

# Informative Inventory Report for 2015

Environment and Resources Authority  
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## Table of Contents

Executive Summary .....	4
Chapter 1. Introduction .....	4
1. National Inventory Background .....	4
2. Institutional arrangements .....	4
3. Methods and data sources .....	5
4. Key Categories.....	5
i. Explanation of method used to determine key categories.....	5
ii. List of key categories by pollutant .....	6
5. General Assessment of completeness .....	12
i. Sources Not Estimated (NE) .....	12
ii. Sources Included Elsewhere (IE) .....	15
Chapter 2. Explanation of key trends.....	16
Chapter 3. Energy (NFR 1).....	20
Chapter 4: Industrial Processes and Product use (NFR sector 2).....	29
Chapter 5: Agriculture (NFR sector 3).....	29
Chapter 6: Waste (NFR sector 5).....	31
Chapter 7. Projections, Reporting of gridded emissions and LPS.....	33
Chapter 8. References.....	34
Figure 1: Time series of national totals 2000-2015; emissions in kt.....	17
Figure 2: NO <sub>x</sub> time series (from 2000 – 2015); emissions in kt.....	17
Figure 3: NMVOC time series (from 2000 to 2015); emissions in kt.....	18
Figure 4: SO <sub>x</sub> time series (from 2000 to 2015); emissions in kt .....	19
Figure 5: NH <sub>3</sub> time series (from 2000 to 2015); emissions in kt .....	19
Table 1: Table of key source categories.....	6
Table 2: Table illustrating sources Not Estimated (NE).....	12
Table 3: Table illustrating sources Included Elsewhere (IE).....	15
Table 4: Energy mix in 2015 .....	22
Table 5: Energy mix in 2014 .....	22
Table 6: List of NMVOCs contribution to the national NMVOC total .....	24
Table 7: List of pollutants per key sources making up the road transport sector .....	24
Table 8: Waste streams treated at MTTF in 2015.....	32

Equation 1: Basic equation for the estimation of emissions submitted in the national inventory .....	5
Equation 2: Equation for level assessment calculation .....	5
Equation 3: Equation for the estimation of waste anaerobic digestion at biogas facilities .....	31

## **Executive Summary**

This is the 5<sup>th</sup> Informative Inventory Report (IIR) for Malta and contains detailed information on annual emission estimates of air quality pollutants by source in the Maltese Islands from 2000 to 2015. This report is a result of the requirements of the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP). The IIR is now also a requirement under the new National Emissions Ceilings (NEC) Directive 2016/2284.

## **Chapter 1. Introduction**

### **1. National Inventory Background**

The national inventory falls under the remit of the Environment and Resources Authority (ERA) which was set up in 2016 following the demerger of the MEPA (Malta Environment and Planning Authority). The current complement working on the inventory is of one full time employee.

This report aims at providing a detailed analysis of the trends and methodologies used to estimate emissions in the last inventory uploaded on the EIONET website for 2015 data (v.v.1) and for the 2014 inventory (v.v.1.2).

### **2. Institutional arrangements**

ERA has worked in close cooperation with the climate change inventory team at the Malta Resources Authority (MRA) in order to ensure consistency of data uploaded on EIONET. The National Statistics Office (NSO) has also cooperated extensively with ERA throughout the inventory compilation phase.

Inventory improvements in this submission include updates to the road transport, commercial and institutional, waste and agriculture sectors. This update was carried out for 2014 and 2015 national inventories. Emissions from the following sectors were estimated for the first time; Residential: Stationary (1A4bi), Inorganic N-fertilizer (3Da1), Solid waste disposal on land (5A), anaerobic digestion at Biogas Facility (5B2) and Industrial Waste Water Handling (5D2). Future submissions will eventually include updates of the time series at least until 2000 to guarantee comparability of data.

### 3. Methods and data sources

Whenever direct emission data was not available, methodologies obtained from the EEA/EMEP guidebook of 2013 and 2016 were followed. The former guidebook version was used for some sectors since at that time the 2016 guidebook was not yet published.

The equation below was applied when estimating emissions using default factors;

$$Emission_{pollutant} = \sum Activity\ Data \times Emission\ Factor_{activity,pollutant}$$

Equation 1: Basic equation for the estimation of emissions submitted in the national inventory

In case this basic approach was not used, a suitable explanation is given for the respective NFR code in each relevant section.

### 4. Key Categories

#### i. Explanation of method used to determine key categories.

In order to identify the key source categories, an assessment was carried out to identify the level of contribution each source had on the national inventory. The methodology followed was based on the equation shown below and obtained from the 2016 EEA/EMEP guidebook.

$$L_{x,t} = E_{x,t} / \sum E_t \times 100\%$$

Equation 2: Equation for level assessment calculation

Level assessment for the base year and trend assessment were not calculated due to time constraints; however, this will be addressed in future submissions.

ii. List of key categories by pollutant

Table 1: Table of key source categories

Pollutant	NFR category	% contribution to national total	NFR code
NO <sub>x</sub>	Public electricity and heat production	31.5	1A1a
	Road transport: Passenger cars	21.1	1A3bi
	Road transport: Heavy duty vehicles and buses	13.1	1A3biii
	Road transport: Light duty vehicles	10.8	1A3bii
	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	9.8	1A2gviii
NMVOC	Other product use	46.4	2G
	Road transport: Passenger cars	36.2	1A3bi
SO <sub>x</sub>	Public electricity and heat production	93.9	1A1a
NH <sub>3</sub>	Manure management - Swine	51.0	3B3
	Manure management - Non-dairy cattle	14.7	3B1b
	Manure management - Laying hens	9.3	3B4gi
	Manure management - Dairy cattle	8	3B1a

PM <sub>2.5</sub>	Public electricity and heat production	28.4	1A1a
	Road transport: Light duty vehicles	16.4	1A3bii
	Road transport: Passenger cars	14.7	1A3bi
	Road transport: Automobile tyre and brake wear	12.5	1A3bvi
	Road transport: Heavy duty vehicles and buses	9.0	1A3biii
PM <sub>10</sub>	Public electricity and heat production	22.6	1A1a
	Road transport: Automobile tyre and brake wear	17.2	1A3bvi
	Road transport: Light duty vehicles	11.6	1A3bii
	Road transport: Passenger Cars	10.4	1A3bi
	Road transport: Manure management - Broilers	9.5	3B4gii
	Manure management - Laying hens	8.5	3B4gi
	Road transport: Heavy duty vehicles and buses	7.1	1A3biii
	Public electricity and heat production	25.8	1A1a

TSP	Road transport: Passenger Cars	17.3	1A3bvi
	Road transport: Automobile tyre and brake wear	10.9	1A3bi
	Road transport: Light duty vehicles	10	1A3bii
	Manure management - Broilers	7.6	3B4gii
	Manure management - Laying hens	6.8	3B4gi
	Road transport: Heavy duty vehicles and buses	6.2	1A3biii
BC	Road transport: Passenger cars	27.2	1A3bi



	Road transport: Light duty vehicles	26.4	1A3bii
	Road transport: Heavy duty vehicles and buses	15.4	1A3biii
	Public electricity and heat production	11.1	1A1a
CO	Road transport: Passenger cars	76.3	1A3bi
	Road transport: Mopeds & motorcycles	9.3	1A3biv
Hg	Public electricity and heat production	66.2	1A1a
	Road transport: Passenger cars	18.6	1A3bi

Ni	Public electricity and heat production	98.0	1A1a
Se	Public electricity and heat production	85.0	1A1a
Zn	Public electricity and heat production	63.2	1A1a
	Road transport: Automobile tyre and brake wear	19.8	1A3bvi
PCCD/F	Public electricity and heat production	95.7	1A1a
Benzo(a)pyrene	Stationary combustion in manufacturing industries and construction: Other	96	1A2gviii

Benzo(b)fluoranthene	Stationary combustion in manufacturing industries and construction: Other	98.0	1A2gviii
Benzo(k)fluoranthene	Stationary combustion in manufacturing industries and construction: Other	92.6	1A2gviii
Indeno (1,2,3-cd) pyrene	Stationary combustion in manufacturing industries and construction: Other	94.6	1A2gviii
HCB	National navigation (shipping)	98	1A3dii
PCB	National navigation (shipping)	95.8	1A3dii

## 5. General Assessment of completeness

### i. Sources Not Estimated (NE)

**Table 2: Table illustrating sources Not Estimated (NE)**

Pollutants	Sector	NFR code	Reason
HCB,PCB	Public electricity and heat production	1A1a	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Iron and steel	1A2a	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	1A2b	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Chemicals	1A2c	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	1A2d	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	1A2e	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1A2f	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	1A2gvii	No emissions factors in guidebook
NH <sub>3</sub> ,HCB,PCB	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	1A2gviii	No emissions factors in guidebook
All pollutants except NO <sub>x</sub> , SO <sub>x</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , CO	International aviation LTO (civil)	1A3ai(i)	Emission loads were directly obtained from EUROCONTROL. The new methodology made available in the 2016 EEA/EMEP guidebook will be used in the future to calculate these emissions

			together with NMVOC and TSP.
All pollutants except NO <sub>x</sub> , SO <sub>x</sub> , PM <sub>2.5</sub> , PM <sub>10</sub> , CO	Domestic aviation LTO (civil)	1A3aii(i)	Same as above
NMVOC	Road transport: Gasoline evaporation	1A3bv	NMVOC was not estimated due to time constraints. However, it is being aimed to use the EEA/EMEP 2016 guidebook for future submissions
PAHs	Road transport: Automobile Tyre and Break wear	1A3bvi	No emission factors
PM <sub>2.5</sub> , PM <sub>10</sub> , TSP, PAHs	Road transport: Automobile road abrasion	1A3bvii	No estimation of pollutants from this sector due to time constraints. The EEA/EMEP 2016 guidebook will be used to calculate emissions from this sector for future submissions.
NH <sub>3</sub> , BC, PAHs	National navigation (shipping)	1A3dii	No Emission factor
NH <sub>3</sub> , HCB, PCB	Commercial/institutional: Stationary	1A4ai	HCB and PCB are not applicable while the EEA/EMEP guidebook of 2016 lack emission factors for NH <sub>3</sub>
All pollutants	Commercial/institutional: Mobile	1A4aii	No emission factors
All pollutants except NO <sub>x</sub> , NMVOC, SO <sub>x</sub> , PM <sub>10</sub> , TSP, CO	Residential: Stationary	1A4bi	No emission factors
All pollutants except NH <sub>3</sub> which is not observed	Residential: Household and gardening (mobile)	1A4bii	Sector was considered as being very small
NH <sub>3</sub> , HCB, PCB	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	1A4cii	No emission factor
SOX, NMVOC, PCDD/F	Distribution of oil products	1B2av	No activity data was collected
All pollutants	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	1B2b	Emission factors not available
BC, TSP, PM <sub>2.5</sub> , PM <sub>10</sub>	Cement production	2A1	No activity data was made available
PM <sub>2.5</sub> , PM <sub>10</sub> , BC, TSP	Glass production	2A3	No activity data was made available
PM <sub>10</sub> , BC, TSP	Quarrying and mining of minerals other than coal	2A5a	No activity data was made available

PM <sub>2.5</sub> , PM <sub>10</sub> , TSP	Construction and demolition	2A5b	No activity data was made available
All pollutants except TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	Ferroalloys production	2C2	No emission factor
BC	Aluminium production	2C3	No activity data available
BC	Magnesium production	2C4	No activity data available
BC	Lead production	2C5	No activity data available
BC	Zinc production	2C6	No activity data available
BC	Copper production	2C7a	No activity data available
BC	Nickel production	2C7b	No activity data available
BC	Other metal production (please specify in the IIR)	2C7c	No activity data available
BC	Storage, handling and transport of metal products (please specify in the IIR)	2C7d	No activity data available
BC, PCCD/F, PAHs, HCB, PCB	Road paving with asphalt	2D3b	No activity data available
NM VOC	Asphalt roofing	2D3c	No activity data available
NM VOC	Coating applications	2D3d	No activity data available
BC	Chemical products	2D3g	No activity data available
BC	Printing	2D3h	No activity data available
BC	Other solvent use (please specify in the IIR)	2D3i	No activity data available
BC	Other product use (please specify in the IIR)	2G	No activity data available
BC	Food and beverages industry	2H2	No activity data available
BC	Other industrial processes (please specify in the IIR)	2H3	No activity data available
BC	Wood processing	2I	No activity data available
BC	Production of POPs	3B4f	No activity data available
NM VOC, BC	Urine and dung deposited by grazing animals	3Da3	No activity data available
All pollutants	Crop residues applied to soils	3Da4	No activity data available
All pollutants	Indirect emissions from managed soils	3Db	No activity data available
All pollutants	Cultivated crops	3De	No activity data available
All pollutants	Use of pesticides	3Df	No activity data available
All pollutants except (NO <sub>x</sub> , NM VOC, SO <sub>x</sub> , NH <sub>3</sub> )	Biological treatment of waste - Solid waste disposal on land	5A	No emissions factors in guidebook
BC	Clinical waste incineration	5C1biii	No emissions factors in guidebook
BC	Sewage sludge incineration	5C1biv	No emissions factors in guidebook
BC	Industrial wastewater handling	5D2	No emissions factors in guidebook
BC	Other wastewater handling	5D3	No emissions factors in guidebook

## ii. Sources Included Elsewhere (IE)

**Table 3: Table illustrating sources Included Elsewhere (IE)**

<b>Pollutants</b>	<b>Sector</b>	<b>NFR code</b>	<b>Reason</b>
As, Cr, Cu	1A1a	Public electricity and heat production	Included under Pb
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Included under 1A2gviii
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Included under 1A2gviii
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Included under 1A2gviii
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Included under 1A2gviii
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Included under 1A2gviii
All pollutants except NH <sub>3</sub> , HCB, PCB	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Included under 1A2gviii
PCDD/F, PAHs, HCB, PCB	1A3bii	Road transport: Light duty vehicles	Included in 1A3bi
Same as above	1A3biii	Road transport: Heavy duty vehicles and buses	Included in 1A3bi
Same as above	1A3biv	Road transport: Mopeds & motorcycles	Included in 1A3bi
All pollutants	1A4ciii	Agriculture/Forestry/Fishing: National fishing	Included in 1A4cii
All pollutants	3Da2a	Animal manure applied to soils	Included in 3B
All pollutants	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	Included in 1A4cii
All pollutants	3Dd	Off-farm storage, handling and transport of bulk agricultural products	Included in 1A4cii
All pollutants	5C1a	Municipal waste	Included in 5C1bv

		incineration	
All pollutants excluding NH <sub>3</sub> ,BC	5C1bi	Industrial waste incineration	Included in 5C1bv
All pollutants excluding NH <sub>3</sub> ,BC	5C1biii	Clinical waste incineration	Included in 5C1bv
All pollutants	5D1	Domestic wastewater handling	Included in 5D2

Included Elsewhere (IE) and Not Estimated (NE) notation keys were used to explain missing values. NA (not applicable) was used for pollutants which could not have been emitted from that particular source. On the other hand, Not Observed (NO) was used for activity or sectors which were non-existent.

## Chapter 2. Explanation of key trends

This chapter includes key trend analysis of NO<sub>x</sub>, NMVOC, SO<sub>x</sub> and NH<sub>3</sub> emissions from a range of sectors (i.e. Energy (1A1a), Industry (1A2gviii), Road Transport (1A3bi-iv), Road Transport Other (1A3ai (i)- ii (i), 1A3dii) and Waste/Cremation (5C1bv)).

The profile of emissions covering the period 2000 to 2015 generally shows a downward trend. The methodology used to estimate emissions from 2010 to 2014 was based on EEA/EMEP 2013 guidelines while estimation of emissions for previous years was based on the IPCC 1996 and EEA/EMEP 2006 guidelines.

Estimation of emissions from heavy metals started in 2010; therefore, they were not included in the time series. The EEA/EMEP guidebooks of 2013 and 2016 were used for the estimation of emissions for 2015 activity data. In the future the time series will be updated to include heavy metals as based on the latest guidelines.



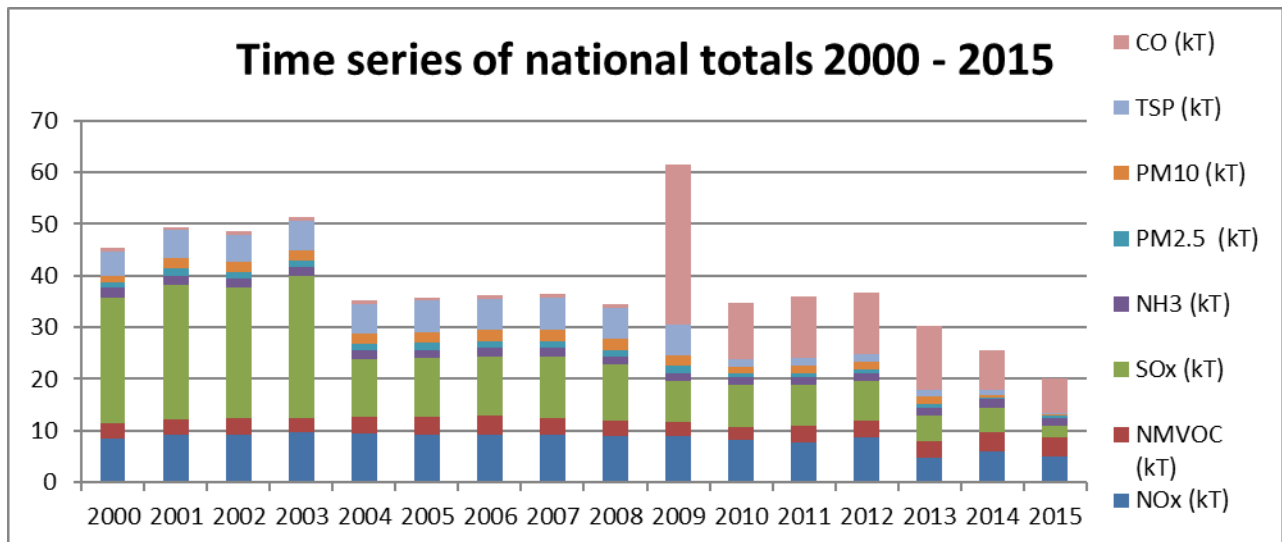


Figure 1: Time series of national totals 2000-2015; emissions in kt

The figure below shows the trend of NO<sub>x</sub> emissions across the entire time series. NO<sub>x</sub> emissions have decreased by 3.24kt from 2000 to 2015. This decrease is assumed to be related to the energy sector which, as shown below is one of the largest contributors to the NO<sub>x</sub> national total. Another major contributor to NO<sub>x</sub> is the road transport sector. Emissions for this sector were estimated using COPERT 5 both for 2014 and 2015. Recalculations using COPERT 5 were carried out for the road transport sector for 2014 activity data. In the future the time series will be updated to deal with the discrepancy observed in 2013 for which, at the moment, there is no plausible explanation.

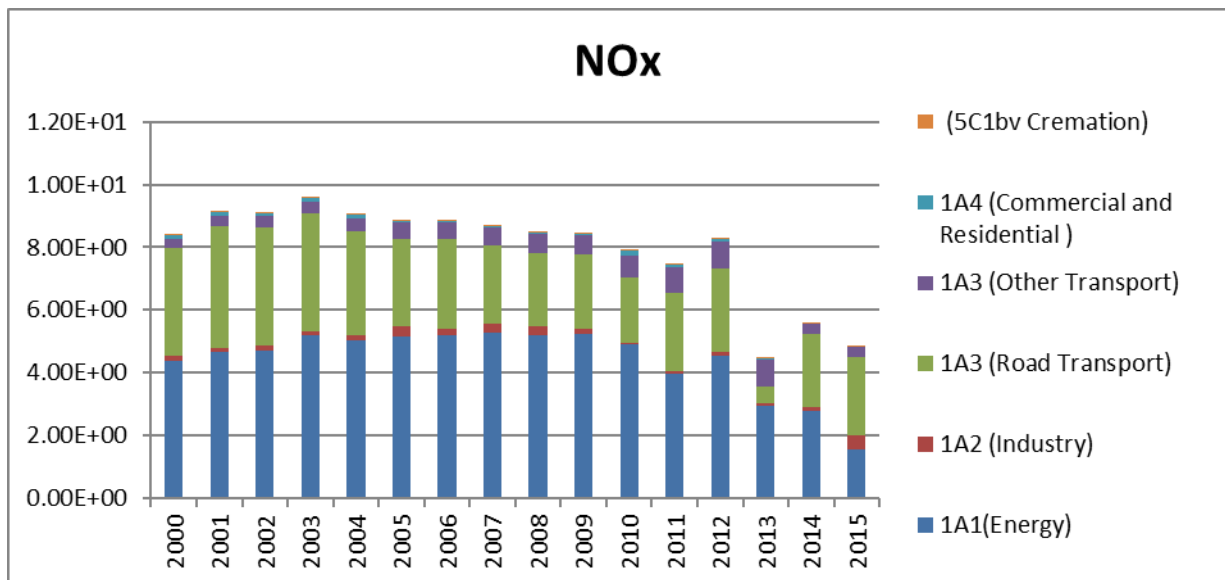


Figure 2: NO<sub>x</sub> time series (from 2000 – 2015); emissions in kt

In 2014 and 2015, calculation of emissions for road transport sectors was done through the use of COPERT (Tier 3). Prior to that, a customised Tier 2 methodology was used. This could explain the variations in the load of NMVOC. It is planned that future inventory submissions address this issue by applying the same methodology for the whole time series.

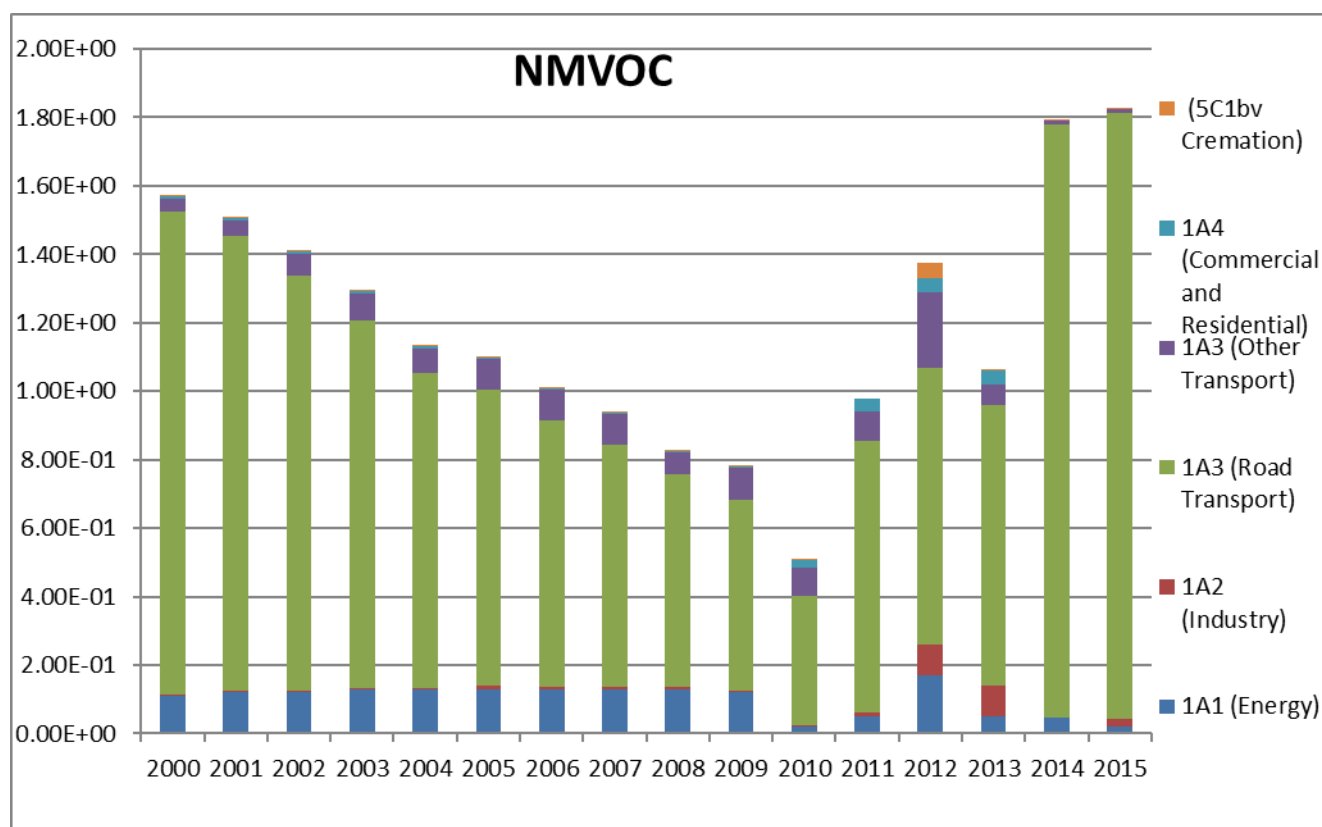


Figure 3: NMVOC time series (from 2000 to 2015); emissions in kt

The trends in SO<sub>2</sub> emissions, which are heavily influenced by NFR sector 1A1, show a stepwise decrease in emissions across the times series. There are various reasons behind this reduction and all of which are believed to be related to the developments in the energy generation sector since Malta's accession to the EU. These include the introduction of 1% Sulphur Heavy Fuel Oil (HFO) as from 2004 (as opposed to 3.5% Sulphur HFO), which was eventually reduced to 0.7% Sulphur HFO in 2010. In addition, from 2013 onwards, a more efficient plant made up of 6 compression ignition engines (partly) replaced an old inefficient plant dating back to the 1980's. In 2015, extensive use was made of an interconnector link to Sicily.

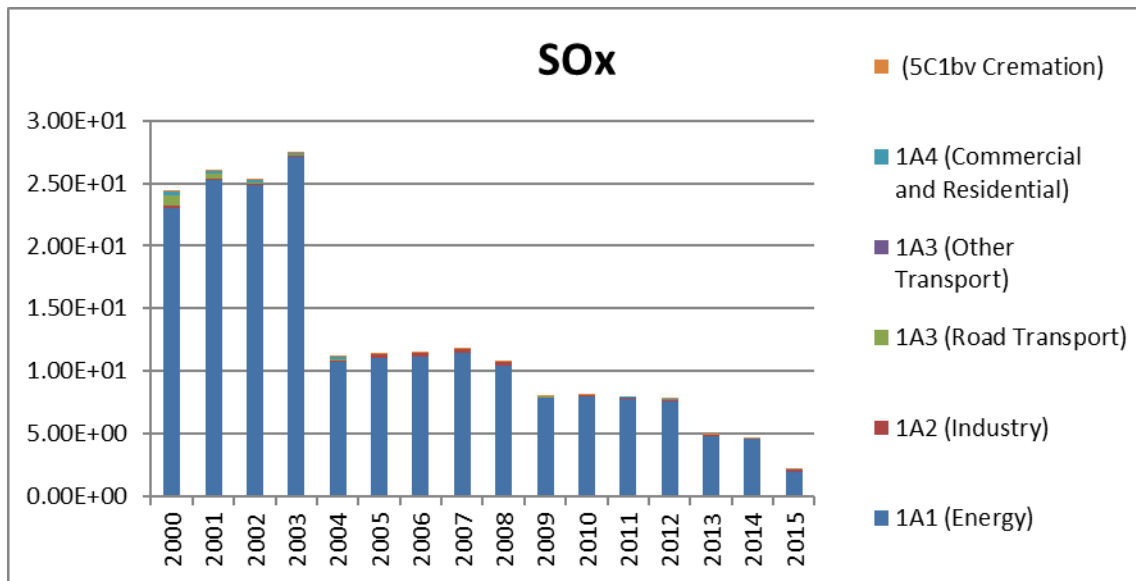


Figure 4: SOx time series (from 2000 to 2015); emissions in kt

The agriculture sector is the major contributor to the NH<sub>3</sub> national total. There was a decrease of 17% from 2000 to 2015. This could be due to a decrease in animal heads over the entire timeseries.

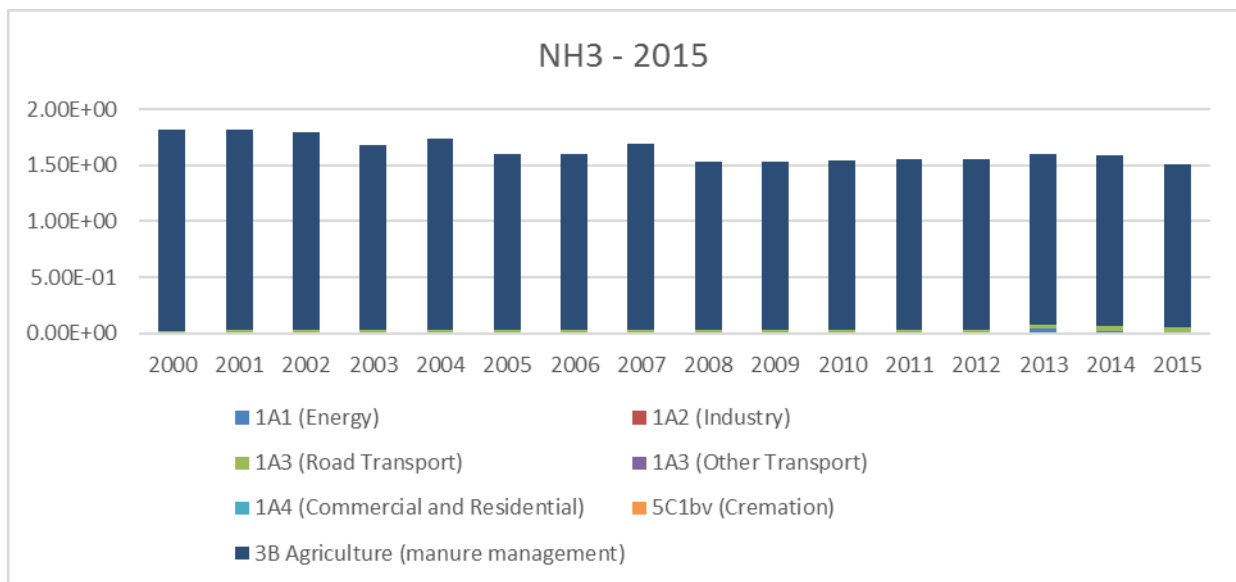


Figure 5: NH<sub>3</sub> time series (from 2000 to 2015); emissions in kt

## Chapter 3. Energy (NFR 1)

**Sector 1A1a (Public electricity and heat production):** In 2015, two power plants were operative: the Marsa Power Station and the Delimara power Station (MPS and DPS, respectively). The emission loads of each pollutant presented in NFR14 for section 1A1a consists of the summation of the loads of both stations.

This sector has been updated on an annual basis since 2005. MPS consists of five combustion plants (MPS 1-5). MPS 1-4 utilize steam cycle technology while MPS 5 utilizes gas turbine technology. MPS 1 (boilers 3 and 4), MPS 2 (boiler 5 and 6) and MPS 3 (boiler 7) ceased to operate in early 2015, while MPS 4 operated for 1,084 hours only. By mid-2015 all the plants at MPS were shut down with the exception of MPS5, which operated for only 38.7 hours.

NO<sub>x</sub>, SO<sub>2</sub> and TSP emission loads using automated measurement systems were obtained from the 2015 Marsa Annual Environment Report (AER) and measured using Continuous Emission Monitoring System (CEMS). The Marsa power plant does not include a secondary deNoxing plant and therefore NH<sub>3</sub> emissions were absent. On the other hand, Non-methane Volatile Organic Compounds (NMVOC), Black Carbon (BC) and Carbon Monoxide (CO) were estimated from Tier 2 emission factors obtained from the EEA/EMEP guidebook 2013.

In the 2015 submission, PM<sub>10</sub> and PM<sub>2.5</sub> were estimated from the ratio of each PM fraction to TSP obtained from the 2013 EEA/EMEP guidebook. PM<sub>10</sub> and PM<sub>2.5</sub> emissions for 2013 and 2014 submissions were recalculated accordingly. The methodology followed is explained below.

**Methodology for the estimation of PM<sub>2.5</sub>&PM<sub>10</sub>:** The TSP emission loads measured by CEMS for each plant technology was multiplied by a factor representing the ratio of PM<sub>2.5</sub> to TSP. This was obtained by dividing the EF-GB2013\* of PM<sub>2.5</sub> by EF-GB2013\*

*EF-GB2013\* = Emission Factor obtained from guidebook 2013.*

The emission loads of cadmium and other heavy metals i.e. Arsenic (As), Chromium (Cr), Copper (Cu), Lead (Pb) and Nickel (Ni) were calculated by multiplying the flue gas concentration with the flow rate. The former three (As, Cr, Cu) were given the notation key of IE (included elsewhere) and the summation of each load was included to that of Pb. Mercury (Hg), Zinc (Zn) and Selenium (Se) were estimated from the application of Tier 2 emission factors since their concentration was not reported in the Marsa-AER. As per IPPC permit requirements, dioxins and furans (PCDD/F) are to be reported every two years and the last reporting was in 2013. Therefore, since no PCDD/F data was available in 2015 (which is normally below the detection limit), pollution loads had to be estimated by means

of Tier 2 emission factors from the EEA/EMEP guidebook 2013. This applied to benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene and indeno(1,2,3-cd) pyrene as well, since Polycyclic Aromatic Hydrocarbons (PAHs) were also not reported in the Marsa-AER. Hexachlorobenzene (HCB) and polychlorinated biphenyls (PCB) were assigned the notation key of NE.

The DPS consists of six combustion plants. DPS 1 consists of steam boilers which run on heavy fuel oil (HFO), DPS 2, DPS 3, DPS 4 and DPS 5 are gas turbines and run on gas diesel oil (GDO) while DPS 6 consists of diesel engines running both on HFO and Gas Diesel Oil (GDO). NO<sub>x</sub>, SO<sub>2</sub> and TSP pollution loads have also been measured by CEMS and reported in the 2015 Delimara Power Station Annual Environment Report.

The diesel engines in DPS 6 have selective catalytic reduction technology and therefore NH<sub>3</sub> emission loads for this sector have been reported only for the latter plant. On the other hand, NMVOC, BC and CO were estimated from Tier 2 emission factors obtained from the EEA/EMEP guidebook 2013. PM<sub>10</sub> and PM<sub>2.5</sub> were calculated as explained above. DPS 1 and 6 fired HFO in 2015. Flue gases were analyzed for metal content of dust.

Cadmium's (measured together with thallium) annual average concentration was less than the detection limit i.e. 0.001 mg/Nm<sup>3</sup>. Therefore, the procedure followed to determine the pollution load was to divide the concentration by two and then multiply by the flow rate. The same procedure was applied for the emission loads of other metals i.e. Arsenic (As), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni), Mercury (Hg), Zinc (Zn) and Selenium (Se). Loads of As, Cr, Cu were given the notation key of IE (included elsewhere) and their combined emission load was summed to that of Pb and inserted in the Pb cell. It is important to note that the results from the key source analysis with regards to Pb, As, Cu and Cr were removed from the list since they are not representative of the real scenario.

As in the case of Marsa, the last PCDD/F submission for Delimara was in 2013, therefore, pollution loads had to be estimated from emission factors obtained from the 2013 guidebook as well. This applied for PAHs as well. HCB and PCB were assigned the notation key of NE.

Thermal energy generated (activity data) by DPS and MPS amounts to 10614.5 TJ/yr and 616.7 TJ/yr respectively. The total activity data for sector 1A1a in 2015 was 11231.1 TJ/yr. This is relatively lower than that of 2014 which amounted to 21145.0 TJ/yr. The reason behind this discrepancy could be attributed to the fact that activity at the MPS was heavily reduced prior to its switching off in mid-2015. To compensate for this reduction, alternative energy production systems fed electricity to the grid. The table below shows the energy mix fed into the grid in 2015 (Ing Carmen Abela, personal communication, October 13, 2016).

Table 4: Energy mix in 2015

2015	MWh	TJ	TJ as calculated from fuel burn
Units sent out MPS	44,126	0.158	616.67
Units sent out DPS	1,095,209	3, 942.752 4	10, 614.5
PVs estimated	78,209	0.281	NA
Interconnector Sent out to grid	1,022,615	3, 681.41	NA

In 2014, the electricity fed to the grid was as follows:

Table 5: Energy mix in 2014

2014	MWh	TJ
Units sent out MPS (MWh)	369,496	1330.18
Units sent out DPS (MWh)	1,692,291	6092.24
PVs (MWh) estimated	57,596	NA

*Note: Units sent out = Units generated – (units used in station + cable losses)*

Sector 1A1a is a source category for many pollutants including **NO<sub>x</sub>**, **SO<sub>x</sub>**, **PM<sub>2.5</sub>**, **PM<sub>10</sub>**, **TSP**, **BC**, **Hg**, **Ni**, **Se**, **Zn** and **PCDD/F**.

**Sector 1A2gviii (Stationary Combustion in manufacturing industries and construction):** This sector was updated with 2015 emission data. Activity data or fuel consumption was obtained from the fuel survey conducted by NSO and MRA. In 2014, the activity data used to estimate emissions from this sector consisted of fuel consumed by the Manufacturing sector (NACE code C). The 2015 fuel survey included updated data for the same NACE sector for 2014 and therefore, emissions were recalculated including contribution from the Construction sector - NACE code F. Activity data for the 2015 submission was also obtained from the fuel survey under NACE code C and F.

The net fuel consumption amounted to 953.31 TJ in 2015 which is slightly higher than the 897.90 TJ reported in the 2014 inventory. Pollution estimation for each pollutant (except NH<sub>3</sub>, HCB and PCB which were given the notation key of NE) was obtained following a Tier 1 methodology, as outlined in the EEA/EMEP guidebook 2016.

Sector 1A2gviii is a key source for **NO<sub>x</sub>**, **benzo(a)pyrene**, **benzo(b)fluoranthene**, **benzo(k)fluoranthene** and **indeno (1,2,3-cd) pyrene**.

**Category 1A3a (Aviation LTO):** The aviation sector was last updated in 2014. The climate change team provided EUROCONTROL data containing emissions loads for NO<sub>x</sub>, SO<sub>x</sub>, NMVOC, CO, PM<sub>2.5</sub> and PM<sub>10</sub>, however, this year no data was made available from Eurocontrol. Activity data used by Eurocontrol and reported in the NFR-14 template was 3.74x10<sup>4</sup> landing and takeoff (LTO) cycles for sector 1A3ai(i) and 258 LTO cycles for sector 1A3aii(i). The data covered LTO and cruise for international and domestic routes. Future submissions will use the methodology made available in the 2016 EEA/EMEP guidebook, 'Aviation emissions calculator' and will be applied to the entire time series.

This sector was not identified as being a key source for any of the pollutants.

**Category 1A3b (Road Transport):** The road transport sector was last updated for 2015 data. Vehicle fleet data was originally collected from Transport Malta. Quality checks were applied to the dataset by NSO before forwarding to ERA. Other parameters such as monthly atmospheric temperature and average speed in urban areas were required to estimate emission loads by means of COPERT 5 (the latest model version).

The same approach was used to recalculate 2014 data. COPERT 5 calculates the total emission load (VEX) of each pollutant together with its respective total non-exhaust (NEX) emission load. The difference between NEX and VEX was calculated for each pollutant for each respective road transport sector.

Sector 1A3bvii (Road transport: Automobile road abrasion) was not estimated since it is not included in COPERT. Future submissions will eventually include all road transport sectors and pollutants including the latter sector which will be estimated using the current methodology made available in the guidebook.

Persistent organic pollutants (POPs) were included in the NMVOC total. The table below shows the percentage contribution of POPs to the NMVOC national total. This was done since apart from estimating the NMVOC emission load per vehicle category, COPERT 5 also estimates NMVOC speciation. The latter function gives the emission loads of a variety of POPs including those which are required under CLRTAP. Hence, the total emission load of dioxins and furans, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene and indeno(1,2,3-cd) pyrene were included in the NMVOC total per vehicle category.

**Table 6: List of NMVOCs contribution to the national NMVOC total**

<b><u>National Total</u></b>	<b><u>Pollutant</u></b>	<b><u>Load in kg</u></b>	<b><u>% contribution to NMVOC national total</u></b>
National Total	Benzo(a)pyrene	2.70E+00	1.53E-04
National Total	Benzo(b)fluoranthene	3.85E+00	2.18E-04
National Total	Benzo(k)fluoranthene	3.23E+00	1.82E-04
National Total	Indeno(1,2,3-cd)pyrene	2.82E+00	1.59E-04
National Total	PCCD/F	9.79E-05	5.53E-09
National Total	NMVOC	1.77E+06	1.00E+02

The table below shows the list of road transport sectors which are key sources of the following pollutants.

**Table 7: List of pollutants per key sources making up the road transport sector**

<b>Pollutant</b>	<b>Sector</b>	<b>NFR code (in descending order of contribution)</b>
NO <sub>x</sub>	Road transport: Passenger cars	1A3bi
	Road transport: Heavy duty vehicles and buses	1A3biii
	Road transport: Light duty vehicles	1A3bii



NMVOC	Road transport: Passenger cars	1A3bi
PM <sub>2.5</sub>	Road transport: Light duty vehicles	1A3bii
	Road transport: Passenger cars	1A3bi
	Road transport: Automobile tyre and brake wear	1A3bvi
	Road transport: Heavy duty vehicles and buses	1A3biii
PM <sub>10</sub>	Road transport: Automobile tyre and brake wear	1A3bvi

	Road transport: Heavy duty vehicles and buses	1A3biii
	Road transport: Light duty vehicles	1A3bii
	Road transport: Passenger cars	1A3bi
TSP	Road transport: Automobile tyre and brake wear	1A3bvi
	Road transport: Passenger cars	1A3bi
	Road transport: Light duty vehicles	1A3bii
	Road transport: Heavy duty vehicles and buses	1A3biii
BC	Road transport: Passenger cars	1A3bi
	Road transport: Light duty vehicles	1A3bii

	Road transport: Heavy duty vehicles and buses	1A3biii
CO	Road transport: Passenger cars	1A3bi
	Road transport: Mopeds & Motorcycles	1A3biv
Hg	Road transport: Passenger cars	1A3bi
Zn	Road transport: Passenger cars	1A3bi

**Category 1A3dii (National navigation (shipping)):** This sector was last updated for 2014 data. Activity data was obtained from the 'Gozo Channel' which is the main company providing access to the Island of Gozo from Malta by means of a number of ferries which run on marine diesel oil. The total annual volume of fuel consumed during 2014 was used to estimate emissions by means of a Tier 1 methodology (as made available in the 2013 EEA/EMEP guidebook). It is planned that future submissions include an update of this sector with the latest fuel consumption statistics for the whole sector.

This sector is a key source for HCB and PCB.

**Sector 1A4ai (Commercial/institutional: stationary):** This sector was last updated for 2015. Activity data for the estimation of emissions from this sector was obtained from the 2015 fuel survey results for NACE code G, Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles and NACE code I, Accommodation and Food Service Activities (the same NACE codes used for the estimation of 2014 emissions for the same sector). A Tier 1 methodology obtained from the 2013 EEA/EMEP guidebook was applied. No key sources were identified for this sector.

**Sector 1A4bi (Residential: Stationary):** This sector was last updated with 2015 data and it includes emissions from small combustion installations, mainly intended for heating (gas heater or gas stove) and cooking (cooker) in the residential sector. Fireplaces, stoves and small boilers for residential heating are rare in Malta. Most of the residential heating and cooking is done using bottled Liquid Petroleum Gas (LPG). The only alternative option is that of using electricity.

Data on LPG sold to residential units was obtained from REWS (Regulator for Energy and Water Services). The emission factors used were obtained from Table A18 of the 2016 EEA/EMEP guidebook '*Emission factors for domestic combustion processes (g/GJ) in the Netherlands*'. This table was chosen in the absence of national data on individual installations other than the annual fuel consumption. The table included default factors for LPG fuel. Table A18 was used over Table 3-4, 'Tier 1 emission factors for NFR source category 1.A.4.b using gaseous fuels' since the term 'gaseous fuel' in the latter table refers to a wide range of gases while the former is specific to LPG. Table A18 was chosen over Table A25 since the emission factors in the latter table consisted of average values with a very large range of magnitude.

This sector was not identified as a key source for any of the pollutants.

**Category 1A4ci (Agriculture/Forestry/Fishing: Stationary):** This sector was last updated with 2015 data. Emissions were assigned the notation key of NO and the 2014 national inventory template was updated accordingly.

**Category 1A4cii (Agriculture/Forestry/Fishing: Off-road vehicles and other machinery):** This sector was last updated for 2015 data. This year's submission included an update of this sector for 2014 and 2015 data. An update of the 2014 submission was necessary following new activity data obtained from the 2015 fuel survey under NACE code A - Agriculture, Forestry & Fisheries. Tier 1 emission factors were obtained from the 2013 guidebook. The total energy consumed within this sector was equivalent to 182.53TJ which is very close to that of 2014 which amounted to 180.60TJ. It is planned that future submissions will include an update of the entire time series.

This sector was not identified as a key source for any of the pollutants.

**Category 1A4ciii (Agriculture/Forestry/Fishing: National fishing):** The last inventory submission included latest updates for 2014 and 2015 data. The notation key 'included elsewhere' was used to show that emission loads for this sector were included under sector 1A4cii.

This sector was not identified to be a key source for any of the pollutants.

## Chapter 4: Industrial Processes and Product use (NFR sector 2)

**Sector 2B10b (Storage, handling and transport of chemical products):** NMVOC loads emitted from this sector were last updated in 2004 and the activity data used was the number of ships. This value is not representative of the current situation; however, it was not removed from the 2015 inventory so as not to cause a considerable dip in the time series analysis of NMVOC.

This sector was not identified to be a key source for any of the pollutants.

**Sector 2D3b (Road Paving with asphalt):** This has last been updated with 2009 data. The annual total mass of asphalt was used to estimate emissions. Although the NMVOC emission load originating from this sector is not representative of the current situation, it was not removed so as not to cause a considerable dip in the time series analysis. It is planned that future improvements include updates for the entire time series.

This sector was not identified to be a key source for any of the pollutants.

**Sector 2G: (Other product use):** NMVOC emissions were last updated with 2010 data. Annual solvent consumption was used for the estimation of emission loads from this sector. This was not removed so as not to cause a considerable dip in the time series analysis. It is planned that future improvements will consider updating this sector for the entire time series.

This sector was identified to be a key source for NMVOC.

**Sector 2H2: (Food and Beverages industry):** This was last updated with 2000 data. The emission load for NMVOC was not removed since it would cause a considerable dip in the time series analysis. It is planned that future improvements will consider updating this sector for the entire time series.

This sector was not identified to be a key source for any of the pollutants.

## Chapter 5: Agriculture (NFR sector 3)

**Sector 3B1a: (Manure Management):** This sector was last updated in 2015. Emissions from agriculture were estimated from Tier 1 emission factors obtained from the EEA/EMEP guidebook 2013 while activity data used consisted of the annual average number of animals for each livestock category which was obtained from the National Statistical Office (NSO). The animals considered for this exercise were cattle, fattening pigs and sows, sheep, horses, laying hens and broilers. Information on the state of manure was obtained from the Rural Development Department-Agriculture Directorate in the Ministry for Sustainable Development, the Environment and Climate Change. The pollutant loads estimated were those of NH<sub>3</sub>, TSP, PM<sub>10</sub> and PM<sub>2.5</sub>. NMVOC was not calculated since no data on silage feeding was available. The animals making up the sector 'other poultry' included geese, ducks and turkeys and sector 'other animals' included rabbits. Activity data from the latter two sectors were provided by the Climate Change Team. Data on horses was also made available from the Climate Change team which was calculated by extrapolation from 2013 data obtained from the Farm Structure Survey (NSO). On the other hand, the annual number of

mules and asses was not made available. Future improvements will consider updating this sector for the entire time series.

Sector 3B1a, 3B3, 3B1b and 3B4gi were identified as key source categories for NH<sub>3</sub>; 3B4gi and 3B4gii were identified as key source categories for TSP while 3B4gii was identified as a key source category for PM<sub>10</sub>.

It is worth pointing out that sectors 3B4gi and 3B4gii were estimated using a Tier 1 methodology (probably an overestimate) while the road transport sector was estimated using a Tier 3 methodology. This is thought to be the reason behind the relatively high contribution to PM<sub>10</sub> and TSP emissions observed in the key source analysis compared to the contribution by the road transport sector.

**Sector 3Da1: (Inorganic N-fertilisers (includes also urea)):** This sector was last updated with 2015 data. Prior to this submission, the NH<sub>3</sub> load was last updated in 2012. The EEA/EMEP guidebook 2016 defines emissions originating from this sector as 'Emissions that arise during and after the application of N fertilisers to land'. The ammonia emission load was estimated from the methodology followed by the climate change team. An estimate of the utilized agricultural area equivalent to 11846.47 Ha was multiplied with the rate of nitrogen (N) application to land which was equivalent to 55 kg N/Ha (both figures provided by the climate change team). The product represented the N input to land from synthetic fertilizers and this was ultimately multiplied by the default factor of NH<sub>3</sub> applied to land, which was obtained from the EEA/EMEP guidebook of 2016. Future submissions will look in to the use of the methodology made available in the 2016 EEA/EMEP guidebook.

**Sectors 3Da2a: (Animal manure applied to soils) and 3Da3: (Urine and dung deposited by grazing livestock):** This sector was last updated for 2015 data. The annotation key of 'IE' was used for NH<sub>3</sub> under NFR code 3Da2a (Animal manure applied to soils) and 3Da3 (Urine and dung deposited by grazing animals). Emissions related to the two sectors were included under sector 3B1a (Manure Management).

**Sector 3Da2b: (Sewage sludge applied to soils):** No official data exists on the amount of sewage sludge applied to soils hence this sector was not updated and the notation key 'NO' was used.

**Sector 3Da2c: Other organic fertilizers applied to soils (including compost):** Official reported waste data shows that no composting was produced in 2015.

**Sectors 3Da4: (Crop residues applied to soils) and 3Db: (Indirect emissions from managed soils) and 3.Dd (Off-farm storage, handling and transport of bulk agricultural products), 3.De Cultivated Crops and 3Df Use of pesticides:** The notation key 'NE' was used for each of these sectors since they are not considered as areas of main concern.

**Sector 3Dc: Farm-level agricultural operations including storage, handling and transport of agriculture products.** Emissions from transport of agricultural products were included in sector 1A4ci the Agriculture/Forestry/Fishing: Stationary

**Sector 3.F: Field burning of agriculture residues:** No data was made available for this sector.

## Chapter 6: Waste (NFR sector 5)

**Sector 5A: (Biological Treatment of Waste-Solid waste disposal on land):** Emissions from this sector were last updated with 2015 activity data. Solid waste was disposed at an engineered landfill called 'Ghallis Non Hazardous Landfill Facility'.

Data was obtained from the waste team at the Ambient Quality and Waste unit at ERA. The weight of waste disposed at the landfill was reported for a set of European Waste Codes (EWC). The total quantity of waste disposed amounted to 278.18kt. The waste load consisting of animal manure (NFR-3B) amounted to 1.54kt (EWC 02 01 06 – animal faeces and manure) and that consisting of digestate (EWC 19 06 04) produced from municipal organic waste by anaerobic treatment at biogas facility (NFR-5B2) amounted to 2.79kt. Both waste types were subtracted from the total amount of solid waste disposed at the landfill to avoid double counting of emissions. The Tier 2 methodology applied to estimate NMVOC, TSP, PM<sub>2.5</sub> and PM<sub>10</sub> from this sector was obtained from the 2016 EEA/EMEP guidebook.

This sector was not identified as being a key source category for any pollutant.

**Sector 5B2: (Biological Treatment of waste-anaerobic digestion at biogas facilities):** This sector was estimated for the first time with 2015 activity data which was made available from the Ambient Quality and Waste team at ERA. The equation below was used to calculate emissions based on a Tier 2 methodology obtained from the 2016 guidebook.

$$E_{NH_3} = AR_{feedstock} \times \sum_{stages} EF_{NH_3-N_{stage\ i}} \times 17/14$$

**Equation 3: Equation for the estimation of waste anaerobic digestion at biogas facilities**

**AR feedstock** is the total annual amount of N in feedstock, in kg a-1. This was derived using the following method: The default factor for N content in municipal organic waste (fresh matter content) obtained from table 3.7 of the 2016 EEA/EMEP guidebook was multiplied with the annual mass of waste inputted in the digester to acquire the total N in feedstock for the year of 2015.

The emission factor for NH<sub>3</sub>-N for stage i (i is the **pre-storage**, digester, separation of digestate and storage of digestate) is related to **N in feedstock**, in kg NH<sub>3</sub>-N per kg N and made available in the 2016 EEA/EMEP guidebook.

The annual amount of N in feedstock was multiplied by the emission factors of nitrogen in ammonia for the **pre-storage** and **storage of non-separation of digestate** stage. Emissions from the *digester stage* were considered to be negligible (as suggested in the guidebook) and those related to *separation of digestate* were not included since digestate was not separated. Future submissions will consider an update of the entire time series based on the above methodology.

This sector was not identified to be a key source for any of the pollutants in the NFR-14 template.

**Sector 5C1bv (Cremation):** This sector was last updated with 2015 data. Each type of waste was incinerated collectively hence emissions from sectors 5C1a (municipal waste incineration), 5C1bi (industrial waste incineration) and 5C1biii (clinical waste incineration) were reported under sector 5C1bv. Industrial Waste Incineration included hazardous waste incineration (5C1bii). No sewage sludge incineration (5C1biv) was reported for the year 2015 and it is being assumed that it has been disposed at the landfill hence emissions were included in sector 5A.

The 2015 Annual Environment Report of the Marsa Thermal Treatment Facility (MTTF) illustrated the amounts of different waste streams treated at the incineration facility and these were grouped as shown below;

**Table 8: Waste streams treated at MTTF in 2015.**

Animal by products	5024.62t	Cremation
Oil contaminated material + pharmaceutical waste + paints	203.28t	Industrial
clinical	361.74t	Clinical
Expired food waste	141.26t	MSW

The MTTF AER report included the emission loads of NO<sub>x</sub>, SO<sub>x</sub>, TOC (NMVOC), NH<sub>3</sub>, TSP and CO all of which were measured by CEMS. All other pollutants were estimated by means of Tier 1 emission factors as made available in the EEA/EMEP guidebook 2013.

The methodology for the estimation of PM<sub>2.5</sub> and PM<sub>10</sub> emission loads was based on the direct measurement of the TSP load, the same approach was followed in sector 1A1a but with the factors for incineration.

This sector was not identified as a key source for any of the pollutants.

With the exception of road transport, BC for other sectors was calculated based on the methodology made available in the 2016/2013 EEA/EMEP guidebook, where the emission factors used were a percentage of PM<sub>2.5</sub>. As has already been stated, point sources such as power generation and incineration were calculated by multiplying TSP loads from automated measurement systems by the ratio of Tier 1 factors for PM<sub>2.5</sub> to that of TSP from the guidebook. Therefore, it is likely that inaccuracies in the estimates add up.

**Sector 5C2: (Open burning of waste):** Emissions from this sector were not estimated and are being considered as 'not observed – NO'.

**Sector 5D2: (Industrial wastewater handling):** Emissions from this sector were estimated for the first time using 2015 activity data. Latrines as defined in the guidelines are very uncommon in Malta and therefore the main source of emissions from this sector was assumed to originate from waste water treatment plants. There are four waste water treatment plants in Malta, all of which are managed by the Water Services Corporation (Water services Annual Report 2015). The total amount of waste water handled by each of the four plants was equivalent to 22 million cubic meters including domestic and non-domestic discharges such as industrial and farmyard related waste.

The table below illustrates the volume of waste water treated at each plant.



**Table 9: List of waste water treatment plants in the Maltese Islands**

<b>Name of Plant</b>	<b>Volume of waste water treated</b>
Ta'Barkat	15.86m <sup>3</sup>
Iċ-Ċumnija	3.15m <sup>3</sup>
Gozo	1.66m <sup>3</sup>
Sant Antnin	1.51m <sup>3</sup>

Each plant treated domestic, industrial and other type of wastes collectively therefore the estimated emission loads were included under the sector **Industrial wastewater handling (5D2)**. Emissions from the **Domestic wastewater handling (5D1)** sector were given the annotation key IE while emissions from the **Other wastewater handling (5D3)** sector were given the annotation key NO. NMVOC emissions from this sector were estimated based on Tier 1 methodology as made available in the EEA/EMEP guidebook 2016.

This sector was not identified as being a key source category for any of the pollutants included in the NFR-14 template.

## **Chapter 7. Projections, Reporting of gridded emissions and LPS**

This report will be updated to include Projections, gridded emissions and reporting of LPS.

## Chapter 8. References

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