically composed of six industry blocks, one of which is the value-added block disaggregated at sectoral level. The value-added sectors which are modelled in this block are mainly:

- Goods sectors:
- Manufacture of Chemical and Chemical products, basic pharmaceutical products and pharmaceuticals operations (NACE 19-21) (CHEMPHAR);
- Manufacture of Computer, Electronic and Optical Products, manufacture of Electrical Equipment and Manufacture of Machinery and Equipment n.e.c (NACE 26-28) (EM);
- Construction sector and Real Estate Activities sector (NACE 41-43, 68). (RCONS) (F,L);
- Other Goods sectors (all the A-F sectors not included in the previous/other domestic sectors) (OG).

- Services sectors:

- Government Sector; O-Q sectors (NACE 84-88) (PS) (O-Q);
- Financial and Insurance Activities sector (NACE 64-66) (FIS) (K);
- Other Business Services Sector (NACE 69-75) (OBS) (M);
- Gaming Sector (NACE 92) (RG) (R);
- Accommodation and food service activities (NACE 55-56) (TOUR) (G,H,I);
- Wholesale and retail trade; repair of motor vehicles and motorcycles, transportation and storage sectors (NACE 45-54) (WRT) (G,H,I);
- Other services sector (all the G-U sectors not includes above/other domestic sectors) (OS) (J).

- Other Domestic Sectors (includes the A, B, D and N sectors) (OD).

Projections modelling - Industrial Process and Product Use

The model developed to project GHG emissions from IPPU sector is limited to project emissions from the *Refrigeration and Air conditioning* category (CRF 2.F.1) only, since, in recent years, the emissions of HFCs from this category add up account for almost the entirety of the GHG emissions from the sector.

The model takes into consideration five different groups, namely, residential (domestic), commercial, ships, transport and stationary. Based on historical data, including demand, imports, stock and emissions, the model estimates the stock and imports of a list of refrigerants (imported and used in the groups listed above).

The IPPU model includes two scenarios, namely the BAU and WEM scenarios. This model allows for the introduction of new measures affecting the generation of GHG emissions in the category refrigeration and air conditioning.

A brief description of the equations underpinning the key factors making up the IPPU model is presented below.

- Forecasting stock

stock in base year × (1 - emission factor + reuse) + imports

The stock forecast depends on the stock in existence from previous year, the amount escaped through emissions and the amount reused. This is subsequently added to the amount imported.

- Forecasting imports

stock in base year × (1 + activity growth) × exp(efficiency improvement) – (1 - emission factor + reuse)

The forecast of imports depends on the stock level from the previous year, the sector or activity growth rate and the improvement in efficiency which increases exponentially. It

also depends on its emission factor or fugitives which have to be replaced and the amount of gases that will be reused and thus deducted from the amount to be imported.

- Forecasting activity growth

The forecast of activity growth depends on the activity indicators and its stock elasticity to the activity indicator.

Domestic sector: private consumption × elasticity of activity growth to household consumption
Commercial sector: GDP × elasticity of activity growth to GDP

In case of the domestic sector, the activity indicator used is private consumption, whilst GDP is used for the commercial sector.

Projections modelling - Agriculture

In agriculture, future GHG emission trends may be influenced both by measures taken to address emissions directly or measures that indirectly contribute towards decreasing emissions, and by inherent trends in activity in the sector.

The model being used to produce the projections reported in this PAMs and Projections Report has been developed in 2018, and has been verified by experts from ICF and Aether as part of capacity-building projects undertaken by the MRA. The model, which covers projections of GHG emissions over a period spanning from 2016 – 2030, based on historic data from 1990 – 2015, has been quality controlled to ensure compliance with the IPCC's TCCAA principles. The model currently caters for 2 scenarios, the Business as Usual' (BAU) and a 'With Existing Measures' (WEM) scenario, which currently includes one measure. The BAU scenario employs solely a 3-year moving average of the activity data being used in the compilation of the agriculture GHG inventory on historical values (i.e. 1990 – 2015); i.e. population, milk production, land area and synthetic fertilizer application. The extrapolation is performed using a 3-year moving average of all livestock population categories.

The WEM scenario for the agriculture sector takes into consideration the Mechanical Biological Treatment Plant, which treats 35,000T and 4,000T of cattle and poultry manure respectively. These values were introduced into equations calculating the nitrogen excretion rates of cattle and sheep, which ultimately affect the emissions emanating from the management of manure. The projections of cattle and poultry manure treated, and manure remaining were calculated based on the projected BAU cattle and poultry populations and the projected N excretion. The N excretion is calculated by multiplying the default N_{rate} (given in the 2006 IPCC guidelines) by the weight of the animal/1000 * 365 days. Since animal weight and N_{rate} remain constant throughout the time period, there is no projection of the value.

The following description shows the method how emissions are estimated, integrating the measure of cattle and poultry manure treatment.

$$\textbf{Cattle manure produced} = \frac{\textbf{BAU Nexcretion}}{\textbf{N content in manure}}$$

The N content in cattle manure is taken as 0.0056, while 0.0207 is used for poultry as specified in the NAP schedule.
Cattle manure treated = 35,000,000 kg

Poultry manure treated = 4,000,000 kg

$$\boldsymbol{Manure\ remaining\ (kg) = Manure\ produced - Manure\ treated}$$

$$\boldsymbol{Manure\ remaining\ (kgN) = Manure\ Remaining\ (kg) * N\ content}$$

The percentage dairy cattle manure and other cattle manure is worked out from the total BAU cattle N excretion, to give DC manure % and OC manure %. The same is done for Layers and Broilers and Other Poultry.

$$\boldsymbol{MBT\ N\ excretion = Manure\ Remaining * Manure}\ \%$$

Emissions are then worked out according to 2006 IPCC Guidelines

$$\boldsymbol{Nvol = \frac{MBT\ N\ excretion * FracGasMS}{100}}$$

$Frac_{GasMS}$ DC = 30%, OC = 45%
$Frac_{GasMS}$ Layers = 55%, Broilers & Other Poultry = 40%

$$\boldsymbol{N\ lost\ as\ N_2O\ (kgN_2O) = cattle\ manure\ remaining * EF_3}$$

EF_3 Cattle = 0.005 kgN20-N
EF_3 Poultry = 0.001 kgN20-N

$$\boldsymbol{MBT\ Direct\ N_2O\ emissions = \left(\frac{N\ lost\ as\ N_2O * \left(\frac{44}{28}\right)}{10^6}\right) * 298}$$

$$\boldsymbol{MBT\ Indirect\ N_2O\ emissions = NvolTotal * EF4 * \frac{\frac{44}{28}}{10^6}}$$

EF_4 Cattle = 0.01 kgN20-N
EF_4 Poultry = 0.01 kgN20-N

Moreover, four sensitivity scenarios were tested where cattle, swine and poultry populations are reduced by 5% and rabbit population by 20%.

Projections modelling - Land Use, Land-use Change and Forestry

The LULUCF model was developed to construct various scenario-based projections, to analyse the variations between the projected emissions within the sector. The projections were developed based on scenarios, which involve hypothetical measures, since currently no major measures are in place on a national scale that could affect the sequestration rates from the land-uses.

A series of scenarios were analysed based on the historic data from the base year period beginning 1990. The historic data was acquired from the data presented in the LULUCF sector of the GHG Inventory report. The Baseline scenarios were acquired by utilising the least square function based on the historic data. These include a LINEST function based on a 5-year moving average, a baseline moving average which begins from the base period of the 1990 data, and one starting from the latest reported emission value which

practically leads to a straight-line projection through all the years. The WEM scenario was created to analyse a hypothetical measure, since none are currently in place. The scenario assumed an increase in the Cropland category which is coming from the Grassland category, as a result an increasing Cropland area, whereas decreasing Grassland area. The measure impacts assumed a 95% to 75% varying change. The sensitivity analysis was carried out as a result of the uncertainty analysis, which was analysed on all the LULUCF categories using past inventories and acquiring a maximum and minimum percentage rates. These percentages were used to construct the percentage change in the sensitivity analysis for the land use remaining and land use changes areas. Figure 25 shows the results for the various scenarios used and analysed in the LULUCF model.

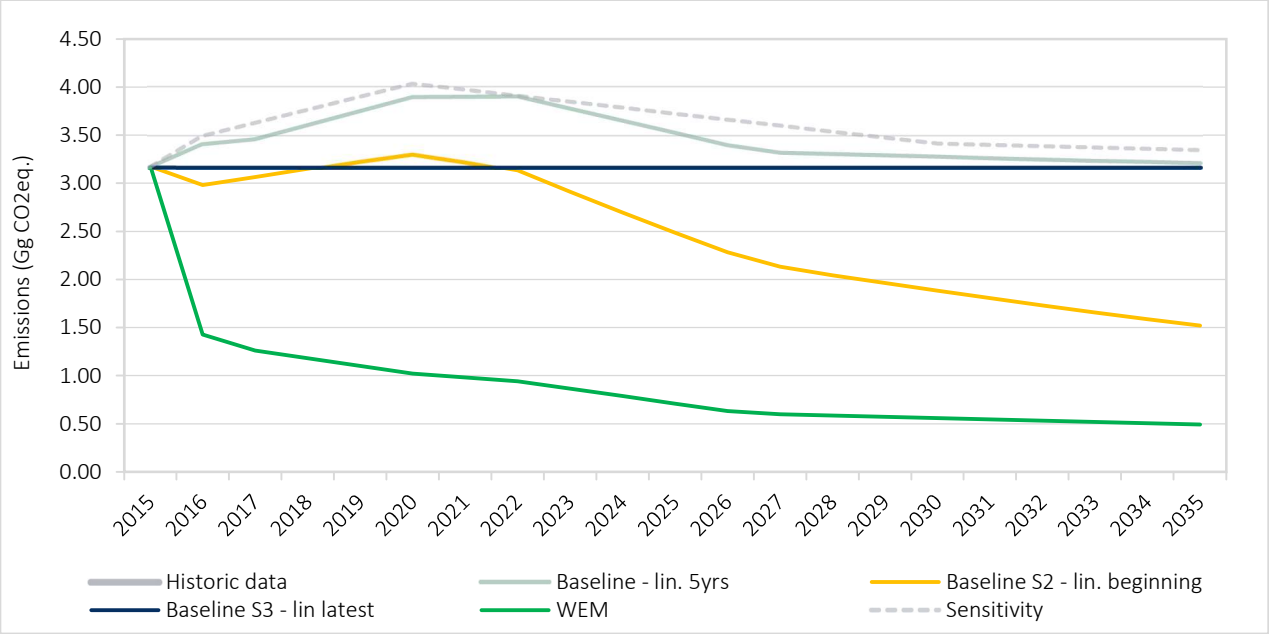

Figure 25 Sector LULUCF model results

(adapted from LULUCF emissions projections model data by Malta Resources Authority).

The growth in the level of sequestration of carbon in the LULUCF sector is not expected to be major, with minimum variations between the different scenarios presented.

Currently there are ongoing updates in the LULUCF sector projections, whereby a model incorporating calculations in removals from the Forest Land category is being developed. This is a result of the preparation of Malta's National Forestry Accounting Plan (NFAP) under the EU's LULUCF Regulation. New data on Forest Land has been acquired to facilitate the compilation of the NFAP report. The NFAP was prepared with expert assistance provided under the European Commission project 'Capacity building activities related to the establishment of Forest Reference Levels (FRLs) and improved inventories. The information pertaining to the Forest Land model and NFAP model will eventually be included as part of the overall LULUCF projections model.

The Forest Land projections model is being developed through the assistance provided from the ICF as well. This model is largely based on the NFAP model, since similar

parameters and forest areas considered for the NFAP are being utilised for the Forest Land category. Updated projections should be available for reporting in future submissions.

Projections modelling - Waste

The projection of waste generation is based on the relation between a relevant driver trend between 2013 and 2016, and the actual trend in waste generation 2013-2016. This relation is represented by a constant which is multiplied by the projected macroeconomic driver to result in a projected waste generation for that particular year. This exercise has been repeated for all waste streams as published in the National Statistics Office waste statistics, with each waste stream associated with a specific relevant driver[46].

Following the completion of a waste generation scenario, each waste stream was portioned into the different waste treatment options based on the reference or policy scenario. In the reference scenario, the capacity of existing options is respected, with the remainder being directed to landfilling. In both scenarios, it is assumed that landfilling space will not run out at any moment and that capacity of present plants will be retained all along the period. This means that if any plant included in the reference ceases to

[46]

EWC-Stat code	Description	Selected Driver
1.1	Spent solvents	Gross Domestic Product
1.3	Used oils	Gross Domestic Product
1.4, 2, 3.1	Chemical wastes	Gross Domestic Product
1.4, 2, 3.1	Chemical wastes	Gross Domestic Product
3.2	Industrial effluent sludges	Gross Domestic Product
3.2	Industrial effluent sludges	Gross Domestic Product
3.3	Sludges & liquid wastes from waste treatment*	Population
5	Health care and biological wastes	Population
5	Health care and biological wastes	Population
7.2	Paper and cardboard wastes	Disposable Income
7.3	Rubber wastes	Gross Domestic Product
7.4	Plastic wastes	Gross Domestic Product
7.5	Wood wastes	Gross Domestic Product
7.6	Textile wastes	Disposable Income
8 (excl. 8.1, 8.41)	Discarded equipment	Disposable Income
8 (excl. 8.1, 8.41)	Discarded equipment	Gross Domestic Product
8.1	Discarded vehicles	Disposable Income
8.41	Batteries and accumulators waste	Gross Domestic Product
8.41	Batteries and accumulators waste	Gross Domestic Product
9.1	Animal and mixed food waste	Population
9.2	Vegetal wastes	Population
9.3	Animal faeces, urine and manure	Gross Domestic Product
10.1	Household and similar wastes	Disposable Income
10.2	Mixed and undifferentiated materials	Population
10.2	Mixed and undifferentiated materials	Population
10.3	Sorting residues*	Gross Domestic Product
11	Common sludges	Gross Domestic Product
12.1	Mineral waste from construction & demolition	Gross Domestic Product
12.1	Mineral waste from construction & demolition	Gross Domestic Product
12.2, 12.3, 12.5	Other mineral wastes	Gross Domestic Product
12.2, 12.3, 12.5	Other mineral wastes	Gross Domestic Product
12.4	Combustion wastes	Gross Domestic Product
12.4	Combustion wastes	Gross Domestic Product
12.7	Dredging spoils	Gross Domestic Product
12.8, 13	Mineral waste from waste treatment & stabilised waste*	Gross Domestic Product
12.8, 13	Mineral waste from waste treatment & stabilised waste*	Gross Domestic Product

operate in the timeframe of the projection, a similar plant in terms of technology and capacity will replace it immediately. The difference between the reference and policy scenarios, is due to shifting of waste streams from one option (e.g. landfilling) to another option higher in the waste hierarchy (e.g. waste to energy, biodigestion or recycling). To date, the model does not account for behavioural changes that induce quantitative waste generation changes, thus waste avoidance is not accounted for at this stage. This is mainly due to the low confidence and inability to model behavioural change induced by measures included both in the reference and policy scenario.

The waste sector will see a relevant decrease in the waste going to landfill, especially for municipal wastes which will be diverted to either biological treatment or incineration. The advent of the incineration of municipal waste will appear as a net increase in emissions for the year of application, with a gradual but constant decrease in emissions from landfilling becoming more accentuated in the later period. This trade off comes due to the obligation on Malta to address other targets in the waste sector, and land space issues caused by ever expanding landfill sites.

The below charts illustrate the waste distribution for the landfilling (Figure 26), incineration (Figure 27) and biological treatment (Figure 28) waste treatment options.

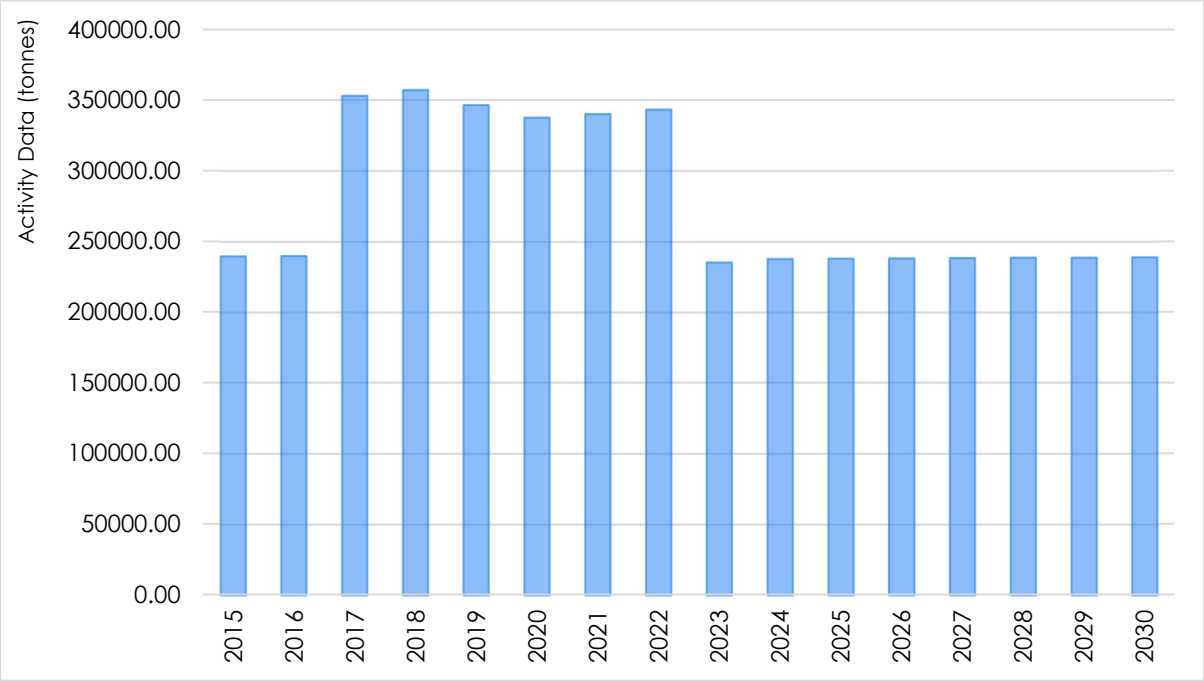

Figure 26 Landfilling profile under the policy scenario between 2015 and 2030.

(source: adapted from data provided by the Ministry for the Environment, Sustainable Development and Climate Change).

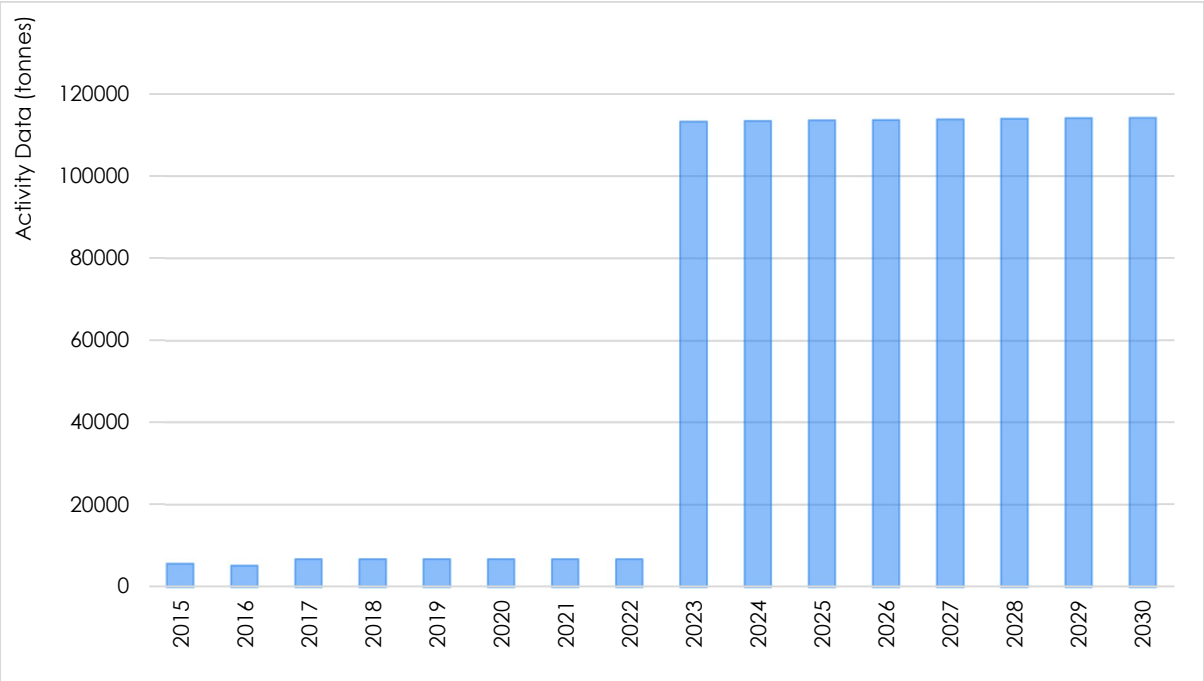

Figure 27 Incineration profile projections under the policy scenario between 2015 and 2030.

(source: adapted from data provided by the Ministry for the Environment, Sustainable Development and Climate Change).

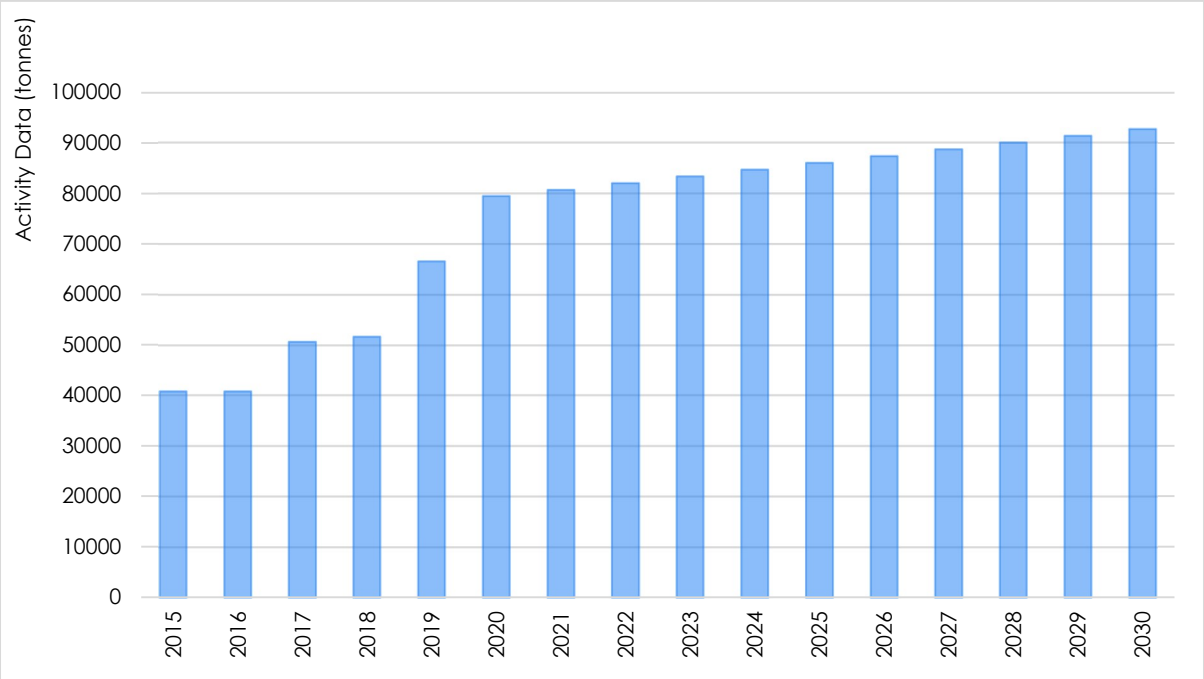

Figure 28 Biological treatment under the policy scenario between 2015 and 2030.

(source: adapted from data provided by the Ministry for the Environment, Sustainable Development and Climate Change).

Following this distribution, the waste quantities are converted into emissions through emission estimation methodologies based on the IPCC 2006 guidelines (Figure 29).

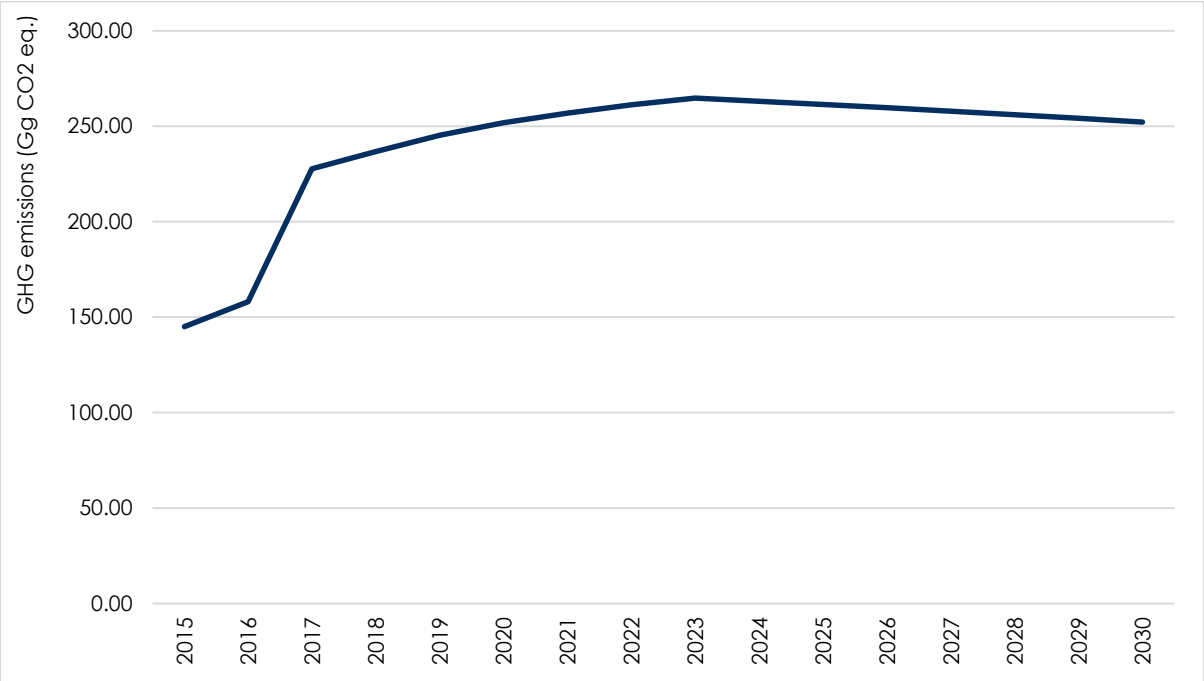

Figure 29 Emission projections in the sector Waste for the with existing measures scenario up to 2030.

(adapted from Waste emissions projections data by Malta Resources Authority).

At present, projections of emissions from wastewater management are not being carried out. Future capacity building in the field of greenhouse gas emissions projections will hopefully contribute towards closing this lacuna so as to ensure a truly comprehensive coverage.

ASSESSMENT OF THE IMPACT OF THE POLICIES AND MEASURES

This section provides a detailed analysis of the impact of the policies and measures in reducing GHG emissions over a time period covering 2017 - 2030. A comparative exercise is undertaken between the BAU and WEM scenario for each sector. Subsequently, a comparison at a more aggregated level is carried out, whereby the total projected emissions of the ESD and ETS sectors are compared for the WEM and BAU scenario, respectively.

Efforts continue to update projections of all relevant sectors, in order to better reflect the local policy framework and associated actions, with an emphasis on those sectors with a particularly significant impact on overall projected emission trends. These include changes in policy direction, changes in the econometric estimation of a sector, the provision of new data and timing in the collection or revisions in the various data streams. This implies that whenever there is a significant update, the probability is that there will be significant movements (either upwards or downwards, as the case may be) in the results as compared to a previous projection. This issue is further compounded by the small-scale numbers inherent in Malta's absolute emissions: a small change in a large contributing sector would have a disproportionate impact on the total emissions. It is pertinent to note that the projections presented hereunder reflect those measures that have been reported by the entity responsible for their implementation and which could be quantified in terms of emissions reductions in tonnes of CO_2 equivalent. Hence, those measures that have not been reported or which are inherently unquantifiable, are excluded from the projections. As previously stated, efforts are ongoing to include all those measures that have a quantifiable impact on national GHG emissions.

Projections analysis - Energy

The energy sector includes emissions from fuel combustion activities, namely public electricity and heat production, fuel combustion in manufacturing industries and construction, commercial and institutional, residential, agriculture, forestry and fisheries, and transport. Emissions from the energy sector are estimated to increase. The change between the BAU and with existing measures scenario is minimal: the fact is that the measures taken into account in the BAU scenario are already close to the maximum emission reduction effort possible in this sector, and currently there is little additional emission reduction potential identified.

Table 8 Projected GHG emissions for sector Energy, by category

	WEM GHG emissions (Gg CO_2eq.)			
	2015	**2020**	**2025**	**2030**
Energy Industries Total	892.46	961.77	1023.64	1076.40
Transport Total	661.32	657.70	668.15	622.10
Industry Total	30.22	80.19	74.60	110.18
Other: Commercial + Residential + Agriculture	177.48	166.61	189.86	215.78
Other: Military Total	4.20	5.01	6.37	8.53
ENERGY TOTAL	**1765.44**	**1871.27**	**1962.63**	**2032.98**

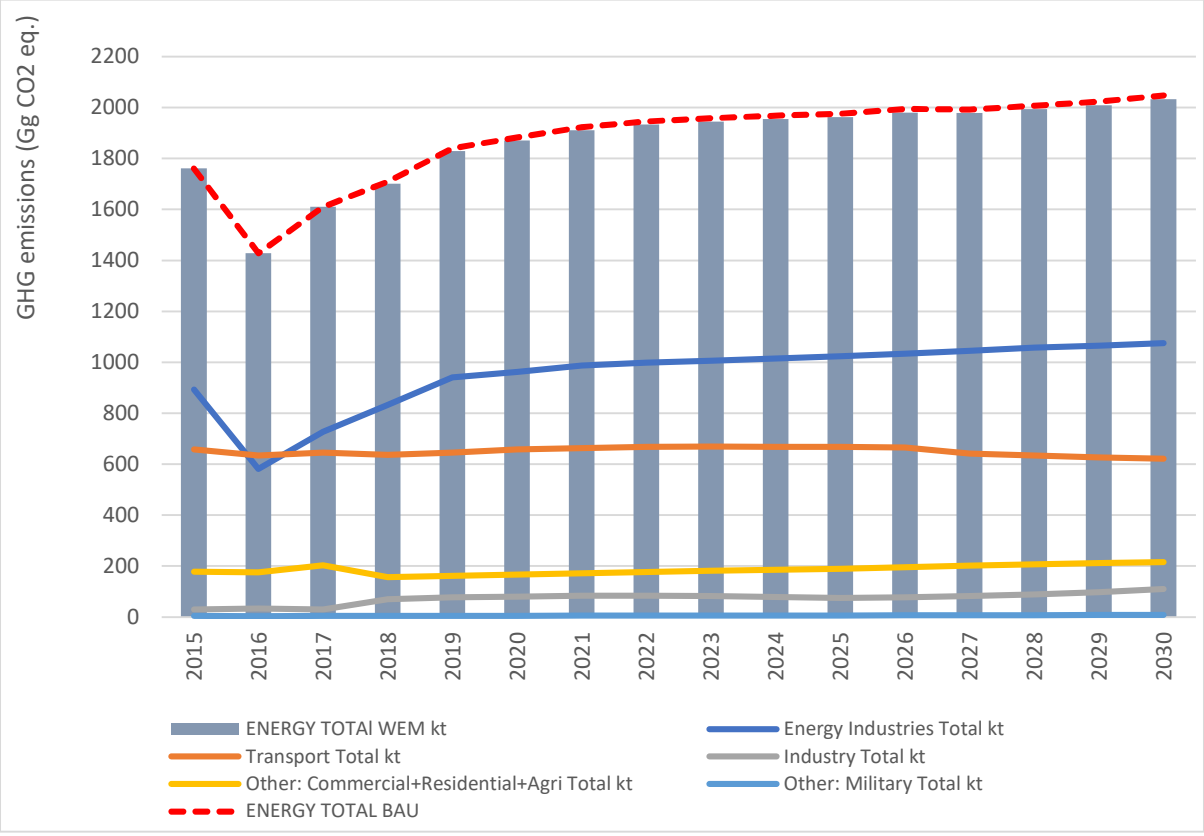

Figure 30 Projections of GHG emissions for sector Energy

(adapted from Energy emissions projections model data by the Energy & Water Agency).

Projections analysis - Industrial Processes and Product Use

The main measure that is expected to curb emissions from this sector is the implementation of the F-gas Regulation. This is expected to have a considerable positive influence on the manner and the extent to which fluorinated gases are used in the future. However, the effect of this measure has not been defined as yet. This is the subject of ongoing work in order to determine whether, and if so, to what extent, this measure will translate into tangible emissions reduction compared to a BAU situation. Consequently, in the 2019 submission of this report, the BAU scenario and the WEM scenario are identical.

Table 9 Projected GHG emissions for sector IPPU

			WEM GHG emissions (Gg CO_2eq.)	
IPPU	**2015**	**2020**	**2025**	**2030**
	247.77	240.18	276.85	315.55

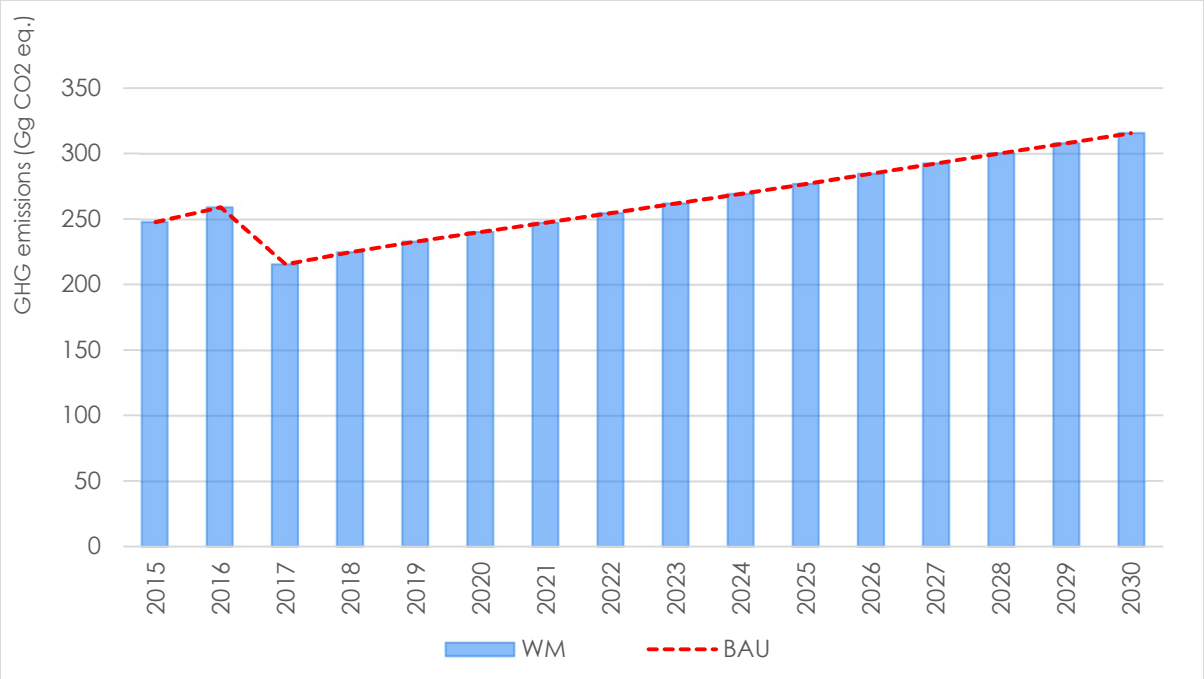

Figure 31 Projections of GHG emissions for sector IPPU

(adapted from IPPU emissions projections model data by Malta Resources Authority).

Projections analysis - Agriculture

Apart from the impact policies and measures may have on the agriculture sector, trends arising from the activities within the sector should also be kept in mind. For instance, changes in the amount of land being cultivated may have an impact. Water scarcity could compound such a trend. In animal husbandry, the sector has had to restructure to conform with EU legislation applying to animal welfare, food safety, veterinary and waste management, thus reducing the extent to which this activity is practiced, naturally leading to reductions in emissions, or forcing the implementation of practices that inherently reduce emissions.

Though only one measure is included in the agriculture model in this report, there are other policies and measures which could have a large impact on emission projections and lower them substantially. This stresses the importance of data availability within the sector, and the importance of making available the impact of such measures, in numerical terms, so that they can be included in the model. If more measures could be quantified, the projected emissions from the agriculture sector would be even lower, showing that Malta's effort in decreasing emissions from the agriculture sector are ongoing.

The measure that is expected to effect emissions in the WEM scenario is the treatment of manure in the Malta North MBT, processing cattle and poultry manure. For the evaluation of this measure it is assumed that emissions due to that manure which is treated in the MBT are prevented.

Four sensitivity scenarios were tested, where the populations of cattle, swine and poultry were reduced by 5% and rabbit population by 20%. In all scenarios, emissions decreased. A decrease of 5% in cattle population resulted in a reduction of 8% in overall emissions compared to the 2030 BAU scenario, whereas a 20% reduction in rabbit population decreased overall emissions by 3%. Moreover, a 5% reduction in swine and poultry populations resulted in an overall decrease of 2.86 $ktCO_2eq$ and 3.41 $ktCO_2eq$ respectively by 2030, compared to 2015 levels.

Table 10 Projected GHG emissions for sector Agriculture

			WM GHG emissions (Gg $CO_2eq.$)	
Agriculture	**2015**	**2020**	**2025**	**2030**
	65.84	62.14	62.52	63.01

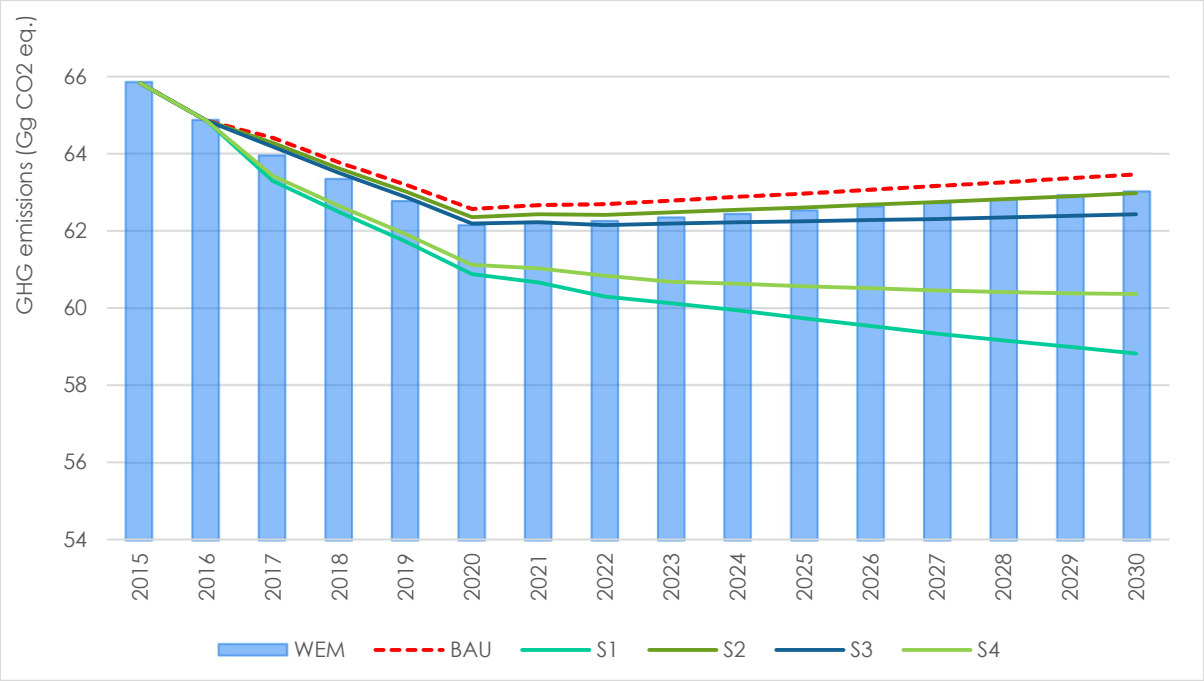

Figure 32 Projections of GHG emissions for sector Agriculture

(adapted from Agriculture emissions projections model data by Malta Resources Authority).

Projections analysis - Land Use, Land Use Change and Forestry

The impact from the carbon sequestration in the LULUCF sector is not expected to be major, with minimum variations between the different scenarios. At present, no actions are taking place nationally on a large enough scale to affect the projected emissions.

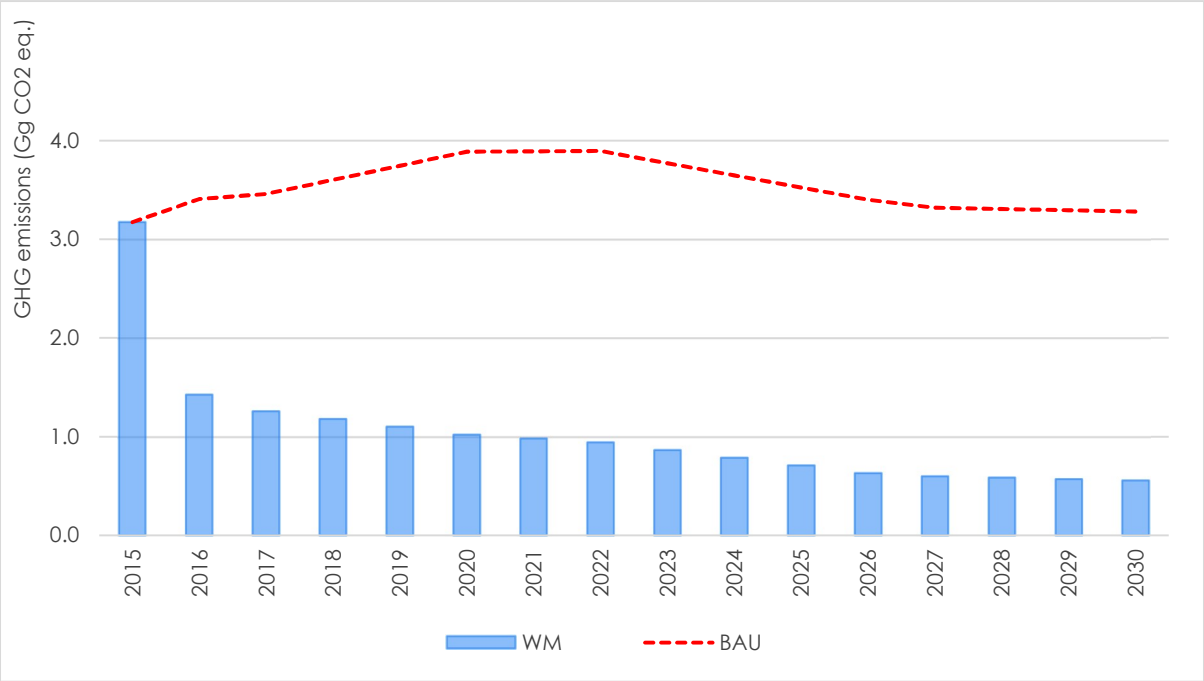

Figure 33 Projections of GHG emissions for sector LULUCF.

(adapted from LULUCF emissions projections model data by Malta Resources Authority).

Table 11 Projected GHG emissions for sector LULUCF

			WM GHG emissions (Gg CO_2eq.)	
LULUCF	**2015**	**2020**	**2025**	**2030**
	3.18	1.02	0.71	0.56

Projections analysis - Waste

The categories within the waste sector which are relevant for projections presented in this report include landfilling, incineration and biological treatment (projections of wastewater emissions are currently not being carried out).

Projected landfill emissions are expected to decrease whereas the projected incineration and biological treatment emissions will increase. However, the increase in categories is expected as from year 2023 onwards waste will be diverted into the Waste-to-Energy (WtE) facility. Moreover, treating waste in the biodigester, Anaerobic Digestion (AD), is considered to be more beneficial.

Table 12 Projected GHG emissions for sector Waste

	'With Existing Measures' scenario GHG emissions (Gg CO_2eq.)			
	2015	**2020**	**2025**	**2030**
Landfilling	136.47	239.78	249.14	239.67
Incineration	0.81	10.53	10.61	10.67
Biological Treatment	0.81	1.59	1.72	1.85
WASTE TOTAL	**145.11***	**251.90**	**261.46**	**252.19**

***including emissions also from wastewater**

The projections of emissions from the waste sector have been based on the model described in the previous section. It also builds upon a 'decomposition' model which 'assigns' the expected waste generation to waste treatment plants, incinerator and landfilling, respectively according to their capacity. A number of assumptions have been taken into consideration, including the following:

- The trend in MSW/Capita and Industrial Waste/GDP are maintained throughout the projected time;
- MSW composition values (%) for landfilling have been updated;
- Landfilling amounts do not take into consideration whether the specific active landfill is exhausted or not. It is assumed that all future landfills are managed to the same standard as the landfill currently in use;
- All methane generated from biological treatment of waste is flared and all resulting emissions are considered biogenic.

The projected emissions from the waste sector presented in this report take into account measures relating to solid waste. It is projected that the biggest saving will be due to saved methane emissions from landfills.

As the below figure displays, the projected waste emissions (Gg CO_2 eq.) for the With Existing Measures (WEM) scenario will decrease when compared with the Business as Usual (BAU) scenario (a decrease of 10.23% in year 2030).

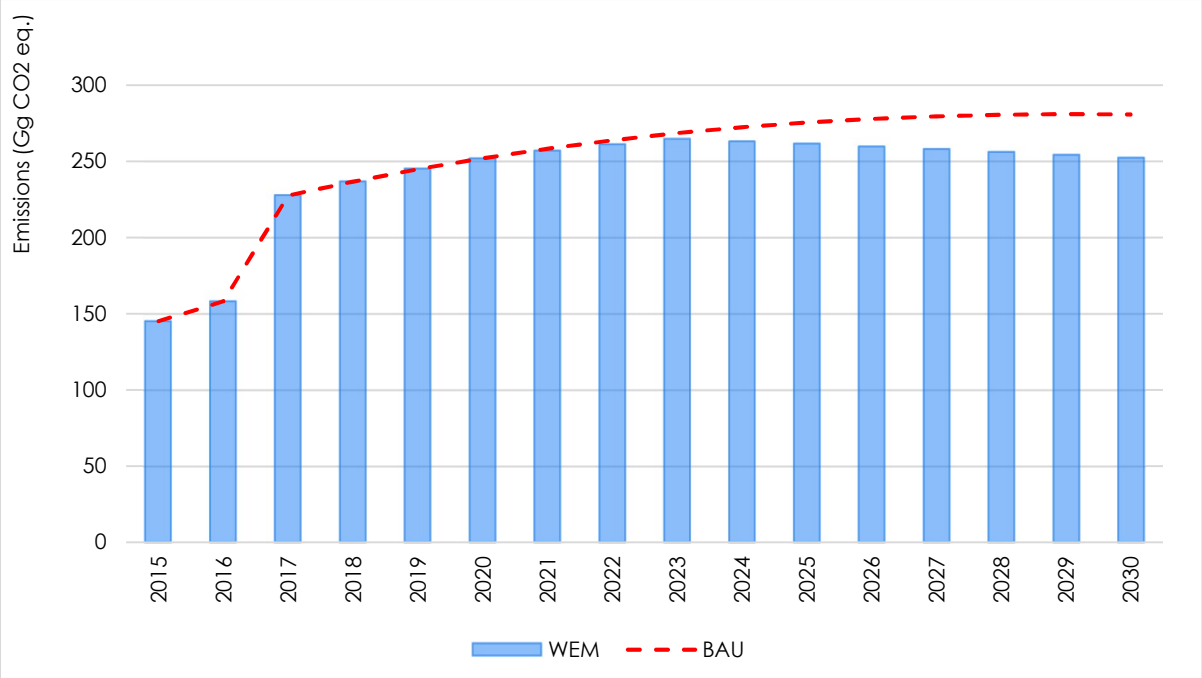

Figure 34 Projections of GHG emissions for sector Waste

(adapted from Waste emissions projections model data by Malta Resources Authority).

Assessment of overall impact of the Policies and Measures on GHG Emissions for Malta

Table 13 presents the emission projections split by sector and by gas for the years 2020, 2025 and 2030, for the WEM scenario. The aggregated effect of the policies and measures for the same scenario is illustrated in Figure 35. Figure 36 compares the projected emissions for the WEM and BAU scenarios.

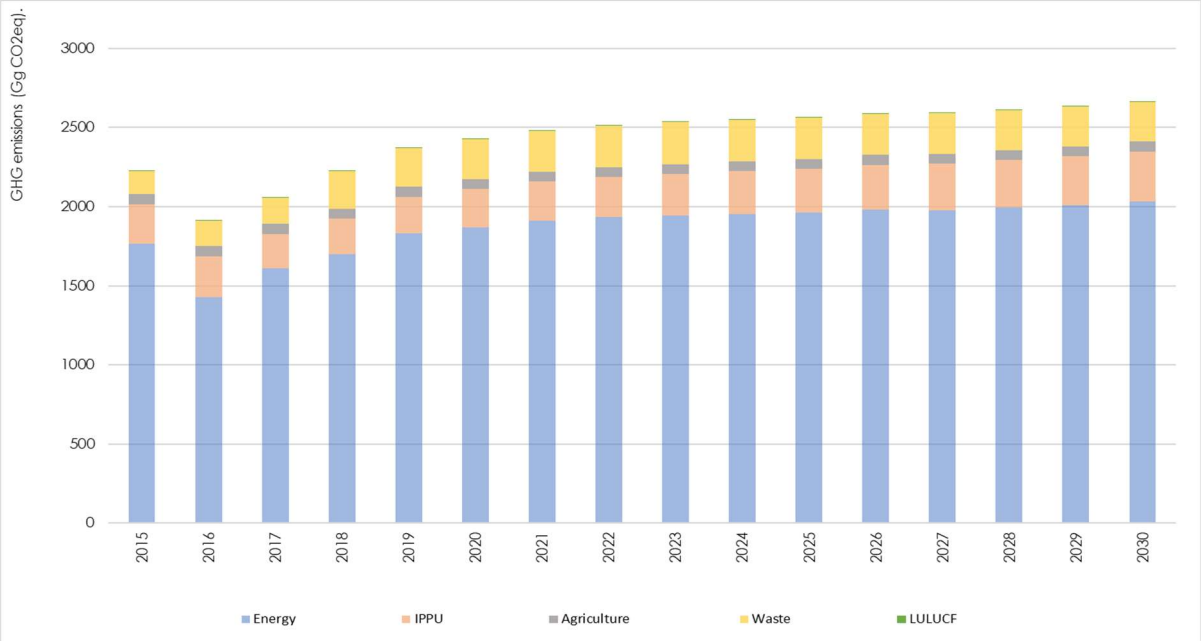

Figure 35 WEM emission projections by sector

(adapted from emissions projections data by Malta Resources Authority and Energy & Water Agency).

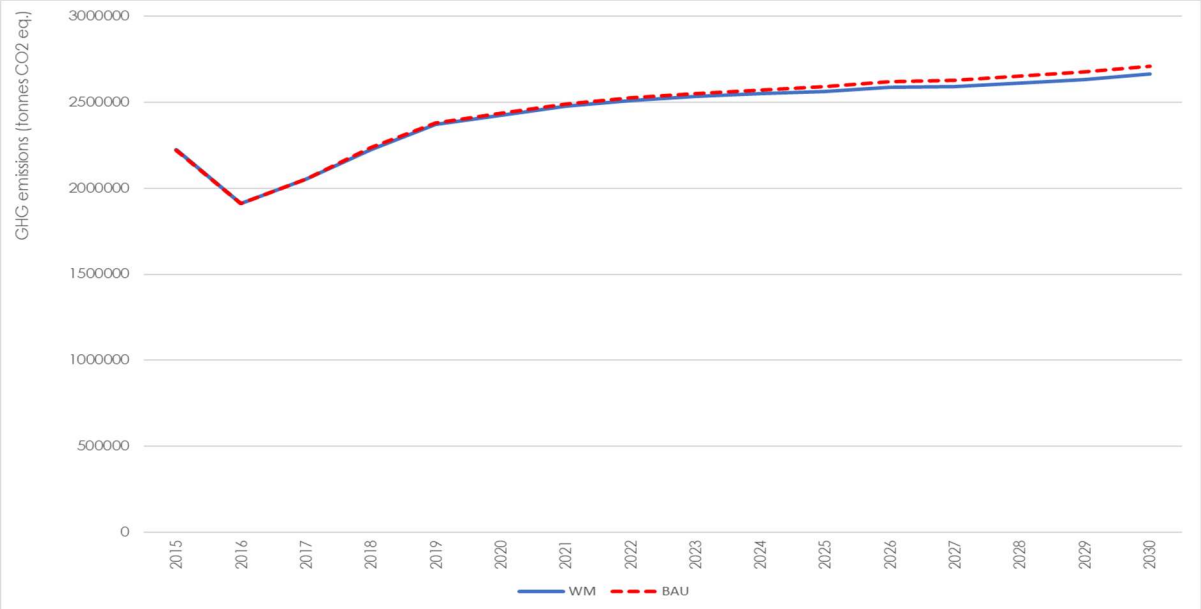

Figure 36 Comparison of projected emissions for the WEM and BAU scenarios

(adapted from emissions projections data by Malta Resources Authority and Energy & Water Agency).

Table 13 GHG emissions projections, by sector and by gas, for the WEM scenario

(NOTE: Total values may not always be equal to the sum of disaggregated values, due to rounding.)

WEM	Gg CO_2 eq.	2020	2025	2030
1. Energy	CO_2	1862.12	1953.05	2023.22
	CH_4	4.03	4.20	4.22
	N_2O	5.13	5.37	5.55
		1871.27	1962.63	2032.98
2. Industrial Processes and Product Use	HFC	240.18	276.85	315.55
		240.18	276.85	315.55
3. Agriculture	CH_4	33.16	33.32	33.53
	N_2O	29.98	29.20	29.48
		62.14	62.52	63.01
5. Waste	CO_2	10.33	10.40	10.46
	CH_4	241.37	250.85	241.52
	N_2O	0.20	0.20	0.20
		251.90	261.46	252.19
4. LULUCF	CO_2	1.02	0.71	0.56
		1.02	0.71	0.56
TOTAL	Total with LULUCF	2426.46	2564.17	2664.28
	Total without LULUCF	2425.43	2563.46	2663.72

The very minimal difference between the WEM and BAU scenarios clearly shows that the emission reduction potential of the existing package of measures, at least those that Malta has been able to quantify, is limited and has been practically exhausted. New actions to reduce greenhouse gas emissions are needed over and above existing ones, while further capacity building is required to improve the emissions projections capability of the country: this will be crucial in order to better inform policy-making across all sectors.

It is very probable that significant additional reductions in emissions will require action in two sectors mainly, sector Energy and sector IPPU. The Energy Industries category may have little additional potential to reduce emissions, though this is not to say that efforts should not continue, especially on the side of energy demand management, and further diversification of the sourcing of energy, including through greater uptake of renewables and additional sourcing of electricity from the European grid, subject to economic viability. Transport on the other hand, particularly road transport, may offer the potential for substantial reductions. The impact of the transition to lower GWP HFCs through the

provisions of the EU's F-gases Regulation remains to be assessed in greater depth: indeed, here there may also be substantial emission reduction potential to tap into in future.

This is not to say that the other sectors don't have anything more to contribute. Indeed, there may be scope for additional emissions reduction effort in the Waste sector, building on the actions already in place to better manage waste generation and treatment in Malta. The LULUCF sector, which currently represents net emissions could, with more effort, at least reach a net zero emission state, or even transition to net removals, though one must acknowledge that the limitations of space in Malta for major afforestation projects are not easy to surmount.

MEETING THE NATIONAL GREENHOUSE GAS EMISSIONS REDUCTION COMMITMENTS

As already observed earlier in this report (refer to Chapter 2), the Energy Industries category has experienced important reductions in emissions since 2012. The bulk of greenhouse gas emissions for this category (carbon dioxide) fall within the scope of the EU Emissions Trading System. This system does not set definite emission limitation or reduction targets on the participating entities; however, the design of the system is aimed towards incentivizing general emission reductions from the industrial establishments concerned. It is not easy to determine to what extent the EU ETS itself has been the cause of the emission reductions observed in the local electricity generation sector. It is more probable that other actions, such as investment in new and more efficient generating capacity, fuel switching, the inclusion of the interconnector in the local energy mix and efforts to increase energy generation from renewable sources may be considered as having driven the observed emission reductions, independent of the EU ETS. The latter however will certainly become an even more important element of decision-making in the energy generation industry as carbon prices are expected to continue to increase in future.

Emissions from activities not covered by the EU ETS are evaluated against the targets applicable for Malta under the Effort Sharing Decision (ESD). The Decision sets a target for Malta limiting emissions to a level not higher than 5% over 2005 levels, by 2020. Furthermore, the Decision establishes a trajectory of interim targets for the years up to 2020, in accordance with the rule that "*each Member State with a positive limit under Annex II* [to the Effort-Sharing Decision] *shall ensure* [...] *that its greenhouse gas emissions in 2013 do not exceed a level defined by a linear trajectory, starting in 2009 on its average annual greenhouse gas emissions during 2008, 2009 and 2010,* [...] *ending in 2020 on the limit for that Member State as specified in Annex II*".

As shown in Figure 37, Malta has not been able to limit its ESD emissions to the interim targets to-date and it is projected that this situation will remain at least until 2020. Total ESD emissions are higher than the trajectory targets for all the years. Yet, Malta remains fully compliant with the requirements of the ESD by acquiring annual emission allowances to account for the exceedances each year.

It is pertinent to note that the country's emissions trajectory is dependent on a number of factors that highlight the particular situation inherent in small countries when considering emission mitigation policies and measures, such as that a single emission source or, the non-implementation of a particular measure, can have a significant impact on the country's emissions with a concomitant impact on its ability to meet quantified obligations This is not necessarily the case in larger countries.

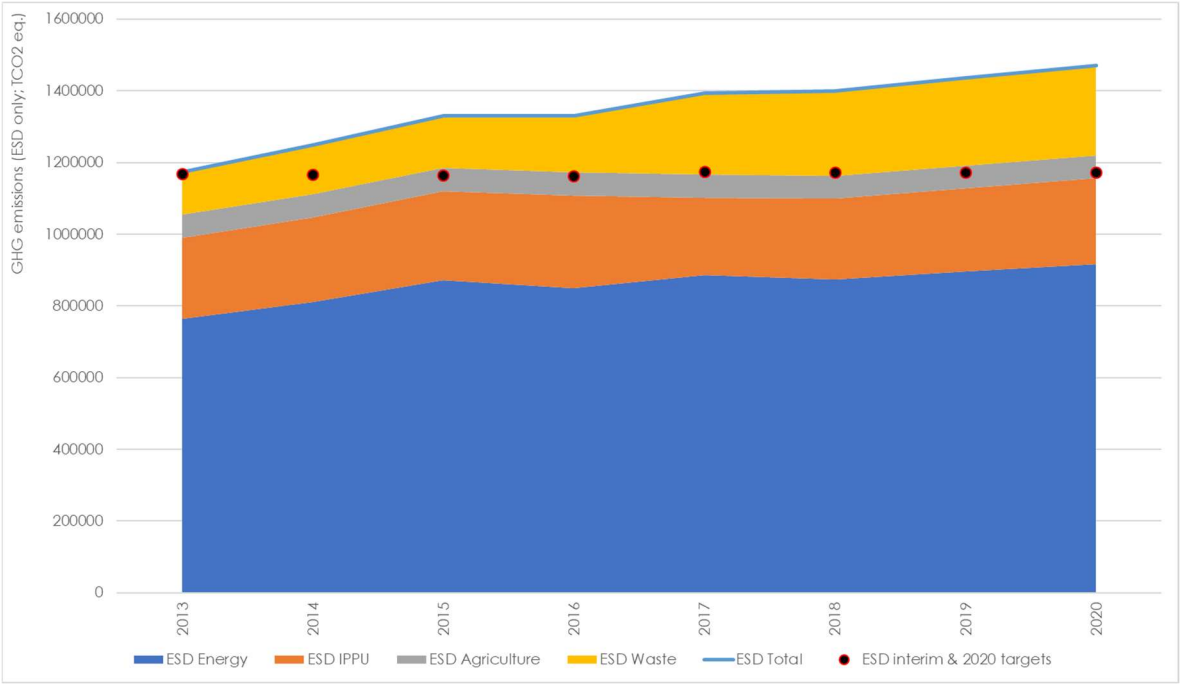

Figure 37 Projections of WEM emissions covered by the Effort Sharing Decision, compared to the interim and 2020 targets applicable to Malta under the Decision.

Moreover, it is recognised that the availability of better activity data and closer monitoring of implemented measures will play a key role in determining the accuracy of projections. Malta acknowledges that there is still effort to be made to develop its capacity in the area of emissions projections, and the capacity building projects that it has, is, and continues to participate in will not only ensure better representation of future emission trends, but, even more crucially, will further improve the technical information available for appropriate policy-making.

The gap to the 2020 ESD target and the annual targets for the years 2016 to 2019 is quantified in Table 14. The gap is calculated as the difference of the projected emissions from the ESD annual target.

Table 14 Projected gap to ESD 2020 target and 2016-2019 interim targets

	2016	2017	2018	2019	2020
Gap (Gg CO_2 eq.)	-167.50	-219.10	-225.46	-263.96	-299.36

INTERNATIONAL BUNKERS

International aviation and maritime bunkering activities related to Malta are important sources of greenhouse gas emissions. As explained earlier, emissions from civil aviation activities are, to a large extent, subject to the requirements of the EU Emissions Trading System for aviation activities; as most aviation activities taking place to and from Malta are international in nature, these will also be subject to the ICAO's CORSIA as of the near future. Efforts to reduce emissions from aviation are highly dependent on technological (e.g. aircraft and engine design; alternative fuels) and air traffic management measures. It is difficult to imagine alternative transport modes for the carriage of passengers, mail and certain types of goods that would meet the expectations of Malta's citizens, tourists and economy in general.

Though not yet subject to specific and binding emission limitation or reduction targets (except in the case of national navigation), emissions from the maritime sector are currently subject to the Shipping MRV Regulation of the European Union and, in the near future, to a global MRV system established by the IMO. Like the case of aviation, an adequate alternative to shipping for the transport of goods to and from Malta is not easy to envisage for an island economy. Technological and operational measures taken by operators of ships probably offer the best potential for emission limitation or reduction in this sector.

Chapter 6: Provision of Financial, Technological and Capacity-building Support to Developing Country Parties

The UNFCCC, in Article 4, requests that developed country Parties listed in Annex II to the Convention provide financial resources to meet the costs incurred by developing country Parties in complying with their commitments under the UNFCCC, to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation, and to promote, facilitate and finance the transfer of and access to environmentally sound technologies and expertise to other Parties, especially supporting the development of endogenous capacity and technologies of developing country Parties.

Malta is not inscribed in Annex II to the Convention. Notwithstanding, it still provides support to developing countries in the sphere of mitigation and adaptation actions and capacity building. Since 2013, Malta has provided financial support for climate action totalling €726,694, through both bilateral and multilateral funding channels (Table 15).

Table 15 Financial support provided by Malta for years 2013 to 2018

(source: annual reporting by Malta pursuant to Article 16 of Regulation (EU) No 525/2013)

	Bilateral/regional funding channels	Multilateral funding channels
	Euros	
2013	29,637	N/A
2014	30,725	50,000
2015	105,953	54,410
2016	96,704	100,000
2017	69,265	90,000
2018	N/A	100,000

Other Reporting Matters

There is currently no further information to report.

Glossary

AEA	Annual Emission Allocation
AR4	Fourth Assessment Report
ARMS	Automated Revenue Management Services
AVR	Accreditation and Verification Regulation
BAU	Business as Usual
BEV	Battery Electric Vehicle
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CEF	Connecting Europe Facility
CER	Certified Emission Reduction
CH_4	Methane
CHP	Combined Heat and Power
CO_2	Carbon dioxide
CVA	Controlled Vehicular Access
DOC	Degradable Organic Carbon
DPS	Delimara Power Station
EAFRD	European Agricultural Fund for Rural Development
EED	Energy Efficiency Directive
EPRDM	Energy Performance Rating for Dwellings in Malta
ERDF	European Regional Development Fund
ERU	Emission Reduction Unit
ESD	Effort Sharing Decision
ETBE	Ethyl Tert-butyl Ether
ETS	Emission Trading Scheme
EUA	European Union Allowance
EUTL	European Union Transaction Log
FSRU	Floating Storage and Regasification Unit
GDP	Gross Domestic Product
GHG	Greenhouse gas
Gg	Gigagramme
GIS	Geographic Information System
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
IC	Interconnector

ICT	Information and Communication Technology
IMSAC	Inter-Ministerial Steering Action Committee
IPPU	Industrial Processes and Product Use
ITMS	Intelligent Traffic Management System
ITS	Intelligent Transport System
JI	Joint Implementation
kWh	kilowatt hour
kWp	kilowatt peak
LCPD	Large Combustion Plants Directive
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
MBT	Mechanical Biological Treatment Plant
MEPA	Malta Environment and Planning Authority
MMR	Monitoring Mechanism Regulation
MPS	Marsa Power Station
MRA	Malta Resources Authority
MRV	Monitoring, Reporting, and Verification
MS	Member State
MESDC	Ministry for the Environment, Sustainable Development and Climate Change (formerly MSDEC)
MEW	Ministry for Energy and Water
MSW	Municipal Solid Waste
MTIP	Ministry for Transport, Infrastructure and Capital Projects
MWh	Megawatt hour
N_2O	Nitrous oxide
NAP	Nitrates Action Plan
NAU	Nitrates Action Unit
NECP	National Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NG	Natural Gas
NGO	Non-government Organisation
NREAP	National Renewable Energy Action Plan
NSO	National Statistics Office
PAM	Policy and Measure
PCI	Project of Common Interest

PFC	Perfluorocarbon
PM	Particulate matter
PV	Photovoltaic
RO	Reverse Osmosis
RDP	Rural Development Programme
SF_6	Sulphur hexafluoride
TEN-E	Trans-European Energy network
TEN-T	Trans-European Transport network
TJ	Terajoule
TM	Transport Malta
UTMC	Urban Traffic Management and Control
UWWTP	Urban Waste Water Treatment Plant
W2E	Waste to Energy
WAM	With additional measures
WEM	With existing measures
WOM	Without measures

APPENDIX 1: SUMMARY INFORMATION ON POLICIES AND MEASURES

Notes to tables:
Status 'Implemented' refers to mitigation actions that have either been implemented and concluded, or that are currently ongoing implementation.
More detailed information on the mitigation actions listed in this appendix may be found in CTF table 3.

Policies and measures in Energy (other than Transport)

Name of mitigation action	GHGs affected	Type of instrument	Status	Start year of implementation	Implementing entity
Submarine electrical connection to European electricity network	CO_2, CH_4, N_2O	Economic	Implemented	2015	Enemalta p.l.c.
Rebates on energy-efficient domestic appliances	CO_2, CH_4, N_2O	Economic	Implemented	2006	Government: Malta Resources Authority.
Distribution of energy saving lamps to households	CO_2, CH_4, N_2O	Economic	Implemented	2009	Government.
Promotion of Solar water heating	CO_2, CH_4, N_2O	Economic	Implemented	2006	Government: Regulator for Energy and Water Services.
Incentives for photovoltaic systems	CO_2, CH_4, N_2O	Economic	Implemented	2006	Government: Regulator for Energy and Water Services.
Grant on purchase of micro wind-turbines	CO_2, CH_4, N_2O	Economic	Implemented	2006	Government
Energy savings and renewables in state schools	CO_2, CH_4, N_2O	Economic	Implemented	2005	Government: Foundation for Tomorrow's Schools.
Energy saving measures in social housing	CO_2, CH_4, N_2O	Economic	Implemented	2004	Government: Housing Authority.
Energy efficiency action in the public sector	CO_2, CH_4, N_2O	Information	Implemented	2004	Government.
Energy saving measures in government owned industrial establishments	CO_2, CH_4, N_2O	Other (Planning)	Implemented	1995	Government: Water Services Corporation (for actions in reverse osmosis plants; Malta Shipyards (no longer existing; for actions in shipyards).
Support schemes for industry and commercial sectors	CO_2, CH_4, N_2O	Economic	Implemented	2009	Government.
Intelligent metering	CO_2, CH_4, N_2O	Information	Implemented	2009	Government: Enemalta plc.
Supply of natural gas for electricity generation.	CO_2, CH_4, N_2O	Economic	Implemented	2016	Government: Ministry for Energy and Water Conservation.
PV Grant Scheme	CO_2, CH_4, N_2O	Economic	Implemented	2014	Government: Energy and Water Agency (formerly Sustainable Energy and Water Conservation Unit (SEWCU))
PV Feed-in-Tariff Schee	CO_2, CH_4, N_2O	Economic	Implemented	2014	Government: Energy and Water Agency (formerly SEWCU)

PV: Communal PV Farms	CO_2, CH_4, N_2O	Economic	Implemented	2014	Government: Energy and Water Agency (formerly SEWCU)
Financial support schemes for Solar PV	CO_2, CH_4, N_2O	Economic	Planned	2021	Government; Energy and Water Agency; Regulator for Energy and Water Services.
Stakeholder engagement fo increased RES deployment.	CO_2, CH_4, N_2O	Voluntary Agreement	Planned	2021	Government: Energy and Water Agency.
Solar Water Heaters Scheme	CO_2, CH_4, N_2O	Economic	Planned	2021	Government: Regulator for Energy and Water Services.
Electricity tariffs	CO_2, CH_4, N_2O	Regulatory	Planned	2021	Government: Energy and Water Agency; Regulator for Energy and Water Services; Enemalta plc
Support scheme for services and industrial sectors	CO_2, CH_4, N_2O	Economic	Planned	2022	Government: Energy and Water Agency.
Energy Efficient Street Lighting	CO_2, CH_4, N_2O	Economic	Planned	2019	Government: Energy and Water Agency.
Projects in primary water infrastructure and wastewater treatment	CO_2, CH_4, N_2O	Economic	Planned	2021	Government: Water Services Corporation.
Gas Pipeline	CO_2, CH_4, N_2O	Economic	Planned	2024	Government: Ministry for Energy and Water Management.
Replacement of Appliances in Households Scheme	CO_2, CH_4, N_2O	Economic	Implemented		Government: Foundation for Welfare Services.
Development of R&I strategy for Energy and Water	CO_2, CH_4, N_2O	Research	Planned	2020	Government: Ministry for Energy and Water Management; Energy and Water Agency.

Policies and measures in Transport

Name of mitigation action	GHGs affected	Type of instrument	Status	Start year of implementation	Implementing entity
Biofuel substitution obligation.	CO_2	Regulatory	Implemented	2011	Government: Malta Resources Authority.
Introduction of autogas	CO_2	Regulatory	Implemented	2011	Government: Malta Resources Authority.
Uptake of electric vehicles	CO_2	Fiscal	Implemented	2011	Government: Transport Malta.
E-working and teleworking	CO_2	Voluntary Agreement	Implemented	2010	Government.
Modal shift to public transport and public transport reform.	CO_2	Voluntary Agreement	Implemented	2012	Government: Transport Malta.
Biofuel substitution obligation 2021-2030	CO_2	Regulatory	Planned	2021	Government: Regulator for Energy and Water Services.
Removing traffic bottlenecks - Marsa Road Project	CO_2	Other (Planning)	Adopted	2021	Government: Ministry for Transport, Infrastructure and Capital Projects
Removing traffic bottlenecks: Addolorata Junction	CO_2	Other (Planning)	Implemented	2017	Government: Ministry for Transport, Infrastructure and Capital Projects
Removing traffic bottlenecks: Kappara Junction	CO_2	Other (Planning)	Implemented	2016	Government: Ministry for Transport, Infrastructure and Capital Projects.
Road infrastructural works	CO_2	Other (Planning)	Planned	2019	Ministry for Transport, Infrastructure and Capital Projects
Public Transit Quality Corridors	CO_2	Other (Planning)	Implemented	2018	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta
Improving ferry landing places	CO_2	Other (Planning)	Implemented	2019	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
Cycling corridors	CO_2	Other (Planning)	Implemented	2019	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
Introduction of low-emission zone	CO_2	Regulatory	Planned	2020	Government: Ministry for Transport, Infrastructure and Capital Projects.
Introduction of electric buses in Gozo	CO_2	Economic	Planned	2019	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
Fast inter-island ferry service	CO_2	Other (Planning)	Planned	2020	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
Free public transport schemes	CO_2	Economic	Implemented	2018	Government: Ministry for Education and Employment.

Car-sharing scheme	CO_2	Voluntary Agreement	Implemented	2018	Government: Ministry for Transport, Infrastructure and Capital Projects
Last-mile delivery for Valletta	CO_2	Other (Planning)	Planned	2019	Government: Ministry for Transport, Infrastructure and Capital Projects
Sustainable Urban Mobility Plan for Valletta	CO_2	Other (Planning)	Planned	2019	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
National Bicycle Strategy	CO_2	Other (Planning)	Implemented	2018	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.
Intelligent transport systems	CO_2	Information	Planned	2020	Government: Ministry for Transport, Infrastructure and Capital Projects.
Smart parking system in Valletta	CO_2	Information	Planned	2020	Government: Ministry for Transport, Infrastructure and Capital Projects; Transport Malta.

Policies and measures in IPPU

Name of mitigation action	GHGs affected	Type of instrument	Status	Start year of implementation	Implementing entity
EU F-gases Regulation	HFCs	Regulatory, Education	Implemented	2012	Government: Malta Competition and Consumer Affairs Authority.
Competence of persons handling F-gases	HFCs, PFCs, SF_6	Regulatory	Implemented	2018	Government: Malta Competition and Consumer Affairs Authority.
Implementation of the F-gases quota system	HFCs	Regulatory	Planned	2019	Government: Malta Competition and Consumer Affairs Authority.
Effective monitoring of F-gases	HFCs, PFCs, SF_6	Regulatory	Implemented	2018	Government: Malta Competition and Consumer Affairs Authority
Labelling of products and equipment containing F-gases	HFCs, PFCs, SF_6	Regulatory	Implemented	2019	Government: Malta Competition and Consumer Affairs Authority.
Bans on F-gases	HFCs, PFCs	Regulatory	Planned	2019	Government: Malta Competition and Consumer Affairs Authority

Policies and measures in Agriculture

Name of mitigation action	GHGs affected	Type of instrument	Status	Start year of implementation	Implementing entity
Agriculture Waste Management in the Maltese Islands 2015-2030	CH_4, N_2O	Regulatory	Implemented	2015	Government: Ministry for the Environment, Sustainable Development and Climate Change.
Mechanical Biological Treatment Plant (Malta North)	CH_4, N_2O	Economic	Implemented	2016	Government: Wasteserv

Policies and measures in Waste

Name of mitigation action	GHGs affected	Type of instrument	Status	Start year of implementation	Implementing entity
Aerial emissions control in landfills	CH_4	Economic	Implemented	2008	Government: Wasteserv.
Sant' Antnin Mechanical Biological Treatment Plant	CH_4	Economic	Implemented	2011	Government: Wasteserv.
Urban Wastewater treatment	N_2O	Economic	Implemented	2011	Government: Water Services Corporation.
Wastewater sludge treatment	CH_4	Economic	Implemented	2012	Government: Water Services Corporation.
Waste Management Plan for the Maltese Islands 2014-2020	CO_2, CH_4, N_2O	Regulatory	Implemented	2014	Government: Ministry for the Environment, Sustainable Development and Climate Change.
Waste-to-Energy facility	CO_2, CH_4, N_2O	Economic	Planned	2023	Government: Ministry for the Environment, Sustainable Development and Climate Change

APPENDIX 2: SUMMARY INFORMATION ON MODELS USED FOR THE ESTIMATION OF PROJECTIONS OF GREENHOUSE GAS EMISSIONS

Model name	Electricity dispatch model
Full model name	Electricity dispatch model
Model version and status	V1 (under revision)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	An electricity dispatch model for the sector power generation, projecting the electricity demand for the period 2017 - 2030. Fuel affected: natural gas. Driver: GDP.
Intended field of application	Power generation - Energy
Description of main input data categories and data sources	GDP
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Energy Industries (Public electricity and heat production)
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A *Will be linked to sectoral electricity demand model (being developed for final NECP 2019 submission)*
Input from other models	N/A *(Will be linked to sectoral electricity demand model)*

Model name	Industry Fuel Consumption model
Full model name	Industry Fuel Consumption model (non-transport)
Model version and status	V1 (under revision)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A non-transport fuel consumption model for the industry sector, projecting the fuel demand for the period 2017 - 2030. Fuel affected: All non-transport fuels Driver: GVA.
Intended field of application	Industry Fuel Consumption
Description of main input data categories and data sources	GVA
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Manufacturing Industries
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Services Fuel Consumption model
Full model name	Services Fuel Consumption model (non-transport)
Model version and status	V1 (under revision)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A non-transport fuel consumption model for the commercial and institutional sector, projecting the fuel demand for the period 2017 - 2030. Fuel affected: All non-transport fuels Driver: GVA.
Intended field of application	Commercial and Intitutional Services Fuel Consumption
Description of main input data categories and data sources	GVA
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Other Sectors - Commercial and Institutional
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Residential Fuel Consumption model
Full model name	Residential Fuel Consumption model (non-transport)
Model version and status	V1 (under revision)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A fuel consumption model for the residential sector, projecting the fuel demand for the period 2017 - 2030. Fuel affected: All non-transport fuels Driver: Population
Intended field of application	Residential Fuel Consumption
Description of main input data categories and data sources	Population
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Other sectors - Residential
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	AFF Fuel Consumption model
Full model name	Agriculture, Forestry and fisheries Fuel Consumption model (non-transport)
Model version and status	V1 (under revision)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A non-transport fuel consumption model for the agriculture, fisheries and forestry sector, projecting the fuel demand for the period 2017 - 2030. Fuel affected: All non-transport fuels Driver: GVA.
Intended field of application	Agriculture, forestry and fisheries Fuel Consumption
Description of main input data categories and data sources	GVA
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - ther Sectors - Agriculture, fisheries and forestry
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Road Transport Biofuels S/O
Full model name	Road transport Biofuels S/O Model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A Road transport model projecting the biofuel and diesel demand for the period 2017 - 2030. Fuel affected: Diesel Driver: Substitution onligation -14% by 2030
Intended field of application	Road Transport
Description of main input data categories and data sources	Substitution onligation -14% by 2030
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy- Transport - Road Transport
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Road Transport Model
Full model name	Road transport Model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A transport model projecting the biofuel and diesel demand for the period 2017 - 2030. Fuel affected: Diesel & Petrol Driver: Population and GVA
Intended field of application	Road Transport
Description of main input data categories and data sources	Population and GVA
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Transport - Road Transport
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Inland Navigation Fuel Consumption Model
Full model name	Inland Navigation Fuel Consumption Model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	An inland navigation fuel consumption model, projecting Gasoil, diesel and petrol consumption for the period 2017 - 2030. Fuel affected: Gasoil, Diesel & Petrol Driver: GDP (also takes into account fast ferry and gozo tunnel passenger rates).
Intended field of application	National Navigation
Description of main input data categories and data sources	GDP (also takes into account fast ferry and gozo tunnel passenger rates).
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Transport - Navigation
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Aviation Model
Full model name	Aviation Model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	An aviation model, projecting Gasoil, diesel and petrol consumption for the period 2017 - 2030. Fuel affected: Jet A1 Driver: Number of departures projected from MIA
Intended field of application	Energy - Transport- Aviation
Description of main input data categories and data sources	Number of departures projected from MIA
GHG covered	CO2, CH4, N2O
Sectoral coverage	Transport
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	PV Production model
Full model name	Photovoltaic production model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	A model estimating the potential of residential and non-residential PVs for the period 2017 - 2030. Fuel affected: N/A Driver: Past trends, cost projections, feed in tariffs and PV technical potential study (Energy and Water Agency (EWA)).
Intended field of application	Energy - Energy Industries (Public electricity and heat production)
Description of main input data categories and data sources	Past trends, cost projections, feed in tariffs and PV technical potential study (Energy and Water Agency (EWA)).
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Energy Industries (Public electricity and heat production)
Geographical coverage	National
Temporal coverage,(e.g. time steps, time span)	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	Heat Pump Projections Model
Full model name	Heat Pump Projections Model
Model version and status	V1 (final)
Latest date of revision	Dec-18
Model type	N/A
Model description	N/A
Summary	Model projecting the number of heat pumps for the period 2017 - 2030. Fuel affected: N/A Driver: Number of households, past trends and GDP.
Intended field of application	Energy - Energy Industries (Public electricity and heat production)
Description of main input data categories and data sources	Number of households, past trends and GDP.
GHG covered	CO2, CH4, N2O
Sectoral coverage	Energy - Energy Industries (Public electricity and heat production)
Geographical coverage	National
Temporal coverage	2017-2030
Interface with other models	N/A
Input from other models	N/A

Model name	IPPU Model
Full model name	Modelling of IPPU for the Estimation of GHG Emissions Projections (1990-2050)
Model version and status	IPPU model for NECP 2018_11_15 MRA_DECC - 3
Latest date of revision	March 2019
Model type	Excel file
Model description	Model is limited to project emissions from category 2.F.1 Refrigeration and Air conditioning. The model takes into consideration five different groups, namely, residential (domestic), commercial, ships, transport and stationary. Based on historical data, including demand, imports, stock and emissions, the model estimates the stock and imports of a list of refrigerants (imported and used in these groups). The IPPU model includes two scenarios, namely the BAU and WEM scenarios.
Summary	Please refer to row above.
Intended field of application	IPPU sector – refrigeration and air conditioning.
Description of main input data categories and data sources	historical data: demand, imports, stock, emissions; factors: emission factor, reuse factor, efficiency improvement factor; drivers: disposable income, GDP
GHG covered	HFCs
Sectoral coverage	2.F.1
Geographical coverage	The Maltese Islands
Temporal coverage	1990-2050, annual
Interface with other models	not applicable
Input from other models	Model used to estimate historic emissions from category 2.F.1

Model name	Agriculture Model
Full model name	Agriculture Model
Model version and status	v1
Latest date of revision	16/11/2018
Model type	Excel-based .XML
Model description	The Agriculture Model is used to forecast emissions associated with Malta's Agriculture Sector under different scenarios for individual years running until 2050. These modelled scenarios are based on specific assumptions regarding framework conditions or trend analysis of historic data. BAU projections are made using 3-year moving averages, while other projections are based on input parameters such as livestock population, feed, milk production and other livestock and agricultural land related parameters.
Summary	The Agriculture Model is used to forecast emissions associated with the agriculture sector of Malta's GHG inventory under different scenarios for individual years running until 2050.
Intended field of application	Agriculture
Description of main input data categories and data sources	Livestock Population, Animal Weight, Feed proportions, Milk Production, Manure production, N content, N excretion, Agricultural Land
GHG covered	CH4, N2O
Sectoral coverage	Enteric Fermentation, Manure Management and Managed Agricultural Soils
Geographical coverage	National
Temporal coverage	1990 - 2050, Annual basis
Interface with other models	N/A
Input from other models	N/A

Model name	LULUCF model
Full model name	LULUCF model
Model version and status	V2
Latest date of revision	October 2018
Model type	Excel based
Model description	The LULCF model provides a tool to develop the projections of LULUCF emissions and removals. The spreadsheet has been created to analyse and construct scenario-based projections. No modelling or simulation algorithms are hidden in the background of the spreadsheet. The LULUCF model aims in achieving to construct projections of emissions/removals based on estimates of activity rates and emission factors, and to analyse trends in historical activity rates on national reporting. The scenarios considered for the projections are all described in the PAMs report.
Summary	The LULCF model provides a tool to develop the projections of LULUCF emissions and removals and assist to analyse and construct scenario based projections.
Intended field of application	Land Use, Land Use Change and Forestry
Description of main input data categories and data sources	Covers all LULUCF categories, all carbon pools. Data sources include data input of C stock change as Implied Emission Factor, and area as Activity data.
GHG covered	CO2, CH4, N2O
Sectoral coverage	All categories
Geographical coverage	National
Temporal coverage,(e.g. time steps, time span)	1990-2050
Interface with other models	N/A
Input from other models	N/A [*work currently ongoing on a Forest Land model based on new information and data supplied to compile the NFAP, thus the Forest Land model will be integrated with the LULUCF model.*

Model name	Waste generation and treatment model (Waste sector)
Full model name	Waste generation and treatment model
Model version and status	v1
Latest date of revision	Oct-18
Model type	Excel-based
Model description	The Waste generation and treatment model is based on the relation between a relevant driver trend between years 2013 and 2016, and the actual trend in waste generation between 2013 and 2016. This relation is represented by a constant which is multiplied by the projected macroeconomic driver to result in a projected waste generation for that particular year. The drivers used for the waste projections, both BAU and WEM, are the GDP, population and disposable income.
Summary	The Waste Model is used to project emissions under both BAU and WEM scenarios between years 2017 and 2050.
Intended field of application	Waste; Landfilling, Incineration and Biological Treatment
Description of main input data categories and data sources	Gross Domestic Product, population and disposable income
Validation and evaluation	N.A.
Output quantities	tonnes
GHG covered	CO2, CH4, N2O
Sectoral coverage	Waste; Landfilling, Incineration and Biological Treatment
Geographical coverage	National
Temporal coverage	2017-2050
Interface with other models	N.A.
Input from other models	N.A.