2024 SUBMISSION

MALTA'S ANNUAL INFORMATIVE INVENTORY

Submission under the UNECE Convention on Long-range Transboundary Air Pollution and Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants

Emission inventories from 1990 to 2022

MALTA'S ANNUAL INFORMATIVE INVENTORY REPORT, 2024
FOR REFERENCE YEAR 2022

REPORT PURSUANT TO

The UNECE Convention on Long-Range Transboundary Air Pollution and Directive (EU) 2016/2284 on the Reduction of National Emissions of Certain Atmospheric Pollutants

PREPARED BY THE ENVIRONMENT AND RESOURCES AUTHORITY

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Glossary of terms

Table 1: Glossary of terms

Term	Definition
2023GB	2023 guidebook
AAP	Annual animal population (animal heads)
AD	Anaerobic Digester
AER	Annual environment report
As	Arsenic
ATV	All-Terrain Vehicle
BC	Black Carbon
BPR	Bureau of public roads
Cd	Cadmium
CEMS	Continuous emission monitoring system
CH_4	Methane
CLRTAP	Convention on Long-range Transboundary Air Pollution
CO	Carbon monoxide
COVID-19	Coronavirus disease - Severe acute respiratory syndrome coronavirus 2
Cr	Chromium
Cu	Copper
D3PG	D3 Power Generation Limited
EEA	European Environment Agency
EF	Emission factors
EGM	Electrogas Malta
EGTEI	Expert group on techno-economic issues
EI	Emission inventory
EMEP	European Monitoring and Evaluation Programme
ERA	Environment and Resources Authority
EU	European Union
EUROSTAT	Statistical office of the European Union
EV	Electric vehicles
EWA	Energy and Water Agency
EWC	European waste catalogue

FAOSTAT	Food and Agriculture Organization corporate statistical database
GCV	Good Commercial Vehicles
GE	Gross Feed Intake
GHG	Greenhouse Gas
GVA	Gross Value Added
GVW	Gross Vehicle Weight
HCB	Hexachlorobenzene
HDV	Heavy duty vehicle
HFO	Heavy fuel oil
Hg	Mercury
ICE	Internal combustion engine
IE	Included elsewhere
IEF	Implied Emission Factors
IFR	Instrument Flight Rules
IIR	Informative inventory report
IPCC	Intergovernmental panel on climate change
KPH	Milk breeders co-operative
LCV	Light commercial vehicles
LPG	Liquefied petroleum gas
LTO	Landing and Take-off cycle
MA	Mean activity
MC	Motorcycles
MDP	Malta Dairy Products
MEEE	Ministry for the Environment, Energy and Regeneration of the Grand Harbour
MPS5	Marsa Power Station Turbine 5
MRA	Malta Resources Authority
MTP	Mechanical Treatment Plant
MTTF	Malta Thermal Treatment Facility
NA	Not applicable
NAPCP	National Air Pollution Control Programme
NE	Not estimated

NECD	Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC
NEX	Nitrogen excretion
NFR	Nomenclature for reporting
NFR1	Energy Sector
NFR2	IPPU Sector
NFR3	Agricultural Sector
NFR5	Waste Sector
Ni	Nickel
NMVOC	Non-methane volatile organic compounds
NO	Not occurring
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSO	National Statistics Office
NTM	National transport model
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PC	Passenger cars
PCB	Polychlorinated Biphenyls
PCDD/Fs	Polychlorinated Dibenzodioxins/ Dibenzofurans
PHEV	Plug-in hybrid electric vehicles
PI	Projections Inventory
PM_{10}	Particulate matter of size 10 microns
$PM_{2.5}$	Particulate matter of size 2.5 microns
POPs	Persistent Organic Pollutants
ppm	Parts per million
QA/QC	Quality assurance and quality control
REWS	Regulator of Energy and Water Services
S.L.	Subsidiary legislation
SCR	Selective catalytic reduction
Se	Selenium
SO_2	Sulphur dioxide

SO_x	Sulphur oxides
SPED	Strategic Plan for the Environment and Development
SPV	Special Purpose Vehicles
STS	Special Trade Statistics
TERT	Technical Expert Review Team
TFTEI	Task Force on Techno-Economic Issues
TM	Transport Malta
TSP	Total Suspended Particles
TU	Tractor Unit
UAA	Utilized Agricultural Area
UNECE	United Nations economic commission for Europe
UNFCCC	United Nations framework convention on climate change
VERA	Vehicle Registration and Administrative System
Vkm	Vehicle/kilometres (mileage or activity)
VRT	Vehicle roadworthiness testing
VS	Volatilized Solids
WaM	With additional measures
WM	With measures
YOM	Year of manufacture
Zn	Zinc

1 Executive summary

Chapter Updated: 2024

Malta's Annual Informative Inventory Report (IIR) and the NFR tables covering years 1990 to 2022 (submitted in digital format) represent Malta's official submission under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP) and under Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants (NECD). The Environment and Resources Authority in its role as the national regulator for ambient air quality compiles Malta's IIR and emission inventories.

As a party under the CLRTAP and a Member State, with responsibilities under the NECD, Malta is required to report emissions of air pollutants as follows:

Nitrogen oxides (NO_x), Sulphur oxides (SO_x), Non-Methane Volatile Organic Compounds (NMVOC), Ammonia (NH_3), Particulate Matter (PM) - fine fraction - $PM_{2.5}$ and coarse fraction - PM_{10}, Total Suspended Particles (TSP), Black Carbon (BC), Carbon monoxide (CO), heavy metals including; Lead (Pb), Cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr), Copper (Cu), Nickel (Ni), Selenium (Se) And Zinc (Zn), Persistent Organic Pollutants (POPs) including; Polychlorinated dibenzodioxins/ dibenzofurans (PCDD/Fs), Polycyclic aromatic hydrocarbons (PAHs), Hexachlorobenzene (HCB) and Polychlorinated biphenyls (PCBs).

In order to fulfil these reporting obligations, Malta compiles an annual Emission Inventory (EI), a biennial Projections Inventory (PI) and an Informative Inventory Report, which provides a description of the data sources used, the methodologies applied to estimate emissions for the aforementioned air pollutants. This year the IIR includes information on the entire historical time series from 1990 to 2022 together with information on quality assurance and quality control (QA/QC), uncertainties and recalculations, trends and planned improvements for the years to come.

1.1 Modifications from previous submissions

As a result of continuous improvements, Malta carried out recalculations for several sectors based on updated activity data sources or improved methodologies. The following points provide a summary of the major changes carried out this year, which can be viewed as Malta's efforts to improving the emission inventory. The emission inventory guidebook was updated in 2023 and hence new emission factors were used across all sectors within this submission.

- The Eurostat Energy Balance provided revised values for fuel consumption for data years 2018 onwards. This change impacted most sectors within NFR 1.
- For the Road Transport (1A3bi - 1A3bvii) sector, an updated model (COPERT 5.7.2) was used to estimate emissions. In addition, improvements were made in the post-2010 stocks. Additionally, improvements in vehicle kilometerage (VKM) were carried out for the L-category to take into consideration the drastic rise in food delivery services as of 2020. Furthermore, the calculations for the non-exhaust emissions of electric vehicles (EV) has shifted to a tier 3 methodology using COPERT to estimate emissions for Passenger Cars. Malta also included other vehicle category EVs as Passenger Cars using a multiplication factor based on VKM to take into consideration their size and mileage.
- The National Navigation sector (1A3dii) Valletta Ferry Services provided fuel data from 2015 till 2019 for the first time in this submission. Furthermore, the technology specific emission factors were refined to match vessel technology in line with the specifications of Regulation 13 within MARPOL Annex VI.
- For Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery sector (1A4cii), an updated model was used to include a shift in emission factors based on technological improvements across the time series.
- For sector Other, Mobile (including military, land based and recreational boats) (1A5b) a change in emission factors was carried out to include the share of 2-stroke and 4-stroke vessels as well as vessels compliant with directive 2003/44/EC.
- For sector 2D3b (Road paving with asphalt) an updated model was used to move this sector from a tier 1 to a tier 2.
- Sectors 2D3e and 2D3f (Degreasing and Dry Cleaning, respectively) were calculated for the first time in this submission.

- Beer production was estimated for the first time within sector 2H2 (Food and Beverage)
- A new sector was included for the first time with this submission under Crop Production and Agricultural Soils, namely Crop residues applied to soils (3Da4).
- The number of animal heads, weight and the nitrogen excretion rate was updated for most livestock types.
- Emissions of NMVOC from the application of manure were included within Animal manure applied to soils (3Da2a).
- The incorporation of mineral waste handling, specifically recycling practices, into the activity data for solid waste disposal on land, 5A sector.
- The extraction of manure from the overall fresh feedstock, enabling the separate calculation of nitrogen (N) in the feedstock for biological treatment of waste, 5B2 sector. As well as acknowledgment of digested material storage conditions which prompted a change in the calculation methodology.
- The proportion of detached houses, undetached houses, and apartments catching fire, was updated with the latest 2021 Census for other waste, 5E sector.
- A new sector covering the emissions generated through the excretion of cats and dogs was included for the first time with this submission, and reported under the 'Other' sector (6A).

Further details on improvements and recalculations under all NFR sectors can be found under their respective chapters.

1.2 Incompleteness or inconsistencies in the time series

Despite attempts to minimize discrepancies in Malta's emission inventory, a significant inconsistency that exists in multiple sectors is the lack of uniformity in activity data throughout the entire time series. In terms of the power generation sector activity data from 2005 onwards is rather accurate since a continuous emission monitoring system (CEMS) is used, whereas for pre-2005 data the activity data used is the fuel consumed as provided by Eurostat's energy Balance. Another example of this is the aviation sector, activity data prior to 1999 was sourced from the Civil Aviation Department at Transport Malta, while data from 1999 to 2004 was provided by the Malta International Airport. Post-2004 data was computed directly by EUROCONTROL. Having different data sources throughout the time series results in inaccuracies.

1.3 A brief of changes in emission trends

A brief summary of the trends across the main five pollutants is presented below.

- Nitrogen oxides (NO_x):
    - The energy sector is the dominant source of this pollutant. This is seen throughout the entire time-series from 1990 to 2022. In 2005, the total NOx emissions were at 9.57kt, which have since decreased to 4.54kt in 2022.
- Non-Methane Volatile Organic Compounds (NMVOC):
    - The energy sector is the dominant source of this pollutant. However, the IPPU and the Agricultural sector also feature quite prominently, particularly in recent years. In 2005, the total NMVOC emissions were at 3.57kt, which have since decreased to 2.25kt in 2022.
- Sulphur oxides (SO_x):
    - Yet again, the energy sector is the dominant source of this pollutant and has been throughout the entire time series. Malta recorded a drastic decrease in emissions under this sector from 12.22kt in 2005 to 0.16kt in 2022.
- Ammonia (NH_3):
    - Contrary to other pollutants, the agricultural sector is the dominant source of this pollutant. In 2005, the total NH_3 emissions were at 1.87kt, which have since decreased to 1.58kt in 2022.
- Fine Particulate Matter ($PM_{2.5}$):
    - The energy sector is the dominant source of this pollutant with IPPU also contributing in recent years. In 2005, the total $PM_{2.5}$ emissions were at 0.75kt, which have since decreased to 0.38kt in 2022.

2 Introduction

Chapter Updated: 2024

The Environment and Resources Authority (ERA) is tasked with the responsibility of assembling the national emission inventories and submitting them to the European Commission in accordance with the National Emission Ceilings Directive (NECD) and the Convention on Long-Range Transboundary Air Pollution (CLRTAP). Within ERA, the emission inventory team is accountable for all activities related to compiling the national emission inventory of air pollutants, which includes estimating emissions and preparing associated reports.

Under the revised 2023 EMEP/EEA Air Pollutant Emission Inventory Guidebook, all Member States must annually report national emissions of Sulphur oxides (SO_x), Nitrogen oxides (NO_x), Non-Methane Volatile Organic Compounds (NMVOC), Carbon monoxide (CO), Ammonia (NH_3), Particulate matter ($PM_{2.5}$, PM_{10}, BC & TSP), various heavy metals, and POPs.

Directive (EU) 2016/2284, came into force on December 14, 2016, and was transposed into national legislation via Subsidiary Legislation (S.L.) 549.124. Malta published the National Air Pollution Control Programme (NAPCP) in 2020, which outlines the strategies, policies, and measures that have been implemented and those planned for implementation to adhere to the national emission reduction commitments specified in Annex II of NECD for the years 2020 and 2030.

2.1 National inventory background & institutional arrangements

As per the NECD requirements, an annual Informative Inventory Report (IIR) must be submitted, detailing the compilation process of the emission inventory for all relevant pollutants, including updates on methodologies, recalculations, and other relevant sections.

The tasks related to both the emission inventory and the creation of the IIR are conducted collaboratively with various entities, including the (Maltese) National Statistics Office (NSO), the Energy and Water Agency (EWA), the Regulator for Energy and Water Services (REWS), the Malta Resources Authority (MRA), Transport Malta (TM), as well as pertinent public entities (such as ministries, departments, and regulatory agencies) and private establishments. Annex II provides a concise list of all contributing entities that provide relevant activity data for the report's compilation. The diagram below outlines the responsibilities of each entity involved in this process.

Within its role as the compiler of the Emission Inventory (EI) and IIR, the ERA gathers all necessary data and information from the relevant entities to estimate emissions for all pollutants across the entire time series. The compiled data, along with methodological notes and correspondence, are stored within ERA's mainframe system.

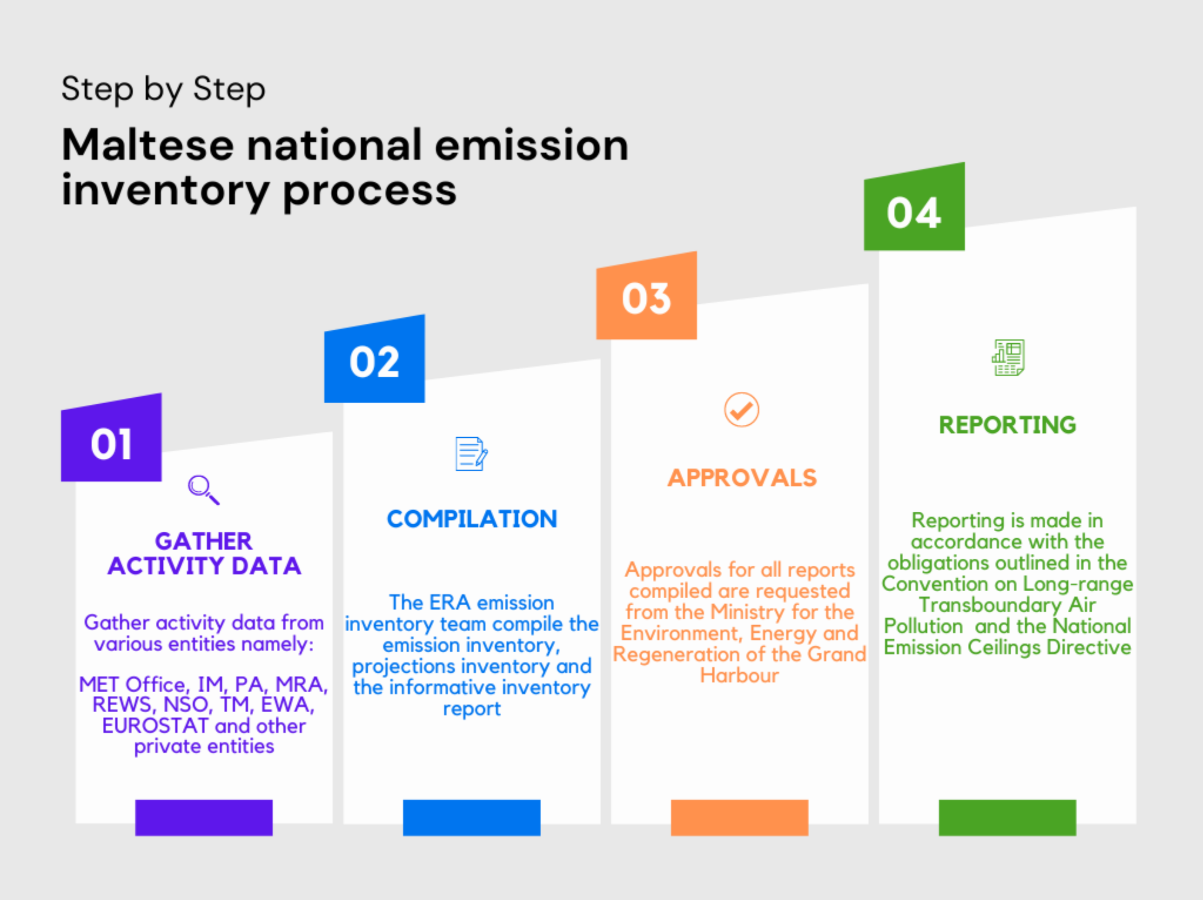

Figure 1: The Maltese national emission inventory process

2.2 Inventory preparation process

As previously mentioned, the ERA is responsible for the compilation of the EI, PI and the IIR. The following sections provide a description of the main responsibilities of ERA.

2.2.1 Inventory preparation & management

The team responsible for managing the emissions inventory conducts various tasks, including gathering data from relevant authorities, calculating emissions, and preparing reports. Throughout this process, meetings are held with officers from other public authorities.

The inventory team comprises of four primary compilers, one assistant compiler, and a manager who supervises the entire compilation process. All discussions regarding inventory planning, preparation, and management occur centrally. Specific category-related issues are presented by the corresponding inventory focal point and discussed internally as a team.

Regular communication occurs between the air emission inventory team and the MRA's inventory team, which handles Greenhouse Gas (GHG) inventory compilation. These two entities exchange data, share methodological experiences and assumptions, and are collaborating on establishing a shared dataset. When additional expertise beyond the Authority is required, other expert groups and a consultancy firm are brought in to assist in the compilation process.

2.2.2 Inventory planning

Inventory planning commences annually following the submission process. This initial phase involves researching enhancements to current data. Activities during this period include engaging stakeholders and data providers, fostering relationships with potential contributors, and collaborating with national entities for studies on national air pollution emissions and any new information available. Discussions also focus on the necessity of updating datasets to refine assumptions utilized by various entities sharing the same data. Effective collection of essential activity data hinges on the strong rapport between the inventory team and data providers.

2.2.3 Inventory improvements

Prioritization of improvements is based on their significance, determined by their potential impact on key categories and their influence on meeting emission ceilings. The Technical Expert Review Team (TERT) identifies these areas for improvement, which are then discussed and ranked by the inventory team.

Efforts are underway within the inventory team to pinpoint missing data sources and explore methods for enhancement. This involves reviewing activity data necessary for addressing gaps and making tier 1 estimations. Malta aims to transition to higher tiers whenever feasible to obtain more precise country-specific emission estimates.

2.3 Methods and data sources

The methodology used in compiling this year's emission inventory was mainly based on the 2023 EMEP/EEA Air Pollutant Emission Inventory Guidebook.

Equation 1 shows the basic equation for the compilation of the emission inventory.

$$emission\ load = activity\ data * emission\ factor$$

Equation 1: Basic equation to estimate emission loads

Further information on the specific methodologies used for each sector is included under each chapter together with a detailed description of the activity data used to estimate emission loads.

2.3.1 Finalization, publication and submission of the inventory

As with all other Member States, Malta submits the inventory to the CLRTAP/UNECE and NEC Directive/European Commission on February 15th annually. Reported data in the submission of year X relates to emissions for year X-2, in other words emissions, which took place during 2022, are reported in early 2024.

2.3.2 Data storage

Concerning storage of files, all activity data, compilation files, inventory submissions and IIRs are digitally stored in a server, accessible to members of the inventory team. Data is updated annually by the inventory team.

2.4 Key category analysis

In this submission, *Approach 1 of the level of assessment* of emissions was calculated in line with the methodology presented within the EMEP/EEA Air Pollutants Emission Inventory Guidebook 2023. Key categories are defined as follows:

"Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80 % of the total level".

The key category analysis for this submission can be found in Section 14.

2.5 QA/QC and verification methods

The inventory team has recognized the necessity of establishing a Quality Assurance/Quality Control (QA/QC) system within the national emission inventory to uphold a high standard of quality and reliability during compilation. Efforts to develop this system commenced two years ago, aiming to align all processes with principles of transparency, accuracy, consistency, comparability, and completeness. For this submission, the team utilized the best available data sources, incorporating in-situ monitoring data in specific sectors like power generation and cremation. Sectoral experts focused on improving model clarity and reproducibility of the emissions inventory through model enhancements.

Each sector underwent a QA/QC exercise, ensuring correctness of input activity data, emission factors, and formulas used in models to the best of their ability. The inventory team internally verified all assumptions and criteria relevant to activity data. Additionally, meticulous checks were conducted to ensure accurate unit conversions throughout the inventory, with results and pollutant trends analysed using an in-house trend checker model. This model considers year-on-year variances and changes in emissions compared to the previous submission (2024 for reporting year 2022).

2.6 General uncertainty evaluation

In an inventory process, uncertainty estimates are an essential element. Uncertainties are associated with both the activity data and emission factors, and are therefore reflected in the results. This year was Malta's third time incorporating an uncertainty assessment in its IIR for the historical emissions. Section 3 provides an in depth account of how this was carried out together with the uncertainties for each sector for the main five pollutants; Nitrogen oxides (NO_x), Sulphur oxides (SO_x), Non-Methane Volatile Organic Compounds (NMVOC), Ammonia (NH_3), and fine Particulate matter ($PM_{2.5}$).

2.7 General assessment of completeness

This submission includes the estimation of emissions from all the relevant sources and emissions listed in the NFR-19 template and explained in the EMEP/EEA air pollutant emission inventory guidebook 2023. Each chapter includes a comprehensive explanation on the use of notation keys for all the relevant sectors. The NFR as reported by Malta makes use of four notation keys: NO (Not Occurring), NA (Not Applicable), NE (Not Estimated) and IE (Included Elsewhere).

- NO refers to "categories or processes within a particular source category that do not occur within a Party".
- NA refers to "activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant".
- NE refers to instances where "for activity data and/or emissions by sources of pollutants which have not been estimated but for which a corresponding activity may occur within a Party".
- IE refers to instances where the "emissions by sources of pollutants estimated but included elsewhere in the inventory instead of under the expected source category".

3 Uncertainty assessment

Chapter Updated: 2024

The uncertainty analysis was carried out for the main pollutants NO_x, SO_x, NMVOCs, NH_3, PM_{10} and $PM_{2.5}$, based on emission data for the base year 2005 and the reporting reference year 2022. For this year's submission, Malta is making use of a tool developed by external consultants. The said tool provides detailed uncertainties to Malta's emission inventory.

3.1 Methodology

The uncertainty assessment depends on the uncertainty associated with every type of data used to inform the inventory. The method used for this assessment is Approach 1 as described in the EMEP/EEA Guidebook (2023). This method was applied to all pollutants included in Malta's uncertainty analysis namely; NO_x, SO_x, NMVOCs, NH_3, PM_{10} and $PM_{2.5}$. Malta used the error propagation method, which estimates uncertainties by source category as well as the overall uncertainty for one year (2022) and the uncertainty in the trend. The Approach 1 method (error propagation) was considered more favourable than Approach 2 (Monte Carlo Simulation) method as it provides a good indication of the uncertainty per pollutant.

3.2 Data sources

Quantification of both activity data uncertainties and emission factor uncertainties were calculated in order to estimate the overall uncertainty for each sector and each main pollutant. Malta makes use of the uncertainties of activity data at sectoral level based on the GHG uncertainty analysis coupled with the application of expert judgement.

In cases where uncertainties were not available, Table 2-1 of Chapter 5 of the EMEP/EEA Guidebook (2023) was used to assign a percentage uncertainty based on the source of data.

3.3 Results

As highlighted in previous sections, the quantitative uncertainty assessment was carried out using Approach 1 in accordance with the methodology laid out in the EMEP/EEA Guidebook (2023) for the following main pollutants NO_x, SO_x, NMVOC, NH_3, PM_{10} and $PM_{2.5}$ for 2022.

The estimated uncertainties are shown in Table 2 below, which includes all sectors reported.

Table 2: Table containing emissions (kt) and uncertainty estimates by pollutant

Pollutant	2022 Emissions (kt)	Contribution to Variance by Category in Year 2022	Combined Uncertainty in Trend in Total Emissions
NH_3	1.5833	32%	12%
NMVOC	2.7139	29%	3%
NO_x (as NO_2)	4.7315	31%	3%
PM_{10}	1.8328	55%	6%
$PM_{2.5}$	0.3789	33%	2%
SO_x (as SO_2)	0.1618	18%	3%

Further detail on the uncertainties at sectoral levels is provided in the following tables.

Table 3: Uncertainty estimation of NH_3 emissions

NH_3

Sector	Emissions (kt)	Sum of Sum of AD Uncertainty (%)	Sum of Combined Uncertainty (%)	Sum of Type A Sensitivity (%)	Sum of Type B Sensitivity (%)	Sum of Uncertainty in Trend in Total Emissions due to EF (%)	Sum of Uncertainty in Trend in Total Emissions due to AD (%)	Sum of Combined Uncertainty in Trend in Total Emissions (%)
1A1a	0.001	1.0%	100.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%
1A2gviii	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A3ai(i)	0.000	2.0%	2.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A3aii(i)	0.000	2.0%	2.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A3bi	0.038	5.0%	100.1%	-0.1%	2.0%	-0.1%	0.1%	0.0%
1A3bii	0.001	5.0%	100.1%	-0.1%	0.1%	-0.1%	0.0%	0.0%
1A3biii	0.002	5.0%	100.1%	-0.1%	0.1%	-0.1%	0.0%	0.0%
1A3biv	0.000	5.0%	100.1%	-0.1%	0.0%	-0.1%	0.0%	0.0%
1A3bv	0.000	0.0%	100.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%
1A3bvi	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A3bvii	0.000	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A3dii	0.000	2.0%	2.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A4ai	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A4bi	0.000	5.0%	100.1%	-0.1%	0.0%	-0.1%	0.0%	0.0%
1A4cii	0.000	5.0%	100.1%	-0.1%	0.0%	-0.1%	0.0%	0.0%
1A4ciii	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
1A5b	0.065	5.0%	100.1%	-0.1%	3.5%	-0.1%	0.2%	0.0%
1B2av	0.000	10.0%	10.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2A5b	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2B10b	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2D3a	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2D3b	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%

2D3d	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2D3h	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2G	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
2H2	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
3B1a	0.002	5.0%	100.1%	-0.1%	0.1%	-0.1%	0.0%	0.0%
3B1b	0.000	5.0%	5.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
3B2	0.151	20.0%	72.8%	-0.1%	8.2%	-0.1%	2.3%	0.1%
3B3	0.093	20.0%	72.8%	-0.1%	5.0%	-0.1%	1.4%	0.0%
3B4d	0.012	20.0%	72.8%	-0.1%	0.7%	-0.1%	0.2%	0.0%
3B4e	0.150	20.0%	72.8%	-0.1%	8.1%	-0.1%	2.3%	0.1%
3B4f	0.009	20.0%	72.8%	-0.1%	0.5%	-0.1%	0.1%	0.0%
3B4gi	0.053	20.0%	72.8%	-0.1%	2.9%	-0.1%	0.8%	0.0%
3B4gii	0.005	20.0%	72.8%	-0.1%	0.3%	-0.1%	0.1%	0.0%
3B4giii	0.047	20.0%	72.8%	-0.1%	2.5%	-0.1%	0.7%	0.0%
3B4giv	0.056	20.0%	72.8%	-0.1%	3.0%	-0.1%	0.9%	0.0%
3B4h	0.008	20.0%	72.8%	-0.1%	0.4%	-0.1%	0.1%	0.0%
3Da1	0.000	20.0%	72.8%	-0.1%	0.0%	-0.1%	0.0%	0.0%
3Da2a	0.098	20.0%	72.8%	-0.1%	5.3%	-0.1%	1.5%	0.0%
3Dc	0.175	50.0%	103.0%	-0.1%	9.4%	-0.1%	6.7%	0.4%
3De	0.577	20.0%	72.8%	-0.1%	31.2%	-0.1%	8.8%	0.8%
3F	0.027	20.0%	92.2%	-0.1%	1.4%	-0.1%	0.4%	0.0%
5A	0.000	50.0%	50.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
5B1	0.000	50.0%	50.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
5B2	0.000	50.0%	111.8%	-0.1%	0.0%	-0.1%	0.0%	0.0%
Total	1.571	602.0%	2435.4%	-6.4%	84.9%	-3.1%	26.8%	1.4%

Table 4: Uncertainty estimation of NMVOC emissions

NMVOC

Sector	Emissions (kt)	Sum of Sum of AD Uncertainty (%)	Sum of Combined Uncertainty (%)	Sum of Type A Sensitivity (%)	Sum of Type B Sensitivity (%)	Sum of Uncertainty in Trend in Total Emissions due to EF (%)	Sum of Uncertainty in Trend in Total Emissions due to AD (%)	Sum of Combined Uncertainty in Trend in Total Emissions (%)
1A1a	0.043	1.0%	100.0%	-0.3%	1.1%	-0.3%	0.0%	0.0%
1A2gviii	0.027	5.0%	70.2%	-0.3%	0.7%	-0.2%	0.0%	0.0%
1A3ai(i)	0.014	2.0%	100.0%	-0.3%	0.4%	-0.3%	0.0%	0.0%
1A3aii(i)	0.000	2.0%	100.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
1A3bi	0.254	5.0%	100.1%	-0.3%	6.3%	-0.3%	0.4%	0.0%
1A3bii	0.026	5.0%	100.1%	-0.3%	0.6%	-0.3%	0.0%	0.0%
1A3biii	0.046	5.0%	100.1%	-0.3%	1.1%	-0.3%	0.1%	0.0%
1A3biv	0.072	5.0%	100.1%	-0.3%	1.8%	-0.3%	0.1%	0.0%
1A3bv	0.222	5.0%	100.1%	-0.3%	5.5%	-0.3%	0.4%	0.0%
1A3bvi	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
1A3bvii	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
1A3dii	0.016	2.0%	100.0%	-0.3%	0.4%	-0.3%	0.0%	0.0%
1A4ai	0.020	5.0%	70.2%	-0.3%	0.5%	-0.2%	0.0%	0.0%
1A4bi	0.008	5.0%	80.2%	-0.3%	0.2%	-0.2%	0.0%	0.0%
1A4cii	0.023	5.0%	100.1%	-0.3%	0.6%	-0.3%	0.0%	0.0%
1A4ciii	0.017	5.0%	100.1%	-0.3%	0.4%	-0.3%	0.0%	0.0%
1A5b	0.134	5.0%	100.1%	-0.3%	3.3%	-0.3%	0.2%	0.0%
1B2av	0.081	10.0%	100.5%	-0.3%	2.0%	-0.3%	0.3%	0.0%
2A5b	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2B10b	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2D3a	0.309	5.0%	100.1%	-0.3%	7.6%	-0.3%	0.5%	0.0%
2D3b	0.004	5.0%	100.1%	-0.3%	0.1%	-0.3%	0.0%	0.0%

2D3d	0.369	5.0%	100.1%	-0.3%	9.1%	-0.3%	0.6%	0.0%
2D3h	0.106	5.0%	100.1%	-0.3%	2.6%	-0.3%	0.2%	0.0%
2G	0.000	5.0%	100.1%	-0.3%	0.0%	-0.3%	0.0%	0.0%
2H2	0.343	5.0%	100.1%	-0.3%	8.5%	-0.3%	0.6%	0.0%
3B1a	0.003	5.0%	100.1%	-0.3%	0.1%	-0.3%	0.0%	0.0%
3B1b	0.090	5.0%	83.2%	-0.3%	2.2%	-0.3%	0.2%	0.0%
3B2	0.064	20.0%	102.0%	-0.3%	1.6%	-0.3%	0.4%	0.0%
3B3	0.018	20.0%	102.0%	-0.3%	0.5%	-0.3%	0.1%	0.0%
3B4d	0.002	20.0%	102.0%	-0.3%	0.1%	-0.3%	0.0%	0.0%
3B4e	0.001	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4f	0.001	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4gi	0.012	20.0%	102.0%	-0.3%	0.3%	-0.3%	0.1%	0.0%
3B4gii	0.001	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4giii	0.033	20.0%	102.0%	-0.3%	0.8%	-0.3%	0.2%	0.0%
3B4giv	0.087	20.0%	102.0%	-0.3%	2.2%	-0.3%	0.6%	0.0%
3B4h	0.002	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Da1	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Da2a	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Dc	0.000	50.0%	50.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
3De	0.234	20.0%	102.0%	-0.3%	5.8%	-0.3%	1.6%	0.0%
3F	0.000	20.0%	20.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
5A	0.000	50.0%	50.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
5B1	0.005	50.0%	111.8%	-0.3%	0.1%	-0.3%	0.1%	0.0%
5B2	0.000	50.0%	111.8%	-0.3%	0.0%	-0.3%	0.0%	0.0%
Total	2.688	612.0%	3995.5%	-14.3%	66.4%	-11.8%	7.2%	0.1%

Table 5: Uncertainty estimation of NO_x emissions

NO_x (as NO_2)

Sector	Emissions (kt)	Sum of Sum of AD Uncertainty (%)	Sum of Combined Uncertainty (%)	Sum of Type A Sensitivity (%)	Sum of Type B Sensitivity (%)	Sum of Uncertainty in Trend in Total Emissions due to EF (%)	Sum of Uncertainty in Trend in Total Emissions due to AD (%)	Sum of Combined Uncertainty in Trend in Total Emissions (%)
1A1a	0.553	1.0%	100.0%	-0.5%	5.7%	-0.5%	0.1%	0.0%
1A2gviii	0.283	5.0%	70.2%	-0.5%	2.9%	-0.3%	0.2%	0.0%
1A3ai(i)	0.216	2.0%	100.0%	-0.5%	2.2%	-0.5%	0.1%	0.0%
1A3aii(i)	0.001	2.0%	100.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
1A3bi	0.734	5.0%	100.1%	-0.5%	7.5%	-0.5%	0.5%	0.0%
1A3bii	0.427	5.0%	100.1%	-0.5%	4.4%	-0.5%	0.3%	0.0%
1A3biii	0.838	5.0%	100.1%	-0.5%	8.6%	-0.5%	0.6%	0.0%
1A3biv	0.006	5.0%	100.1%	-0.5%	0.1%	-0.5%	0.0%	0.0%
1A3bv	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
1A3bvi	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
1A3bvii	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
1A3dii	0.582	2.0%	70.0%	-0.5%	6.0%	-0.3%	0.2%	0.0%
1A4ai	0.140	5.0%	70.2%	-0.5%	1.4%	-0.3%	0.1%	0.0%
1A4bi	0.028	5.0%	80.2%	-0.5%	0.3%	-0.4%	0.0%	0.0%
1A4cii	0.162	5.0%	80.2%	-0.5%	1.7%	-0.4%	0.1%	0.0%
1A4ciii	0.244	5.0%	100.1%	-0.5%	2.5%	-0.5%	0.2%	0.0%
1A5b	0.316	5.0%	100.1%	-0.5%	3.3%	-0.5%	0.2%	0.0%
1B2av	0.000	10.0%	10.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2A5b	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2B10b	0.000	0.0%	0.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2D3a	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2D3b	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%

2D3d	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2D3h	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2G	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
2H2	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
3B1a	0.001	5.0%	100.1%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B1b	0.000	5.0%	5.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
3B2	0.002	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B3	0.001	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4d	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4e	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4f	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4gi	0.001	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4gii	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4giii	0.002	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4giv	0.002	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3B4h	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3Da1	0.000	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3Da2a	0.003	20.0%	102.0%	-0.5%	0.0%	-0.5%	0.0%	0.0%
3Dc	0.082	50.0%	111.8%	-0.5%	0.8%	-0.5%	0.6%	0.0%
3De	0.095	20.0%	102.0%	-0.5%	1.0%	-0.5%	0.3%	0.0%
3F	0.000	20.0%	20.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
5A	0.000	50.0%	50.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
5B1	0.000	50.0%	50.0%	-0.5%	0.0%	0.0%	0.0%	0.0%
5B2	0.000	50.0%	111.8%	-0.5%	0.0%	-0.5%	0.0%	0.0%
Total	4.719	607.0%	3106.0%	-22.5%	48.5%	-14.0%	3.5%	0.1%

Table 6: Uncertainty estimation of $PM_{2.5}$ emissions

$PM_{2.5}$

Sector	Emissions (kt)	Sum of Sum of AD Uncertainty (%)	Sum of Combined Uncertainty (%)	Sum of Type A Sensitivity (%)	Sum of Type B Sensitivity (%)	Sum of Uncertainty in Trend in Total Emissions due to EF (%)	Sum of Uncertainty in Trend in Total Emissions due to AD (%)	Sum of Combined Uncertainty in Trend in Total Emissions (%)
1A1a	0.007	1.0%	100.0%	-0.3%	0.9%	-0.3%	0.0%	0.0%
1A2gviii	0.009	5.0%	80.2%	-0.3%	1.2%	-0.2%	0.1%	0.0%
1A3ai(i)	0.002	2.0%	30.1%	-0.3%	0.2%	-0.1%	0.0%	0.0%
1A3aii(i)	0.000	2.0%	30.1%	-0.3%	0.0%	-0.1%	0.0%	0.0%
1A3bi	0.017	5.0%	100.1%	-0.3%	2.3%	-0.3%	0.2%	0.0%
1A3bii	0.022	5.0%	100.1%	-0.3%	3.0%	-0.3%	0.2%	0.0%
1A3biii	0.015	5.0%	100.1%	-0.3%	2.1%	-0.3%	0.1%	0.0%
1A3biv	0.001	5.0%	100.1%	-0.3%	0.2%	-0.3%	0.0%	0.0%
1A3bv	0.000	0.0%	0.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
1A3bvi	0.041	10.0%	100.5%	-0.3%	5.6%	-0.3%	0.8%	0.0%
1A3bvii	0.015	15.0%	101.1%	-0.3%	2.0%	-0.3%	0.4%	0.0%
1A3dii	0.007	2.0%	100.0%	-0.3%	1.0%	-0.3%	0.0%	0.0%
1A4ai	0.004	5.0%	80.2%	-0.3%	0.5%	-0.2%	0.0%	0.0%
1A4bi	0.011	5.0%	70.2%	-0.3%	1.5%	-0.2%	0.1%	0.0%
1A4cii	0.006	5.0%	100.1%	-0.3%	0.8%	-0.3%	0.1%	0.0%
1A4ciii	0.004	5.0%	100.1%	-0.3%	0.6%	-0.3%	0.0%	0.0%
1A5b	0.059	5.0%	100.1%	-0.3%	8.0%	-0.3%	0.6%	0.0%
1B2av	0.000	10.0%	10.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2A5b	0.075	5.0%	100.1%	-0.3%	10.1%	-0.3%	0.7%	0.0%
2B10b	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2D3a	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2D3b	0.026	5.0%	100.1%	-0.3%	3.4%	-0.3%	0.2%	0.0%
2D3d	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%

2D3h	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2G	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
2H2	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
3B1a	0.020	5.0%	100.1%	-0.3%	2.7%	-0.3%	0.2%	0.0%
3B1b	0.000	5.0%	5.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
3B2	0.003	20.0%	102.0%	-0.3%	0.3%	-0.3%	0.1%	0.0%
3B3	0.001	20.0%	102.0%	-0.3%	0.1%	-0.3%	0.0%	0.0%
3B4d	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4e	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4f	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4gi	0.001	20.0%	102.0%	-0.3%	0.1%	-0.3%	0.0%	0.0%
3B4gii	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3B4giii	0.001	20.0%	102.0%	-0.3%	0.2%	-0.3%	0.0%	0.0%
3B4giv	0.001	20.0%	102.0%	-0.3%	0.2%	-0.3%	0.0%	0.0%
3B4h	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Da1	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Da2a	0.000	20.0%	102.0%	-0.3%	0.0%	-0.3%	0.0%	0.0%
3Dc	0.000	50.0%	50.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
3De	0.000	20.0%	20.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
3F	0.000	20.0%	20.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
5A	0.003	50.0%	103.0%	-0.3%	0.4%	-0.3%	0.3%	0.0%
5B1	0.000	50.0%	50.0%	-0.3%	0.0%	0.0%	0.0%	0.0%
5B2	0.000	50.0%	111.8%	-0.3%	0.0%	-0.3%	0.0%	0.0%
Total	0.354	622.0%	3317.0%	-14.2%	47.6%	-9.5%	4.5%	0.0%

Table 7: Uncertainty estimation of SO_x emissions

SO_x (as SO_2)

Sector	Emissions (kt)	Sum of Sum of AD Uncertainty (%)	Sum of Combined Uncertainty (%)	Sum of Type A Sensitivity (%)	Sum of Type B Sensitivity (%)	Sum of Uncertainty in Trend in Total Emissions due to EF (%)	Sum of Uncertainty in Trend in Total Emissions due to AD (%)	Sum of Combined Uncertainty in Trend in Total Emissions (%)
1A1a	0.023	1.0%	100.0%	-0.9%	0.2%	-0.9%	0.0%	0.0%
1A2gviii	0.038	5.0%	30.4%	-0.9%	0.3%	-0.3%	0.0%	0.0%
1A3ai(i)	0.013	2.0%	30.1%	-0.9%	0.1%	-0.3%	0.0%	0.0%
1A3aii(i)	0.000	2.0%	30.1%	-0.9%	0.0%	-0.3%	0.0%	0.0%
1A3bi	0.001	5.0%	100.1%	-0.9%	0.0%	-0.9%	0.0%	0.0%
1A3bii	0.000	5.0%	100.1%	-0.9%	0.0%	-0.9%	0.0%	0.0%
1A3biii	0.001	5.0%	100.1%	-0.9%	0.0%	-0.9%	0.0%	0.0%
1A3biv	0.000	5.0%	100.1%	-0.9%	0.0%	-0.9%	0.0%	0.0%
1A3bv	0.000	0.0%	0.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
1A3bvi	0.000	2.0%	2.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
1A3bvii	0.000	2.0%	2.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
1A3dii	0.011	2.0%	30.1%	-0.9%	0.1%	-0.3%	0.0%	0.0%
1A4ai	0.028	5.0%	30.4%	-0.9%	0.2%	-0.3%	0.0%	0.0%
1A4bi	0.001	5.0%	30.4%	-0.9%	0.0%	-0.3%	0.0%	0.0%
1A4cii	0.024	5.0%	30.4%	-0.9%	0.2%	-0.3%	0.0%	0.0%
1A4ciii	0.004	5.0%	30.4%	-0.9%	0.0%	-0.3%	0.0%	0.0%
1A5b	0.016	5.0%	30.4%	-0.9%	0.1%	-0.3%	0.0%	0.0%
1B2av	0.000	10.0%	10.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2A5b	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2B10b	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2D3a	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2D3b	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2D3d	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%

2D3h	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2G	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
2H2	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B1a	0.000	5.0%	100.1%	-0.9%	0.0%	-0.9%	0.0%	0.0%
3B1b	0.000	5.0%	5.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B2	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B3	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4d	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4e	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4f	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4gi	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4gii	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4giii	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4giv	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3B4h	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3Da1	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3Da2a	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3Dc	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3De	0.000	50.0%	50.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
3F	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
5A	0.000	20.0%	20.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
5B1	0.000	50.0%	50.0%	-0.9%	0.0%	0.0%	0.0%	0.0%
5B2	0.000	50.0%	111.8%	-0.9%	0.0%	-0.9%	0.0%	0.0%
Total	0.160	571.0%	1444.1%	-42.0%	1.3%	-8.9%	0.1%	0.1%

4 Energy (NFR 1)

Chapter Updated: 2024

4.1 Category description

Table 8 shows the detailed source categories for energy. The relevant pollutant trends for key categories, as well as the methodologies used are explained in the sections below.

The sub-categories estimated in this submission are listed below.

Table 8: Coverage of NFR 1 categories in 2022

NFR Code	Pollutants			Method	KC
	Covered	Exceptions			
		NE	NA		
1A1a	Rest of Pollutants	-	HCB, PCBs	Tier 1, 2, 3	✓
1A1b	Not Occurring				✕
1A1c	Not Occurring				✕
1A2a	Not Occurring				✕
1A2b	Not Occurring				✕
1A2c	Not Occurring				✕
1A2d	Not Occurring				✕
1A2e	Not Occurring				✕
1A2f	Not Occurring				✕
1A2gvii	Included Elsewhere (reported in 1A2gviii)				✕
1A2gviii	Rest of Pollutants	-	NH_3, HCB, PCBs	Tier 1, 2	✓
1A3ai(i)	NO_x, NMVOC, SO_x, TSP, CO	-	Rest of Pollutants	Tier 3	✕
1A3aii(i)	NO_x, NMVOC, SO_x, TSP, CO	-	Rest of Pollutants	Tier 3	✕
1A3bi	Rest of Pollutants	-	-	Tier 3	✓
1A3bii	Rest of Pollutants	-	-	Tier 3	✓
1A3biii	Rest of Pollutants	-	-	Tier 3	✓
1A3biv	Rest of Pollutants	-	-	Tier 3	✓
1A3bv	NMVOC	-	Rest of Pollutants	Tier 3	✓
1A3bvi	Rest of Pollutants	Hg, PCDD/PCDF, Benzo(a)pyrene, Benzo(b)flouranthene, Benzo(k)flouranthene, Indeno (1,2,3-cd)pyrene, HCB, PCBs	NO_x, NMVOC, SO_x, NH_3, CO	Tier 3	✓
1A3bvii	$PM_{2.5}$, PM_{10}, TSP, BC	Rest of Pollutants	NO_x, NMVOC SO_x, NH_3, CO	Tier 3	✓
1A3c	Not Occurring				✕
1A3di(ii)	Not Occurring				✕
1A3dii	Rest of Pollutants	-	NH_3	Tier 2	✓

1A3ei	Not Occurring				✕
1A3eii	Not Occurring				✕
1A4ai	All pollutants	-	-	Tier 1, 2	✓
1A4aii	Included Elsewhere (reported in 1A4ai)				✕
1A4bi	All pollutants	-	-	Tier 1, 2	✕
1A4bii	Included Elsewhere (reported in 1A4bi)				✕
1A4ci	Not Occurring				✕
1A4cii	Rest of Pollutants	-	PCDD/PCDF, Indeno (1,2,3-cd)pyrene	Tier 1, 2	✓
1A4ciii	Rest of Pollutants	NH_3	PCDD/PCDF	Tier 1	✕
1A5a	Not Occurring				✕
1A5b	All pollutants	-	-	Tier 1, 2	✓
1B1a	Not Occurring				✕
1B1b	Not Occurring				✕
1B1c	Not Occurring				✕
1B2ai	Not Occurring				✕
1B2aiv	Not Occurring				✕
1B2av	NMVOC	-	Rest of Pollutants	Tier 1	✓
1B2b	Not Occurring				✕
1B2c	Not Occurring				✕
1B2d	Not Occurring				✕

NE: Not Estimated, NA: Not Applicable, KC: Key Category.

Shares of emissions from this NFR sector for all pollutants in 2022 are shown

Figure 2. Most pollutant emissions originate primarily from NFR 1.

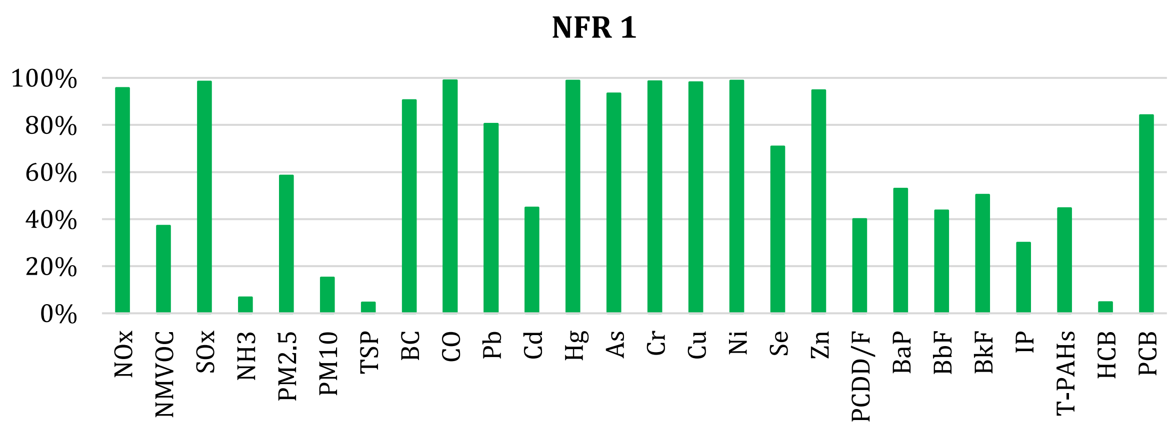

Figure 2: Shares of emissions from the NFR 1 category in percentage of national total

4.2 Sector 1A1a: Public Electricity and Heat Production

Table 9: Sector 1A1a general characteristics

NFR Code	**1A1a**
Sub-Category	Power Generation and Electricity Production
Method	2023GB
Activity Data	AER & Eurostat
Emission Factors	Tier 1, Tier 2 & Tier 3 (Direct Measurements)
Key Category	NO_x, SO_x, As & Hg
Year of Last Update	2024 submission

4.2.1 Sector description

This subcategory includes emissions of air pollutants from large combustion plants (> 50 MWth) as point sources.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in

Figure *3*.

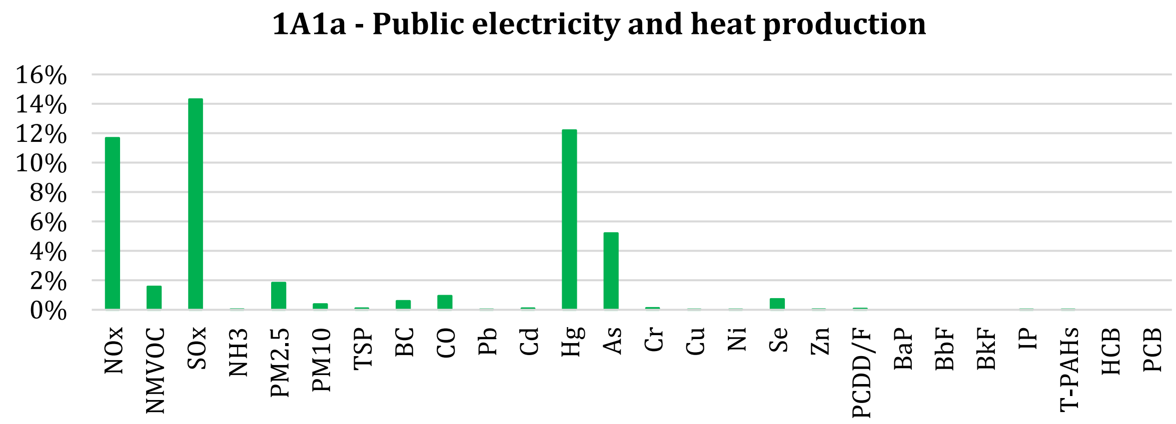

Figure 3: Shares of emissions from the NFR 1A1a category in percentage of national total

4.2.2 Methodology

The methodology used to estimate emissions from this sector is as follows:

- 1990-2004:
  - Calculated through a Tier 1 methodology, by multiplying the total fuel by type, as found under the 'Electricity & heat generation' section in the Eurostat Energy Balance, with the respective EF found within the 2023GB.
- 2005-2016:
  - NO_x, SO_x, NH_3, TSP, and heavy metals emissions from Enemalta were measured through CEMS and reported in their respective AER.
  - Emissions of $PM_{2.5}$ and PM_{10} were estimated by taking the ratio of the $PM_{2.5}$ and PM_{10} EF to TSP, as provided within the 2023GB, and the multiplying that ratio by the TSP emission load reported through CEMS.
  - The total emissions from As, Cr, Cd, Cu, Ni, and Pb, from 2011-2016 were estimated by splitting the emission load reported for heavy metals within the AER by the EFs for each pollutant. The EFs (as provided though the 2023GB) were taken according to the fuel consumed and the technology utilized by each plant. The emission load for heavy metals was not provided from 2005-2010. Hence, an emission load was calculated through the use of a country-specific EF, based on the fuel consumption and emission loads reported for 2011-2016. The emissions for each heavy metal were then calculated through the same methodology as that used for 2011-2016.

  - All other pollutants were estimated through the Tier 1 and Tier 2 methodology provided within the 2023GB.
- 2017-2022:
  - The Electrogas and D3 Power Generation Limited commenced their operations in 2017. The emissions of NO_x, SO_x, TSP, NH3 and CO from these facilities were monitored through CEMS. The Enemalta power station was converted into a back-up plant, and hence, the CEMS was decommissioned.
  - Emissions of $PM_{2.5}$, PM_{10}, and BC were estimated by taking the ratio of the $PM_{2.5}$, PM_{10}, and BC EFs to TSP, as provided within the 2023GB, and multiplying that ratio by the TSP emission load reported through CEMS.
  - The emissions of Pb, Cd, Hg, As, Cr, Cu, Ni, Se, and Zn from Electrogas Malta were estimated through the use of plant-specific EFs.
  - All other pollutants from the other power plants were estimated through the Tier 2 methodology provided within the 2023GB.

4.2.3 Activity data

4.2.3.1 Historical

Malta's power station has mostly relied on Heavy Fuel Oil (HFO) and Gasoil for electricity production, with a small amount of coal utilized until 1995. However, a major change in local electricity production took place in 2017, with the introduction of two privately owned power plants running on natural gas; Electrogas Malta (EGM) and D3 Power Generation Limited (D3PG). Both plants joined Enemalta, i.e. the state owned energy producer, in the local production of electricity. Moreover, Enemalta also operates another power plant in Marsa, which has one operating gas turbine (MPS5). This turbine is on standby and it is only permitted to operate for testing or emergency purposes. As from 2018, Heavy Fuel Oil was fully phased out.

The below table shows the set-up of the electricity generating plants present locally during 2022.

Table 10: Set up of electricity generating plants

Operator	Plant	Technology	Fuel
Electrogas Malta	CCGT 1	Combined Cycle Gas Turbines	Natural Gas
	CCGT 2	Combined Cycle Gas Turbines	
	CCGT 3	Combined Cycle Gas Turbines	
Enemalta	DPS2	Gas Turbine	Gasoil
	DPS3	Gas Turbine	
	DPS4	Gas Turbine	
	DPS5	Gas Turbine	
	DPS6 A	Diesel Engines	HFO/Gasoil
	DPS6 B	Diesel Engines	HFO/Gasoil
	MPS 5	Gas Turbine	Gasoil
D3PG (D3 Power Generation Limited)	DPS6 C	Diesel Engines	Natural Gas/Gasoil
	DPS6 D	Diesel Engines	
	DPS6 A	Diesel Engines	Natural Gas
	DPS6 B	Diesel Engines	

In addition to gaseous and liquid fuel plants, the interconnector (electricity imported to Malta from mainland Europe) and renewable energy sources such as photovoltaic (PV) cells, supply the remaining electricity entering the grid.

4.2.4 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

4.2.5 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The emission loads and fuel consumption reported within the AERs were compared to the emission calculation worksheets provided by the facility operator. Checks were also carried out on the emission factors and the formulas utilized within the model. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.2.6 Sector-specific recalculations

The recalculations in 1A1a address a linking error that resulted in an overestimation of $PM_{2.5}$ compared to PM_{10} for the year(s) 2018-2021, as pointed out by the TERT in the 2023 submission. This also prompted recalculations for the year 2017 for BC and TSP.

4.2.7 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

4.3 Sector 1A2gviii: Stationary Combustion in Manufacturing Industries and Construction

Table 11: Sector 1A2gviii general characteristics

NFR Code	**1A2gviii**
Sub-Category	Stationary Combustion in Manufacturing Industries and Construction: Other
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1 & 2
Key Category	NO_x, SO_x, Hg, As, Ni, PCDD-PCDF, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, & indeno(1,2,3-cd)pyrene
Year of Last Update	2024 submission

4.3.1 Introduction

This subcategory includes emissions of air pollutants from the energy generation, which is used in activities, such as manufacturing.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in

Figure *4*.

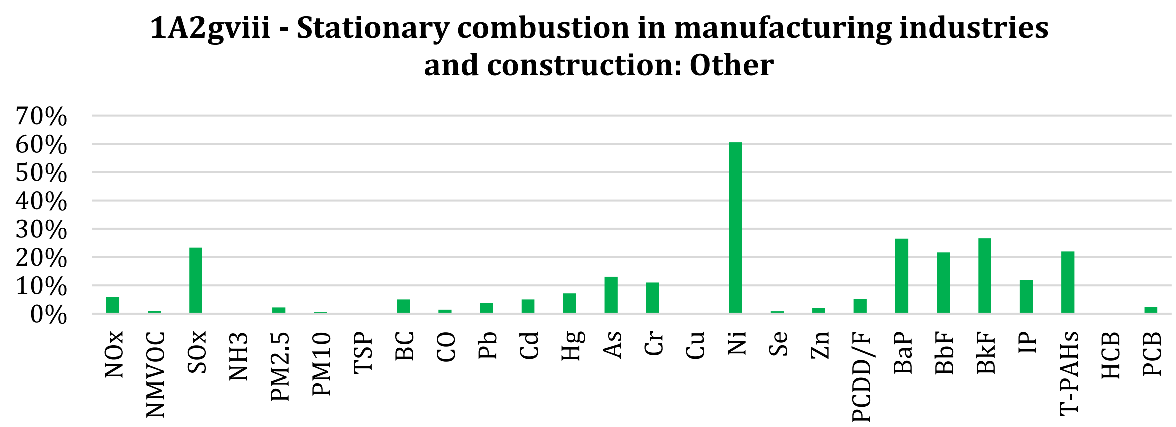

Figure 4: Shares of emissions from the NFR 1A2gviii category in percentage of national total

4.3.2 Methodology

Emissions from the combustion of gasoil and fuel oil were estimated through a Tier 2 methodology, whereas the remaining fuels were estimated through a Tier 1 methodology, as provided within the 2023GB.

The tables used, as provided within the 2023GB, are provided below:

Table 12: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Motor gasoline	N/A	Table 3-4	1.A.2 Manufacturing industries and construction (combustion)
Other kerosene	N/A	Table 3-4	1.A.2 Manufacturing industries and construction (combustion)
Gas oil and diesel oil	Boiler	Table 3-24	1.A.4 Small combustion
Gas oil and diesel oil	Generator	Table 3-31	1.A.4 Small combustion
Fuel oil	N/A	Table 3-24	1.A.4 Small combustion

Liquefied petroleum gases	N/A	Table 3-3	1.A.2 Manufacturing industries and construction (combustion)

4.3.3 Activity Data

The quantities of fuel used from 2005 onwards were taken from the 'Industry sector' section within the Eurostat Energy Balance. The Energy Balance could not be used from 1990-2004, since the figures reported within the Energy Balance were all '0'. Data from the climate change model was used to gap fill these years.

4.3.3.1 Gasoil and diesel oil

An exercise was carried out, for the 2023 submission, to determine the share of technology used to combust gasoil for both NFR 1A2gviii and NFR1A4ai. The fuel consumption per technology for all permitted combustion plants in 2019 was noted. The consumption of gasoil under these permitted facilities comprised 5.4% of the total gasoil combusted under both NFR1A2gviii and NFR1A4ai, as reported through the Eurostat Energy Balance. Thus, for that 5.4% of gasoil consumed, the technology share reported through the permitted facilities (as provided within Table 13) was taken. For the remaining 94.6% of gasoil combusted, the default technology share provided through the 2023GB, as provided in Table 13, was taken.

Table 13: Share of technology type per gasoil consumed in NFR1A2gviii

Technology	Permit fuel use %	2023GB fuel use %
Reciprocating Engine	10.9%	20.0%
Boiler	89.1%	80.0%

The technology share for gasoil consumption was assumed to be the same for all the years.

4.3.3.2 Sulphur content

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2014 to 2022. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.3.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.3.5 Sector-specific recalculations

- All the pollutants emissions were updated as a minor linking error was fixed.
- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.

4.3.6 Sector-specific planned improvements

Efforts will be made to provide more representative EFs across the time series.

4.4 Sector 1A3ai(i): International aviation LTO (civil)

Table 14: Sector 1A3ai(i) general characteristics

NFR Code	**1A3ai(i)**
Sub-Category	International aviation LTO (civil)
Method	2019 LTO emissions calculator & EUROCONTROL data
Activity Data	Malta International Airport
Emission Factors	EUROCONTROL
Key Category	Not Applicable
Year of Last Update	2024 submission

4.4.1 Sector description

This subcategory includes emissions of air pollutants generated from the civil commercial use of aeroplanes, during the landing and take-off cycles (LTOs), on flights which departed from the Malta International Airport and landed in foreign airports. Shares of emissions of the particular pollutants from 1A3ai(i) in 2022 are shown in Figure 5.

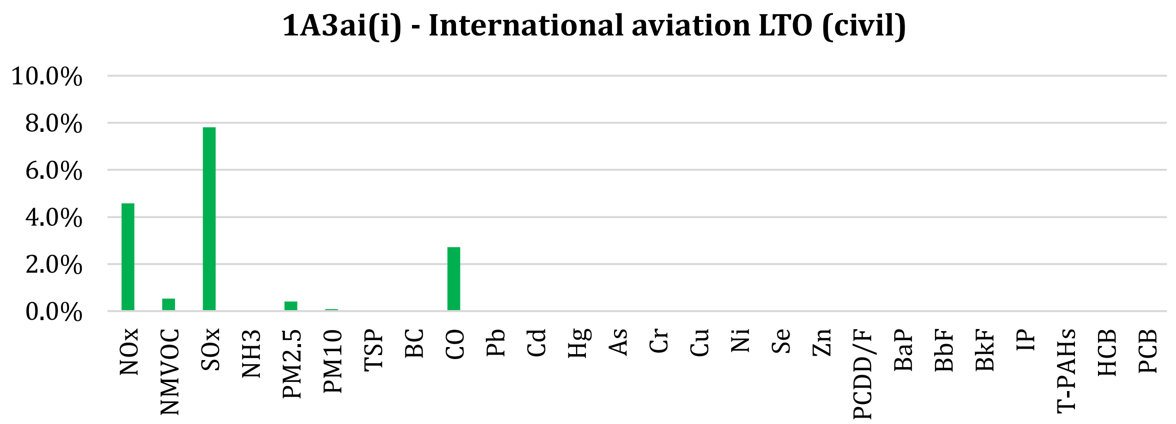

Figure 5: Shares of emissions from the NFR 1A3ai(i) category in percentage of national total

4.4.2 Methodology & activity data - Historical

Emissions from 1990 to 2004 are estimated through using the 2019 LTO emissions calculator, which was developed by EUROCONTROL. This methodology assigns a specific EF to each aircraft type, according to its ICAO classification. Additionally, the taxi in and out are altered based on the specific airport and year in question. The taxi arrival and departure times from 2005 were applied to the period from 1990 to 2004, as they were deemed the most closely aligned with the emission years being calculated. The number of LTO cycles for international flights from 1990 to 1998 were provided by the Civil Aviation Department at Transport Malta whilst the number of LTO cycles from 1999 to 2004 were provided by the Malta International Airport.

Conversely, LTO emissions from 2005 to 2022 are calculated directly by EUROCONTROL, and the values provided are reported directly within the NFR table. The emissions estimated directly by EUROCONTROL are deemed more representative, since they take into consideration the flight paths.

4.4.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

4.4.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.4.5 Sector-specific recalculations

The recalculations made were prompted by observed discrepancies in the values provided by EUROCONTROL for the years 2005 to 2022.

4.4.6 Sector-specific planned improvements

Data years 1990 to 2004 will be updated in the next submission to reflect the changes introduced with the 2023 LTO emissions calculator.

4.5 Sector 1A3aii(i): Domestic aviation LTO (civil)

Table 15: Sector 1A3aii(i) general characteristics.

NFR Code	**1A3aii(i)**
Sub-Category	Domestic Aviation LTO (civil)
Method	2019 LTO emissions calculator & EUROCONTROL data
Activity Data	Malta International Airport
Emission Factors	EUROCONTROL
Key Category	Not Applicable
Year of Last Update	2024 submission

4.5.1 Sector description

This subcategory includes emissions of air pollutants generated from the civil commercial use of aeroplanes, during the landing and take-off cycles (LTOs), on flights which departed and landed in the Maltese Islands. Shares of emissions of the particular pollutants from 1A3aii(i) in 2022 are shown in Figure 6.

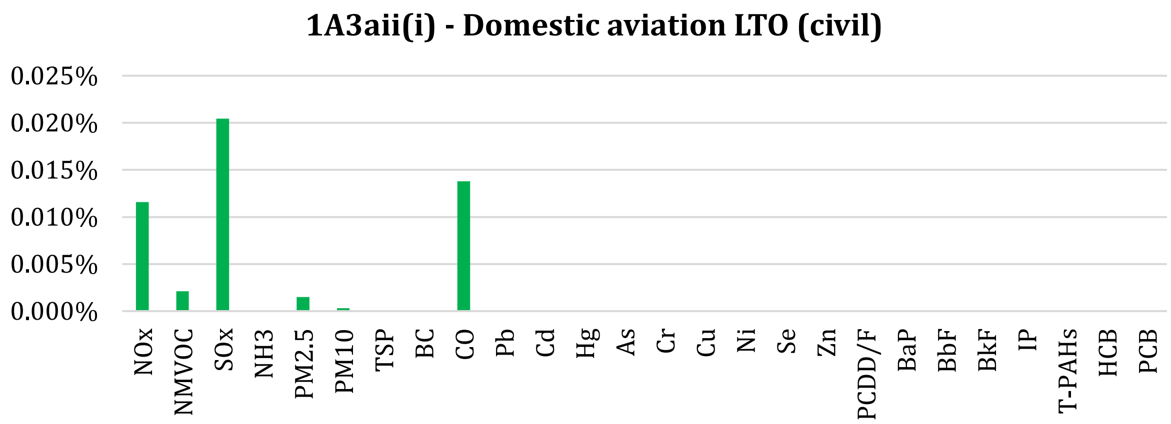

Figure 6: Shares of emissions from the NFR 1A3aii(i) category in percentage of national total

4.5.2 Methodology & activity data - Historical

Emissions from 1990 to 2004 are estimated through the 2019 LTO emissions calculator, which was developed by EUROCONTROL. This methodology assigns a specific EF to each aircraft type, according to its ICAO classification. Additionally, the taxi in and out are altered based on the specific airport and year in question. The taxi arrival and departure times from 2005 were applied to the period from 1990 to 2004, as they were deemed the most closely aligned with the emission years being calculated. The number of LTOs from 1999-2004 were provided by the Malta International Airport. No activity data was available for domestic flights prior to 1999 therefore, to estimate the activity data for these years, a rounded up average of the number of LTO cycles from 1999 to 2004 is used as a proxy. This approach was considered reasonable as there was no significant change in the number of domestic flights during this period, and it allowed for the calculation of estimates for the entire time series.

Conversely, LTO Emissions from 2005-2022 are calculated directly by EUROCONTROL, and the values provided are reported directly within the NFR table. The emissions estimated directly by EUROCONTROL are deemed more representative, since they take into consideration the flight paths.

4.5.3 Methodology & activity data - Projections

No projections were considered in the preparation of this submission.

4.5.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.5.5 Sector-specific recalculations

The recalculations made were prompted by observed discrepancies in the values provided by EUROCONTROL for the years 2005 to 2022.

4.5.6 Sector-specific planned improvements

Data years 1990 to 2004 will be updated in the next submission to reflect the changes introduced with the 2023 LTO emissions calculator.

4.6 Sector 1A3b: Road Transport

Table 16: Sector 1A3b general characteristics

NFR Code	**1A3b**
Sub-Category	Road Transport
Method	COPERT 5.7.2
Activity Data	Energy and Water Agency Malta Resources Authority Transport Malta Regulator for Energy and Water Services MET Office
Emission Factors	Tier 3
Key Category	NO_x, NMVOC, $PM_{2.5}$, PM_{10}, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Se, Zn, & PCDD/PCDF
Year of Last Update	2024 submission

4.6.1 Sector description

This subcategory includes emissions from internal-combustion engine vehicles (ICE) and electric vehicles (EV) in Malta. Emissions estimated under this sector were based on the licenced vehicle fleet circulating on public roads, excluding those that are considered non-road machinery such as machinery for agricultural use and military transport.

Emissions were calculated for each of the following categories:

- 1A.3.bi, Passenger Cars;
- 1A.3.bii, Light Duty Vehicles;
- 1A.3.biii, Heavy-Duty Vehicles and Buses;
- 1A.3.biv, Mopeds and Motorcycles;
- 1A.3.b.v, Gasoline Evaporation;
- 1A.3.b.vi, Tyre & brake Wear;
- 1.A.3.b.vii, Road Surface Abrasion

The shares of emissions for all pollutants estimated under this subcategory in 2024 for the reference year 2022, as a percentage of the national total are shown in Figure 7.

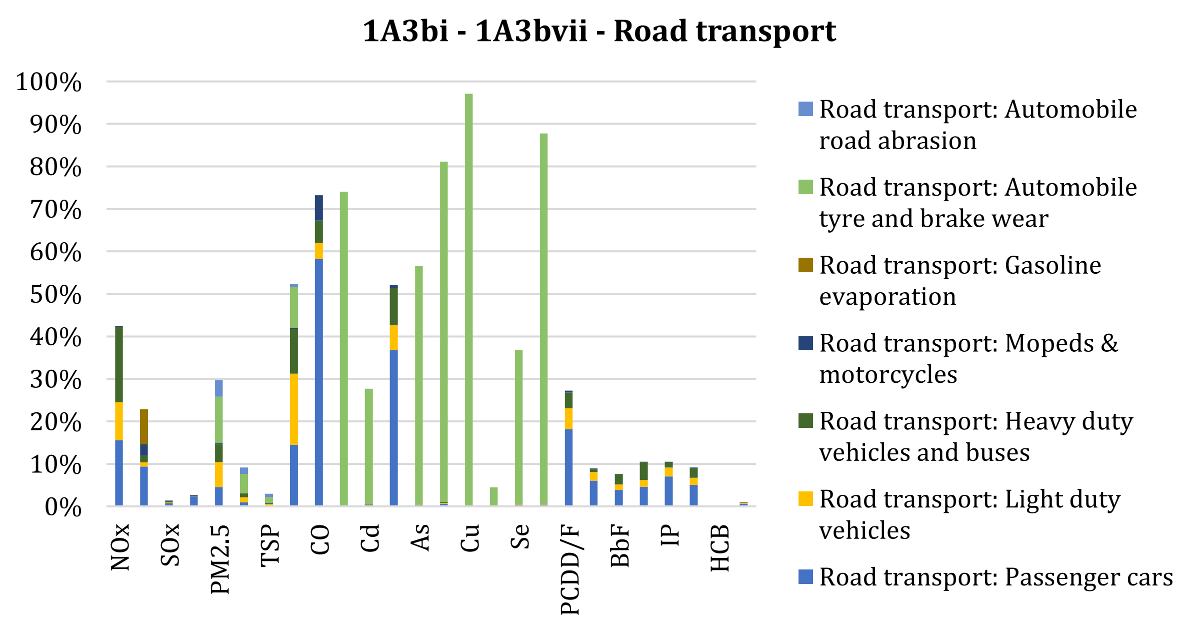

Figure 7: Shares of emissions from the NFR 1A1b category in percentage of the national total

4.6.2 Methodology – Historical

For this sector, Malta made use of a tier 3 approach using a vehicle activity based model, which estimates exhaust emissions using a combination of firm technical data and activity data. The road transport emissions were estimated using COPERT 5.7.2, which makes use of various parameters including vehicle stock, mileage, speed and meteorological data, amongst others to calculate emissions derived from the road transport sector.

4.6.3 Activity Data - Historical

A list of the activity data together with a list of their respective data sources is provided below:

Table 17: List of activity data utilised for the Road Transport sector together with the entity that provides the data.

Parameters	Source of parameters used
Environmental Information	Data was obtained from the National Meteorological Office. This includes minimum and maximum average monthly temperatures as well as monthly average %age humidity from 1990 to 2022.
Trip Characteristics (average trip duration and average trip length)	This data was provided by Transport Malta (TM) as obtained from the National Transport Model (NTM), which uses Census data to establish trip origins and destinations. Due to the COVID-19 situation in 2020, different trip duration values were used, since Malta experienced less traffic and congestion, therefore trips were shorter albeit the same length. For 2021 and 2022, the same values used for the pre-2020 historical years were used.
Fuel Specifications	The sulphur content in fuel for the years 2004 for diesel and 2005 for petrol was carried backwards to cover from 1990 to 2003. For the years 2004 to 2007 the values used were as reported under Directive 98/70/EC and the Malta Resources Authority (MRA) provided these figures. Concerning sulphur content for the years 2008 to 2013, extrapolated values were used whereas for the years 2014 to 2022 the sulphur content was obtained from the Regulator of Energy and Water Services (REWS). As for lead content in fuel, the REWS provided values for the years between 2004 and 2010. In this context, the value for petrol in 2004 was carried backwards. The COPERT default values were used from 2011 onwards as local data was not available. As for diesel, there is no obligation for lead testing in this fuel so the default COPERT lead content was used throughout the entire time series.
Statistical consumption	The total fuel sales were obtained from Eurostat for the entire time series.
Stock	Vehicle stock for the years 1995 to 2022 was obtained from TM. For the pre-1995 years, ERA uses the fleet totals split according to the vehicle share categories of 1995.
VKM[1]	For the period 1990 to 2009, the mean VKM per age of vehicle was assumed equal to the data provided by the Energy and Water Agency (EWA) from 2010 onwards. Data for 2010 to 2022 was generated using a model, which EWA developed in order to generate VKM for historical and projected years (up to 2040).
Circulation (Average speed and percentage mileage share per road type)	This data was provided by Transport Malta (TM) as obtained from the National Transport Model (NTM).

[1] VKM refers to the total vehicle kilometres done one year by each vehicle category. In Malta, distance is measured in kilometres and colloquially the term mileage is used even though the answer is given in kilometres. Hence, any mention of the term mileage refers to kilometres travelled.

	Due to the COVID-19 pandemic and the introduction of several restrictions in the country, traffic and congestion decreased in 2020 and as a result, speed data for that same year differs from the rest of the historical data.
Fuel blend	The REWS provided fuel blends as follows: E0 (petrol) and B7 (diesel).
Load and road slope	This was assumed to be 50% and 0% respectively.

The following compilation of activity data was used for this year's submission of the emission inventory and projections reporting.

4.6.3.1 Stock data

In previous submissions, the historical stock data for post-2010 years were based on actual data acquired from the EWA, through the National Statistics Office (NSO) and TM for the years 1995-2009. However, following an extensive internal exercise with MRA, large discrepancies were noted and efforts were made throughout the year to identify the best stock dataset available. In this context, actual vehicle registration data as provided by Transport Malta was used. TM in fact keeps a register that contains the complete details of all vehicles registered and licenced in Malta in a database known as the Vehicle Registration and Administrative System (VERA). The following vehicle categories have been reported in this year's submission for all historical years:

Table 18: Table highlighting Malta's stock for the historical

Category	Fuel	Segment
Passenger Cars	Petrol	Small
		Medium
		Large-SUV-Executive
	Diesel	Small
		Medium
		Large-SUV-Executive
	LPG Bifuel	Medium
	Battery Electric	Small
		Medium
		Large-SUV-Executive
Light Commercial Vehicles	Petrol	N1-I
		N1-II
		N1-III
	Diesel	N1-I
		N1-II
		N1-III
Heavy-Duty Vehicles	Diesel	Diesel Rigid ≤7.5t
		Diesel Rigid 7.5-12t
		Diesel Rigid 12-14t
		Diesel Rigid 14-20t
		Diesel Articulated 14-20t
Buses	Diesel	Urban Buses Midi ≤15t
		Urban Buses Standard 15-18t
		Coaches Standard ≤18t

L-category	Petrol	Mopeds 2-stroke <50 cm^3
		Motorcycles 2-stroke >50 cm^3
		Motorcycles 4-stroke <250 cm^3
		Quads & ATVs

Various assumptions were considered for the compilation of stock data and these were in line with assumptions taken by EWA in their post-2010 stock and VKM model as highlighted in previous IIRs.

Below is a list of general assumptions considered for the historical timeseries;

1 Heavy Commercial Vehicles:
   - Due to the lack of VKM data for HDVs greater than 14t, all such vehicles were considered under the COPERT category HDV 14t-20t.

2 Motorcycles and Quads/ATVs:
   - COPERT Emission factors are only provided for petrol L-category vehicles. A small number of diesel L-category vehicles was added to the stock of petrol vehicles.

3 Buses:
   - COPERT Emission factors are only provided for diesel buses. A small fraction of petrol buses was added to the stock of diesel vehicles for the purposes of this analysis.

4 Freight:
   - The average VKM for Tractor Units (TU) was extremely high when compared to the HDV fleet VKM and would have skewed the combined average when categorized together with Goods Commercial Vehicles (GCV) and Special Purpose Vehicles (SPV). Therefore, their total annual VKM was estimated separately from the LCV and HDV analyses and added to HDV for forecasting purposes.
   - It is assumed that a significant percentage of the total VKM driven by freight vehicles are driven overseas. Therefore, EWA's model assumes that only 5% of the total freight VKM is driven in Malta. Hence, only this fraction was considered for the articulated 14-20t diesel HDVs.
   - Since COPERT provides no emission factors for freight, the factors for *Articulated HDV >14t* were assumed as 99% of the stock TU are heavier than 15 tonnes.
   - Contrary to previous reporting years, stock and VKM data was provided for all vehicle Euro standards as opposed to only Euro II and Euro VI A/B/C category. In cases where VKM data was lacking but stock information was available, a linear interpolation was used to estimate the mean activity.

5 Passenger Cars
   - Plug-in Hybrid Electric Vehicles (PHEVs) were considered electric vehicles (EVs) and this is because PHEVs do not consume any road petrol or diesel as they are expected to carry out most of their daily trips on battery power due to Malta's small size and relatively short journey lengths.

In addition to the aforementioned general assumptions, certain assumptions were considered in order to be able to sort the VERA data provided by TM into the appropriate COPERT vehicle categories for the years 1995 to 2022. These were also somewhat in line with the assumptions made by EWA for different stocks reported in previous years[2].

- Non-road machineries such as agricultural tractors and large construction machinery were not included in the stock;
- Caravan trailers were also not included with the premise that the majority of such vehicles are parked in designated parking areas (long term) and are never moved, whereas some others are used to travel overseas, therefore the majority of their VKM is driven outside of Malta's territory;

[2] Assumptions considered by EWA for post-2010 stock as reported in previous years may be found in Malta's Annual Informative Inventory Report – 2023 submission

- The following fuel related assumptions were also considered:
  - Vehicles with paraffin as their fuel type were considered petrol. This was considered a human error when inputting data into the VERA database;
  - Where no fuel type was assigned to motorcycles, these were assigned to the petrol category since COPERT only provides petrol L-category classes;
  - Vehicles categorised under the N2, N3, M2, M3, SP1 and SP2 with no fuel type assigned were considered to be diesel vehicles under their respective category;
  - Passenger cars and LCVs that had no fuel information assigned to them were assigned either diesel or petrol fuel at random based on the fuel share assigned to these two categories for the year 2017[3] as per below percentages:

Table 19: Table highlighting the percentage share of PCs and LCVs in 2017, which percentages were applied to the vehicles that had no fuel assigned to them in the pre-2010 stock.

	Petrol	Diesel
Passenger Cars	68%	32%
Light Commercial Vehicles	0.34%	96.6%

- All vehicles classified under the M1 category but having more than 9 seats were classified under the buses categories according to their body type;
- All N1 vehicles and commercial special purpose vehicles (excluding caravans) were included under the LCV category;
- Diesel LCVs that were heavier than 3.5t were moved to the HDV category according to their Gross Vehicle Weight (GVW);
- All N2 and N3 vehicles were categorised under the HDV category according to GVW;
- All TUs were considered *Articulated* HDV based on the same assumption as mentioned above, whereas those that are not TU were considered *Rigid* HDVs;
- Concerning buses, there were two approaches which Malta considered:
  - Classification according to the GVW of the vehicle which would also fit into the COPERT classification; and
  - All buses identified as route buses were considered Urban Buses Standard to match the EWA classification, Coaches Standard classification includes the following category of vehicles: CO, CBP, PM3, PT3 and P6 (excl. vans, limousines and ambulances) as well as single/double-decker buses, and all remaining bus categories were placed under the Urban Buses Midi as these include the minibuses;
- Concerning the L-category, all petrol vehicles were considered except categories L6 and L7, including also the M1s classified as tricycles. Those that have an engine size <50cc were classified under the <50 2-stroke category, those >50cc were classified under the >50 cc 4-stroke and the rest were classified according to engine size;
- All L7 and L6 vehicles were grouped under the Quads category as well as those M1 vehicles which had a body type classified as buggy or all-terrain vehicles (ATVs);
- Additional updates were considered to ensure that all on-road vehicles were being catered for under different vehicle categories. Given that the EWA VKM model lacks VKM for various vehicle categories, certain stocks present in the VERA database could not be considered, as there was no VKM data available. The below table provides a summary of those vehicle categories, that were assigned to other COPERT categories due to lack of VKM data. This is an improvement that Malta would like to work on in the coming years in order to improve the stock and to the extent possible accurately report vehicles under their correct category.

3 2017 was chosen as the reference year since that is the year in which the EWA model was developed

Table 20: Vehicle categories for which stock was available from 1990-2009, which have been assigned to similar vehicle categories since VKM was lacking.

Available stock between 1990-2009	**Assigned to existing categories**
Rigid 20 - 26 t	Rigid 14 - 20 t
Rigid 26 - 28 t	
Rigid 28 - 32 t	
Rigid >32 t	
Coaches Articulated >18t	Coaches Standard ≤18 t
Urban Buses Articulated >18t	Urban Buses Standard 15-18t
Motorcycles 4-stroke 250 - 750 cm^3	Motorcycles 4-stroke <250 cm^3
Motorcycles 4-stroke >750 cm^3	

4.6.3.2 Annual average vehicle per km data

The 2017 - 2022 Vehicle Roadworthiness Testing (VRT) data provided by NSO to EWA included VKM data. This data was used to determine the annual mean mileage a vehicle is expected to drive, based on its year of manufacture. A database was generated with the total mileage of each car aged between 4 and 100 years.

The VRT data indicates the vehicle type, engine size, vehicle weight, fuel type, year of manufacture, and a sample of vehicles feeding into the annual VKM estimate. The NSO noted that the annual average VKM was calculated as follows:

$$VRT\ Mileage\ difference\ =\ VRTyear2 - VRTyear1\ =\ A$$

$$VRT\ Days\ =\ VRTdate2 - VRTdate1\ =\ B$$

$$VKM\ average\ /\ day\ =\ A/B\ =\ C$$

$$Annual\ Ave.VKM\ =\ C * 365\ days\ =\ D$$

Equation 2: Calculation of annual average VKM

Only vehicles with an annual average VKM between 500KM<=D<=150,000KM were considered to remove the effect of data anomalies. Furthermore, following this filter, outliers deemed unrealistic by the NSO have also been removed. Additionally, vehicles under 5 years of age were not subject to a VRT. Hence, a constant VKM figure was used for such vehicles. The resulting normalized plot indicated that as a vehicle gets older, the respective annual mileage decreases.

Given that the EWA VKM model only caters for VKM post-2010, for the period 1990 to 2009, the mean VKM per age of vehicle was assumed equal to the data provided by EWA from 2010 onwards. An important thing to note is that fact that this year Malta made use of VKM provided by EWA but stock provided by TM. EWA's VKM is calculated using vehicle stock as provided by NSO. However, due to large discrepancies with the data, ERA opted to make use of actual stock data. In this context, in order to get the mean activity for all vehicles, the VKM provided for the various vehicle types was divided by the actual stock data provided by TM. The resulting mean activity was used as input data into COPERT 5.7.2.

4.6.3.3 Fuel consumption data

The total fuel share for the entire time series was obtained from Eurostat's Energy Balances. Having a look at the fuel consumption trend across the time series as shown in Figure 8, one would note that there are certain fluctuations in fuel use particularly for pre-2005 years. The model that EWA generated, provides a more accurate representation of the driving patterns in Malta across the time series than fuel consumption data provides. In this context, the energy balance function within COPERT is not utilized as ERA makes use of the VKM rather than the fuel consumption to estimate emissions.

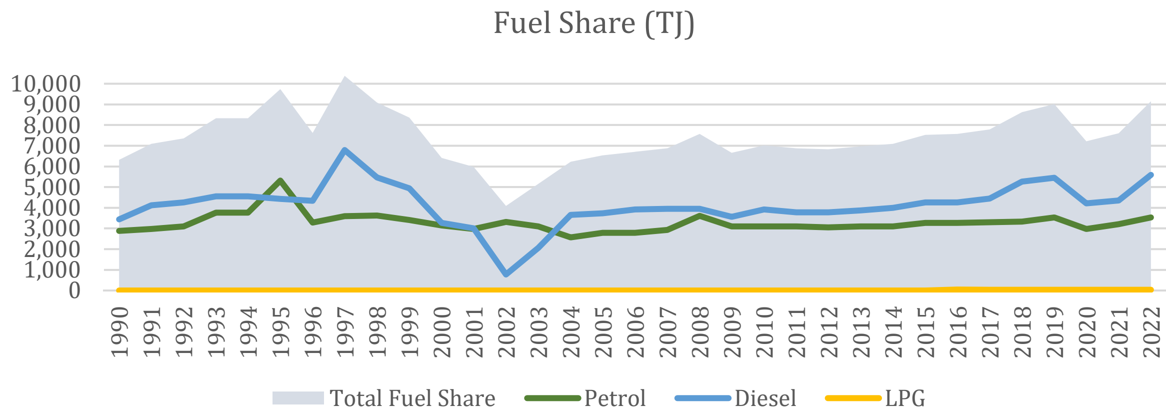

Figure 8: Fuel consumption per fuel type and as totals for road transport 1990-2022

4.6.3.4 Trip characteristics and circulation data

4.6.3.4.1 Trip length and trip duration

Trip length and trip duration data was provided by Transport Malta (TM) as calculated from the National Transport Model (NTM), which uses Census data to establish trip origins and destinations. The average of AM and PM trip durations and lengths was used for the average daily trip distance, as the NTM does not cater for off-peak scenarios. Data on the average trip duration for the year 2017 was used for the entire time series and projected years except for 2020. Due to the COVID-19 pandemic, a different trip duration was provided due to an increase in speeds as a result of the restrictions put in place in the country during the initial months of the pandemic. The pre-2020 parameters were used for the year 2021 and 2022. The current NTM is under revision so Malta is expecting updates in the next report.

The values provided by TM were used for the passenger cars, light commercial vehicles and the L-category. TM values also applied to HDVs and Buses, however, noting that bus trips and HDV trips are generally longer and lengthier, different values were used for both parameters. In last year's submission default, COPERT values were used, however, such values have now been considered unrealistic for the Maltese scenario. The below table provides an overview of the values used for every parameter.

Table 21: Input parameters used for trip length and trip duration

Vehicle category	**Trip Length (km)**	**Trip Duration (hr)**	
		Pre-2020, 2021, 2025 & 2030 (WM/WaM)	**2020**
Passenger cars	5.95	0.25	0.23
Light Commercial Vehicles	5.95	0.25	0.23
Heavy Duty Vehicles	12.0	0.85	0.85
Buses	12.0	0.85	0.85
L-category	5.95	0.25	0.23

Concerning the average trip length this was the same for the entire time series as this is based on the trip origins and destinations as modelled by TM. This might be revised once the updated NTM is published.

4.6.3.4.2 Average speed and road share

The COPERT 5.7.2 model requires circulation and speed values for both off-peak and peak periods. However, the NTM simulated the road network during peak hour conditions and therefore long-term traffic count data in conjunction with Bureau of Public Roads (BPR) curves were used to resolve this issue. BPR curves present the relationship of the time-delay (and therefore speed) function and congestion. This data was provided by TM and the same average speed based on 2017 calculations was used for the entire time series from 1990 to 2019 and 2021 to 2022.

For the year 2020, because of the local restrictions as a result of the COVID-19 pandemic, speeds were expected to increase due to a decrease in traffic and congestion. In this context, an adjusted factor to represent 2020 volume-capacity ratio was used. Pre-2020 figures were used for the year 2021 and 2022 since TM was not in a position to revise the figures for the latest year. This might be revised once the updated NTM is published.

As for road shares (%), COPERT 5.7.2 provides 3 types of roads categories:

- Highway
- Rural
- Urban (peak and off peak)

On the other hand, the NTM provides for different road classifications, so efforts were made to convert the road classes as provided by the NTM's structure plan into COPERT's road classifications. A shapefile of the urban area, as defined by the Strategic Plan for the Environment and Development (SPED) was used to classify the road links accordingly.

The average daily speed was then calculated for each road category as well as the percentage mileage share per road type. No distinction was made between different vehicle types since the information was not available at this level of detail. The table below provides a summary of the data inputted into COPERT 5.7.2.

Table 22: Circulation data

	Urban Peak	**Urban Off Peak**	**Rural**	**Highway**	**Urban Peak**	**Urban Off Peak**	**Rural**	**Highway**
	% shares				**Speed in km/h**			
Pre-2020, 2021, 2025 and 2030 (WM/WaM)	2.55	34.94	28.7	33.82	14.92	28.59	14.41	53.77
2020					15.85	29.40	14.81	55.44

4.6.3.5 Additional parameters

As previously highlighted, the energy balance function was not checked for all the years, as the actual mileage data was considered sufficiently representative of the real scenario. Furthermore, SCR CO_2 emissions, A/C usage, CO_2 emissions from lube oil and mileage degradation functions were all unchecked and the inspection and maintenance scheme (IM effect) was not considered when running the model with the above input parameters.

4.6.4 Methodology and Activity data – Projections

No projections were considered in the preparation of this submission. However, for a list of assumptions and methodologies used for last year's projections reporting refer to Malta's Annual Informative Inventory Report – 2023 submission.

4.6.5 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for the Road transport sector. The sector compiler ensured that input activity data for the emission calculations done by COPERT were properly referenced. As previously mentioned all input data originates from other entities, however, the compilation of the Road Transport emission inventory is done by the Environment and Resources Authority. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted to satisfy COPERT's requirements, as is the case for trip duration, road share and total fuel sales, amongst others. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.6.6 Sector-specific recalculations

4.6.6.1 Updates to stock

Over the last two years, substantial improvements have been carried out to the entire time series particularly in terms of stock. For the 2022 submission year, Malta had carried out improvements to the pre-2010 stock. The TERT reviewers had also identified discrepancies in the data, which resulted in over/under estimates for particular years. Through an internal exercise with MRA and TM, Malta managed to solve these discrepancies. A major overhaul to the stock data was in fact carried out for the years 1995 to 2009 and the assumptions considered for this exercise are highlighted in the previous sections. For this reporting period, Malta managed to further update the stock for post 2010 years and has now streamlined the stock data throughout the entire time series. By making use of data as provided by the TM, Malta managed to address all discrepancies that were identified by the TERT reviewers.

One particular discrepancy that was addressed was related to implied emission factors (IEF) changes between the years 2004 and 2005. The stock exercise noted that the number of vehicles reported under diesel and petrol for several vehicle categories were incorrect and the VERA data showed that the number of petrol passenger cars were higher than their diesel counterparts. The newly reported stock also shows a linear increasing trend in vehicles over the years, which in previous reports was not showing. The below graph provides an overview of the improvements carried out to the stock by comparing the stock reported in 2022, which made use of data from different sources, and the stock reported in this submission, which corrects the discrepancies in data between earlier years in the time series.

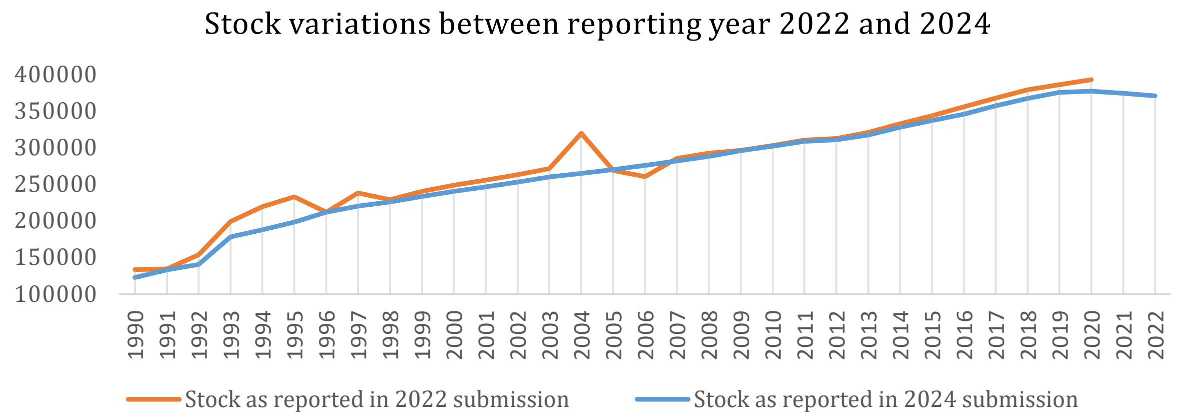

Figure 9: Graph comparing the total stock reported in the 2022 submission against the latest stock reported in the 2024 submission. This data excludes LPG and Electric vehicles.

4.6.6.2 Inclusion of LPG vehicles

Malta has included LPG vehicles in last year's submission for the first time and it continued doing so also for this submission. Malta was able to acquire data on LPG vehicles from both TM and EWA. This was also a planned improvement which Malta hoped to work on and include. However, Malta currently only has one category of LPG passenger cars due to lack of VKM data for the medium and large LPG PC. Malta hopes to further improve the emission estimates from this category by further subdividing the available stock into different sub-categories.

4.6.6.3 Updates to the electric vehicle fleet

In previous reports, Malta had always used a tier 1 methodology to calculate non-exhaust emissions from Electric Vehicles. Recent COPERT versions provide emission factors for Passenger Car (PC) EVs, therefore, PCs have now been included under this new category and split by size. In addition to PCs (EVs), Malta has several other EVs such as LCVs, HDVs, Buses, Motorcycles, and Quads within its fleet. However, due to COPERT only catering to PC EVs, Malta has developed a model, whereby EVs of other vehicle categories are considered within the stock using VKM as the driver to apply a yearly multiplication factor to the number of PC vehicles. Size was also an attributing factor to decide under which category to put all electric vehicles that are not passenger cars. The below table provides a summary of the classifications used to report such EVs.

Table 23: Table highlighting the classification of all other electric vehicles under PCs according to size.

Electric Vehicle Category	Passenger Car Category
HDVs (incl. buses)	Large PCs
LCVs	Large PCs
L-category	Small PCs

4.6.6.4 Updates to the L-category

As a result of COVID-19 restrictions, the food industry experienced a shift from dining in to take-away deliveries largely carried out by motorcycles. Given that VRT data for the L-category is not available post-2018 and given the surge of motorcycle courier services post-2020, Malta had to make certain assumptions in order to consider the increase in trips generated by this category. For the last reporting period (2023 submission), Malta assumed that the distance travelled by courier service motorcycles increased significantly by approximately four times as that covered in 2018. Since the number of motorcycles engaged for these services was not known, all newly registered motorcycles in 2020 and 2021 were assumed to be used for delivery of goods. In this context, the mean activity assigned to these newly registered vehicles was increased fourfold, whereas the mean activity for the recurring stock was not adjusted.

For this reporting period, however, Malta managed to acquire VKM and courier count data for 2022 from one major delivery service company and as a result was able to update the VKM accordingly. It is assumed that there are two main service providers, each having a market share of 50%. The distribution of courier motorcycles by size and age was assumed to follow the distribution of the licensed motorcycle fleet

4.6.6.5 Updates to the Light Commercial Vehicles VKM

Whilst compiling the activity data for this year and previous emission inventories, Malta always had reservations on the VKM assigned to LCVs. For the LCV category, stock and VKM were calculated for the category as a whole and then disaggregated into the three subcategories (N1-I, N1-II and N1-III) using fixed distributions. However, this re-distribution of total VKM and stock resulted in a mean mileage of ~30,000 to 45,000 km for the N1-I categories as well as other unrealistic mean VKM for several other N1 categories with specific Euro standards. The impact of this on energy consumption was minimal since both N1-II and N1-III vehicles have the same energy consumption factor. However, this would have had an impact on the calculated emissions originated from this category. In this context, the following calculation was used to determine a more appropriate mean activity for all vehicle categories under the LCV category:

$$Overall\ MA = \frac{Sum(VKM)}{Sum(stock)}$$

$$\%VKM = \frac{Original\ MA}{Sum(Original\ MA\ of\ an\ LCV\ Segment)}$$

$$New\ MA = (Overall\ MA * N) * \%VKM$$

Equation 3: Summary of the calculations used to determine a more appropriate mean activity for the LCV categories

Where; the ***Overall MA*** is a generic mean activity that is derived from the ratio of the summed VKM and summed stock which is then used to determine the ***%VKM*** by dividing the Overall MA by the sum of the ***Original MA*** of each LCV Segment, that is N1-I, N1-II and N1-III for both petrol and diesel engines. The ***New MA*** is the mean activity derived from multiplying the Overall MA by the number of Euro standard category under each segment (***N***) and the %age VKM. Malta hopes to carry out further analysis on this category with the aim to improve the overall stock classification and their respective VKM.

4.6.7 Sector-specific planned improvements

The following is a list of improvements that Malta wishes to work on for its next submission:

- After the major changes carried out to the entire stock, Malta would now like to focus on fine-tuning its sorting criteria in order to ensure the data is as accurate as possible.

- Malta also aims to present updates trip characteristics data, based on the revised national transport model. Update to trip duration, length, speed and road shares is expected from this update.
- Malta also aims to improve the VKM of the large commercial vehicles and eliminate discrepancies within the data, which are portraying an unrealistic scenario, potentially leading to over or under estimates within the category.
- As previously mentioned, several vehicle categories had to be grouped under specific categories for which VKM was already available. Malta would now like to work on estimating VKM for such vehicle categories in order to further improve emission estimates. These include LPG vehicles, HDVs bigger than 20t, buses and large motorcycles.

4.7 Sector 1A3dii: National navigation (shipping)

Table 24: Sector 1A3dii general characteristics

NFR Code	**1A3dii**
Sub-Category	National navigation (shipping)
Method	2023GB
Activity Data	Direct communication
Emission Factors	Tier 2
Key Category	NO_x, Hg & PCBs
Year of Last Update	2024 submission

4.7.1 Sector category description

This subcategory includes emissions of air pollutants from the combustion of fuel from vessels (excluding recreational crafts), which depart and arrive in the Maltese Islands.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 10.

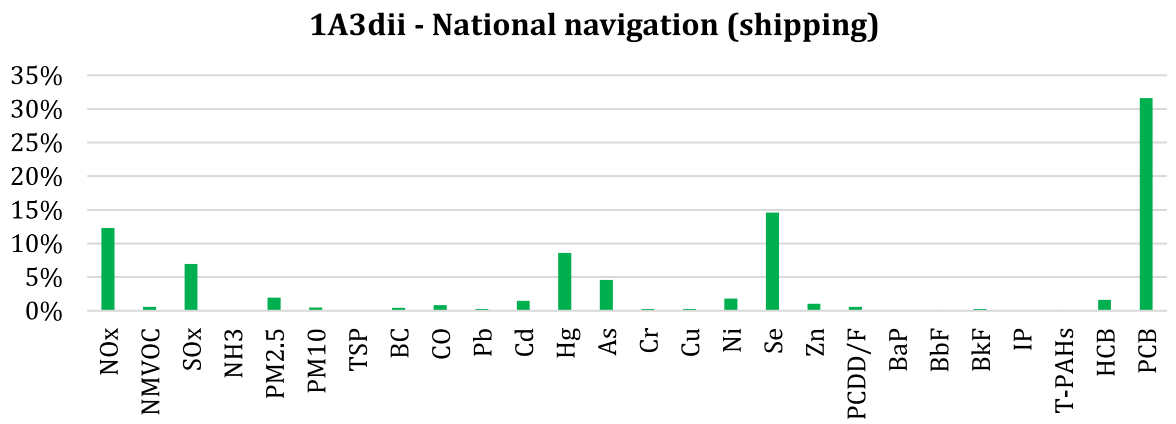

Figure 10: Shares of emissions from the NFR 1A3dii category in percentage of national total

4.7.2 Methodology

Following a suggestion by the TERT, emissions from recreational crafts were reported under NFR 1A5b. Hence, emissions under this sector were attributed to the Gozo Channel Ferry, the Valletta Ferry Services, and the Fast Ferry. This sector was estimated through the Tier 2 methodology presented within the 2023GB. The Gozo Channel Ferry was classified as a medium speed diesel engine, while both the Valletta Ferry Services and Fast Ferry were deemed to operate through a high speed diesel engine. The Tier allocation per vessel was explained in the activity data section below.

The tables used, as provided within the 2023GB, are provided below:

Table 25: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Gasoil and diesel oil	Tier 0	Table 3-2	1.A.3.d Navigation (shipping)
Gasoil and diesel oil	Tier I, II, III	Table 3-7	1.A.3.d Navigation (shipping)

4.7.3 Activity Data

For this submission, the fuel consumption from the Gozo Channel Ferry, the Valletta Ferry Services, and the Fast Ferry were considered under this sector. The Gozo Channel has been operating prior to 1990, the Valletta Ferry Services commenced its operations in October 2012, whereas the Fast Ferry started operating in 2021.

NO_x emissions are determined by the Tier system employed through regulation 13 in Annex VI of the MARPOL Convention. The regulation applies for vessels having a power output, which is greater than 130kW. All the vessels within the National Navigation sector were deemed to comply with this requirement. Furthermore, the maritime territory surrounding the Maltese Islands is not designated as a NO_x Emission Control Area, under the aforementioned regulation. Therefore, Tier III limits cannot be applied locally.

4.7.3.1 Gozo Channel

All three operators run on marine gas diesel oil. The fuel consumption from the Gozo Channel Ferry was available from 2002, and hence, the value for 2002 was carried backwards. The current fleet consists of the MV Ta' Pinu, MV Gaudos, and MV Malita, which were introduced as new vessels in 2000, 2001, and 2002 respectively. These three vessels are classified as Tier I. Prior to the introduction of all vessels were classified as Tier 0. In 2019, the Nikolaos was introduced. Since this vessel was constructed in 1987, it was classified as Tier 0. The table below presents the change in Tiers across the time series:

Table 26: Gozo Channel vessels and their respective Tier classification

Tier level	1990-1999	2000-2001	2002-2018	2019-
Tier 0	All vessels	Shift occurring due to the introduction of new vessels	No vessels	1 vessel
Tier I	No vessels		3 vessels	3 vessels

4.7.3.2 Valletta Ferries

The Valletta Ferry service was introduced in late 2012, with multiple different vessels being used until the introduction of Top Cat One in late 2014 and Top Cat Two in 2015. Both these vessels were constructed in 2014, and they are still currently in use. The fuel data provided by the operator is available from 2015 onwards. Thus, fuel consumption before 2015 had to be carried backwards. This assumption was adjusted to reflect the fact that the Valletta Ferries only operated for a few months in 2012.

The table below presents the share of fuel consumption and the respective Tiers applied:

Table 27: Valletta Ferries vessels and their Tier classification

Tier level	2012	2013	2014	2015	2016 onwards
Tier 0	1 vessel	1 vessel	1 vessel (full year) & 1 vessel (half year)	1 vessel (half year)	0 vessels
Tier I	1 vessel	1 vessel	1 vessel (half year)	0 vessels	0 vessels
Tier II	0 vessels	0 vessels	0 vessels	1 vessel (half year)	2 vessels

4.7.3.3 Gozo Fast Ferry

The fuel consumption for 2021 and 2022 was provided by both Virtu Ferries Ltd and Gozo Fast Ferry Ltd. There are four vessels operating this service. In 2021, a total of four vessels were used. Two vessels were constructed in 2018, and the other two were constructed in 1989 and 1990 respectively. However, in 2022 the ferry constructed in 1990 was replaced with a vessel constructed in 2022. The table below explains this change in vessels according to the Tier structure utilised:

Table 28: The Gozo Fast Ferries and their respective Tier classification

Tier level	2021	2022
Tier 0	2 vessels	1 vessel
Tier II	2 vessels	3 vessels

4.7.3.4 Sulphur content

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2018 to 2021. The average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020, 2021 and 2022 values were not considered within this average, since the sulphur content for these years was significantly lower than that of the previous two years.

4.7.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.7.5 Sector-specific recalculations

- The emissions for all pollutants were recalculated, as technology specific EFs were used for all vessels. The full detail is provided in Section 4.7.2.
- The fuel consumption for the Valletta Ferries from 2015-2019 was provided for the first time in this submission.

4.7.6 Sector-specific planned improvements

Efforts will be made to provide more representative EFs across the time series.

4.8 Sector 1A4ai: Commercial/Institutional: Stationary

Table 29: Sector 1A4ai general characteristics

NFR Code	**1A4ai**
Sub-Category	Commercial/Institutional: Stationary
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1 & 2
Key Category	SOx, As, Ni, Benzo(a) pyrene, Benzo(b) fluoranthene, & benzo(k) fluoranthene
Year of Last Update	2024 submission

4.8.1 Sector category description

This subcategory includes emissions of air pollutants from energy generation, which is used in activities related to commercial and public services.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 11.

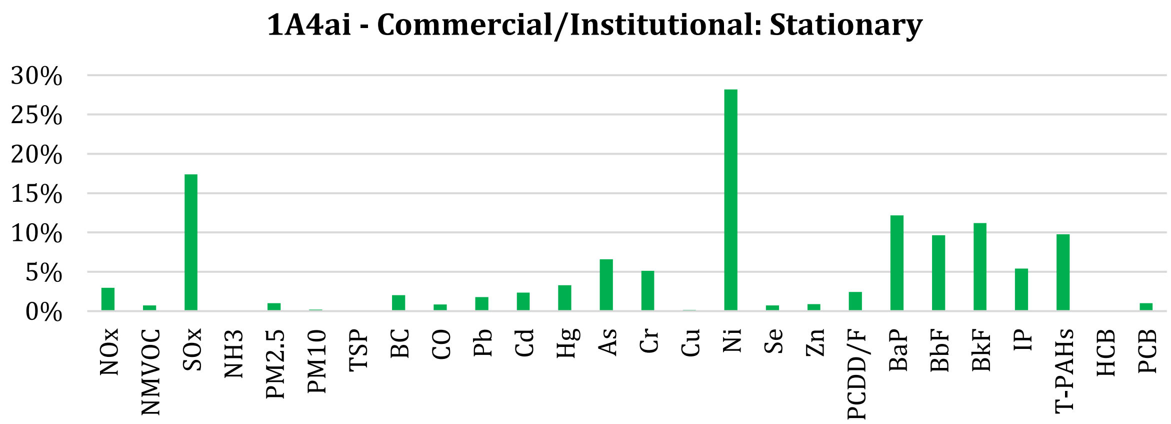

Figure 11: Shares of emissions from the NFR 1A4ai category in percentage of national total

4.8.2 Methodology

Emissions from the combustion of gasoil and fuel oil were estimated through a Tier 2 methodology, whereas the remaining fuels were estimated through a Tier 1 methodology, as provided within the 2023GB.The tables used, as provided within the 2023GB, are provided below:

Table 30: Source of emission factors split by fuel and technology

Fuel	Technology	Table	Chapter
Motor gasoline	N/A	Table 3-9	1.A.4 Small combustion
Other kerosene	N/A	Table 3-9	1.A.4 Small combustion
Gas oil and diesel oil	Boiler	Table 3-24	1.A.4 Small combustion
Gas oil and diesel oil	Generator	Table 3-31	1.A.4 Small combustion
Fuel oil	N/A	Table 3-24	1.A.4 Small combustion
Liquefied petroleum gases	N/A	Table 3-8	1.A.4 Small combustion
Biogases	N/A	Table 3-8	1.A.4 Small combustion

4.8.3 Activity Data

Quantities of fuel used from 2005 onwards were taken from the 'Commercial & public services' section within the Eurostat Energy Balance. The Energy Balance could not be used from 1990-2004, since the figures reported within the Energy Balance were all ‘0’. Data from the climate change model was used to gap fill these years.

4.8.3.1 Gasoil and diesel oil

An exercise was carried out for the 2023 submission, to determine the share of technology used to combust gasoil for both NFR 1A2gviii and NFR1A4ai. The fuel consumption per technology for all permitted combustion plants in 2019 was noted. The consumption of gasoil under these permitted facilities comprised 5.4% of the total gasoil combusted under both NFR1A2gviii and NFR1A4ai, as reported through the Eurostat Energy Balance. Thus, for that 5.4% of gasoil consumed, the technology share reported through the permitted facilities (as provided within Table 31 was taken. For the remaining 94.6% of gasoil combusted, the default technology share provided through the 2023GB, as provided in Table 31 was taken.

Table 31: Share of technology type per gasoil consumed in NFR1A4ai

Technology	Permit fuel use %	2023GB fuel use %
Reciprocating Engine	10.9%	20.0%
Boiler	89.1%	80.0%

The technology share for gasoil consumption was assumed to be the same for all the years.

4.8.3.2 Sulphur content

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2014 to 2022. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.8.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.8.5 Sector-specific recalculations

- All the pollutants emissions were updated as a minor linking error was fixed.
- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.

4.8.6 Sector-specific planned improvements

Efforts will be made to provide more representative EFs across the time series

4.9 Sector 1A4bi: Residential: Stationary

Table 32: Sector 1A4bi general characteristics

NFR Code	**1A4bi**
Sub-Category	Residential: Stationary
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

4.9.1 Sector category description

This subcategory includes emissions of air pollutants from small combustion activities, such as domestic internal heating.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 12.

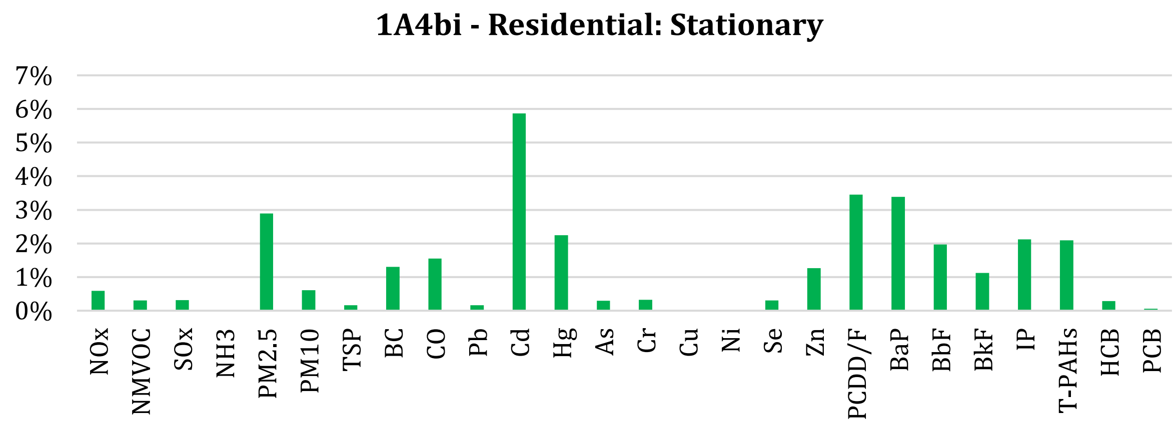

Figure 12: Shares of emissions from the NFR 1A4bi category in percentage of national total

Emissions from combustion in the residential sector were reported under NFR code 1A4bi. This sub-category includes emissions from small combustion activities, such as domestic internal heating.

4.9.2 Methodology

Emissions from LPG, Other kerosene, and gasoil were estimated through the Tier 1 methodology provided within the 2023GB. In contrast, emissions from primary solid biofuels were estimated through a Tier 2 methodology by making use of the technology shares provided through the GAINS model. These shares can be observed in the table below:

Table 33: Technology share for primary solid fuel combustion

Technology	1990-2010	2011-2015	2016-2020	2021-2022
Rural Fireplaces (households)	0.0%	0.0%	11.1%	0.0%
Rural Single house boilers (<50 kW) - automatic (households)	66.7%	75.0%	55.6%	75.0%
Rural Single house boilers (<50 kW) - manual (households)	0.0%	0.0%	11.1%	0.0%
Rural Heating stoves (households)	33.3%	25.0%	22.2%	25.0%

The tables used, as provided within the 2023GB, are provided below:

Table 34: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Liquefied petroleum gases	N/A	Table 3-4	1.A.4 Small combustion
Other kerosene	N/A	Table 3-5	1.A.4 Small combustion
Gas oil and diesel oil	N/A	Table 3-5	1.A.4 Small combustion
Primary solid biofuels	Rural fireplaces (households)	Table 3-39	1.A.4 Small combustion
Primary solid biofuels	Rural Single house boilers (<50 kW) - automatic (households)	Table 3-44	1.A.4 Small combustion
Primary solid biofuels	Rural Single house boilers (<50 kW) - manual (households)	Table 3-43	1.A.4 Small combustion
Primary solid biofuels	Rural heating stoves (households)	Table 3-40	1.A.4 Small combustion

4.9.3 Activity Data

The quantities of fuel used from 2005 onwards were taken from the 'Households' section within the Eurostat Energy Balance. The Energy Balance could not be used from 1990-2004, since the figures reported within the Energy Balance were all '0'. Data from the climate change model was used to gap fill these years.

4.9.3.1 Primary solid biofuels

The quantities of primary solid biofuels are only available from 2010 onwards in the Eurostat Energy Balance. Hence, an exercise was carried out to obtain the quantities of primary solid biofuels pre-2010. The Trade Statistics Unit within the NSO were contacted, following a suggestion by the EWA. The Trade Statistics Unit provided the quantities of biofuels imported by HS code from 2004-2020. The data from the Trade Statistics Unit was compared to the data in the Eurostat Energy Balance. The values provided by the Trade Statistics Unit were found to be similar, i.e. on average 4.7% greater than those in the Eurostat Energy Balance from 2010-2020.

The Energy Balance was assumed to better reflect the combustion of biofuels. Thus, the quantity of primary solid biofuels consumed from 2010-2020 was taken from the Eurostat Energy Balance. The quantities of biofuels provided by the Trade Statistics Unit from 2004-2009 were calibrated to the values in the Eurostat Energy Balance by dividing by 104.7%.

However, upon closer inspection, it was noted that certain categories of biofuels were not included in 2004-2009. Additionally, multiple HS codes had the same, or a similar definition. As a result, a particular biofuel may have been classified differently across the years. Consequently, HS codes had to be grouped together, and then a gap filling exercise would be carried out for the missing HS codes. The HS code groupings can be observed in Table 35. Once the HS codes were grouped, gap-filling techniques such as a 3 or 5-year moving average, or carrying a value backwards were applied. The nature of each trend was considered when choosing the gap-filling technique. The same gap-filling techniques were then used for pre-2004 data. Figure 13 compares the trends with and without gap-filling.

Table 35: HS Code classification groupings for gap filling

HS Code	1A4bi
44011000 **44011100** **44011200**	Fuel wood, in logs, billets, twigs, faggots or similar forms Fuel wood, in logs, billets, twigs, faggots or similar forms, coniferous Fuel wood, in logs, billets, twigs, faggots or similar forms, non-coniferous
44012100	Coniferous wood in chips or particles (excl. those of a kind used principally for dying or tanning purposes)
44012200	Wood in chips or particles (excl. those of a kind used principally for dying or tanning purposes, and coniferous wood)
44013020 **44013100**	Sawdust and wood waste and scrap, agglomerated in pellets Wood pellets

44013080 **44013990** **44013980** **44014090**	Wood waste and scrap, whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets) Wood waste and scrap, whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets) Wood waste and scrap, not agglomerated (excl. sawdust) Wood waste and scrap, not agglomerated (excl. sawdust)
44013040 **44013900** **44013910** **44013920** **44013930** **44014010**	Sawdust of wood, whether or not agglomerated in logs, briquettes or similar forms (excl. pellets) Sawdust and wood waste and scrap, agglomerated in logs, briquettes or similar forms (excl. pellets) Sawdust of wood, whether or not agglomerated in logs, briquettes or similar forms (excl. pellets) Sawdust and wood waste and scrap, agglomerated in logs, briquettes or similar forms (excl. pellets) Sawdust of wood, not agglomerated Sawdust, not agglomerated
44021000	Bamboo charcoal, incl. shell or nut charcoal, whether or not agglomerated (excl. used as a medicament, mixed with incense, activated bamboo charcoal and in the form of crayons)
44029000	Wood charcoal, incl. shell or nut charcoal, whether or not agglomerated (excl. bamboo charcoal, wood charcoal used as a medicament, charcoal mixed with incense, activated charcoal and charcoal in the form of crayons)

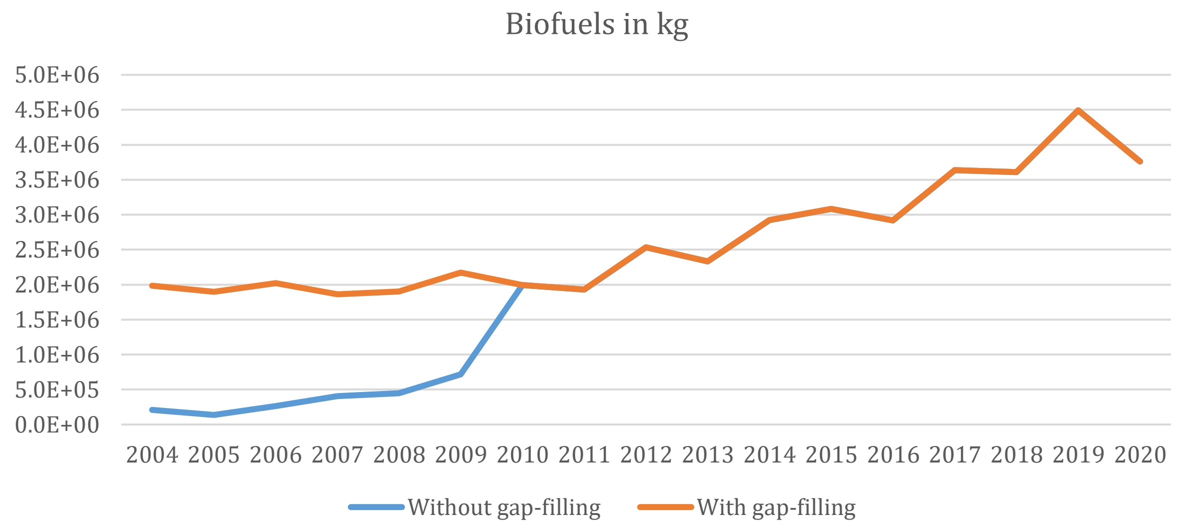

Figure 13: Results from gap-filling exercise on quantity of biofuels

4.9.3.2 Sulphur content

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2014 to 2022. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.9.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.9.5 Sector-specific recalculations

- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.
- Emissions from NH_3, PCDD/PCDF, Benzo(b)fluoranthene, benzo(k)fluoranthene & Indeno(1,2,3-cd)pyrene were recalculated due to changes in the emission factors provided within the 2023GB.

4.9.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

4.10 Sector 1A4cii: Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery

Table 36: Sector 1A4cii general characteristics

NFR Code	**1A4cii**
Sub-Category	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1 & 2
Key Category	SO_x & CO
Year of Last Update	2024 submission

4.10.1 Sector category description

This subcategory includes emissions of air pollutants from off-road vehicles and other machinery used in agriculture/forestry mobile machinery (excluding fishing).

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 14.

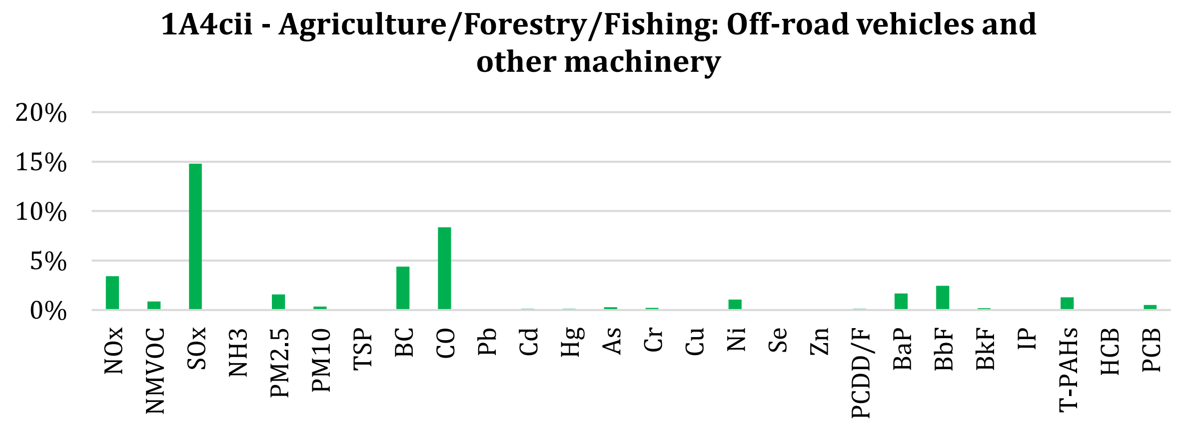

Figure 14: Shares of emissions from the NFR 1A4cii category in percentage of national total

4.10.2 Methodology

Emissions from the combustion of gasoil were estimated through the Tier 2 methodology provided within the 2023GB for the first time in this submission. The remaining fuels were estimated through a Tier 1 methodology.

The share of engine technology was required to estimate emissions from the combustion of gasoil at a Tier 2 level. The split of fuel consumption per engine age was taken from Table 3-3 of the 2023GB. The engine age was then combined with the EU Directive requirements relevant for emissions control from diesel-fuelled non-road machinery, as provided in Table 2-3 of the 2023GB. The table below provides a summary of the share of emission control requirements across the time series:

Table 37: Share of technology across the time series

Step 2: Share of technology	Fuel type	Engine use	1990	2005	2015	2020	2021	2022
Pre-1981	Gasoil	Agriculture	38.1%	5.7%	0.0%	0.0%	0.0%	0.0%
1981-1990	Gasoil	Agriculture	61.9%	16.6%	5.7%	0.0%	0.0%	0.0%
1991-Stage I	Gasoil	Agriculture	0.0%	30.2%	12.7%	9.9%	8.5%	7.0%
Stage I	Gasoil	Agriculture	0.0%	32.0%	12.2%	8.5%	8.1%	7.8%
Stage II	Gasoil	Agriculture	0.0%	15.6%	16.7%	9.0%	8.1%	7.5%
Stage IIIA	Gasoil	Agriculture	0.0%	0.0%	29.9%	19.9%	17.9%	15.9%

Stage IIB	Gasoil	Agriculture	0.0%	0.0%	7.2%	5.2%	4.8%	4.4%
Stage IV	Gasoil	Agriculture	0.0%	0.0%	15.6%	32.0%	29.9%	27.9%
Stage V	Gasoil	Agriculture	0.0%	0.0%	0.0%	15.6%	22.8%	29.6%

The tables used, as provided within the 2023GB, are provided below:

Table 38: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Liquefied petroleum gases	N/A	Table 3-1	1.A.4 Non-road mobile sources and machinery
Motor gasoline	Four-stroke	Table 3-1	1.A.4 Non-road mobile sources and machinery
Kerosene-type jet fuel	N/A	Table 3-9	1.A.4 Small combustion
Other kerosene	N/A	Table 3-9	1.A.4 Small combustion
Fuel oil	N/A	Table 3-9	1.A.4 Small combustion
Blended biodiesels	N/A	Table 3-9	1.A.4 Small combustion
Gas oil and diesel oil	Tier 1	Table 3-1	1.A.4 Non-road mobile sources and machinery
Gas oil and diesel oil	Tier 2 - Agriculture	Table 3-2	1.A.4 Non-road mobile sources and machinery

4.10.3 Activity Data

The quantities of fuel used from 2005 onwards were taken from the 'Agriculture & forestry' section within the Eurostat Energy Balance. The Energy Balance could not be used from 1990 to 2004, since the figures reported within the Energy Balance were all '0'. Data from the climate change model was used to gap fill these years; however, there are significant differences between the two datasets. Additionally, the Energy Balance does not differentiate between mobile and stationary fuel use. Hence, the notation key 'IE' is used for sector 1A4ci, since emissions under the agriculture/forestry/fishing sector are included under the mobile sector.

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2014 to 2022. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.10.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.10.5 Sector-specific recalculations

- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.
- Emissions of NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, and CO were recalculated.

4.10.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

4.11 Sector 1A4ciii: Agriculture/Forestry/Fishing: National Fishing

Table 39: Sector 1A4ciii general characteristics

NFR Code	**1A4cii**
Sub-Category	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1
Key Category	Not Applicable
Year of Last Update	2024 submission

4.11.1 Sector category description

This subcategory includes emissions of air pollutants from fuels combusted for inland, coastal and deep-sea fishing.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 15.

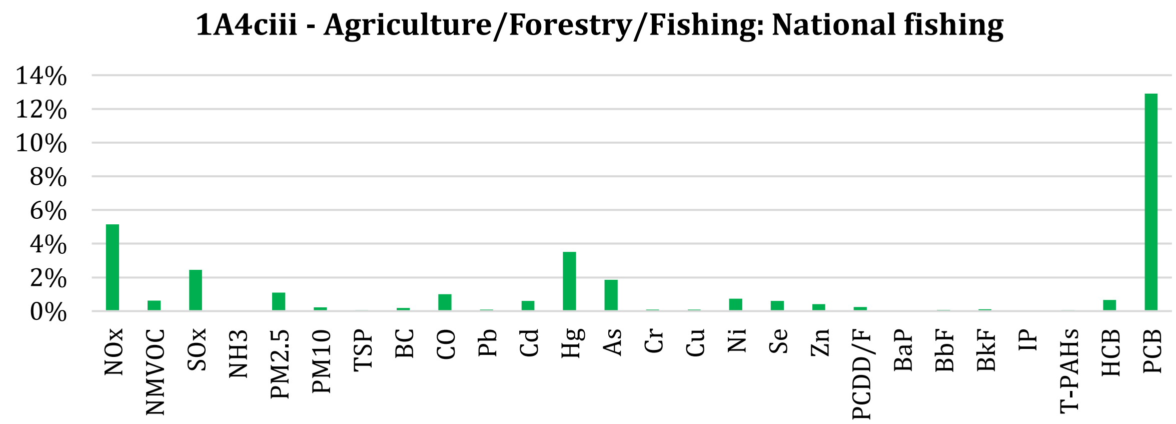

Figure 15: Shares of emissions from the NFR 1A4ciii category in percentage of national total

4.11.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2023GB.

The tables used, as provided within the 2023GB, are provided below:

Table 40: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Liquefied petroleum gases	N/A	Table 3-3	1.A.3.d Navigation (shipping)
Motor gasoline	N/A	Table 3-4	1.A.3.d Navigation (shipping)
Gas oil and diesel oil	N/A	Table 3-2	1.A.3.d Navigation (shipping)

4.11.3 Activity Data

The quantities of fuel used from 2005 onwards were taken from the 'Fishing' section within the Eurostat Energy Balance. The Energy Balance could not be used from 1990-2004, since the figures reported within the Energy Balance were all '0'. Data from the climate change model was used to gap fill these years; however, there are significant differences between the two datasets.

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2018 to 2022. The average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020, 2021, and 2022 values were not considered within this average, since the sulphur content for both these years was significantly lower than that of the previous two years.

4.11.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.11.5 Sector-specific recalculations

- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.
- The emissions of NO_x, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, and Cu were recalculated for all years following and update in the emission factors within the 2023GB.

4.11.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

4.12 Sector 1A5b: Other, Mobile (including military, land based and recreational boats)

Table 41: Sector 1A5b general characteristics

NFR Code	**1A5b**
Sub-Category	Other, Mobile (including military, land based and recreational boats)
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1 & 2
Key Category	NO_x, NMVOC, NH_3, $PM_{2.5}$, BC, CO, Hg, Se, & PCBs
Year of Last Update	2024 submission

4.12.1 Sector category description

This subcategory includes emissions of air pollutants from the operation of recreational crafts within the Maltese Islands.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 16.

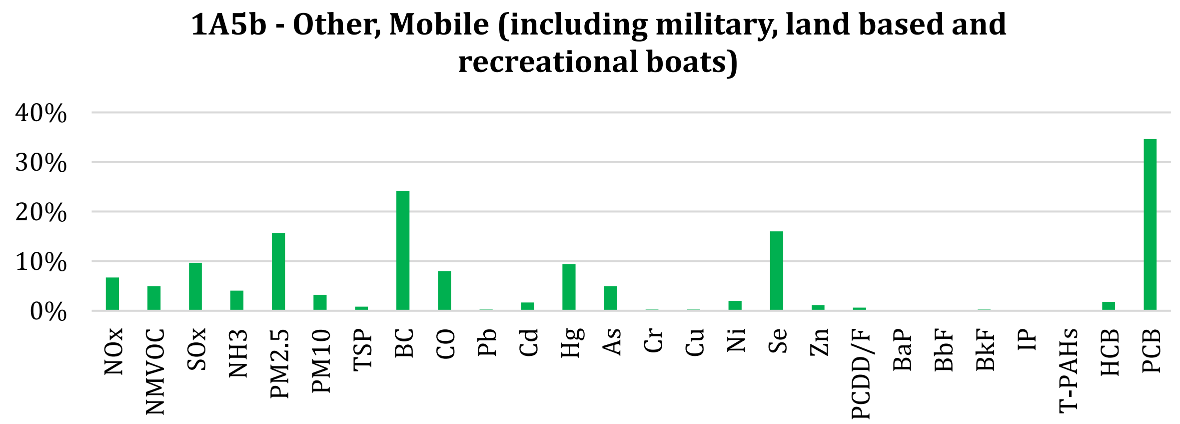

Figure 16: Shares of emissions from the NFR 1A5b category in percentage of national total

4.12.2 Methodology

The emissions from the combustion of gasoil and motor gasoline were estimated through the Tier 2 methodology provided within the 2023GB. The shares of 2-stroke and 4-stroke vessels, as well as the respective shares of vessels complying with the requirements of Directive 2003/44/EC, are explained in section 4.12.3.2 below. Moreover, emissions from Heavy Fuel Oil were estimated through the Tier 1 methodology provided within the 2023GB.

The tables used, as provided within the 2023GB, are provided below:

Table 42: Source of Emission Factors within the 2023GB

Fuel	Technology	Table	Chapter
Heavy fuel oil	N/A	Table 3-1	1.A.3.d Navigation (shipping)
Motor gasoline	2-stroke	Table 3-8	1.A.3.d Navigation (shipping)
Motor gasoline	4-stroke Conventional	Table 3-8	1.A.3.d Navigation (shipping)
Motor gasoline	4-stroke 2003/44/EC	Table 3-8	1.A.3.d Navigation (shipping)
Gasoil and diesel oil	Conventional	Table 3-8	1.A.3.d Navigation (shipping)
Gas oil and diesel oil	2003/44/EC	Table 3-8	1.A.3.d Navigation (shipping)

4.12.3 Activity Data

The fuel consumption was obtained by subtracting the fuel consumption from the Gozo Channel Ferry, Valletta Ferry Services, and the Fast Ferry, from the total fuel reported as 'Domestic navigation' section within the Eurostat Energy Balance. However, only data from 2005 onwards was used, since the Energy Balance reported a '0' value from 1990-2004. Hence, the values were taken from the climate change model, as provided by the Malta Resources Authority (MRA).

The TERT noted a significant increase in emissions for multiple pollutants from 2020 to 2021. This increase can be attributed to an increase in gasoil consumption, which was reported in the Eurostat Energy Balance.

4.12.3.1 Motor Gasoline

No values for motor gasoline were provided from 2005-2016. A gap-filling exercise was carried out to identify the quantities of motor gasoline consumed in these years. The methodology to gap-fill these years is provided below:

Two potential data sources were identified for values from 2013-16, i.e. the National Statistics Office (NSO) and the Regulator for Energy and Water Services (REWS). When comparing the values provided by both data suppliers for 2017-2019 to those in the Eurostat Energy Balance, and it was noted that the values provided by the NSO were almost identical, differing by less than 0.1%. Hence, the data from the NSO was chosen for gap-filling from 2013-2016.

For the remaining years, i.e. 2005-2012, a linear interpolation was carried out from 2004-2013, as no potential indicators were identified. It is worth noting that the data from 2013 onwards is considered as being more robust than the data from pre-2005.

The share of 2-stroke and 4-stroke engines was not available. Thus, a share of 75% 2-stroke and 25% 4-stroke was assumed for the entire time series, in line with the note in Table 3-4 of the 2023GB.

4.12.3.2 Compliance with Directive 2003/44/EC

The number of vessels complying with the requirements of Directive 2003/44/EC was not available. However, the 2023GB states that a marine engine has a life cycle of 25 years, which is equivalent to annual replacement rate of 4%. The transposition of Directive 2003/44/EC, i.e. L.N. 128 of 2005, started applying to vessels constructed from 2006 onwards. An annual replacement of 4% was applied, ensuring that the share of vessels complying with the requirements of the Directive gradually increased across the time series.

4.12.3.3 Sulphur content

The percentage sulphur content obtained from the Regulator for Energy and Water Services (REWS) was used to estimate SO_x for some years and fuels. Data was available for 2018 to 2022 for gasoil and gasoline, and from 2014-2020 onwards for heavy fuel oil. For both gasoline and gasoil the average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020, 2021, and 2022 values were not considered within this average, since the sulphur content for these years was significantly lower than that of the previous two years. Conversely, for heavy fuel oil, the sulphur content for 2014 was carried backwards.

4.12.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.12.5 Sector-specific recalculations

- All the pollutants emissions were updated as the fuel reported in the Eurostat Energy Balance from 2018 onwards was revised.
- The emissions from all pollutants were recalculated, due to the split in the share of 2-stroke and 4-stroke engines for the combustion of motor gasoline. In addition, the share between vessels complying with Directive 2003/44/EC, and those which did not, was included for the first time in this submission.

4.12.6 Sector-specific planned improvements

Efforts will be made to further refine the technology share within this sector.

4.13 Sector 1B2av: Distribution of Oil Products

Table 43: Sector 1B2av general characteristics

NFR Code	**1B2av**
Sub-Category	Distribution of Oil Products
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1
Key Category	NMVOC
Year of Last Update	2024 submission

4.13.1 Sector category description

This subcategory includes emissions of air pollutants from the filling of transport equipment and storage tanks, border terminal dispatch stations, and service stations while refuelling gasoline cars.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 17.

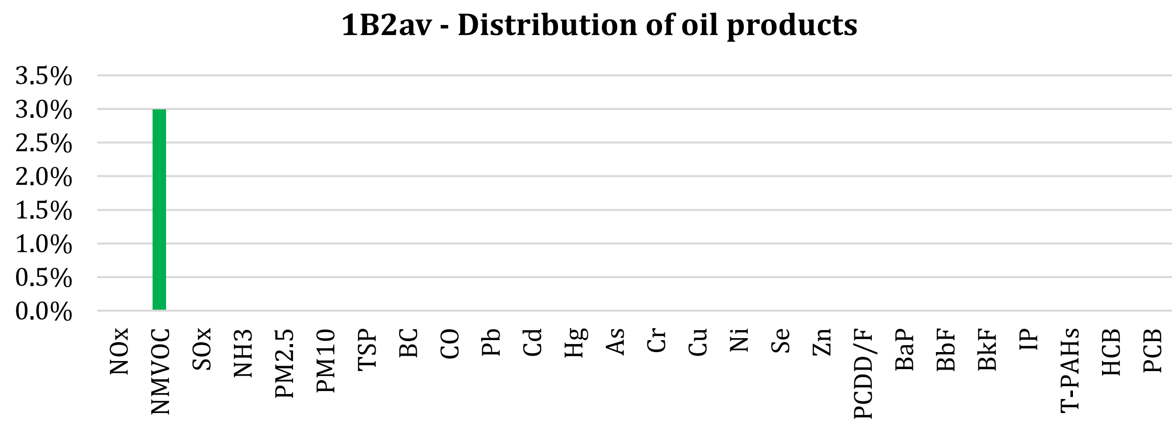

Figure 17: Shares of emissions from the NFR 1B2av category in percentage of national total

4.13.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2023GB.

4.13.3 Activity Data

The emissions from 1990-2005 were based on the gross inland consumption of gasoline (gasoline without bio component and aviation gasoline), as reported by Eurostat. The activity data from 2006 onwards was modelled in line with the emission trends reported by Italy in its 2023 emission inventory submission. The TERT had proposed this methodology, as opposed to making use of the data from Eurostat, since the trends emerging from the Eurostat data differed significantly from those within the EU region.

4.13.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by comparing the values submitted within the Eurostat Energy Balance to those utilised in the Eurostat Energy Balance database), the emission factors, and the formulas utilised within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

4.13.5 Sector-specific recalculations

The emissions of NMVOC were recalculated from 2006 onwards, due to changes in Italy's submission.

4.13.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5 Industry (NFR 2)

Chapter Updated: 2024

5.1 Category overview

Emissions from the following sectors are estimated:

- 2A5b (construction and demolition)
- 2D3a (domestic solvent use including fungicides)
- 2D3b (road paving with asphalt)
- 2D3d (coating applications)
- 2D3e (degreasing)
- 2D3f (dry cleaning)
- 2D3h (printing)
- 2G (other product use)
- 2H2 (food and beverages industry)

This sector includes all emissions emanating from the industrial processes, which are not related to the combustion of fossil fuels. Malta has a limited industrial landscape mainly due to limitations in land area. Hence, Malta is forced to opt for imports of products, which are not produced locally. The main pollutants emitted from industrial processes in Malta are NMVOC and PMs.

Table 44 shows the detailed source categories for the industry sector. The relevant pollutant trends for key categories, as well as, the methodologies used are explained in the sections below.

Table 44: Coverage of NFR 2 categories in 2022

NFR Code	Pollutants			Method	KC
	Covered	Exceptions			
		NE	NA		
2A1	Not Occurring				✕
2A2	Not Occurring				✕
2A3	Not Occurring				✕
2A5a	Not Occurring				✕
2A5b	$PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 1	✓
2A5c	Not Occurring				✕
2A6	Not Occurring				✕
2B1	Not Occurring				✕
2B2	Not Occurring				✕
2B3	Not Occurring				✕
2B5	Not Occurring				✕
2B6	Not Occurring				✕
2B7	Not Occurring				✕
2B10a	Not Occurring				✕
2B10b	Not Occurring				✕
2C1	Not Occurring				✕
2C2	Not Occurring				✕
2C3	Not Occurring				✕
2C4	Not Occurring				✕
2C5	Not Occurring				✕
2C6	Not Occurring				✕

2C7a	Not Occurring				✕
2C7b	Not Occurring				✕
2C7c	Not Occurring				✕
2C7d	Not Occurring				✕
2D3a	NMVOC	-	Rest of Pollutants	Tier 2	✓
2D3b	NMVOC , $PM_{2.5}$, PM_{10}, TSP, BC	-	Rest of Pollutants	Tier 2	✓
2D3c	Not Occurring				✕
2D3d	NMVOC	-	Rest of Pollutants	Tier 2	✓
2D3e	NMVOC	-	Rest of Pollutants	Tier 1	✓
2D3f	NMVOC	-	Rest of Pollutants	Tier 1	✕
2D3g	Not Occurring				✕
2D3h	NMVOC	-	Rest of Pollutants	Tier 2	✓
2D3i	Not Occurring				✕
2G	Rest of Pollutants	-	Se, HCB, PCB	Tier 2	✓
2H1	Not Occurring				✕
2H2	NMVOC, PM_{10}	-	Rest of Pollutants	Tier 2	✓
2H3	Not Occurring				✕
2I	Not Occurring				✕
2J	Not Occurring				✕
2K	Not Occurring				✕
2L	Not Occurring				✕

NE: Not Estimated, NA: Not Applicable, KC: Key Category.

Shares of emissions from this NFR sector for all pollutants in 2022 are shown Figure 18. Most pollutant emissions originate primarily from NFR 2.

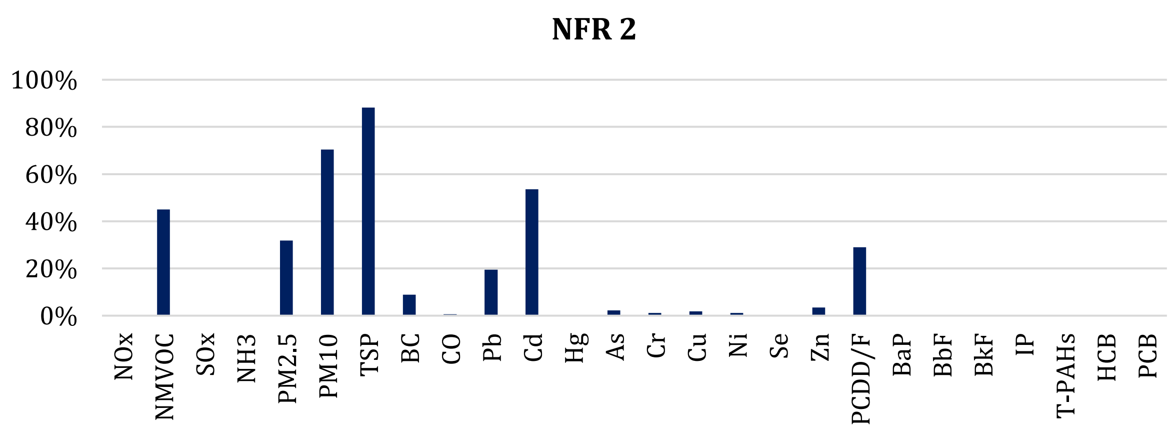

Figure 18: Shares of emissions from the NFR 2 category in percentage of national total

5.2 Sector 2A5b: Construction and demolition

Table 45: Sector 2A5b general characteristics

NFR Code	**2A5b**
Sub-Category	Construction and demolition
Method	2023GB
Activity Data	Eurostat Malta MET Office Building and Construction Authority Planning Authority
Emission Factors	Tier 1
Key Category	$PM_{2.5}$, PM_{10} & TSP
Year of Last Update	2024 submission

5.2.1 Sector description

This sector covers the emissions emerging from the construction of buildings. Emissions emerging from the construction of roads are not included within this sector as no activity data is currently available. Shares of emissions of the particular pollutants from 2A5b in 2022 are shown in Figure 19.

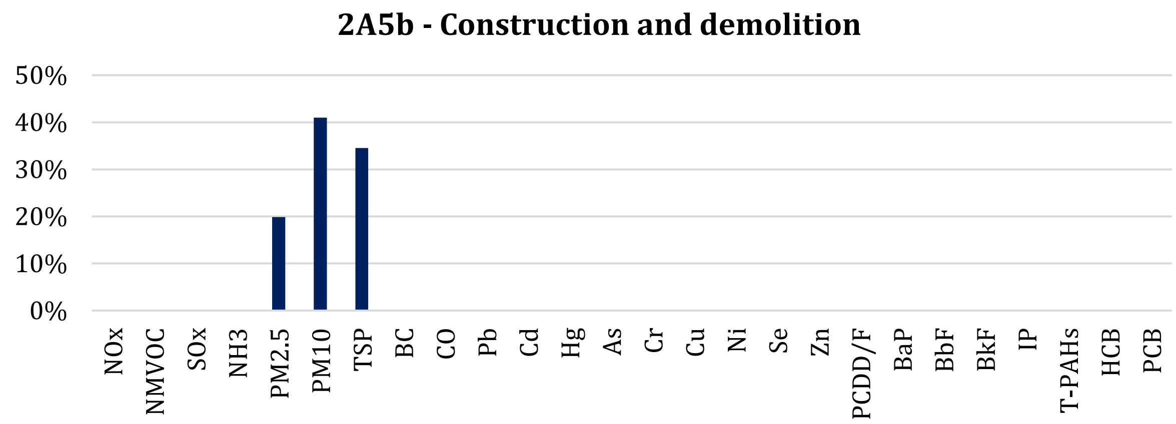

Figure 19: Shares of emissions from the NFR 2A5b category in percentage of the national total

5.2.2 Methodology & activity data – Historical

The estimations of the emissions are based on the US EPA tier 1 methodology as described within the 2023GB. Effort was made to use country-specific parameters whenever this was deemed optimal by the sectoral expert. As previously disclosed, the data required to estimate the emissions emerging from the construction of roads was not available for this submission. Hence, no emissions resulting from the construction of roads have been included within this year's submission.

Estimations made utilized the following base equation (US EPA method):

$$EM_{PM10} = EF_{PM10} * A_{affected} * d * (1 - CE) * \left(\frac{24}{PE}\right) * \left(\frac{s}{9\%}\right)$$

Equation 4: Equation utilized to estimated construction and demolition emissions based on the US EPA method.

Where:

- EM_{PM10} = PM_{10} emissions (kg)
- EF_{PM10} = Emission factor for PM_{10} (kg/(m^2.year))
- $A_{affected}$ = Area affected by construction (m^2)
- d = duration of construction (year)
- CE = efficiency of emission control measures
- PE = Thornthwaite precipitation-evaporation index

- s = soil silt content (%)

The emission factors applied in this sector are derived from those specified in the Tier 1 methodology outlined in the 2023GB. Detailed information can be located in Table 46.

Table 46: Emission factors utilised for all years [1990 to 2022] based on the Tier 1 methodology.

Emission Factors	Units	TSP	PM_{10}	$PM_{2.5}$
Houses	kg/[m^2 year]	0.29	0.086	0.0086
Apartments	kg/[m^2 year]	1	0.3	0.03
Non-residential buildings	kg/[m^2 year]	3.3	1	0.1

The duration and soil silt content were also extracted from the Tier 1 methodology presented within the 2023GB. The related information can be located in Table 47.

Table 47: Parameter data inputs utilised for all years [1990 to 2022] based on Tier 1 methodology.

Parameters	**Duration** (Years)	**Soil Silt Content** (%)
Houses	0.5	29%
Apartments	0.75	29%
Non-residential buildings	0.83	29%

The affect area varies from year to year. This parameter is mainly based on data provided by the PA. For houses and apartments, PA provided the total site area from 2010 to 2022. For years 2000 to 2009, area affected was extrapolated using Eurostat data on one-dwelling buildings and two- and more dwelling buildings respectively, in order to inform the trend. Subsequent extrapolation was conducted for the years 1995 to 1999, employing Eurostat Gross Value Added (GVA) data specifically related to the construction sector to guide the trend analysis. The 1995 value was utilized for 1990 to 1994. For non-residential building construction, the PA provided the total site area from 2013 to 2022. For the period spanning 2007 to 2012, projections were derived by extrapolating values based on data from the relevant permits granted, as provided by PA. Additionally, extending from 1995 to 2006, Eurostat GVA data pertaining to the construction sector was utilized for further extrapolation to delineate the trend. The 1995 value was than utilized for 1990 to 1994. Excerpts from the data can be found in Table 48.

Table 48: Affected area for years 2005 and the latest 3 data years.

Affected Area	Units	2005	2020	2021	2022
Houses	m^2	109196.2	104188.5	135219.0	125601.5
Apartments	m^2	225714.5	276849.5	309269.6	237418.7
Non-residential buildings	m^2	42127.5	150151.1	161938.1	308869.1

Discussions with the Building and Construction Authority (BCA) were held regarding the use of emission control measures in Maltese work sites. BCA specified that although wetting is required by law during all construction and demolition activities (as per S.L.552.09) not all sites utilize this practice. BCA quantified that around 35% of sites utilized wetting in 2005 whilst 60% utilized wetting in 2022. In the year 2030 BCA estimates that around 75% of sites will be utilising this practice. Excerpts from the data utilized can be found in Table 49.

Table 49: Efficiency of emission control measures for years 2005 and the latest 3 data years.

Efficiency of emission control measures	2005	2020	2021	2022
Houses Apartments Non-residential buildings	0.18	0.29	0.29	0.30

The Thornthwaite precipitation-evaporation index was calculated based upon the monthly total precipitation and the mean monthly temperature provided by the Malta MET Office. Excerpts from the data utilized can be found in Table 50.

Table 50: Thornthwaite precipitation-evaporation index for years 2005 and the latest 3 data years.

Thornthwaite precipitation-evaporation index	2005	2020	2021	2022
Houses Apartments Non-residential buildings	33.42	21.82	35.08	22.70

5.2.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.2.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.2.5 Sector-specific recalculations

Minor recalculations for all related pollutants ($PM_{2.5}$, PM_{10} & TSP) took place as a result of a modification in PA activity data for years 2011 to 2013 and 2018 to 2021.

Table 51: Modified activity data – changes in apartments affected area

Activity Data – Affected area (m²) - Apartments

Year	2023 Submission	2024 Submission
2011	155412.65	156062.65
2012	89726.28	88794.28
2013	69404.95	69514.95
2018	335428.86	335627.26
2019	317580.85	318087.85
2020	274010.83	276849.48
2021	243184.83	309269.65

Table 52: Modified activity data – changes in non-residential buildings affected area.

Activity Data – Affected area (m²) - Non-residential buildings

Year	2023 Submission	2024 Submission
2021	104300.93	125601.45

5.2.6 Sector-specific planned improvements

Effort is being made to obtain the necessary data to calculate the emissions emerging from the construction of roads.

5.3 Sector 2D3a: Domestic solvent use including fungicides

Table 53: Sector 2D3a general characteristics

NFR Code	**2D3a**
Sub-Category	Domestic solvent use including fungicides
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 2
Key Category	NMVOC
Year of Last Update	2024 submission

5.3.1 Sector description

This sector covers the emissions emerging from the domestic use of solvent-containing products. It should be noted that many of these products are also used in industry and commerce. Shares of emissions of the particular pollutants from 2D3a in 2022 are shown in Figure 20.

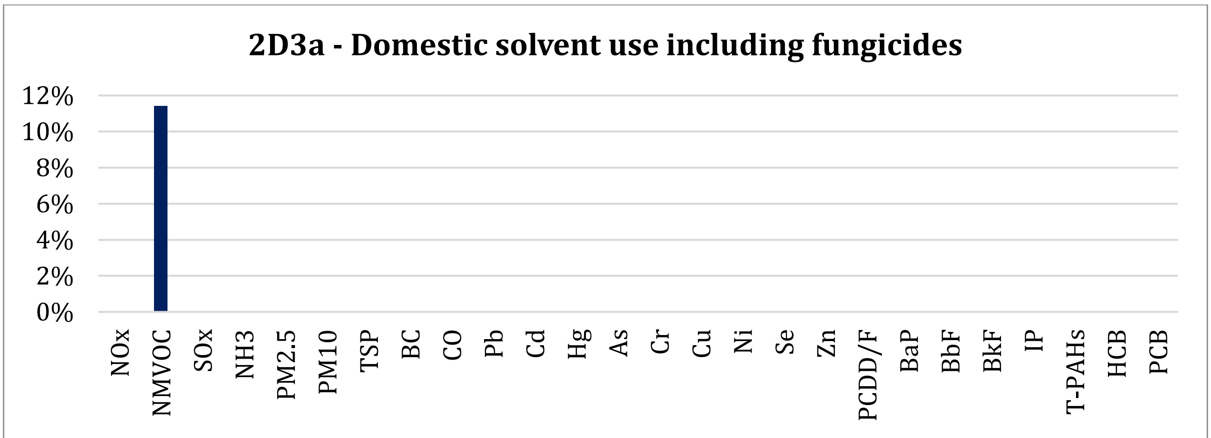

Figure 20: Shares of emissions from the NFR 2D3a category in percentage of the national total

5.3.2 Methodology & activity data - Historical

The tier 2 approach employed in the previous submission, has been retained for this submission. This approach involves utilizing import and export data of domestic solvent products, categorized by PRODCOM codes, and complemented by special trade statistics (STS) as activity data. Eurostat has made available data starting from 2003. For previous years (1990 to 2002), the activity data was estimated using a five-year moving average for both imports and exports.

Total products per annum (Kg) =
Products imported (Kg) + Products produced locally (Kg) - Products exported (Kg)

Equation 5: 2D3a total products utilized by MT calculation

Equation 5 is utilized to estimate the apparent consumption; however, it is documented that the results of this calculation can be unreliable due to a range of factors. An assumption is required in this methodology for cases where the above formula produced a negative value (i.e. the number of products exported were higher than imported and produced combined), the weight of products for that year was assumed to be zero. Therefore, it was assumed that such products were not consumed locally. It is likely that this is caused by a discrepancy between the coverage of production statistics and trade statistics.

This methodology assumes that all the product destined for use in Malta will be sold and utilized within a five-year period. Consequently, any emissions resulting from the use of these products are evenly distributed over the data year and the following four years. All solvents disposed of in landfills were excluded from the total product utilization. These reduction in activity data was directly attributing to the year of disposal. This methodology involves a combination of tier 2A and tier 2B, as necessitated by the data collection process. Excerpts from the activity data can be found in Table 54.

Table 54: Product total for each PRODCOM code for years 2005 and the latest 3 data years.

Product Total (PRODCOM code)	Units	2005	2020	2021	2022
20421915	Kg	424108	463573	485491	524244
20421930	Kg	136922	862945	932855	1001619
20413150	Kg	135156	47269	31235	35632
20413250	Kg	7117620	10067010	10345626	10086315
20413120	Kg	314041	212695	215074	227378
20413180	Kg	192564	335525	367629	510021
20413240	Kg	221587	2528329	2562984	2511449
20412020	Kg	400967	228939	218230	218712
20412030	Kg	17795	32441	27458	14813
20412050	Kg	190814	143313	143038	140709
20412090	Kg	89299	75478	59774	64342
20414100	Kg	0	0	0	0
20414330	Kg	1892	11391	12780	11850
20414350	Kg	70192	23800	23976	25079
20414389	Kg	83300	17475	18013	23459
20414383	Kg	53090	23343	19983	18232
20414400	Kg	140645	80610	80720	63519
20414370	Kg	40536	47628	47558	50426
20594350	Kg	310717	241496	251421	256757
20421150	Kg	0	0	0	0
20421170	Kg	0	0	0	0
20421945	Kg	0	0	0	0
20421250	Kg	0	0	0	0
20421270	Kg	0	0	0	0
20421400	Kg	0	0	0	0
20421500	Kg	0	0	0	0
20421300	Kg	0	0	0	0
20421630	Kg	0	0	0	0
20421650	Kg	0	0	0	0
20421670	Kg	0	0	0	0
20421700	Kg	0	0	0	0
20421960	Kg	0	0	0	0
20421975	Kg	0	0	0	0
20421990	Kg	0	0	0	0
20421850	Kg	0	0	0	0
20421890	Kg	0	0	0	0
20531020	Kg	2692	6153	7020	8004

Tier 2A relies on the solvent amount per product as the emission factor, while tier 2B multiplies the product quantity by the emission factor provided in the 2023GB. This improvement was developed in collaboration with an external consultant as part of the NECD capacity-building project carried out in 2021.

Table 55 provides a comprehensive list of the PRODCOM codes used in estimating this sector using the tier 2A methodology, along with the consistent solvent content of each product. PRODCOM data are detailed production data at an 8-digit level. It is important to highlight that the solvent content remains consistent throughout the entire time series. As a result, the emission estimates do not incorporate any variations in the solvent content of products over time. Table 56 lists the PRODCOM codes used to estimate this sector via the tier 2B methodology

Table 55: PRODCOM codes utilized and the corresponding solvent content used for the tier 2A calculation.

Categories	PRODCOM Label	PRODCOM Code	Solvent Content (% Mass)
Soap	Soap and organic surface-active products in bars, etc., for toilet use	20421915	3.5
	Organic surface-active products and preparations for washing the skin; whether or not containing soap, p.r.s.	20421930	0.5
	Soap in the form of flakes, wafers, granules or powders	20413150	0.5
Deodorants	Preparations for perfuming or deodorising rooms	20414100	28.95
Shoe and leather care products	Polishes, creams and similar preparations, for footwear or leather (excluding artificial and prepared waxes)	20414330	31.38
Furniture and floor care products	Polishes, creams and similar preparations, for the maintenance of wooden furniture, floors or other woodwork (excluding artificial and prepared waxes)	20414350	46.00
	Other polishes, creams and similar preparations, n.e.c.	20414389	27
Polishing and abrasives	Metal polishes	20414383	49.6
	Scouring pastes and powders and other scouring preparations	20414400	4
Car care products	Anti-freezing preparations and prepared de-icing fluids	20594350	20
Perfumes	Perfumes	20421150	82.5
	Toilet waters	20421170	76.25
Makeup products	Lip make-up preparations	20421250	30
	Eye make-up preparations	20421270	5
	Powders, whether or not compressed, for cosmetic use (including talcum powder)	20421400	1
Preparations for the care of hands and feet	Manicure or pedicure preparations	20421300	81
Hair care and washing products	Shampoos	20421630	3.2
	Preparations for permanent waving or straightening of hair	20421650	13.5
	Hair lacquers	20421670	95
	Hair preparations (excluding shampoos, permanent waving and hair straightening preparations, lacquers)	20421700	3.125

Shaving, olfaction, personal hygiene and beauty products prepared	Pre-shave, shaving and after-shave preparations (excluding shaving soap in blocks)	20421945	5
	Personal deodorants and anti-perspirants	20421960	50
	Perfumed bath salts and other bath preparations	20421975	1
	Dentifrices (including toothpaste, denture cleaners)	20421850	5
	Preparations for oral or dental hygiene (including denture fixative pastes; powders and tablets, mouth washes and oral perfumes, dental floss) (excluding dentifrices)	20421890	5
Essential oils	Essential oils	20531020	0.135

Table 56: PRODCOM codes utilized and the corresponding EF used for the tier 2B calculation.

Categories	PRODCOM Label	PRODCOM Code	EF from GB (Kg NMVOCs per Kg Product)
Washing, cleaning and rinsing	Washing preparations and cleaning preparations, with or without soap, p.r.s. including auxiliary washing preparations excluding those for use as soap, surface-active preparations	20413250	0.016
	Soap and organic surface-active products in bars, etc., n.e.c.	20413120	0.016
	Soap in forms excluding bars, cakes or moulded shapes, paper, wadding, felt and non-wovens impregnated or coated with soap/detergent, flakes, granules or powders	20413180	0.016
	Surface-active preparations, whether or not containing soap, p.r.s. (excluding those for use as soap)	20413240	0.016
	Anionic organic surface-active agents (excluding soap)	20412020	0.016
	Cationic organic surface-active agents (excluding soap)	20412030	0.016
	Non-ionic organic surface-active agents (excluding soap)	20412050	0.016
	Organic surface-active agents (excluding soap, anionic, cationic, non-ionic)	20412090	0.016
Car care products	Polishes and similar preparations, for coachwork (excluding artificial and prepared waxes, metal polishes)	20414370	0.18
Other preparations for beauty treatments	Beauty, make-up and skin care preparations including suntan (excluding medicaments, lip and eye make-up, manicure and pedicure preparations, powders for cosmetic use and talcum powder)	20421500	0.127
Shaving, olfaction, personal hygiene and beauty products prepared	Other personal preparations (perfumeries, toilet, depilatories...)	20421990	0.127

Equation 6 and Equation 7 are utilized to calculate the final emissions emerging from this sector.

NMVOC emissions (Kg)=
Weight of product total (Kg) * Solvent content of product (%) * Kg NMVOC per Kg solvent [EF]

Equation 6: Formula to calculate NMVOC emissions through the tier 2A methodology.

NMVOC emissions (Kg)=
Weight of product total (Kg) * Kg NMVOC per Kg product [EF]

Equation 7: Formula to calculate NMVOC emissions through the tier 2B methodology.

5.3.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.3.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.3.5 Sector-specific recalculations

Major recalculations for PRODCOM code 20413250 took place because of a modification in Eurostat activity data for years 2014 and 2016. Since the methodology assumes that all the product destined for use in Malta is sold and utilized within a five-year period, this amendment in activity data had a discernible impact on emissions from the years 2014 to 2021, as illustrated in Table 57.

Table 57: Modified activity data – changes in PRODCOM Code 20413250 for data years 2014 to 2021.

Product Total PRODCOM Code [20413250]	**Units**	**2023 Submission**	**2024 Submission**
2014	Kg	14137159	9359380
2015	Kg	13761479	8983700
2016	Kg	18771000	8978780
2017	Kg	19040640	9248420
2018	Kg	19024760	9232540
2019	Kg	14417080	9402640
2020	Kg	14961617	10067010
2021	Kg	10178888	10345626

Minor recalculations as shown in Table 58 for years 2020 and 2021 due to adjustments in EUROSTAT activity data.

Table 58: Modified activity data – changes in various PRODCOM Codes for data years 2020 and 2021.

Product Total PRODCOM Code	**Units**	**2020** **2023 Submission**	**2020** **2024 Submission**	**2021** **2023 Submission**	**2021** **2024 Submission**
20421915	Kg	461620	463573	482147	485491
20421930	Kg	852667	862945	912538	932855
20413150	Kg	46370	47269	29567	31235
20413120	Kg	208195	212695	209174	215074
20413180	Kg	326603	335525	358036	367629

20413240	Kg	2508406	2528329	2535844	2562984
20412020	Kg	228255	228939	217019	218230
20412030	Kg	32326	32441	27342	27458
20412050	Kg	135274	143313	128346	143038
20412090	Kg	69554	75478	52835	59774
20414330	Kg	11309	11391	12611	12780
20414350	Kg	22362	23800	22504	23976
20414389	Kg	15654	17475	15273	18013
20414383	Kg	23142	23343	19779	19983
20414400	Kg	80321	80610	80122	80720
20414370	Kg	47031	47628	45573	47558
20594350	Kg	238996	241496	243105	251421
20531020	Kg	6111	6153	6758	7020

5.3.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.4 Sector 2D3b: Road paving with asphalt

Table 59: Sector 2D3b general characteristics

NFR Code	**2D3b**
Sub-Category	Road paving with asphalt
Method	2023GB
Activity Data	Transport Malta & Infrastructure Malta
Emission Factors	Tier 2
Key Category	$PM_{2.5}$, PM_{10} & TSP
Year of Last Update	2024 submission

5.4.1 Sector description

This sector covers the emissions emerging from asphalt road surfacing. Shares of emissions of the particular pollutants from 2D3b in 2022 are shown in Figure 21.

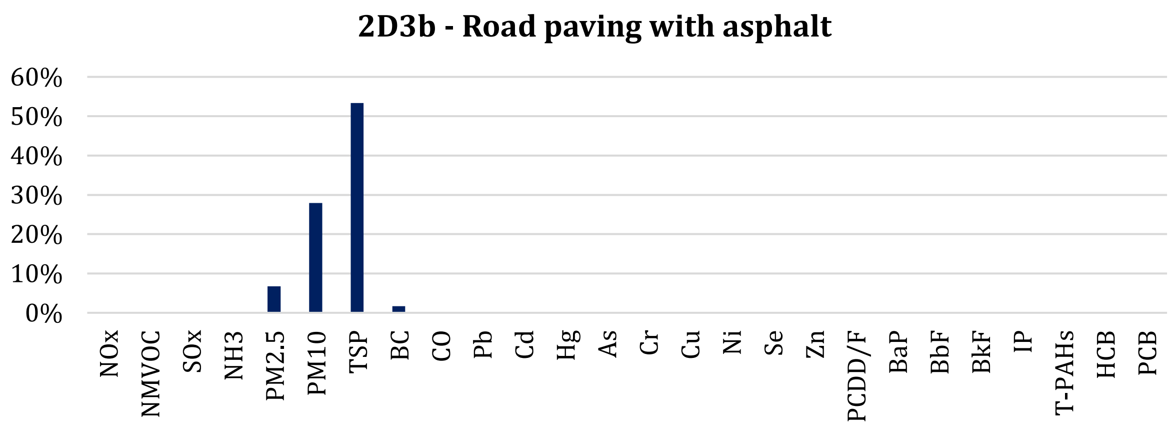

Figure 21: Shares of emissions from the NFR 2D3b category in percentage of the national total

5.4.2 Methodology & activity data - Historical

Emissions were estimated through the use of the tier 2 hot mix emission factors directly taken from the 2023GB as suggested within the 2023 historical inventory TERT review. Infrastructure Malta currently supplies the activity data, encompassing the volume of asphalt laid for the years 2018 to 2022. These provided values undergo a multiplication process using a standard factor of 2.50 tons/m^3, yielding the final activity data expressed in terms of tonnes of asphalt laid. Data for years 2000 to 2010 was provided by Transport Malta who at the time were in charge of Malta's road infrastructure. As suggested by external consultants activity data for years 2011 to 2017 were estimated using interpolation. Additionally, the external consultants further suggested to make use of a static value for 1990 to 1999, which was utilized based on the average from 2000 to 2003. Excerpts from the activity data can be found in Table 60.

Table 60: Asphalt laid for years 2005 and the latest 3 data years.

	Units	**2005**	**2020**	**2021**	**2022**
Asphalt Laid	Tonnes	137931	245130	215000	256000

5.4.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.4.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.4.5 Sector-specific recalculations

Significant recalculations for pollutants NMVOC, TSP, PM_{10}, $PM_{2.5}$ & BC spanning all years arise from the adoption of a tier 2 methodology, in contrast to the previously employed tier 1.

5.4.6 Sector-specific planned improvements

Diligent endeavors are underway to acquire refined data and enhance the comprehension of country-specific information, with the ultimate goal of elevating the quality standards within this sector.

5.5 Sector 2D3d: Coating applications

Table 61: Sector 2D3d general characteristics

NFR Code	**2D3d**
Sub-Category	Coating applications
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 2
Key Category	NMVOC
Year of Last Update	2024 submission

5.5.1 Sector description

This sector covers the emissions emerging from the use of paints within the industrial and domestic sectors. Shares of emissions of the particular pollutants from 2D3d in 2022 are shown in Figure 22.

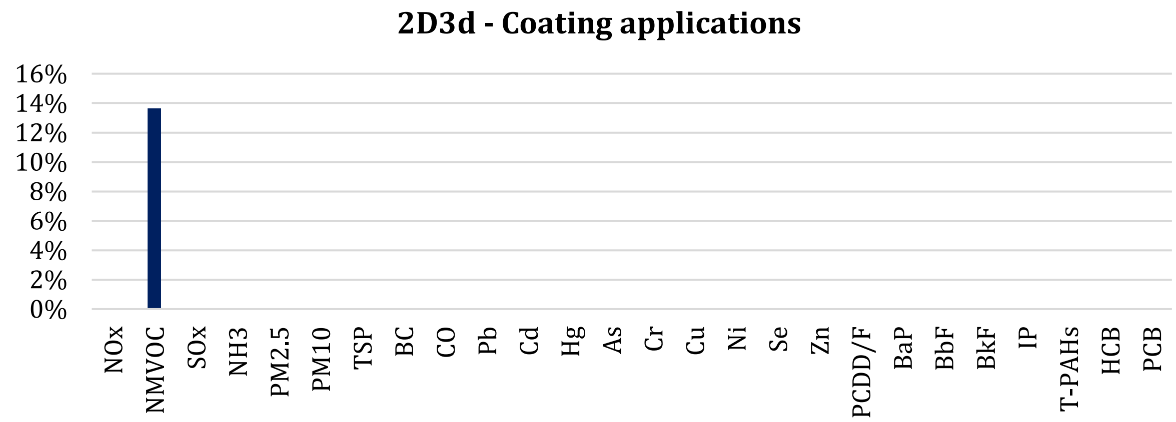

Figure 22: Shares of emissions from the NFR 2D3d category in percentage of the national total

5.5.2 Methodology & activity data – Historical

The tier 2 approach employed in the previous submission, has been retained for this submission. This approach involves utilizing import and export data of paint products, categorized by PRODCOM codes, and complemented by special trade statistics (STS) as activity data. Eurostat has made available data starting from 2003. For previous years (1990 to 2002), the activity data was estimated using a five-year moving average for both imports and exports. Equation 8 is used to calculate the products utilized by MT for each data year.

$$\text{Total products per annum (Kg)} = \text{Products imported (Kg)} + \text{Products produced locally (Kg)} - \text{Products exported (Kg)}$$

Equation 8: 2D3d total products utilized by MT calculation.

Equation 8 is utilized to estimate the apparent consumption; however, it is documented that the results of this calculation can be unreliable due to a range of factors. An assumption is required in this methodology for cases where the above formula produced a negative value (i.e. the number of products exported were higher than imported and produced combined), the weight of products for that year was assumed to be zero. Therefore, it was assumed that such products were not consumed locally. It is likely that this is caused by a discrepancy between the coverage of production statistics and trade statistics.

This methodology assumes that all the product destined for use in Malta will be sold and utilized within a five-year period. Consequently, any emissions resulting from the use of these products are evenly distributed over the data year and the following four years. All paints disposed of in landfills were excluded from the total product utilization. These reductions in activity data was directly attributing to the year of disposal.

Table 62: PRODCOM codes for sector 2D3d

PRODCOM Label	PRODCOM Codes
Paints and varnishes, based on acrylic or vinyl polymers dispersed or dissolved in an aqueous medium (including enamels and lacquers)	20301150
Other paints, varnishes dispersed or dissolved in an aqueous medium	20301170
Paints and varnishes, based on polyesters dispersed/dissolved in a non-aqueous medium, weight of the solvent > 50 % of the weight of the solution including enamels and lacquers	20301225
Paints and varnishes, based on polyesters dispersed/dissolved in a non-aqueous medium including enamels and lacquers excluding weight of the solvent > 50 % of the weight of the solution	20301229
Paints and varnishes, based on acrylic or vinyl polymers dispersed/dissolved in non-aqueous medium, weight of the solvent > 50 % of the solution weight including enamels and lacquers	20301230
Other paints and varnishes based on acrylic or vinyl polymers	20301250
Paints and varnishes: solutions n.e.c.	20301270
Other paints and varnishes based on synthetic polymers n.e.c.	20301290
Glaziers putty, grafting putty, resin cements, caulking compounds and other mastics	20302253
Painters fillings	20302255

The emission factors for this sector were the solvent content per product, which varies at regular intervals in accordance with an EGTEI study through a TFTEI EU-wide study. The solvent content in paints has experienced a steady decrease since 1990 due to the introduction of EU legislation, mainly through the Paints Directive.

Table 63 : Emission factors utilized for 2D3d

Year	Total paint & cleaning solvent (g/kg)
1990	165.46
2000	137.58
2007	61.08
2010	54.83

5.5.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.5.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.5.5 Sector-specific recalculations

Minor recalculations for years 2020 and 2021 were carried out due to changes in EUROSTAT data for these years.

5.5.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.6 Sector 2D3e: Degreasing

Table 64: Sector 2D3e general characteristics

NFR Code	**2D3e**
Sub-Category	Degreasing
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1
Key Category	NMVOC
Year of Last Update	2024 submission

5.6.1 Sector description

This sector covers the emissions emerging from the printing sector. Shares of emissions of the particular pollutants from 2D3e in 2022 are shown in Figure 23.

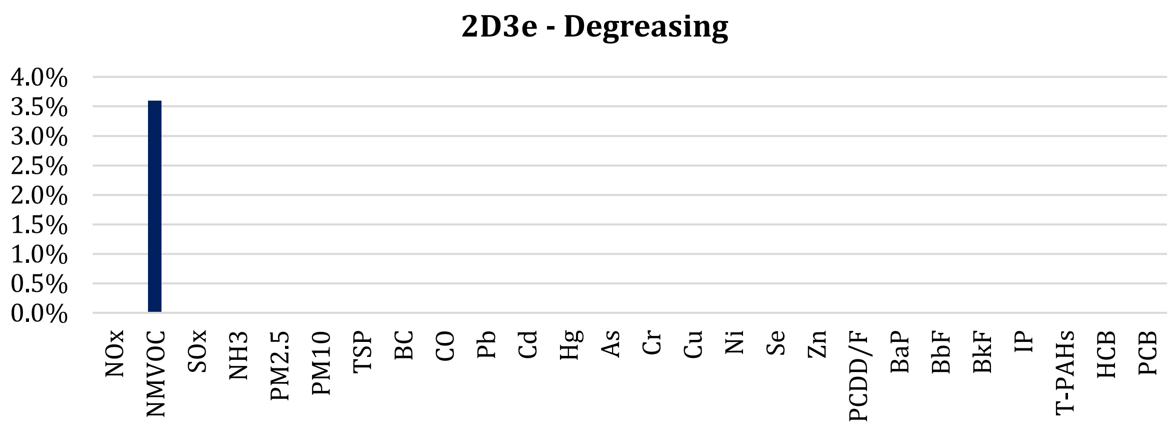

Figure 23: Shares of emissions from the NFR 2D3e category in percentage of the national total

5.6.2 Methodology & activity data - Historical

The methodology utilised for this sector is based on TERT recommendations emerging from the 2023 review. Activity data for this sector is based upon Eurostat import, export and production data for years 2003 to 2022. For previous years (1990 to 2002), the activity data was estimated using a five-year moving average for both imports and exports. The products being considered can be found in Table 65.

Table 65: Products being considered within the degreasing sector.

PRC Label	PRC Codes
o-Xylene	20141243
p-Xylene	20141245
m-Xylene and mixed xylene isomers	20141247
Dichloromethane (methylene chloride)	20141315
Benzol (benzene), toluol (toluene) and xylol (xylenes)	20147320

It was projected that the entire quantity of product intended for use in Malta would be sold and utilized within a five-year timeframe. As a result, any emissions arising from the use of these products are evenly distributed over the course of the data year and subsequent four years.

Total products per annum =
products imported (kg) + products produced (kg) - products exported (kg)

Equation 9: 2D3e total products utilized by MT calculation.

The emission factor for this sector was taken directly from Table 3-1 of the 2D3e chapter of the 2023GB.

5.6.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.6.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission

5.6.5 Sector-specific recalculations

This source was calculated for the first time in this year's submission.

5.6.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.7 Sector 2D3f: Dry cleaning

Table 66: Sector 2D3f general characteristics

NFR Code	**2D3f**
Sub-Category	Dry cleaning
Method	2023GB
Activity Data	Eurostat
Emission Factors	Tier 1
Key Category	Not Applicable
Year of Last Update	2024 submission

5.7.1 Sector description

This sector covers the emissions emerging from the dry cleaning sector. Shares of emissions of the particular pollutants from 2D3f in 2022 are shown in Figure 24.

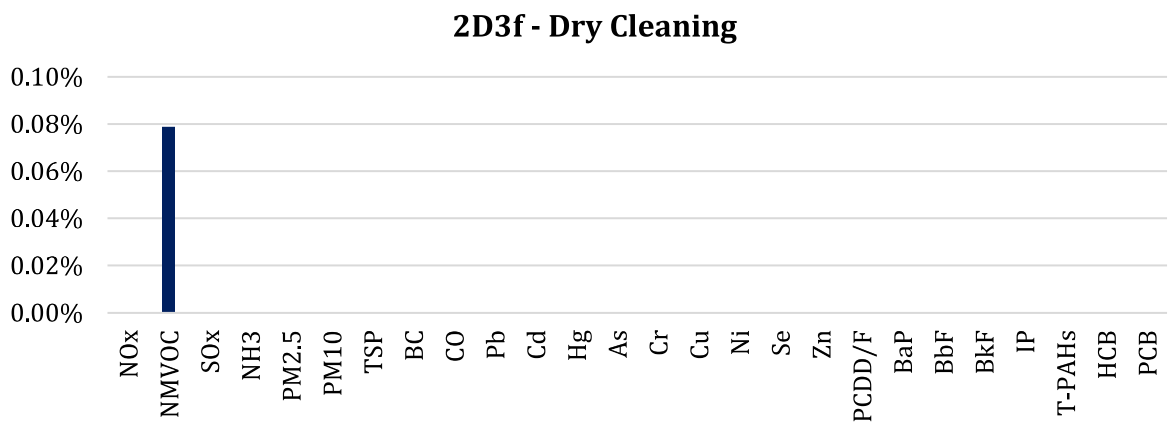

Figure 24: Shares of emissions from the NFR 2D3f category in percentage of the national total

5.7.2 Methodology & activity data - Historical

The methodology utilised for this sector is based on TERT recommendations emerging from the 2023 review. Activity data for this sector is based upon Eurostat import, export and production data for years 2003 to 2022 for trichloroethylene; tetrachloroethylene (perchloroethylene) [20141374]. For previous years (1990 to 2002), the activity data was estimated using a five-year moving average for both imports and exports.

Total product per annum =
product imported (kg) + products produced (kg) - product exported (kg)

Equation 10: 2D3f total products utilized by MT calculation.

The emission factors for this sector was provided by the TERT during the 2023 review. It assumes that all machinery is closed circuit and compliant with the European Solvent Directive.

5.7.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.7.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. The trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission

5.7.5 Sector-specific recalculations

This source was calculated for the first time in this year’s submission.

5.7.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.8 Sector 2D3h: Printing

Table 67: Sector 2D3h general characteristics

NFR Code	**2D3h**
Sub-Category	Printing
Method	2023GB
Activity Data	Eurostat & UNdata
Emission Factors	Tier 2
Key Category	NMVOC
Year of Last Update	2024 submission

5.8.1 Sector description

This sector covers the emissions emerging from the printing sector. Shares of emissions of the particular pollutants from 2D3h in 2022 are shown in Figure 25.

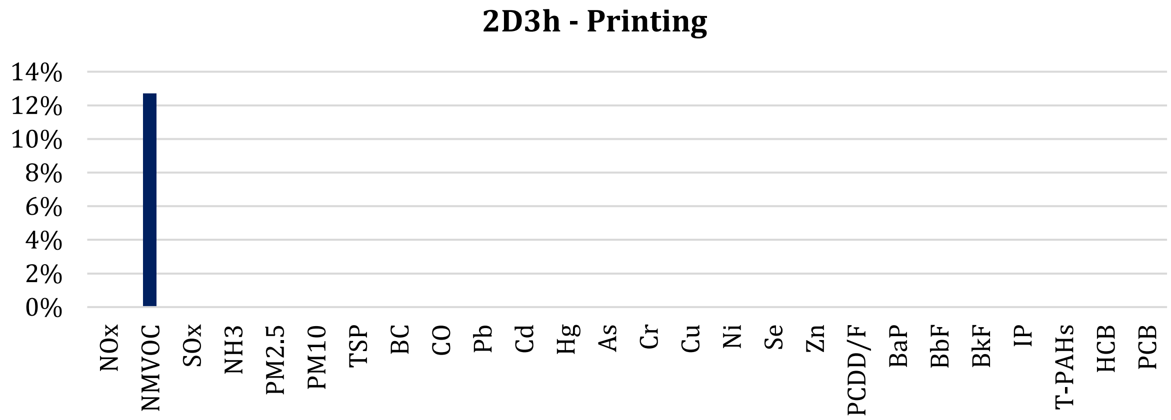

Figure 25: Shares of emissions from the NFR 2D3h category in percentage of the national total

5.8.2 Methodology & activity data - Historical

The methodology utilised for this sector is based on TERT recommendations emerging from the 2022 review. Activity data for this sector is based upon Eurostat import, export and production data for years 2003 to 2021. However, it should be noted that 2010, 2015, 2017 and 2018 were identified as clear outliers and hence for these respective years an interpolation was utilized. UNdata was then utilized for years 1994 to 2002 whilst extrapolation was utilized for years 1990 to 1993. It was projected that the entire quantity of product intended for use in Malta would be sold and utilized within a five-year timeframe. As a result, any emissions arising from the use of these products are evenly distributed over the course of the data year and subsequent four years. Furthermore, it has been ensured that any printing ink disposed of in landfills have been excluded from the total product utilized. This printing ink has been duly attributed to the year in which it was discarded.

Total products per annum =
products imported (kg) + product produced (kg) - products exported (kg)

Equation 11: 2D3h total products utilized by MT calculation.

The emission factors for this sector were taken directly from Table 26 of the additional guidance document, which is part of the 2023GB.

5.8.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.8.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.8.5 Sector-specific recalculations

Minor recalculations took place as a result of a modification in Eurostat activity data, leading to an increase of 30,595 kg and 3,905 kg of printing ink in 2020 and 2021, respectively.

5.8.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.9 Sector 2G: Other product use

Table 68: Sector 2G general characteristics

NFR Code	**2G**
Sub-Category	Other product use: fireworks & tobacco combustion
Method	2023GB
Activity Data	AFM (fireworks) & Eurostat (fireworks & tobacco)
Emission Factors	Tier 2
Key Category	$PM_{2.5}$, BC, Pb, Cd, PCDD/PCDF
Year of Last Update	2024 submission

5.9.1 Sector description

This sector covers the emissions emerging from the use of fireworks and tobacco combustion. Shares of emissions of the particular pollutants from 2G in 2022 are shown in Figure 26.

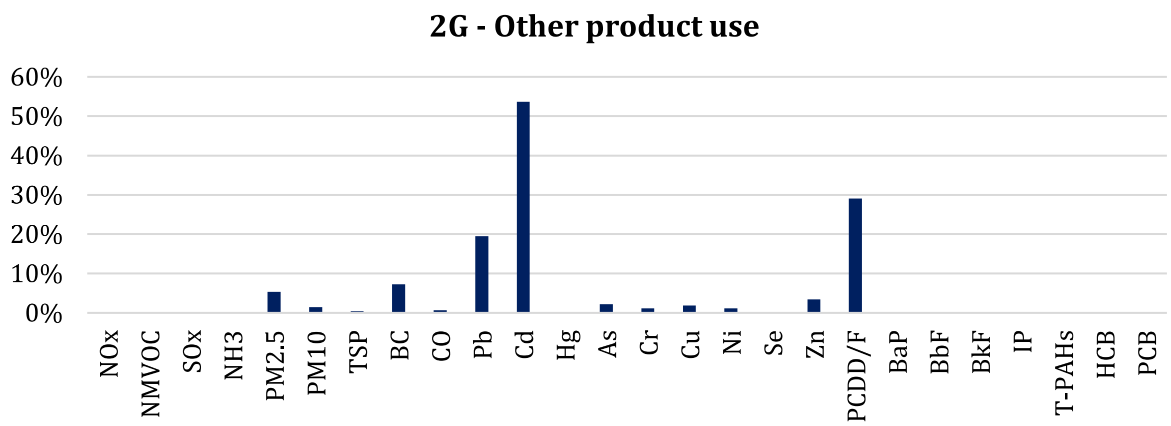

Figure 26: Shares of emissions from the NFR 2G category in percentage of the national total

5.9.2 Methodology & activity data - Historical

The same tier 2 approach utilized within the previous submission was employed. Emissions were estimated through the use of the tier 2 emission factors taken directly from the 2023GB.

5.9.2.1 Fireworks

The majority of fireworks utilized within the region are locally manufactured, with raw materials procured from the Armed Forces of Malta. However, a small percentage of fireworks are sourced from foreign countries through importation.

The total mass of materials used was calculated by subtracting the mass of exports by the total imports of CN codes 36041000 (fireworks) and 36049000 (Signalling flares, rain rockets, fog signals and other pyrotechnic articles excl. fireworks and cartridge blanks).

The information regarding imported fireworks and flares was obtained from Eurostat, rather than the NSO. Upon further inquiry with the NSO, it was discovered that general trade statistics are provided by the organization, while Eurostat furnishes special trade statistics. Considering that general trade statistics may include products that have not yet been introduced to the market or may never be, the utilization of specialized trade statistics was considered more suitable.

The quantity of locally produced fireworks was not ascertainable. Consequently, the volume of raw materials employed in their production, as provided by the Armed Forces of Malta, had to be employed instead. To estimate this figure, the methodology employed in a national study conducted by Camilleri and Vella (2016) was adopted. The data for potassium chlorate and potassium nitrate was available from 2011 to 2017. Data for previous years, and for 2018-2020, was extrapolated. Missing quantities for aluminium powder were replaced with the two-year annual average available in the study by Camilleri and Vella (2016), and this value was applied for the entire time series.

Table 69: Annual average of imported oxidants & fuels in firework manufacturing from 2012 to 2014.

Potassium Chlorate (Kg)	Q1	15050
Aluminium (Kg)	Q2	2035
Potassium Nitrate (Kg)	Q3	60325

Table 70: Calculations utilised to estimate the yearly average quantities of flash crackers, coloured stars and black powder from 2012 to 2014.

Type of firework	**Equation to determine annual quantities (Kg each firework type)**
Flash Crackers (Kg)	Q4=Q2/0.3
OX used for flash comp in kg	Q5=0.7*Q4
OX used for star comp in kg	Q6=Q1-Q5
OX used for red STARS in kg	Q7= Q6/3
OX used for blue STARS in kg	-
OX used for green STARS in kg	-
Red stars in kg	Q8=Q7/0.7
Blue stars in kg	Q9=Q7/0.65
Green stars in kg	Q10=Q7/0.833
Black Powder	Q11=Q3/0.75
OX used for flash comp in kg	Q5=0.7*Q4
OX used for star comp in kg	Q6=Q1-Q5
OX used for red STARS in kg	Q7= Q6/3
OX used for blue STARS in kg	
OX used for green STARS in kg	Q8=Q7/0.7
Red stars in kg	Q9=Q7/0.65
Blue stars in kg	Q10=Q7/0.833
Green stars in kg	Q11=Q3/0.75

5.9.2.2 Tobacco

The information regarding imported tobacco was obtained from Eurostat, rather than the NSO. As with fireworks and flares, upon further inquiry with the NSO, it was discovered that general trade statistics are provided by the organization, while Eurostat furnishes special trade statistics. Given that, general trade statistics may encompass products that are yet to be or may not be placed on the market, the utilization of special trade statistics was deemed more appropriate. The CN codes related to this activity were 24022090 (cigarettes, containing tobacco excl. containing cloves), 24021000 (cigars, cheroots and cigarillos containing tobacco), 24022000 (cigarettes containing tobacco) and 24029000 (cigars, cheroots, cigarillos and cigarettes consisting wholly of tobacco substitutes). A 5-year moving average is employed to extrapolate pre-2005 data not available from Eurostat. The total amount of exports was subtracted from the total imports, and the result was presumed to be equal to the amount of tobacco combusted locally.

5.9.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.9.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.9.5 Sector-specific recalculations

No adjustments were made for this sector through recalculations.

5.9.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

5.10 Sector 2H2: Food & beverages industry

Table 71: Sector 2H2 general characteristics

NFR Code	**2H2**
Sub-Category	Food & beverages industry
Method	2023GB
Activity Data	NSO & Local Brewery
Emission Factors	Tier 2
Key Category	NMVOC
Year of Last Update	2024 submission

5.10.1 Sector description

This sector covers the emissions emerging from food and beverages manufacturing. Shares of emissions of the particular pollutants from 2H2 in 2022 are shown in Figure 27. The calculations made for this sector encompass all locally occurring categories, as confirmation has been received from the NSO indicating that Malta does not engage in the manufacturing of spirits, sugar, margarine, and solid edible oils.

Figure 27: Shares of emissions from the NFR 2H2 category in percentage of the national total

5.10.2 Methodology & activity data - Historical

The NSO provided the necessary activity data required to calculate the following categories:

- Production of meat, fish and poultry
  - Production of home killed meat (1995 to 2022)
  - Fish and seafood landed (1995 to 2022)
  - Production of poultry meat (1995 to 2022)
- Production of animal feed (2003 to 2022)
- Production of red wine (2004 to 2022)
- Production of white wine (2004 to 2022)
- Production of coffee – Based on:
  - Coffee [excluding roasted and decaffeinated] (2005 to 2022)
  - Decaffeinated coffee [excluding roasted] (2005 to 2022)
- Production of bread – Based on:
  - Flour of common wheat and spelt (2004 to 2022)
  - Rye flour (2004 to 2022)
- Agricultural products (1995 to 2022)

Data on beer production spanning from 2013 to 2022 was supplied by a local brewery.

5.10.2.1 Methodology

The same tier 2 approach utilized within the previous submission was employed. The data utilized for the years with missing data across all NSO sourced categories is estimated through the application of a 5-year moving average.

5.10.2.1.1 Bread production

The quantity of bread produced is determined by aggregating the imported flour of common wheat, spelt, and rye. The Malta Bakers' Cooperative had stated that a 50kg sack of flour is capable of producing an estimated 100 loaves, and each individual baked loaf weighs approximately 540g. The resultant calculations can be visualised below:

First, the weight of flour per loaf is calculated:

$$1 \text{ sack} = \frac{50\text{Kg of flour}}{100 \text{ loaves}} = 500\text{g of flour per loaf}$$

Equation 12: Equation to calculate the weight of flour per loaf.

Then, the number of loaves is calculated:

$$\text{Number of loaves} = \frac{x \text{ Kg of flour}}{500\text{g of flour}}$$

Equation 13: Equation to calculate the number of loaves

Finally, the mass of bread is calculated:

$$\text{Mass of bread produced} = \text{Number of loaves} * 540\text{g (mass per loaf)}$$

Equation 14: Equation to calculate the total mass of bread produced

5.10.2.1.2 Beer production

The sector 2H2 now includes beer production. The relevant data spanning from 2013 to 2022 was supplied by a local brewery. For the period prior to 2013, population data was utilised as a proxy to estimate the quantity of beer produced from 1990 to 2012.

5.10.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

5.10.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

5.10.5 Sector-specific recalculations

Major recalculations took place as a result of the inclusion of beer production for the entire time-series. Minor recalculations were also prepared as NSO had revised data for the year 2021 pertaining to coffee (excluding roasted and decaffeinated), flour of common wheat, and spelt and rye flour.

5.10.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

6 Agriculture (NFR 3)

Chapter Updated: 2024

6.1 Category overview

Emissions from the following sectors are estimated:

- 3B (Manure management)
- 3D (Crop production and agricultural soils)
- 3F (Field burning of agricultural residues)

Table 72 shows the detailed source categories for agriculture. The relevant pollutant trends for key categories, as well as the methodologies used are explained in the sections below.

Table 72: Coverage of NFR 3 categories in 2022

NFR Code	Pollutants			Method	KC
	Covered	Exceptions			
		NE	NA		
3B1a	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✓
3B1b	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✓
3B2	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B3	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✓
3B4a	Not Occurring				✕
3B4d	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4e	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4f	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4gi	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4gii	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✓
3B4giii	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4giv	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3B4h	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✓
3Da1	NO_x, NH_3	-	Rest of Pollutants	Tier 1	✓
3Da2a	NO_x, NH_3	-	Rest of Pollutants	Tier 2	✓
3Da2b	Not Occurring				✕
3Da2c	Included Elsewhere (reported in 3Da1)				✕
3Da4	NH_3	-	Rest of Pollutants	Tier 1	✕
3Db	Not Applicable (no methodology)				✕
3Dc	$PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 2	✕
3Dd	Not Applicable (no methodology)				✕
3De	NMVOC	-	Rest of Pollutants	Tier 2	✕
3Df	Not Estimated				✕
3F	Rest of Pollutants	-	HCB, PCBs	Tier 1	✓
3I	Not Occurring				✕

NE: Not Estimated, NA: Not Applicable, KC: Key Category.

Shares of emissions from this NFR sector for all pollutants in 2022 are shown in Figure 28. NH_3 emissions originate primarily from NFR 3.

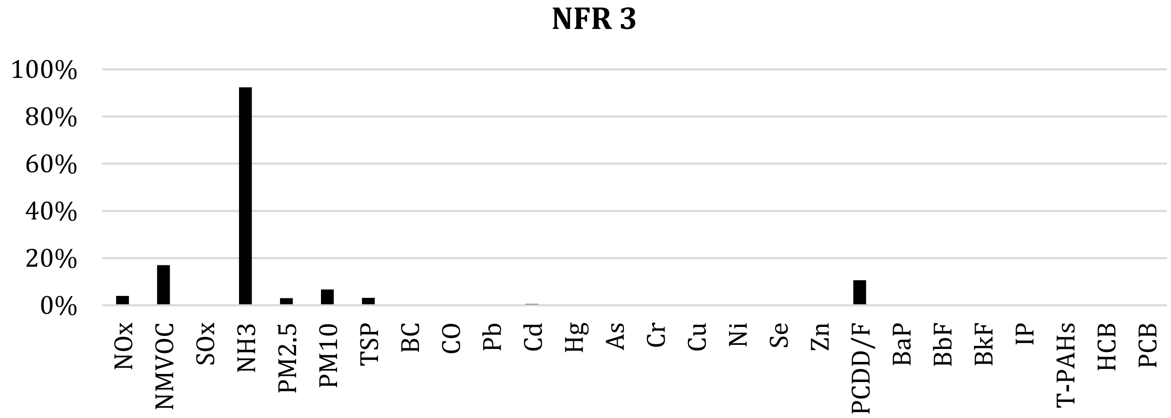

Figure 28: Shares of emissions from the NFR 3 category in percentage of national total

6.2 Sector 3B: Manure Management

6.2.1 Sector category description

Sector 3B 'Manure Management' accounts for emissions generated from the various stages of manure management, such as from livestock housing, open yard areas, and manure stores. Emissions from the application of manure are included within NFR 3Da2a, whereas emissions from grazing are assumed to be '0', following communication with the Agricultural Directorate.

The methodology for estimating emissions is the same for all sub-sectors within this sector. Therefore, all the activity data will be presented collectively within this section. Nevertheless, since the methodological notes and the recalculations may differ, these will be included within each sub-sector.

The different activity data parameters used can be found below.

6.2.1.1 Number of animal heads

The number of animal heads was provided by the NSO and is in line with the climate change (Malta Resources Authority) model. The total number of animal heads, as well as the change in animal heads compared to the previous submission, can be observed in the Table 73 and Table 74 below.

Table 73: Number of animal heads in AAP

Livestock type	1990	2005	2015	2020	2021	2022
Dairy cattle	9,175	7,832	6,374	6,055	5,874	6,119
Non-dairy cattle	6,290	6,285	4,474	3,868	3,865	3,735
Non-dairy cattle (calves)	5,535	5,625	4,172	4,368	4,277	4,346
Sheep	16,000	14,641	11,076	13,150	12,730	14,465
Swine - Sows	35,667	26,884	13,578	13,795	13,060	10,123
Swine - Fattening pigs	65,533	46,141	30,056	226,295	26,989	19,431
Goats	6,254	6,273	4,937	5,528	5,635	6,519
Horses	944	1,322	2,195	5,117	5,51	4,629
Mules and Asses	800	800	777	777	777	777
Laying hens	517,555	469,188	294,003	338,516	368,566	405,690
Broilers	994,144	575,152	553,398	545,396	559,876	598,451
Turkeys	18,000	10,000	13,000	12000	12000	12000
Other Poultry	14,993	7,673	165	1,109	1,077	NO
Other animals (Rabbits)	51,104	85,660	78,692	76,492	76,492	76,492

Table 74: Number of animal heads recalculations in AAP

Livestock type	1990	2005	2015	2020	2021
Dairy cattle	0	0	0	0	0
Non-dairy cattle	0	0	0	0	0
Non-dairy cattle (calves)	0	0	0	0	0
Sheep	0	0	0	0	0
Swine - Sows	0	0	0	0	0
Swine - Fattening pigs	0	0	0	0	0
Goats	0	0	0	0	0
Horses	0	0	0	0	0

Mules and Asses	0	0	0	0	0
Laying hens	0	0	0	0	0
Broilers	0	0	0	0	0
Turkeys	0	0	0	0	0
Other Poultry	0	0	0	0	0
Other animals (Rabbits)	24,495	75,419	69,284	67,347	69,166

6.2.1.2 Weight

Table 75 shows country-specific activity data for animal weight, compared with the default factors in the EEA Guidebook. The weight was assumed to be constant across all historical and projected years.

Table 75: Animal weight per livestock type

Livestock type	**Animal weight (kg)**		**MT: Data source**
	2023 Submission	**2024 Submission**	
Dairy cattle	550	550	KPH (Milk breeders co-operative)
Non-dairy cattle	512	513	KPH (Milk breeders co-operative)
Non-dairy cattle (calves)	200	200	KPH (Milk breeders co-operative)
Sheep	48	47	KPH (Milk breeders co-operative)
Swine (finishing pigs)	60	62	Pig Breeders Co-operative
Swine (sows)	60	60	Pig Breeders Co-operative
Goats	35	35	KPH (Milk breeders co-operative)
Horses	550	550	KPH (Milk breeders co-operative)
Mules and asses	350	350	EEA Guidebook
Laying hens	1.9	1.9	Malta Resources Authority (MRA)
Broilers	1.2	1.2	Malta Resources Authority (MRA)
Turkeys	6.8	6.8	EEA Guidebook
Other poultry	3.5	1.2	Malta Resources Authority (MRA)
Other animals (fur animals)	2	2	Malta Resources Authority (MRA)

6.2.1.3 Housing period and excretion on yards

Following communication with the Agricultural Directorate, it was assumed that according to S.L. 549.66 all animal holdings and passageways are to be covered at all times, indicating that livestock is constantly kept under housing. However, 9% of beef cattle, and 35% of sheep and goats, are exempt from the regulation, and are thus kept in yards. To reflect this policy in the N-flow tool, the total housing period was assumed to be 365 days for all livestock types. In contrast, the proportion of manure excreted in yards was modified to reflect the excretion period on yards for non-dairy cattle, sheep, and goats. The housing period and excretion on yards was assumed to be constant across all historical and projected years. The parameters used can be observed in Table 76 and Table 77.

Table 76: Housing period per livestock type

Livestock type	MT: Housing period (days)	2023GB: Housed period (days)	MT: Data source
Dairy cattle	365	180	Agricultural Department
Non-dairy cattle	365	180	Agricultural Department
Sheep	365	30	Agricultural Department
Swine (finishing pigs)	365	365	Agricultural Department
Swine (sows)	365	365	Agricultural Department
Goats	365	30	Agricultural Department
Horses	365	180	Agricultural Department
Mules and asses	365	365	Agricultural Department
Laying hens	365	365	Agricultural Department
Broilers	365	365	Agricultural Department
Turkeys	365	365	Agricultural Department
Other poultry	365	365	Agricultural Department
Other animals (fur animals)	365	365	Agricultural Department

Table 77: Proportion of manure excreted on yards

Livestock type	MT: Proportion excreted on yards	2023GB: Proportion excreted on yards	MT: Data source
Dairy cattle	0	0.25	Agricultural Department
Non-dairy cattle	0.09	0.1	Agricultural Department
Sheep	0.35	0.02	Agricultural Department
Swine (finishing pigs)	0	0	Agricultural Department
Swine (sows)	0	0	Agricultural Department
Goats	0.35	0	Agricultural Department
Horses	0	0	Agricultural Department
Mules and asses	0	0	Agricultural Department
Laying hens	0	0	Agricultural Department
Broilers	0	0	Agricultural Department
Turkeys	0	0	Agricultural Department
Other poultry	0	0	Agricultural Department
Other animals (fur animals)	0	0	Agricultural Department

6.2.1.4 Proportion of solid/slurry manure

Moreover, the manure type produced per livestock type was determined following consultation with the Department of Agriculture and is shown in Table 78. The values were assumed to be constant across all historical and projected years.

Table 78: Proportion of manure type by livestock

Livestock	Manure type	Proportion by manure type
Cattle	Solid	50%
	Slurry	50%
Fattening pigs	Solid	5%
	Slurry	95%
Sows	Solid	5%
	Slurry	95%
	Outdoor	Not Applicable
Layers	(Semi) Solid	100%

6.2.1.5 Proportion of manure stored, applied, and entering the digester

Following communication with the Agricultural Directorate, it was assumed that according to S.L. 549.66 slurry could not be applied, whereas solid manure could only be applied from the 15th March until the 15th October.

Furthermore, from 2018 until 2021 manure from cows and chickens entered the anaerobic digester (AD) at the Malta North Waste Treatment Plant. The annual quantities of manure from cows and chickens was provided by Wasteserv. However, no disaggregated data was available, and therefore manure generated by cows had to split equally into dairy and non-dairy cattle. Similarly, manure from chickens was split equally into manure from laying hens, broilers, and other poultry.

The share of manure entering the AD, was calculated by first multiplying the quantity of manure in tonnes by the N content of manure as can be seen in Equation 15. Table 79 provides the percentage of nitrogen in manure taken from the Nitrates Action Programme (Government of Malta, 2011).

$$Mass\ of\ manure * \ nitrogen\ content = Mass\ of\ nitrogen\ manure$$

Equation 15: Convert mass of manure to mass of nitrogen manure

Table 79: Nitrogen content in manure by livestock category

Livestock type	N content in manure
Dairy Cattle	0.56%
Non-dairy Cattle	0.56%
Average for Chicken	2.07%

The share of manure entering the Anaerobic Digester was then calculated through Equation 16. The Nitrogen excreted by cows/chickens was calculated through the N-flow tool.

$$\frac{Mass\ of\ nitrogen\ maure}{Nitrogen\ excreted\ by\ cows/chickens} = Percentage\ of\ manure\ entering\ the\ anerobic\ digester$$

Equation 16: Calculation to obtain the share of manure entering the anaerobic digester

Table 80: Proportion of manure stored - slurry

Livestock type	Scenario	Storage	Application	Anaerobic Digester
Dairy cattle	2005	1.00	0.00	0.00
	2021	0.99	0.00	0.09
	2022	1.00	0.00	0.00
Non-dairy cattle	2005	1.00	0.00	0.00
	2021	0.99	0.00	0.01

	2022	0.84	0.00	0.16
Non-dairy cattle (calves)	2005	1.00	0.00	0.00
	2021	0.99	0.00	0.01
	2022	1.00	0.00	0.00
Sheep	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	1.00
Swine (finishing pigs)	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	1.00
Swine (sows)	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	1.00
Goats	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	1.00
Horses	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	0.00
Mules and asses	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	0.00
Laying hens	2005	1.00	0.00	0.00
	2021	0.94	0.00	0.06
	2022	1.00	0.00	0.00
Broilers	2005	1.00	0.00	0.00
	2021	0.94	0.00	0.06
	2022	1.00	0.00	0.00
Turkeys	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	0.00
Other poultry	2005	1.00	0.00	0.00
	2021	0.94	0.00	0.06
	2022	1.00	0.00	0.00
Other animals (rabbits)	2005	1.00	0.00	0.00
	2021	1.00	0.00	0.00
	2022	1.00	0.00	0.00

Table 81: Proportion of manure stored - solid

Livestock type	Scenario	Storage	Application	Anaerobic Digester
Dairy cattle	2005	0.42	0.58	0.00
	2021	0.41	0.58	0.01
	2022	0.42	0.58	0.00
Non-dairy cattle	2005	0.42	0.58	0.00
	2021	0.41	0.58	0.01
	2022	0.42	0.58	0.16
Non-dairy cattle (calves)	2005	0.42	0.58	0.00
	2021	0.41	0.58	0.01
	2022	0.42	0.58	0.00
Sheep	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Swine (finishing pigs)	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Swine (sows)	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Goats	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Horses	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Mules and asses	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Laying hens	2005	0.42	0.58	0.00
	2021	0.39	0.55	0.06
	2022	0.42	0.55	0.00
Broilers	2005	0.42	0.58	0.00
	2021	0.39	0.55	0.06
	2022	0.42	0.58	0.00
Turkeys	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00
Other poultry	2005	0.42	0.58	0.00
	2021	0.39	0.55	0.06

	2022	0.42	0.58	0.00
Other animals (rabbits)	2005	0.42	0.58	0.00
	2021	0.42	0.58	0.00
	2022	0.42	0.58	0.00

6.2.1.6 Nitrogen excretion

The table below compares the Nex values provided in the N-flow tool and the revised data as used in the 2024 submission, which is in line with the updated values utilized by the Malta Resources Authority. The changes in Nex values can be observed Table 82. The values were assumed constant across all historical and projected years.

Table 82: Changes in Nex values in kg N/1000 kg animal mass day^{-1}

Animal type	N-flow tool	2024 submission
Dairy cattle	0.5	0.66
Non-dairy cattle	0.42	0.36
Non-dairy cattle (calves)	0.42	0.40
Sheep	0.36	0.2
Swine (finishing pigs)	0.76	0.75
Swine (sows)	0.38	0.64
Goats	0.46	0.46
Horses	0.26	0.26
Mules and asses	0.26	0.26
Laying hens	1.08	0.87
Broilers	2.25	0.82
Turkeys	0.74	0.74
Other poultry	0.83	0.82
Other animals (rabbits)	13.87	8.1

6.2.1.7 Other parameters

- No activity data on silage was available, and thus it was assumed to be zero
- National Statistics Office provided total cow and milk produced
- Malta Dairy Products (MDP) provided the cow milk fat content (%)
- The Gross Feed Intake (GE) for cattle was provided by the NSO, while the Volatilized Solids (VS) for the remaining livestock types were taken from the UNFCCC guidelines. Both these values were in line with the values used by the Malta Resources Authority.

6.2.2 Sub-sector 3B1a: Dairy cattle

Table 83: Sector 3B1a general characteristics

NFR Code	3B1a
Sub-Category	Manure management - Dairy cattle
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	NH_3
Year of Last Update	2024 submission

6.2.2.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of dairy cows and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 29.

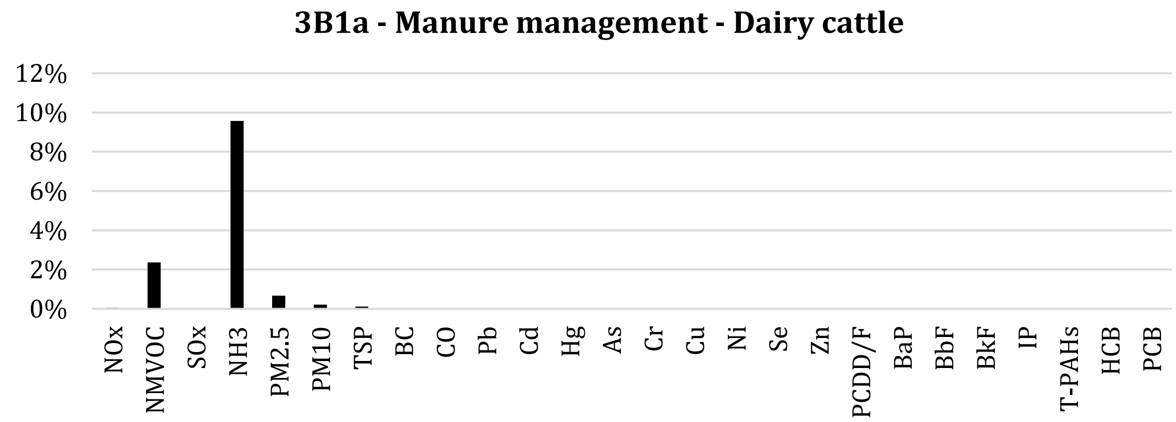

Figure 29: Shares of emissions from the NFR 3B1a category in percentage of national total

6.2.2.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.2.3 Activity data

The source of the activity data is explained in Section 6.2.1.

6.2.2.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were properly converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.2.5 Sub-sector-specific recalculations

- The Nitrogen excretion (Nex) rate was also updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 82.
- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.2.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.3 Sub-sector 3B1b: Non-dairy cattle

Table 84: Sector 3B1b general characteristics

NFR Code	**3B1b**
Sub-Category	Manure management – Non-dairy cattle
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	NH_3
Year of Last Update	2024 submission

6.2.3.1 Sector category description

This subcategory includes emissions of air pollutants from the feeding of non-dairy cows and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 30.

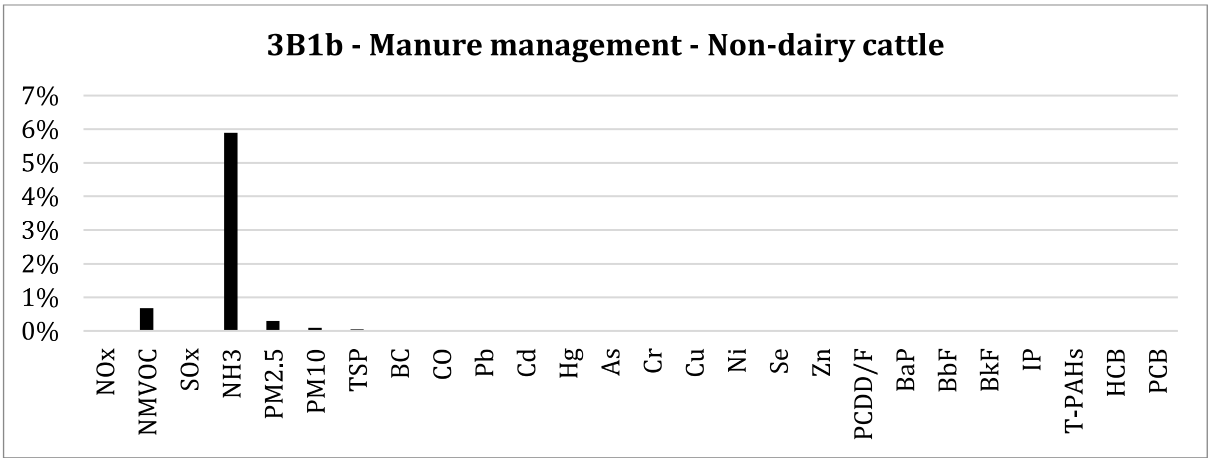

Figure 30: Shares of emissions from the NFR 3B1b category in percentage of national total

6.2.3.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.3.3 Activity data

The sources of the activity data are explained in Section 6.2.1. As can be observed through the table below, the number of animal heads and the weight was provided at a sub-division level, rather than for non-dairy cattle as a whole. Concerning animal heads, the categories in the table below were summed together. The animal weight for non-dairy cattle was calculated annually by taking a weighted average of the weights from growing cattle, bulls, and non-lactating cows. The weight for calves was taken directly from the table below.

Table 85: Categorized weight

Livestock type	Detailed classification	Weight (kg)
Calves	Male Cattle (<1 Year)	200
	Female Cattle (<1 Year)	
Growing Cattle	Male Cattle (1 to 2 Years)	480
	Female Cattle [Not Yet Mated] (1 to 2 Years)	
	Heifers [For Slaughter] (1 to 2 Years)	
	[Other] Heifers (1 to 2 Years)	
Bulls	Male Cattle (>2 Years)	630
Non-lactating Cows	Heifers [For Slaughter Cattle] (>2 Years)	640
	[Other] Heifers Cattle (>2 Years)	
	[Other] Cows Cattle (>2 Years)	

6.2.3.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.3.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.
- The weight was updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 75.
- The Nitrogen excretion (Nex) rate was also updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 82.

6.2.3.6 Sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.4 Sector 3B2: Sheep

Table 86: Sector 3B2 general characteristics

NFR Code	**3B2**
Sub-Category	Manure management – Sheep
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.4.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of sheep and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 31.

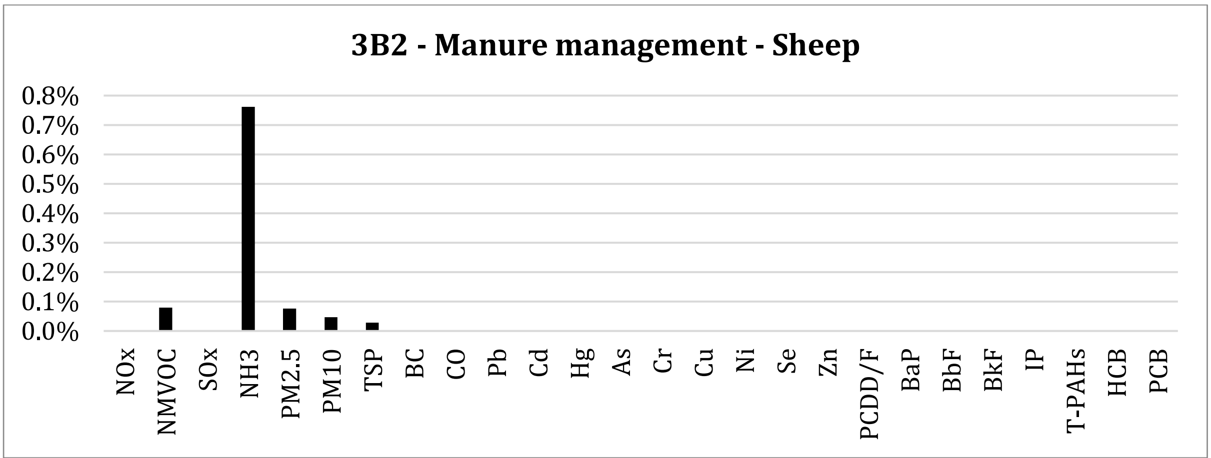

Figure 31: Shares of emissions from the NFR 3B2 category in percentage of national total

6.2.4.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.4.3 Activity data

The sources of the activity data are explained in Section 6.2.1. As can be observed through the table below, the number of animal heads and the weight was provided at a sub-division level, rather than for sheep as a whole. Concerning animal heads, the categories in the table below were summed together. The animal weight for sheep was calculated annually by taking a weighted average of the weights from growing lambs, breeding females, and other mature sheep (>1 Year).

Table 87: Categorized weight

Livestock type	Detailed classification	Weight (kg)
Growing lambs	Female Lambs	20
	Male Lambs	
Breeding females	Ewe Lambs	50
	Ewes	
Other mature sheep (>1 Year)	Male Sheep (Ram)	60

6.2.4.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.4.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.
- The weight was updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 75.

6.2.4.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.5 Sub-sector 3B3: Swine

Table 88: Sector 3B3 general characteristics

NFR Code	**3B3**
Sub-Category	Manure management – Swine
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	NH_3
Year of Last Update	2024 submission

6.2.5.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of swine and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 32.

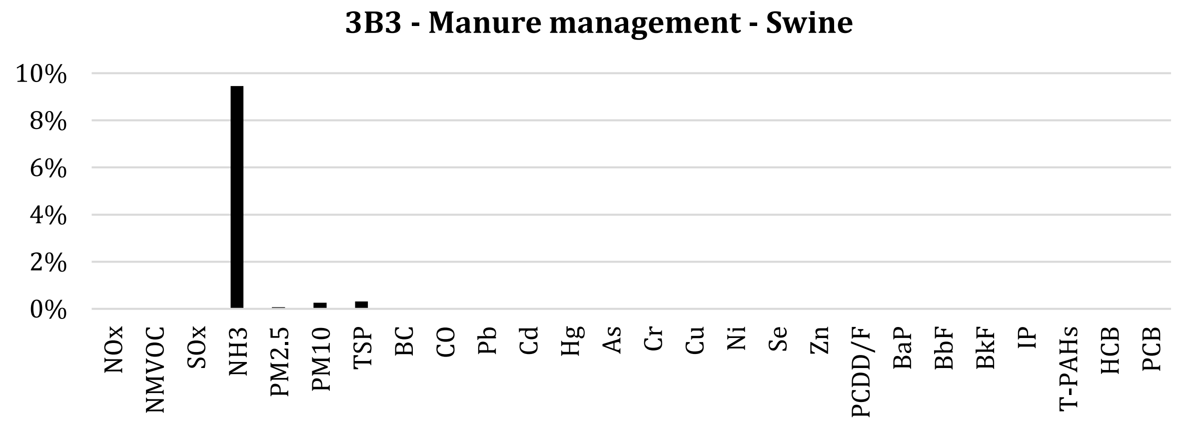

Figure 32: Shares of emissions from the NFR 3B3 category in percentage of national total

6.2.5.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. Emissions from 'sows' and 'fattening pigs' were calculated separately within the N-flow tool, and were then summed up within NFR 3B3.The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.5.3 Activity Data

The sources of the activity data are explained in Section 6.2.1. As can be observed through the table below, the number of animal heads and the weight was provided at a sub-division level, rather than for swine as a whole. Additionally, these categories were further sub-divided into 'sows' and 'fattening pigs'. Concerning animal heads, the categories in the table below were summed together. The animal weight for sows and fattening pigs was calculated annually by taking a weighted average of the weights from piglets (<20kg) and breeding sows, and young piglets (20 to 50kg), fattening pigs (>51kg), gilts, and breeding boars respectively.

Table 89: Categorized weight

Livestock type	Detailed classification	Weight (kg)
Sows	Piglets (<20kg)	10.5
	Breeding Sows	175
Fattening pigs	Young Piglets (20 to 50kg)	35
	Fattening pigs (>51kg)	75
	Gilts	120
	Breeding boars	250

6.2.5.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.5.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.
- The weight was updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 75. The Nitrogen excretion (Nex) rate was also updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 82.

6.2.5.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.6 Sub-sector 3B4d: Goats

Table 90: Sector 3B4d general characteristics

NFR Code	**3B4d**
Sub-Category	Manure management – Goats
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.6.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of goats and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 33.

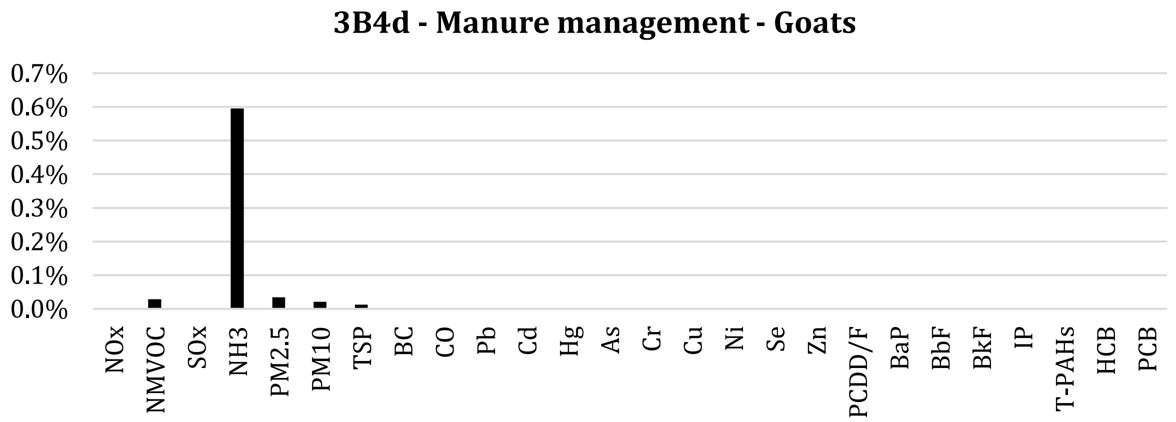

Figure 33: Shares of emissions from the NFR 3B4d category in percentage of national total

6.2.6.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.6.3 Activity data

The sources of the activity data are explained in Section 6.2.1. As can be observed through the table below, the number of animal heads was provided at a sub-division level, rather than for goats as a whole. The number of animal heads per category was summed together. In contrast, there was only one value for weight.

Table 91: Categorized weight

Livestock type	**Detailed classification**	**Weight (kg)**
Goats	Female Kids	35
	Male Kids	
	Goats [Mated for the First Time]	
	Goats [That Have Already Kidded]	
	Male Goats	

6.2.6.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.6.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR 3Da2a.

6.2.6.6 Sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.7 Sector 3B4e: Horses

Table 92: Sector 3B4e general characteristics

NFR Code	3B4e
Sub-Category	Manure management – Horses
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.7.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of horses and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2024 are shown in Figure 34.

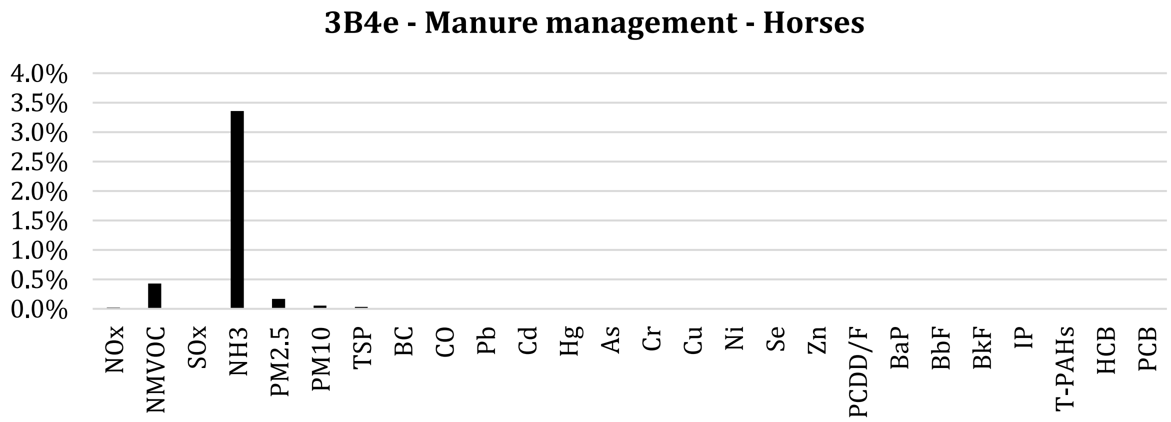

Figure 34: Shares of emissions from the NFR 3B4e category in percentage of national total

6.2.7.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.7.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.2.7.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.7.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. ‘ENMVOC,appl.’ were subtracted from this sub-chapter and placed within NFR 3Da2a.

6.2.7.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.8 Sub-sector 3B4f: Mules and Asses

Table 93: Sector 3B4f general characteristics

NFR Code	**3B4f**
Sub-Category	Manure management – Mules and Asses
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.8.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of mules and asses, and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 35.

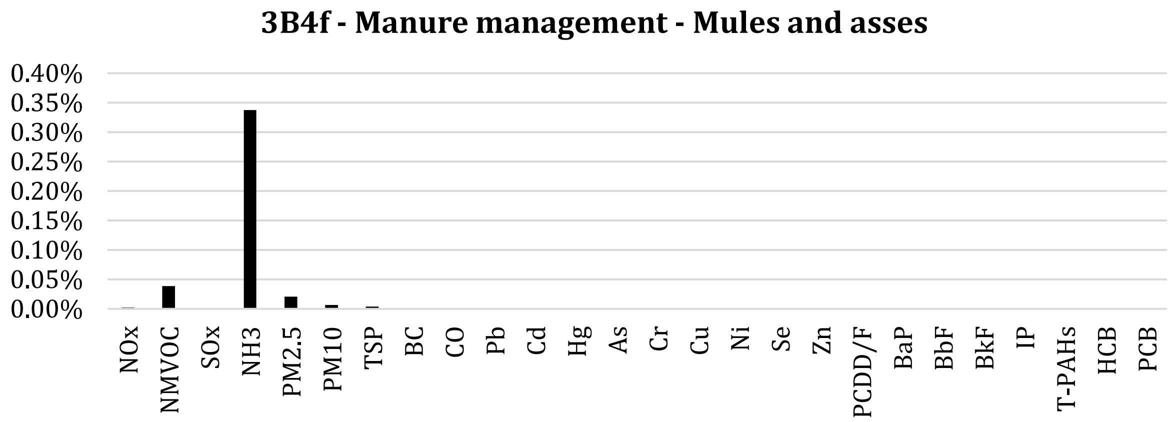

Figure 35: Shares of emissions from the NFR 3B4e category in percentage of national total

6.2.8.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.8.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.2.8.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.8.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. ‘ENMVOC,appl.’ were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.8.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series

6.2.9 Sub-sector 3B4gi: Laying Hens

Table 94: Sector 3B4gi general characteristics

NFR Code	3B4gi
Sub-Category	Manure management – Laying hens
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.9.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of laying hens and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 36.

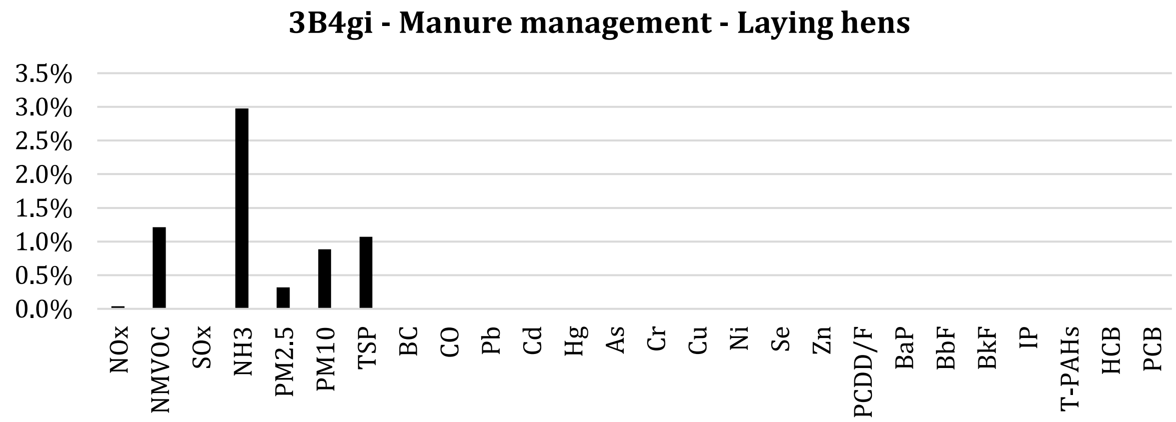

Figure 36: Shares of emissions from the NFR 3B4gi category in percentage of national total

6.2.9.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.9.3 Activity data

The sources of the activity data are explained in Section 6.2.1. The local values for Nex of 0.87kgN/place, were taken from the Sustech (2008) report.

6.2.9.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.9.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.
- The weight was updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 75.

6.2.9.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.10 Sub-sector 3B4gii: Broilers

Table 95: Sector 3B4gii general characteristics

NFR Code	**3B4gii**
Sub-Category	Manure management – Broilers
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	NMVOC
Year of Last Update	2024 submission

6.2.10.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of broilers and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 37.

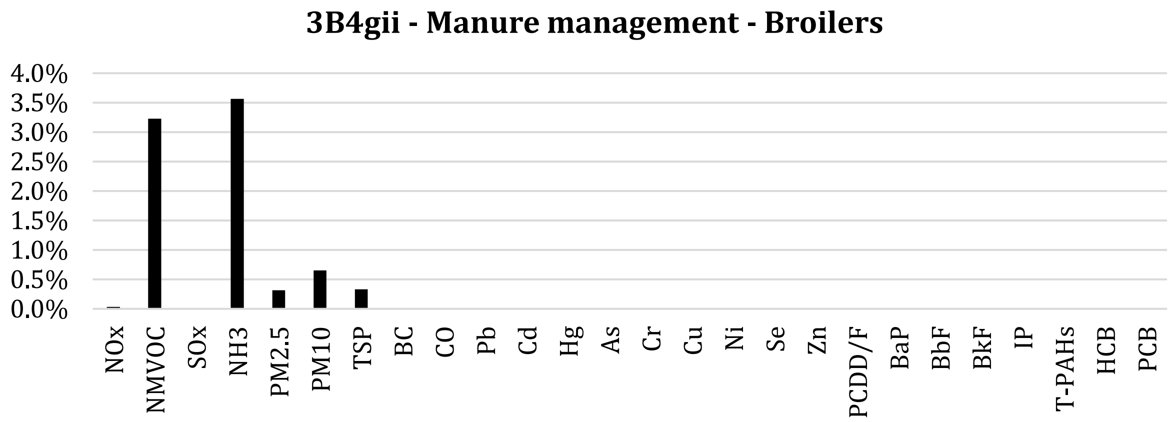

Figure 37: Shares of emissions from the NFR 3B4gii category in percentage of national total

6.2.10.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.10.3 Activity data

The sources of the activity data are explained in Section 6.2.1. The Sustech report (Sustech, 2008) provided a range of Nex from 0.35kgN/place to 0.82kgN/place. The highest value of 0.82kgN/place was taken as a worst-case scenario.

6.2.10.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.10.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.10.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.11 Sub-sector 3B4giii: Turkeys

Table 96: Sector 3B4gii general characteristics

NFR Code	**3B4giii**
Sub-Category	Manure management – Turkeys
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.11.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of turkeys and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 38.

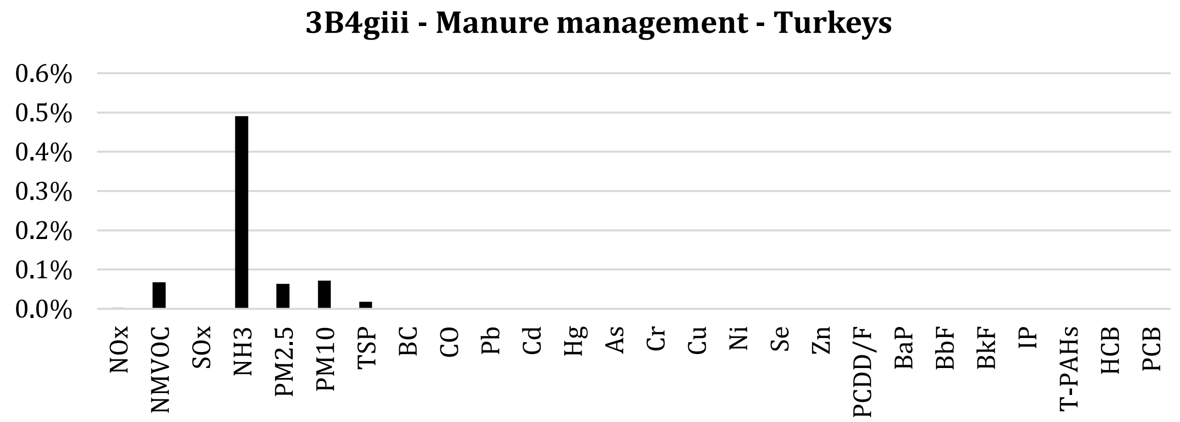

Figure 38: Shares of emissions from the NFR 3B4e category in percentage of national total

6.2.11.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.11.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.2.11.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.11.5 Sub-sector-specific recalculations

- NMVOC emissions from the application of manure, i.e. ‘ENMVOC,appl.’ were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.11.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.12 Sub-sector 3B4giv: Other Poultry

Table 97: Sector 3B4giv general characteristics

NFR Code	**3B4giv**
Sub-Category	Manure management – Other Poultry
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.2.12.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of other poultry and the generation and storage of their manure.

6.2.12.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.12.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.2.12.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.12.5 Sub-sector-specific recalculations

- The weight was updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 75.
- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.12.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.2.13 Sub-sector 3B4h: Other animals (rabbits)

Table 98: Sector 3B4h general characteristics

NFR Code	**3B4h**
Sub-Category	Manure management – Other animals (rabbits)
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1 & 2
Key Category	NH_3
Year of Last Update	2024 submission

6.2.13.1 Sub-sector category description

This subcategory includes emissions of air pollutants from the feeding of rabbits and the generation and storage of their manure.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 39.

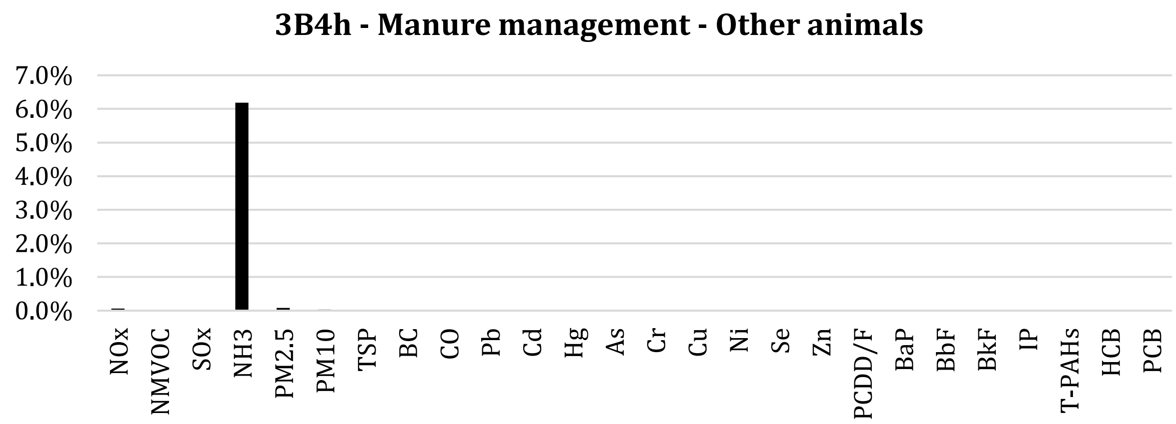

Figure 39: Shares of emissions from the NFR 3B4h category in percentage of national total

6.2.13.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB. Emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from the calculation. Emissions of $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology.

6.2.13.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.2.13.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.2.13.5 Sub-sector-specific recalculations

- The number of animal heads was updated in line with the activity data used by the Malta Resources Authority. Table 74 provides an overview of the changes in animal heads across the entire time series.
- The Nitrogen excretion (Nex) rate was also updated in line with the values provided by the Malta Resources Authority, with the updated value being shown in Table 82.
- NMVOC emissions from the application of manure, i.e. 'ENMVOC,appl.' were subtracted from this sub-chapter and placed within NFR3Da2a.

6.2.13.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.3 Sector 3D: Crop Production and Agricultural Soils

6.3.1 Sub-Sector 3Da1: Inorganic N fertilisers (Includes Urea)

Table 99: Sector 3Da1 general characteristics

NFR Code	3Da1
Sub-Category	Inorganic N fertilisers (Includes Urea)
Method	2023GB
Activity Data	Malta Resources Authority
Emission Factors	Tier 1
Key Category	NH_3
Year of Last Update	2024 submission

6.3.1.1 Sub-sector description

This subcategory includes emissions of air pollutants that arise during and after the application of N fertilisers to land.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 40.

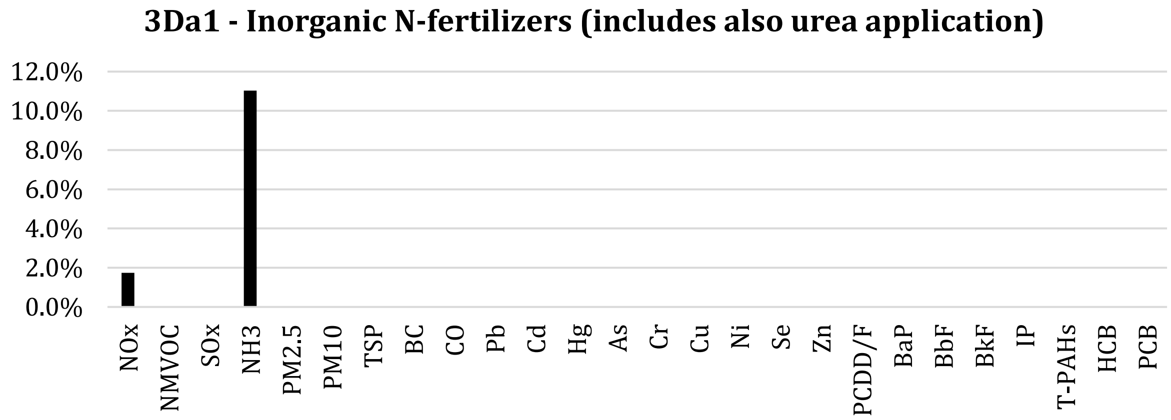

Figure 40: Shares of emissions from the NFR 3Da1 category in percentage of national total

6.3.1.2 Methodology

This sector was calculated through a tier 1 methodology provided within the 2023GB. The nitrogen input to soil from synthetic fertilisers was required as activity data, and the main pollutants emitted from this sub-category were NH_3 and NO_x.

6.3.1.3 Activity Data

The quantity of synthetic fertilizers applied has been recalculated by the Malta Resources Authority. Synthetic fertilizer application rates were not available over a time series. However, a methodology was developed by the Malta Resources Authority to obtain a representative estimate by making use of two indicators.

Import data per type of fertilizer from 2017-2021 was provided by the NSO. This data served to inform a study conducted by the Ministry for Agriculture, Fisheries and Animal Rights on the quantities of inorganic fertilizers imported. Additionally, the NSO study on the Gross Nitrogen Balance for Malta conducted in 2007 served to provide the N input per hectare from synthetic fertilizers for that year, which was of 60.3 kgN/ha. The import data from 2017-2021 was used to estimate the N input to soils per hectare from 2017 onwards. The N input to soils per hectare pre-2007 was assumed to correspond to 60.3 kgN/ha. Whereas an interpolation was carried out to obtain values from 2008-2016. The N input to soils per hectare was then multiplied by the Utilised Agricultural Area (UAA).

The table below presents the total N input to soils, which shows the steady increase in fertilizer application across the years.

Table 100: Total fertilizer input to soils in kg of Nitrogen

Fertilizer N applied in kg of N	**1990**	**2005**	**2015**	**2021**	**2022**
2023 submission	373,071	590,817	552,721	534,425	544,031
2024 submission	589,714	618,075	1,719,199	2,054,448	1,903,602

6.3.1.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.3.1.5 Sub-sector-specific recalculations

The quantity of fertilizer N applied to soils was recalculated by the Malta Resources Authority in this submission.

6.3.1.6 Sub-sector-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.3.2 Sub-sector 3Da2a: Animal manure applied to soils

Table 101: Sector 3Da2a general characteristics

NFR Code	**3Da2a**
Sub-Category	Animal manure applied to soils
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 2
Key Category	NMVOC & NH_3
Year of Last Update	2024 submission

6.3.2.1 Introduction

This subcategory includes emissions of air pollutants that arise during and after the application of animal manure to soils.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 41.

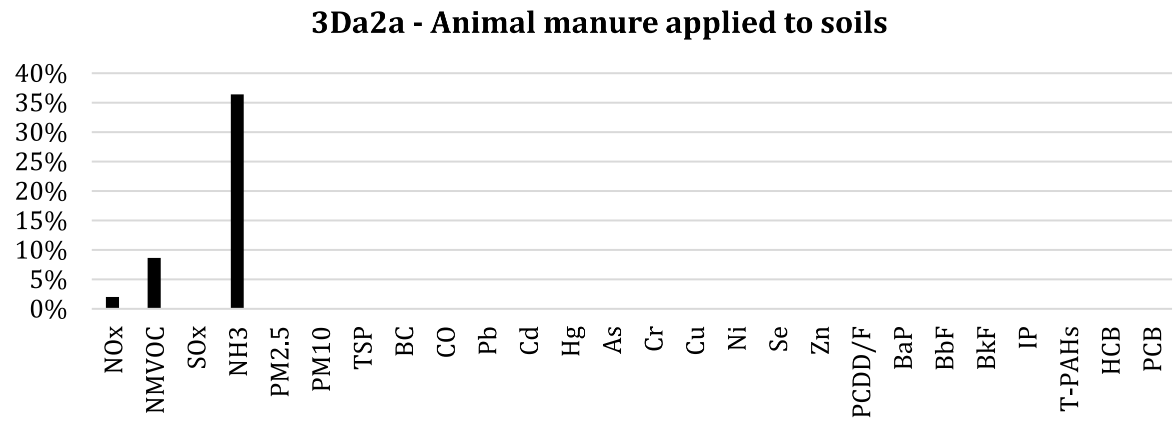

Figure 41: Shares of emissions from the NFR 3Da2a category in percentage of national total

6.3.2.2 Methodology

NH_3 and NO_x emissions are calculated through the Manure Management N-flow tool, as provided within the 2023GB. The tool was updated in January 2021, and this version of the tool was used for this submission. NMVOC emissions were estimated through the Tier 2 methodology provided within the 2023GB, by summing up the manure applied by all livestock. This manure is classified as 'ENMVOC,appl.' in the 2023GB.

6.3.2.3 Activity data

The sources of the activity data are explained in Section 6.2.1.

6.3.2.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.3.2.5 Sub-sector-specific recalculations

- The recalculations for each livestock type are explained under the 'Recalculations' section of each sector under Chapter 3B.
- Emissions from NMVOC were placed from the application of manure were placed under this sector for the first time.

6.3.2.6 Sub-sector-specific planned improvements

Efforts will be made to better represent local practices across the time series.

6.3.3 Sub-sector 3Da4: Crop residues applied to soils

Table 102: Sector 3Da4 general characteristics

NFR Code	**3Da4**
Sub-Category	Crop residues applied to soils
Method	2023GB
Activity Data	Malta Resources Authority
Emission Factors	Tier 1
Key Category	N/A
Year of Last Update	2024 submission

6.3.3.1 Introduction

This subcategory includes emissions of air pollutants that arise from crop residues left on fields. Crop residues are defined as those parts of the crop left on the soil surface following harvest or after another management action such as cutting grass for silage or hay, or trimming pasture to stimulate fresh growth.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 42.

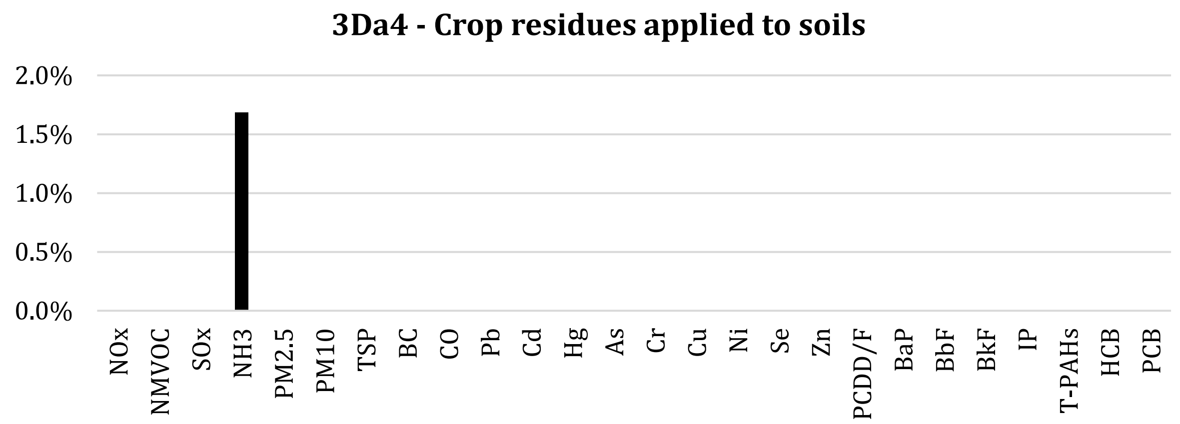

Figure 42: Shares of emissions from the NFR 3Da4 category in percentage of national total

6.3.3.2 Methodology

NH_3 emissions from this sector were calculated through the tier 1 methodology provided by the 2023GB.

6.3.3.3 Activity data

The total mass of crop residues left on soils was provided by the Malta Resources Authority. This value was calculated by multiplying the area in ha for each crop type, as provided by the NSO, with the methodology and the default parameters provided within the IPCC 2019 refinement to the 2006 Guidelines. The mass of crop residues is provided in the table below:

Table 103: Crop residues in kg of N

Parameter	1990	2005	2015	2020	2021	2022
Crop residues	878182	722806	787398	785265	791234	785776

6.3.3.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.3.3.5 Sub-sector-specific recalculations

This sector was estimated for the first time in this submission.

6.3.3.6 Sub-sector-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.3.4 Sub-sector 3Dc: Farm-level agricultural operations including storage, handling and transport of agricultural products

Table 104: Sector 3Dc general characteristics

NFR Code	**3Dc**
Sub-Category	Farm-level agricultural operations including storage, handling and transport of agricultural products
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 2
Key Category	PM_{10}
Year of Last Update	2024 submission

6.3.4.1 Introduction

This subcategory includes emissions of air pollutants that arise from the handling and storage of agricultural products on farms, such as grain, and during the handling and storage of products produced elsewhere to be used on the farm, such as fertilisers and livestock feeds.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 43.

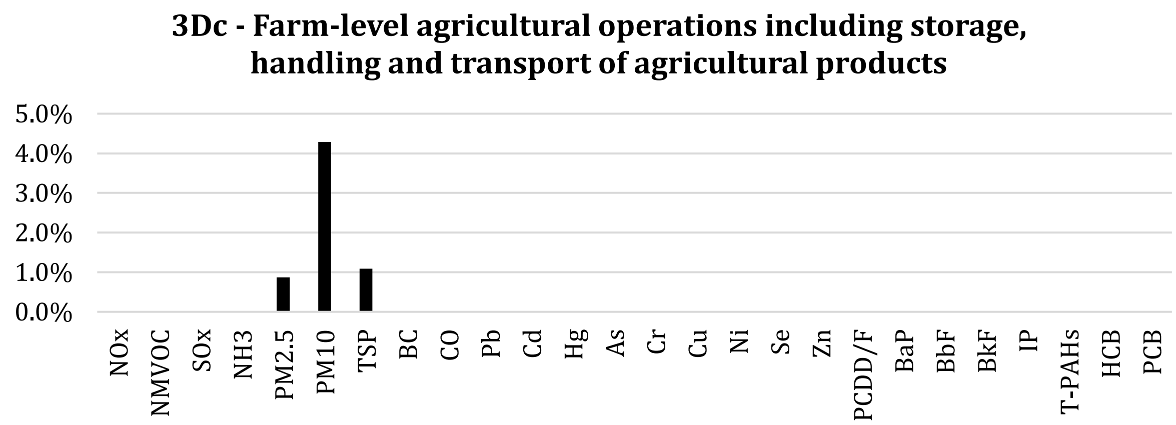

Figure 43: Shares of emissions from the NFR 3Dc category in percentage of national total

6.3.4.2 Methodology

$PM_{2.5}$, PM_{10}, and TSP emissions from this sector were calculated through the tier 2 methodology provided by the 2023GB. The $PM_{2.5}$ and PM_{10} EFs for 'other arable' were not provided for the 'Harvesting' and 'Cleaning' operations. Therefore, an emission factor was obtained by averaging the emission factors from wheat, barley, and rye. TSP emissions were assumed to be equal to those of PM_{10}, since no Tier 2 EF for TSP was available.

6.3.4.3 Activity data

The land area by crop type was provided by NSO & FAOSTAT, and is in line with the values used by the Malta Resources Authority. The table below shows how local crop types are classified according to the categories provided within the 2023GB. The dry climate EFs were used, as Malta has a semi-arid climate (Galdies, 2011).

Table 105: Crop type for each category under 3DC

Category in 2023GB	Crop type
Wheat	Land area under wheat
Barley	Land area under barley
Other arable	Land area under bean, potato, carrot, clover & vetch (sulla)
Grass	Land area under fodder & other fodder

Additionally, the change in crop area across the time series is presented below:

Table 106: Crop area in ha for sector 3Dc

Crop type	1990	2005	2015	2020	2021	2022
Wheat	2381	2618	3050	3182	3219	3186
Rye	0	0	0	0	0	0
Barley	542	550	498	519	525	520
Oat	0	0	0	0	0	0
Other arable	3135	1662	1714	1534	1528	1533
Grass	6755	4626	5173	5313	5313	5313

The number of agricultural operations were assumed to remain unchanged across the entire time series. The number of operations is presented below:

Table 107: Number of agricultural operations by crop type

Crop type	Soil cultivation	Harvesting	Cleaning
Wheat	4	1	1
Rye	4	1	1
Barley	4	1	1
Oat	4	1	1
Other arable	4	1	1
Grass	4	1	1

6.3.4.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.3.4.5 Sub-sector-specific recalculations

- The crop area was modified in line with the table below:

Table 108: Crop area recalculations for 3Dc in ha

Crop type	1990	2005	2015	2020	2021
Wheat	0	0	0	0	0
Rye	0	0	0	0	0
Barley	0	0	0	0	0

Oat	0	-15	-25	-30	-31
Other arable	0	0	0	0	0
Grass	0	0	0	0	0

6.3.4.6 Sub-sector-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.3.5 Sub-sector 3De: Cultivated crops

Table 109: Sector 3De general characteristics

NFR Code	3De
Sub-Category	Cultivated crops
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 2
Key Category	Not Applicable
Year of Last Update	2024 submission

6.3.5.1 Introduction

This subcategory includes emissions of air pollutants that arise from standing or 'cultivated' crops.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 44.

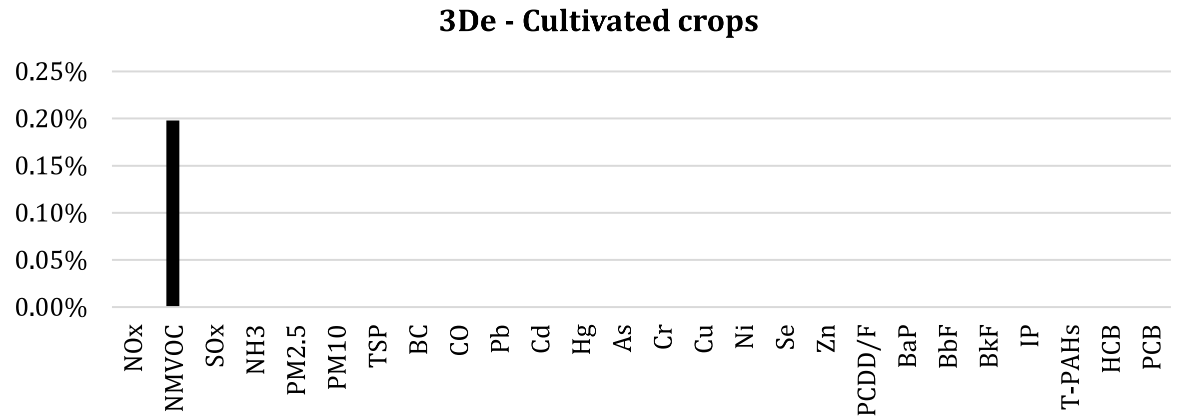

Figure 44: Shares of emissions from the NFR 3De category in percentage of national total

6.3.5.2 Methodology

NMVOC emissions from this sector were calculated through the tier 2 methodology presented in the 2023GB. Following communication with IIASA, the emission factor for 'Other' crops was obtained by calculating a weighted average of the emission factors from 'Wheat', 'Rye', and 'Rapeseed', and considering the crop share provided within the 2023GB.

6.3.5.3 Activity data

The land area by crop type was provided by NSO & FAOSTAT and is in line with the values used by the Malta Resources Authority. The table below shows how local crop types are classified according to the categories provided within the 2023GB. The country specific value of 4534.6kg of dry matter per ha, as provided by the Malta Resources Authority, was used for wheat.

Table 110: Crop type for each category under 3DE

Category in 2023GB	Crop type
Wheat	Land area under wheat
Other arable	Land area under barley, bean, potato, carrot, clover & vetch (sulla), land area under fodder & other fodder

Additionally, the crop area across the time series is presented below:

Table 111: Area by crop type in ha

Crop type	1990	2005	2015	2020	2021	2022
Wheat	2381	2618	3050	3182	3219	3186
Rye	0	0	0	0	0	0
Rape	0	0	0	0	0	0
Grass (15C)	0	0	0	0	0	0
Grass (25C)	0	0	0	0	0	0
Other	10432	6838	7385	7366	7366	7366

6.3.5.4 Sub-sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.3.5.5 Sub-sector-specific recalculations

No recalculations were carried out in this submission.

6.3.5.6 Sub-sector-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.4 Sector 3F: Field burning of agricultural residues

Table 112: Sector 3F general characteristics

NFR Code	**3F**
Sub-Category	Field burning of agricultural residues
Method	2023GB
Activity Data	National Statistics Office
Emission Factors	Tier 1
Key Category	PCDD/PCDF
Year of Last Update	2024 submission

6.4.1 Introduction

This subcategory includes emissions of air pollutants that arise during the open burning of crop residue on arable land after harvesting.

Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 45.

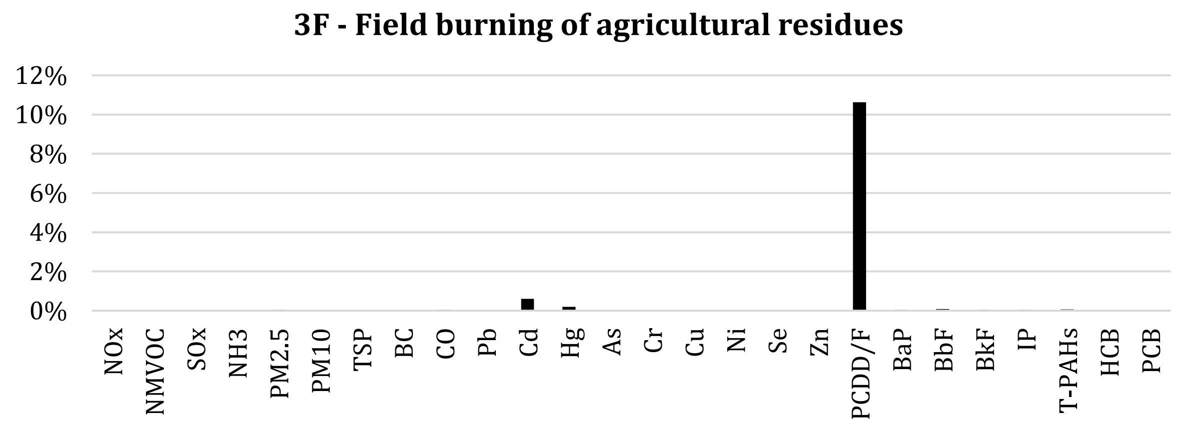

Figure 45: Shares of emissions from the NFR 3F category in percentage of national total

6.4.2 Methodology

Emissions from this sector were calculated through the Tier 1 methodology provided within the 2023GB.

6.4.3 Activity data

The total burnt area in ha was not available, therefore, the entire Utilized Agriculture Area (UAA) was assumed to be burnt. The UAA is provided by the NSO, and the table below provides the values across the time series:

Table 113: UAA in ha across the time series

Parameter	**1990**	**2005**	**2015**	**2020**	**2021**	**2022**
Utilised Agricultural Area (UAA)	9780	10250	11080	10731	10731	11651

The UAA is subdivided under the categories provided in Table 114.

Table 114: Subdivisions of Utilized Agriculture Area

Type of crop	**Crops included**
Wheat	Wheat, total land area under fodder, potato, carrot, clover (sulla) & vetch
Barley	Barley
Beans	Bean & other fodder (including green beans and chickpeas)

The remaining parameters, as taken from the 2023GB are presented in Table 115 (where no EF for beans or barley is available, the value for wheat was used).

Table 115: Remaining parameters

Parameter	Crop type	Value
Dry matter yield (y)	Wheat	3.6
Dry matter content (d)	Wheat	0.85
Ratio of residue mass to crop yield(s)	Wheat	1.3
	Barley	1.2
	Beans	2.1
Proportions of residues burned (Pb)	Wheat	1
	Barley	1
	Beans	1
Combustion Factor (Cf)	Wheat	0.9

6.4.4 Sector-specific QA/QC and verification

QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data (by being in line with those used by the Malta Resources Authority), the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

6.4.5 Sector-specific recalculations

No recalculations were carried out for this submission.

6.4.6 Sector-specific planned improvements

Following communication with the Agricultural Directorate, it was determined that not all of the UAA is burnt locally. Nevertheless, no activity data on the area of fields burnt, or the quantities of crop residues burnt is currently available. Efforts will be made to obtain a more representative value than the one used at present.

7 Waste (NFR 5)

Chapter Updated: 2024

7.1 Category overview

Emissions from the following sectors are estimated:

- 5A (Solid waste disposal on land, including mineral waste handling)
- 5B1 (biological treatment of waste – composting)
- 5B2 (biological treatment of waste - anaerobic digestion at biogas facilities)
- 5C1bv (cremation)
- 5C2 (open burning of waste)
- 5D3 (other wastewater handling)
- 5E (other waste)

Table 116 provides details on the relevant pollutant trends covered under each waste sector including those that are of a key category, as well as the methodologies used.

Table 116: Coverage of NFR 5 categories in 2022

NFR Code	Pollutants			Method	KC
	Covered	Exceptions			
		NE	NA		
5A	NMVOC, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Mixed Tier	✓
5B1	NH_3	-	Rest of Pollutants	Tier 2	✕
5B2	NH_3	-	Rest of Pollutants	Tier 2	✕
5C1a	Included Elsewhere (Reported in 5C1bv)				✕
5C1bi	Included Elsewhere (Reported in 5C1bv)				✕
5C1bii	Included Elsewhere (Reported in 5C1bv)				✕
5C1biii	Included Elsewhere (Reported in 5C1bv)				✕
5C1biv	Not Occurring				✕
5C1bv	All	-	-	Mixed Tier	✓
5C1bvi	Not Occurring				✕
5C2	Rest of Pollutants	-	NH_3, Hg, Ni, Indeno (1,2,3-cd) pyrene, HCB, PCBs	Tier 1	✕
5D1	Included Elsewhere (Reported in 5D3)				✕
5D2	Included Elsewhere (Reported in 5D3)				✕
5D3	NMVOC	-	Rest of Pollutants	Tier 1	✕
5E	$PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Hg, As, Cr, Cu, PCDD/PCDF	-	Rest of Pollutants	Tier 2	✓

The shares of emissions from this NFR sector for all pollutants in 2022 are shown in Figure 46. Most pollutant emissions from this category are below 10% of the national total with the exception of Se, PCDD/PCDF, PAHs, PCB and HCB.

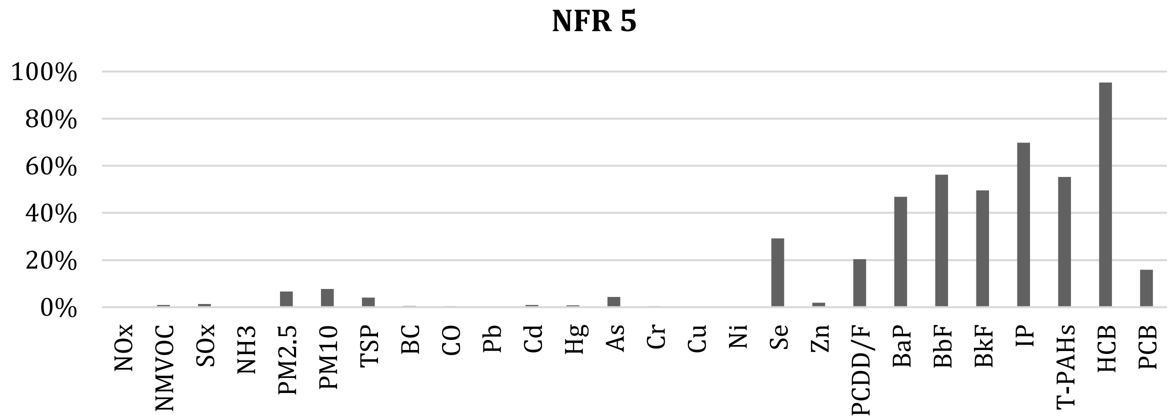

Figure 46: Shares of emissions from the NFR 5 category in percentage of the national total

7.2 Sector 5A: Solid waste disposal on land (including mineral waste handling)

Table 117: Sector 5A general characteristics

NFR Code	**5A**
Sub-Category	Solid waste disposal on land (including mineral waste handling)
Method	2023GB
Activity Data	MRA & ERA (Waste & CED teams)
Emission Factors	Mixed Tier
Key Category	$PM_{2.5}$ & PM_{10}
Year of Last Update	2024 submission

7.2.1 Sector description

This subcategory includes emissions of air pollutants from organic waste degradation in landfills and from the handling of mineral waste during backfilling and its reuse as construction material. Shares of emissions of the various pollutants emitted from 5A in 2022 are shown in Figure 47.

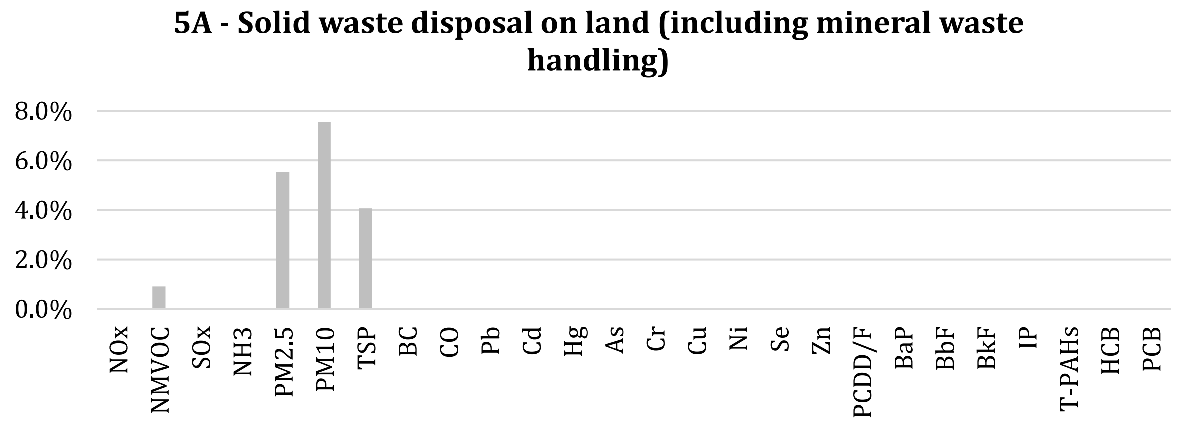

Figure 47: Shares of emissions from the NFR 5A category in percentage of the national total

7.2.2 Methodology & activity data - Historical

The calculation for NMVOC emissions followed a Tier 1 approach, taking into account the annual CH_4 emissions data provided by the Malta Resources Authority and utilizing the NMVOC EF from the 2023 guidebook in line with the below equation.

$$E_{NMVOC} = E_{CH4} * EF_{NMVOC} * 10^{-6}$$

Equation 17: Calculation of NMVOC emissions

Where:

- E_{NMVOC} = NMVOC emissions (kt)
- E_{CH4} = CH_4 emissions (Mg)
- EF_{NMVOC} = NMVOC emission factor (kg/Mg CH_4)

The table below presents the total CH_4 emissions in Mg for the year 2005 and the last 3 reporting years:

Table 118: CH_4 emissions for 2005 and 2020 to 2022.

Year	**E_{CH4} (Mg)**
2005	5804.90
2020	6244.31
2021	6509.65
2022	6807.23

Since the proportion of NMVOC per m³ of landfill gas remains unknown for Malta, the calculation suggested by the 2023GB, as outlined below, could not be applied.

$$E_{NMVOC} = V_{LG} * EF_{NMVOC}$$

Equation 18: Proposed calculation of NMVOC emissions

Where:

- E_{NMVOC} = NMVOC emissions (kg)
- V_{LG} = Volume of landfill gas (m^3)
- EF_{NMVOC} = NMVOC emission factor (kg/Mg CH_4)

The calculation of $PM_{2.5}$, PM_{10}, and TSP emissions followed a Tier 3 approach, taking into account the methodology present within the 2023GB. The equation below was utilised:

$$E = k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$$

Equation 19: Calculation to obtain $PM_{2.5}$, PM_{10} and TSP emission factors

Where:

- E = emission factor (kg/Mg)
- k = particle size multiplier; k (PM_{TSP}) = 0.74, k (PM_{10}) = 0.35 & k ($PM_{2.5}$) = 0.053
- U = mean wind speed (m/s)
- M = material moisture content (%); M = 11%

The default factor provided in the 2023GB was used for the moisture content of the materials landfilled. Meanwhile, the mean wind speed specific to the country, expressed in meters per second, as provided by Malta's MET office, is presented for the year 2005 and the three most recent reporting years in the below table:

Table 119: Mean wind speed for 2005 and 2020 to 2022.

Year	U (m/s)
2005	4.05
2020	4.54
2021	4.61
2022	4.28

The resultant emission factor is multiplied by the activity data, which consists of all waste disposed of in landfills and by the total amount of mineral waste treated (backfilled, recycled and stored) within quarries. The waste team at ERA provided the total waste disposed in landfills as reported in the waste management facility reports. Meanwhile, the compliance & enforcement team at ERA provided data on mineral waste treated in tonnes from 2006 onwards.

7.2.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.2.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.2.5 Sector-specific recalculations

Recalculations in 5A involve updated data from MRA for CH_4 emissions. Consequently, NMVOC emissions were revised for the year 2021 and recalculated for historic years due to the transition from tier 2 to tier 1. This adjustment is necessary as Malta lacks a country-specific NMVOC EF derived from measurements of NMVOC concentration from landfill gas.

The inclusion of mineral waste handling, specifically recycling practices, into the activity data of this chapter has led to a modification in the entire time series of $PM_{2.5}$, PM_{10}, and TSP emissions from 2006 onwards.

Following communication with Wasteserv – the landfill operator in Malta, as explained in the 5B2 sector, the digested material transferred to the landfill for final disposal has been incorporated into the calculations. As a result, $PM_{2.5}$, PM_{10}, and TSP emissions from 2015 onwards have been updated.

Furthermore, the identification of previously absent EWC codes in the revised waste management facility reports has resulted in an updated activity data. This inclusion led to a modification in the entire time series of all emissions from 2017 onwards.

7.2.6 Sector-specific planned improvements

Malta anticipates initiating the measurement of moisture content in upcoming characterization surveys.

7.3 Sector 5B1: Composting

Table 120: Sector 5B1 general characteristics

NFR Code	**5B1**
Sub-Category	Biological Treatment of Waste - Composting
Method	2023GB
Activity Data	Wasteserv
Emission Factors	Tier 2
Key Category	Not Applicable
Year of Last Update	2023 submission

7.3.1 Sector description

This subcategory includes NH_3 emissions from the composting of domestic and commercial organic waste between 1993 and 2006.

The graph below illustrates the emissions of this pollutant during the years when composting was still conducted in Malta.

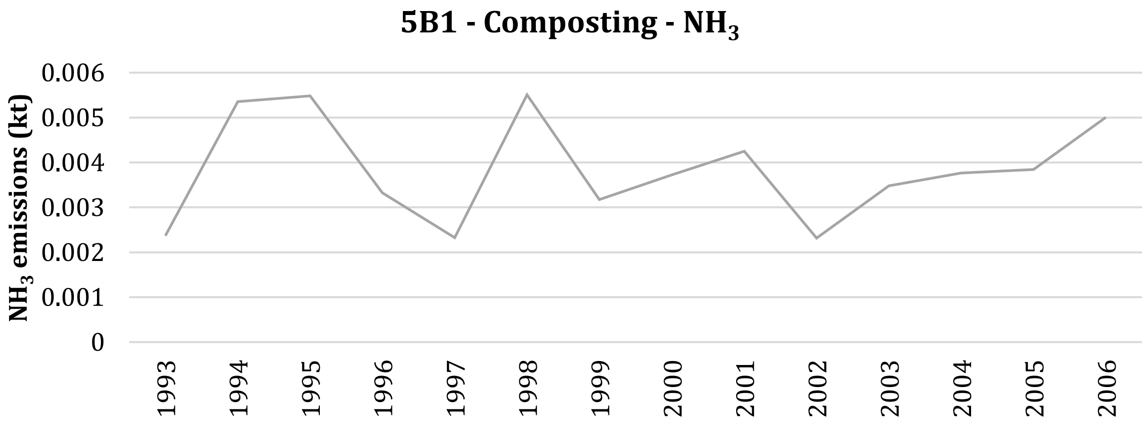

Figure 48: 5B1 emission throughout the time series

7.3.2 Methodology & activity data - Historical

NH_3 emissions were calculated through a tier 2 methodology using the following equation from the 2023GB.

$$E_{NH_3} = AR_{production} * EF_{technology\ pollutant}$$

Equation 20: Calculation of NH_3 emissions from composting

Where:

- $AR_{production}$ = amount of domestic and commercial organic waste being composed (t)
- $EF_{technology\ pollutant}$ = default value provided in 2023GB for NH_3 emissions

Data on the organic fraction being composted was provided for 1993 to 2006, which are synonymous with the years when this biological waste treatment plant was in operation. The data was reported to MRA in 2007 by Wasteserv and made available to ERA in 2023. The table below presents the total waste composted for the latest available three years:

Table 121: Organic waste composted for 2004 to 2006.

Year	Organic waste (t)
2004	15685
2005	16030
2006	20846

7.3.3 Methodology & activity data – Projections

This practice is no longer occurring locally so no projections were calculated.

7.3.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factor for NH_3, and the formula utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.3.5 Sector-specific recalculations

No recalculations were done for this sector.

7.3.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

7.4 Sector 5B2: Biological Treatment of Waste – Anaerobic Digestion at Biogas Facilities

Table 122: Sector 5B2 general characteristics

NFR Code	**5B2**
Sub-Category	Biological Treatment of Waste - Anaerobic Digestion at Biogas Facilities
Method	2023GB
Activity Data	ERA Waste Team and Wasteserv
Emission Factors	Tier 2
Key Category	Not Applicable
Year of Last Update	2024 submission

7.4.1 Sector description

This subcategory includes NH_3 emissions from the biological treatment of waste - anaerobic digestion (AD) at biogas facilities. There is currently only one AD facility in operation in Malta. This is the Malta North waste treatment facility in Maghtab. Up until the end of 2019, the Sant' Antnin waste treatment facility (SAWTP) was also in operation. The shares of emissions of the various pollutants emitted from 5B2 in 2022 are shown in Figure 49.

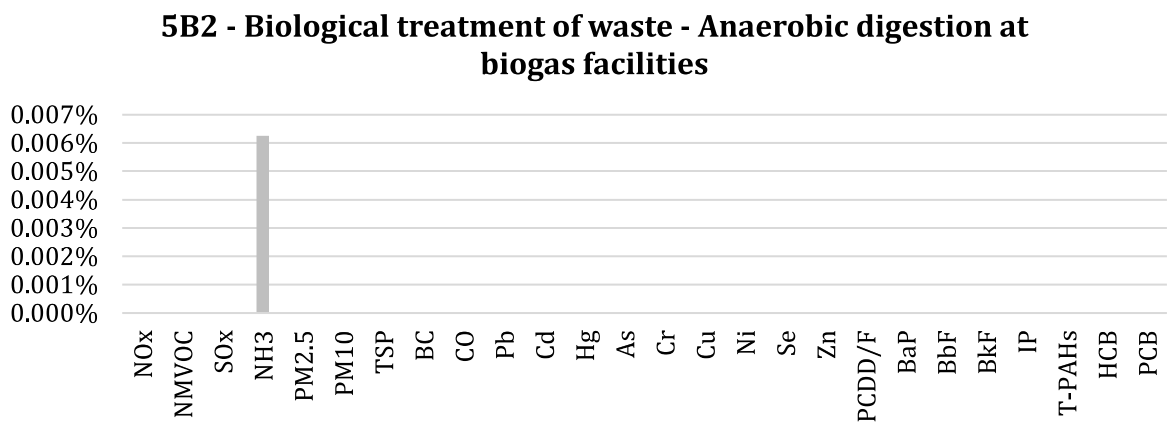

Figure 49: Shares of emissions from the NFR 5B2 category in percentage of the national total

7.4.2 Methodology & activity data - Historical

A tier 2 methodology based on the 2023GB was used to estimate emissions. The following equation was used to estimate NH_3 emissions:

$$E_{\mathrm{NH3}} = \mathrm{AR}_{\mathrm{feedstock}} * \mathrm{EF}_{\mathrm{NH3}} - \mathrm{N, stage\ i} * \frac{17}{14}$$

Equation 21: Calculation of NH_3 emissions from anaerobic digestion

The $AR_{feedstock}$ represents the yearly sum of nitrogen (N) in feedstock, considering both organic and manure fractions entering the biogas facility. Given that a specific N amount is provided exclusively from the 3B and 3D agricultural sectors for manure feedstock, $AR_{organic}$ was determined by multiplying the organic feedstock provided by Wasteserv with the corresponding N content default factor specified in the 2023GB.

Emission factors of NH_3 *stage I,* refer to NH_3 emission factors at different stages. Communication with Wasteserv revealed that the digested material is stored in sealed tanks briefly before being transferred to the landfill for ultimate disposal, therefore the pre-storage stage was considered the only relevant stage for local practices and thus ammonia emissions were considered negligible. This applies for both treatment facilities: SWATP and Malta North.

The organic fraction entering the Anaerobic Digester at Sant' Antnin waste treatment facility was provided for the years 2011 to 2017 and that entering the Malta North waste treatment facility from 2017 onwards. The 2018 and 2019 figures from Sant' Antnin facility were estimated by taking an average fraction of the total waste from the Dry Mechanical Treatment Plant that entered the AD for the years 2011 to 2017, and then applying that fraction to the total weight of waste entering the Dry MTP. The manure fraction was provided for the years 2018 to 2021, representing the sole period during which this feedstock was entering the Anaerobic Digester at the Malta North waste treatment facility. However, this data was included in the 3B and 3D agricultural sectors to calculate N content.

Data pertaining to this sector was provided by the Waste Team within ERA for the years 2011 to 2017 through the annual environmental reports and through direct communications with Wasteserv from 2018 onwards. The SAWTP facility was established in 2010; however, no data for that year was made available, and therefore emissions were calculated as from 2011. The Malta North Waste treatment facility commenced operations in 2016; however, data was made available as from 2017.

7.4.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.4.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.4.5 Sector-specific recalculations

Recalculation in 5B2 involved an activity data verification exercise, which revealed some inconsistences for SAWTP in the total output as Wet MTP for the years 2013 and 2014 and total input as Dry MTP for the years 2018 and 2019. Following updates in these values, updated to NH_3 emissions for the specified years also occurred.

The extraction of manure from the overall fresh feedstock, which enabled the separate calculation of nitrogen (N) in the feedstock, has facilitated the calculation of more accurate emissions for the years 2018 to 2021.

Furthermore, the acknowledgment of digested material storage conditions, as informed by Wasteserv, prompted a revision in the calculation methodology, uncovering an overestimation of emissions across the entire time series.

7.4.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

7.5 Sector 5C1bv: Cremation

Table 123: Sector 5C1bv general characteristics

NFR Code	**5C1bv**
Sub-Category	Cremation
Method	2023GB
Activity Data	ERA Waste Team
Emission Factors	Mixed Tiers
Key Category	SE, Benzo(a)pyrene, Benzo(b)flouranthene, Benzo(k)flouranthene, Indeno (1,2,3-cd)pyrene, HCB & PCBs
Year of Last Update	2024 submission

7.5.1 Sector description

Waste covered in the following categories within the 2023GB: Municipal Solid Waste (5C1a), Industrial Waste (5C1b), Clinical waste (5C1biii), and Cremation (5C1bv) are incinerated together within the Marsa Thermal Treatment Facility (MTTF). Thus, the emissions were all added to the Cremation sector (5C1bv). For this reason, categories 5C1a, 5C1b, and 5C1biii are all classified as IE as marked in Table 116. This category also covers the Island Sanctuary Crematorium that cremates deceased pets.

Shares of emissions of the particular pollutants from 5C1bv in 2022 are shown in Figure 50.

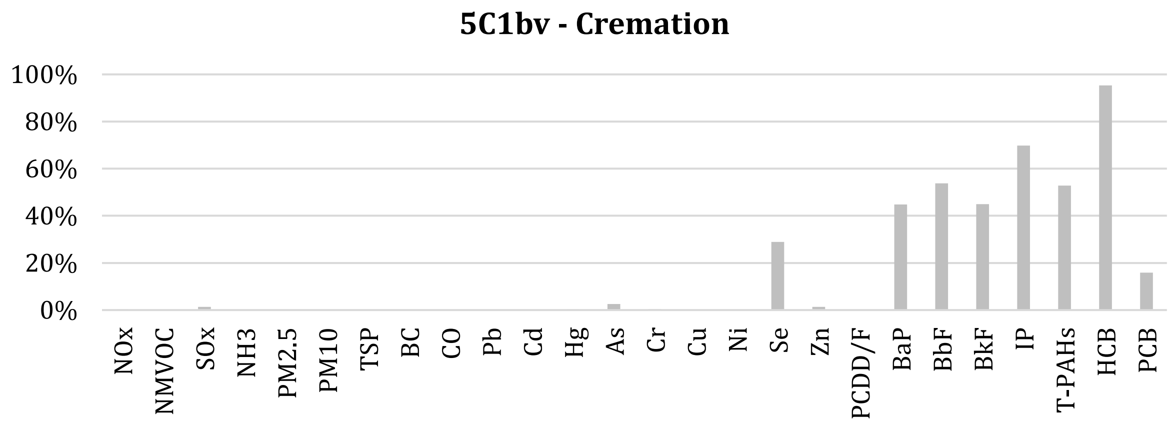

Figure 50: Shares of emissions from the NFR 5C1bv category in percentage of the national total

7.5.2 Methodology & activity data - Historical

7.5.2.1 Marsa Thermal Treatment Facility

This facility commenced its operation in late 2007; however, the first activity data available is from 2009. The Waste Team at ERA provided the activity data including the emissions from continuous monitoring through the annual environmental reports.

A tier 3 methodology was used for the following pollutants, as the emissions were directly measured at the site: NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni and PCDD/PCDF. Certain pollutants had missing data for some years, as also experienced in this reporting year for NMVOC. In these cases, a country-specific emission factor was calculated, by obtaining an average emission load per mass of waste entering the facility. The mass of waste entering the facility in a year was then multiplied by the country-specific emission factor.

No direct emissions data was available for BC, Se, Zn, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, and PCBs, and thus these emissions had to be calculated through the tier 1 methodology provided in the 2023GB.

The total waste entering the facility was classified according to the EWC codes. The EWC codes were then used as a guidance, to separate the waste into four categories: Municipal solid waste (5C1a), Industrial waste (5C1b), Clinical waste (5C1biii), and Cremation (5C1bv). The mass of waste from each category was then multiplied by the relevant Tier 1 emission factor, as provided within the 2023GB. The emissions from the four categories were summed to obtain a single emission load per pollutant. The table below presents the total waste entering the facility, classified into the specified categories for the last three reporting years:

Table 124: Waste incinerated at MTTF for 2020 to 2022.

Waste incinerated at MTTF	2020	2021	2022
Animal by-products (t)	5342.69	5169.24	5336.24
Municipal solid waste (t)	66.69	19.84	5.10
Industrial waste (t)	40.11	19.70	45.88
Clinical waste (t)	659.08	476.98	264.12
Total (t)	6108.56	5685.77	5651.34

Figure 51 shows the total waste entering the MTTF, categorized into four groups. The predominant fraction of waste entering the MTTF is animal by-products. Since there is no specific emission factor (EF) for the cremation of animal by-products, the EF for the cremation of human bodies has been utilized to calculate emissions for this sector. Clinical waste constitutes the second-largest source of waste, while municipal solid waste and industrial waste represent significantly smaller proportions. The overall trend indicates a slight decrease in waste entering the facility in 2022, primarily attributed to clinical waste. In contrast, there has been an increase in animal by-products waste for the current reporting year.

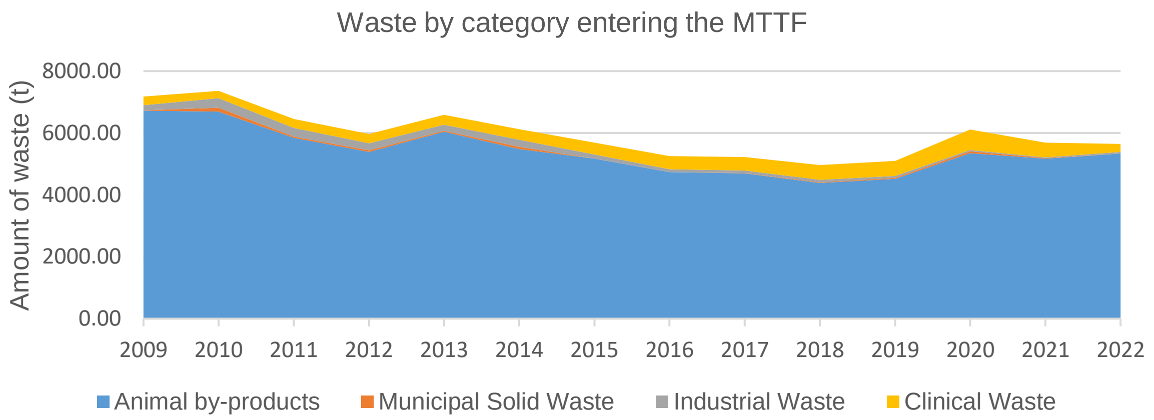

Figure 51: Waste entering the MTTF from 2009 to 2022 classified by category

7.5.2.2 Island Sanctuary Crematorium

This facility commenced its operation in late 2018; however, the first activity data available is from 2019. The Waste Team at ERA provided the activity data. The total waste entering this facility was classified according to the EWC codes. The two EWC codes cremated within this facility are: 20 02 01 (Excrement from the on-site keeping of dogs) classified as Animal by-product and 18 02 03 (Pet remains) classified as Municipal Solid Waste. The mass of waste from each category was then multiplied by the relevant tier 1 emission factors, as provided within the 2023GB. The emissions from the two categories were summed to obtain a single emission load per pollutant.

7.5.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.5.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.5.5 Sector-specific recalculations

Country specific emission factors of pollutants; CO, SO_x, TSP, NH_3, NO_x, Hg, PCDD/F, PM_{10}, $PM_{2.5}$, As, Cd, Cr, Cu, Ni, Pb, PCBs and Total 4 PAHs have been updated to include latest data year within the calculation.

A discrepancy in PCB emissions for 2019 was identified. This was flagged and corrected, leading to recalculations of this pollutant for data years 2009 to 2019.

Additionally, the emission factors (EF) for industrial and clinical waste have been updated in accordance with the 2023GB. This has resulted in the recalculation of PCDD/F (industrial and clinical waste) for the years 2013 to 2018, where no direct measurements were taken. TSP (clinical waste) has been recalculated for the year 2016, again when no direct measurements were available. Furthermore, Pb, Cd, Cr, and Ni (clinical waste) have been recalculated for the years 2013 to 2016 and Hg (clinical waste) for the years 2014 to 2016, both in instances where no direct measurements were taken. Additionally, Cu (clinical waste) has been recalculated for the years 2013 to 2018, once again when no direct measurements were available.

7.5.6 Sector-specific planned improvements

Presently, no improvements are planned for this sector.

7.6 Sector 5C2: Open Burning of Waste

Table 125: Sector 5C2 general characteristics

NFR Code	**5C2**
Sub-Category	Open Burning of Waste
Method	2023GB
Activity Data	MRA
Emission Factors	Tier 1
Key Category	Not Applicable
Year of Last Update	2024 submission

7.6.1 Sector description

This category covers the volume reduction, by open burning, of small-scale (agricultural) waste. Shares of emissions of the particular pollutants from 5C2 in 2022 are shown in Figure 52.

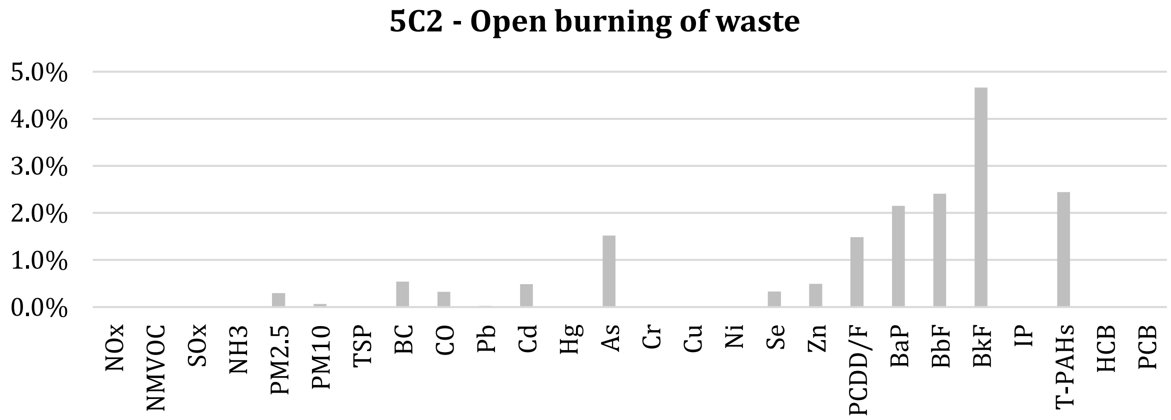

Figure 52: Shares of emissions from the NFR 5C2 category in percentage of the national total

7.6.2 Methodology & activity data - Historical

A tier 1 methodology is utilized for this sector. The data "amount of waste burnt" is not currently available and hence, the 2023GB estimate of 25kg of waste burnt per hectare arable area was utilized. The arable area was assumed to be equal to the utilized agricultural area (UAA) and provided by the Malta Resources Authority. This sector generates various pollutant emissions, and these were calculated by multiplying the activity data with the tier 1 emission factors in the 2023GB.

The TERT noted that there might be an under-estimate of emissions because emissions from orchard residues and forest residues may be missing. The waste category taken into account in the calculation is arable farmland since the practice of burning of orchard and forest residues does not occur within the Maltese Islands and hence, no activity data is available.

The table below presents the UAA of 2005 and the last three reporting years as provided by MRA:

Table 126: Utilized agricultural area for years 2005 and 2020 to 2022.

Year	UAA (ha)
2005	10250
2020	10731
2021	10731
2022	10731

7.6.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.6.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.6.5 Sector-specific recalculations

The tier 1 EFs for this chapter have been updated in accordance with the 2023GB. This has resulted in the recalculation of Benzo(b)fluoranthene, Benzo(k)fluoranthene and Benzo(a)pyrene for the entire time series.

7.6.6 Sector-specific planned improvements

Presently, no planned improvements planned for this sector unless new data becomes available.

7.7 Sector 5D3: Other Wastewater Handling

Table 127: Sector 5D3 general characteristics

NFR Code	**5D3**
Sub-Category	Other Wastewater Handling
Method	2023GB
Activity Data	Water Services Corporation
Emission Factors	Tier 1
Key Category	Not Applicable
Year of Last Update	2024 submission

7.7.1 Sector description

This subcategory covers emissions from treated wastewater. Shares of emissions of the particular pollutants from 5D3 in 2022 are shown in Figure 53.

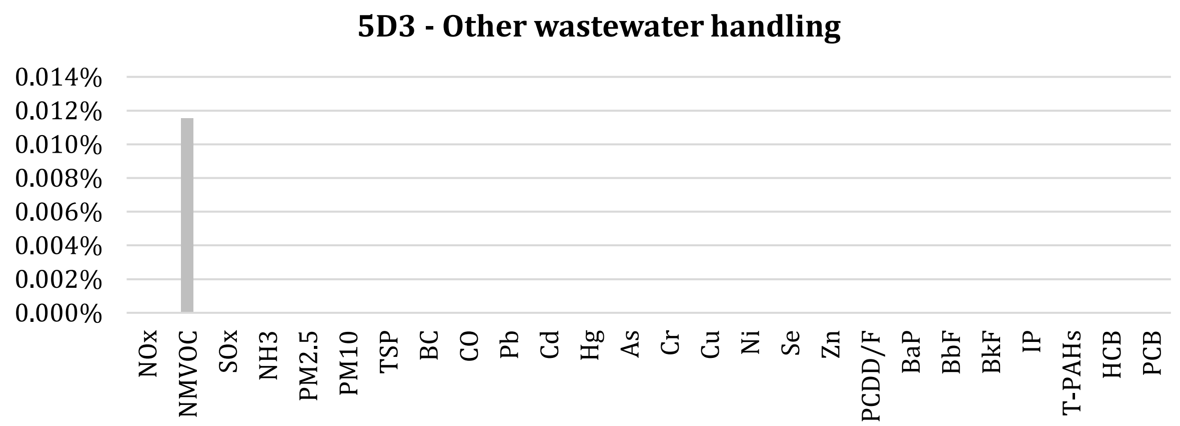

Figure 53: Shares of emissions from the NFR 5D3 category in percentage of the national total

7.7.2 Methodology & activity data – Historical

A tier 1 methodology, based on the 2023GB, was utilized to estimate NMVOC emissions for this subcategory given that wastewater is not distinguished by sector (i.e. domestic, commercial and industrial). The activity data, encompassing the annual cubic meters of wastewater treated at four facilities, was provided by the Water Services Corporation (WSC) for 1990 to 2022:

- Ta' Barkat Sewage Treatment Plant
- Iċ-Ċumnija Sewage Treatment Plant
- The Sant'Antnin Mechanical and Biological Treatment Plant (in operation until 2018)
- Ras il-Hobż Sewage Treatment Plant

7.7.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.7.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. The activity data utilized is in line with that of MRA. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.7.5 Sector-specific recalculations

No recalculations were performed for this sector.

7.7.6 Sector-specific planned improvements

Presently, no planned improvements planned for this sector.

7.8 Sector 5E: Other Waste

Table 128: Sector 5E general characteristics

NFR Code	**5E**
Sub-Category	Other Waste
Method	2023GB
Activity Data	Civil Protection Department
Emission Factors	Tier 2
Key Category	PCDD/PCDF (dioxins/furans)
Year of Last Update	2024 submission

7.8.1 Sector description

This category covers the emissions originating from car and building fires. Shares of emissions of the particular pollutants from 5E in 2022 are shown in Figure 54.

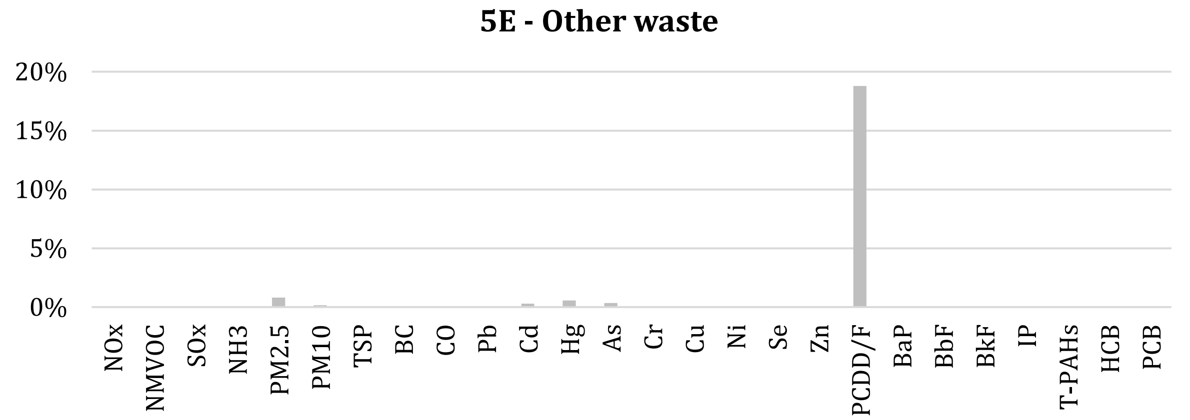

Figure 54: Shares of emissions from the NFR 5E category in percentage of the national total

7.8.2 Methodology & activity data - Historical

The Civil Protection Department (CPD) provided the activity data for the years 2000 to 2022. Data for the remaining historical years was extrapolated from the aforementioned data.

The activity data was provided for the following parameters: houses/apartments, hotels/guest houses, industrial buildings, and vehicles/trucks for the years 2000 to 2015. Starting from the year 2016 onwards, the CPD provided all calls received from their end without specific categorization. Categorization of the various call descriptions was carried out to enable successful calculation of emissions. The Table 129 presents the reported fires categorized for the last three reporting years:

Table 129: Total fires per category for the years 2020 to 2022.

Category	**Occurrences**		
	2020	**2021**	**2022**
Houses	64	65	56
Apartments	69	79	78
Hotel/Guest houses	8	13	13
Industrial buildings	31	35	27
Vehicles/Trucks	207	71	147

Since the number of house fires did not differentiate between different types of dwellings, the proportion of dwellings outlined in NSO's 2011 and 2021 censuses were utilized to determine the distribution of detached houses, undetached houses, and apartments in Malta, as illustrated in Table 130. This was then multiplied by the total reported fires within this category.

Table 130: Share of dwellings in Malta

NSO Census 2011		
House Type	**% Share Dwellings**	**% share detached/undetached**
Apartment	61.5	-
Detached house	7.0	18.2
Undetached house	31.5	81.8
NSO Census 2021		
House type	**% share dwellings**	**% share detached/undetached**
Apartment	72.5	-
Detached house	4.6	16.9
Undetached house	22.9	83.1

The tier 2 approach provided in the 2023GB was utilized for this submission. It is important to note that no EFs were provided for hotels, therefore the EFs for apartments were used, since hotels tend to comprise of small rooms that are most similar to apartments. The CPD indicated that when a fire takes place, only one or two rooms in reality catch fire. Additionally, the entire car tends to be burnt in the event of a fire, whereas 60% of an industrial building tends to catch fire. Considering this information, and taking the average number of rooms as provided by the 2011 and 2021 NSO census, the average area percentage of cars and buildings burnt during a fire, was calculated as shown in Table 131.

Table 131: Share of vehicles and buildings burnt

Parameter	Rooms burnt	No. of rooms	% of structure
Car	N/A	N/A	100.0%
Undetached house	2	9	22.2%
Detached house	2	12	16.6%
Apartment	2	5	40.0%
Hotel/Guest house	2	112	1.8%
Industrial building	N/A	N/A	60.0%

7.8.3 Methodology & activity data – Projections

No projections were considered in the preparation of this submission.

7.8.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

7.8.5 Sector-specific recalculations

The share of dwellings provided by the NSO, which is used to determine the proportion of detached houses, undetached houses, and apartments catching fire, was updated according to the latest 2021 Census. Consequently, activity data for 2012 onwards was updated, resulting in recalculations of emissions for the mentioned years.

7.8.6 Sector-specific planned improvements

Presently, no planned improvements are scheduled for category 5E.

8 Other sources (NFR 6)

Chapter Updated: 2024

8.1 Category overview

In terms of the emission inventory, emissions from the following sectors are estimated:

- 6A Other

8.2 Sector 6A: Other

Table 132: Sector 6A general characteristics

NFR Code	6A
Sub-Category	Other
Method	2023GB
Activity Data	Department of Animal Health and Welfare
Emission Factors	Tier 1
Key Category	Not Applicable
Year of Last Update	2024 submission

8.2.1 Introduction

This subcategory includes emissions of air pollutants that arise from the excretion of cats and dogs. Shares of emissions of the particular pollutants from this sector in 2022 are shown in Figure 55.

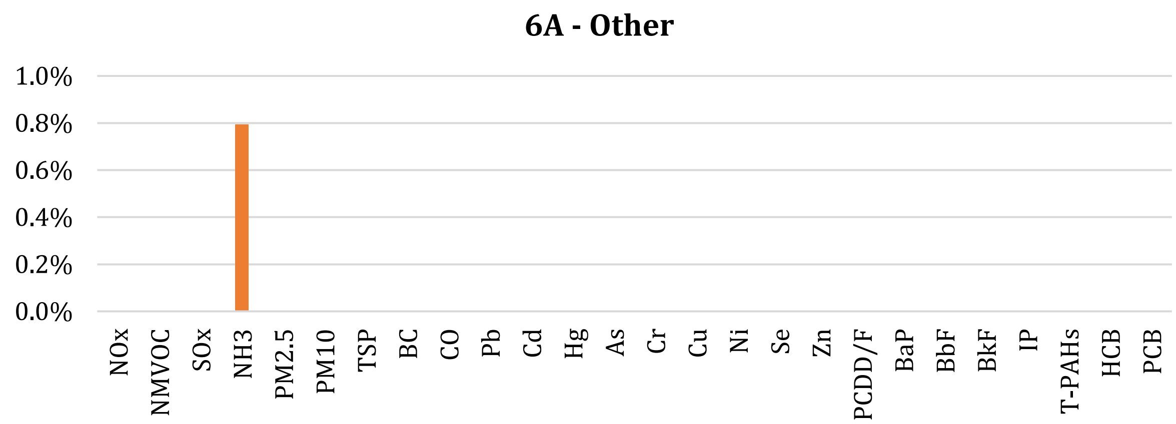

Figure 55: Shares of emissions from the NFR 6A category in percentage of national total

8.2.2 Methodology

NH_3 emissions from this sector were calculated through the tier 1 methodology provided by the 2023GB.

8.2.3 Activity data

The annual number of cats and dogs was not available. However, the Department of Animal Health and Welfare had provided an estimate on the population of cats and dogs in August 2021, following a parliamentary question (TVM News, 2021). Considering that no other information was available, the values of 85,079 dogs and 11,673 cats in August 2021 was applied for all years.

8.2.4 Sector-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data, the emission factors, and the formulas utilized within the model, were correct. All assumptions and criteria relevant to any of the activity data are checked in house. Furthermore, checks were made to ensure that units were converted correctly throughout the model. Trends for each pollutant are analysed through a trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission.

8.2.5 Sector-specific recalculations

This sector was estimated for the first time in this submission.

8.2.6 Sector-specific planned improvements

Presently, no planned improvements are scheduled for this category.

9 Projections

Chapter Updated: 2024

Pursuant to Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants and the LRTAP Convention, Projected Emissions are to be reported every two years. Malta reported Projected Emissions in 2023 and the methodologies used for such compilation was reported in the Informative Inventory Report for Malta 2023. No projected emissions were expected for the 2024 submission. Projected Emissions will be reported in the 2025 submission for reference year 2025 and 2030.

10 Trends

Chapter Updated: 2024

This chapter provides a description of the trends of the main air pollutant emissions, which Malta is bound to report pursuant to Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants and the LRTAP Convention.

10.1 Nitrogen oxides (NO_x)

The energy sector is the dominant source of this pollutant. This is seen throughout the entire time-series from 1990 to 2022. In 1990, the total NO_x emissions were at 7.24kt, which have since decreased to 4.73kt in 2022. From the below figure, one can note that the period with the highest NO_x emissions were between 2005 to 2010 with the highest load recorded in 2008 at 9.77kt. Following the decommissioning of the Marsa Power Station in 2015 and the inauguration of the Malta-Sicily interconnector cable in the same year, Malta recorded lower levels of NO_x emissions. As expected, the lowest levels recorded to date, were in 2020, and this is primarily attributed to the COVID-19 restrictions, which were in place for almost half a year and significantly impacted sectors such as road transport, navigation, and aviation, among others.

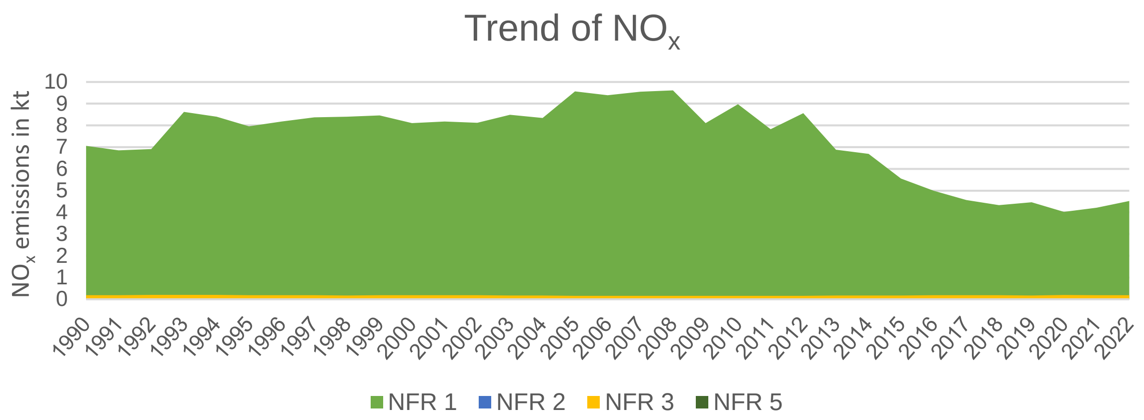

Figure 56: NO_x trends throughout the time series

In 2022, the major contributor to NO_x emissions within the Energy sector was road transport, particularly emissions from Heavy duty vehicles incl. buses (1A3biii) and Passenger Cars (1A3bi) at 17.7% and 15.5% of the total NO_x respectively. National navigation (1A3dii) is the third largest source of NO_x emissions at 12.3% followed by the public electricity and heat production (1A1a) at 11.7%, the Light Commercial Vehicles from the Road Transport sector (1A3bii) at 9.0% and other, mobile machinery (1A5b) at 6.7%. Together, these six sectors make up almost 72.9% of the NO_x emissions. The below table provides a summary of the top ten sources of NO_x emissions in 2022.

Table 133: Table summarising the top 10 contributors of NO_x emissions in 2022

Rank	NFR Code	Long name	% share	% sum
1	1A3biii	Road transport: Heavy duty vehicles and buses	17.7%	17.7%
2	1A3bi	Road transport: Passenger cars	15.5%	33.2%
3	1A3dii	National navigation (shipping)	12.3%	45.5%
4	1A1a	Public electricity and heat production	11.7%	57.2%
5	1A3bii	Road transport: Light duty vehicles	9.0%	66.2%
6	1A5b	Other, Mobile (including military, land based and recreational boats)	6.7%	72.9%
7	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	6.0%	78.9%
8	1A4ciii	Agriculture/Forestry/Fishing: National fishing	5.1%	84.0%
9	1A3ai(i)	International aviation LTO (civil)	4.6%	88.6%

10	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	3.4%	92.0%

10.2 Non-Methane Volatile Organic Compounds (NMVOC)

NMVOC emissions originate from various sources and are mainly split in two main categories: (i) those considered to be evaporative emissions and (ii) those originating from incomplete combustion. Once again the main contributor to NMVOCs is the energy sector, however, as one can note in Figure 57 below, the IPPU and the Agricultural sector also feature quite prominently. The highest emissions were recorded between 1993 and 1999, with 1995 synonymous with the highest emissions on record at 5.85kt. A decreasing trend is visible from the early 2000s with the lowest load recorded in 2020 at 2.45kt.

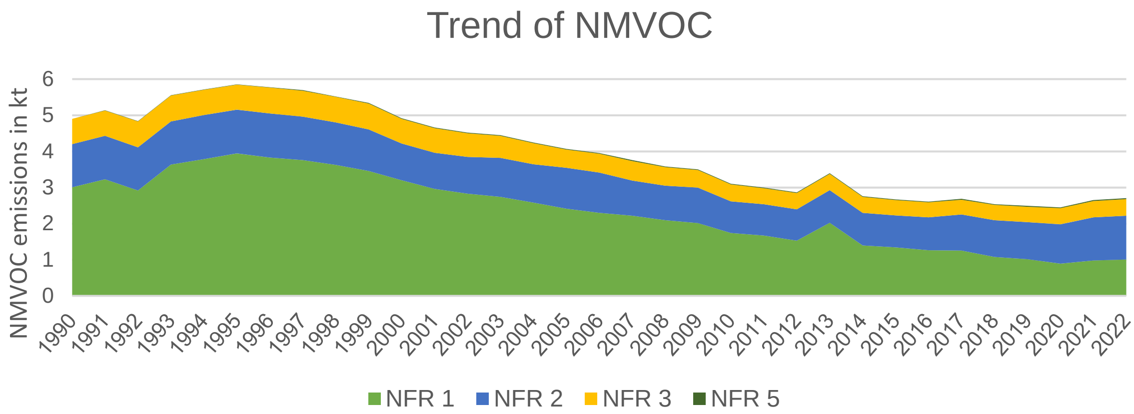

Figure 57: NMVOC trend throughout the time series

As already mentioned emissions for this pollutant are not dominated by a NFR sector. In fact, three reported NFRs are included in the top ten contributing sectors in 2022 as seen in Table 134 below. 13.6% of NMVOCs originate from the industrial processes and product use sector, particularly the Coating applications (2D3d) followed by Printing (2D3h) at 12.7%, Domestic solvent use including fungicides (2D3a) at 11.4%, Passenger Cars (1A3bi) at 9.4%, and Animal manure applied to soils (3Da2a) at 8.6%. Together, these five sectors make up around 55.8% of the total NMVOC emissions.

Table 134: Table summarising the top 10 contributors of NMVOC emissions in 2022

Rank	NFR Code	Long name	% share	% sum
1	2D3d	Coating applications	13.6%	13.6%
2	2D3h	Printing	12.7%	26.3%
3	2D3a	Domestic solvent use including fungicides	11.4%	37.8%
4	1A3bi	Road transport: Passenger cars	9.4%	47.1%
5	3Da2a	Animal manure applied to soils	8.6%	55.8%
6	1A3bv	Road transport: Gasoline evaporation	8.2%	64.0%
7	1A5b	Other, Mobile (including military, land based and recreational boats)	5.0%	69.0%
8	2D3e	Degreasing	3.6%	72.6%
9	2H2	Food and beverages industry	3.3%	75.9%
10	3B4gii	Manure management - Broilers	3.2%	79.1%

10.3 Sulphur oxides (SO_x)

The Energy sector is responsible for the majority of SO_x emissions, and the highest load ever recorded was in 1993 at 15.09kt, whereas the lowest recorded emissions were observed in 2021 at 0.15kt. In recent years, following the introduction of lower sulphur content of certain liquid fuels, the closure of the Marsa Power Station, the introduction of the Malta-Sicily interconnector and the shift from heavy fuel oil to liquefied natural gas at the Delimara Power station, led to a drastic reduction of SO_x emissions to the point that this pollutant is no longer considered a pollutant or great concern. This decreasing trend is visible in the below table.

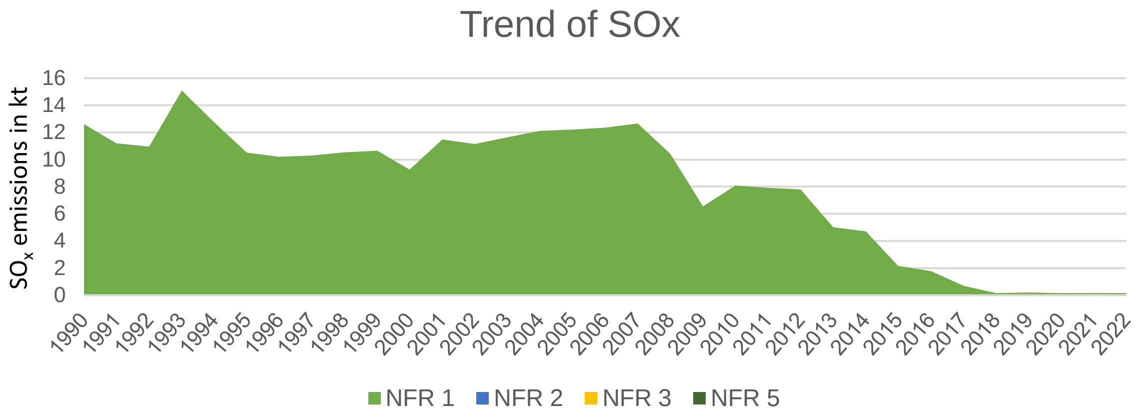

Figure 58: SO_x trend throughout the time series

In 2022, the main contributor to SO_x emissions in Malta, is the stationary combustion sector (1A2gviii) which constitutes 23.3% of the total emissions. This is followed by the commercial and institutional sector (1A4ai) at 17.4%, the off road vehicles and other machinery sector (1A4cii) at 14.8% and the public electricity and heat sector (1A1a) at 14.3%. Together these four sectors cover 69.8% of the entire SO_x emissions. The below table provides an overview of the top ten contributors of sulphur dioxide emissions in Malta:

Table 135: Table summarising the top 10 contributors of SO_x emissions in 2022

Rank	NFR Code	Long name	% share	% sum
1	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	23.3%	23.3%
2	1A4ai	Commercial/Institutional: Stationary	17.4%	40.7%
3	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	14.8%	55.5%
4	1A1a	Public electricity and heat production	14.3%	69.8%
5	1A5b	Other, Mobile (including military, land based and recreational boats)	9.7%	79.5%
6	1A3ai(i)	International aviation LTO (civil)	7.8%	87.3%
7	1A3dii	National navigation (shipping)	6.9%	94.3%
8	1A4ciii	Agriculture/Forestry/Fishing: National fishing	2.5%	96.7%
9	5C1bv	Cremation	1.4%	98.1%
10	1A3bi	Road transport: Passenger cars	0.7%	98.8%

10.4 Ammonia (NH_3)

Ammonia is the only pollutant that is not synonymous with the energy sector. In fact, the dominant NFR sector is the agricultural sector, which makes up about 92% of emissions in 2022. The initial years in the time-series were synonymous with rather high emission loads with emissions from the agricultural sector exceeding the 2kt per year until 2002. A decreasing trend is visible in the below figure, and the lowest load was observed in 2017 at 1.5kt.

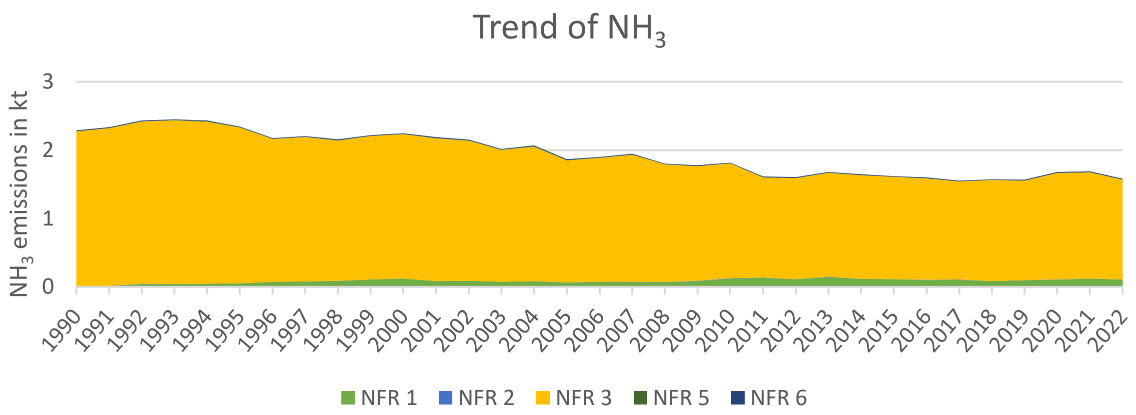

Figure 59: NH_3 trend throughout the time series

As already mentioned the agricultural sector is the main contributor to NH_3 emissions. In 2022, 36.4% of the total NH_3 emissions originated from animal manure applied to soils (3Da2a), followed by Inorganic N-fertilizers (3Da1) at 11.0% and a further 41.0% stems from manure management of dairy cattle, swine, other animals, non-dairy cattle, broilers, horses and laying hens. The below table provides an overview of the top ten contributors of ammonia emissions in Malta:

Table 136: Table summarising the top 10 contributors of NH3 emissions in 2022

Rank	NFR Code	Long name	% share	% sum
1	3Da2a	Animal manure applied to soils	36.4%	36.4%
2	3Da1	Inorganic N-fertilizers (includes also urea application)	11.0%	47.5%
3	3B1a	Manure management - Dairy cattle	9.6%	57.0%
4	3B3	Manure management - Swine	9.5%	66.5%
5	3B4h	Manure management - Other animals	6.2%	72.7%
6	3B1b	Manure management - Non-dairy cattle	5.9%	78.6%
7	1A5b	Other, Mobile (including military, land based and recreational boats)	4.1%	82.6%
8	3B4gii	Manure management - Broilers	3.6%	86.2%
9	3B4e	Manure management - Horses	3.4%	89.6%
10	3B4gi	Manure management - Laying hens	3.0%	92.5%

10.5 Particulate Matter ($PM_{2.5}$)

The main sectoral contributors to the finer fraction of particulate matter are Energy and IPPU. However, taking a look at the below figure, one would note that contributions from the energy sector were more evident particularly in the earlier years of the time-series. 2004 experienced the highest loads of $PM_{2.5}$ with emissions of 0.83kt. The lowest levels were observed in 2021 where 0.34kt of $PM_{2.5}$ were reported. A decreasing trend is noticeable post-2004 as can be seen in Figure 60.

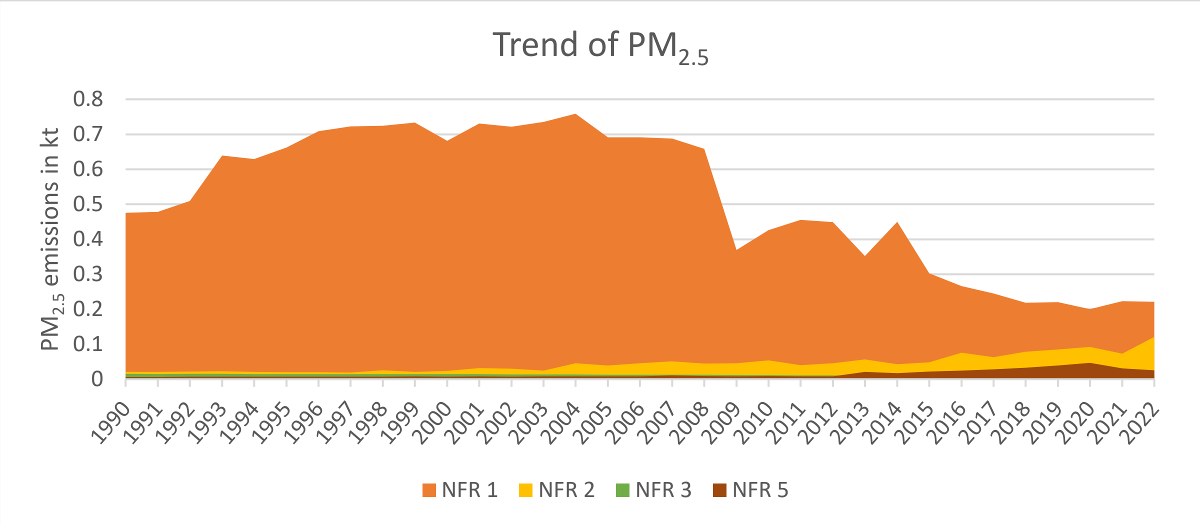

Figure 60: NH_3 trend throughout the time series

Within the IPPU sector the main contributor to $PM_{2.5}$ emissions in 2022 is the construction and demolition sector (2D5b) making up 19.8% of the total emissions. This sector is followed by other mobile machinery (1A5b) at 15.7% and non-exhaust emissions from tyre wear and brake wear (1A3bvi) of the road transport sector at 10.9%. Road paving with asphalt (2D3b) sector also features amongst the top five main sources of $PM_{2.5}$ with a 6.8% contribution. Overall, both exhaust and non-exhaust road transport emissions make up 29.4% of $PM_{2.5}$ emissions. The below table provides an overview of the top ten contributors of the finer fraction of PM emissions in Malta:

Table 137: Table summarising the top 10 contributors of $PM_{2.5}$ emissions in 2022

Rank	NFR Code	Long name	% share	% sum
1	2A5b	Construction and demolition	19.8%	19.8%
2	1A5b	Other, Mobile (including military, land based and recreational boats)	15.7%	35.5%
3	1A3bvi	Road transport: Automobile tyre and brake wear	10.9%	46.4%
4	2D3b	Road paving with asphalt	6.8%	53.2%
5	1A3bii	Road transport: Light duty vehicles	5.9%	59.1%
6	5A	Biological treatment of waste - Solid waste disposal on land	5.5%	64.6%
7	2G	Other product use	5.3%	69.9%
8	1A3bi	Road transport: Passenger cars	4.6%	74.5%
9	1A3biii	Road transport: Heavy duty vehicles and buses	4.1%	78.5%
10	1A3bvii	Road transport: Automobile road abrasion	3.9%	82.5%

10.6 Emission ceilings and Adjustments

Article 4 of Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants lays out provisions for Member States to limit their annual anthropogenic emissions of SO_x, NO_x, NMVOC, NH_3 and $PM_{2.5}$ in accordance with the national emission reduction commitments applicable from 2020. The following text provides an overview of how Malta performed in relation to the 2020 and 2030 emission reduction commitment for the five main pollutants.

The below table provides a summary of Malta's performance in 2022 against the 2005 base year and the actual percentage deduction Malta managed to attain in order to be compliant with the 2020 ceilings as established by Directive 2016/2284.

	NO_X	NMVOC	SO_x	NH_3	$PM_{2.5}$
2005 base year results (kt)	9.57	3.57	12.22	1.87	0.75
2022 results (kt)	4.54	2.25	0.16	1.58	0.38
2020 reduction targets	42%	23%	77%	4%	25%
Deductions from the base year	52.5%	37%	99%	15%	50%

10.6.1 Nitrogen Oxides (NO_x)

In 2022, Malta managed to deduct the total NO_x emissions by 52.5% over the 2005 base year emissions. The total NO_x emissions estimated for 2022 were 4.5kt and in order for Malta to be compliant with the 2020 NO_x emissions ceilings, the total amount of NO_x emitted by the country had to be 5.5kt or lower. In order for Malta to comply with the 2030 ceilings, a further decrease of 2.53kt of the total NO_x emissions is required. This is a very difficult task for Malta, as it requires drastic changes in transport policy as well as other sectors. The below figures illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for NO_x.

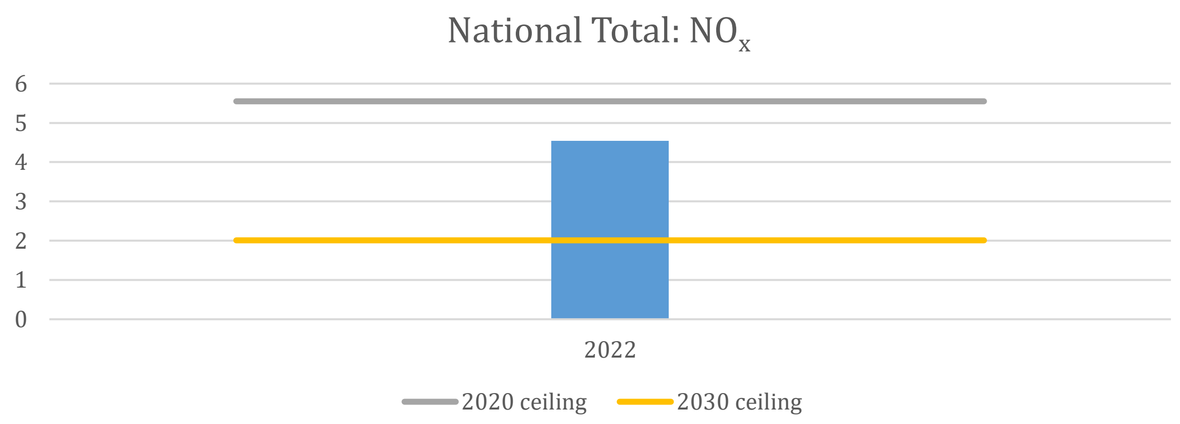

Figure 61: The total amount of NO_x emissions in kt in 2022 compared to the 2020 and 2030 ceilings

10.6.2 Non-methane Volatile Organic Compounds (NMVOC)

In 2022, Malta managed to deduct the total NMVOC emissions by 37% over the 2005 base year emissions. The total NMVOC emissions estimated for 2022 were 2.25kt and in order for Malta to be compliant with the 2020 NMVOC emissions ceilings, the total amount of NMVOC emitted by the country had to be 2.75kt or lower. Malta is also in compliance with the 2030 ceilings by 0.36kt. The below figures illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for NMVOC.

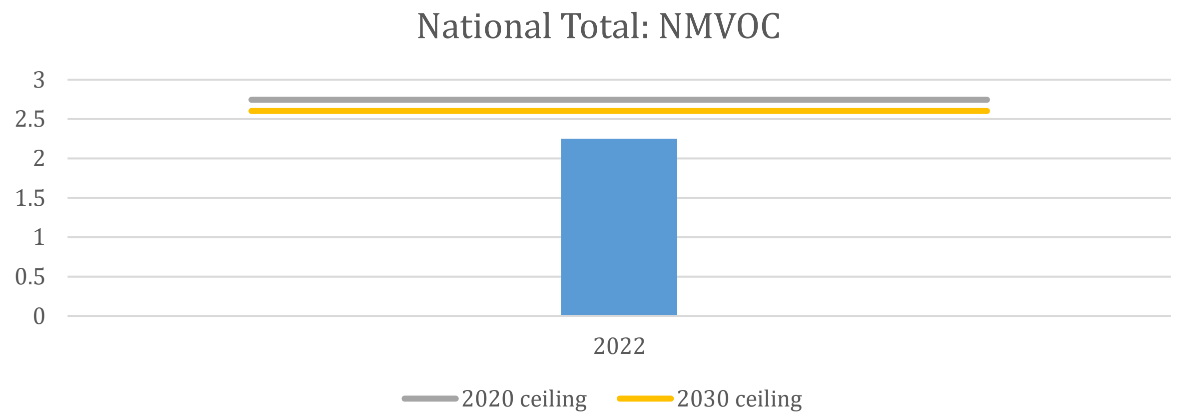

Figure 62: The total amount of NMVOC emissions in kt in 2022 compared to the 2020 and 2030 ceilings

10.6.3 Sulphur Oxides (SO_x)

In 2022, Malta managed to deduct the total SO_x emissions by 99% over the 2005 base year emissions. The total SO_x emissions estimated for 2022 were 0.16kt and in order for Malta to be compliant with the 2020 SO_x emissions ceilings, the total amount of SO_x emitted by the country had to be 2.81kt or lower. Malta is already in compliance with the 2030 ceilings. The below figures illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for SO_x.

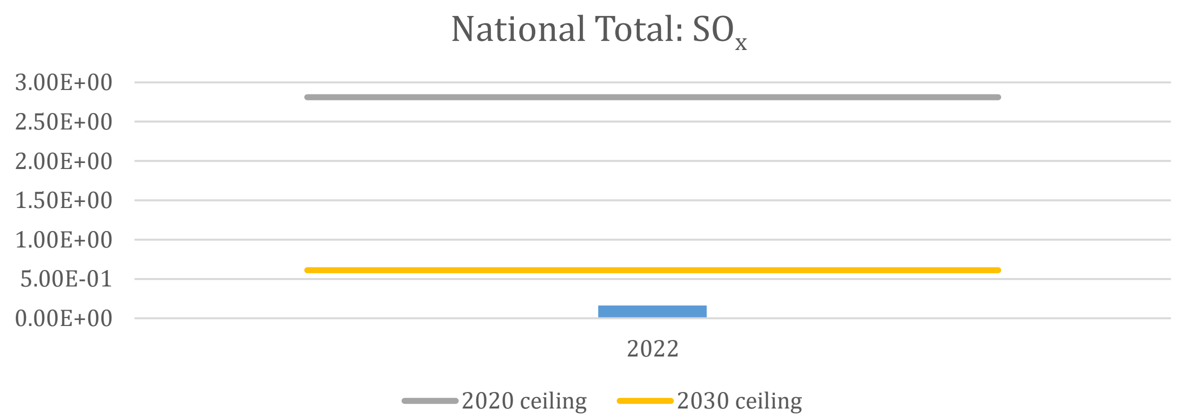

Figure 63: The total amount of SO_x emissions in kt in 2022 compared to the 2020 and 2030 ceilings

10.6.4 Ammonia (NH_3)

In 2022, Malta managed to deduct the total NH_3 emissions by 15% over the 2005 base year emissions. The total NH_3 emissions estimated for 2022 were 1.58kt and in order for Malta to be compliant with the 2020 NH_3 emissions ceilings, the total amount of NH_3 emitted by the country had to be 1.79kt or lower. In order for Malta to be in compliance with the 2030 ceilings, a further decrease of 0.17kt of the total NH_3 emissions required. The below figures illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for NH_3.

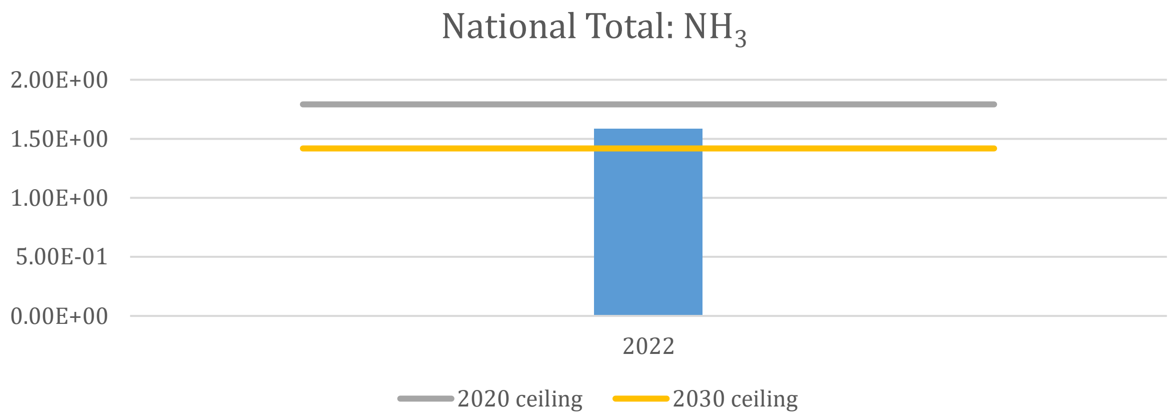

Figure 64: The total amount of NH_3 emissions in kt in 2022 compared to the 2020 and 2030 ceilings

10.6.5 Fine Particulate Matter ($PM_{2.5}$)

In 2021, Malta managed to deduct the total $PM_{2.5}$ emissions by 50% over the 2005 base year emissions. The total $PM_{2.5}$ emissions estimated for 2022 were 0.38kt and in order for Malta to be compliant with the 2020 $PM_{2.5}$ emissions ceilings, the total amount of $PM_{2.5}$ emitted by the country had to be 0.56kt or lower. Malta is already in compliance with the 2030 ceilings. The below figures illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for $PM_{2.5}$.

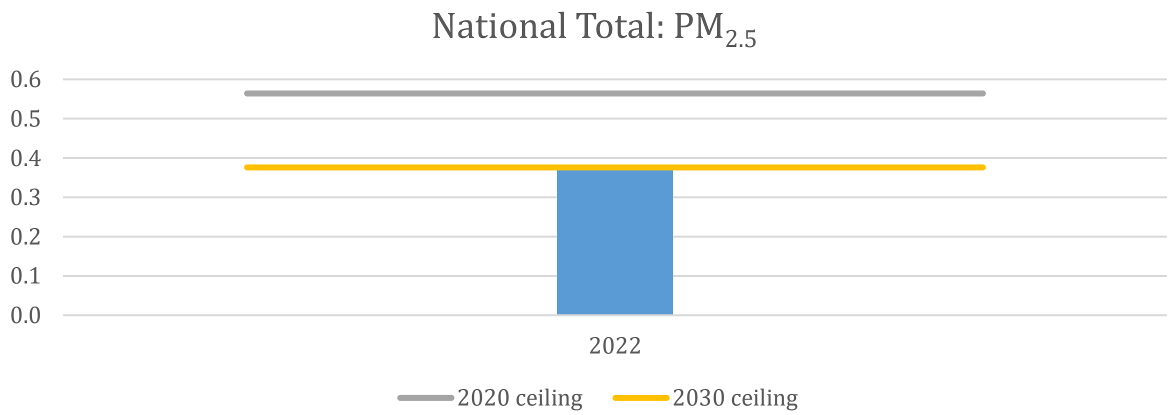

Figure 65: The total amount of $PM_{2.5}$ emissions in kt in 2022 compared to the 2020 and 2030 ceilings

11 Recalculations and Improvements

Chapter Updated: 2024

For a comprehensive understanding of the recalculations and enhancements under consideration across all sectors, it is recommended to consult the corresponding chapters for detailed descriptions. Each sector-specific chapter delves into the intricacies of proposed revisions and optimizations, providing a thorough overview of the planned improvements.

12 Reporting of Gridded Emissions and LPS

Chapter Updated: 2024

Pursuant to Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants and the LRTAP Convention, Gridded Emissions and emissions from Large Point Sources are to be reported every four years starting in 2017. Malta reported Gridded Emissions and those from LPS in 2021 for reference year 2019 and the methodologies used for such compilation was reported in the Informative Inventory Report for Malta 2019. No gridded emissions and LPS reporting was expected for the 2024 submission for reference year 2022. Gridded emissions and emissions from LPS will be reported in the 2025 submission for reference year 2023.

13 References

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14 Annex I – Key Category Analysis

Table 138: Key Category Analysis

Pollutant	NFR	Long Name	% Share	% Sum
NO_x (as NO_2)	1A3biii	Road transport: Heavy duty vehicles and buses	17.7%	17.7%
	1A3bi	Road transport: Passenger cars	15.5%	33.2%
	1A3dii	National navigation (shipping)	12.3%	45.5%
	1A1a	Public electricity and heat production	11.7%	57.2%
	1A3bii	Road transport: Light duty vehicles	9.0%	66.2%
	1A5b	Other, Mobile (including military, land based and recreational boats)	6.7%	72.9%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	6.0%	78.9%
NMVOC	2D3d	Coating applications	13.6%	13.6%
	2D3h	Printing	12.7%	26.3%
	2D3a	Domestic solvent use including fungicides	11.4%	37.8%
	1A3bi	Road transport: Passenger cars	9.4%	47.1%
	3Da2a	Animal manure applied to soils	8.6%	55.8%
	1A3bv	Road transport: Gasoline evaporation	8.2%	64.0%
	1A5b	Other, Mobile (including military, land based and recreational boats)	5.0%	69.0%
	2D3e	Degreasing	3.6%	72.6%
	2H2	Food and beverages industry	3.3%	75.9%
	3B4gii	Manure management - Broilers	3.2%	79.1%
	1B2av	Distribution of oil products	3.0%	82.1%
SO_x (as SO_2)	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	23.3%	23.3%
	1A4ai	Commercial/Institutional: Stationary	17.4%	40.7%
	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	14.8%	55.5%
	1A1a	Public electricity and heat production	14.3%	69.8%
NH_3	3Da2a	Animal manure applied to soils	36.4%	36.4%
	3Da1	Inorganic N-fertilizers (includes also urea application)	11.0%	47.5%
	3B1a	Manure management - Dairy cattle	9.6%	57.0%
	3B3	Manure management - Swine	9.5%	66.5%
	3B4h	Manure management - Other animals	6.2%	72.7%
	3B1b	Manure management - Non-dairy cattle	5.9%	78.6%
	1A5b	Other, Mobile (including military, land based and recreational boats)	4.1%	82.6%
$PM_{2.5}$	2A5b	Construction and demolition	19.8%	19.8%
	1A5b	Other, Mobile (including military, land based and recreational boats)	15.7%	35.5%

	1A3bvi	Road transport: Automobile tyre and brake wear	10.9%	46.4%
	2D3b	Road paving with asphalt	6.8%	53.2%
	1A3bii	Road transport: Light duty vehicles	5.9%	59.1%
	5A	Biological treatment of waste - Solid waste disposal on land	5.5%	64.6%
	2G	Other product use	5.3%	69.9%
	1A3bi	Road transport: Passenger cars	4.6%	74.5%
	1A3biii	Road transport: Heavy duty vehicles and buses	4.1%	78.5%
	1A3bvii	Road transport: Automobile road abrasion	3.9%	82.5%
PM_{10}	2A5b	Construction and demolition	41.0%	41.0%
	2D3b	Road paving with asphalt	27.9%	68.9%
	5A	Biological treatment of waste - Solid waste disposal on land	7.5%	76.5%
	1A3bvi	Road transport: Automobile tyre and brake wear	4.6%	81.0%
TSP	2D3b	Road paving with asphalt	53.4%	53.4%
	2A5b	Construction and demolition	34.5%	87.9%
BC	1A5b	Other, Mobile (including military, land based and recreational boats)	24.2%	24.2%
	1A3bii	Road transport: Light duty vehicles	16.7%	40.9%
	1A3bi	Road transport: Passenger cars	14.5%	55.4%
	1A3biii	Road transport: Heavy duty vehicles and buses	10.6%	66.0%
	1A3bvi	Road transport: Automobile tyre and brake wear	9.6%	75.6%
	2G	Other product use	7.2%	82.8%
CO	1A3bi	Road transport: Passenger cars	58.2%	58.2%
	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	8.4%	66.6%
	1A5b	Other, Mobile (including military, land based and recreational boats)	8.0%	74.6%
	1A3biv	Road transport: Mopeds & motorcycles	6.0%	80.6%
Pb	1A3bvi	Road transport: Automobile tyre and brake wear	74.0%	74.0%
	2G	Other product use	19.4%	93.5%
Cd	2G	Other product use	53.7%	53.7%
	1A3bvi	Road transport: Automobile tyre and brake wear	27.2%	80.9%
Hg	1A3bi	Road transport: Passenger cars	36.8%	36.8%
	1A1a	Public electricity and heat production	12.2%	49.0%
	1A5b	Other, Mobile (including military, land based and recreational boats)	9.4%	58.5%
	1A3biii	Road transport: Heavy duty vehicles and buses	8.7%	67.1%
	1A3dii	National navigation (shipping)	8.6%	75.8%

	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	7.2%	83.0%
As	1A3bvi	Road transport: Automobile tyre and brake wear	56.0%	56.0%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	13.1%	69.1%
	1A4ai	Commercial/Institutional: Stationary	6.6%	75.7%
	1A1a	Public electricity and heat production	5.2%	80.9%
Cr	1A3bvi	Road transport: Automobile tyre and brake wear	80.1%	80.1%
Cu	1A3bvi	Road transport: Automobile tyre and brake wear	97.1%	97.1%
Ni	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	60.5%	60.5%
	1A4ai	Commercial/Institutional: Stationary	28.2%	88.7%
Se	1A3bvi	Road transport: Automobile tyre and brake wear	36.3%	36.3%
	5C1bv	Cremation	28.9%	65.2%
	1A5b	Other, Mobile (including military, land based and recreational boats)	16.0%	81.2%
Zn	1A3bvi	Road transport: Automobile tyre and brake wear	87.2%	87.2%
PCDD/PCDF (dioxins/furans)	2G	Other product use	29.1%	29.1%
	5E	Other waste	18.8%	47.8%
	1A3bi	Road transport: Passenger cars	18.2%	66.0%
	3F	Field burning of agricultural residues	10.6%	76.7%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	5.2%	81.9%
benzo(a)pyrene	5C1bv	Cremation	44.7%	44.7%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	26.6%	71.3%
	1A4ai	Commercial/Institutional: Stationary	12.2%	83.5%
benzo(b)fluoranthene	5C1bv	Cremation	53.7%	53.7%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	21.6%	75.4%
	1A4ai	Commercial/Institutional: Stationary	9.6%	85.0%
benzo(k)fluoranthene	5C1bv	Cremation	45.0%	45.0%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	26.6%	71.5%
	1A4ai	Commercial/Institutional: Stationary	11.2%	82.7%
Indeno (1,2,3-cd)pyrene	5C1bv	Cremation	69.9%	69.9%

	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	11.9%	81.7%
HCB	5C1bv	Cremation	95.4%	95.4%
PCBs	1A5b	Other, Mobile (including military, land based and recreational boats)	34.6%	34.6%
	1A3dii	National navigation (shipping)	31.6%	66.2%
	5C1bv	Cremation	15.9%	82.1%

15 Annex II – TERT Questions

Below is a list of questions that Malta received from the TERT reviewers in 2023 for reference year 2021. Malta took note of the suggestions and concerns that the TERT highlighted and carried out improvements to the relevant sectors accordingly in this year's emission inventory submission.

Sector	ID	TERT recommendation for the issue identified	Replies
General	MT-0A-2023-0001	The TERT notes that the value 'zero' is reported in 1280 instance(s) across 5 pollutant(s) and 8 memo NFR sector(s). Please refer to the accompanying file for a full breakdown of pollutants, sectors and years where 'zero' emissions have been reported. Appropriate notation keys should be used when emission values are not estimated. Please provide the values (estimates or notation keys) that should have been reported and confirm that this will be corrected in the 2023 submission.	Malta is currently working to update the current submission, thereby ensuring that there will be no '0' values.
Energy	MT-1A1a-2023-0001	The TERT notes that the $PM_{2.5}$ estimate for category 1A1a Public electricity and heat production for the year(s) 2018-2021 is larger than the estimate for PM_{10}, which is not expected. Please explain why $PM_{2.5}$ estimates are larger than estimates for PM_{10} and if appropriate, provide a corrected estimate or confirm how this will be addressed in the 2024 submission.	This error was identified and addressed.
Energy	MT-1A1a-2023-0005	For 1A1a, NO_X, SO_2, $PM_{2.5}$ and years 2019-2021, the TERT notes that there may be over- or under-estimates of emissions. This under- or over-estimates may have an impact on total emissions that is above the threshold of significance. The TERT notes that this over- or underestimation may be because from 2019 to 2020 NO_X emissions have increased by 100 %, SO_2 emissions have increased by 143 % and $PM_{2.5}$ emissions have increased by 65 % while reported activity data (natural gas consumption) has only increased by 2 %. From 2020 to 2021 NO_X emissions have decreased by 41 % and SO_2 emissions have decreased by 61 % while reported activity data (natural gas consumption) has only decreased by 3 %. The TERT further notes that liquid fuel consumption is reported for category 1A1a while the IIR from previous submission 2022 (chapter 9.1) suggests that power	NO_x, SO_2, and $PM_{2.5}$ are monitored through a continuous emissions monitoring system. Therefore, the values reported are taken from direct monitoring. The increase is due to the increase of gasoil combusted in 2020 compared to other years. Gasoil is only combusted through the back up plants, and the use of these plants was greatly increased in 2020 following damage to the Malta Sicily interconnector.

		stations switched to natural gas. Please provide further justification for your current estimate or provide a revised estimate that resolves the potential over-estimate. You may also wish to provide evidence in case you consider that the impact of the over-estimate is below the threshold of significance.	
Energy	MT-1A2gvii-2023-0001	For 1A2gvii Mobile combustion in manufacturing industries and construction (please specify in the IIR), NH_3, and years 1990-2021, the TERT notes that the notation key “NA” (not applicable) is used whilst a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. Moreover, the TERT notes that the notation key “IE” (included elsewhere) is used for reporting the activity of this category and other pollutants. Please (i) use the appropriate notation key for this pollutant of this category in the 2024 submission, and (ii) confirm if the estimate has not been made or explain how the estimate is included elsewhere.	No EF is provided for NH_3 in the 2023GB. Furthermore, the notation key 'IE' is used since emissions from NFR1A2gvii are reported under NFR1A2gviii.
Energy	MT-1A2gviii-2023-0005	For 1A2gviii, SO_X, NO_X, $PM_{2.5}$, 2005, 2019-2021, the TERT notes that Malta has heavily revised activity data (liquid fuels) and emissions. The calculated implied emission factors for SO_2 and NO_X are exceptionally high, e.g. for 2005: 846 g NO_X/GJ and 953 g SO_2/GJ and for 2021: 978 g NO_X/GJ and 468 g SO_2/GJ, while for $PM_{2.5}$ the implied emission factors are in a common range, e.g. for 2005: 26 g/GJ and for 2021: 31 g/GJ. As Malta has not submitted an IIR in the 2023 submission, the TERT is not in a position to validate the methodologies applied for category 1A2gviii. Please explain the revised methodology and provide the sources of the emission factors and activity data.	There was an error in the activity data presented within the NFR table, which has now been fixed. Furthermore, a description of the proposed updates in the methodology is included within Section 4.2.3.
Energy	MT-1A2gviii-2022-0003	The TERT notes with reference to IIR from submission 2022, Chapter 4.3,Table 14, that a Tier 1 method is used for category 1A2gviii and key source pollutants NOX and SO_2. This was raised during the 2022 NECD inventory review. The TERT notes that using a Tier 1 method is not best practice, and could result in an over- or under-estimate of emissions. This over- or under-estimate may	This sector is now being estimated through a Tier 2 methodology, as is explained in Section 4.3.2.

		have an impact on total emissions that is above the threshold of significance. The TERT is of the view that application of a Tier 2 method from the guidebook could be possible for Malta. Please provide a revised estimate (i.e. calculate NO_X, SO_2 emissions from 1A2gviii using a Tier 2 or Tier 3 method) that follows best practice or provide a clear justification for using a Tier 1 method for this key category. You may also wish to provide evidence in case you consider that the impact of the potential over- or under-estimate is below the threshold of significance.	
Energy	MT-1A3b-2022-0001	The TERT notes that a great work has been implemented to improve estimations of SO_x, NO_x, NH_3, NMVOC and $PM_{2.5}$ of 1A3b Road transport in 2023 Submission. Indeed, it seems that there is no more discrepancies in the evolution of the IEFs (see attached file). However, the TRT has no access to 2023 IIR. By consequence, the TRT is unable to identify clear explanations (methodology, datasets and assumptions) for those recalculations. Please provide further explanation for your current estimate.	Malta would like to confirm that all the information regarding the recalculations of the road transport sector including methodologies and assumptions used are included in the IIR which Malta will be submitting in the near future. At this stage, Malta would like to confirm that indeed great improvements were carried out to the pre-2010 vehicle fleet, whereby Malta managed to acquire data from the transport authority from 1995 onwards on the vehicle fleet per year. Malta then carried out an extensive exercise to categories the entire fleet into COPERT vehicle categories using similar assumptions to those used by the energy and water agency for the post 2010 vehicle fleet. Malta would also like to point out that contrary to previous submissions, for all years in the historical time series (except 1990-1994), Malta makes use of actual data and does not make use of any projected data for this year's submission (excluding projected years 2025/2030).
Energy	MT-1A3bi-2023-0002	For 1A3bi Road transport: Passenger cars, NMVOC, and the year 2021, where natural gas has been excluded from the activity, the TERT notes that the IEF (implied emission factor) is higher (outside of the 95% confidence interval) when compared to the other Member States (c.f. attached files). Please provide further justification for your current estimate.	Malta would like to point out that for NMVOC, NO_x and CO, we noted an unrealistic implied emission factor for the Euro 6 PC and LCVs. Following analysis, Malta spoke with EMISIA to highlight this issue and they confirmed that indeed the implied emission factors for cold start emissions for the said pollutants were wrong and that they would be updating them in a newer version. Due to the fact that Malta in recent years has seen an increase in Euro 6 vehicles, the resulting emissions from these 3 pollutants were overestimated. Malta has since updated the historical time series using the latest version of the model and will be providing updates in the near future.

Energy	MT-1A3bi-2023-0004	For 1A3bi Road transport: Passenger cars, NMVOC, and years 2018-2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category (e.g. +50.6%; from 0.38kt to 0.58kt in 2020, see attached file). Please explain why significant recalculations have taken place.	Malta would like to point out that for NMVOC, NO_x and CO, we noted an unrealistic implied emission factor for the Euro 6 PC and LCVs. Following analysis, Malta spoke with EMISIA to highlight this issue and they confirmed that indeed the implied emission factors for cold start emissions for the said pollutants were wrong and that they would be updating them in a newer version. Due to the fact that Malta in recent years has seen an increase in Euro 6 vehicles, the resulting emissions from these 3 pollutants were overestimated. Malta has since updated the historical time series using the latest version of the model and will be providing updates in the near future.
Energy	MT-1A3bii-2023-0001	For 1A3bii Road transport: Light duty vehicles, NO_x, and years 2019-2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category (e.g. -11.8%; from 0.39kt to 0.34kt in 2020, see attached file). Please explain why significant recalculations have taken place.	With regards to 2019 and 2020 data, Malta would like to point out that in previous reports it had used a projected stock based on actual data for 2010-2017. However, this year Malta reported actual stock data (not projected) which saw a difference in number of LCVs amongst others and also differences in Vkm were noted. More details are listed in the IIR which will be submitted in the near future.
Energy	MT-1A3biii-2023-0001	For 1A3biii Road transport: Heavy-duty vehicles and buses, NO_x and $PM_{2.5}$, and years 2005 and 2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category (see attached files). Please explain why significant recalculations have taken place.	In last year's report, Malta highlighted that improvements to the pre-2010 stock would be the main focus for this year's submission. As a result, Malta sought to make efforts to generate improved figures for its stock from 1990 to 2009. A major overhaul to the stock data was carried out for the years 1995 to 2009 with assumptions that are very similar to the stock for post-2010. With regards to 2020 data, Malta would like to point out that in previous reports it had used a projected stock and vkm based on actual data for 2010-2017. However, this year Malta reported actual stock data and vkm (not projected) which saw a difference in number of HDVs and buses amongst others. More details are listed in the IIR which will be submitted in the near future.
Energy	MT-1A3bvi-2023-0001	For 1A3bvi Road transport: Automobile tyre and brake wear, $PM_{2.5}$ and years 2005, 2019-2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category (e.g. +21.2%; from 0.03kt to 0.04kt in 2020, see attached file). Please explain why significant recalculations have taken place.	The significant recalculations are as a result of updates in the methodology regarding electric vehicles. In last year's report, Malta used a Tier 1 methodology to estimate emissions from EV passenger cars only. In previous submissions, Malta used emission factors extracted from Timmers and Achten (2016) for tyre wear and road abrasion. For this reporting period,

			Malta made use of COPERT to calculate non-exhaust emissions for EVs since the new software version now provides emission factors for Passenger Car (PC) EVs, therefore, PCs have now been included under this new category and split by size. In addition, to PCs (EVs), Malta has also several other EVs such as LCVs, HDVs, Buses, Motorcycles, and Quads within its fleet. However, due to COPERT only catering to PC EVs, Malta has developed a model, whereby EVs of other vehicle categories are considered within the stock using VKM as the driver to apply a multiplication factor to the number of PC vehicles. In previous years, only passenger cars were being included in the estimates.
Energy	MT-1A3dii-2023-0002	For 1A3dii National navigation (shipping), SO_2, and years 2019-2020, the TERT notes that, while fuel consumption for this category grows equal to a factor of 1.02 for the years 2019 to 2020, SO_2 emissions decrease equal to a factor of 0.4 in the 2023 submission (see attached file). Please explain the reason(s) behind this time series variability.	The decrease is SO_2 emissions results from the decrease in sulphur content of gasoil and gasoline (from 0.17% in 2019 to 0.07% in 2020) and in heavy fuel oil (from 2.59% in 2019 to 0.44% in 2020).
Energy	MT-1A3dii-2023-0003	For 1A3dii National navigation (shipping), NO_x, and years 2019-2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category (e.g. +16.8%; from 0.39kt to 0.46kt, see attached file). Please explain why significant recalculations have taken place.	The EFs for NO_x were updated in line with the description provided in Section 4.7.5.
Energy	MT-1A4ai-2023-0002	For 1A4ai, $PM_{2.5}$, PM_{10}, 2005-2016 the TERT notes that the $PM_{2.5}$ estimate is equal to the estimate for PM_{10}. The TERT would expect that PM_{10} estimates are higher than (rather than equal to) PM2.5 estimates. Please explain why PM_{10} and $PM_{2.5}$ estimates are the same. If appropriate, please provide corrected values or confirm how this will be addressed in the 2024 submission.	The error was corrected for this submission.
Energy	MT-1A4ai-2023-0003	For 1A4ai, NO_X, SO_2, $PM_{2.5}$, NMVOC and years 2005, 2019-2020 the TERT notes that significant recalculations have been applied. Activity data has been revised by e.g. -78% for 2005 and -77% for 2021 while SO_2 emissions have been revised by e.g. +36 % for 2005 and + 123% for 2021. This means that the calculated implied emission factors	This sector is now being estimated through a Tier 2 methodology, as is explained in Section 4.8.2.

		for SO_2 are now significantly higher (e.g. 2005: 459 g/GJ, 2021: 415 g/GJ). Please explain why significant recalculations have taken place and explain the methodology for SO_2 emission calculation.	
Energy	MT-1A4aii-2023-0001	For 1A4aii Commercial/Institutional: Mobile, NH_3, and years 1990-2021, the TERT notes that the notation key "NA" (not applicable) is used whilst a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. Moreover, the TERT notes that the notation key "IE" (included elsewhere) is used for reporting the activity of this category and other pollutants. Please (i) use the appropriate notation key for this pollutant of this category in the 2024 submission, and (ii) confirm if the estimate has not been made or explain how the estimate is included elsewhere.	The EF for NH_3 is not available.
Energy	MT-1A4bii-2023-0001	For 1A4bii Residential: Household and gardening (mobile), NH_3, and years 1990-2021, the TERT notes that the notation key "NA" (not applicable) is used whilst a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. Moreover, the TERT notes that the notation key "IE" (included elsewhere) is used for reporting the activity of this category and other pollutants. Please (i) use the appropriate notation key for this pollutant of this category in the 2024 submission, and (ii) confirm if the estimate has not been made or explain how the estimate is included elsewhere.	The notation key 'IE' was used as from the submission.
Energy	MT-1A4ciii-2023-0002	For 1A4ciii Agriculture/Forestry/Fishing: National fishing, SO_2, and years 2019-2020, the TERT notes that there is an annual change equal to a factor of 0.36 for the years 2019 to 2020 in the 2023 submission (see attached file). Please explain the reason(s) behind this time series variability.	The decrease in SO_2 emissions results from the decrease in fuel sulphur content, as explained in Section 4.11.3.
Energy	MT-1A5b-2023-0002	For 1A5b Other, Mobile (including military, land based and recreational boats), NO_x, SO_2, NH_3 and $PM_{2.5}$, and years 2020-2021, the TERT notes that there is an annual change equal to a factor of 2.27 for NO_x, 2.14 for SO_2, 2.24 for NH_3 and 2.08 for $PM_{2.5}$ for the years 2020 to 2021 in	The increase in emissions from 2020 to 2021 results from a drastic increase in consumption of gasoil, as reported through the Eurostat Energy Balance explained in Section 4.12.3.

		the 2023 submission (see attached file). Please explain the reason(s) behind this time series variability.	
Energy	MT-1A5b-2023-0005	For 1A5b Other, Mobile (including military, land based and recreational boats), SO_2, and years 2019-2020, the TERT notes that there is an annual change equal to a factor of 0.24 for the years 2019 to 2020 in the 2023 submission. Please explain the reason(s) behind this time series variability.	The decrease in SO_2 emissions results from the decrease in sulphur content of fuel, explained in Section 4.12.3.
Energy	MT-1A5b-2023-0007	For 1A5b Other, Mobile (including military, land based and recreational boats), NH_3, NO_x and $PM_{2.5}$, and the year 2020, the TERT notes that significant recalculations have been applied (>10% change) for this key category. Please explain why significant recalculations have taken place.	The emissions were recalculated following a revision in the fuel consumption of gasoil, as explained in Section 4.12.5.
IPPU	MT-2-2022-0001	The TERT noted with reference to the NFR tables (MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021.xlsx) for category 2D3g Chemical products, and the period 1990-2020, and the activity data, which have to be reported, the notation key 'NA' (not applicable) has been used. The TERT would expect that the notation key 'NE' will be used, as it is used for reporting the NMVOC emissions. The TERT noted that in the previous submission with reference to the NFR tables (CLRTAP_Submission_2022_-_Final_version_2xlsx.xlsx) the notation key 'NE' (not estimated) has been used. Please explain why the notation keys 'NA' has been used?	The use of 'NA' has been deemed an error. 'NE' should have been used. This will be fixed in next year's submission.
IPPU	MT-2A5b-2023-0001	The TERT notes that significant recalculations have been applied (e.g. -45%; from 0.08kt to 0.04kt in 2019 for PM2.5) for the key category 2A5b for the pollutant(s) PM2.5 and year(s) (2005, 2019). Please explain why significant recalculations have taken place.	As highlighted within the TERT review the estimates provided during the 2022 review process were proportionally high. Attached find relevant file explaining the calculation methodology and recalculations.
IPPU	MT-2A5b-2022-0001	The previous TERT recommended that Malta collect activity data for road construction and include this in the estimates. As no IIR is available, please provide an update on this recommendation.	Sectoral experts can confirm that the emissions emerging from road construction were not included in the 2A5b estimates provided within the 2023 submission. Activity data for 2A5b road construction is not currently available. Efforts will be made to include such estimates in future submissions provided that activity data becomes available.

IPPU	MT-2A5b-2017-0001	The previous TERT recommended that Malta to estimate emissions using a higher Tier. As no IIR is available, please provide an update on this recommendation.	Malta has successfully revised estimates provide during the 2022 review process which were proportionally high. Efforts will be made to move this sector to a high tier provided that this data becomes available.
IPPU	MT-2D-2023-0001	For 2D3e Degreasing, 2D3f Dry cleaning, 2D3g Chemical products, 1990-2021 the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, cells AK86, AK87, AK88, that there is a lack of transparency regarding the reporting of activity data with the notation key "NA". The TERT would expect the use of the notation key "NE" (Not estimated), because NMVOC emissions have been reported with "NE". Malta's IIR was unavailable, so the information of this issue was unable to be checked. The TERT is unable to determine whether there is an over/under-estimate of NMVOC emissions that may be above the threshold of significance. Please provide further clarification on the use of the notation key "NA" (Not applicable) by providing information on why Malta used it if NMVOC emissions were reported with the notation key "NE" (Not estimated).	The use of 'NA' has been deemed an error. 'NE' should have been used. This will be fixed in next year's submission.
IPPU	MT-2D3a-2023-0001	The TERT notes that significant recalculations have been applied (e.g. +26.7%; from 0.3kt to 0.38kt in 2020 for NMVOC) for the key category 2D3a for the pollutant(s) NMVOC and year(s) (2019-2020). Please explain why significant recalculations have taken place.	2D3a recalculations include revised data from EUROSTAT for years 2004 and 2005 for PRODCOM codes 20412020, 20412030, 20412050 and 20412090. In the previous submission only the import data was extrapolated from 1990 to 2004. In this submission both imports and exports were extrapolated to provide a more holistic time series. The enhancement of time series consistency achieved by assuming that the total amount of product designated for utilization in Malta would be sold and utilized within a period of five years resulted in changes in activity data for all data years. Additionally, the removal of disposed solvents as reported within the landfill AER also altered the activity data for all data years.
IPPU	MT-2D3a-2022-0001	For 2D3a Domestic solvent use including fungicides, 1990 - 2021, the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, cell F82 that there is a lack of transparency	Sectoral experts can confirm that the NMVOC emissions reported are indeed correct. Recalculations for all data years were made to fix issues with time series consistency. This was achieved by assuming that the total amount of product

		regarding the implementation of the previous recommendation, https://emrt-necd.eionet.europa.eu/2021/MT-2D3a-2022-0001, which was checked in Malta's NFR tables submitted in 2023. At the time of the initial checks, Malta's IIR was unavailable, so the full implementation of this recommendation was unable to be checked. However, the TERT notes two outliers in historic activity data trend i.e. jumps in product used in 2014 (38.42 kt) and 2016 (38.41 kt) which are approximately 3 times higher values in comparison years before and after, and TERT would also expected the highest NMVOC emissions in these years, but that is not so. The TERT is unable to determine whether there is an over/under-estimate of NMVOC emissions that may be above the threshold of significance. Please provide further clarification of activity data used for NMVOC emission calculation in 2014 and 2016, and if the reported data related to the product used and NMHOS emissions in 2014 and 2016 are correct, to provide an explanation for these outliers.	designated for utilization in Malta would be sold and utilized within a period of five years resulted in changes in activity data for all data years. Additionally, a new methodology was employed to remove disposed solvents as reported within the landfill AERs.
IPPU	MT-2D3b-2022-0001	The previous TERT recommended that Malta included activity data in the NFR and provided a trend description in the IIR. The TERT notes that activity data are reported in the NFR, but as no IIR is available, it has not been possible to assess the other part of the recommendation, please provide an update on the status of implementation.	A trend description will be provided within the 2024 IIR.
IPPU	MT-2D3b-2022-0002	The TERT identified a potential over-estimate exceeding the threshold of significance for category 2D3b Road paving with asphalt and pollutants $PM_{2.5}$ and PM_{10} in 1990-2020 - Malta are using a Tier 1 methodology for a key source. Therefore, this is a case for a potential technical correction (see attached a draft technical correction calculated by the TERT). The TERT invites Malta to provide revised estimates for this category by 28 July, or to confirm by the same date whether Malta agrees with the attached draft technical correction. The TERT notes that there appears to be only one asphalt plant in Malta and it should be possible to get information on the	Sectoral experts would like to clarify that Malta has more than one road works operator currently active. Nonetheless, Malta is in agreement with the assumptions made within the PTC (i.e. assuming that all road paving is done using hot mix). With regards to abatement measures, further clarification with local operators are required to better understand if and to what extent such measures are performed locally. However, the use of EUROSTAT energy balance bitumen values do not seem to represent the local scenario based on data provided by Infrastructure Malta, hence the use of Malta's reported activity data was kept. Malta has also noted that although the final emissions calculated within the PTC are correct the

		specific technology and information on any abatement measures in place. If you decide to provide a revised estimate, please send the calculation sheet attached to your reply to make it transparent which emissions are revised and which parameters were used for calculating the revised estimate. Please also provide a short explanation of the method used for calculating the revised estimate so that the review team can make a proper judgement on the revised estimate. As the NECD review of main pollutants focuses on the years 2005 and 2019-2021, please provide a revised estimate for 2005 and 2019-2021.	calculations utilised mainly with regards to conversion factors seem to be incorrect. Attached file shows corrections made to the supplied PTC. File attached named "MT-2D3b-2022-002" shows revised estimates.
IPPU	MT-2D3d-2023-0001	The TERT notes that significant recalculations have been applied (e.g. -21.5%; from 0.32kt to 0.25kt in 2020 for NMVOC) for the key category 2D3d for the pollutant(s) NMVOC and year(s) (2005, 2019-2020). Please explain why significant recalculations have taken place.	2D3d recalculations include the enhancement of time series consistency achieved by assuming that the total amount of product designated for utilization in Malta would be sold and utilised within a period of five years resulted in changes in activity data for all data years. Additionally, the removal of disposed paints as reported within the landfill AER also altered the activity data for all data years.
IPPU	MT-2D3e-2022-0001	The TERT noted that NMVOC emissions are not estimated from 2D3e Degreasing in years 2005, 2019-2021, and that this potential over-/under- estimate exceeds the threshold of significance. Therefore, this is a case for a potential technical correction (see attached a draft technical correction calculated by the TERT). The TERT would prefer to obtain a revised estimate from Malta instead of having to use the technical correction prepared by the TERT in the review report. Therefore, the TERT invites Malta to provide revised estimates for this category by 28 July or to confirm by the same date whether Malta agrees with the attached draft technical correction. If you decide to provide a revised estimate, please send the calculation sheet attached to your reply to make it transparent which emissions are revised and which parameters were used for calculating the revised estimate. Please also provide a short explanation of the method used for calculating the revised estimate so that the review team can make a proper judgement on the	Sectoral experts would like to thank the TERT for the methodology provided. Malta will review the methodology proposed further and assess whether there is local activity data available which may be utilised in future submissions.

		revised estimate. As the NECD inventory review of main pollutants focuses on the years 2005, 2019-2021 please provide a revised estimate for 2005, 2019-2021.	
IPPU	MT-2D3f-2022-0001	The TERT noted that the previous recommendation, https://emrt-necd.eionet.europa.eu/2021/MT-2D3f-2022-0001, has not been implemented and NMVOC emissions for 2D3f are still reported as 'NE'. The TERT identified this as a potential under- estimate exceeding the threshold of significance for 2D3f Dry cleaning in years 2005, 2019-2021. Therefore, this is a case for a potential technical correction (see attached a draft technical correction calculated by the TERT). The TERT would prefer to obtain a revised estimate from Malta instead of having to use the technical correction prepared by the TERT in the review report. Therefore, the TERT invites Malta to provide revised estimates for this category by 28 July or to confirm by the same date whether Malta agrees with the attached draft technical correction. If you decide to provide a revised estimate, please send the calculation sheet attached to your reply to make it transparent which emissions are revised and which parameters were used for calculating the revised estimate. Please also provide a short explanation of the method used for calculating the revised estimate so that the review team can make a proper judgement on the revised estimate. As the NECD inventory review of main pollutants focuses on the years 2005, 2019-2021 please provide a revised estimate for 2005, 2019-2021.	Sectoral experts would like to thank the TERT for the methodology provided. Malta will review the methodology proposed further and assess whether there is local activity data available which may be utilised in future submissions.
IPPU	MT-2D3g-2022-0001	For category 2D3g Chemical Products and NMVOC for 1990-2021 the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, cell F88 that there may be an over/under-estimate of emissions. This was raised during the 2022 NECD inventory review. This over/under-estimate may have an impact on total emissions that is above the threshold of significance. The TERT notes that this over/under-estimate may be due to the previous recommendation, https://emrt-necd.eionet.europa.eu/2021/MT-2D3g-	As previously communicated sectoral experts cannot provide revised emissions estimates for 2D3g at this time since no activity data is available. Efforts will be made to provide estimates for this sector in future submissions provided that this data becomes available.

		2022-0001, has not been implemented. Please provide further justification for your current estimate or provide a revised estimate that resolves the potential over/under-estimate. You may also wish to provide evidence in case you consider that the impact of the over/under-estimate is below the threshold of significance.	
IPPU	MT-2D3i-2023-0001	For 2D3i Other solvent use, 1990-2021 the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, that there is a lack of transparency regarding the use of notation key "NO" (Not occurring). During the review, Malta's IIR was not available, so information on this matter was unable to be checked. The TERT notes that activities such as: Glass wool enduction, Mineral wool enduction, Fat, edible and non-edible oil extraction, Application of glues and adhesives, Preservation of wood, Underseal treatment and conservation of vehicles, Vehicles dewaxing can exist on the territory pf Malta. The TERT is unable to determine whether there is an over/under-estimate of NMVOC emission that may be above the threshold of significance. Please provide further clarification for the use of the notation key "NO" (Not occurring) by providing evidence that none of the above activities exist on the territory of Malta.	Sectoral experts agree with the TERT that activities such as oil extraction and application of glue and adhesives may take place. Hence, this sector will be reported as "NE" in future submissions. Efforts will be made to estimate this sector in future submissions provided that reliable activity data becomes available.
IPPU	MT-2D3i-2023-0002	For 2G Other product use, 1990-2021 the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, cell AK91, that there is a lack of transparency regarding the reporting of activity data with the notation key "NA" and resulting emissions. Malta's IIR was unavailable, so the information on which of the following activities: Use of fireworks, Use of tobacco, Use of shoes, Other product use (use of concrete additive, cooling lubricant, lubricant, pesticide, other industrial application) are included in the inventory and information about what are their activity data time series and resulting pollutants emissions, were unable to be checked. The TERT is unable to determine whether there	Attached please find relevant file explaining the activities taken into account, calculation methodology and recalculations.

		is an over/under-estimate of NMVOC, SO_2, NO_x, NH_3, PM_{10}, $PM_{2.5}$ emissions that may be above the threshold of significance. Please provide further clarification of report the notation key "NA" (Not applicable) for activity data by providing information on which of the above mentioned activities are included in the inventory, methodology, emission factors, and time series for the period 1990-2021 of all activity data used for pollutants emission calculations in Excel.	
IPPU	MT-2G-2023-0001	For 2G Other product use, 1990-2021 the TERT notes that NFR table MT_Report_-_National_Sector_Emissions_Inventory_Report_1990-2021, cell AK91, that there is a lack of transparency regarding the reporting of activity data with the notation key "NA" and resulting emissions. Malta's IIR was unavailable, so the information on which of the following activities: Use of fireworks, Use of tobacco, Use of shoes, Other product use (use of concrete additive, cooling lubricant, lubricant, pesticide, other industrial application) are included in the inventory and information about what are their activity data time series and resulting pollutants emissions, were unable to be checked. The TERT is unable to determine whether there is an over/under-estimate of NMVOC, SO2, NOx, NH3, PM10, PM2.5 emissions that may be above the threshold of significance. Please provide further clarification of report the notation key "NA" (Not applicable) for activity data by providing information on which of the above mentioned activities are included in the inventory, methodology, emission factors, and time series for the period 1990-2021 of all activity data used for pollutants emission calculations in Excel.	Attached please find relevant file explaining the activities taken into account, calculation methodology and recalculations.
IPPU	MT-2H2-2022-0001	The previous TERT recommended that Malta collected the activity data and includes the missing NMVOC emissions from these sources (beer, spirits, sugar, margarine and solid edible oils) in the next submission. As no IIR is available, please provide an update on this recommendation.	Effort is being made to include beer production emissions within the next submission if data becomes available. Sectoral experts have confirmation that Malta does not manufacture spirits, sugar, margarine and solid edible oils.

Agriculture	MT-3B-2023-0001	For 3Ba1 NH_3, NO_x and NMVOC 1990-2021 the TERT notes that no IIR are provided but in the file "Recalculations" provided by Malta, Table 10 and 11 shows livestock animal weight and nitrogen excretion (Nex), respectively, which indicate that same Nex are used for all years. During review 2022 Malta provided the information that Nex values from the GHG submission are used in the N-flow tool. Reviewing the Nex in the GHG submission shows a decreasing trend in Nex (kg N/head/year) from dairy cattle for the years 1990-2021 (150 kg N/head/year in 1990 to 138 kg N/head/year in 2021). Can you please explain why the Nex have a decreasing trend over the years if the same livestock animal weight and nitrogen excretion rate (kg N/1000 kg animal mass/day) are used for all years? Can you further provide explanation for the significant decrease in Nex in the years 2000 and 2005?	The Nitrogen excretion values are included within Section 6.2.
Agriculture	MT-3B-2022-0001	For 3B Manure management NH_3 1990-2021 the TERT notes that there may be an over/under-estimate of emissions. This was raised during the 2022 NECD inventory review. The TERT notes that an inconsistency regarding the implied emission factor (IEF, kg NH3/head/year) for a range of years, which are significantly different compared to other years (see attached Excel spreadsheet “MT-3B-2023-0001”). No IIR are submitted, but in the file ”Addressing TERT clarifications” send by Malta, it is stated that this issue was due to an error in the reported activity data and has been corrected. But as shown in the Excel spreadsheet there are still inconsistencies regarding the implied emission factor and also for the pollutants; NO_x, NMVOC, $PM_{2.5}$, PM_{10} and TSP. Please provide further justification for the changes in IEFs or provide a revised estimate that resolves the potential over/under-estimate. You may also wish to provide evidence in case you consider that the impact of the over/under-estimate is below the threshold of significance.	The activity data has been corrected, and it is provided within Section 6.2.

Agriculture	MT-3B1b-2023-0001	The TERT notes that significant recalculations have been applied (e.g. -13%; from 0.11kt to 0.1kt in 2020 for NH_3) for the key category 3B1b for the pollutant NH_3 and years 2005, 2019-2020. No IIR are submitted, but the file "Recalculations" provided by Malta shows a recalculation of nitrogen excretion for non-dairy cattle. Can you confirm that the recalculation of NH_3 is due to recalculations of nitrogen excretion for non-dairy cattle?	The recalculations of NH_3 are due to a recalculation of Nex, as well as the diversion of a fraction of the manure to the anaerobic digester from 2018-2021. This activity data is presented within Section 6.2.
Agriculture	MT-3B1a-2023-0001	The TERT notes that significant recalculations have been applied (e.g. +39.6%; from 0.11kt to 0.15kt in 2020 for NH_3) for the key category 3B1a for the pollutant NH_3 and years 2005, 2019-2020. No IIR are submitted, but the file "Recalculations" provided by Malta shows a recalculation of nitrogen excretion for dairy cattle. Can you confirm that the recalculation of NH_3 is due to recalculations of nitrogen excretion for dairy cattle?	The recalculations of NH_3 are due to a recalculation of Nex, as well as the diversion of a fraction of the manure to the anaerobic digester from 2018-2021. This activity data is presented within Section 6.2.
Agriculture	MT-3B3-2023-0001	The TERT notes that significant recalculations have been applied (e.g. +14.8%; from 0.17kt to 0.2kt in 2020 for NH_3) for the key category 3B3 for the pollutant NH_3 and years 2005, 2019-2020. No IIR are submitted, but the file "Recalculations" provided by Malta shows a recalculation of nitrogen excretion for swine. Can you confirm that the recalculation of NH_3 is due to recalculations of nitrogen excretion for swine?	The recalculation of NH3 is due to the recalculation of Nex for both fattening pigs and sows. This activity data is presented within Section 6.2.
Agriculture	MT-3B4e-2023-0001	The TERT notes that significant recalculations have been applied (e.g. +287.7%; from 0.02kt to 0.06kt in 2020 for NH3) for the key category 3B4e for the pollutant NH3 and years 2019-2020. No IIR are submitted, but the file "Recalculations" provided by Malta shows a recalculation of number of horses. Can you confirm that the recalculation of NH_3 is due to recalculations of number of horse?	The recalculations result from the revised number of animal heads for horses. This activity data is presented within Section 6.2.
Agriculture	MT-3Da1-2023-0002	For 3Da1 NH_3 and NO_X 1990-2021, the TERT notes that implied emission factor (IEF) calculated from data reported under the NFR tables shows a IEF equal to the default given in EMEP/EEA Guidebook 2019 (0.050 for NH3 and 0.040 for NO_X) for the years 1990-2017, but for the years 2018-2021 IEF are decreased to 0.048 for NH_3	The quantity of fertiliser N applied was not incorrectly inputted from 2018-2021. Corrected values are attached to this reply. This activity data is presented within Section 6.3.1.3

		and 0.039 for NO_X. Can you explain why the emission factor changes in 2018-2021?	
Agriculture	MT-3Da1-2023-0003	For 3Da1 Inorganic N-fertilizers NH_3 and NO_x 1990-2021 the TERT notes that activity data given in the NFR tables is not consistent with numbers registered in the GHG emission inventory CRF Table 3D (see attached Excel spreadsheet "MT-3Da1-2023-0003"). This may be an over/under-estimate of emissions. In 2019-2021 the amount of N from inorganic fertiliser in CRF are almost 75 % higher than in NFR. This over/under-estimate may have an impact on total emissions that is above the threshold of significance. Please provide further justification for your current estimate and explain the difference between NFR and CRF or provide a revised estimate that resolves the potential over/under-estimate. You may also wish to provide evidence in case you consider that the impact of the over/under-estimate is below the threshold of significance.	The activity data for this sector was updated to reflect the latest data utilised in the CFR submission.
Agriculture	MT-3Da2a-2022-0001	For 3Da2a Animal manure applied to soils NMVOC 1990-2021, the TERT notes that the notation key 'NA' (not applicable) is used for NMVOC 1990-2021 whilst emission estimates are expected, because Malta use a Tier 2 calculation. This was raised during the 2022 NECD inventory review. No IIR are submitted, but in the file "Addressing TERT clarifications" send by Malta, it is stated that this issue was solved as emissions of NMVOC are now reported under 3Da2a. But in the NFR the notation key 'NA' (not applicable) is used for NMVOC 1990-2021. Please provide further justification for the reported notation key or explain how reporting will be corrected in the 2024 submission.	The NMVOC emissions from 3Da2a are now being reported under sector 3Da2a.
Agriculture	MT-3Da2a-2022-0002	For 3Da2a NH_3 and NO_X 1990-2021 the TERT notes that during the review in 2022 a potential over/under estimate exceeding the threshold of significance were identified. During the review Malta provided the N-flow tool and stated that information on the activity used, including the manure type and housing days were provided in IIR. Since no IIR are provided for	The methodologies use to calculate the emissions of GHGs and air pollutants vary, since GHGs are not estimated through the N-flow tool. Whilst the activity data may be the same, some assumption or parameter may differ across both methodologies. Efforts will be made to understand whether the underlying assumptions between the two models differ.

		submission 2023 and the emission calculations has been updated with, among other things, emissions from mules/asses and turkeys the TERT are unable to review if the emissions has been revised and parameters are explained in IIR. Please provide further justification for your current estimate by sending N-flow tool calculations for this year submission and information on the activity used, including the manure type and housing days.	
Agriculture	MT-3Da2a-2023-0002	The TERT notes that significant recalculations have been applied (e.g. +12%; from 0.55kt to 0.62kt in 2020 for NH_3) for the key category 3Da2a for the pollutant NH_3 and years 2019-2020. No IIR are submitted and the file "Recalculations" provided by Malta due not explain the recalculation transparently. Please explain why significant recalculations have taken place.	The complete list of recalculations is presented within Section 6.3.2.5.
Waste	MT-5-2022-0001	For $PM_{2.5}$ from NFR 5A – Waste disposal for the complete time series the TERT notes that there is a lack of transparency regarding parameters used to estimate $PM_{2.5}$ and PM_{10} emissions. This was raised during the 2022 NECD inventory review and the recommendation was to provide country specific value used for mean wind speed in the 2023 IIR. However, the 2023 IIR is not available. Please explain how the 2024 IIR will be completed.	The Annual Mean wind speed for 2005 and the three latest reporting years, provided by the Malta MET office, is being incorporated into sector 5A, 2024 IIR.
Waste	MT-5A-2023-0001	For NMVOC emissions from 5A-Waste disposal on land the TERT notes that, even if the estimates are correct, there is a lack of transparency regarding the methodological description. Indeed, in the 2022 IIR (no 2023 IIR provided) the TERT notes that the equation presented page 143 for the estimate of the volume of CH_4 is wrong because "/16" is missing. The equation should be "Total CH_4 emitted / 16 * CH_4 molecular density (0.714) = Volume of CH_4". Please explain how the IIR will be corrected in the 2024 submission.	Following updates within 2023GB for this sector and considering that Malta does not have a country-specific NMVOC EF derived from measurements of NMVOC concentration in landfill gas, the methodology to estimate emissions from this pollutant has been revised and described in sector 5A, 2024 IIR.
Waste	MT-5B1-2023-0001	For NH_3 emissions from 5B1- composting for all years, the TERT notes in the NFR tables that there may be an under-estimate of emissions. This under-estimate may have an impact on total emissions that is above the threshold of	Sectoral experts confirmed that the emission values provided within the NFR table were indeed correct. The factor of a 1000 issue stems from the activity data title, which was not appropriately altered. The activity data title should have read

		significance. The TERT notes that emissions are reported for the first time for the 2000-2005 period and NO for other years. This under-estimate may be due to a wrong estimate of a factor 1000 over the 2000-2005 period and the lack of justification for reporting "NO" for other years (especially after 2005). Please provide further justification for your current estimate or provide a revised estimate that resolves the potential under-estimate over the 2000-2005 period. Moreover, please provide further justification for reporting NO since 2005 or provide a revised estimate that resolves the potential under-estimate over the 2006-2021 period. You may also wish to provide evidence in case you consider that the impact of the under-estimate is below the threshold of significance.	"Waste composted [t]" instead of the default "Organic domestic waste [kt]". The methodology utilized and the activity data provided can be found within the 5B1 sector, 2024 IIR.
Waste	MT-5C1bv-2023-0001	The TERT notes that for category 5C1bv for the pollutant(s): SO_2, there is an annual change equal to a factor of 2.14 for the years 2020 to 2021 in the 2023 submission. Please explain the reason(s) behind this time series variability.	The SO_2 values provided within the NFR table are based on the Tier 3 methodology. Final emissions loads were reported by the facility via CEMS.
Waste	MT-5C1bv-2023-0002	In the 2022 IIR it was indicated that EF from the 2019 EMEP/EEA GB was applied, whereas in your answer it is indicated that CS EF "based upon the direct emission loads submitted by the facility" are used. Moreover, you are indicating that animal by-products are incinerated with other waste stream in an incinerator, so how could you derive CS based on emission load only for animal by-product? Maybe you could send a short description of your current methodology?	A Tier 3 methodology was used for the following pollutants, as the emissions were directly measured at the site: NOx, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Ni and PCDD/PCDF. Certain pollutants had missing data for some years. In these cases, a country-specific emission factor was calculated, by obtaining an average emission load per mass of total waste entering the facility (not differenciated). The mass of waste entering the facility in a year was then multiplied by the country-specific emission factor. No direct emissions data was available for BC, Se, Zn, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, and PCBs, and thus these emissions had to be calculated through the tier 1 methodology provided in the 2023GB. The total waste entering the facility was classified according to the EWC codes. The EWC codes were then used as a guidance, to separate the waste into four categories: Municipal solid waste (5C1a), Industrial waste (5C1b), Clinical waste (5C1biii), and Cremation (5C1bv). The mass of waste

			from each category was then multiplied by the relevant emission factor, as provided within the 2023GB. The emissions from the four categories were summed to obtain a single emission load per pollutant. Further details on the methodology can be found in sector 5C1BV, 2024 IIR.
Waste	MT-5C2-2022-0001	For all pollutants from 5C2-Open burning the TERT notes that there may be an under-estimate of emissions because emissions from orchard residues and forest residues may be missing. This was raised during the 2022 NECD inventory review. As this under-estimate was not expected to have an impact on total emissions that is above the threshold of significance the recommendation was that Malta provide more information in the IIR in the next submission about the waste categories taken into account in the calculation and justify those which are not taken into account including for example the legislation reference and the date of the ban. The TERT notes that the 2023 IIR was not submitted and that there is no recalculation of 5C2. Please provide further justification for your current estimate which doesn't not account for open burning of orchard residues and forest residues or explain how reporting will be completed in the 2024 submission.	The sectoral experts can confirm that neither orchard nor forest residues were taken into account within this calculation. It is to our understanding that burning of orchard and forest residues does not occur within the Maltese Islands and hence, no activity data is available.
Waste	MT-5E-2022-0001	For PM_{10} and $PM_{2.5}$ from 5E - Other waste for all years the TERT notes that there is a lack of transparency regarding the methodological description. This was raised during the 2022 NECD inventory review and the recommendation was to include all information provided during the review, particularly indicating the number of fires for each category and the repartition used to split the number of Houses / Apartments fires between Apartment, Detached house and Undetached house in the 2023 IIR. However the 2023 IIR is not available. Please explain how the 2024 IIR will be completed.	All information is being provided within the 2024 IIR showing the respective values of 2005 and the 3 latest reporting years.