MALTA'S ANNUAL INFORMATIVE INVENTORY REPORT 2022

Emission inventories from 1990 to 2020

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

2022 submission

ERA
Environment & Resources Authority

Title	Malta's Annual Informative Inventory Report 2022

Report pursuant to	The 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

Version	Date	Notes
Version 1	15/03/2022	Final IIR for submission

Contributors	Nadine Mercieca
	Marc' Andrea Cassar
	Ariana Schembri
	Alistair Grima

Environment and Resources Authority

Spencer Hill

Marsa MRS 1441

Malta

Table of Contents

1 Executive Summary 26
1.1 Modifications from the previous submission 26
1.2 Incompleteness or inconsistencies in the time series 28
1.3 Explanation of significant changes in emission trends 28
2 Introduction 30
2.1 National Inventory background & institutional arrangements 30
2.2 Inventory preparation process 32
2.2.1 Inventory preparation & management 32
2.2.2 Inventory planning 32
2.2.3 Inventory improvements 32
2.3 Methods and data sources 33
2.3.1 Finalization, publication and submission of the inventory 33
2.3.2 Data storage 33
2.4 Key category analysis 33
2.5 QA/QC and verification methods 33
2.6 General uncertainty evaluation 34
2.7 General assessment of completeness 34
3 Uncertainty Assessment 35
3.1 Methodology 35
3.2 Data Sources 35
3.3 Results 36
3.3.1 Quantitative Uncertainty Assessment 36
4 Energy (NFR 1) 50
4.1 Category description 50
4.2 Sector 1A1a: Public Electricity and Heat Production 51
4.2.1 Source category description 52
4.2.2 Methodology 52

4.2.3 Activity Data 54
4.2.4 Source-specific QA/QC and verification 55
4.2.5 Source-specific recalculations 55
4.2.6 Source-specific planned improvements 55
4.3 Sector 1A2gviii: Stationary Combustion in Manufacturing Industries and Construction 56
4.3.1 Introduction 56
4.3.2 Methodology 56
4.3.3 Activity Data 56
4.3.4 Source-specific QA/QC and verification 57
4.3.5 Source-specific recalculations 57
4.3.6 Source-specific planned improvements 57
4.4 Sector 1A3: Transport 57
4.4.1 Sector 1A3ai(i): International aviation LTO (civil) 57
4.4.1.1 Introduction 57
4.4.1.2 Methodology 58
4.4.1.3 Activity Data 58
4.4.1.4 Source-specific QA/QC and verification 58
4.4.1.5 Source-specific recalculations 58
4.4.1.6 Source-specific planned improvements 59
4.4.2 Sector 1A3aii(i): Domestic aviation LTO (civil) 59
4.4.2.1 Introduction 59
4.4.2.2 Methodology 59
4.4.2.3 Activity Data 60
4.4.2.4 Source-specific QA/QC and verification 60
4.4.2.5 Source-specific recalculations 60
4.4.2.6 Source-specific planned improvements 60
4.4.3 Sector 1A3b: Road Transport 60
4.4.3.1 Source category description 61
4.4.3.2 Methodology 61
4.4.3.3 Activity data 62

4.4.3.3.1 Sulphur content 63
4.4.3.3.2 Annual Average vehicle per km (Vkm) 64
4.4.3.3.3 Total vehicle kilometres 65
4.4.3.3.4 Stock of vehicles 66
4.4.3.3.5 Inclusion of Electric Vehicles 67
4.4.3.3.6 Fuel Consumption 68
4.4.3.3.7 Trip Characteristics and Circulation Data 68
4.4.3.3.7.1 Trip length and Trip Duration 68
4.4.3.3.7.2 Average Speed and Road Share 69
4.4.3.3.8 Additional parameters 70
4.4.3.4 Improvements made to the time series 70
4.4.3.5 Source-specific QA/QC and verification 74
4.4.3.6 Source-specific recalculations and assumptions 74
4.4.3.7 Source-specific planned improvements 78
4.4.4 Sector 1A3dii: National navigation (shipping) 80
4.4.4.1 Source category description 80
4.4.4.2 Methodology 80
4.4.4.3 Activity Data 80
4.4.4.4 Source-specific QA/QC and verification 81
4.4.4.5 Source-specific recalculations 81
4.4.4.6 Source-specific planned improvements 81
4.4.5 Sector 1A4ai: Commercial/Institutional: Stationary 81
4.4.5.1 Source category description 82
4.4.5.2 Methodology 82
4.4.5.3 Activity Data 82
4.4.5.4 Source-specific QA/QC and verification 82
4.4.5.5 Source-specific recalculations 83
4.4.5.6 Source-specific planned improvements 83
4.5 Sector 1A4bi: Residential: Stationary 83
4.5.1 Source category description 83
4.5.2 Methodology 84
4.5.3 Activity Data 84
4.5.4 Source-specific QA/QC and verification 84

4.5.5 Source-specific recalculations 84
4.5.6 Source-specific planned improvements 86
4.6 Sector 1A4cii: Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery 86
4.6.1 Source category description 87
4.6.2 Methodology 87
4.6.3 Activity Data 87
4.6.4 Source-specific QA/QC and verification 88
4.6.5 Source-specific recalculations 88
4.6.6 Source-specific planned improvements 88
4.7 Sector 1A4ciii: Agriculture/Forestry/Fishing: National Fishing 88
4.7.1 Source category description 88
4.7.2 Methodology 89
4.7.3 Activity Data 89
4.7.4 Source-specific QA/QC and verification 89
4.7.5 Source-specific recalculations 89
4.7.6 Source-specific planned improvements 89
4.8 Sector 1A5b: Other, Mobile (including military, land based and recreational boats) 90
4.8.1 Source category description 90
4.8.2 Methodology 90
4.8.3 Activity Data 90
4.8.4 Source-specific QA/QC and verification 91
4.8.5 Source-specific recalculations 91
4.8.6 Source-specific planned improvements 91
4.9 Sector 1B2av: Distribution of Oil Products 91
4.9.1 Source category description 92
4.9.2 Methodology 92
4.9.3 Activity Data 92

4.9.4 Source-specific QA/QC and verification 92
4.9.5 Source-specific recalculations 93
4.9.6 Source-specific planned improvements 93
5 Industry (NFR 2) 94
5.1 Category overview 94
5.2 Sector 2A5b: Construction and Demolition 95
5.2.1 Source category description 96
5.2.2 Methodology 96
5.2.3 Activity Data 97
5.2.4 Source-specific QA/QC and verification 97
5.2.5 Source-specific recalculations 97
5.2.6 Source-specific planned improvements 97
5.3 Sector 2B10b: Storage, Handling and Transport of Chemical Products 97
5.3.1 Source category description 98
5.3.2 Methodology 98
5.3.3 Activity Data 98
5.3.4 Source-specific QA/QC and verification 98
5.3.5 Source-specific recalculations 98
5.3.6 Source-specific planned improvements 98
5.4 Sector 2D3a: Domestic Solvent Use Including Fungicides 98
5.4.1 Source category description 99
5.4.2 Methodology 99
5.4.3 Activity Data 102
5.4.4 Source-specific QA/QC and verification 102
5.4.5 Source-specific recalculations 102
5.4.6 Source-specific planned improvements 102
5.5 Sector 2D3b: Road paving with asphalt 102
5.5.1 Source category description 103

5.5.2 Methodology 103
5.5.3 Activity Data 103
5.5.4 Source-specific QA/QC and verification 103
5.5.5 Source-specific recalculations 103
5.5.6 Source-specific planned improvements 103
5.6 Sector 2D3d: Coating applications 104
5.6.1 Source category description 104
5.6.2 Methodology 104
5.6.3 Activity Data 105
5.6.4 Source-specific QA/QC and verification 106
5.6.5 Source-specific recalculations 106
5.6.6 Source-specific planned improvements 106
5.7 Sector 2G: Other product use 106
5.7.1 Source category description 106
5.7.2 Methodology 107
5.7.2.1 Firework use 107
5.7.2.2 Tobacco combustion 107
5.7.3 Activity Data 107
5.7.3.1 Firework use 107
5.7.3.2 Tobacco combustion 109
5.7.4 Source-specific QA/QC and verification 109
5.7.5 Source-specific recalculations 109
5.7.6 Source-specific planned improvements 109
5.8 Sector 2H2: Food & Beverages Industry 109
5.8.1 Source category description 110
5.8.2 Methodology 110
5.8.3 Activity Data 110
5.8.4 Source-specific QA/QC and verification 111
5.8.5 Source-specific recalculations 111

5.8.6 Source-specific planned improvements 111
6 Agriculture (NFR 3) 112
6.1 Category overview 112
6.2 Sector 3B: Manure Management 113
6.2.1 Source category description 113
6.3 Sector 3B1a: Dairy cattle 118
6.3.1 Source category description 118
6.3.2 Methodology 118
6.3.3 Activity Data 118
6.3.4 Source-specific QA/QC and verification 119
6.3.5 Source-specific recalculations 119
6.3.6 Source-specific planned improvements 119
6.4 Sector 3B1b: Non-dairy cattle 119
6.4.1 Source category description 120
6.4.2 Methodology 120
6.4.3 Activity Data 120
6.4.4 Source-specific QA/QC and verification 121
6.4.5 Source-specific recalculations 121
6.4.6 Source-specific planned improvements 121
6.5 Sector 3B2: Sheep 121
6.5.1 Source category description 122
6.5.2 Methodology 122
6.5.3 Activity Data 122
6.5.4 Source-specific QA/QC and verification 122
6.5.5 Source-specific recalculations 123
6.5.6 Source-specific planned improvements 123
6.6 Sector 3B3: Swine 123
6.6.1 Source category description 123

6.6.2 Methodology 124
6.6.3 Activity Data 124
6.6.4 Source-specific QA/QC and verification 124
6.6.5 Source-specific recalculations 124
6.6.6 Source-specific planned improvements 125
6.7 Sector 3B4d: Goats 125
6.7.1 Source category description 125
6.7.2 Methodology 125
6.7.3 Activity Data 125
6.7.4 Source-specific QA/QC and verification 126
6.7.5 Source-specific recalculations 126
6.7.6 Source-specific planned improvements 126
6.8 Sector 3B4e: Horses 126
6.8.1 Source category description 127
6.8.2 Methodology 127
6.8.3 Activity Data 127
6.8.4 Source-specific QA/QC and verification 127
6.8.5 Source-specific recalculations 127
6.8.6 Source-specific planned improvements 127
6.9 Sector 3B4gi: Laying Hens 127
6.9.1 Source category description 128
6.9.2 Methodology 128
6.9.3 Activity Data 128
6.9.4 Source-specific QA/QC and verification 128
6.9.5 Source-specific recalculations 129
6.9.6 Source-specific planned improvements 129
6.10 Sector 3B4gii: Broilers 129
6.10.1 Source category description 129

6.10.2 Methodology 130
6.10.3 Activity Data 130
6.10.4 Source-specific QA/QC and verification 130
6.10.5 Source-specific recalculations 130
6.10.6 Source-specific planned improvements 130
6.11 Sector 3B4giv: Other Poultry 130
6.11.1 Source category description 131
6.11.2 Methodology 131
6.11.3 Activity Data 131
6.11.4 Source-specific QA/QC and verification 131
6.11.5 Source-specific recalculations 132
6.11.6 Source-specific planned improvements 132
6.12 Sector 3B4h: Other animals (rabbits) 132
6.12.1 Source category description 132
6.12.2 Methodology 132
6.12.3 Activity Data 133
6.12.4 Source-specific QA/QC and verification 133
6.12.5 Source-specific recalculations 133
6.12.6 Source-specific planned improvements 133
6.13 Sector 3D: Crop Production and Agricultural Soils 133
6.13.1 Sector 3Da1: Inorganic N fertilisers (Includes Urea) 133
6.13.1.1 Source category description 133
6.13.1.2 Methodology 134
6.13.1.3 Activity Data 134
6.13.1.4 Source-specific QA/QC and verification 134
6.13.1.5 Source-specific recalculations 134
6.13.1.6 Source-specific planned improvements 135
6.13.2 Sector 3Da2a: Animal manure applied to soils 135
6.13.2.1 Introduction 135
6.13.2.2 Methodology 135

6.13.2.3 Activity Data 135
6.13.2.4 Source-specific QA/QC and verification 135
6.13.2.5 Source-specific recalculations 136
6.13.2.6 Source-specific planned improvements 136
6.13.3 Sector 3Dc: Farm-level agricultural operations including storage, handling and transport of agricultural products 136
6.13.3.1 Introduction 136
6.13.3.2 Methodology 137
6.13.3.3 Activity Data 137
6.13.3.4 Source-specific QA/QC and verification 137
6.13.3.5 Source-specific recalculations 137
6.13.3.6 Source-specific planned improvements 138
6.13.4 Sector 3De: Cultivated crops 138
6.13.4.1 Introduction 138
6.13.4.2 Methodology 138
6.13.4.3 Activity Data 138
6.13.4.4 Source-specific QA/QC and verification 139
6.13.4.5 Source-specific recalculations 139
6.13.4.6 Source-specific planned improvements 139
6.13.5 Sector 3F: Field burning of agricultural residues 139
6.13.5.1 Introduction 140
6.13.5.2 Methodology 140
6.13.5.3 Activity Data 140
6.13.5.4 Source-specific QA/QC and verification 141
6.13.5.5 Source-specific recalculations 141
6.13.5.6 Source-specific planned improvements 141
7 Waste (NFR 5) 141
7.1 Category overview 141
7.2 Sector 5A: Biological Treatment of Waste – Solid Waste Disposal 142
7.2.1 Source category description 143
7.2.2 Methodology 143
7.2.3 Activity Data 144
7.2.4 Source-specific QA/QC and verification 144

7.2.5 Source-specific recalculations 144
7.2.6 Source-specific planned improvements 144
7.3 Sector 5B2: Biological Treatment of Waste – Anaerobic Digestion at Biogas Facilities 145
7.3.1 Source category description 145
7.3.2 Methodology 145
7.3.3 Activity Data 146
7.3.4 Source-specific QA/QC and verification 146
7.3.5 Source-specific recalculations 146
7.3.6 Source-specific planned improvements 146
7.4 Sector 5C1bv: Cremation 146
7.4.1 Source category description 147
7.4.2 Methodology 147
7.4.3 Activity Data 148
7.4.4 Source-specific QA/QC and verification 148
7.4.5 Source-specific recalculations 148
7.4.6 Source-specific planned improvements 149
7.5 Sector 5C2: Open Burning of Waste 149
7.5.1 Source category description 149
7.5.2 Methodology 150
7.5.3 Activity Data 150
7.5.4 Source-specific QA/QC and verification 150
7.5.5 Source-specific recalculations 150
7.5.6 Source-specific planned improvements 150
7.6 Sector 5D3: Other Wastewater Handling 150
7.6.1 Source category description 151
7.6.2 Methodology 151
7.6.3 Activity Data 151

7.6.4 Source-specific QA/QC and verification 151
7.6.5 Source-specific recalculations 151
7.6.6 Source-specific planned improvements 151
7.7 Sector 5E: Other Waste 152
7.7.1 Source category description 152
7.7.2 Methodology 152
7.7.3 Activity Data 153
7.7.4 Source-specific QA/QC and verification 153
7.7.5 Source-specific recalculations 153
7.7.6 Source-specific planned improvements 153
8 Projections 154
9 Trends 154
9.1 Trends for Nitrogen Oxides (NO_x) 154
9.2 Trends for Non-Methane Volatile Organic Compounds (NMVOC) 155
9.3 Trends for Sulphur Oxides (SO_x) 157
9.4 Trends for Ammonia (NH_3) 158
9.5 Trends for Particulate Matter of size 2.5µm ($PM_{2.5}$) 160
9.6 The COVID-19 situation 161
9.7 Emission Ceilings and Adjustments 163
9.7.1 Nitrogen Oxides (NO_x) 164
9.7.2 Non-Methane Volatile Organic Compounds (NMVOC) 164
9.7.3 Sulphur dioxide (SO_2) 165
9.7.4 Ammonia (NH_3) 165
9.7.5 Fine Particulate matter ($PM_{2.5}$) 166
10 Recalculations and Improvements 166
11 Reporting of Gridded Emissions and LPS 167
12 References 168
13 Annex I 169

14 Annex II 172
15 Annex III 173

List of Figures

Figure 1: The Maltese National Emission Inventory Process 31
Figure 2: Shares of emissions from the NFR 1 category in percentage of national total 51
Figure 3: Shares of emissions from the NFR 1A1a category in percentage of national total 52
Figure 4: Shares of emissions from the NFR 1A2gviii category in percentage of national total 56
Figure 5: Shares of emissions from the NFR 1A3ai(i) category in percentage of national total 58
Figure 6: Shares of emissions from the NFR 1A3aii(i) category in percentage of national total 59
Figure 7: Shares of emissions from the NFR 1A3b category as a percentage of the national total 61
Figure 8: Sulphur content in ppm in petrol 64
Figure 9: Sulphur content in ppm in diesel 64
Figure 10: Fuel consumption per fuel type and as totals for road transport 1990-2020 68
Figure 11: Line graph showing the issues experienced by Malta as a result of incorrect exporting of data. 72
Figure 12: Shares of emissions from the NFR 1A3dii category in percentage of national total 80
Figure 13: Shares of emissions from the NFR 1A4ai category in percentage of national total 82
Figure 14: Shares of emissions from the NFR 1A4bi category in percentage of national total 83
Figure 15: Results from gap-filling exercise on quantity of biofuels 86
Figure 16: Shares of emissions from the NFR 1A4cii category in percentage of national total 87
Figure 17: Shares of emissions from the NFR 1A4ciii category in percentage of national total 89
Figure 18: Shares of emissions from the NFR 1A5b category in percentage of national total 90
Figure 19: Shares of emissions from the NFR 1B2av category in percentage of national total 92
Figure 20: Shares of emissions from the NFR 2 category in percentage of national total 95
Figure 21: Shares of emissions from the NFR 2A5b category in percentage of national total 96
Figure 22: Shares of emissions from the NFR 2B10b category in percentage of national total 98
Figure 23: Shares of emissions from the NFR 2D3a category in percentage of national total 99
Figure 24: Shares of emissions from the NFR 2D3b category in percentage of national total 103

Figure 25: Shares of emissions from the NFR 2D3d category in percentage of national total 104
Figure 26: Shares of emissions from the NFR 2G category in percentage of national total 107
Figure 27: Shares of emissions from the NFR 2H2 category in percentage of national total 110
Figure 28: Shares of emissions from the NFR 3 category in percentage of national total 113
Figure 29: Shares of emissions from the NFR 3B1a category in percentage of national total 118
Figure 30: Shares of emissions from the NFR 3B1b category in percentage of national total 120
Figure 31: Shares of emissions from the NFR 3B2 category in percentage of national total 122
Figure 32: Shares of emissions from the NFR 3B3 category in percentage of national total 123
Figure 33: Shares of emissions from the NFR 3B4d category in percentage of national total 125
Figure 34: Shares of emissions from the NFR 3B4e category in percentage of national total 127
Figure 35: Shares of emissions from the NFR 3B4gi category in percentage of national total 128
Figure 36: Shares of emissions from the NFR 3B4gii category in percentage of national total 130
Figure 37: Shares of emissions from the NFR 3B4giv category in percentage of national total 131
Figure 38: Shares of emissions from the NFR 3B4h category in percentage of national total 132
Figure 39: Shares of emissions from the NFR 3Da1 category in percentage of national total 134
Figure 40: Shares of emissions from the NFR 3Da2a category in percentage of national total 135
Figure 41: Shares of emissions from the NFR 3Dc category in percentage of national total 137
Figure 42: Shares of emissions from the NFR 3De category in percentage of national total 138
Figure 43: Shares of emissions from the NFR 3F category in percentage of national total 140
Figure 44: Shares of emissions from the NFR 5 category in percentage of national total 142
Figure 45: Shares of emissions from the NFR 5A category in percentage of national total 143
Figure 46: Shares of emissions from the NFR 5B2 category in percentage of national total 145
Figure 47: Shares of emissions from the NFR 5C1bv category in percentage of national total 147

Figure 48: Categorised waste entering the thermal treatment facility 148
Figure 49: Shares of emissions from the NFR 5C2 category in percentage of national total 149
Figure 50: Shares of emissions from the NFR 5D3 category in percentage of national total 151
Figure 51: Shares of emissions from the NFR 5E category in percentage of national total 152
Figure 52: NO_x emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs 154
Figure 53: NMVOC emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs 156
Figure 54: SO_x emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs 157
Figure 55: NH_3 emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs 159
Figure 56: $PM_{2.5}$ emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs 160
Figure 57: NO_x emissions generated from International aviation for the years 2019 and 2020 162
Figure 58: The number of international and domestic landing and take-offs (LTO) recorded in 2019 and 2020 162
Figure 59: NOx emissions generated from Road Transport for the years 2019 and 2020 163
Figure 60: NMVOC emissions generated from Road Transport for the years 2019 and 2020 163
Figure 61: The total amount of NO_x emissions in 2020 compared to the 2020 and 2030 ceilings 164
Figure 62: The total amount of NMVOC emissions in 2020 compared to the 2020 and 2030 ceilings 165
Figure 63: The total amount of SO2 emissions in 2020 compared to the 2020 and 2030 ceilings 165
Figure 64: The total amount of NH_3 emissions in 2020 compared to the 2020 and 2030 ceilings 166
Figure 65: The total amount of $PM_{2.5}$ emissions in 2020 compared to the 2020 and 2030 ceilings 166

List of Tables

Table 1: Glossary of terms 23
Table 2: Recalculations carried out in NFR 3 27
Table 3: Indicative error ranges in activity data for uncertainty analysis 35
Table 4: Result of overall uncertainty estimation for the main pollutants 36
Table 5: Uncertainty estimation of NH_3 emissions 38
Table 6: Uncertainty estimation of NMVOC emissions 40
Table 7: Uncertainty estimation of NO_x emissions 42
Table 8: Uncertainty estimation of SO_x emissions 44
Table 9: Uncertainty estimation of $PM_{2.5}$ emissions 46
Table 10: Uncertainty estimation of PM_{10} emissions 48
Table 11: Coverage of NFR 1 categories in 2020 50
Table 12: Sector 1A1a general characteristics 51
Table 13: Set up of electricity generating plants 54
Table 14: Sector 1A2gviii general characteristics 56
Table 15: Sector 1A3ai(i) general characteristics 57
Table 16: Sector 1A3ii(i) general characteristics 59
Table 17: Sector 1A3b general characteristics 60
Table 18: COPERT parameters used 62
Table 19: Macroeconomic drivers used to project VKM 65
Table 20: Vehicle sub-categories 66
Table 21: PM emission factors for EVs 67
Table 22: Circulation data 69
Table 23: Summary table of how the 2021 road transport data was reported leading to inconsistencies within the data. 70
Table 24: Differences in implied emission factors for Malta's stock configuration between COPERT versions 5.3 and 5.5.1 for the main pollutants. 73
Table 25: Summary of the Euro standards that needed to be updated to actual Euro standards as established in the 2019GB for all vehicle categories. 75
Table 26: Vehicle categories for which stock was available from 1990-2009, which have been assigned to similar vehicle categories since VKM was lacking. 77
Table 27: PM emissions from tyre and brake wear 78
Table 28: Sector 1A3dii general characteristics 80
Table 29: Sector 1A4ai general characteristics 81
Table 30: Sector 1A4bi general characteristics 83
Table 31: HS Code classification groupings for gap-filling 85
Table 32: Sector 1A4cii general characteristics 86
Table 33: Sector 1A4ciii general characteristics 88
Table 34: Sector 1A5b general characteristics 90
Table 35: Sector 1B2av general characteristics 91
Table 36: Coverage of NFR categories 2020 94
Table 37: Sector 2A5b general characteristics 95
Table 38: Sector 2B10b general characteristics 97
Table 39: Sector 2D3a general characteristics 98

Table 40: PRODCOM codes utilised and the corresponding solvent content used for Tier 2A calculation 99
Table 41: PRODCOM codes utilised for the Tier 2B calculation 101
Table 42: Sector 2D3b general characteristics 102
Table 43: Sector 2D3d general characteristics 104
Table 44: Emission factors utilised for 2D3d 104
Table 45: PRODCOM codes for sector 2D3d 105
Table 46: Sector 2G general characteristics 106
Table 47: Annual average of imported oxidants & fuels in firework manufacturing from 2012 to 2014 108
Table 48: Calculations and assumptions for estimating the yearly average quantities of flash crackers, coloured stars and black powder used in Malta from 2012 to 2014. 108
Table 49: Sector 2H2 general characteristics 109
Table 50: Coverage of NFR 3 categories in 2020 112
Table 51: Number of animal heads recalculations 113
Table 52: Animal weight per livestock type 114
Table 53: Housing period per livestock type 115
Table 54: Proportion of manure excreted on yards 115
Table 55: Proportion of manure type by livestock 116
Table 56: Changes in Nex values 117
Table 57: Sector 3B1a general characteristics 118
Table 58: Gross feed intake recalculations 119
Table 59: Sector 3B1b general characteristics 119
Table 60: Categorized weight 120
Table 61: Sector 3B2 general characteristics 121
Table 62: Categorized weight 122
Table 63: Sector 3B3 general characteristics 123
Table 64: Categorized weight 124
Table 65: Sector 3B4d general characteristics 125
Table 66: Categorized weight 126
Table 67: Sector 3B4e general characteristics 126
Table 68: Sector 3B4gi general characteristics 127
Table 69: Sector 3B4gii general characteristics 129
Table 70: Sector 3B4giv general characteristics 130
Table 71: Sector 3B4h general characteristics 132
Table 72: Sector 3Da1 general characteristics 133
Table 73: Sector 3Da2a general characteristics 135
Table 74: Sector 3Dc general characteristics 136
Table 75: Crop type for each category under 3DC 137
Table 76: Sector 3De general characteristics 138
Table 77: Crop type for each category under 3DE 139
Table 78: Sector 3F general characteristics 139
Table 79: Subdivisions of Utilised Agriculture Area 140
Table 80: Remaining parameters 140
Table 81: Coverage of NFR 5 categories in 2020 141

Table 82: Sector 5A general characteristics 142
Table 83: Sector 5B2 general characteristics 145
Table 84: Sector 5C1bv general characteristics 146
Table 85: Sector 5C2 general characteristics 149
Table 86: Sector 5D3 general characteristics 150
Table 87: Sector 5E general characteristics 152
Table 88: Share of vehicles and buildings burnt 152
Table 89: Summary of the sectors, which contribute the most towards the total NOx emissions 155
Table 90: Summary of the sectors, which contribute the most towards the total NMVOC emissions 156
Table 91: Summary of the sectors which contribute the most towards the total NH_3 emissions 159
Table 92: Summary of the sectors which contribute the most towards the total $PM_{2.5}$ emissions 160
Table 93: Malta's performance vis-a-vis the 2020 ceilings 164

List of Equations

Equation 1: Basic equation to estimate emission loads 33
Equation 2: Equation to estimate total mileage by vehicle type 65
Equation 3: Equation for the survival rate profile of vehicles 66
Equation 4: 2D3a total products utilised by MT calculation 101
Equation 5: Formula to calculate NMVOC emissions through the Tier 2A methodology 102
Equation 6: Formula to calculate NMVOC emissions through the Tier 2B methodology 102
Equation 7: 2D3d total products utilised by MT calculation 105
Equation 8: Equation to calculate the weight of flour per loaf. 111
Equation 9: Equation to calculate the number of loaves 111
Equation 10: Equation to calculate the total mass of bread produced 111
Equation 11: Calculation of volume of CH_4 143
Equation 12: Calculation of volume of biogas 143
Equation 13: Calculation of NMVOC emissions 144
Equation 14: Calculation of the $PM_{2.5}$*,* PM_{10} *and TSP emissions* 144
Equation 15: Calculation of NH_3 *emissions from anaerobic digestion* 145

Glossary of terms

Table 1: Glossary of terms

Term	Definition
WM	With measures
WaM	With additional measures
SCR	Selective catalytic reduction
AER	Annual environment report
TERT	Technical expert review team
HFO	Heavy fuel oil
GDO	Gas diesel oil
LPG	Liquified Petroleum Gas
EF	Emission factors
Vkm	Vehicle/kilometres (mileage or activity)
EUROSTAT	Statistical office of the European Union
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
NFR-19	Nomenclature for reporting template 2019
2019GB	2019 guidebook
EGTEI	Expert Group on Techno-Economic Issues
TFTEI	Task Force on Techno-Economic Issues
ERA	Environment and Resources Authority
EWA	Energy and Water Agency
EWC	European Waste Catalogue
MRA	Malta Resources Authority
NSO	National Statistics Office
REWS	Regulator of Energy and Water Services

TM	Transport Malta
NTM	National Transport Model
ppm	Parts per million
VRT	Vehicle Roadworthiness Testing
PC	Passenger Cars
LCV	Light Commercial Vehicles
HDV	Heavy Duty Vehicle
MC	Motorcycles
YOM	Year of manufacture
EV	Electric Vehicles
PHEV	Plug-in Hybrid Electric Vehicles
COVID-19	Coronavirus Disease
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
BPR	Bureau of Public Roads
SPED	Strategic Plan for the Environment and Development
QA/QC	Quality assurance, quality control
OECD	Organisation for Economic Co-operation and Development
IEA	International Energy Agency
UN	United Nations
NECD	Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national
CLRTAP	Convention on Long-range Transboundary Air Pollution
UNECE	United Nations Economic Commission for Europe
S.L.	Subsidiary Legislation
NAPCP	National Air Pollution Control Programme

NO	Not occurring
NA	Not applicable
NE	Not estimated
IE	Included elsewhere
IIR	Informative Inventory Report
EI	Emission Inventory
CEMS	Continuous Emission Monitoring System
AAP	Annual Animal Population (Animal Heads)
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change

1 Executive Summary

Chapter Updated: March 2022

Malta's Annual Informative Inventory Report (IIR) and the NFR tables covering years 1990 to 2020 (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 (NEC Directive). 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 LRTAP Convention and a Member State, with responsibilities under the NEC Directive, 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), Nickle (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 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 from 1990 to 2020, information on quality assurance and quality control (QA/QC), uncertainties and recalculations, together with planned improvements for the years to come.

1.1 Modifications from the previous submission

As a result of continuous improvements, Malta carried out recalculations for several sectors on the basis of 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.

i. In NFR sector 1 Energy, changes have been carried out to the following sub-sectors:

- The methodology for sectors *1A3ai(i) – International Aviation* and *1A3aii(i) – Domestic Aviation* has also been updated. For pre-2005 emission estimates, the LTO emissions calculator was used , whereas for post-2005 to 2020, emission estimates were calculated directly by EUROCONTROL;
- For the *Road Transport (1A3bi - 1A3bvii)* sector, an updated model (COPERT 5.5.1) was used to estimate emissions. In addition, improvements were made in the stock's Euro standards to bring them in line with those stipulated in the 2019GB. Furthermore, revisions to the VKM were carried out to take into consideration the

reduction in trips as a result of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic in 2020, henceforth referred to as COVID-19;

- PAHs emissions were estimated for the first time in this submission for sector *1A3dii – National Navigation*. Furthermore, recreational crafts are no longer included under this sector but have been assigned to sector *1A5b - Other, Mobile (recreational boats)*.

ii. In NFR sector 2 IPPU, the major change was carried out in the following sub-sector:

- Sector *2D3a - Domestic solvent use including fungicides* was in previous submissions considered to include all domestic solvent use. However, for this year's submission this sector was split into two separate sectors: *2D3a - Domestic solvent use including fungicides* and *2D3d - Coating applications*, both of which have now been estimated using a Tier 2 methodology;

iii. In NFR sector 3 Agriculture, recalculations were carried out for the number of animal heads across multiple livestock categories (3B1a - 3B4h) in line with the activity data used by the Malta Resources authority for the GHG inventory as follows:

Table 2: Recalculations carried out in NFR 3

Sector	Recalculations for years in the time series
3B1a - Dairy cattle	From 1990-1999
3B1b - Non-dairy cattle	From 1990-1999, and 2019
3B2 - Sheep	For 2001 only
3B3 - Swine	For finishing pigs from 1990 to 2019 For sows from 1990 to 2000
3B4d - Goats	From 1990-1999
3B4gi - Laying hens	From 1990-2000
3B4gii - Broilers	From 1990-2000
3B4giv – Other poultry	From 1990-2000
3B4h – Rabbits	From 1990-2000

iv. In NFR sector 5 Waste, changes have been carried out in the following sub-sectors:

- With regards to sector *5C2 – Open burning of waste* activity data was provided by the National Statistics Office, which altered the 2019 Utilised Agricultural Area. As a result, 2019 emissions estimates were updated.
- Concerning sector *5E- Other waste*, the activity data provided by the Civil Protection Department was rather disaggregated into several similar categories

which were not in line with the categories listed in the 2019GB. By ensuring that fires reported were classified under the correct category in line with those established in the 2019GB, the Environment and Resources Authority made sure that all relevant fires were being considered in the calculation to estimate emissions from this sector.

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

In addition to the above recalculations, new sectors have been added to Malta's emission inventory for the first time in this submission. These are: *2A5b - Construction and demolition sector*, *2D3d - Coating applications,* and *1A5b - Other, Mobile (recreational boats)*.

1.2 Incompleteness or inconsistencies in the time series

Even though efforts were made to limit inconsistencies in Malta's emission inventory, one major incongruity, which is present in several sectors, is the fact that activity data for the entire time series is not harmonious throughout. In terms of activity data for Road Transport, pre-2010 data is provided by the Malta Resources Authority, whereas that for 2010 onwards, as provided by the Energy and Water Agency, is based on national statistics and can be considered to be more accurate. In terms of the Power generation sector activity data from 2005 onwards is rather accurate since CEMS is used, whereas for pre-2005 data the activity data used is the fuel consumed as provided by Eurostat's energy Balance. Concerning aviation, pre-1999 activity data originates from the Civil Aviation Department at Transport Malta, that between 1999 and 2004 was provided by the Malta International Airport and post-2004 data was calculated directly by EUROCONTROL. Having different data sources throughout the time series results in inaccuracies.

1.3 Explanation of significant changes in emission trends

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

i. Nitrogen Oxides (NO_x):

- In 1990, the national total of NO_x emissions amounted to 8.3kt, whereas in 2020 the total NO_x emissions amounted to 5.04kt. The greatest decreases were attributed to the Public Electricity and Heat Production sector (1A1a) following the decommissioning of the Marsa Power Station in 2015, and Malta's switch to natural gas in 2017. The Road Transport (1A3b-1A3iv) sector is currently the main source of emissions, comprising 38.4% of the national total followed by the Commercial and Institutional sector (1A4ai), National Navigation (1A3dii), and the Stationary Combustion sector (1A2gviii). Malta is compliant with the 2020 NO_x emissions ceiling. However, Malta will need to achieve a further decrease of 2.84kt to be in compliance with the 2030 ceilings.
- The COVID-19 pandemic, which reached the Maltese Islands in Mid-March of 2020, affected two key sectors: Road Transport and Aviation. Concerning the latter, all international flights were suspended from the 20th of March until the 1st of July of the same year. As a result, NO_x emissions decreased by more than 50% in 2020, when compared to 2019. Likewise, the closure of non-essential outlets,

schools, and a shift towards teleworking resulted in a 16% reduction in petrol use and a 22% reduction in diesel use, when compared to 2019. NO_x emissions decreased by 28% for Road Transport: Heavy Duty Vehicles (1A3biii), and by 24% for Road Transport: Light Duty Vehicles (1A3bii).

ii. Non-Methane Volatile Organic Compounds (NMVOC):

- In 1990, the national total of NMVOC emissions amounted to 4.4kt, whereas in 2020 the total NMVOC emissions amounted to 2.6kt. The Road Transport (1A3b-1A3iv) sector is currently the main source of emissions, comprising 33.5% of the national total followed by Domestic Solvents (2D3a), Coating Applications (2D3d), and manure management (3B1a- 3B4h). Malta is compliant with the 2020 and 2030 NMVOCs emissions ceilings.

iii. Sulphur Oxides (SO_x):

- In 1990, the national total of SO_x emissions amounted to 12.6kt, whereas in 2020 the total SO_x emissions amounted 0.14kt. The greatest decreases were attributed to the Public Electricity and Heat Production sector (1A1a) following the decommissioning of the Marsa Power Station in 2015, and Malta's switch to natural gas in 2017. The major contributor to this pollutant are Public Electricity and Heat Production sector (1A1a) comprising 33.1% of the national total followed by, National Navigation (1A3dii), International Aviation (1A3ai(i)), the Commercial and Institutional sector (1A4ai) and Recreational Navigation (1A5b). Malta is compliant with the 2020 and 2030 SO_x emissions ceilings.

iv. Ammonia (NH_3):

- In 1990, the national total of NH_3 emissions amounted to 2.2kt, whereas in 2020 the total NH_3 emissions amounted to 1.4kt. The main sources contributing towards the total NH_3 emissions originate from the Agricultural sector namely the application of manure to soils (3Da2a), comprising 39.0% of the national total, followed by Swine (3B3), Other animals (rabbits) (3B4h), Dairy and non-dairy cattle (3B1a and 3B1b respectively). Malta is compliant with the 2020 and 2030 NH_3 emissions ceilings.

v. Fine Particulate Matter ($PM_{2.5}$):

- In 1990, the national total of $PM_{2.5}$ emissions amounted to 0.6kt whereas in 2020 the total $PM_{2.5}$ emissions amounted to 0.4kt. The greatest decreases were attributed to the Public Electricity and Heat Production sector (1A1a) following the decommissioning of the Marsa Power Station in 2015, and Malta's switch to natural gas in 2017. The Road paving with asphalt (2D3b) sector is currently the main source of emissions, comprising 22.5% of the national total, followed by Construction and Demolition (2A5b), Residential (1A4bi), and Road transport: Automobile tyre and brake wear (1A3bvi). Malta is compliant with the 2020 $PM_{2.5}$ emissions ceiling. However, Malta will need a further decrease of 0.02kt to be in compliance with the 2030 ceilings.

2 Introduction

Chapter Updated: March 2022

The Environment and Resources Authority (ERA) is entrusted with the role of compiling the national emission inventories and their submission to the European Commission as an obligation under the National Emission Ceilings Directive (NECD) and the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The emission inventory team at ERA is responsible for all the work related to the national emission inventory of air pollutants, including the estimation of emissions and respective drafting of reports.

Specifically, all Member States are required to submit annual national emissions of Sulphur dioxide (SO_x), Nitrogen dioxide (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 using the revised 2019GB.

Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, henceforth referred to as NECD, came into force on the 14th of December 2016. This Directive was transposed into national legislation through Subsidiary Legislation (S.L.) 549.124.

In 2020, Malta published the National Air Pollution Control Programme (NAPCP). This programme outlines the plans, policies and measures taking place in Malta in order to comply with national emission reduction commitments, as laid down in Annex II of the previously mentioned Directive, for years 2020 and 2030.

2.1 National Inventory background & institutional arrangements

As stipulated by the NECD an Informative Inventory Report (IIR) shall be reported annually providing details on how the Emission Inventory was compiled for all years and all relevant pollutants with updates on new methodologies, recalculations and various other sections, which make up the IIR. The 2022 Emission Inventory and IIR caters for emissions for the entire time series from 1990 to 2020.

The work concerning both the emission inventory and the compilation of the IIR is carried out in cooperation with various other 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), as well as relevant public entities (such as Ministries, Departments, and Regulatory Agencies), and private establishments.

Annex II provides a summary list of all the entities that contribute towards the compilation of this report by providing the relevant activity data. The below schema illustrates the responsibilities of the different entities involved in the compilation of such report.

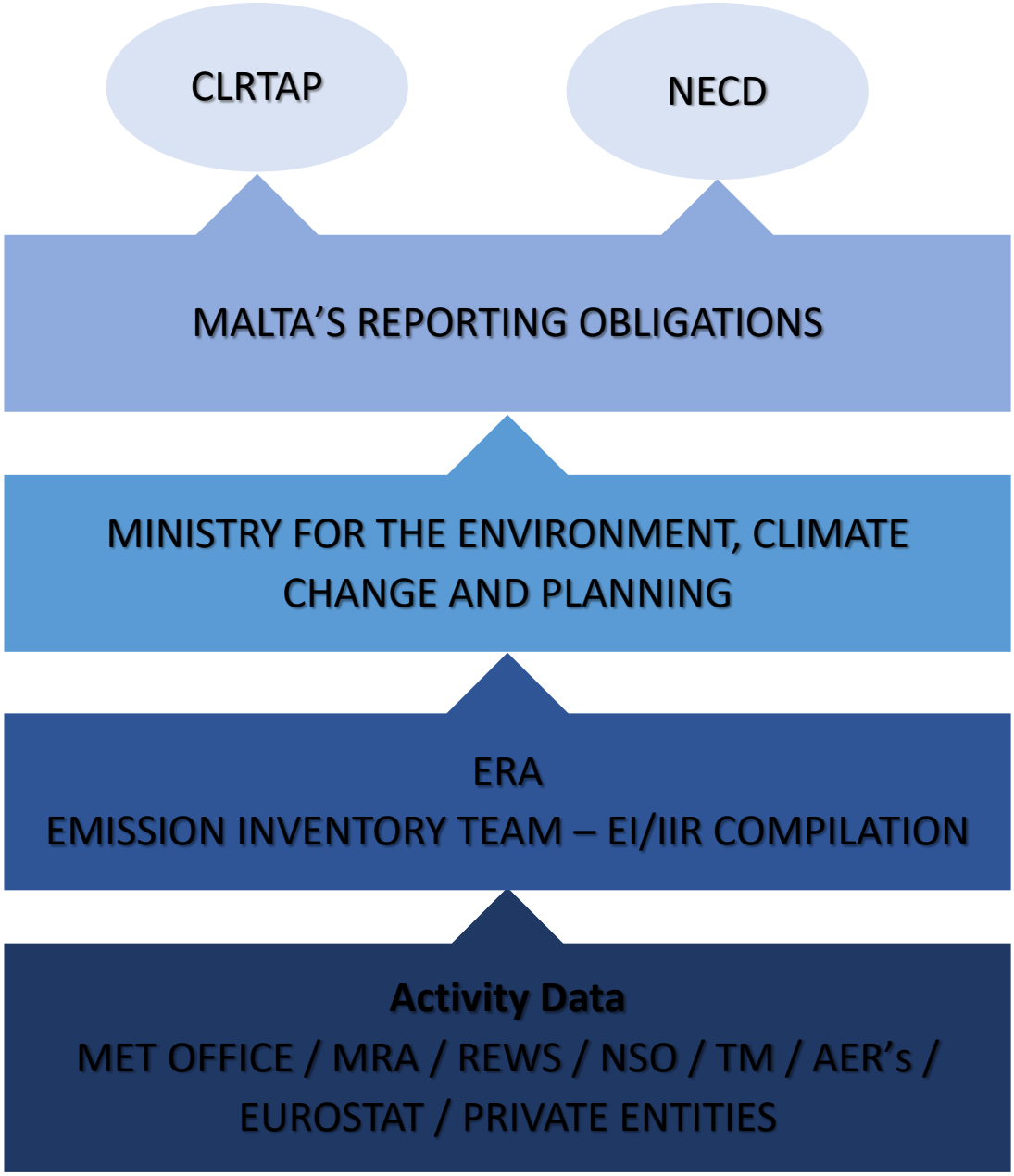

Figure 1: The Maltese National Emission Inventory Process

The Environment and Resources Authority (ERA) within its role as compiler of the Emission Inventory and Informative Inventory Report collects all the required data and information from the relevant entities in order to estimate emissions for all pollutants for the entire time series. The collated data together with the relevant methodological notes and correspondence are stored within ERA's mainframe.

2.2 Inventory preparation process

As previously mentioned, the ERA is responsible for the compilation of the Emission Inventory and the Informative Inventory Report. The following sections provide a description of the main responsibilities of ERA.

2.2.1 Inventory preparation & management

The Inventory Team is responsible for the work on the emissions inventory, which includes data collection through the aforementioned authorities, calculating emissions and preparing the relevant reports. During this process, meetings with the relevant officers from other public authorities are held.

The inventory team consists of three compilers and a manager who oversees the entire inventory compilation process. All discussions on inventory planning, preparation, and management are taken through a centralised discussion. Issues related to specific categories are presented by the inventory compiler working on that category, and are discussed as a team, internally. The air emission inventory team is in regular contact with the inventory team at the Malta Resources Authority (MRA) responsible for the compilation of the GHG inventory. The two authorities share data, experiences on methodologies and assumptions and are also working on having a shared dataset.

In cases where further assistance outside of the Authority is necessary, other expert groups and a consultancy firm are involved in the compilation process. In fact, the ERA engaged Aether Ltd. UK – an environmental consultancy specialising in the compilation of emission inventories to provide assistance, where needed.

2.2.2 Inventory planning

Planning of the inventory starts after submission every year. Improvements to the existing data is researched during this time. This first period includes communications with stakeholders and data providers, building relationships with potential contributors and collaborating with national entities for national studies and any new information regarding air pollution emissions. Efficient collection of the necessary activity data relies on a good relationship between the inventory team and the data providers.

2.2.3 Inventory improvements

Improvements are prioritised according to their significance, which is in turn a result of whether the improvement will affect a key category, and whether that category could influence compliance with an emission ceiling. These areas for improvement are identified by the technical expert review team (TERT), and are then discussed and prioritised accordingly by the Inventory Team.

The inventory team is working to identify missing data sources and methods of improvements, by reviewing the activity data required for missing sources and Tier 1 estimations. Where possible, Malta strives to move to higher Tiers to have more country-specific emission estimates. The latter point is being addressed through the engagement of a consultancy firm (Aether Ltd. UK), which is assisting by providing training and recommendations for improvement in various emission inventory sectors.

The inventory team has also taken part in the capacity building project organised by the European Commission in 2021.

2.3 Methods and data sources

The methodology used in compiling this year's emission inventory was mainly based on the 2019GB.

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

$$\text{Emission load} = \text{Activity data} * \text{Emission factor}$$

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 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 2020, are reported in early 2022.

2.3.2 Data storage

With regards to 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 2019GB. 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 Annex I.

2.5 QA/QC and verification methods

The inventory team has identified the need for the development of a Quality Assurance/Quality Control (QA/QC) system within the national emission inventory. During the compilation of the inventory, efforts were made to ensure as high a level of quality and reliability as possible. Work to develop a QA/QC system has started in order to ensure that all processes are in line with the principles of transparency, accuracy, consistency, comparability and completeness. In this submission, the best available sources of data have been used, and in specific sectors, such as power generation and cremation, in-situ monitoring data was used. Each sectoral expert works towards model improvement, specifically in terms of clarity of the data and calculations in order to increase reproducibility of the emissions inventory.

The Inventory Team ensured that for each sector a QA/QC exercise was carried out. The sector compiler ensured that input activity data, emission factors, and the formulas utilised within all models, were correct. All assumptions and criteria relevant to any of the activity data are checked in house by the Inventory Team. Furthermore, checks were made to ensure that units were converted correctly throughout and results and trends for each pollutant were analysed through an in-house trend checker model, which considers both the year-on-year variance, as well as the change in emissions compared to the previous submission (2021 for reporting year 2019).

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 final result. This year was Malta's first time incorporating an uncertainty assessment in its IIR. 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 dioxide (SO_2), 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 2019GB. 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 "for categories or processes within a particular source category that do not occur within a Party";
- NA refers "for 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"; and
- 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: March 2022

This year's submission is the first year that Malta carried out a full quantitative uncertainty assessment. The uncertainty analysis was done for the five main pollutants, NOx, SO_2, NMVOCs, NH_3, PM_{10} and $PM_{2.5}$. The uncertainty estimates are based on emission data for the base year 2005 and the reporting year 2020.

For this compilation, Malta has requested support from external consultants (Aether Ltd. UK), which helped in setting up a tool that provides detailed uncertainties to Malta's emission inventory. The following chapters include information on the methodology and data sources used for this assessment.

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 year's assessment is Approach 1 as described in the 2019GB. This method was applied to all pollutants included in Malta's uncertainty analysis namely; NOx, SO_2, 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 (2020) 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 unavailable, the below table, as extracted from the 2019GB, was used to assign a percentage uncertainty based on the source of data:

Table 3: Indicative error ranges in activity data for uncertainty analysis

Data source	Error range (%)	Remarks
The national (official) statistics	0-2	The official statistics of a country may be reported with an uncertainty range, although it is also common for the data to be assumed to be 'fixed', with no uncertainty. In fact, however, for energy data an indication of the uncertainties could be derived from the entry under 'statistical differences', representing the mismatch between production and consumption.

An update of last year's statistics, using gross economic growth factors	0-2	The economic system of a country will probably not shift more than a few per cent between successive years. Hence, if an update of last year's data is used, an uncertainty of a few per cent seems reasonable
IEA energy statistics/balances	OECD: 2-3 non-OECD: 5-10	The International Energy Agency (IEA) publishes national energy statistics and balances for many countries. For the Organisation for Economic Co-operation and Development (OECD) countries these statistics will ideally be equal to the official energy statistics. For other countries the uncertainties could be expected to be in the order of 5 to 10 % (educated guess).
UN statistical databases	5-10	These data might have a similar uncertainty as the ones provided by IEA.
Default values, other sectors and data	30-100	

3.3 Results

3.3.1 Quantitative Uncertainty Assessment

As previously pointed out, the quantitative uncertainty assessment was carried out using Approach 1 in accordance with the methodology laid out in the 2019GB for the following main pollutants NOx, SO_2, NMVOCs, NH_3, PM_{10} and $PM_{2.5}$ for 2020.

The estimated uncertainties are shown in Table 4 below, which includes all sectors reported by Malta.

Table 4: Result of overall uncertainty estimation for the main pollutants

Pollutant	Emissions 2020 (kt)	Contribution to Variance by Category in Year 2020	Combined Uncertainty in Trend in Total Emissions
NH_3	1.4106	29%	11%
NMVOC	2.5793	25%	2%
NO_x (as NO_2)	5.0362	29%	2%
PM_{10}	1.6346	53%	3%
$PM_{2.5}$	0.4355	27%	2%

SO_x (as SO_2)	0.1422	41%	2%

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

Table 5: Uncertainty estimation of NH_3 emissions

NH_3									
NFR Sector	*Emissions (kt)*	*Sum of AD Uncertainty (%)*	*Sum of Combined Uncertainty (%)*	*Sum of Contribution to Variance by Category in Year 2020 (%)*	*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	1.00%	1.00%	0.00%	-0.22%	0.06%	0.00%	0.00%	0.00%
1A2gviii	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3ai(i)	0.000	2.00%	2.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3aii(i)	0.000	2.00%	2.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3bi	0.041	5.00%	50.25%	0.02%	-0.22%	2.17%	-0.11%	0.15%	0.00%
1A3bii	0.001	5.00%	50.25%	0.00%	-0.22%	0.05%	-0.11%	0.00%	0.00%
1A3biii	0.001	5.00%	50.25%	0.00%	-0.22%	0.06%	-0.11%	0.00%	0.00%
1A3biv	0.000	5.00%	57.00%	0.00%	-0.22%	0.01%	-0.13%	0.00%	0.00%
1A3bv	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3bvi	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3bvii	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A3dii	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A4ai	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A4bi	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A4cii	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A4ciii	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1B2av	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2A5b	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2B10b	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2D3a	0.000	2.00%	2.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2D3b	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2D3d	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
2G	0.002	2.00%	53.05%	0.00%	-0.22%	0.11%	-0.12%	0.00%	0.00%
2H2	0.000	2.00%	2.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%

3B1a	0.111	20.00%	101.98%	0.64%	-0.22%	5.89%	-0.22%	1.67%	0.03%
3B1b	0.109	20.00%	101.98%	0.63%	-0.22%	5.82%	-0.22%	1.65%	0.03%
3B2	0.020	20.00%	101.98%	0.02%	-0.22%	1.08%	-0.22%	0.31%	0.00%
3B3	0.173	20.00%	101.98%	1.56%	-0.22%	9.20%	-0.22%	2.60%	0.07%
3B4d	0.008	20.00%	20.00%	0.00%	-0.22%	0.43%	0.00%	0.12%	0.00%
3B4e	0.015	20.00%	101.98%	0.01%	-0.22%	0.81%	-0.22%	0.23%	0.00%
3B4gi	0.059	20.00%	101.98%	0.18%	-0.22%	3.16%	-0.22%	0.89%	0.01%
3B4gii	0.108	20.00%	101.98%	0.61%	-0.22%	5.74%	-0.22%	1.62%	0.03%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.22%	0.02%	0.00%	0.00%	0.00%
3B4h	0.134	50.00%	50.00%	0.23%	-0.22%	7.14%	0.00%	5.05%	0.25%
3Da1	0.029	100.00%	141.42%	0.09%	-0.22%	1.56%	-0.22%	2.20%	0.05%
3Da2a	0.551	20.00%	53.85%	4.42%	-0.22%	29.28%	-0.11%	8.28%	0.69%
3Dc	0.000	10.00%	10.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
3De	0.000	10.00%	10.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
3F	0.000	100.00%	125.00%	0.00%	-0.22%	0.01%	-0.17%	0.01%	0.00%
5A	0.000	10.00%	10.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
5B2	0.005	10.00%	88.16%	0.00%	-0.22%	0.29%	-0.19%	0.04%	0.00%
5C1bv	0.000	15.00%	15.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
5C2	0.000	100.00%	100.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
5D3	0.000	2.00%	2.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
5E	0.000	5.00%	5.00%	0.00%	-0.22%	0.00%	0.00%	0.00%	0.00%
1A5b	0.040	5.00%	5.00%	0.00%	-0.22%	2.15%	0.00%	0.15%	0.00%
Total	**1.411**	**718.00%**	**1709.09%**	**8.41%**	**-10.15%**	**75.01%**	**-2.81%**	**24.99%**	**1.15%**

Table 6: Uncertainty estimation of NMVOC emissions

NMVOC									
Sector	*Emissions (kt)*	*Sum of Sum of AD Uncertainty (%)*	*Sum of Combined Uncertainty (%)*	*Sum of Contribution to Variance by Category in Year 2020 (%)*	*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	0.024	1.00%	100.00%	0.01%	-0.29%	0.64%	-0.29%	0.01%	0.00%
1A2gviii	0.019	5.00%	71.91%	0.00%	-0.29%	0.51%	-0.21%	0.04%	0.00%
1A3ai(i)	0.007	2.00%	2.00%	0.00%	-0.29%	0.19%	0.00%	0.01%	0.00%
1A3aii(i)	0.000	2.00%	100.02%	0.00%	-0.29%	0.00%	-0.29%	0.00%	0.00%
1A3bi	0.385	5.00%	100.12%	2.19%	-0.29%	10.07%	-0.29%	0.71%	0.01%
1A3bii	0.029	5.00%	63.83%	0.01%	-0.29%	0.77%	-0.19%	0.05%	0.00%
1A3biii	0.062	5.00%	98.30%	0.05%	-0.29%	1.61%	-0.29%	0.11%	0.00%
1A3biv	0.059	5.00%	100.12%	0.05%	-0.29%	1.54%	-0.29%	0.11%	0.00%
1A3bv	0.352	5.00%	60.87%	0.68%	-0.29%	9.22%	-0.18%	0.65%	0.00%
1A3bvi	0.000	5.00%	5.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
1A3bvii	0.000	5.00%	5.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
1A3dii	0.018	5.00%	5.00%	0.00%	-0.29%	0.47%	0.00%	0.03%	0.00%
1A4ai	0.051	5.00%	100.12%	0.04%	-0.29%	1.34%	-0.29%	0.10%	0.00%
1A4bi	0.036	5.00%	68.60%	0.01%	-0.29%	0.95%	-0.20%	0.07%	0.00%
1A4cii	0.022	5.00%	5.00%	0.00%	-0.29%	0.57%	0.00%	0.04%	0.00%
1A4ciii	0.008	5.00%	5.00%	0.00%	-0.29%	0.21%	0.00%	0.02%	0.00%
1B2av	0.140	5.00%	100.12%	0.29%	-0.29%	3.66%	-0.29%	0.26%	0.00%
2A5b	0.000	5.00%	5.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
2B10b	0.037	5.00%	5.00%	0.00%	-0.29%	0.96%	0.00%	0.07%	0.00%
2D3a	0.299	2.00%	83.36%	0.92%	-0.29%	7.83%	-0.24%	0.22%	0.00%
2D3b	0.004	5.00%	100.12%	0.00%	-0.29%	0.10%	-0.29%	0.01%	0.00%
2D3d	0.324	5.00%	100.12%	1.55%	-0.29%	8.49%	-0.29%	0.60%	0.00%
2G	0.002	2.00%	100.02%	0.00%	-0.29%	0.06%	-0.29%	0.00%	0.00%

2H2	0.088	2.00%	100.02%	0.11%	-0.29%	2.31%	-0.29%	0.07%	0.00%
3B1a	0.155	20.00%	101.98%	0.37%	-0.29%	4.06%	-0.29%	1.15%	0.01%
3B1b	0.042	20.00%	101.98%	0.03%	-0.29%	1.09%	-0.29%	0.31%	0.00%
3B2	0.002	20.00%	101.98%	0.00%	-0.29%	0.06%	-0.29%	0.02%	0.00%
3B3	0.026	20.00%	20.00%	0.00%	-0.29%	0.68%	0.00%	0.19%	0.00%
3B4d	0.000	20.00%	20.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
3B4e	0.000	20.00%	101.98%	0.00%	-0.29%	0.00%	-0.29%	0.00%	0.00%
3B4gi	0.067	20.00%	20.00%	0.00%	-0.29%	1.75%	0.00%	0.49%	0.00%
3B4gii	0.126	20.00%	20.00%	0.01%	-0.29%	3.30%	0.00%	0.93%	0.01%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
3B4h	0.000	50.00%	111.80%	0.00%	-0.29%	0.00%	-0.29%	0.00%	0.00%
3Da1	0.000	100.00%	100.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
3Da2a	0.000	20.00%	20.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
3Dc	0.000	10.00%	10.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
3De	0.005	10.00%	10.00%	0.00%	-0.29%	0.13%	0.00%	0.02%	0.00%
3F	0.000	100.00%	128.06%	0.00%	-0.29%	0.00%	-0.24%	0.00%	0.00%
5A	0.092	10.00%	96.67%	0.12%	-0.29%	2.40%	-0.28%	0.34%	0.00%
5B2	0.000	10.00%	10.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
5C1bv	0.000	15.00%	101.12%	0.00%	-0.29%	0.01%	-0.29%	0.00%	0.00%
5C2	0.000	100.00%	141.42%	0.00%	-0.29%	0.01%	-0.29%	0.01%	0.00%
5D3	0.000	2.00%	2.00%	0.00%	-0.29%	0.01%	0.00%	0.00%	0.00%
5E	0.000	5.00%	5.00%	0.00%	-0.29%	0.00%	0.00%	0.00%	0.00%
1A5b	0.121	5.00%	5.00%	0.00%	-0.29%	3.17%	0.00%	0.22%	0.00%
Total	**2.603**	**718.00%**	**2733.70%**	**6.44%**	**-13.51%**	**68.18%**	**-6.82%**	**6.86%**	**0.06%**

Table 7: 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 Contribution to Variance by Category in Year 2020 (%)*	*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	0.750	1.00%	100.00%	2.08%	-0.46%	7.43%	-0.46%	0.11%	0.00%
1A2gviii	0.342	5.00%	70.16%	0.21%	-0.46%	3.39%	-0.32%	0.24%	0.00%
1A3ai(i)	0.101	2.00%	2.00%	0.00%	-0.46%	1.00%	0.00%	0.03%	0.00%
1A3aii(i)	0.001	2.00%	100.02%	0.00%	-0.46%	0.01%	-0.46%	0.00%	0.00%
1A3bi	0.823	5.00%	100.12%	2.51%	-0.46%	8.16%	-0.46%	0.58%	0.01%
1A3bii	0.426	5.00%	62.01%	0.26%	-0.46%	4.22%	-0.29%	0.30%	0.00%
1A3biii	0.837	5.00%	57.59%	0.86%	-0.46%	8.30%	-0.27%	0.59%	0.00%
1A3biv	0.007	5.00%	80.95%	0.00%	-0.46%	0.07%	-0.37%	0.00%	0.00%
1A3bv	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
1A3bvi	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
1A3bvii	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
1A3dii	0.390	5.00%	5.00%	0.00%	-0.46%	3.86%	0.00%	0.27%	0.00%
1A4ai	0.817	5.00%	100.12%	2.48%	-0.46%	8.10%	-0.46%	0.57%	0.01%
1A4bi	0.036	5.00%	70.77%	0.00%	-0.46%	0.35%	-0.33%	0.03%	0.00%
1A4cii	0.158	5.00%	5.00%	0.00%	-0.46%	1.57%	0.00%	0.11%	0.00%
1A4ciii	0.146	5.00%	5.00%	0.00%	-0.46%	1.45%	0.00%	0.10%	0.00%
1B2av	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2A5b	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2B10b	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2D3a	0.000	2.00%	2.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2D3b	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2D3d	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
2G	0.001	2.00%	100.02%	0.00%	-0.46%	0.01%	-0.46%	0.00%	0.00%

2H2	0.000	2.00%	2.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
3B1a	0.001	20.00%	101.98%	0.00%	-0.46%	0.01%	-0.46%	0.00%	0.00%
3B1b	0.001	20.00%	101.98%	0.00%	-0.46%	0.01%	-0.46%	0.00%	0.00%
3B2	0.000	20.00%	101.98%	0.00%	-0.46%	0.00%	-0.46%	0.00%	0.00%
3B3	0.000	20.00%	20.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
3B4d	0.000	20.00%	101.98%	0.00%	-0.46%	0.00%	-0.46%	0.00%	0.00%
3B4e	0.000	20.00%	101.98%	0.00%	-0.46%	0.00%	-0.46%	0.00%	0.00%
3B4gi	0.002	20.00%	101.98%	0.00%	-0.46%	0.02%	-0.46%	0.01%	0.00%
3B4gii	0.003	20.00%	101.98%	0.00%	-0.46%	0.03%	-0.46%	0.01%	0.00%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
3B4h	0.004	50.00%	111.80%	0.00%	-0.46%	0.04%	-0.46%	0.03%	0.00%
3Da1	0.023	100.00%	141.42%	0.00%	-0.46%	0.23%	-0.46%	0.33%	0.00%
3Da2a	0.099	20.00%	101.98%	0.04%	-0.46%	0.98%	-0.46%	0.28%	0.00%
3Dc	0.000	10.00%	10.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
3De	0.000	10.00%	10.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
3F	0.000	100.00%	118.21%	0.00%	-0.46%	0.00%	-0.29%	0.00%	0.00%
5A	0.000	10.00%	10.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
5B2	0.000	10.00%	10.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
5C1bv	0.009	15.00%	101.12%	0.00%	-0.46%	0.09%	-0.46%	0.02%	0.00%
5C2	0.001	100.00%	141.42%	0.00%	-0.46%	0.01%	-0.46%	0.01%	0.00%
5D3	0.000	2.00%	2.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
5E	0.000	5.00%	5.00%	0.00%	-0.46%	0.00%	0.00%	0.00%	0.00%
1A5b	0.217	5.00%	5.00%	0.00%	-0.46%	2.15%	0.00%	0.15%	0.00%
Total	**5.196**	**718.00%**	**2424.59%**	**8.45%**	**-21.28%**	**51.50%**	**-9.73%**	**3.77%**	**0.06%**

Table 8: 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 Contribution to Variance by Category in Year 2020 (%)*	*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	0.047	1.00%	100.00%	10.93%	-0.91%	0.39%	-0.91%	0.01%	0.01%
1A2gviii	0.012	5.00%	70.39%	0.35%	-0.91%	0.10%	-0.64%	0.01%	0.00%
1A3ai(i)	0.006	2.00%	2.00%	0.00%	-0.91%	0.05%	0.00%	0.00%	0.00%
1A3aii(i)	0.000	2.00%	100.02%	0.00%	-0.91%	0.00%	-0.91%	0.00%	0.01%
1A3bi	0.002	5.00%	5.00%	0.00%	-0.91%	0.02%	0.00%	0.00%	0.00%
1A3bii	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3biii	0.001	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3biv	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3bv	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3bvi	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3bvii	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A3dii	0.009	5.00%	5.00%	0.00%	-0.91%	0.07%	0.00%	0.01%	0.00%
1A4ai	0.045	5.00%	74.64%	5.48%	-0.91%	0.37%	-0.68%	0.03%	0.00%
1A4bi	0.001	5.00%	69.47%	0.00%	-0.91%	0.01%	-0.63%	0.00%	0.00%
1A4cii	0.008	5.00%	5.00%	0.00%	-0.91%	0.07%	0.00%	0.00%	0.00%
1A4ciii	0.003	5.00%	5.00%	0.00%	-0.91%	0.02%	0.00%	0.00%	0.00%
1B2av	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2A5b	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2B10b	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2D3a	0.000	2.00%	2.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2D3b	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2D3d	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
2G	0.000	2.00%	74.53%	0.00%	-0.91%	0.00%	-0.68%	0.00%	0.00%

2H2	0.000	2.00%	2.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B1a	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B1b	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B2	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B3	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4d	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4e	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4gi	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4gii	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3B4h	0.000	50.00%	50.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3Da1	0.000	100.00%	100.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3Da2a	0.000	20.00%	20.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3Dc	0.000	10.00%	10.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3De	0.000	10.00%	10.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
3F	0.000	100.00%	122.07%	0.00%	-0.91%	0.00%	-0.64%	0.00%	0.00%
5A	0.000	10.00%	10.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
5B2	0.000	10.00%	10.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
5C1bv	0.000	15.00%	101.12%	0.00%	-0.91%	0.00%	-0.91%	0.00%	0.01%
5C2	0.000	100.00%	141.42%	0.00%	-0.91%	0.00%	-0.91%	0.00%	0.01%
5D3	0.000	2.00%	2.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
5E	0.000	5.00%	5.00%	0.00%	-0.91%	0.00%	0.00%	0.00%	0.00%
1A5b	0.008	5.00%	5.00%	0.00%	-0.91%	0.07%	0.00%	0.00%	0.00%
Total	**0.142**	**718.00%**	**1336.65%**	**16.77%**	**-42.03%**	**1.18%**	**-6.93%**	**0.06%**	**0.05%**

Table 9: 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 Contribution to Variance by Category in Year 2020 (%)*	*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	0.012	1.00%	100.00%	0.08%	-0.31%	1.43%	-0.31%	0.02%	0.00%
1A2gviii	0.013	5.00%	70.18%	0.04%	-0.31%	1.55%	-0.21%	0.11%	0.00%
1A3ai(i)	0.000	2.00%	2.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
1A3aii(i)	0.000	2.00%	2.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
1A3bi	0.025	5.00%	5.00%	0.00%	-0.31%	2.98%	0.00%	0.21%	0.00%
1A3bii	0.025	5.00%	5.00%	0.00%	-0.31%	2.97%	0.00%	0.21%	0.00%
1A3biii	0.019	5.00%	5.00%	0.00%	-0.31%	2.28%	0.00%	0.16%	0.00%
1A3biv	0.001	5.00%	5.00%	0.00%	-0.31%	0.12%	0.00%	0.01%	0.00%
1A3bv	0.000	5.00%	5.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
1A3bvi	0.033	5.00%	5.00%	0.00%	-0.31%	3.86%	0.00%	0.27%	0.00%
1A3bvii	0.013	5.00%	68.93%	0.04%	-0.31%	1.57%	-0.21%	0.11%	0.00%
1A3dii	0.008	5.00%	5.00%	0.00%	-0.31%	0.99%	0.00%	0.07%	0.00%
1A4ai	0.026	5.00%	100.12%	0.34%	-0.31%	3.03%	-0.31%	0.21%	0.00%
1A4bi	0.044	5.00%	71.01%	0.51%	-0.31%	5.23%	-0.22%	0.37%	0.00%
1A4cii	0.008	5.00%	5.00%	0.00%	-0.31%	0.95%	0.00%	0.07%	0.00%
1A4ciii	0.003	5.00%	5.00%	0.00%	-0.31%	0.33%	0.00%	0.02%	0.00%
1B2av	0.000	5.00%	5.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
2A5b	0.046	5.00%	100.12%	1.11%	-0.31%	5.50%	-0.31%	0.39%	0.00%
2B10b	0.000	5.00%	5.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
2D3a	0.000	2.00%	2.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
2D3b	0.098	5.00%	100.12%	4.95%	-0.30%	11.61%	-0.30%	0.82%	0.01%
2D3d	0.000	5.00%	5.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
2G	0.019	2.00%	86.66%	0.14%	-0.31%	2.24%	-0.26%	0.06%	0.00%

2H2	0.000	2.00%	2.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
3B1a	0.002	20.00%	101.98%	0.00%	-0.31%	0.29%	-0.31%	0.08%	0.00%
3B1b	0.001	20.00%	101.98%	0.00%	-0.31%	0.13%	-0.31%	0.04%	0.00%
3B2	0.000	20.00%	20.00%	0.00%	-0.31%	0.03%	0.00%	0.01%	0.00%
3B3	0.000	20.00%	101.98%	0.00%	-0.31%	0.04%	-0.31%	0.01%	0.00%
3B4d	0.000	20.00%	20.00%	0.00%	-0.31%	0.01%	0.00%	0.00%	0.00%
3B4e	0.000	20.00%	20.00%	0.00%	-0.31%	0.02%	0.00%	0.01%	0.00%
3B4gi	0.001	20.00%	101.98%	0.00%	-0.31%	0.13%	-0.31%	0.04%	0.00%
3B4gii	0.001	20.00%	101.98%	0.00%	-0.31%	0.12%	-0.31%	0.03%	0.00%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
3B4h	0.000	50.00%	50.00%	0.00%	-0.31%	0.04%	0.00%	0.03%	0.00%
3Da1	0.000	100.00%	100.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
3Da2a	0.000	20.00%	20.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
3Dc	0.001	10.00%	10.00%	0.00%	-0.31%	0.16%	0.00%	0.02%	0.00%
3De	0.000	10.00%	10.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
3F	0.000	100.00%	117.68%	0.00%	-0.31%	0.03%	-0.19%	0.04%	0.00%
5A	0.004	10.00%	100.50%	0.01%	-0.31%	0.44%	-0.31%	0.06%	0.00%
5B2	0.000	10.00%	10.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
5C1bv	0.000	15.00%	101.12%	0.00%	-0.31%	0.01%	-0.31%	0.00%	0.00%
5C2	0.001	100.00%	141.42%	0.00%	-0.31%	0.15%	-0.31%	0.21%	0.00%
5D3	0.000	2.00%	2.00%	0.00%	-0.31%	0.00%	0.00%	0.00%	0.00%
5E	0.004	5.00%	100.12%	0.01%	-0.31%	0.45%	-0.31%	0.03%	0.00%
1A5b	0.030	5.00%	5.00%	0.00%	-0.31%	3.57%	0.00%	0.25%	0.00%
Total	**0.441**	**718.00%**	**2122.91%**	**7.23%**	**-14.04%**	**52.26%**	**-5.06%**	**3.99%**	**0.03%**

Table 10: Uncertainty estimation of PM_{10} emissions

PM_{10}									
Sector	*Emissions (kt)*	*Sum of Sum of AD Uncertainty (%)*	*Sum of Combined Uncertainty (%)*	*Sum of Contribution to Variance by Category in Year 2020 (%)*	*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	0.012	1.00%	100.00%	0.01%	-0.12%	0.64%	-0.12%	0.01%	0.00%
1A2gviii	0.013	5.00%	70.18%	0.00%	-0.12%	0.70%	-0.08%	0.05%	0.00%
1A3ai(i)	0.000	2.00%	2.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
1A3aii(i)	0.000	2.00%	2.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
1A3bi	0.025	5.00%	5.00%	0.00%	-0.12%	1.34%	0.00%	0.09%	0.00%
1A3bii	0.025	5.00%	5.00%	0.00%	-0.12%	1.33%	0.00%	0.09%	0.00%
1A3biii	0.019	5.00%	5.00%	0.00%	-0.12%	1.03%	0.00%	0.07%	0.00%
1A3biv	0.001	5.00%	5.00%	0.00%	-0.12%	0.05%	0.00%	0.00%	0.00%
1A3bv	0.000	5.00%	5.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
1A3bvi	0.063	5.00%	5.00%	0.00%	-0.12%	3.34%	0.00%	0.24%	0.00%
1A3bvii	0.025	5.00%	68.52%	0.01%	-0.12%	1.31%	-0.08%	0.09%	0.00%
1A3dii	0.010	5.00%	5.00%	0.00%	-0.12%	0.51%	0.00%	0.04%	0.00%
1A4ai	0.026	5.00%	100.12%	0.02%	-0.12%	1.36%	-0.12%	0.10%	0.00%
1A4bi	0.045	5.00%	71.01%	0.04%	-0.12%	2.42%	-0.08%	0.17%	0.00%
1A4cii	0.008	5.00%	5.00%	0.00%	-0.12%	0.43%	0.00%	0.03%	0.00%
1A4ciii	0.003	5.00%	5.00%	0.00%	-0.12%	0.16%	0.00%	0.01%	0.00%
1B2av	0.000	5.00%	5.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
2A5b	0.464	5.00%	100.12%	8.02%	-0.12%	24.72%	-0.12%	1.75%	0.03%
2B10b	0.000	5.00%	5.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
2D3a	0.000	2.00%	2.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
2D3b	0.735	5.00%	100.12%	20.15%	-0.12%	39.16%	-0.12%	2.77%	0.08%
2D3d	0.000	5.00%	5.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
2G	0.025	2.00%	80.09%	0.01%	-0.12%	1.31%	-0.09%	0.04%	0.00%

2H2	0.001	2.00%	2.00%	0.00%	-0.12%	0.08%	0.00%	0.00%	0.00%
3B1a	0.004	20.00%	101.98%	0.00%	-0.12%	0.20%	-0.12%	0.06%	0.00%
3B1b	0.002	20.00%	101.98%	0.00%	-0.12%	0.09%	-0.12%	0.03%	0.00%
3B2	0.001	20.00%	20.00%	0.00%	-0.12%	0.04%	0.00%	0.01%	0.00%
3B3	0.006	20.00%	101.98%	0.00%	-0.12%	0.34%	-0.12%	0.10%	0.00%
3B4d	0.000	20.00%	20.00%	0.00%	-0.12%	0.02%	0.00%	0.00%	0.00%
3B4e	0.000	20.00%	20.00%	0.00%	-0.12%	0.02%	0.00%	0.00%	0.00%
3B4gi	0.014	20.00%	101.98%	0.01%	-0.12%	0.76%	-0.12%	0.21%	0.00%
3B4gii	0.010	20.00%	101.98%	0.00%	-0.12%	0.53%	-0.12%	0.15%	0.00%
3B4giv	0.000	20.00%	20.00%	0.00%	-0.12%	0.01%	0.00%	0.00%	0.00%
3B4h	0.001	50.00%	50.00%	0.00%	-0.12%	0.03%	0.00%	0.02%	0.00%
3Da1	0.000	100.00%	100.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
3Da2a	0.000	20.00%	20.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
3Dc	0.042	10.00%	10.00%	0.00%	-0.12%	2.22%	0.00%	0.31%	0.00%
3De	0.000	10.00%	10.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
3F	0.000	100.00%	117.81%	0.00%	-0.12%	0.01%	-0.07%	0.02%	0.00%
5A	0.024	10.00%	100.50%	0.02%	-0.12%	1.30%	-0.12%	0.18%	0.00%
5B2	0.000	10.00%	10.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
5C1bv	0.000	15.00%	101.12%	0.00%	-0.12%	0.00%	-0.12%	0.00%	0.00%
5C2	0.001	100.00%	141.42%	0.00%	-0.12%	0.07%	-0.12%	0.10%	0.00%
5D3	0.000	2.00%	2.00%	0.00%	-0.12%	0.00%	0.00%	0.00%	0.00%
5E	0.004	5.00%	100.12%	0.00%	-0.12%	0.20%	-0.12%	0.01%	0.00%
1A5b	0.030	5.00%	5.00%	0.00%	-0.12%	1.61%	0.00%	0.11%	0.00%
Total	**1.640**	**718.00%**	**2116.05%**	**28.31%**	**-5.45%**	**87.36%**	**-1.95%**	**6.89%**	**0.11%**

4 Energy (NFR 1)

Chapter Updated: March 2022

4.1 Category description

Table 11 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 11: Coverage of NFR 1 categories in 2020

NFR Code	Pollutants			Method	KC
	Covered	Exceptions			
		NE	NA		
1A1a	Rest of Pollutants	-	-	Mixed Tier	✓
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	✓
1A3ai(i)	NO_x, NMVOC, SO_2, TSP, CO	-	Rest of Pollutants	Tier 2	✕
1A3aii(i)	NO_x, NMVOC, SO_2, TSP, CO	-	Rest of Pollutants	Tier 2	✕
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, Indeno (1,2,3-cd)pyrene, HCB, PCBs	NO_x, NMVOC, SO_2, NH_3, CO	Tier 3	✓
1A3bvii	$PM_{2.5}$, PM_{10}, TSP, BC, Zn	Rest of Pollutants	NO_x, NMVOC SO_2, 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	Rest of Pollutants	-	NH_3	Tier 1	✓
1A4aii	Included Elsewhere (reported in 1A4ai)				✕
1A4bi	Rest of Pollutants	-	NH_3	Tier 1	✓
1A4bii	Included Elsewhere (reported in 1A4bi)				✕
1A4ci	Not Occurring				✕
1A4cii	Rest of Pollutants	-	Pb, PCDD/PCDF, Indeno (1,2,3-cd)pyrene	Tier 1	✓
1A4ciii	Rest of Pollutants	NH_3	BC, PCDD/PCDF	Tier 1	✕
1A5a	Not Occurring				✕
1A5b	Rest of Pollutants	-	-	Tier 1	✓
1B1a	Not Occurring				✕
1B1b	Not Occurring				✕
1B1c	Not Occurring				✕
1B2ai	Not Occurring				✕
1B2aiv	Not Occurring				✕
1B2av	NMVOC, TSP	-	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 2020 are shown Figure 2. Most pollutant emissions originate primarily from NFR 1.

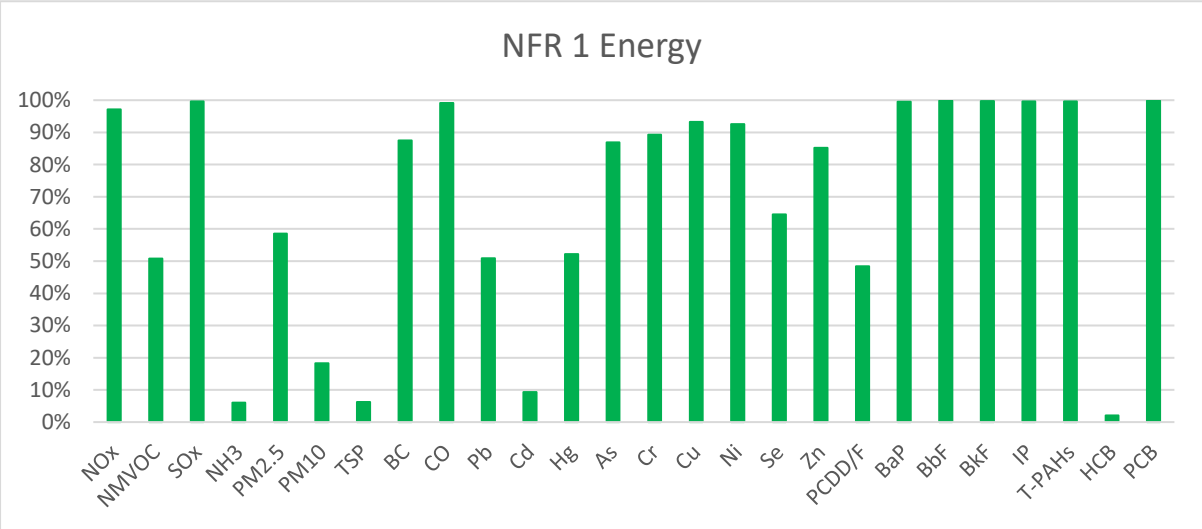

Figure 2: Shares of emissions from the NFR 1 category in percentage of national total

4.2 Sector 1A1a: Public Electricity and Heat Production

Table 12: Sector 1A1a general characteristics

NFR Code	1A1a
Sub-Category	Power Generation and Electricity Production
Method	2019GB
Activity Data	AER & Eurostat
Emission Factor	Tier 1, Tier 2 & Tier 3 (Direct Measurements)
Key Category	NO_x, SO_x, Hg, As, Se & Zn
Year of last update	2022 submission

4.2.1 Source category 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 2020 are shown in Figure 3.

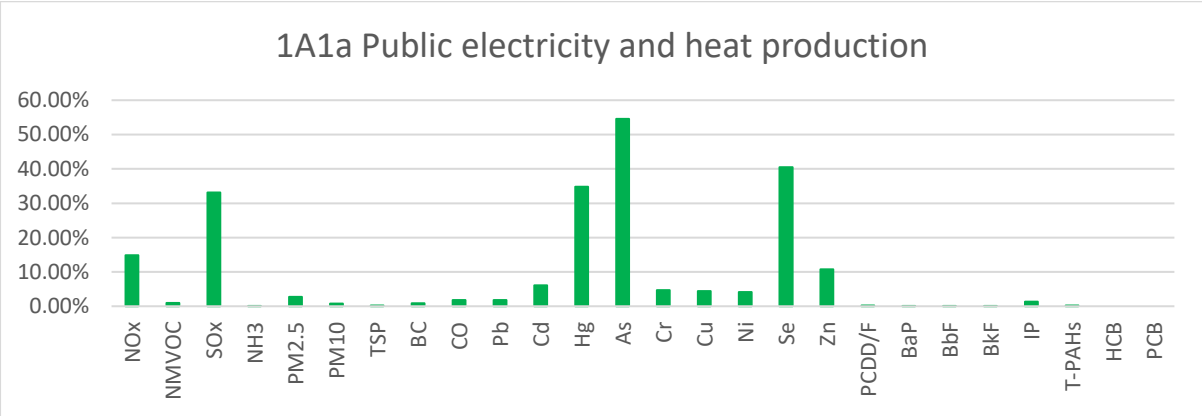

Figure 3: Shares of emissions from the NFR 1A1a category in percentage of national total

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 2019GB.
- 2005-2016:
  - NO_x, SO_x, TSP 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 2019GB, and the multiplying that ratio by the TSP emission load reported through CEMS.
- The total emissions from As, Cr, Cd, Cu, Mn, Ni, Pb, Sb, and V were placed under Pb. This approach was preferred to the Tier 2 methodology within the 2019GB, as the emission estimates would have been severely overestimated.
- All other pollutants were estimated through the Tier 2 methodology provided within the 2019GB.

- 2017-2020:
  - The Electrogas and D3 Power Generation Limited commenced their operations in 2017. The emissions of NO_x, SO_x, TSP, 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 $PM_{2.5}$ and PM_{10} were estimated by taking the ratio of the $PM_{2.5}$ and PM_{10} EF to TSP, as provided within the 2019GB, 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 2019GB.
- Additional notes:
  - The TERT had asked Malta to clarify whether Malta was reporting the entire emission load of NO_x, SO_2, and TSP, or if it was underestimating the emission load by subtracting the confidence interval from the emission load. Following communication with the operators of both EGM and D3pg, it was determined that the emission load in its entirety was being reported, and hence no underestimation had taken place.
  - Benzo(a) pyrene, HCB and PCBs are not estimated from 1996-2010, and from 2018 onwards. No EFs were available for HFO and Gasoil. Coal use was discontinued in 1995, whereas DPS6 (which consists of a large stationary reciprocating internal combustion engine) started operating in 2011. DPS6 was no longer utilized after 2017. Hence, there were no further emissions reported from these pollutants post-2017.

4.2.3 Activity Data

Malta's electricity production has mostly relied on Heavy Fuel Oil (HFO) and Gasoil, 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.

Table 13 shows the set-up of the electricity generating plants present locally during 2020.

Table 13: 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 Source-specific QA/QC and verification

A QA/QC exercise was carried out for this sector. The sector compiler ensured that input activity data was correct. The values submitted within the Eurostat Energy Balance were checked against those present within the Eurostat Energy Balance database. 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 utilised 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.

4.2.5 Source-specific recalculations

The values of NO_x, SO_2, NH_3, $PM_{2.5}$, PM_{10}, and TSP were reviewed from 2005 onwards. Following a QA/QC exercise, a small number of changes were carried out to ensure that all the values reported through CEMS were accurately reflected within this submission.

The values of NMVOC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, and Indeno (1,2,3-cd) pyrene, were revised from 2017 onwards. These changes are attributed to a revision in the fuel consumption at the D3pg plant for the years 2017-2019.

The values of Pb, Cd, Hg, As, Cr, Cu, Ni, Se, and Zn, were further revised from 2017 onwards. A sampling exercise had taken place in 2019, where the flue gas volume for each of the three stacks at the EGM power plant was sampled. The average concentration in mg/m^3 was obtained for each of the pollutants measured previously, at each stack. This average concentration was then multiplied by the annual flue gas volume at each stack. No such exercise was carried out at the D3pg plant, and therefore the Tier 2 methodology was kept for that plant.

The values of BC from 2017 were recalculated in line with the EF provided within Table 3-17 of the 2019GB. This table stated that BC is to be calculated by assuming that it is 2.5% of the $PM_{2.5}$ emission load.

4.2.6 Source-specific planned improvements

Efforts will be made to obtain more representative EFs at D3PG for heavy metals.

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

Table 14: Sector 1A2gviii general characteristics

NFR Code	1A2gviii
Sub-Category	Stationary Combustion in Manufacturing Industries and Construction: Other
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	NO_x, SO_x, BC & Benzo(b)fluoranthene
Year of last update	2022 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 2020 are shown in Figure 4.

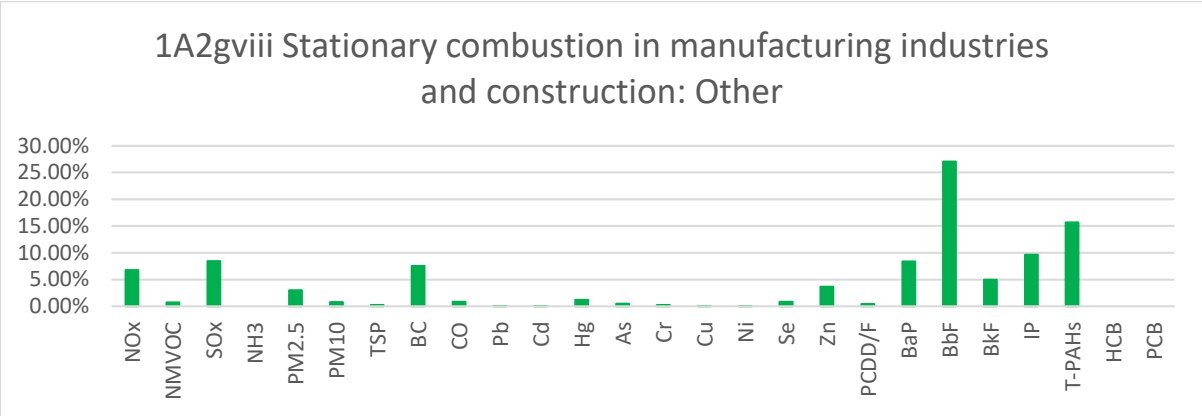

Figure 4: Shares of emissions from the NFR 1A2gviii category in percentage of national total

4.3.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.3.3 Activity Data

The quantities of fuel used were taken from the 'Industry sector' section within the Eurostat Energy Balance. 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 2020. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.3.4 Source-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 Source-specific recalculations

The values for all pollutants for 1990 and 2019 were updated. Concerning the latter, the quantity of Gas Diesel Oil was updated in the 2022 Eurostat Energy Balance. Whereas the formula had to be updated for the year 1990, to rectify an error.

4.3.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

4.4 Sector 1A3: Transport

The transport sector covered in this submission includes the following group of sectors; 1A3ai(i) International aviation LTO (civil), 1A3aii(i) Domestic aviation LTO (civil), 1A3bi-bvii Road transport and 1A3dii National navigation (shipping).

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

Table 15: Sector 1A3ai(i) general characteristics

NFR Code	1A3ai(i)
Sub-Category	International Aviation LTO (civil)
Method	LTO emissions calculator & Eurocontrol data
Activity Data	Malta International Airport & Eurocontrol
Emission Factor	Eurocontrol
Key Category	Not Applicable
Year of last update	2022 submission

4.4.1.1 Introduction

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 Luqa International Airport and landed in foreign airports.

Shares of emissions of the particular pollutants from this sector in 2020 are shown in Figure 5.

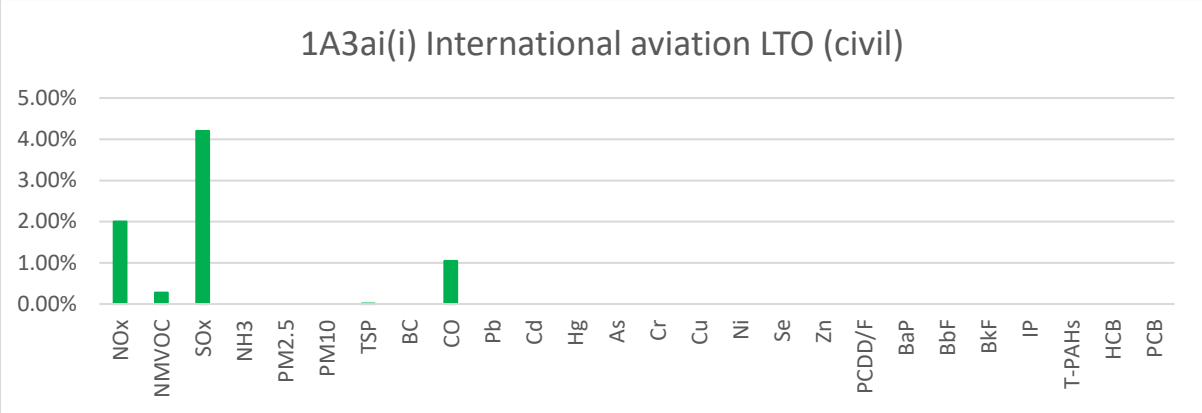

Figure 5: Shares of emissions from the NFR 1A3ai(i) category in percentage of national total

4.4.1.2 Methodology

Emissions from 1990 to 2004 are estimated through the 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 2005 taxi in and out times were utilised for the years 1990 to 2004 since these were the closest to the years in question.

Conversely, LTO Emissions from 2005-2020 are calculated directly by Eurocontrol, and the values provided are reported directly within the NFR table. The emissions estimated directly by Eurocontrol are more representative, since they are based on actual flight paths.

4.4.1.3 Activity Data

The number of LTO cycles for international flights from 1990 to 1998 was provided by the Civil Aviation Department at Transport Malta. The number of LTOs from 1999 to 2004 was provided by the Malta International Airport. As mentioned in the methodology section, the emissions from 2005 onwards were calculated directly by Eurocontrol, and therefore, no additional activity data was sought.

4.4.1.4 Source-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. This included checks of the number of LTOs activity data from 1990 to 2004. 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.

4.4.1.5 Source-specific recalculations

Emissions from 1990-2004 were recalculated through the LTO emissions calculator, whilst the 2021 submission was calculated through the Master Emissions calculator as this was deemed an improved methodology.

The number of LTOs from 1990-2004 was revised, following an internal QA/QC check.

Emissions from 2005 onwards were taken directly from the Eurocontrol calculations, as opposed to being estimated though the Master Emissions calculator.

4.4.1.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

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

Table 16: Sector 1A3ii(i) general characteristics

NFR Code	1A3aii(i)
Sub-Category	Domestic Aviation LTO (civil)
Method	LTO emissions calculator & Eurocontrol data
Activity Data	Malta International Airport & Eurocontrol
Emission Factor	Eurocontrol
Key Category	Not applicable
Year of last update	2022 submission

4.4.2.1 Introduction

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 this sector in 2020 are shown in Figure 6.

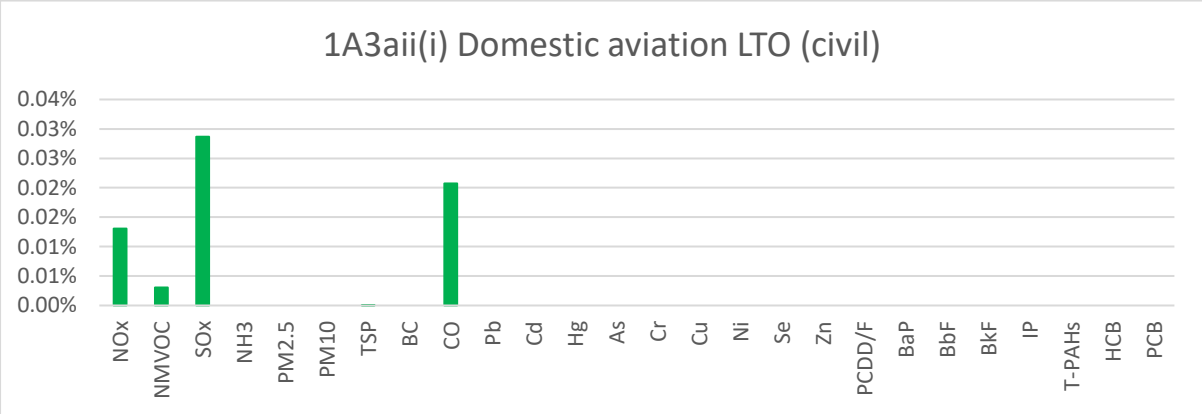

Figure 6: Shares of emissions from the NFR 1A3aii(i) category in percentage of national total

4.4.2.2 Methodology

Emissions from 1990 to 2004 are estimated through the 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 2005 taxi in and out times were utilised for the years 1990 to 2004 since these were the closest to the years in question.

Conversely, LTO Emissions from 2005-2020 are calculated directly by Eurocontrol, and the values provided are reported directly within the NFR table. The emissions estimated directly by Eurocontrol are more representative, since they are based on actual flight paths.

4.4.2.3 Activity Data

No activity data was available for domestic flights prior to 1999, and consequently emissions from 1990 to 1998 were classified as 'NE'. The number of LTOs from 1999-2004 was provided by the Malta International Airport. As mentioned in the methodology section, the emissions from 2005 onwards were calculated directly by Eurocontrol, and therefore, no additional activity data was sought.

4.4.2.4 Source-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. This included checks of the number of LTOs activity data from 1990 to 2004. 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.

4.4.2.5 Source-specific recalculations

Emissions from 1990-2004 were recalculated through the LTO emissions calculator, whilst the 2021 submission was calculated through the Master Emissions calculator as this was deemed an improved methodology.

The number of LTOs from 1999-2004 was revised, following an internal QAQC check.

Emissions from 2005 onwards were taken directly from the Eurocontrol calculations, as opposed to being estimated though the Master Emissions calculator.

4.4.2.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

4.4.3 Sector 1A3b: Road Transport

Table 17: Sector 1A3b general characteristics

NFR Code	1A3b
Sub-Category	Road Transport
Method	COPERT 5.5
Activity Data	EWA, TM, REWS, MRA

Emission Factor	Tier 3
Key Category	NO_x, NMVOC, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Hg, Cr, Cu, Se, Zn & Benzo(a)pyrene,
Year of last update	2022 submission

4.4.3.1 Source category description

This subcategory includes emissions from motorised road vehicles in Malta. Emissions estimated under this sector were based on the vehicle fleet circulating on public roads, excluding those 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 2022 for reference year 2020, as a percentage of the national total are shown in Figure 7.

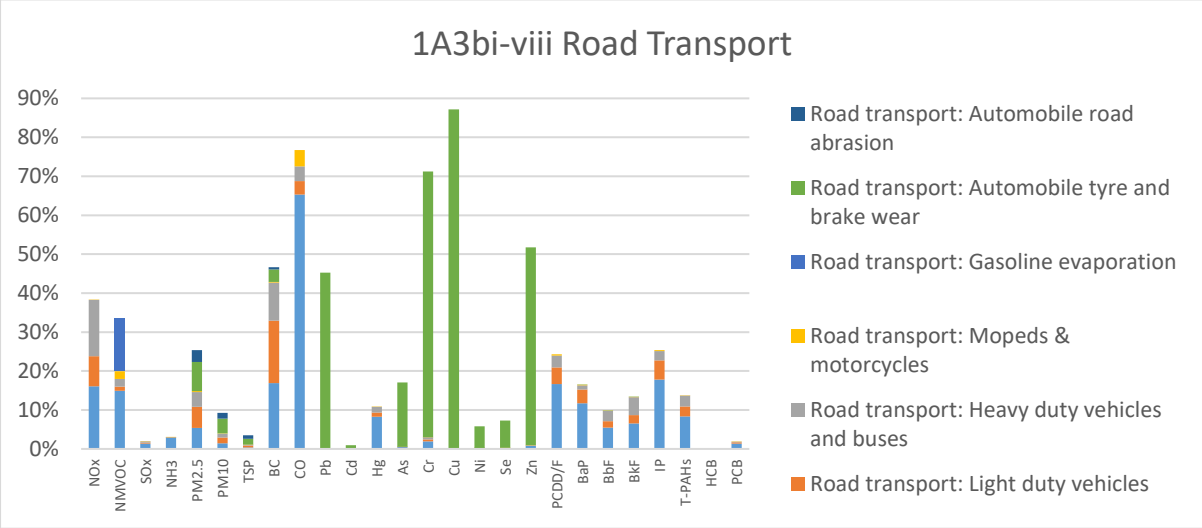

Figure 7: Shares of emissions from the NFR 1A3b category as a percentage of the national total

4.4.3.2 Methodology

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. This year's road transport emissions were estimated using COPERT 5.5.1, 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.

4.4.3.3 Activity data

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

Table 18: COPERT parameters used

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 2020.
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.
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 2020 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 5.5.1 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 5.5.1 lead content was used throughout the entire time series.
Statistical consumption	The total fuel sales were obtained from Eurostat for the entire time series. It is important to note that due to the COVID-19 pandemic, fuel sales dropped by 16% for petrol and 22% for diesel.
Reid Vapour Pressure	The default figures provided in COPERT 5.5.1 (EMISIA S.A) were used.

Stock	Vehicle stock for the years 1990 to 2009 was obtained from the MRA whereas for the years from 2010 to 2020 a model was developed by the Energy and Water Agency (EWA), which generated historical and projected data (until 2040).
VKM and Lifetime cumulative	For the period 1990 to 2009, the mean VKM per age of vehicle was assumed to be equal to the data provided by EWA from 2010 onwards. Data for 2010 to 2020 was generated using a model, which EWA developed in order to generate VKM for historical and projected years (up to 2040). Because of the COVID-19 pandemic and the reductions in fuel at 16% and 22% for petrol and diesel respectively, led to a decrease in the modelled VKM by the same %age of fuel deductions. As for the generation of the lifetime cumulative, an in-house model was used, which calculates the mean distance travelled by the different vehicle categories since their placement on the market.
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).
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.

4.4.3.3.1 Sulphur content

As described in the above table, the sulphur content was only available for a limited number of years. The 2004 value for diesel was carried backwards, since the limits for sulphur content under Directive 98/70/EC were revised in 2005, and therefore values from 2005-2007 would not be representative of data which pre-dates 2004. The sulphur content in petrol for 2004 was not available, and therefore the value from 2005 was carried backwards to 1990. A linear extrapolation was used between 2008 and 2013, and an average for the data from 2014-2019 was used for projected data. The sulphur content of petrol and diesel can be observed in the figures below.

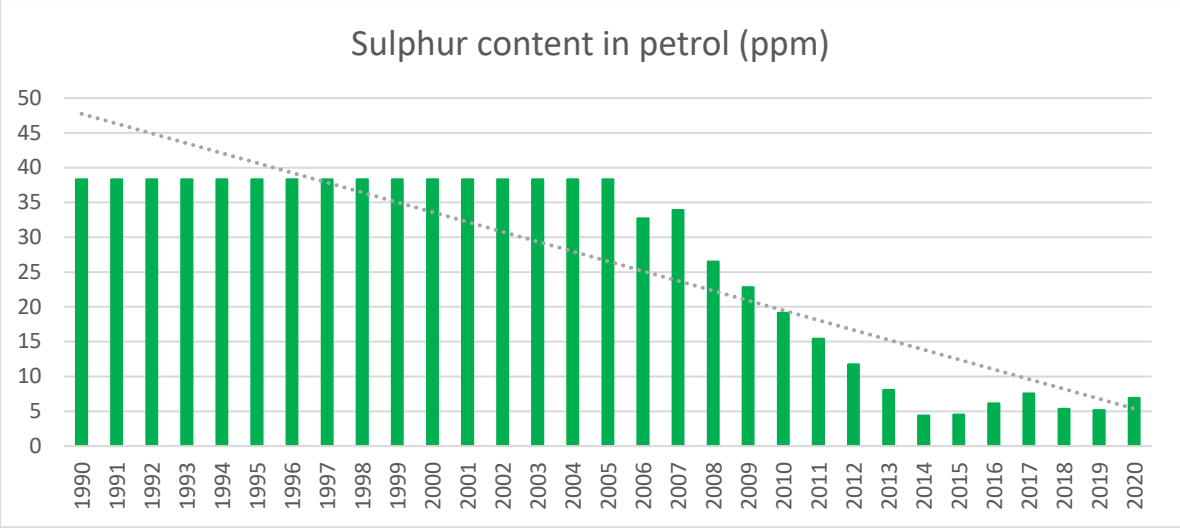

Figure 8: Sulphur content in ppm in petrol

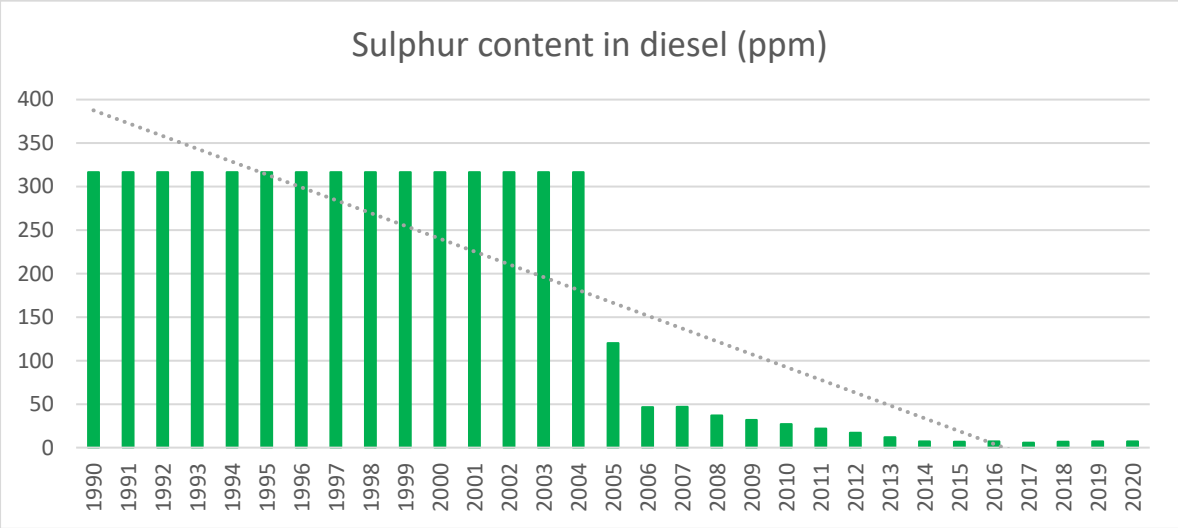

Figure 9: Sulphur content in ppm in diesel

4.4.3.3.2 Annual Average vehicle per km (Vkm)

The following text is a summary of the procedure followed by the EWA to generate the stock and mileage databases from NSO data. This information was sourced from the Methodological Note of the road transport model developed by the EWA.

The 2017 - 2018 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. Outliers were eliminated, and data on vehicles older than 25 years was ignored, as the sample size was not significant. Furthermore, 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.

The cumulative mileage was calculated by summing up the annual mean mileage of each year the vehicle has been on the road. For this submission, this methodology was extended for the years 1990-2009.

4.4.3.3.3 Total vehicle kilometres

Moreover, total VKM was projected for each of the five major vehicle categories. These projections made use of historical information to estimate the elasticity of total VKM of each vehicle type against a macroeconomic indicator.

Table 19: Macroeconomic drivers used to project VKM

Vehicle category	Macroeconomic driver to estimate total VKM
New PC	Population
New LCV	Wholesale and Retail GVA
New HDV	Wholesale, Retail and construction GVA
New MC&QUAD (L-category)	Population
New Buses	MB: Population (4 -15 years) CPB: Inbound tourists (Air passengers) RB: No driver used

The total mileage of each of the five vehicle types between 2018 and 2040 was estimated using the following equation;

$$VKM_t = VKM_{t-1} + (1 \times m \times g_t)$$

Equation 2: Equation to estimate total mileage by vehicle type

Where:

VKM_t = The estimate of total VKM driven by a vehicle category at period *t*; KM_{t-1} = The estimate of total VKM driven by a vehicle category at period *t-1*; m = The elasticity of total VKM of a vehicle category against a macroeconomic indicator which is expected to drive the demand for that vehicle's use; g_t = annual growth rate of the indicator between period *t-1* and *t*

The model was used to estimate annual VKM between 2010 and 2017 for each vehicle category. The resultant data was used to calibrate the model against energy balance statistics. The projected VKM for 2020 - 2040 was considered to be equivalent to the demand to be matched by what remains of the stock as at end of 2017.

To account for the impact of COVID-19 on road transport in 2020, the modelled VKM for that same year was amended to take into consideration the deductions in fuel use. Compared to 2019, petrol consumption decreased by 16%, whilst diesel consumption

decreased by 22% in 2020, hence the VKM for both petrol and diesel was assumed to decrease proportionally.

4.4.3.3.4 Stock of vehicles

Vehicle stock data was provided to EWA by NSO for the five main vehicle categories (Passenger cars, Light Commercial Vehicles, Heavy Duty Vehicles, Buses, and L-categories) and aggregated by fuel type and year of manufacture (YOM). The stock profile of the 2010-2017 database was extracted and used to create a survival profile for each vehicle type using the below equation:

$$Survival\ rate_v = Average\left(\frac{Stock_v - Stock_{v-1}}{Stock_v}\right) * (1 + Survival\ rate_{v-1})$$

Equation 3: Equation for the survival rate profile of vehicles

v = vehicle's age

The survival profile was used to generate both historical and projected stock. The number of new vehicles being introduced on the market was estimated by finding the difference between the total vehicle demand and the actual service demand provided by the existing stock.

Further manipulation of data was required to organize data into COPERT format:

- Each subcategory was further broken down into the respective Euro standards based on the year of manufacture of the vehicle.
- The total mileage generated for each vehicle category was multiplied with the mileage share of each sub-category aggregated by Euro standard of the vehicle stock reported in 2017. The list of sub-categories can be found below:

Table 20: Vehicle sub-categories

Vehicle category	COPERT classification
Passenger Cars	Small (0.8 - 1.4L)
	Medium (1.4-2.0L)
	Large (Large (>2.0L)
Light Commercial Vehicles	N1-I (GVW<=1305kg)
	N1-II (1305kg<GVW<=1760kg)
	N1-III (1760kg<GVW<=3500kg)
Heavy Duty Vehicles	Rigid <=7.5 t

	Rigid 7.5 - 12 t
	Rigid 12 - 14
	Rigid > 14 t
L-Category	Motorcycles < 50 cm³
	Motorcycles > 50 cm³
	Motorcycles < 250 cm³
	Quad and ATVs
Buses	Coaches Standard <=18 t
	Urban Buses Standard 15-18 t
	Urban Buses Midi <=15 t

The total mileage of each sub-category aggregated per Euro standard was divided by the stock to get the average annual VKM.

4.4.3.3.5 Inclusion of Electric Vehicles

The mean mileage was projected for electric vehicles for 2019 and 2020. Non-exhaust emissions from electric vehicles are attributed to sector '1A.3.b.vi, Automobile Tyre & brake wear', and sector '1.A.3.b.vii, Automobile Road Surface Abrasion'. At present, the COPERT stock dataset template does not include electric vehicles, but only caters for plug in hybrids (PHEV). Although in Malta, there are a number of PHEV, such vehicles are assumed to carry most of their daily trips on battery power due to Malta's small size and relatively short journey lengths. In this context, in order to include the contribution of EVs/PHEVs in the above-mentioned sectors, an alternative methodology was used. Timmers and Achten (2016) conducted a study on emissions from electric vehicles and the set of default factors made available from this research were used to estimate particulate matter emissions from this sector.

Table 21: PM emission factors for EVs

Pollutants	EVs EF from Tyre Wear	EVs EF from Road Abrasion
PM_{10}	7.2 mg/Vkm	8.9 mg/Vkm
$PM_{2.5}$	3.7 mg/Vkm	3.8 mg/Vkm

The annual mean mileage of electric vehicles was multiplied by the above EFs, and the results were then added to the emissions of PM_{10} and $PM_{2.5}$ generated by ICE

vehicles. The drawback of this approach is that no EFs were available for TSP, and there were no differences in EFs for the different vehicle categories.

4.4.3.3.6 Fuel Consumption

The total fuel share for the entire time series was obtained from Eurostat's Energy Balances. Figure 10 below provides the total fuel consumption between 1990 and 2020 segregated by fuel type. A rather linear trend is noticeable for both petrol and diesel. As of 2016, LPG started being consumed. However, Malta's stock is divided into the two major fuel types (i) petrol and (ii) diesel, and does not cater for any LPG converted vehicles. This is something that Malta would like to work on improving in future IIRs.

A drop in fuel consumed is noticeable in 2020. This is attributed to the COVID-19 pandemic, whereby the Government introduced restrictions in order to curb the spread of the virus. With such restrictions in place, Malta experienced less traffic and congestion and as a result, a deduction in fuel consumed. In fact, this resulted in a 16% reduction in petrol and a 22% deduction in diesel use within this sector.

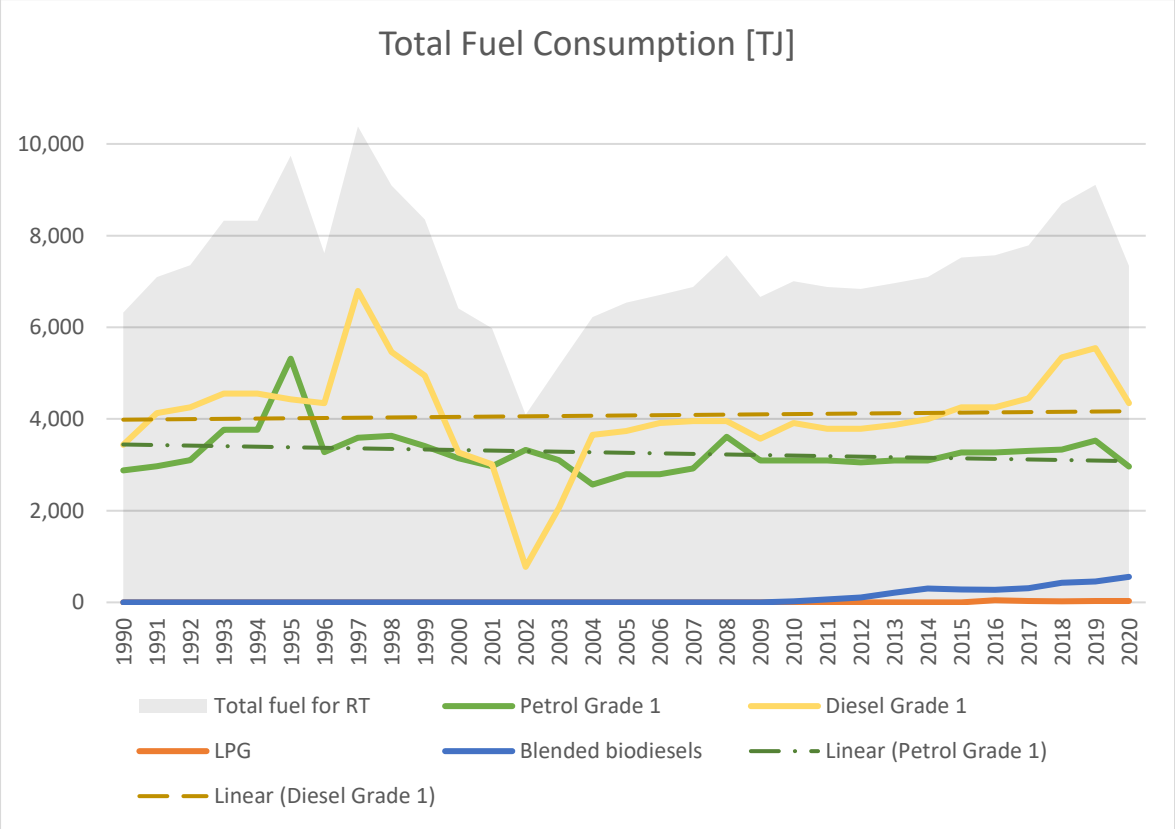

Figure 10: Fuel consumption per fuel type and as totals for road transport 1990-2020

4.4.3.3.7 Trip Characteristics and Circulation Data

4.4.3.3.7.1 Trip length and Trip Duration

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. 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 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. 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.

4.4.3.3.7.2 Average Speed and Road Share

The COPERT 5.5.1 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.

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.

As for road shares (%), COPERT 5.5.1 provides 3 types of roads categories:

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

On the other hand, the NTM provides for different road classifications, so efforts by TM 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 5.5.1:

Table 22: Circulation data

	Urban Peak	**Urban Off Peak**	**Rural**	**Highway**	**Urban Peak**	**Urban Off Peak**	**Rural**	**Highway**
	% Shares				Speed in km/h			
Pre2020	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

4.4.3.3.8 Additional parameters

The fuel 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 IM effect was not considered when running the model with the above input parameters.

4.4.3.4 Improvements made to the time series

During the 2021 TERT review, Malta was asked to clarify why there were under/over-estimates of emissions for several pollutants for a number of years for categories 1A3bi-iv. Following the necessary checks of all input data for the years in question, Malta found no anomalies. However, when emissions were re-calculated using the same software version (i.e. COPERT 5.3) and the same activity data, different results were calculated for a number of the respective years. In order to ensure correctness the same emissions were then calculated on COPERT 5.5.1.and the resulting emissions for the entire time series were the same as those calculated by earlier versions of the model. Malta made contact with EMISIA S.A, the software developers to better understand the situation and to identify the reason behind these errors.

Following discussions, it transpired that the input data and calculations were in fact correct but assignment of the appropriate year in the NFR table was erroneous. The software developers were unable to reproduce the errors; however, they were able to identify that for a number of years, particularly 1993-1997, 1999 and 2005-2006, the wrong data was reported. Essentially, the aforementioned years included data from other years; however, the actual results for their respective years were not included under any other year. There were a number of years that were also considered incorrect, but their respective results were reported under different years. This also meant that some years (2009-2016) were reported twice under different years.

For example, the data reported under 1997 should have been reported under 2004 and that for 2004 should have been reported under 2012. However, the actual correct data for 1997 was not reported under any other year.

The following table and figures provide some clarifications. Table 23 provides a summary of the years, which reporting was considered correct (in green), those that were incorrect as the wrong year data was provided but their actual results were not reported elsewhere (in red) and those that were incorrect, however, the values were reported under a different year (in blue).

Table 23: Summary table of how the 2021 road transport data was reported leading to inconsistencies within the data.

Year	Year with the same data	Necessary changes to resolve issues
1990	-	None
1991	-	None
1992	-	None
1993	2000	Replace with 1993 data
1994	2001	Replace with 1994 data
1995	2002	Replace with 1995 data

1996	2003	Replace with 1996 data
1997	2004	Replace with 1997 data
1998	-	None
1999	2007	Replace with 1999 data
2000	2008	Replace with 2000 data
2001	2009	Replace with 2001 data
2002	2010	Replace with 2002 data
2003	2011	Replace with 2003 data
2004	2012	Replace with 2004 data
2005	2013	Replace with 2005 data
2006	2014	Replace with 2006 data
2007	2015	Replace with 2007 data
2008	2016	Replace with 2008 data
2009	-	None
2010	-	None
2011	-	None
2012	-	None
2013	-	None
2014	-	None
2015	-	None
2016	-	None
2017	-	None
2018	-	None
2019	-	None

	Correct data reported
	Incorrect year reported
	Reported under a different year

The below graph (figure 11) graphically explains the issues faced by Malta in the last reporting period. This graph represents three types of data for the entire time series: (i) data as reported under the 2021 emission inventory (in orange), (ii) data as calculated using COPERT 5.3 (in light blue) and (iii) data as calculated using COPERT 5.5 (in dark blue). One can easily note that the reported data between 1993 and 1997 is similar to the results calculated for the years 2000-2004. Due to software related export issues, a shift in results occurred for a number of years as explained in the previous table.

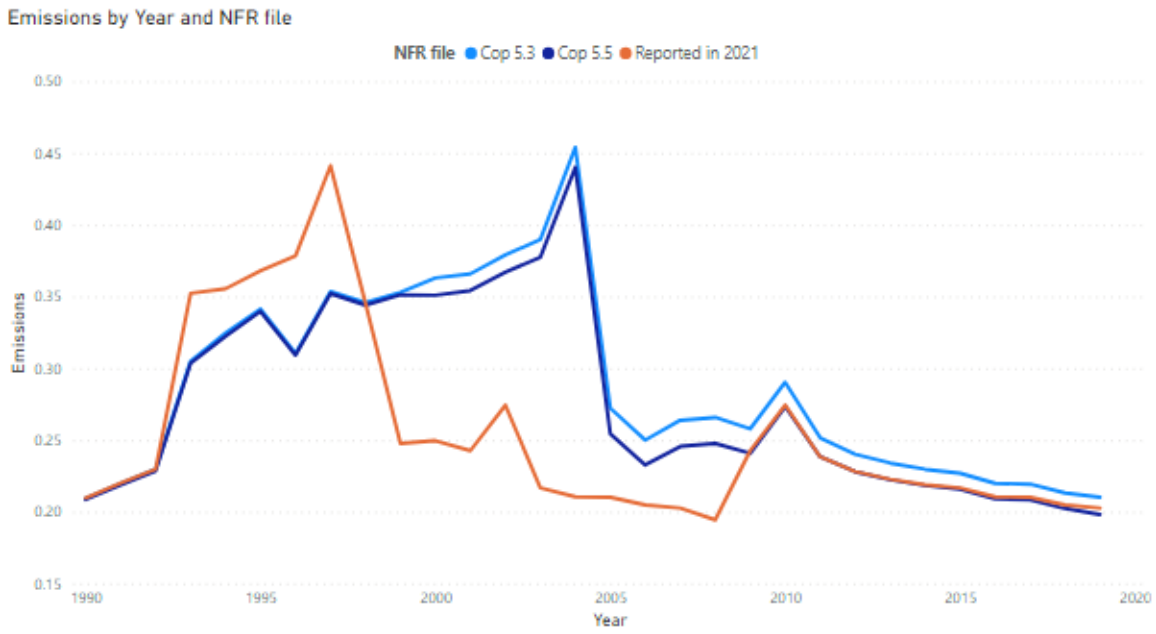

Figure 11: Line graph showing the issues experienced by Malta as a result of incorrect exporting of data.

It is also important to note that for the 2021 emission inventory for reporting year 2019 Malta made use of COPERT 5.3. Several emission factors for Malta's stock configuration were updated in later versions of the software. This also resulted in updated emission estimates for all pollutants. Below is a table highlighting the implied emission factors as extracted from COPERT (version 5.3 and version 5.5.1) for the years 2005 as the base year and 2020 as the reporting year, for the main pollutants: NMVOCs, NOx, SOx, NH_3, and $PM_{2.5}$. Very few emission factors remained the same between both versions of the software and these are highlighted in green (for 2005) and yellow (for 2020). This is only the case for NH_3 (for certain vehicle categories) and all emission factors for the other main pollutants (for all vehicle categories) have been updated in the latest software version.

Table 24: Differences in implied emission factors for Malta's stock configuration between COPERT versions 5.3 and 5.5.1 for the main pollutants.

			NMVOC				NOx				SOx				NH3				PM2.5			
			COPERT 5.3		COPERT 5.5		COPERT 5.3		COPERT 5.5		COPERT 5.3		COPERT 5.5		COPERT 5.3		COPERT 5.5		COPERT 5.3		COPERT 5.5	
Vehicle Category	Fuel Type	Segment	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020	2005	2020
Passenger Cars	Petrol	Small	1.65393	0.50354	1.51756	0.51482	0.59667	0.17006	0.75980	0.22419	0.00669	0.00087	0.00534	0.00095	0.04808	0.02963	0.05386	0.03030	0.01767	0.01627	0.01506	0.01561
		Medium	1.70465	0.72620	1.58213	0.72375	0.69237	0.33206	0.83340	0.38881	0.00814	0.00101	0.00648	0.00112	0.04842	0.03278	0.05561	0.03374	0.01771	0.01632	0.01524	0.01536
		Large-SUV-Executive	2.27592	1.36820	1.99671	1.17322	0.96327	0.55447	1.07013	0.54981	0.01080	0.00140	0.00849	0.00155	0.03837	0.02717	0.04444	0.02834	0.01764	0.01633	0.01502	0.01530
	Diesel	Small	0.05140	0.01755	0.03940	0.01483	0.99495	0.72555	0.84189	0.61669	0.01827	0.00087	0.01506	0.00082	0.00100	0.00213	0.00100	0.00213	0.06641	0.03749	0.05872	0.03476
		Medium	0.12435	0.03075	0.09287	0.02582	0.97932	0.72325	0.79400	0.60955	0.01957	0.00088	0.01593	0.00083	0.00100	0.00290	0.00100	0.00290	0.12753	0.04669	0.10659	0.04268
		Large-SUV-Executive	0.17773	0.02901	0.13562	0.03422	1.04029	0.71677	0.85594	0.61860	0.02441	0.00118	0.02000	0.00111	0.00100	0.00261	0.00100	0.00269	0.12706	0.04139	0.10620	0.04224
Light Commercial Vehicles	Petrol	N1-I	4.02949	1.46136	2.87829	1.17890	1.33159	0.59818	1.77327	0.67267	0.01257	0.00146	0.00650	0.00102	0.02899	0.03303	0.03394	0.03364	0.02424	0.02252	0.02299	0.02226
		N1-II	2.93212	1.30582	2.52223	1.26643	1.37750	0.62048	1.64907	0.69909	0.01141	0.00135	0.00933	0.00158	0.03728	0.03303	0.04687	0.03364	0.02428	0.02229	0.02302	0.02226
		N1-III	4.57424	1.38790	3.56468	1.35307	1.71476	0.62426	1.88649	0.70591	0.01085	0.00135	0.00892	0.00158	0.01661	0.03315	0.02271	0.03445	0.02418	0.02230	0.02294	0.02228
	Diesel	N1-I	0.15858	0.09360	0.13664	0.08119	1.02697	0.82979	1.48087	1.28501	0.02438	0.00116	0.01575	0.00085	0.00100	0.00202	0.00100	0.00222	0.13517	0.09061	0.14510	0.10102
		N1-II	0.18174	0.08486	0.15875	0.08050	2.76060	1.48445	2.01769	1.30977	0.02758	0.00124	0.02278	0.00118	0.00100	0.00206	0.00100	0.00226	0.24208	0.10496	0.23297	0.10033
		N1-III	0.17972	0.07930	0.15686	0.07521	2.55467	1.38815	1.89536	1.22655	0.02736	0.00124	0.02255	0.00118	0.00100	0.00240	0.00100	0.00256	0.22412	0.09954	0.21221	0.09510
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	1.30622	0.37808	0.93253	0.31667	4.66691	3.31611	4.04386	2.93089	0.03703	0.00159	0.03083	0.00153	0.00290	0.00510	0.00290	0.00510	0.37510	0.16907	0.29358	0.14961
		Rigid 7,5 - 12 t	1.53284	0.27407	1.06423	0.22476	9.62239	4.61275	8.06681	3.98778	0.06267	0.00252	0.04973	0.00237	0.00290	0.00633	0.00290	0.00633	0.52324	0.15560	0.39296	0.13004
		Rigid 12 - 14 t	1.66043	0.34622	1.16113	0.28172	11.14441	5.15158	9.19449	4.46975	0.06983	0.00283	0.05467	0.00263	0.00290	0.00577	0.00290	0.00577	0.55917	0.17779	0.42043	0.15115
		Rigid 14 - 20 t	2.70208	0.73496	1.64227	0.59628	15.46070	7.99840	11.62756	6.95858	0.09828	0.00375	0.07184	0.00345	0.00290	0.00527	0.00290	0.00527	0.85422	0.29869	0.56686	0.24951
		Articulated 14 - 20 t	-	0.50822	-	0.38061	-	9.56131	-	7.88193	-	0.00344	-	0.00316	-	0.00290	-	0.00332	-	0.22312	-	0.19321
Buses	Diesel	Urban Buses Midi <=15 t	4.38515	0.33403	2.99546	0.22652	12.25812	6.48548	9.79669	4.31835	0.08916	0.00307	0.06964	0.00292	0.00290	0.00774	0.00290	0.00724	1.15786	0.17714	0.82314	0.12523
		Urban Buses Standard 15 - 18 t	1.06390	0.05141	0.63042	0.04207	13.87052	4.17365	10.32120	2.75602	0.09549	0.00391	0.07521	0.00374	0.00290	0.01005	0.00290	0.00984	0.46316	0.08777	0.32151	0.05269
		Coaches Standard <=18 t	-	0.53579	0.93640	0.42540	-	11.32493	11.09003	8.99339	-	0.00514	0.08502	0.00466	-	0.00593	0.00290	0.00585	0.00000	0.29984	0.47166	0.23073
L-Category	Petrol	Mopeds 2-stroke <50 cm³	3.82347	1.76099	5.76133	2.02968	0.07228	0.10301	0.11038	0.19816	0.00112	0.00014	0.00172	0.00025	0.00065	0.00065	0.00100	0.00100	0.07728	0.02495	0.11590	0.02731
		Motorcycles 2-stroke >50 cm³	-	3.00318	-	2.64893	-	0.05316	-	0.04905	-	0.00028	-	0.00031	-	0.00200	-	0.00200	-	0.04909	-	0.04970
		Motorcycles 4-stroke <250 cm³	2.28662	0.48910	1.64292	0.47007	0.21982	0.10252	0.26738	0.09414	0.00267	0.00025	0.00230	0.00028	0.00200	0.00200	0.00200	0.00200	0.02609	0.01304	0.02576	0.01202
		Quad & ATVs	-	0.61274	-	0.86504	-	0.19633	-	0.35300	-	0.00044	-	0.00079	-	0.00200	-	0.00200	-	0.01932	-	0.01010

4.4.3.5 Source-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 highlighted in Table 18 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.

For this submission the pre-2010 stock data was checked and some inconsistencies with the data were highlighted and addressed. These inconsistencies were identified following a quality check exercise, whereby the stock configuration for the entire time series was mapped out. Via this exercise, the compiler was able to identify that a number of vehicle categories were present for certain years and not present for others. Further details can be found in the next section.

Furthermore, all activity data was reviewed by a second officer in order to ensure that all models, which provide figures for use in COPERT's calculations were correct. Ultimately, COPERT calculations were run by a different emission inventory compiler to ensure that the resulting data was consistent. This exercise ensured quality assurance particularly because the second officer is not responsible for the compilation of the Road Transport sector and therefore the review was conducted, to a certain extent, without bias. For the Road Transport sector, Malta does not engage QA reviewers who were not involved with the preparation of the inventory but this may be something which Malta can improve upon.

4.4.3.6 Source-specific recalculations and assumptions

The below is a list of assumptions and/or recalculations considered in this year's submission:

- The latest version of COPERT (i.e. 5.5.1) was used for this year's submission and Malta carried out recalculations for the entire time-series to take into consideration changes in emission factors for the entire stock configuration as explained in Section 4.4.3.4;
- As explained under Section 4.4.3.3.7 an updated methodology was used to cater for trip characteristics and circulation data. 2017 values generated by the NTM were used for the entire time series, whereas 2020 calculations were used for the reporting year in view of COVID-19 related restrictions. The pandemic brought with it a lower number of trips, particularly during the initial quarter (March to June), which led to increased speeds and a shorter trip duration. As a result, recalculations were necessary for 2020;

- Euro standards for Malta's entire stock were updated to be in line with those highlighted in table 2.2 of the latest version of the Guidebook – 2019GB - Chapter 1.A.3.b.i-iv Road Transport 2019. It is important to note that EWA's VKM model assumes that the stock of Passenger Vehicles and Light Commercial Vehicles for the years 2018 to 2020 fall under Euro 6d and the stock and VKM were updated accordingly. Furthermore, L-category Quads dating pre-2001 were all converted to Euro 1 since COPERT only provides for Euro 1 as the earliest standard for this category. As a result, VKM was also updated to cater for changes made in stock assigned to the new Euro standards. Table 25 below provides a summary of the relevant years that needed updating.

Table 25: Summary of the Euro standards that needed to be updated to actual Euro standards as established in the 2019GB for all vehicle categories.

Vehicle Category	Segment	Fuel Type	Original Euro standard	Relevant year	Updated Euro standard as per the 2019GB
Passenger cars	Small Medium Large	Petrol	Euro 6a/b/c	2018	Euro 6d*
				2019	
		Diesel	Euro 6a/b/c	2018	Euro 6d
				2019	
Light Commercial Vehicles	N1-I/N1-II/N1-III	Petrol	Euro 2	2001	Euro 3
			Euro 3	2006	Euro 4
			Euro 5	2010	Euro 4
			Euro 6 a/b/c	2015	Euro 5
				2018	Euro 6d*
				2019	Euro 6d*
	N1-I/N1-II/N1-III	Diesel	Euro 5	2010	Euro 4
			Euro 5	2015	Euro 6 a/b/c
			Euro 6 a/b/c	2018	Euro 6d*
				2019	Euro 6d*
L-category	Motorcycles	Petrol	Euro 2	2002	Euro 1
			Euro 3	2017	Euro 4
	Quads & ATVs	Petrol	Conventional	1990-2001	Euro I**
Heavy Duty Vehicles	Rigid ≤7.5t Rigid 7.5-12t Rigid 12-14t Rigid >14t	Diesel	Euro II	2000	Euro III
		Diesel	Euro II	1990-2016	Euro II

	Articulated 14-20t			2017-2020	Euro VI
Buses	Coaches Standard ≤18 Urban buses Standard 15-18t Urban buses Midi ≤15	Diesel	Conventional	1992	Euro I
			Conventional	1993	Euro I
			Euro I	1996	Euro II
			Euro V	2013	Euro VI A/B/C
				2014	
				2015	
				2016	
				2017	

* EWA's model assumes that Euro 6d entered into force in 2018
** VKM modelled by EWA was only provided for Euro 1, Euro 2, Euro 3 from 2010, therefore all quads dating pre-2001 were assumed to be Euro 1

This exercise catered for the following major deficiencies:

(i) There were instances in Malta's fleet where stock was available for particular categories but had no VKM assigned to them. As a result, these were not being catered for in the Road Transport calculations. To provide an example, a number of Quads that were categorized under the Conventional Standard were not assigned a VKM since EWA's VKM model provides VKM for Euro 1 onwards. Therefore, a large portion of Quads were not being included in the calculations.

(ii) On the other hand, there were instances where stock was available but VKM was not, only because the year with respect to its Euro standard was incorrect.

(iii) Revisions to the Light Commercial Vehicles stock were also carried out as a result of this exercise. An older version of an in-house model Malta used to calculate lifetime cumulative, and to sum the stock per Euro category was updated. In previous submissions, all segments under the LCV category for both fuel types were being assigned the same Euro standard as category N1-I (petrol). By making reference to table 2.2 of the latest version of the Guidebook – 2019GB - Chapter 1.A.3.b.i-iv Road Transport 2019, one can note that the Euro standards for petrol and diesel LCVs are not entirely the same.

- The EWA VKM model assumes that a significant percentage of the total VKM driven by freight vehicles are driven overseas. Therefore, the model assumes that only 5% of the total freight VKM are driven in Malta. Given that COPERT does not provide an emission factor for freight, the emission factors for HDV Articulated 14-

18t was assigned to them since in 2017[1] 99% of such trucks are heavier than 15 tonnes. Furthermore, Euro II was assigned to all pre-2017 freight trucks because the average age of 2017 freight trucks was 21 years, putting the average TU in the Heavy Duty Vehicles Euro II band. Post-2017 trucks under this category were assigned a Euro VI A/B/C category.

- The pre-2010 stock also underwent certain updates which ensured that all on-road vehicles were being catered for under different vehicle categories. 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 to be equal to the data provided by EWA from 2010 onwards. This meant that certain stock, which does not feature from 2010 onwards could not feature in pre-2010 as there was no VKM available to assign. The below table provides a summary of those vehicle categories, which for this reporting period were assigned to other categories.

Table 26: 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 cm³	Motorcycles 4-stroke <250 cm³
Motorcycles 4-stroke >750 cm³	

* Change carried out for 2007 to 2009

- Furthermore, three of the post-2010 vehicle categories were not present between 1990 and 2009. As a result, the following vehicle categories; (i) HDV – Articulated 14-20t, (ii) L-category – motorcycles 2-stroke >50cm3 and (iii) L-category – Quads feature only in Malta's stock data from 2010 onwards.

[1] 2017 is the year when the model was developed

- Due to COVID-19 and a reduction in trips the amount of fuel used for Road Transport in 2020 decreased by 16% for petrol and 22% for diesel. In this context, the modelled VKM was also deducted by the same percentages in order to reflect that year's activity.
- PAHs were also calculated for this submission using the methodology provided in guidebook – 2019GB - Chapter 1.A3.b.vii Road transport: Automobile road abrasion. The following PM emissions from tyre and brake wear were taken into consideration:

Table 27: PM emissions from tyre and brake wear

Compound	Tyre wear (ppm wt.)	Brake wear (ppm wt.)
Benzo(a)pyrene	3.9	0.74
Benzo(b)flouranthene	0	0.42
Benzo(k)flouranthene	0	0.62
Indeno(1,2,3-cd)pyrene	-	-

- One of COPERT's functions is to calculate emissions from lubricants (except for two-stroke engines). In previous versions of the software these were automatically reported under line 90 of the NFR file which refers to sector *2D3i - Other Solvents Use*. However, emissions from lubricants from the Road Transport sector are now being reported in line 91 of the NFR file referring to sector *2G - Other Product Use*. This allocation is based on the methodology laid out in the 2019GB, whereby emissions related to engine lubricant consumption for vehicles, other than those having a two-stroke engine, should be reported under sector *2G - Other Product Use*. In this context, emissions calculated by COPERT 5.5.1 were added to emissions estimated for that sector.

4.4.3.7 Source-specific planned improvements

Malta would like to improve its stock data for the entire time series, particularly the stock for 1990 to 2009. Malta aims to have a harmonized methodology for all years in order to cater for inconsistencies in the data as previously explained. Malta hopes that this update would also address the lack of vehicles using LPG. As previously noted in Section 4.4.3.3.6, Eurostat data includes this fraction of fuel type under Road Transport, however, there is no stock associated with such fuel use.

Furthermore, at present Malta does not engage QA reviewers who were not involved with the preparation of the inventory for the Road Transport sector. However, this may be something which Malta can improve upon in the coming years.

4.4.4 Sector 1A3dii: National navigation (shipping)

Table 28: Sector 1A3dii general characteristics

NFR Code	1A3dii
Sub-Category	National navigation (shipping)
Method	2019GB
Activity Data	Direct communication
Emission Factor	Tier 2
Key Category	NO_x, SO_x, Ni & PCBs
Year of last update	2022 submission

4.4.4.1 Source 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 2020 are shown in Table 12.

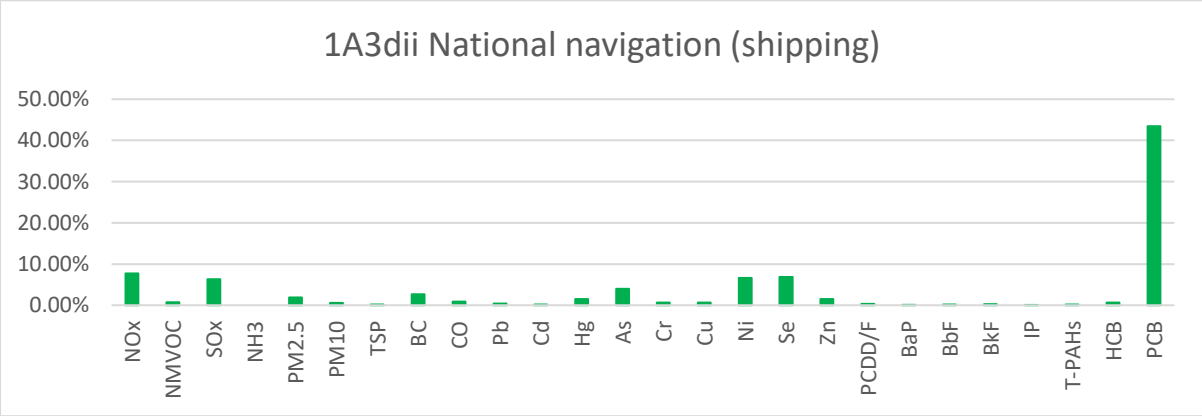

Figure 12: Shares of emissions from the NFR 1A3dii category in percentage of national total

4.4.4.2 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 and the Valletta Ferry Services. This sector was estimated through the Tier 2 methodology presented within the 2019GB. The Gozo Channel Ferry was classified as a medium speed engine, and the Valletta Ferry Services were deemed to operate through a high speed engine.

4.4.4.3 Activity Data

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

The fuel consumption from the Gozo Channel Ferry was available from 2002, and hence, the value for 2002 was carried backwards. Additionally, the fuel consumption for the Valletta Ferry Services was only available for 2020 and 2021. Therefore, the fuel consumption from these years was carried backwards for the entire time series.

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 2020. The average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020 value was not considered within this average, since the sulphur content for 2020 was significantly lower than that of the previous two years.

4.4.4.4 Source-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.

4.4.4.5 Source-specific recalculations

Emissions of Benzo(a) pyrene, benzo(b) flouranthene, benzo(k) flouranthene, and indeno(1, 2, 3-cd) pyrene were estimated for the first time in this submission.

As stated within the methodology section, the emissions from recreational crafts were placed under sector 1A5b for the first time in this submission.

4.4.4.6 Source-specific planned improvements

Efforts will be made to obtain the fuel data on additional ferry services.

4.4.5 Sector 1A4ai: Commercial/Institutional: Stationary

Table 29: Sector 1A4ai general characteristics

NFR Code	**1A4ai**
Sub-Category	Commercial/Institutional: Stationary
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	NOx, SOx, $PM_{2.5}$, BC, As, Cr, Ni, Zn, Benzo(a) pyrene, Benzo(b) fluoranthene, benzo(k) fluoranthene, Indeno (1,2,3-cd) pyrene

Year of last update	2022 submission

4.4.5.1 Source 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 2020 are shown in *Figure 13*.

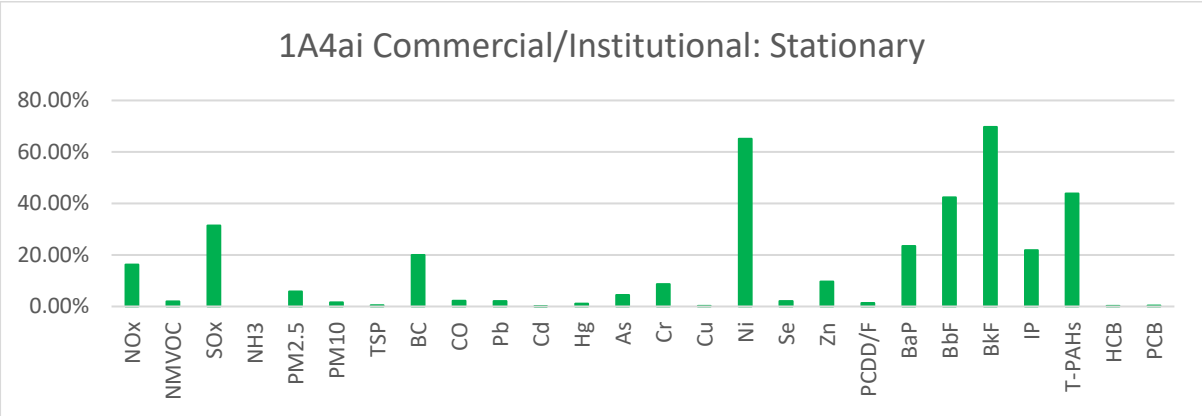

Figure 13: Shares of emissions from the NFR 1A4ai category in percentage of national total

4.4.5.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.4.5.3 Activity Data

The 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. 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 2020. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.4.5.4 Source-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.

4.4.5.5 Source-specific recalculations

The values for all pollutants for 1990 and 2019 were updated. Concerning the latter year, the quantity of Gas Diesel Oil and biogases was updated in the 2022 Eurostat Energy Balance. The formula had to be updated for the year 1990, to rectify an error.

4.4.5.6 Source-specific planned improvements

Efforts will be made to make use of a Tier 2 methodology.

4.5 Sector 1A4bi: Residential: Stationary

Table 30: Sector 1A4bi general characteristics

NFR Code	1A4bi
Sub-Category	Residential: Stationary
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	$PM_{2.5}$, PM_{10}, CO, Zn, PCDD/PCDF, Benzo(a) pyrene, Benzo(b) fluoranthene, benzo(k) fluoranthene & Indeno (1,2,3-cd) pyrene
Year of last update	2022 submission

4.5.1 Source 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 2020 are shown in Figure 14.

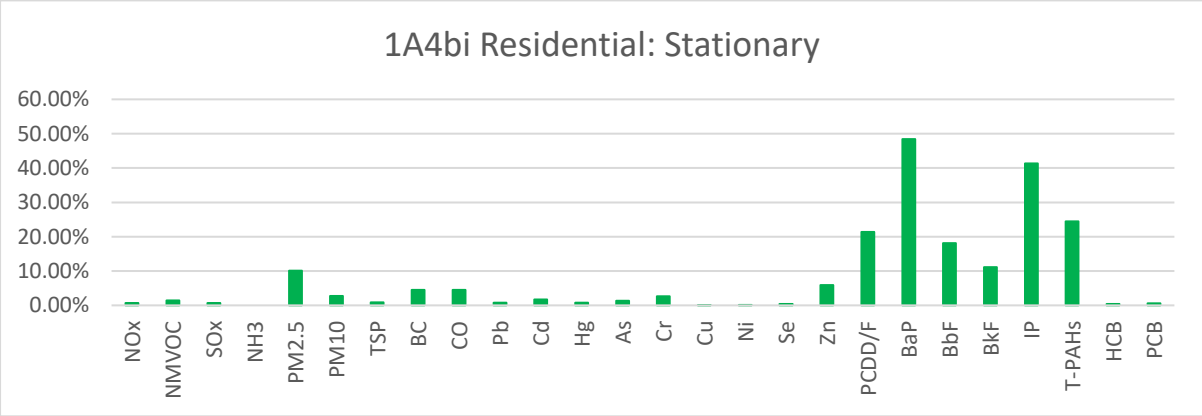

Figure 14: Shares of emissions from the NFR 1A4bi category in percentage of national total

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.

4.5.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.5.3 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. 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 2020. Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.5.4 Source-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.

4.5.5 Source-specific recalculations

The TERT recommended that Malta should report emissions of PCBs and HCB in the residential sector. As from this submission, the emissions of these pollutants from solid biomass combustion are estimated at a Tier 1 level.

The TERT noted a potential overestimate when reporting PAHs and Benzo(a) pyrene emissions. An error was identified in estimation of emissions from the combustion of LPG and gasoil. Consequently, the emissions of benzo(a) pyrene, benzo(b) fluoranthene, benzo(k) fluoranthene, and Indeno (1,2,3-cd) pyrene were recalculated.

The TERT noted a potential underestimate when reporting BC emissions. An error was identified in estimation of emissions from the combustion of solid biomass. Consequently, the emissions of BC were recalculated.

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 4.8% greater than those in the Eurostat Energy Balance from 2010-2019.

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 104.8%.

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 31. 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 15 compares the trends with and without gap-filling.

Table 31: HS Code classification groupings for gap-filling

HS Code	1A4bi
44011000	Fuel wood, in logs, billets, twigs, faggots or similar forms
44011100	Fuel wood, in logs, billets, twigs, faggots or similar forms, coniferous
44011200	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	Sawdust and wood waste and scrap, agglomerated in pellets
44013100	Wood pellets
44013080	Wood waste and scrap, whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets)
44013990	Wood waste and scrap, whether or not agglomerated in logs, briquettes or similar forms (excl. sawdust and pellets)
44013980	Wood waste and scrap, not agglomerated (excl. sawdust)
44014090	Wood waste and scrap, not agglomerated (excl. sawdust)

44013040	Sawdust of wood, whether or not agglomerated in logs, briquettes or similar forms (excl. pellets)
44013900	Sawdust and wood waste and scrap, agglomerated in logs, briquettes or similar forms (excl. pellets)
44013910	Sawdust of wood, whether or not agglomerated in logs, briquettes or similar forms (excl. pellets)
44013920	Sawdust and wood waste and scrap, agglomerated in logs, briquettes or similar forms (excl. pellets)
44013930	Sawdust of wood, not agglomerated
44014010	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)

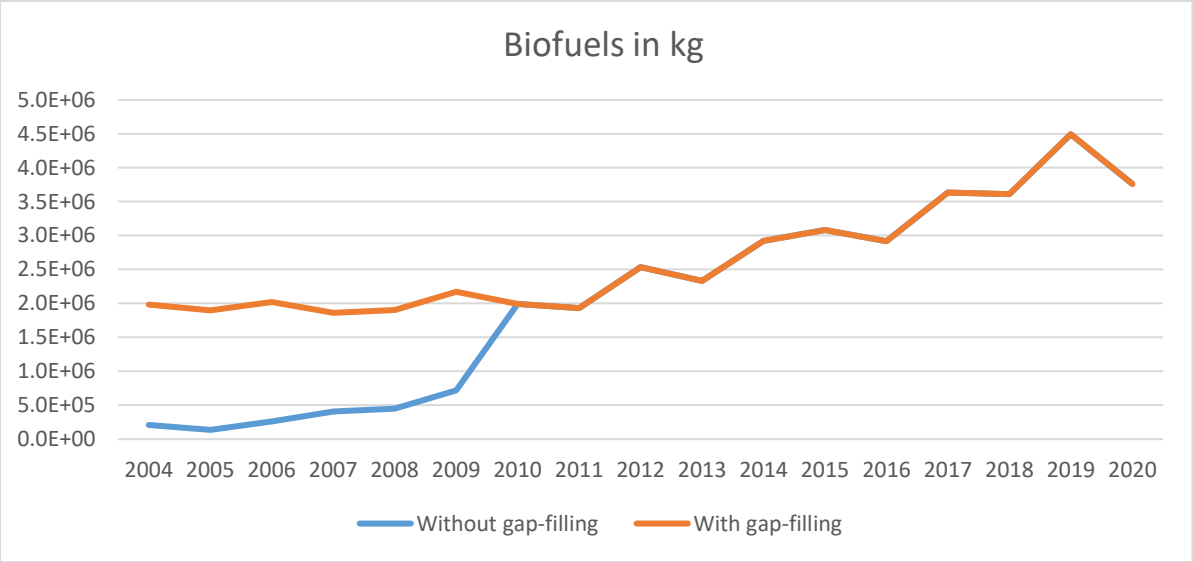

Figure 15: Results from gap-filling exercise on quantity of biofuels

4.5.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

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

Table 32: Sector 1A4cii general characteristics

NFR Code	1A4cii
Sub-Category	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery
Method	2019GB

Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	CO
Year of last update	2022 submission

4.6.1 Source 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 2020 are shown in Figure 16.

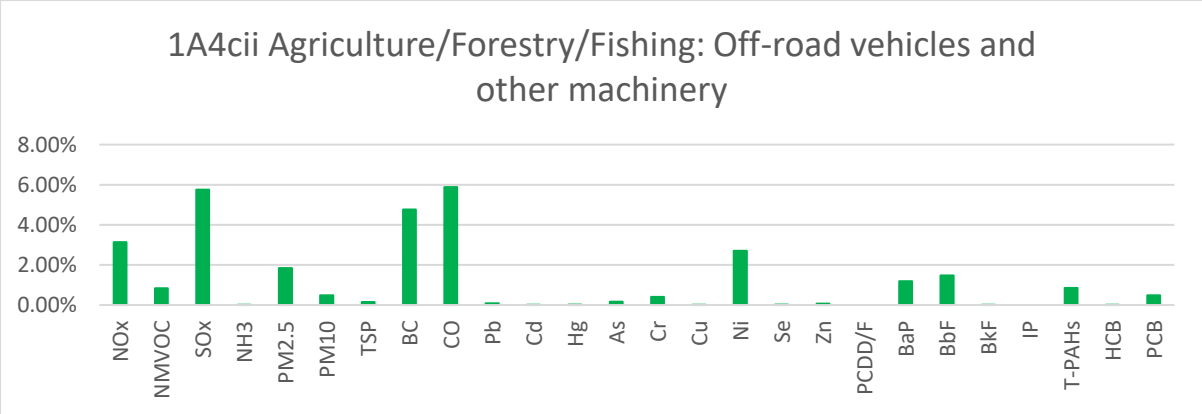

Figure 16: Shares of emissions from the NFR 1A4cii category in percentage of national total

4.6.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

The TERT noted that CO emissions increased greatly from 2004 to 2005. This difference is attributed to a difference in the source of the activity data for both years. The Eurostat Energy Balance was used from 2005 to 2020, while emissions from 1990 to 2004 where based on activity data from the climate change model. Additionally, the Energy Balance does not differentiate between mobile and stationary fuel use. Hence, the notation key 'NO' for sector 1A4ci will be changed to 'IE', since emissions under the agriculture/forestry/fishing sector are included under the mobile sector.

4.6.3 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. 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 2020.

Therefore, the sulphur content from 2014 was used to calculate SO_x emissions prior to 2014.

4.6.4 Source-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.

4.6.5 Source-specific recalculations

No recalculations were carried out for this submission.

4.6.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

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

Table 33: Sector 1A4ciii general characteristics

NFR Code	**1A4ciii**
Sub-Category	Agriculture/Forestry/Fishing: National Fishing
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	Not Applicable
Year of last update	2022 submission

4.7.1 Source 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 2020 are shown in Figure 17.

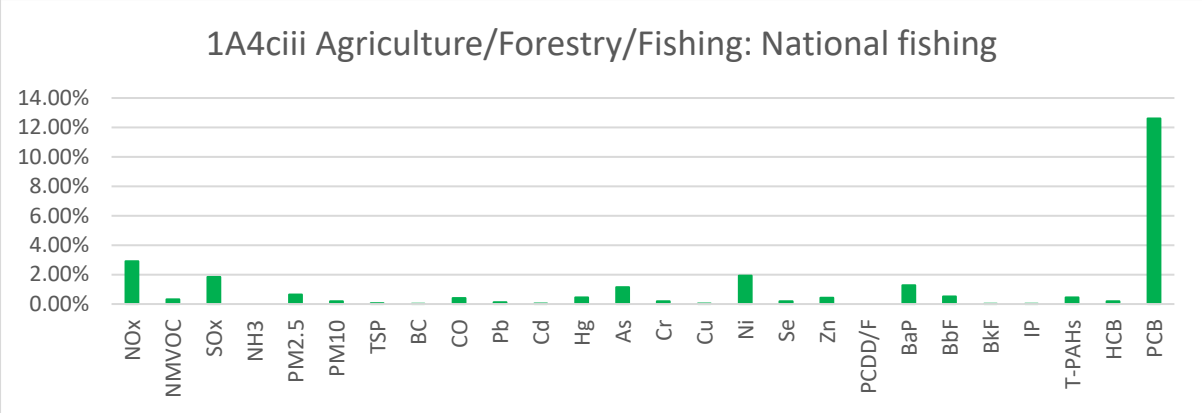

Figure 17: Shares of emissions from the NFR 1A4ciii category in percentage of national total

4.7.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.7.3 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 2020. The average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020 value was not considered within this average, since the sulphur content for 2020 was significantly lower than that of the previous two years.

4.7.4 Source-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.

4.7.5 Source-specific recalculations

The TERT noted a change in the implied EF between 2016 and 2017. An error was identified in the calculation of the emissions generated through the combustion of LPG. Hence, the emissions of all pollutants were recalculated.

4.7.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

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

Table 34: Sector 1A5b general characteristics

NFR Code	1A5b
Sub-Category	Other, Mobile (including military, land based and recreational boats)
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	NMVOC, SO_x, $PM_{2.5}$, CO, Ni & PCBs
Year of last update	2022 submission

4.8.1 Source 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 2020 are shown in Figure 18.

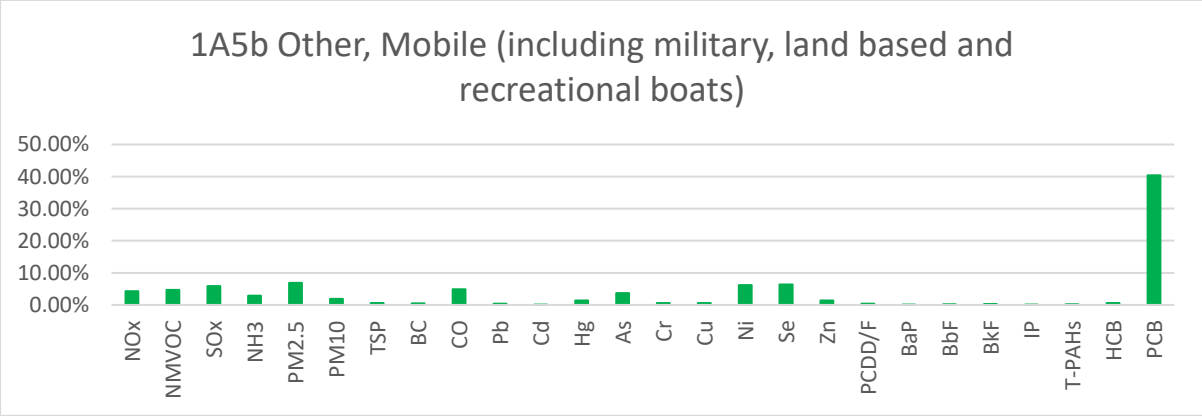

Figure 18: Shares of emissions from the NFR 1A5b category in percentage of national total

4.8.2 Methodology

Following a suggestion by the TERT, emissions from recreational crafts were reported under NFR 1A5b. This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.8.3 Activity Data

The fuel consumption was obtained by subtracting the fuel consumption from the Gozo Channel Ferry and the Valletta Ferry Services, from the total fuel used in national navigation. The quantities of fuel used from 2005 onwards were taken from the 'Domestic navigation' 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’.

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 2020. The average sulphur content from 2018 and 2019 was used to calculate SO_x emissions prior to 2018. The 2020 value was not considered within this average, since the sulphur content for 2020 was significantly lower than that of the previous two years.

4.8.4 Source-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 Source-specific recalculations

The values for all pollutants were recalculated from 2005-2016 in this submission. The Eurostat Energy Balance provided the quantities of motor gasoline from 2017 onwards, whereas the Malta Resources Authority (MRA) had provided data from 1990-2004. A gap-filling exercise was carried out to identify the quantities of motor gasoline consumed in the remaining years.

Both the National Statistics Office (NSO) and the Regulator for Energy and Water Services (REWS) provided values from 2013 onwards. The values provided by both data suppliers for 2017-2019 were compared 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 values for all pollutants in 2019 were updated, as the quantity of the gas diesel oil consumed was updated in the 2022 Eurostat Energy Balance.

4.8.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

4.9 Sector 1B2av: Distribution of Oil Products

Table 35: Sector 1B2av general characteristics

NFR Code	1B2av

Sub-Category	Distribution of Oil Products
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 1
Key Category	NMVOC
Year of last update	2022 submission

4.9.1 Source 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 2020 are shown in Figure 19.

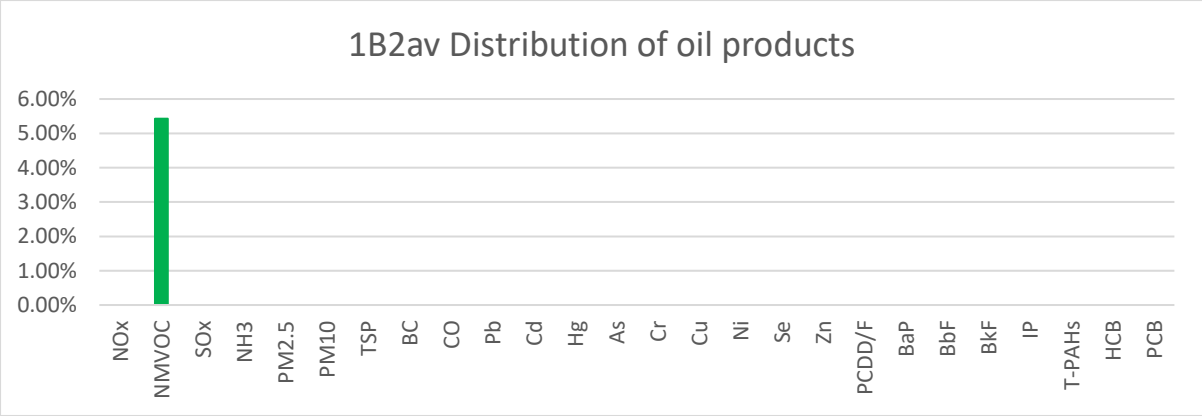

Figure 19: Shares of emissions from the NFR 1B2av category in percentage of national total

4.9.2 Methodology

This sector was estimated through the Tier 1 methodology provided within the 2019GB.

4.9.3 Activity Data

The gross inland consumption of gasoline (gasoline without bio component and aviation gasoline) consumed locally was obtained from Eurostat for 1990 to 2019

4.9.4 Source-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 Source-specific recalculations

No recalculations were carried out for this submission.

4.9.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

5 Industry (NFR 2)

Chapter Updated: March 2022

5.1 Category overview

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

- 2A5b
- 2B10b
- 2D3a
- 2D3b
- 2D3d
- 2G
- 2H2

This sector consists of categories generating fugitive or combustion emissions. In terms of the Maltese situation, many of the sectors under NFR 2 do not occur locally. Malta relies heavily on imports of products due to lack of many of the following processes occurring locally. NMVOC and particulate matter are the main pollutants emitted from industrial processes in Malta

Table 36 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 36: Coverage of NFR categories 2020

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	NMVOC	-	Rest of Pollutants	Recurring Figure	✕
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, PM2.5, PM10, TSP, BC	-	Rest of Pollutants	Tier 1	✓
2D3c	Not Occurring				✕
2D3d	NMVOC	-	Rest of Pollutants	Tier 2	✓
2D3e	Not Estimated				✕
2D3f	Not Estimated				✕
2D3g	Not Estimated				✕
2D3h	Not Estimated				✕
2D3i	Not Occurring				✕
2G	Rest of Pollutants	-	Se, HCB, PCBs	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 2020 are shown in Figure 20.

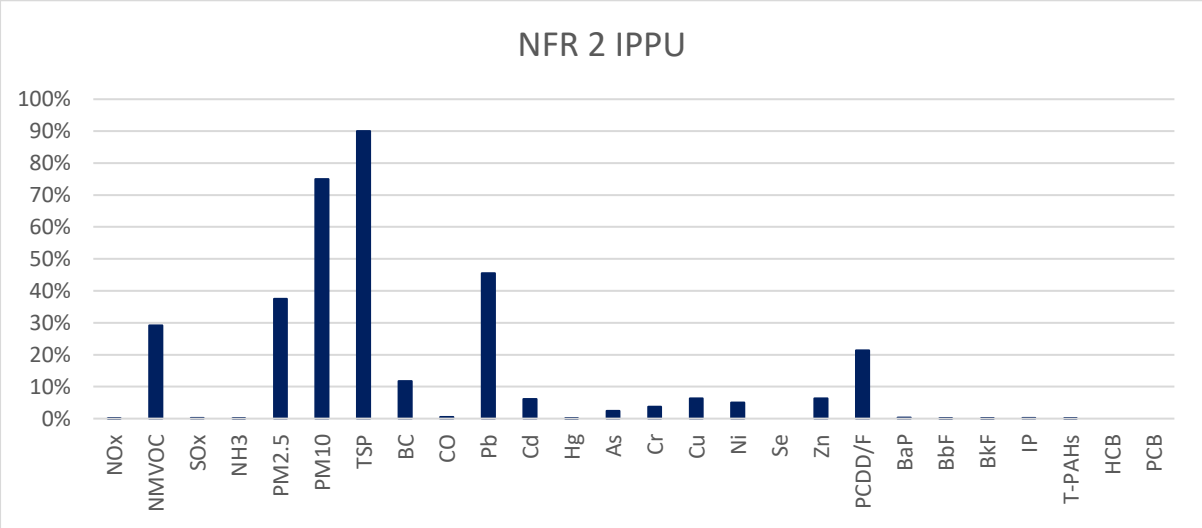

Figure 20: Shares of emissions from the NFR 2 category in percentage of national total

5.2 Sector 2A5b: Construction and Demolition

Table 37: Sector 2A5b general characteristics

NFR Code	2A5b
Sub-Category	Construction and demolition
Method	2019GB
Activity Data	Eurostat, Planning Authority & National Statistics Office
Emission Factor	Tier 1
Key Category	$PM_{2.5}$, PM_{10} & TSP
Year of last update	2022 submission

5.2.1 Source category description

This sector covers the emissions emerging from the construction of buildings (sub-divided into dwellings and non-dwellings) and roads. Shares of emissions of the particular pollutants from 2A5b in 2020 are shown in Figure 21.

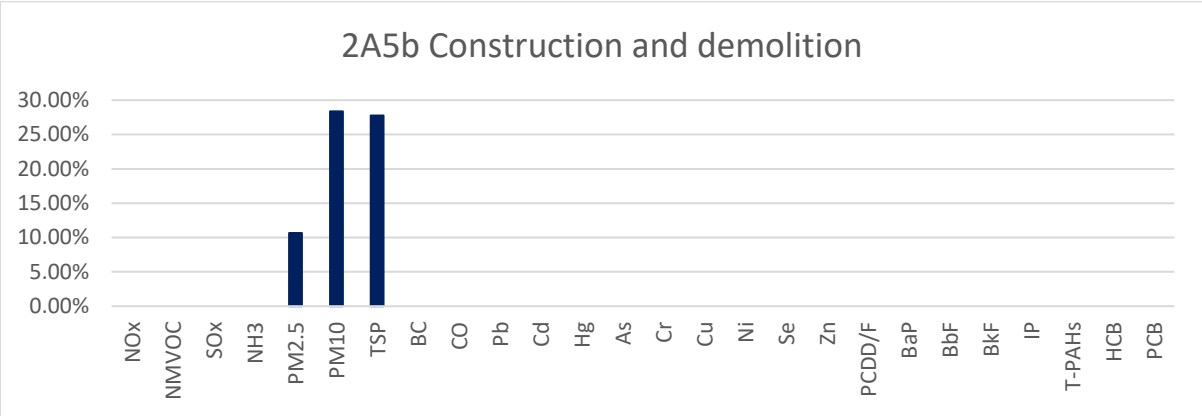

Figure 21: Shares of emissions from the NFR 2A5b category in percentage of national total

5.2.2 Methodology

The 2019GB recommended US EPA methodology was used for this sector, with an effort being made to use country-specific factors as much as possible. The data required to estimate the emissions emerging from the construction of roads was not available for this submission. Hence, emissions resulting from this activity have not been calculated.

As the parameters of the building sector in Malta differ from the default values presented in the 2019GB, efforts were made to adapt the guidebook methodologies to better represent the Maltese situation. One way in which this was achieved was by disregarding the conversion factor that was applied to the areas of buildings. The size of buildings in m^2 was also made more representative utilising data obtained from the Planning Authority. Planning Authority data was acquired in 2021, covering years 2007 to 2020. The data utilised for this exercise was the total area (footprint) of buildings, sub-categorised into the following sectors: office, retail, food and drink, tourism, leisure, industrial, warehouse, other and outdoor space. The total footprint for each

sub-category was sub-divided by the number of permits to obtain the average size of buildings in Malta.

5.2.3 Activity Data

This sector is being estimated for the first time in this submission. It was previously classified as 'NE' as activity data was not available for use. Activity data has been sourced from two entities for this sector, the NSO and PA. The activity data for dwellings and non-dwellings data was sourced from the Planning Authority, whereby number of units was based upon number of permits granted per annum. It is assumed that construction took place in the year that the permit was granted. Activity data exists from the year 2000 for NSO data and from 2007 for PA data. For missing years, a 5-year moving average was utilised.

5.2.4 Source-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. 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 Source-specific recalculations

No recalculations were done for this sector since this sector is being estimated for the first time in this submission.

5.2.6 Source-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 2B10b: Storage, Handling and Transport of Chemical Products

Table 38: Sector 2B10b general characteristics

NFR Code	2B10b
Sub-Category	Storage, handling and transport of chemical products
Method	Recurring Figure
Activity Data	Not Applicable
Emission Factor	Not Applicable
Key Category	Not Applicable
Year of last update	Not Applicable

5.3.1 Source category description

This sector generates NMVOC emissions, which have been carried forward from previous submissions.

Shares of emissions of the particular pollutants from 2B10b in 2020 are shown in Figure 22.

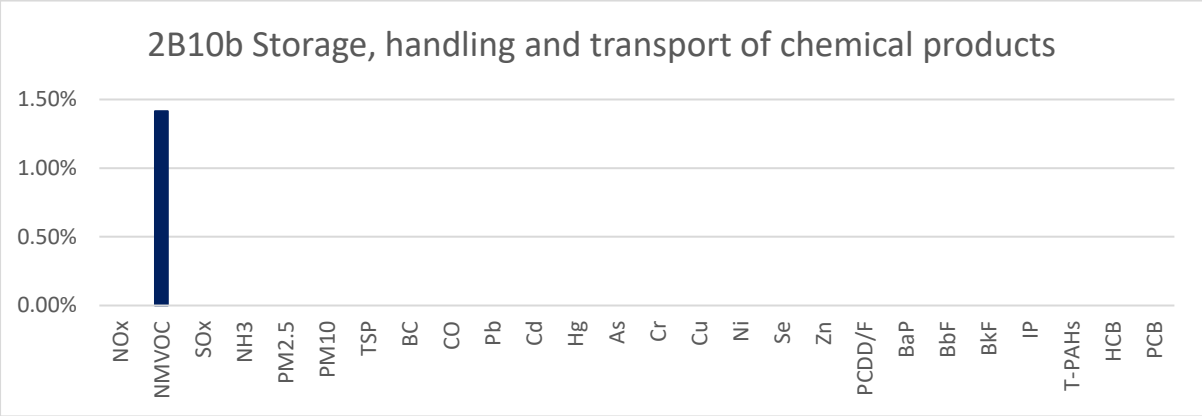

Figure 22: Shares of emissions from the NFR 2B10b category in percentage of national total

5.3.2 Methodology

Since this sector features a recurring figure, no methodology is utilised to estimate these emissions.

5.3.3 Activity Data

No activity data was made available for this sector.

5.3.4 Source-specific QA/QC and verification

No QA/QC and verification was performed for this sector.

5.3.5 Source-specific recalculations

No recalculations were carried out for this submission.

5.3.6 Source-specific planned improvements

Efforts will be made to update this sector in the future.

5.4 Sector 2D3a: Domestic Solvent Use Including Fungicides

Table 39: Sector 2D3a general characteristics

NFR Code	2D3a
Sub-Category	Domestic solvent use including fungicides
Method	2019GB
Activity Data	NSO
Emission Factor	Tier 2

Key Category	NMVOC
Year of last update	2022 submission

5.4.1 Source category description

This sector covers the emissions emerging from the domestic use of solvent-containing products. Many of these products are also used in industry and commerce.

Shares of emissions of the particular pollutants from 2D3a in 2020 are shown in Figure 23.

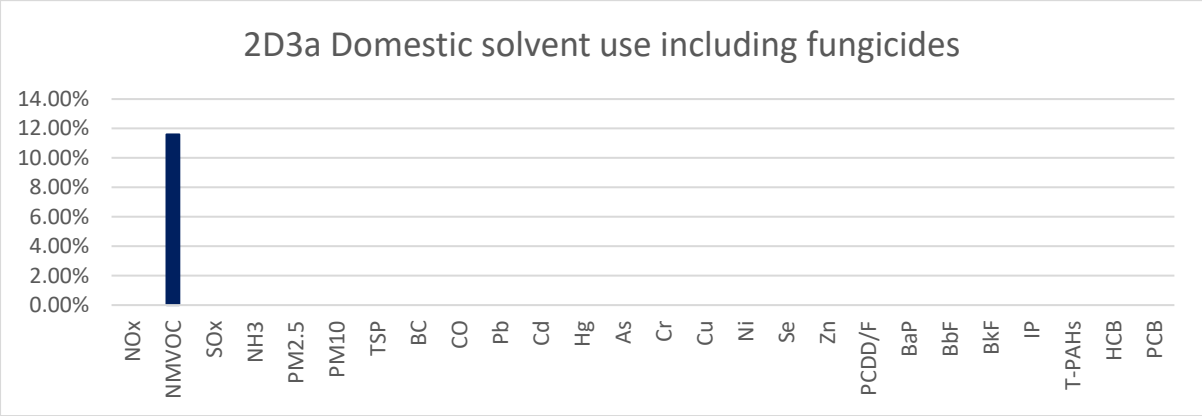

Figure 23: Shares of emissions from the NFR 2D3a category in percentage of national total

5.4.2 Methodology

The methodology utilized to estimate emissions from this sector has been updated for this submission. This improvement involved moving from a Tier 1 approach, which utilized population data as the activity data and a default emission factor (2019GB), to a Tier 2 approach, which uses the import/export data of domestic solvent products (via PRODCOM codes) using the special trade statistics (STS) as activity data. This methodology utilizes a mixture of Tier 2A and Tier 2B, as deemed necessary via the data gathering exercise. The Tier 2A methodology utilized the amount of solvent per product as the EF. The Tier 2B methodology utilised the amount of product multiplied directly by the EF provided within the 2019GB. This improvement was made in collaboration with CITEPA, under the NECD capacity-building project conducted during 2021.

Table 40: PRODCOM codes utilised and the corresponding solvent content used for Tier 2A calculation

Categories	Sub-Categories (PRODCOM)	PRODCOM Codes	Solvent content (%m)
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 water	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
	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	12.7
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	67.54
	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 40 lists the PRODCOM codes used to estimate this sector via the Tier 2A methodology, along with the solvent content of each product. PRODCOM data are detailed production data at an 8-digit level. Solvent content was kept constant across the time series and therefore emission estimates do not consider any change in the solvent content of products over time.

Table 41: PRODCOM codes utilised for the Tier 2B calculation

Categories	Sub-Categories (PRODCOM)	PRODCOM Codes
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
	Soap and organic surface-active products in bars, etc., n.e.c.	20413120
	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
	Surface-active preparations, whether or not containing soap, p.r.s. (excluding those for use as soap)	20413240
	Anionic organic surface-active agents (excluding soap)	20412020
	Cationic organic surface-active agents (excluding soap)	20412030
	Non-ionic organic surface-active agents (excluding soap)	20412050
	Organic surface-active agents (excluding soap, anionic, cationic, non-ionic)	20412090
Car care products	Polishes and similar preparations, for coachwork (excluding artificial and prepared waxes, metal polishes)	20414370
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
Shaving, olfaction, personal hygiene and beauty products prepared	Other personal preparations (perfumeries, toilet, depilatories...)	20421990

Table 41 lists the PRODCOM codes used to estimate this sector via the Tier 2B methodology.

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

Equation 4: 2D3a total products utilised by MT calculation

Equation 4 was utilised 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 was 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, due to being exported during such years. It is likely that this is

caused by a discrepancy between the coverage of production statistics and trade statistics.

$$\text{NMVOC emissions} = \text{Weight of product total} * \text{Solvent content of product} * \text{kg NMVOC per kg solvent (EF)}$$

Equation 5: Formula to calculate NMVOC emissions through the Tier 2A methodology

$$\text{NMVOC emissions} = \text{Weight of product total} * \text{kg NMVOC per kg product (EF)}$$

Equation 6: Formula to calculate NMVOC emissions through the Tier 2B methodology

5.4.3 Activity Data

Data is available from Eurostat from the year 2003, so the activity data for the previous years (1990-2002) was estimated using a 5-year moving average.

5.4.4 Source-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 were checked in house as well as by the external consultants. 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 Source-specific recalculations

The entire sector has been recalculated from a Tier 1 to a Tier 2 methodology. Previously, this sector was estimated by multiplying the population by an EF.

5.4.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

5.5 Sector 2D3b: Road paving with asphalt

Table 42: Sector 2D3b general characteristics

NFR Code	**2D3b**
Sub-Category	Road paving with asphalt
Method	2019GB
Activity Data	Transport Malta & Infrastructure Malta
Emission Factor	Tier 1
Key Category	$PM_{2.5}$, PM_{10}, TSP & BC

Year of last update	2022 submission

5.5.1 Source category description

This sector covers the emissions emerging from asphalt road surfacing.

Shares of emissions of the particular pollutants from 2D3b in 2020 are shown in Figure 24.

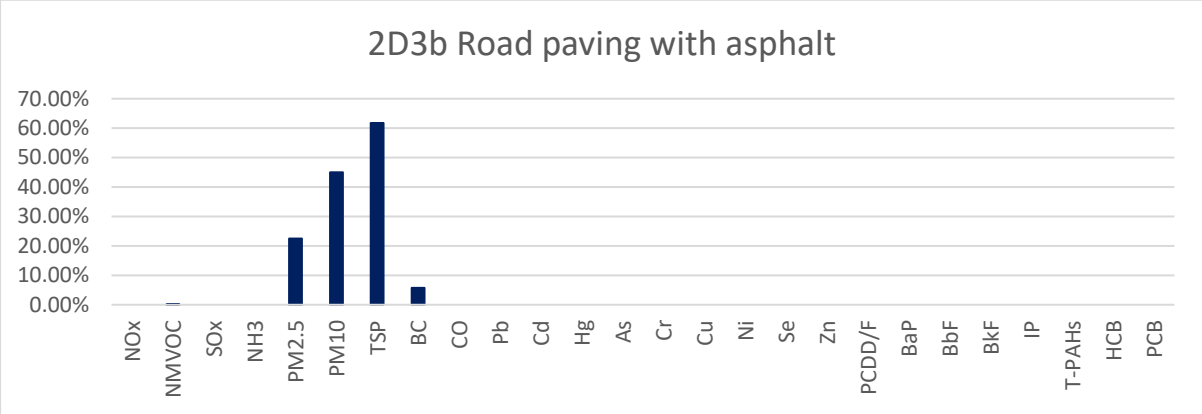

Figure 24: Shares of emissions from the NFR 2D3b category in percentage of national total

5.5.2 Methodology

Emissions were estimated through the use of the emission factors directly taken from the 2019GB.

5.5.3 Activity Data

Data for this sector for the years 2000 to 2010 was provided by Transport Malta. Data for 2018 to 2020 was provided by Infrastructure Malta. 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 utilised based on the average from 2000 to 2003.

5.5.4 Source-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 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.

5.5.5 Source-specific recalculations

The activity data was revised in line with the suggestions provided by external consultants to ensure time series consistency.

5.5.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

5.6 Sector 2D3d: Coating applications

Table 43: Sector 2D3d general characteristics

NFR Code	2D3d
Sub-Category	Coating applications
Method	2019GB
Activity Data	Eurostat
Emission Factor	Tier 2
Key Category	NMVOC
Year of last update	2022 submission

5.6.1 Source category 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 2020 are shown in Figure 25.

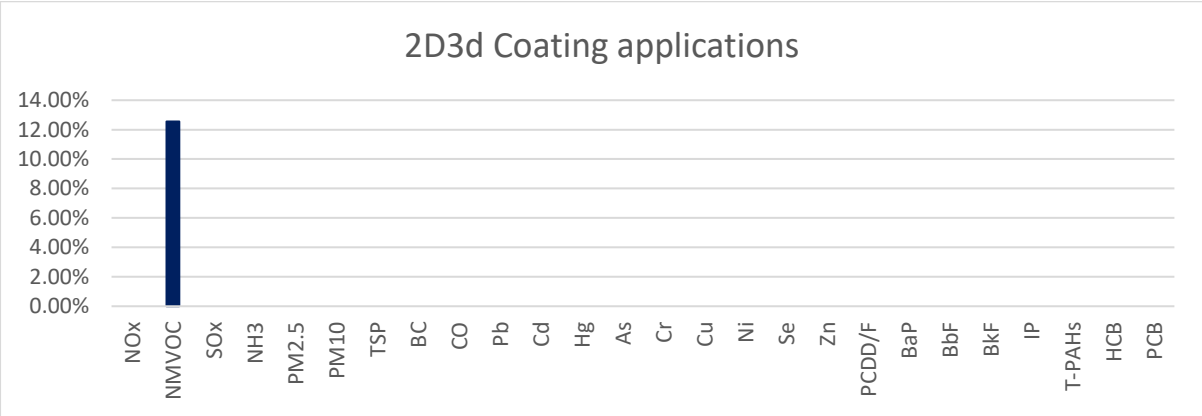

Figure 25: Shares of emissions from the NFR 2D3d category in percentage of national total

5.6.2 Methodology

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 44: Emission factors utilised for 2D3d

Year	Total paint & cleaning solvent (g/kg)
1990	165.46
2000	137.58

2007	61.08
2010	54.83

Equation 7 was used to calculate the products utilised by MT for each data year.

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

Equation 7: 2D3d total products utilised by MT calculation

As described in the section for 2D3a, this equation is for the estimation of apparent consumption, which can lead to the derivation of negative values for the total product. An assumption was therefore made in this methodology, for cases where the formula above produced a negative value (i.e. the number of products exported were higher than imported and produced combined) in that the weight of products for that year was assumed to be zero. Therefore, it was assumed that such products were not consumed locally, due to being exported during such years.

5.6.3 Activity Data

This sector is being estimated for the first time in this submission. In previous years, activity data was not available and was hence previously classified as 'NE'. As suggested by the external consultants, through the NECD capacity building project, and similarly to sector 2D3a, emissions from coating applications were estimated based on the imports and exports of products by their PRODCOM code using the Special Trade Statistics (STS) as activity data.

Data is available from the year 2003, so previous years (1990-2002) were estimated using a 5-year moving average.

Table 45: PRODCOM codes for sector 2D3d

PRODCOM Descriptions	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

5.6.4 Source-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 were checked in house as well as by the external consultants. 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.

5.6.5 Source-specific recalculations

No recalculations were done for this sector since this sector is being estimated for the first time in this submission.

5.6.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

5.7 Sector 2G: Other product use

Table 46: Sector 2G general characteristics

NFR Code	**2G**
Sub-Category	Other Product Use: Fireworks & tobacco combustion
Method	2019GB
Activity Data	Armed forces of Malta (for fireworks) & Eurostat (for both tobacco & fireworks)
Emission Factor	Tier 2
Key Category	PM2.5, BC, Pb, Zn & PCDD/PCDF
Year of last update	2022 submission

5.7.1 Source category 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 2020 are shown in Figure 26.

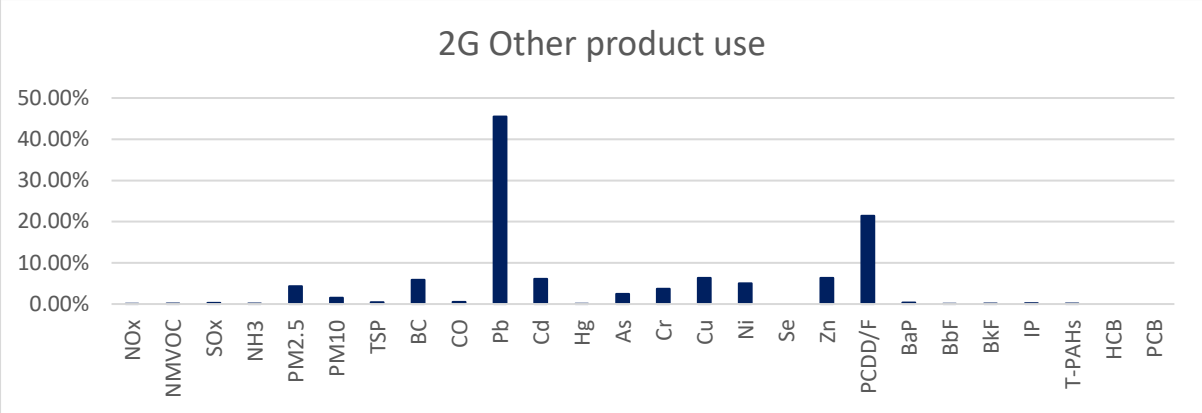

Figure 26: Shares of emissions from the NFR 2G category in percentage of national total

5.7.2 Methodology

5.7.2.1 Firework use

The methodology to estimate emissions from firework use was obtained from the 2019GB.

5.7.2.2 Tobacco combustion

The methodology to estimate emissions from tobacco combustion was obtained from the 2019GB.

5.7.3 Activity Data

5.7.3.1 Firework use

Most fireworks are manufactured locally by using raw materials, purchased from the Armed Forces of Malta. The rest are imported from foreign countries.

The total mass of materials used was calculated by subtracting the mass of exports by the total imports of the following CN codes:

- 36041000 (fireworks)
- 36049000 (Signalling flares, rain rockets, fog signals and other pyrotechnic articles (excl. fireworks and cartridge blanks)

The data on imported fireworks and flares was obtained from Eurostat, rather than the NSO. Following communication with the NSO, it was established that the NSO provides general trade statistics, whereas Eurostat provides special trade statistics. The use of special trade statistics was preferred, as general trade statistics may include products that have not yet, and may not, be placed on the market.

The amount of fireworks manufactured locally was not available. Hence, the amount of raw material used to manufacture them had to be used, and this was provided by the Armed Forces of Malta. This amount was then estimated through the methodology used within a national study by Camilleri and Vella (2016).

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 a two-year annual average available in the study by Camilleri and Vella (2016), and this value was applied for the entire time series.

Table 47: 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 48: Calculations and assumptions for estimating the yearly average quantities of flash crackers, coloured stars and black powder used in Malta 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

5.7.3.2 Tobacco combustion

The quantity of tobacco combusted locally was obtained from Eurostat, rather than the NSO. As with fireworks and flares, it was established that the NSO provides general trade statistics, whereas Eurostat provides special trade statistics. The use of special trade statistics was preferred, since general trade statistics may include products that have not yet, and may not, be placed on the market. 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)
- 24029000 (cigars, cheroots, cigarillos and cigarettes consisting wholly of tobacco substitutes).

The total amount of exports was subtracted from the imports, and the result was assumed to be equal to the amount of tobacco combusted locally.

5.7.4 Source-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.

5.7.5 Source-specific recalculations

Eurostat data was revised for the entire time series.

Model calculation issues were identified and rectified accordingly.

Emissions from lubricants from the Road Transport sector were also added to this sector. These were estimated using COPERT 5.5.1.

5.7.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

5.8 Sector 2H2: Food & Beverages Industry

Table 49: Sector 2H2 general characteristics

NFR Code	2H2

Sub-Category	Food & Beverages Industry
Method	2019GB
Activity Data	NSO
Emission Factor	Tier 2
Key Category	NMVOC
Year of last update	2022 submission

5.8.1 Source category description

This sector covers the emissions emerging from food and beverages manufacturing. Shares of emissions of the particular pollutants from 2H2 in 2020 are shown in Figure 27.

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

5.8.2 Methodology

Emissions were estimated through the use of the Tier 2 emission factors taken directly from the 2019GB.

5.8.3 Activity Data

The National Statistics Office provided most of the activity data, in particular:

- Production of home killed meat (1995 to 2020)
- Fish and seafood landed (1995 to 2020)
- Production of poultry meat (1995 to 2020)
- Production of animal feed (2003 to 2020)
- Production of red wine (2004 to 2020)
- Production of white wine (2004 to 2020)
- Production of coffee (2005 to 2020)
- Agricultural products (1995 to 2020)

The data used in missing years, for all categories, was extrapolated by using a 5-year moving average.

The total mass of bread produced was not available. Hence, the total imported flour of common wheat and spelt and rye flour were used to calculate the mass. In this respect, data on flour was only available from 2004 to 2020. Previous communication with the Malta Bakers' Cooperative had established that a sack of flour weighing 50kg would produce approximately 100 loaves. In turn, each baked loaf weighs around 540g. The calculation can be visualised below:

First, the weight of flour per loaf was calculated:

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

Equation 8: Equation to calculate the weight of flour per loaf.

Then, the number of loaves was calculated:

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

Equation 9: Equation to calculate the number of loaves

Finally, the mass of bread was calculated:

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

Equation 10: Equation to calculate the total mass of bread produced

Concerning beverages, no information was available on the amount of beer produced locally due to the confidentiality of the activity data.

5.8.4 Source-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 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 Source-specific recalculations

Within this submission, wine production was subdivided into red and white wine production.

Coffee production was also calculated within this sector for the first time within this submission.

5.8.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6 Agriculture (NFR 3)

Chapter Updated: March 2022

6.1 Category overview

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

- 3B Manure Management
- 3D Crop production and agricultural soils
- 3F Field burning of agricultural residues.

Table 50 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 50: Coverage of NFR 3 categories in 2020

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	Not Occurring				✕
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	Not Occurring				✕
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)				✕
3Da3	Not Occurring				✕
3Da4	Not Applicable (no methodology)				✕

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 2020 are shown in Figure 28. NH_3 and Cd emissions originate primarily from NFR 3.

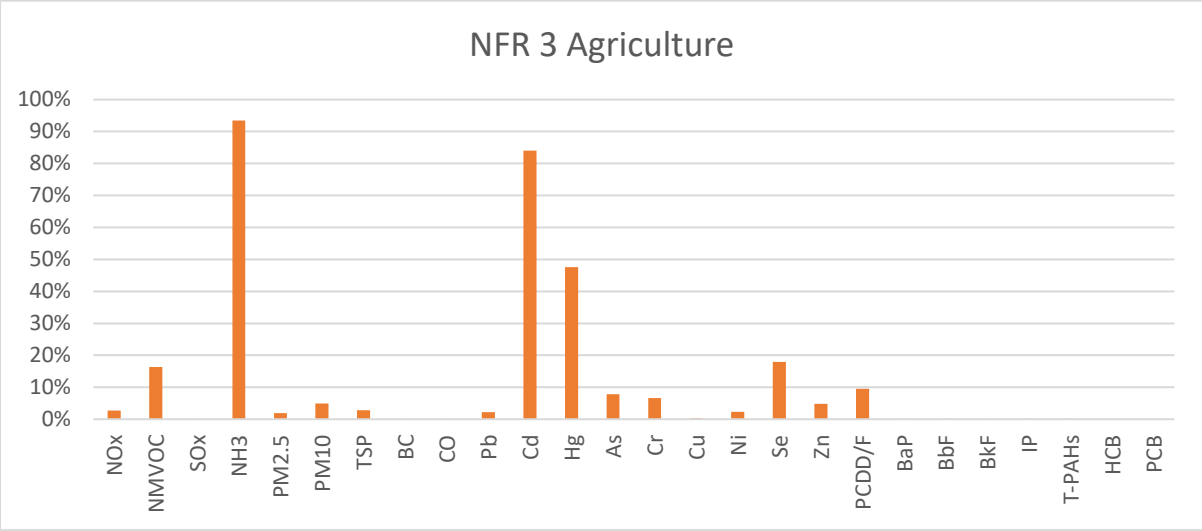

Figure 28: Shares of emissions from the NFR 3 category in percentage of national total

6.2 Sector 3B: Manure Management

6.2.1 Source category description

NH_3 and NO_x emissions from sub-chapter 3B are calculated through the Manure Management N-flow tool, as provided within the 2019GB. 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 2019GB, while $PM_{2.5}$, PM_{10}, and TSP were estimated through a Tier 1 methodology. The different activity data parameters used are as follows:

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 number of animal heads across all categories was recalculated, in line with the updated activity data, obtained from the MRA as can be observed in Table 51.

Table 51: Number of animal heads recalculations

Livestock type	Unit	1990	2000	2005	2010	2015	2018	2019
Dairy cattle	AAP	-83	0	0	0	0	0	0

Non-dairy cattle	AAP	27	0	0	0	0	0	-139
Non-dairy cattle (calves)	AAP	56	0	0	0	0	0	0
Sheep	AAP	0	0	0	0	0	0	0
Swine (finishing pigs)	AAP	-50	-20,717	-19,489	-18,413	-10,047	-8,585	-7,382
Swine (sows)	AAP	50	-98	0	0	0	0	0
Goats	AAP	54	0	0	0	0	0	0
Horses	AAP	0	0	0	0	0	0	0
Laying hens	AAP	41,959	97,327	0	0	0	0	0
Broilers	AAP	33,222	113,462	0	0	0	0	0
Other poultry	AAP	366	636	0	0	0	0	0
Other animals (rabbits)	AAP	24,495	48,467	19,990	9,913	-13,019	-13,954	-8,197

- **Weight:** Table 52 shows country-specific activity data for animal weight, compared with the default factors in the EEA Guidebook.

Table 52: Animal weight per livestock type

Livestock type	MT: Animal weight (kg)	2019GB: Animal weight (kg)	MT: Data source
Dairy cattle	550	600	KPH (Milk breeders co-operative)
Non-dairy cattle	517	340	KPH (Milk breeders co-operative)
Non-dairy cattle (calves)	200	150	KPH (Milk breeders co-operative)
Sheep	48	50	KPH (Milk breeders co-operative)
Swine (finishing pigs)	62	65	Pig Breeders Co-operative
Swine (sows)	56	225	Pig Breeders Co-operative
Goats	35	50	KPH (Milk breeders co-operative)
Horses	550	500	KPH (Milk breeders co-operative)
Laying hens	2.2	2.2	EEA Guidebook

Broilers	1	1	EEA Guidebook
Other poultry	3.5	3.5	EEA Guidebook
Other animals (fur animals)	1.6	1.6	EEA Guidebook

- **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. Hence, the total housing period is assumed to be 365 days for all livestock types. Nevertheless, the proportion of manure excreted in yards is modified to reflect the local situation. The parameters used can be observed in Table 53 and Table 54.

Table 53: Housing period per livestock type

Livestock type	MT: Housing period (days)	2019GB: 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
Laying hens	365	365	Agricultural Department
Broilers	365	365	Agricultural Department
Other poultry	365	365	Agricultural Department
Other animals (fur animals)	365	365	Agricultural Department

Table 54: Proportion of manure excreted on yards

Livestock type	MT: Proportion excreted on yards	2019GB: 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
Laying hens	0	0	Agricultural Department
Broilers	0	0	Agricultural Department
Other poultry	0	0	Agricultural Department
Other animals (fur animals)	0	0	Agricultural Department

- **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 55.

Table 55: 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%

- **Nitrogen excretion:** The Nitrogen excretion rates (Nex) were updated according to the 2019 revision of the 2006 IPCC guidelines to better reflect the latest scientific knowledge. The table below compares the Nex values provided in the N-flow tool and the revised data as used in the 2022 submission.

The changes in Nex values can be observed Table 56.

Table 56: Changes in Nex values

Animal type	Unit	2019GB	2022 submission
Dairy cattle	kg N/1000 kg animal mass day^{-1}	0.48	0.5
Non-dairy cattle	kg N/1000 kg animal mass day^{-1}	0.33	0.42
Non-dairy cattle (calves)	kg N/1000 kg animal mass day^{-1}	0.33	0.42
Sheep	kg N/1000 kg animal mass day^{-1}	0.85	0.36
Swine (finishing pigs)	kg N/1000 kg animal mass day^{-1}	0.51	0.76
Swine (sows)	kg N/1000 kg animal mass day^{-1}	0.42	0.38
Goats	kg N/1000 kg animal mass day^{-1}	1.28	0.46
Horses	kg N/1000 kg animal mass day^{-1}	0.26	0.26
Laying hens	kg N/1000 kg animal mass day^{-1}	0.77	1.08
Broilers	kg N/1000 kg animal mass day^{-1}	0.36	2.25
Other poultry	kg N/1000 kg animal mass day^{-1}	0.83	0.83
Other animals (rabbits)	kg N/1000 kg animal mass day^{-1}	13.87	13.87

- Other parameters:
  - Following communication with the Agricultural Department grazing was assumed to be 0.
  - No activity data on silage was available, and thus it was assumed to be 0.
  - 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.

6.3 Sector 3B1a: Dairy cattle

Table 57: Sector 3B1a general characteristics

NFR Code	3B1a
Sub-Category	Manure management - Dairy cattle
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	NMVOC & NH_3
Year of last update	2022 submission

6.3.1 Source 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 2020 are shown in Figure 29.

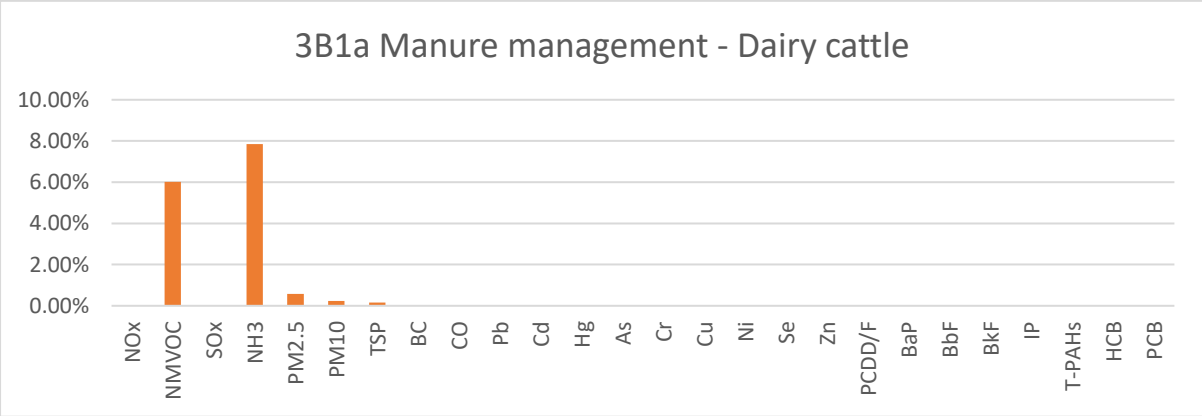

Figure 29: Shares of emissions from the NFR 3B1a category in percentage of national total

6.3.2 Methodology

The methodology is explained in Section 6.2.1.

6.3.3 Activity Data

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

6.3.4 Source-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 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.

6.3.5 Source-specific recalculations

The number of animal heads from 1990-1999 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

Additionally, the Gross Feed Intake (GE), which is calculated by the Malta Resources Authority, has been recalculated for this submission. Table 58 compares the GE value for the 2022 and 2021 submission.

Table 58: Gross feed intake recalculations

Gross Feed Intake	Unit	1990	2000	2005	2010	2015	2018	2019
2022 submission	MJ/day	308.77	319.84	268.46	306.69	291.70	291.10	295.23
2021 submission	MJ/day	271.39	319.84	286.59	327.40	318.90	318.24	322.75

6.3.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.4 Sector 3B1b: Non-dairy cattle

Table 59: Sector 3B1b general characteristics

NFR Code	3B1b
Sub-Category	Manure management – Non-dairy cattle
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	NH_3
Year of last update	2022 submission

6.4.1 Source 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 2020 are shown in Figure 30.

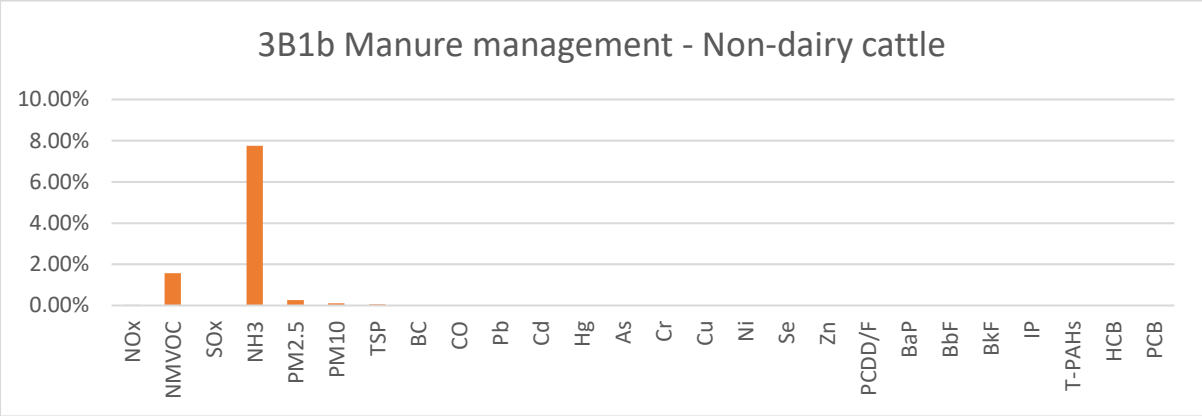

Figure 30: Shares of emissions from the NFR 3B1b category in percentage of national total

6.4.2 Methodology

The methodology is explained in Section 6.2.1. Emissions from calves and from the remaining non-dairy cattle categories were calculated separately within the N-flow tool and were then summed up within NFR 3B1b. Additionally, the 2021 IIR incorrectly stated that NH_3 emissions decreased due to a revision in the Nex value. NH_3 emissions actually increased in line with an increase in the Nex value.

6.4.3 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 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 60: 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)	

6.4.4 Source-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 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.

6.4.5 Source-specific recalculations

The number of animal heads from 1990-1999, and 2019, was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.4.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.5 Sector 3B2: Sheep

Table 61: Sector 3B2 general characteristics

NFR Code	3B2
Sub-Category	Manure management – Sheep
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	Not Applicable
Year of last update	2022 submission

6.5.1 Source 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 2020 are shown in Figure 31.

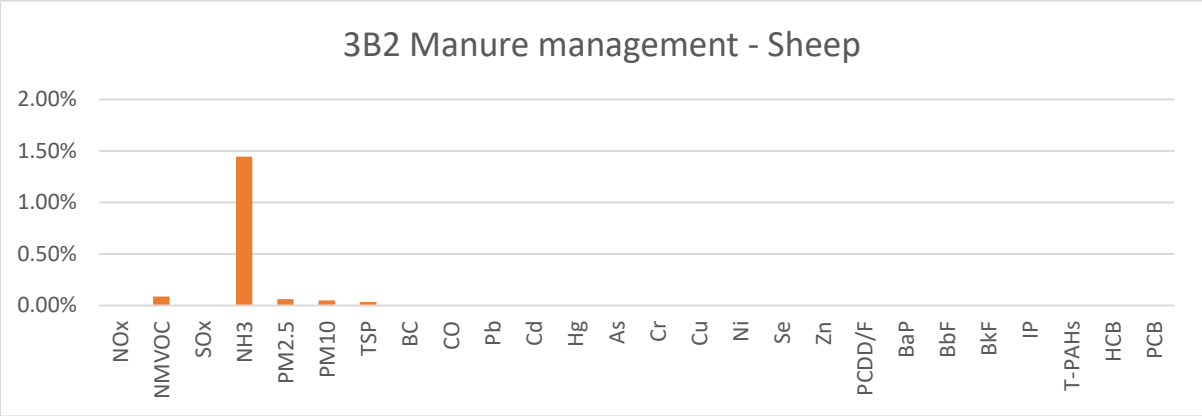

Figure 31: Shares of emissions from the NFR 3B2 category in percentage of national total

6.5.2 Methodology

The methodology is explained in Section 6.2.1.

6.5.3 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 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 62: 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

6.5.4 Source-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 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.

6.5.5 Source-specific recalculations

The number of animal heads for 2001 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.5.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.6 Sector 3B3: Swine

Table 63: Sector 3B3 general characteristics

NFR Code	**3B3**
Sub-Category	Manure management – Swine
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	NH_3
Year of last update	2022 submission

6.6.1 Source 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 2020 are shown in

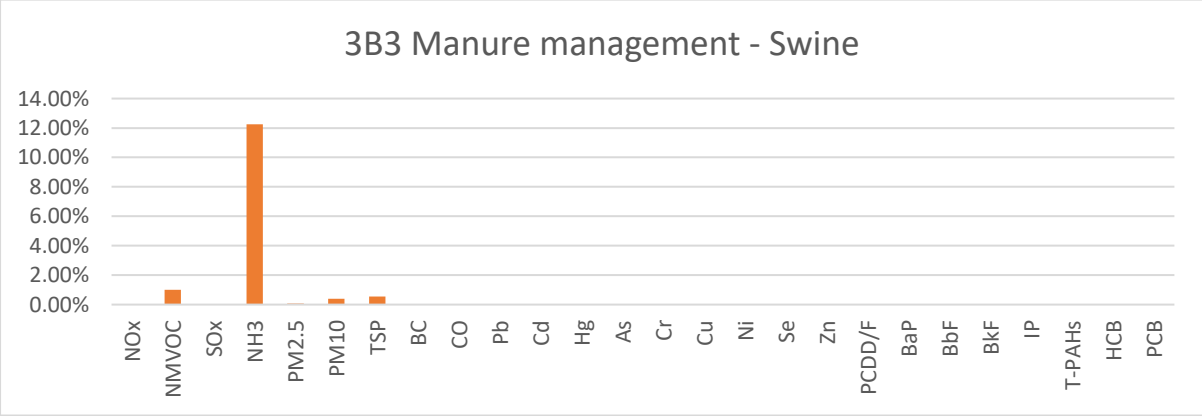

Figure 32: Shares of emissions from the NFR 3B3 category in percentage of national total

6.6.2 Methodology

The methodology is explained in Section 6.2.1. Emissions from ‘sows’ and ‘fattening pigs’ were calculated separately within the N-flow tool, and were then summed up within NFR 3B3.

6.6.3 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 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 64: 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

6.6.4 Source-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 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.

6.6.5 Source-specific recalculations

The number of animal heads for finishing pigs from 1990 to 2019, and the number of animal heads for sows from 1990 to 2000 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series. Additionally, in the 2021 submission, the

animal weight for fattening pigs was incorrectly attributed to sows and vice-versa for all years. This error was corrected for the 2022 submission.

6.6.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.7 Sector 3B4d: Goats

Table 65: Sector 3B4d general characteristics

NFR Code	3B4d
Sub-Category	Manure management – Goats
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	Not Applicable
Year of last update	2022 submission

6.7.1 Source 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 2020 are shown in Figure 33.

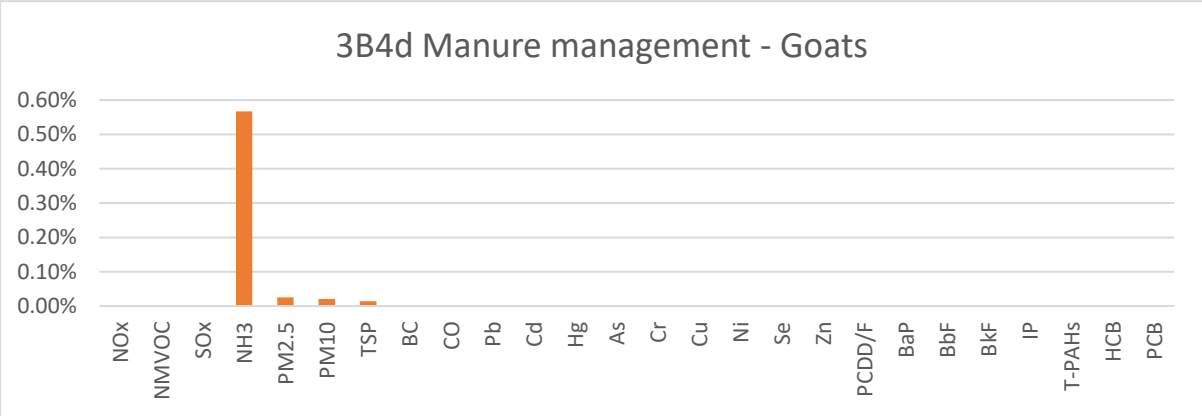

Figure 33: Shares of emissions from the NFR 3B4d category in percentage of national total

6.7.2 Methodology

The methodology is explained in Section 6.2.1.

6.7.3 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 66: 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	

6.7.4 Source-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 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.

6.7.5 Source-specific recalculations

The number of animal heads from 1990 to 1999 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.7.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.8 Sector 3B4e: Horses

Table 67: Sector 3B4e general characteristics

NFR Code	3B4e
Sub-Category	Manure management – Horses
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2

Key Category	Not Applicable
Year of last update	2022 submission

6.8.1 Source 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 2020 are shown in Figure 34.

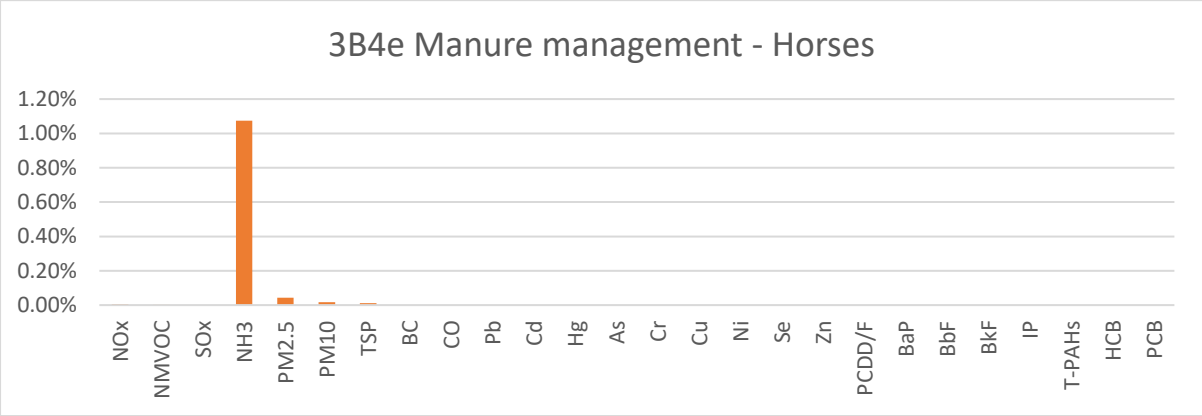

Figure 34: Shares of emissions from the NFR 3B4e category in percentage of national total

6.8.2 Methodology

The methodology is explained in Section 6.2.1.

6.8.3 Activity Data

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

6.8.4 Source-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 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.

6.8.5 Source-specific recalculations

No recalculations were carried out for this submission.

6.8.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.9 Sector 3B4gi: Laying Hens

Table 68: Sector 3B4gi general characteristics

NFR Code	3B4gi
Sub-Category	Manure management – Laying hens
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	Not Applicable
Year of last update	2022 submission

6.9.1 Source 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 2020 are shown in Figure 35.

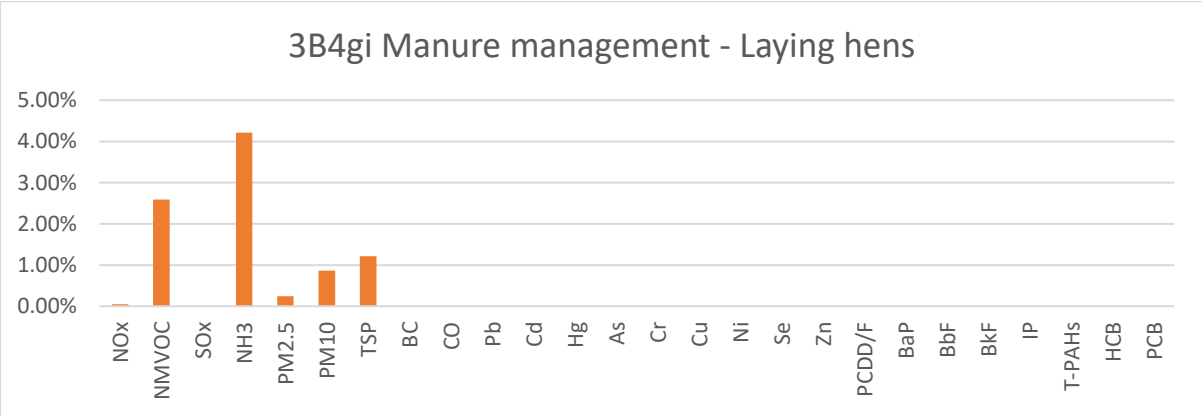

Figure 35: Shares of emissions from the NFR 3B4gi category in percentage of national total

6.9.2 Methodology

The methodology is explained in Section 6.2.1.

6.9.3 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 for laying hens, as with previous submissions. Since the N-flow tool requires that the Nex value is in kgN/1000kg animal mass day^{-1}, the value was converted to 1.1kgN/1000kg animal mass day^{-1}.

6.9.4 Source-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 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.

6.9.5 Source-specific recalculations

The number of animal heads from 1990 to 2000 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.9.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.10 Sector 3B4gii: Broilers

Table 69: Sector 3B4gii general characteristics

NFR Code	3B4gii
Sub-Category	Manure management – Broilers
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	NMVOC & NH_3
Year of last update	2022 submission

6.10.1 Source 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 2020 are shown in Figure 36.

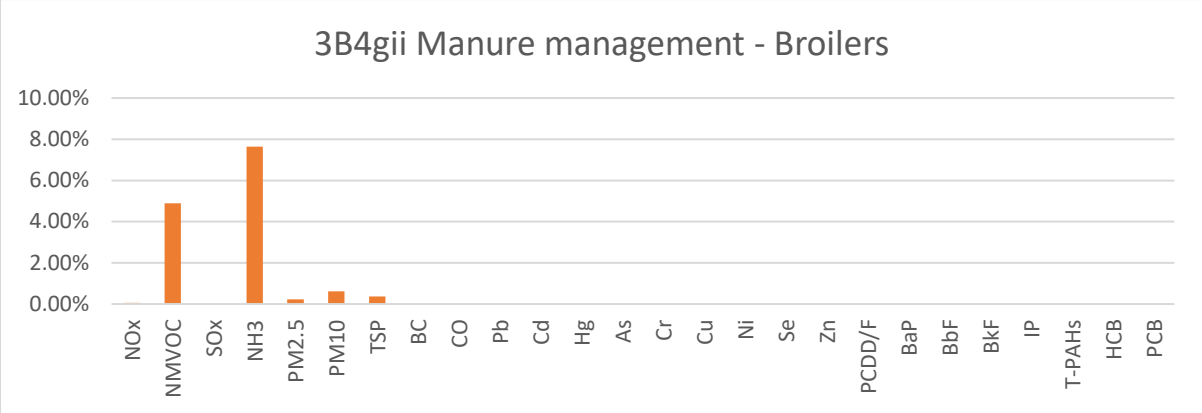

Figure 36: Shares of emissions from the NFR 3B4gii category in percentage of national total

6.10.2 Methodology

The methodology is explained in Section 6.2.1.

6.10.3 Activity Data

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

6.10.4 Source-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 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.

6.10.5 Source-specific recalculations

The number of animal heads from 1990 to 2000, was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

Table 56 shows that the Nex value was changed from the default value provided in the 2019GB. The Sustech report (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. Since the N-flow tool requires that the Nex value is in kgN/1000kg animal mass day^{-1}, the value was converted to 2.25kgN/1000kg animal mass day^{-1}.

6.10.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.11 Sector 3B4giv: Other Poultry

Table 70: Sector 3B4giv general characteristics

NFR Code	3B4giv

Sub-Category	Manure management – Other Poultry
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	Not Applicable
Year of last update	2022 submission

6.11.1 Source category description

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

Shares of emissions of the particular pollutants from this sector in 2020 are shown in Figure 37.

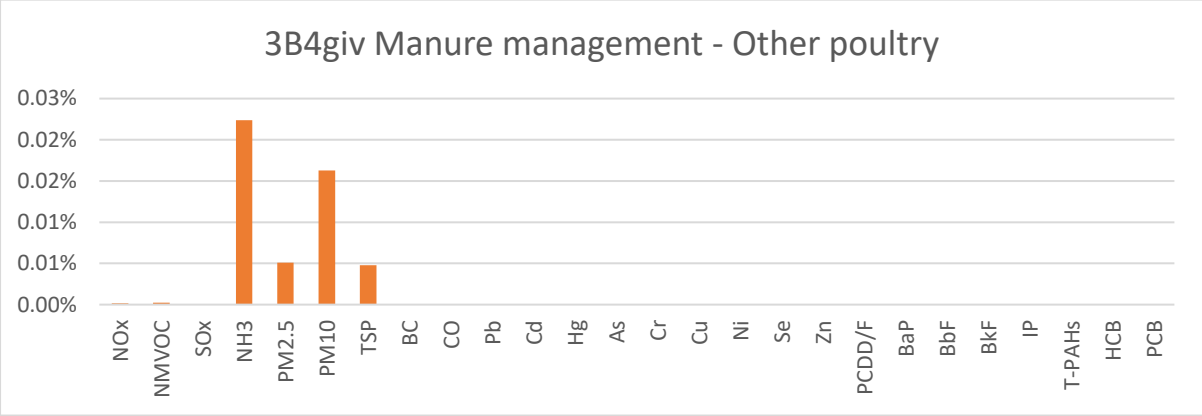

Figure 37: Shares of emissions from the NFR 3B4giv category in percentage of national total

6.11.2 Methodology

The methodology is explained in Section 6.2.1.

6.11.3 Activity Data

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

6.11.4 Source-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 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.

6.11.5 Source-specific recalculations

The number of animal heads from 1990 to 2000, was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.11.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.12 Sector 3B4h: Other animals (rabbits)

Table 71: Sector 3B4h general characteristics

NFR Code	3B4h
Sub-Category	Manure management – Other animals (rabbits)
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1 & 2
Key Category	NH_3
Year of last update	2022 submission

6.12.1 Source 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 2020 are shown in Figure 38.

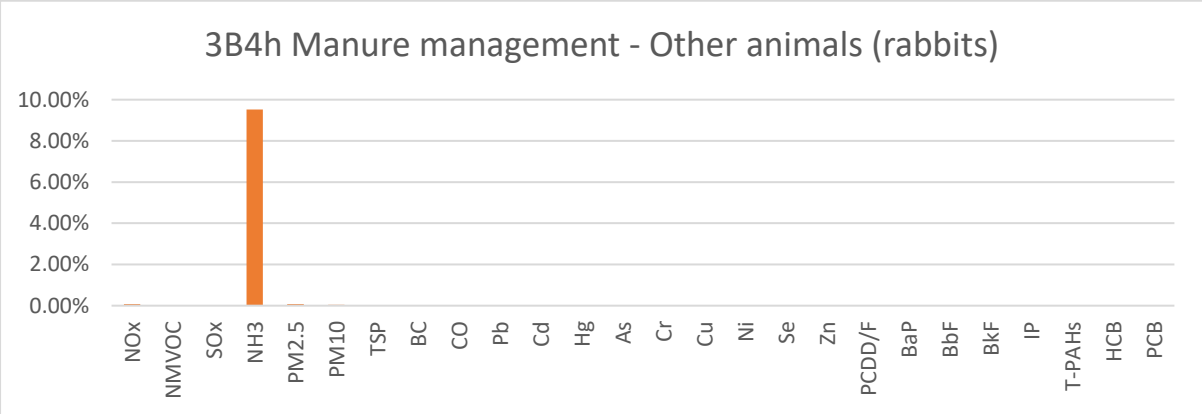

Figure 38: Shares of emissions from the NFR 3B4h category in percentage of national total

6.12.2 Methodology

The methodology is explained in Section 6.2.1.

6.12.3 Activity Data

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

6.12.4 Source-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 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.

6.12.5 Source-specific recalculations

The number of animal heads from 1990 to 2000 was updated in line with the activity data used by the Malta Resources Authority. Table 51 provides an overview of the changes in animal heads across the entire time series.

6.12.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.13 Sector 3D: Crop Production and Agricultural Soils

6.13.1 Sector 3Da1: Inorganic N fertilisers (Includes Urea)

Table 72: Sector 3Da1 general characteristics

NFR Code	3Da1
Sub-Category	Inorganic N fertilisers (Includes Urea)
Method	2019GB
Activity Data	Malta Resources Authority
Emission Factor	Tier 1
Key Category	Not Applicable
Year of last update	2022 submission

6.13.1.1 Source category 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 2020 are shown in Figure 39.

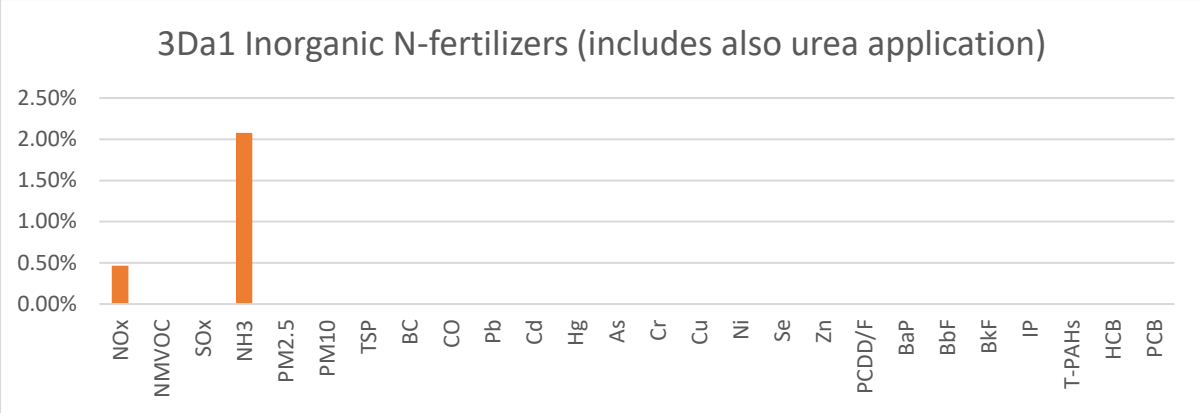

Figure 39: Shares of emissions from the NFR 3Da1 category in percentage of national total

6.13.1.2 Methodology

This sector was calculated through a Tier 1 methodology provided within the 2019GB. 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.

6.13.1.3 Activity Data

Regarding activity data, synthetic fertilizer application rates were not available over a time series. However, an annual figure was obtained through an estimation carried out with the data used by the Malta Resources Authority. The NSO study on the Gross Nitrogen Balance for Malta conducted in 2007 served to provide the N input from synthetic fertilisers for that year, and the study used to estimating the N input across the entire time series. The utilised agricultural area (UAA), as provided by NSO, is available for the entire time series. Hence, an average value of N input of 60.3 kg N per ha of UAA in 2007 was applied across the entire time series, and then modified according to fertilizer consumption rates. The average N input value for a specific year is then multiplied by the UAA. Nevertheless, it is worth noting that the UAA, which is provided by the NSO through its Farm Survey, is only available from 2001 onwards. Furthermore, it is only calculated every 2 or 3 years. FAOSTAT data is used for filling of gaps in the 1990 to 2000 period. Interpolation is used for years where no statistics are available.

6.13.1.4 Source-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 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.

6.13.1.5 Source-specific recalculations

No recalculations were carried out for this submission.

6.13.1.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.13.2 Sector 3Da2a: Animal manure applied to soils

Table 73: Sector 3Da2a general characteristics

NFR Code	3Da2a
Sub-Category	Animal manure applied to soils
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1
Key Category	NH_3
Year of last update	2022 submission

6.13.2.1 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 2020 are shown in Figure 40.

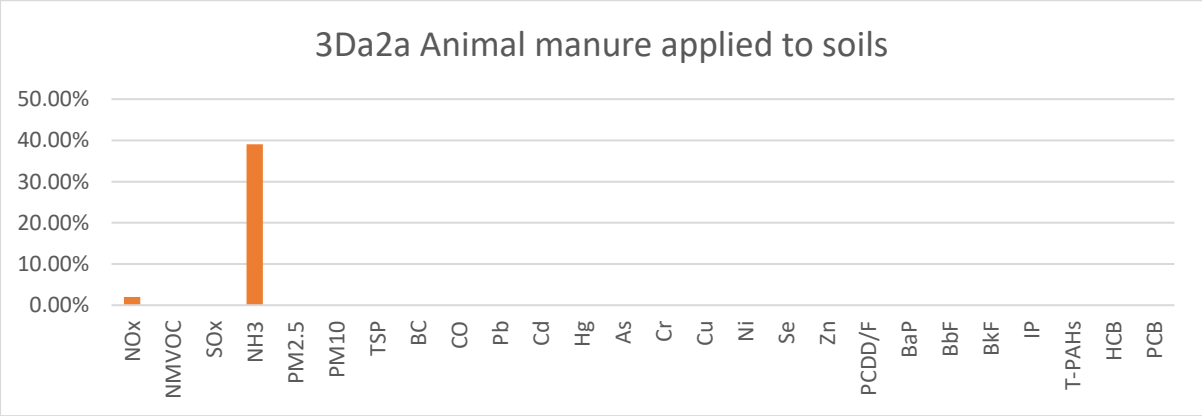

Figure 40: Shares of emissions from the NFR 3Da2a category in percentage of national total

6.13.2.2 Methodology

The methodology is explained in Section 6.2.1.

6.13.2.3 Activity Data

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

6.13.2.4 Source-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 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.

6.13.2.5 Source-specific recalculations

As explained in Section 6.2.1, recalculations were carried out for the number of animal heads across multiple livestock categories, as well as for the Nex value for broilers.

6.13.2.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.13.3 Sector 3Dc: Farm-level agricultural operations including storage, handling and transport of agricultural products

Table 74: Sector 3Dc general characteristics

NFR Code	3Dc
Sub-Category	Farm-level agricultural operations including storage, handling and transport of agricultural products
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 2
Key Category	PM_{10}
Year of last update	2022 submission

6.13.3.1 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 2020 are shown in Figure 41.

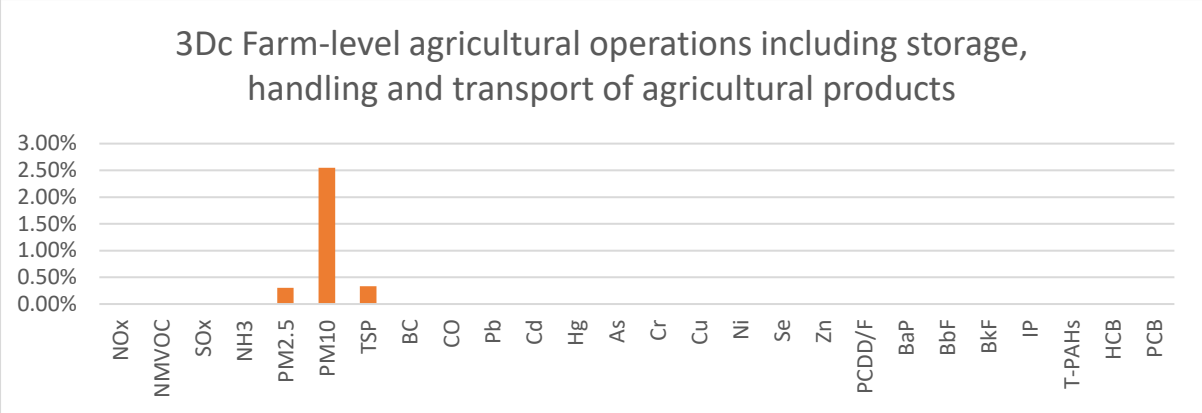

Figure 41: Shares of emissions from the NFR 3Dc category in percentage of national total

6.13.3.2 Methodology

$PM_{2.5}$, PM_{10}, and TSP emissions from this sector were calculated through the Tier 2 methodology provided by the 2019GB.

6.13.3.3 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 2019GB. The dry climate EFs were used, as Malta has a semi-arid climate (Galdies, 2011).

Table 75: Crop type for each category under 3DC

Category in 2019GB	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

6.13.3.4 Source-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 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.

6.13.3.5 Source-specific recalculations

No recalculations were carried out for this submission.

6.13.3.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.13.4 Sector 3De: Cultivated crops

Table 76: Sector 3De general characteristics

NFR Code	3De
Sub-Category	Cultivated crops
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 2
Key Category	Not Applicable
Year of last update	2022 submission

6.13.4.1 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 2020 are shown in Figure 42.

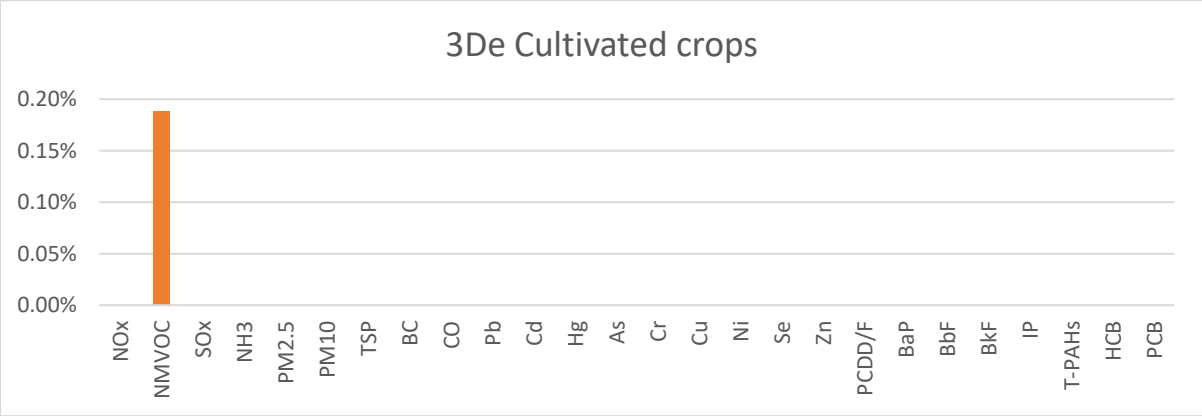

Figure 42: Shares of emissions from the NFR 3De category in percentage of national total

6.13.4.2 Methodology

NMVOC emissions from this sector were calculated through the Tier 2 methodology presented in the 2019GB.

6.13.4.3 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 2019GB. The EF for Grass 25°C was used to better represent Malta's Mediterranean climate (Galdies,

2011). The country specific dry matter per ha, as provided by the MRA, was used for wheat.

Table 77: Crop type for each category under 3DE

Category in 2019GB	Crop type
Wheat	Land area under wheat
Other arable	Land area under barley, bean, potato, carrot, clover & vetch (sulla)
Grass 25°C	Land area under fodder & other fodder

6.13.4.4 Source-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 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.

6.13.4.5 Source-specific recalculations

No recalculations were carried out for this submission.

6.13.4.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

6.13.5 Sector 3F: Field burning of agricultural residues

Table 78: Sector 3F general characteristics

NFR Code	3F
Sub-Category	Field burning of agricultural residues
Method	2019GB
Activity Data	National Statistics Office
Emission Factor	Tier 1
Key Category	Cd, Hg, As, Cr, Se & PCDD/PCDF
Year of last update	2022 submission

6.13.5.1 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 2020 are shown in Figure 43.

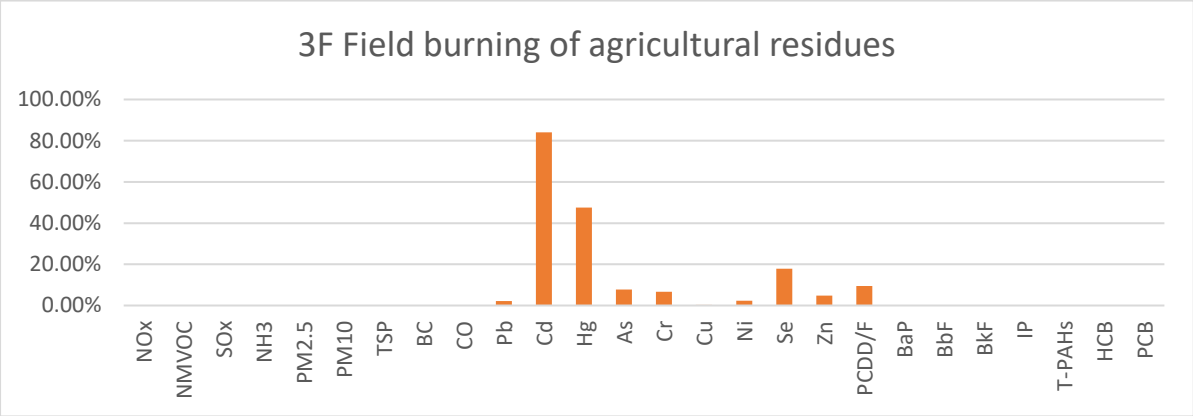

Figure 43: Shares of emissions from the NFR 3F category in percentage of national total

6.13.5.2 Methodology

Emissions from this sector were calculated through the Tier 1 methodology provided within the 2019GB.

6.13.5.3 Activity Data

The total burnt area in ha was not available, therefore, the entire Utilised Agriculture Area (UAA) was assumed to be burnt. The UAA was subdivided as can be seen in Table 79.

Table 79: Subdivisions of Utilised 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 2019GB are presented in Table 80 (where no EF for beans or barley is available, the value for wheat was used).

Table 80: 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

6.13.5.4 Source-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 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.

6.13.5.5 Source-specific recalculations

This sector was recalculated through the methodology provided within the 2019GB for the first time in this submission, as previous submissions were based on recurring figures.

6.13.5.6 Source-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: March 2022

7.1 Category overview

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

- 5A
- 5B2
- 5C1bv
- 5C2
- 5D3
- 5E

Table 81 shows the detailed source categories for waste. The relevant pollutant trends for key categories, as well as the methodologies used are explained in the sections below.

Table 81: Coverage of NFR 5 categories in 2020

NFR Code	**Pollutants**			**Method**	**KC**
	Covered	Exceptions			
		NE	NA		

5A	NMVOC, $PM_{2.5}$, PM_{10}, TSP	-	Rest of Pollutants	Tier 3	✓
5B1	Not Occurring				✕
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	✓

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

Shares of emissions from this NFR sector for all pollutants in 2020 are shown in Figure 44. Most pollutants emissions from this category are below 5% of the national total with the exception of Se, PCDD/PCDF and HCB.

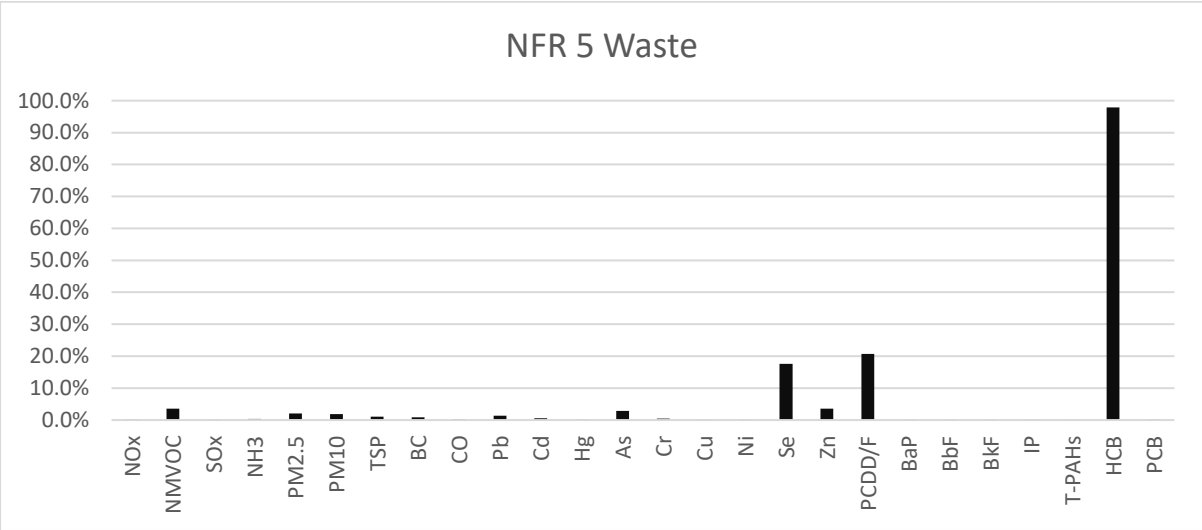

Figure 44: Shares of emissions from the NFR 5 category in percentage of national total

7.2 Sector 5A: Biological Treatment of Waste – Solid Waste Disposal

Table 82: Sector 5A general characteristics

NFR Code	**5A**
Sub-Category	Biological Treatment of Waste – Solid Waste Disposal

Method	2019GB
Activity Data	ERA Waste Team
Emission Factor	Tier 2 & 3
Key Category	NMVOC
Year of last update	2022 submission

7.2.1 Source category description

This subcategory includes emissions of air pollutants from municipal and industrial solid waste treatment by disposal on land. Shares of emissions of the particular pollutants from 5A in 2020 are shown in Figure 45.

Figure 45: Shares of emissions from the NFR 5A category in percentage of national total

7.2.2 Methodology

NMVOC emissions were calculated through a methodology proposed by the TERT, which based its estimation on the CH_4 emissions reported in the UNFCCC Framework. The volume of CH_4 in m^3 was then calculated through the equation below:

$$Total\ \mathrm{CH_4}\ emitted\ *\ \mathrm{CH_4}\ molecular\ density\ (0.714) = Volume\ of\ \mathrm{CH_4}$$

Equation 11: Calculation of volume of CH_4

The volume of biogas in m^3 was then calculated through the equation below, whereby the fraction of CH_4 in biogas was taken from the IPCC 2006 Guidebook:

$$\frac{Volume\ of\ \mathrm{CH_4}}{Fraction\ of\ \mathrm{CH_4}\ in\ biogas\ (50\%)} = Volume\ of\ biogas$$

Equation 12: Calculation of volume of biogas

The final NMVOC emissions were calculated through the equation below, the fraction of NMVOCs was taken from the 2019GB:

$$Volume\ of\ biogas * Fraction\ of\ \text{NMVOC}\ in\ biogas\ (5.65 g/m^3) = \text{NMVOC}\ emissions$$

Equation 13: Calculation of NMVOC emissions

Concerning emissions from $PM_{2.5}$, PM_{10}, and TSP, these were calculated through the Tier 3 methodology present within the 2019GB. The equation below was utilized:

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

Equation 14: Calculation of the $PM_{2.5}$, PM_{10} and TSP emissions

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

7.2.3 Activity Data

The activity data consists of all waste disposed of in landfills, excluding anaerobic digestate and animal manure. The emissions from these two contributions were estimated within other sectors. The Waste Team at the Environment & Resources Authority (ERA) provided the total waste disposed in landfills through the waste management facility reports. Additionally, the mean wind speed was provided by the Malta Met Office. A mean wind speed for each year within the time series was provided. The default factor provided in the 2019GB was used for the moisture content of the materials landfilled. CH_4 emissions were provided by the Malta Resources Authority (MRA).

7.2.4 Source-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 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 Source-specific recalculations

The annual mean wind speeds covering the entire time series were utilized and provided for the first time within this submission. Hence, the entire time series was recalculated for pollutants $PM_{2.5}$, PM_{10} and TSP.

Revised activity data provided by MRA (CH_4) was utilized for this submission. NMVOC emissions were therefore revised for years 2010 onwards.

7.2.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

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

Table 83: Sector 5B2 general characteristics

NFR Code	5B2
Sub-Category	Biological Treatment of Waste – Anaerobic Digestion at Biogas Facilities
Method	2019GB
Activity Data	ERA Waste Team
Emission Factor	Tier 2
Key Category	Not Applicable
Year of last update	2022 submission

7.3.1 Source category description

This subcategory includes NH_3 emissions biological treatment of waste - anaerobic digestion (AD) at biogas facilities. In Malta, we currently have two AD facilities namely:

1. Malta North waste treatment facility
2. Sant'Antnin waste treatment facility

Shares of emissions of the particular pollutants from 5B2 in 2020 are shown in Figure 46.

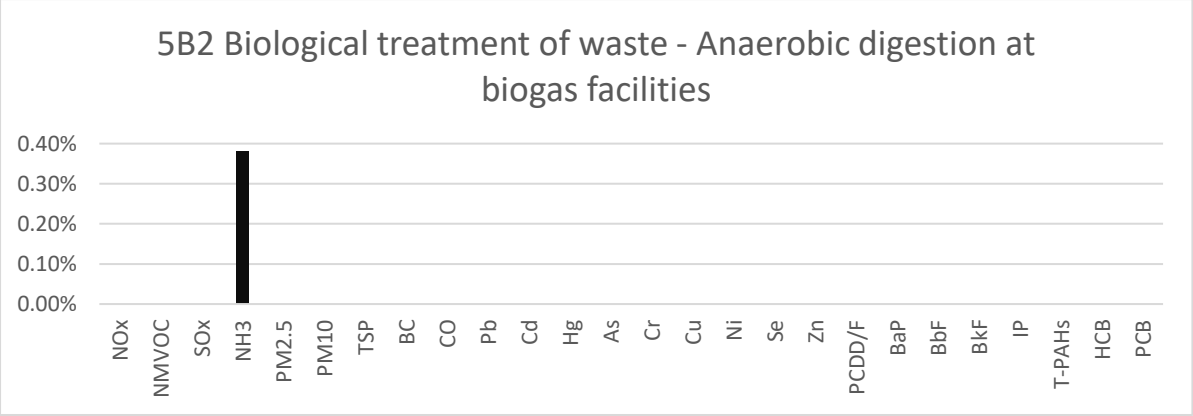

Figure 46: Shares of emissions from the NFR 5B2 category in percentage of national total

7.3.2 Methodology

A Tier 2 methodology based on the 2019GB was used to estimate emissions. The following equation was used to estimate NH_3 emissions:

$$E_{NH_3} = AR_{\text{feedstock}} \text{ x } EF_{NH_3\text{-}N,\, stage\, i} \text{ x } 17/14$$

Equation 15: Calculation of NH_3 emissions from anaerobic digestion

The $AR_{feedstock}$ refers to the total annual amount of N in feedstock (organic fraction entering the biogas facility). This was estimated by multiplying the organic fraction made available in the AER with the respective N content default factor made available in the 2019GB. Emission factors of NH_3, *stage i* refers to NH_3 emission factors at different stages. The pre-storage and storage of non-separate digestate were the only two stages considered relevant for local practices.

7.3.3 Activity Data

The organic fraction entering the Anaerobic Digester was provided for 2011 to 2017 at Sant'Antnin waste treatment facility, and for all years at Malta North waste treatment facility. The 2018 to 2020 figures at Sant' Antnin 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.

Data for this sector was provided by the Waste Team within the Environment & Resources Authority (ERA) through the annual environmental reports. The Sant'Antnin waste treatment 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.

7.3.4 Source-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 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 Source-specific recalculations

An error was identified within the model for years 2018 and 2019 originating from the Sant'Antnin waste treatment facility Wet Mechanical Treatment Plant calculation. The relevant recalculations were performed for both years.

7.3.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

7.4 Sector 5C1bv: Cremation

Table 84: Sector 5C1bv general characteristics

NFR Code	**5C1bv**
Sub-Category	Cremation
Method	2019GB

Activity Data	Annual Environmental Report – ERA Waste Team
Emission Factor	Mixed Tier
Key Category	Se & HCB
Year of last update	2022 submission

7.4.1 Source category description

Waste covered in the following categories within the 2019GB: 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). Hence, the categories 5C1a, 5C1b, and 5C1biii are all classified as IE as clearly marked in Table 81.

Shares of emissions of the particular pollutants from 5C1bv in 2020 are shown in Figure 47.

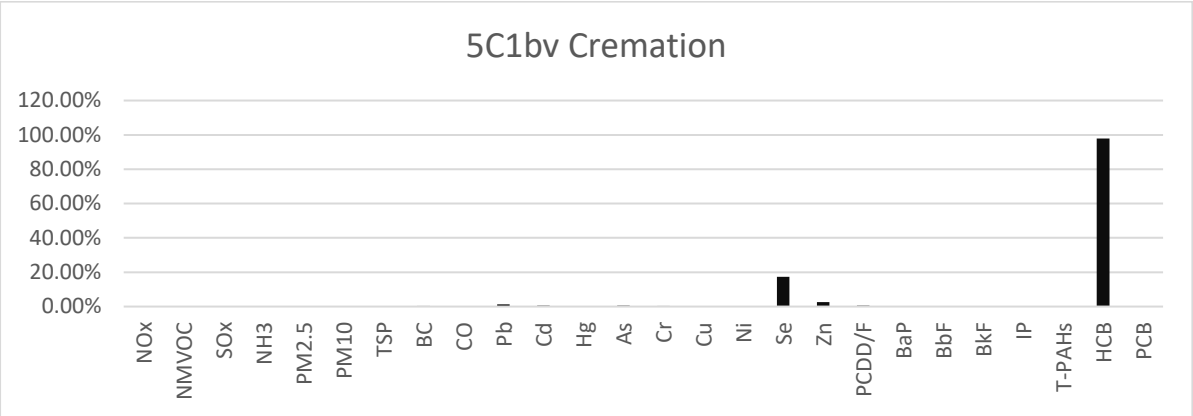

Figure 47: Shares of emissions from the NFR 5C1bv category in percentage of national total

7.4.2 Methodology

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, 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 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 other pollutants, and thus these emissions had to be calculated through the Tier 1 methodology provided in the 2019GB. The pollutants include: BC, Se, Zn, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, and PCBs.

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 2019GB. The emissions from the four categories were summed to obtain a single emission load per pollutant.

7.4.3 Activity Data

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

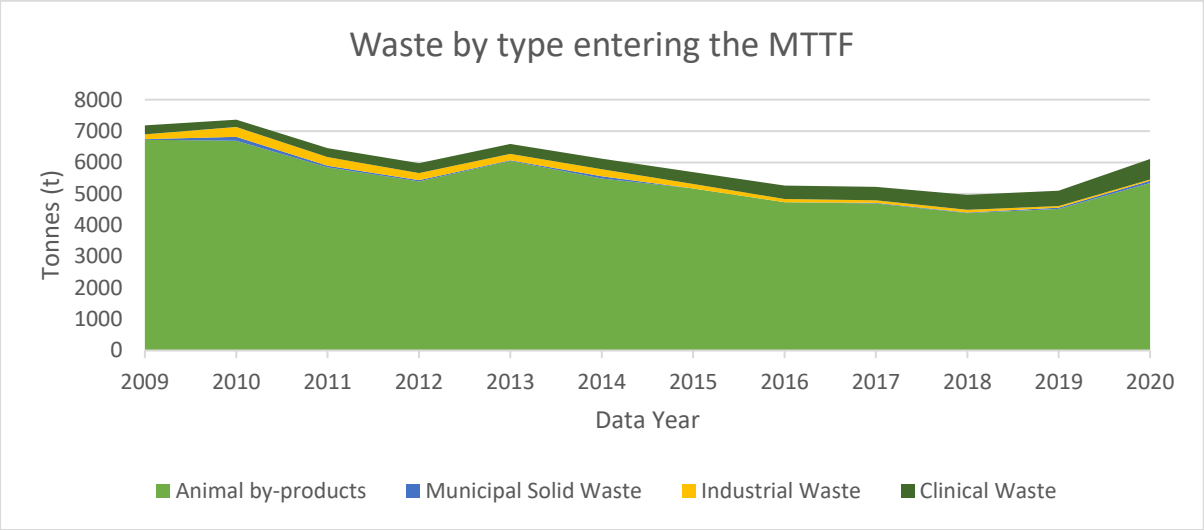

Figure 48: Categorised waste entering the thermal treatment facility

Figure 48 shows the total waste entering the MTTF, as classified by waste type. The greatest fraction of waste entering the MTTF is animal waste. As there is no specific EF for the cremation of animal by products, the EF for the cremation of human bodies [Cremation sector (5C1bv)] has been used to calculate emissions for this sector.

Clinical waste is the second largest source of waste, while municipal solid waste and industrial waste make up significantly smaller fractions. The general trend shows a decrease in waste entering the facility, mostly attributed to a decrease in the cremation sector. In contrast, clinical waste has increased across the time series.

7.4.4 Source-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 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 Source-specific recalculations

An error was identified within the model's conversion factors for the 4 Total PAHs. This was subsequently rectified.

The NH_3 calculation for the year 2019 was incorrect since it utilised values derived from the country specific emission factor as opposed to those obtained through direct measurements.

Country specific emission factors of pollutants; CO, SO_2, NMVOC, 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 years within the calculation.

7.4.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

7.5 Sector 5C2: Open Burning of Waste

Table 85: Sector 5C2 general characteristics

NFR Code	5C2
Sub-Category	Open Burning of Waste
Method	2019GB
Activity Data	NSO
Emission Factor	Tier 1
Key Category	Not Applicable
Year of last update	2022 submission

7.5.1 Source category description

This category covers the volume reduction, by open burning, of small-scale (agricultural) waste. Emissions were first estimated within the 2020 submission. Shares of emissions of the particular pollutants from 5C2 in 2020 are shown in Figure 49.

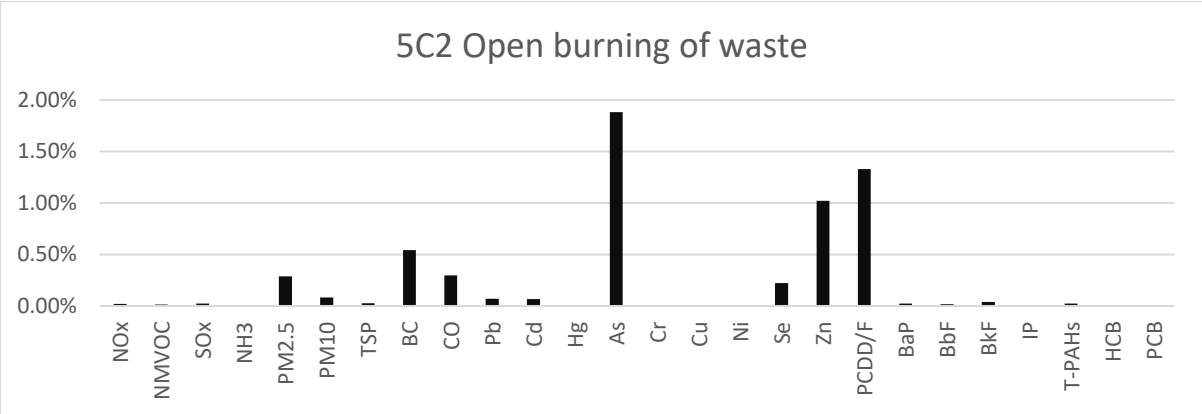

Figure 49: Shares of emissions from the NFR 5C2 category in percentage of national total

7.5.2 Methodology

A Tier 1 methodology is utilized for this sector. The data “Amount of waste burnt” is not currently available. Hence, the 2019GB estimate of 25kg of waste burnt per hectare arable area was utilized. The arable area was assumed to be equal to the utilised agricultural area, which was previously described in Chapter 3D. This sector generates various pollutant emissions, and these were calculated by multiplying the activity data with the Tier 1 emission factors in the 2019GB.

7.5.3 Activity Data

The annual data of utilised agricultural area (UAA) required for this sector’s calculation was provided by NSO.

7.5.4 Source-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 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 Source-specific recalculations

Revised activity data provided by NSO was utilized for this submission, which altered the 2019 UAA. All pollutant emissions were therefore revised for year 2019.

7.5.6 Source-specific planned improvements

Data availability is a major limitation within this sector. Efforts will be made to obtain the necessary data

7.6 Sector 5D3: Other Wastewater Handling

Table 86: Sector 5D3 general characteristics

NFR Code	**5D3**
Sub-Category	Other Wastewater Handling
Method	2019GB
Activity Data	Water Services Corporation
Emission Factor	Tier 1
Key Category	Not Applicable
Year of last update	2022 submission

7.6.1 Source category description

This sector covers emissions from treated wastewater. Shares of emissions of the particular pollutants from 5D3 in 2020 are shown in Figure 50.

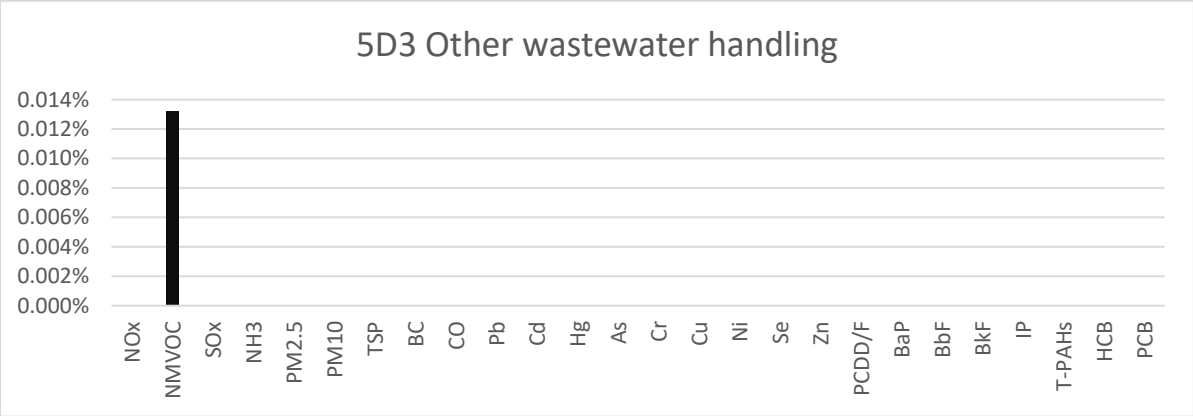

Figure 50: Shares of emissions from the NFR 5D3 category in percentage of national total

7.6.2 Methodology

This sector is estimated through the Tier 1 methodology provided in the 2019GB. This sector generates NMVOC emissions, and these were calculated by multiplying the activity data with the Tier 1 emission factors in the 2019GB.

7.6.3 Activity Data

The Water Services Corporation (WSC) provided the activity data. This consisted of the total wastewater treated annually from 1990 to 2020 at four facilities:

1. Ta' Barkat Sewage Treatment Plant
2. Iċ-Ċumnija Sewage Treatment Plant
3. The Sant'Antnin Mechanical and Biological Treatment Plant
4. Ras il-Ħobż Sewage Treatment Plant

7.6.4 Source-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. The activity data utilised 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.

7.6.5 Source-specific recalculations

No recalculations were carried out for this submission.

7.6.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

7.7 Sector 5E: Other Waste

Table 87: Sector 5E general characteristics

NFR Code	5E
Sub-Category	Other Waste
Method	2019GB
Activity Data	Civil Protection Department
Emission Factor	Tier 2
Key Category	PCDD/PCDF
Year of last update	2022 submission

7.7.1 Source category description

This category covers the emissions originating from car and building fires. Shares of emissions of the particular pollutants from 5E in 2020 are shown in Figure 51.

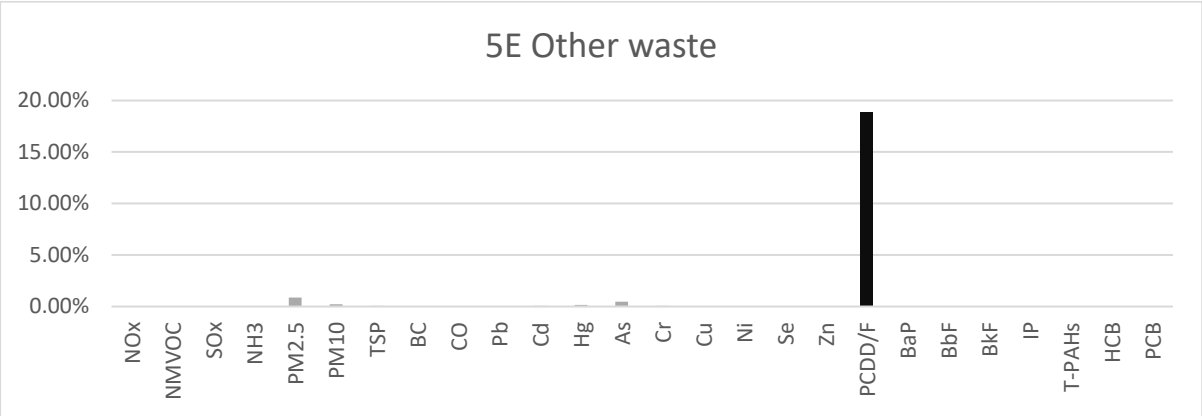

Figure 51: Shares of emissions from the NFR 5E category in percentage of national total

7.7.2 Methodology

The Tier 2 approach provided in the 2019GB was utilised 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 mostly similar to apartments. The Civil Protection Department (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 NSO census, the average area percentage of cars and buildings burnt during a fire, was calculated as shown below:

Table 88: Share of vehicles and buildings burnt

Parameter	Rooms burnt	No. of rooms	% of structure

Car	NA	NA	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	NA	NA	60.0%

7.7.3 Activity Data

The CPD provided the activity data for the years 2000 to 2020. Data for the remaining historical years was extrapolated from the aforementioned data. The activity data made available did not differentiate between different types of dwellings. Hence, the share of dwellings provided within the NSO (2011) census was used to determine the share of detached houses, undetached houses, and apartments catching fire. The number of car and industrial building fires was provided directly by the CPD.

The CPD provided direct values for the following parameters: houses/apartments, hotels/guest houses, industrial building and vehicles/trucks for the years 2000 to 2015. For years 2016 onwards, CPD provided all of the calls received from their end uncategorized. Categorization of the various call descriptions was carried out to enable successful calculation of emissions.

7.7.4 Source-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 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 Source-specific recalculations

The fires listed within the CPD database were not classified according to the categories listed within the 2019GB. The manner in which these fires were classified was altered in this submission.

7.7.6 Source-specific planned improvements

Presently, no planned improvements are scheduled for this category.

8 Projections

Chapter Updated: March 2022

Pursuant to Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants and the LRTAP Convention, projections are to be reported every two years starting in 2017. Malta reported projections in 2021 and reference to these is found in the Informative Inventory Report for Malta 2019. No projections reporting was expected for the 2022 submission for reporting year 2020. Projections will be reported in next year's submission for reporting year 2021.

9 Trends

Chapter Updated: March 2022

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.

9.1 Trends for Nitrogen Oxides (NO_x)

In 1990, the national total of NO_x emissions amounted to 8.3kt whereas in 2020 the total NO_x emissions amounted to 5.04kt. An increasing trend was recorded in the mid-90s, however, as one can note in the below figure, following the decommissioning of the Marsa Power Station in 2015, which operated on heavy fuel oil, the inauguration of the Malta-Sicily interconnector cable in 2015, which transmits more than 200MW of energy and Malta's switch to natural gas in 2017, drastic reductions in NO_x emissions were recorded, particularly in recent years.

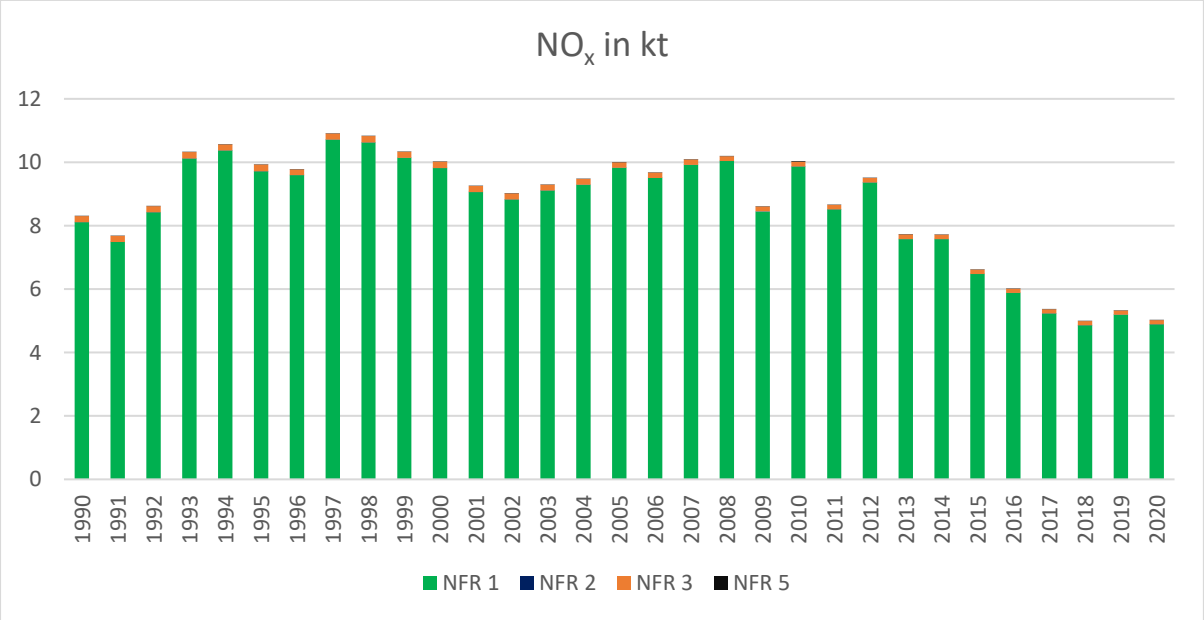

Figure 52: NO_x emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs

Throughout the time series, the largest sources of emissions of NO_x were attributed to the *Road Transport* (1A3b-1A3iv) accounting for an average of 34.9% followed by the

Public Electricity and Heat Production sector (1A1a), which on average constitutes 34.4% of all NO_x emissions. The *Public Electricity and Heat Production* sector recorded an all-time low in 2018 with a 5.6% contribution towards NO_x emissions. At the end of 2019 and throughout the first quarter of 2020, Malta had to switch to the full operation of the Delimara Power Station following damage to the Malta-Sicily sub-marine interconnector cable in order to replace the missing capacity from the interconnector and ensure power generation throughout the country was not disrupted. As a result, an increase in NO_x emissions was recorded. In the last few years Road Transport (1A3bi, 1A3bii, and 1A3biii) has become the major contributor to NO_x emissions followed by the Commercial and Institutional sector (1A4ai), National Navigation (1A3dii) and the Stationary Combustion sector (1A2gviii) as well as Recreational Boating (1A5b). The below table provides an overview of the main sectors that contribute most to the total NO_x emissions for selected years. It is important to note that the term "*Other"* refers to additional sectors, which individually, Malta does not consider as major contributors to the overall NO_x emissions.

Table 89: Summary of the sectors, which contribute the most towards the total NOx emissions

NFR Description	1990	2000	2005	2010	2015	2019	2020
1A1a Public electricity and heat production	41.1%	27.0%	54.1%	48.8%	23.3%	7.0%	14.9%
1A2gviii Stationary combustion in manufacturing industries and construction	4.0%	4.0%	1.7%	1.7%	5.7%	4.9%	6.8%
1A3bi Road transport: Passenger cars	13.7%	14.1%	14.2%	13.3%	18.1%	19.7%	16.0%
1A3bii Road transport: Light duty vehicles	3.3%	5.0%	5.7%	5.9%	7.7%	9.7%	7.8%
1A3biii Road transport: Heavy duty vehicles and buses	8.6%	13.2%	10.4%	11.8%	16.3%	18.9%	14.5%
1A3dii National navigation (shipping)	3.2%	2.7%	2.1%	2.6%	4.2%	7.4%	7.7%
1A4ai Commercial/Institutional: Stationary	19.1%	21.0%	2.0%	3.8%	12.4%	11.5%	16.2%
1A5b Other, Mobile (recreational boats)	2.1%	6.1%	2.7%	5.6%	3.9%	6.3%	4.3%
Other	4.9%	6.8%	7.1%	6.4%	8.5%	14.6%	11.8%

9.2 Trends for Non-Methane Volatile Organic Compounds (NMVOC)

In 1990, the national total NMVOC emissions amounted to 4.4kt whereas in 2020 the total NMVOC emissions amounted to 2.6kt. An overall decreasing trend can be observed throughout the time series from 1990 to 2020. The Energy sector is the major contributor followed by IPPU and Agriculture. NMVOC emissions originate from various sources but these can be split up in two main categories: (i) evaporation and (ii) incomplete combustion. The below figure provides an overview of how NMVOC emissions vary across time.

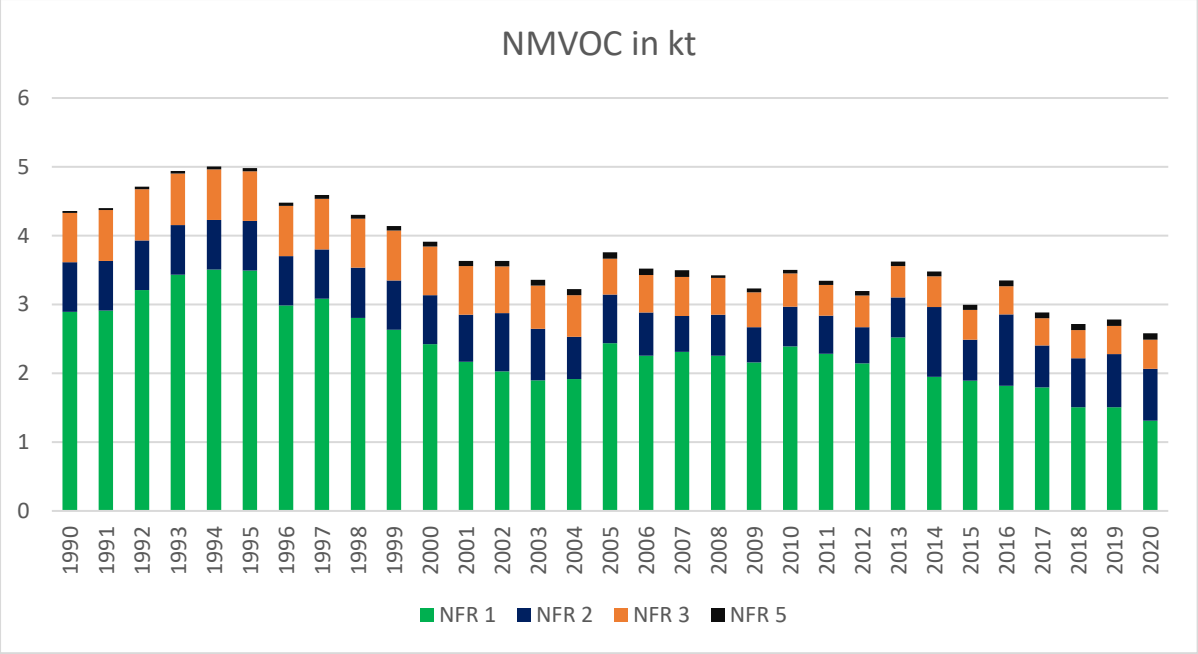

Figure 53: NMVOC emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs

Road transport is the major contributor of NMVOC emissions for both evaporative and incomplete combustion emissions. In fact, Passenger Cars (1A3bii) on average represent 30% of the total NMVOC emissions and this is a result of incomplete combustion, whereas Gasoline Evaporation (1A3bv) constitutes around 12% of the total emissions. The latter, followed by Domestic Solvents (2D3a - 8.7%) and Coating Applications (2D3d - 7.6%) are the major contributors of the evaporative NMVOC emissions. Overall, NMVOC emissions have been decreasing, and the Energy sector is mainly responsible for this decline, particularly due to an increase in the use of catalytic converters and diesel cars. An upgrade in the methodology for the Domestic Solvents (2D3a) and Coating Applications (2D3d) sectors also contributed to this declining trend. Previously, emissions would increase in line with the population increase experienced within the Maltese Islands. However, the updated methodology is based on the quantities of solvents and paints imported locally, and furthermore, the EF used for paints decreased throughout the time series, in line with EU legislation.

Agricultural practices are also considered a main contributor and in fact, around 15.5% of NMVOC emissions originate from the management of manure (3B1a- 3B4h).

The below table provides an overview of the main sectors that contribute most to the total NMVOC emissions for selected years. It is important to note that the term "*Other*" refers to additional sectors, which individually, Malta does not consider as major contributors to the overall NMVOC emissions.

Table 90: Summary of the sectors, which contribute the most towards the total NMVOC emissions

NFR Description	1990	2000	2005	2010	2015	2019	2020
1A3bi Road transport: Passenger cars	37.0%	27.7%	37.3%	33.3%	26.5%	18.8%	14.9%

1A3bv Road transport: Gasoline evaporation	13.1%	9.7%	11.1%	12.7%	14.1%	10.5%	13.6%
1A5b Other, Mobile (recreational boats)	0.5%	2.8%	1.4%	3.6%	4.3%	5.4%	4.7%
1B2av Distribution of oil products	3.0%	3.7%	3.5%	4.2%	5.1%	6.0%	5.4%
2D3a Domestic solvent use including fungicides	6.6%	7.4%	7.0%	9.3%	9.3%	11.1%	11.6%
2D3d Coating applications	8.8%	8.3%	9.6%	3.9%	6.3%	11.7%	12.6%
3B1a Manure management - Dairy cattle	5.5%	6.1%	4.7%	4.7%	5.2%	5.5%	6.0%
3B4gii Manure management - Broilers	5.7%	6.2%	3.9%	4.8%	4.6%	4.4%	4.9%
Other	20.3%	30.9%	23.0%	27.0%	28.9%	32.0%	31.0%

9.3 Trends for Sulphur Oxides (SO_x)

In 1990, the national total SO_x emissions amounted to 12.6kt. Emissions have decreased steadily since then and in 2020 the total emissions amounted to 0.14kt resulting in a 96.9% reduction of SO_x emissions. SO_x emissions are dominated completely by the Energy sector and in fact, the contribution of the IPPU, Agriculture and Waste sectors towards the total SO_x emissions is minimal as can be seen in the below figure.

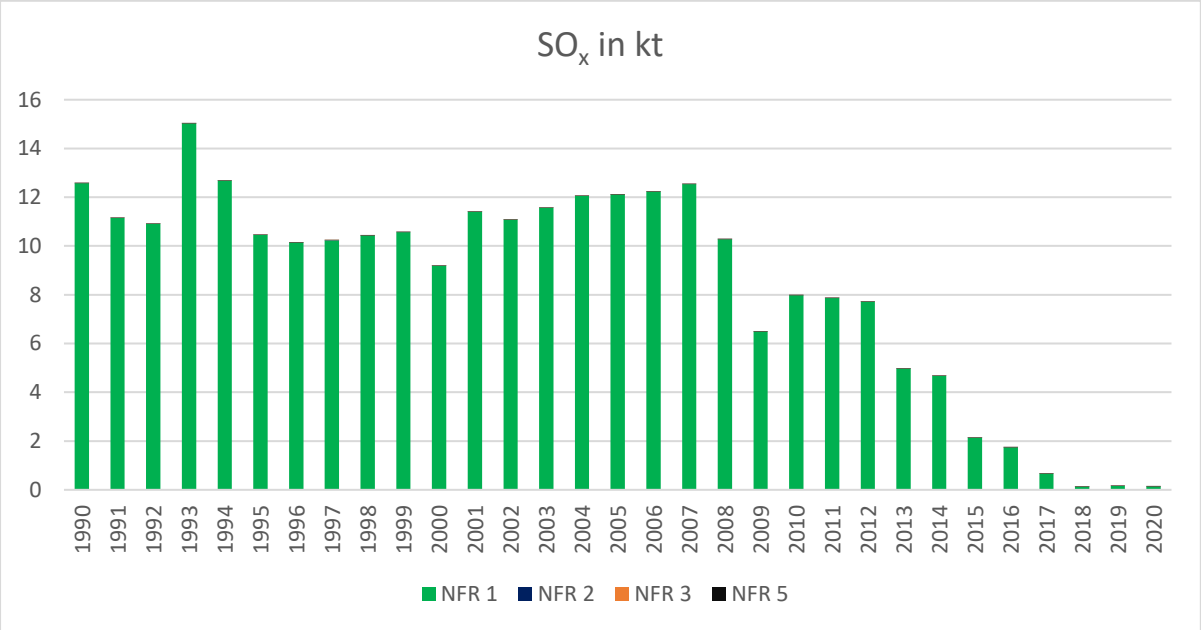

Figure 54: SO_x emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs

On average across the time series 89% of these emissions originate from the Power Generation sector (1A1a). The introduction of the Malta-Sicily interconnector in 2015, and the shift to natural gas in 2017, have reduced SO_x emissions to an extent that this sector is no longer a key category for SO_x. In recent years (post 2017), the major

contributors to this pollutant are National Navigation (1A3dii), International Aviation (1A3ai(i)), the Commercial and Institutional sector (1A4ai) and Recreational Navigation (1A5b). The below table provides an overview of the main sectors that contribute most to the total SO_x emissions for selected years. It is important to note that the term "*Other"* refers to additional sectors, which individually, Malta does not consider as major contributors to the overall SO_x emissions.

NFR Description	1990	2000	2005	2010	2015	2019	2020
1A1a Public electricity and heat production	98.6%	96.5%	98.5%	97.7%	93.6%	12.0%	33.1%
1A2gviii Stationary combustion in manufacturing industries and construction: Other	0.1%	0.1%	0.0%	0.0%	0.8%	6.7%	8.5%
1A3ai(i) International aviation LTO (civil)	0.1%	0.2%	0.1%	0.1%	0.5%	10.0%	4.2%
1A3dii National navigation (shipping)	0.1%	0.2%	0.1%	0.2%	0.7%	14.2%	6.3%
1A4ai Commercial/Institutional: Stationary	0.6%	1.0%	0.4%	0.6%	2.7%	24.1%	31.4%
1A5b Other, Mobile (including military, land based and recreational boats)	0.3%	1.0%	0.5%	1.1%	1.1%	19.9%	5.9%
Other	0.4%	1.1%	0.4%	0.3%	0.6%	13.0%	10.6%

9.4 Trends for Ammonia (NH_3)

In 1990, the national total of NH_3 emissions amounted to 2.2kt whereas in 2020 the total NH_3 emissions amounted to 1.4kt, seeing a 36% deduction over 30 years. A decreasing trend can be observed. Ammonia emissions are entirely dominated by the Agricultural sector, whereas a small percentage of that originates from the Energy sector. The IPPU and Waste sector's contribution towards the total NH_3 emissions is very minimal as can be seen in the below figure.

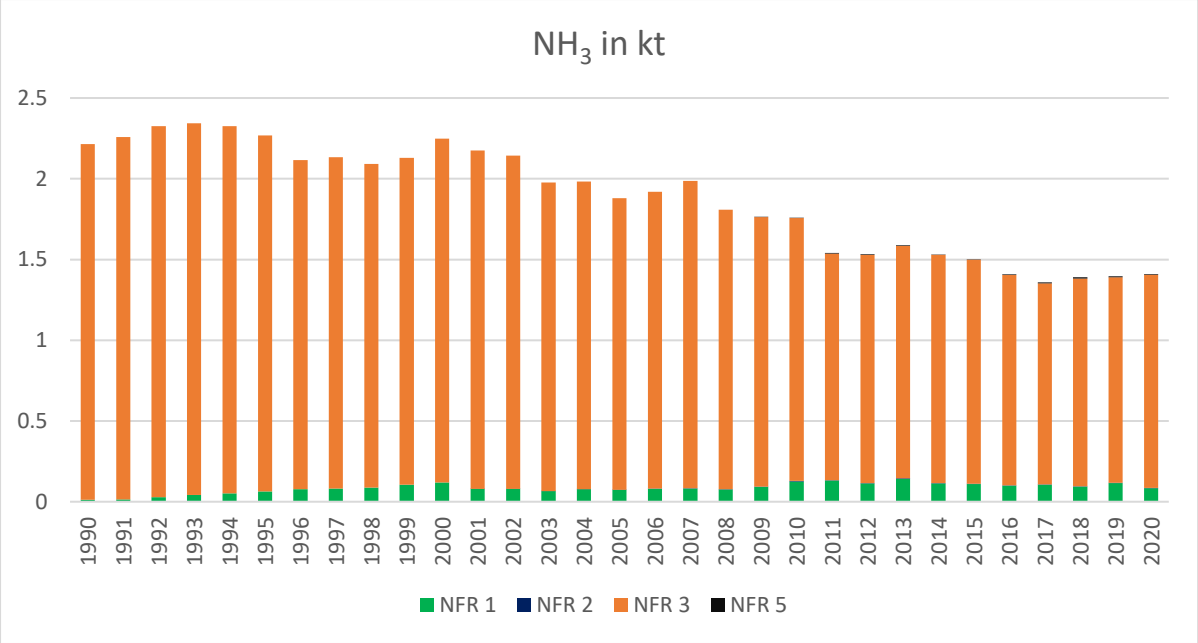

Figure 55: NH_3 emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs

As previously mentioned the main sources contributing towards the total NH_3 emissions originate from the Agricultural sector. In fact, the application of manure to soils (3Da2a) and manure management from animal husbandry (3B1a-3B4h) are the major contributors with swine (3B3) and rabbits (3B4h) topping the list, followed by dairy and non-dairy cattle (3B1a and 3B1b respectively). On average, throughout the time series around 40% of the total NH_3 emissions are attributed to application of animal manure to soils, making it the largest contributor. The below table provides an overview of the main sectors that contribute most to the total NH_3 emissions for selected years. It is important to note that the term "*Other"* refers to additional sectors, which individually, Malta does not consider as major contributors to the overall NH_3 emissions.

Table 91: Summary of the sectors which contribute the most towards the total NH_3 emissions

NFR Description	1990	2000	2005	2010	2015	2019	2020
3B1a Manure management - Dairy cattle	7.6%	7.2%	7.6%	6.6%	7.8%	8.0%	7.9%
3B1b Manure management - Non-dairy cattle	7.6%	7.3%	8.7%	6.6%	7.9%	7.6%	7.8%
3B3 Manure management - Swine	19.5%	15.1%	15.9%	17.0%	12.9%	11.1%	12.3%
3B4gii Manure management - Broilers	9.7%	9.3%	6.6%	8.2%	7.9%	7.4%	7.6%
3B4h Manure management - Other animals	4.0%	7.9%	8.0%	8.9%	9.2%	9.6%	9.5%
3Da2a Animal manure applied to soils	44.1%	40.3%	41.0%	38.3%	38.7%	38.0%	39.0%

Other	7.6%	13.0%	12.2%	14.4%	15.6%	18.2%	15.9%

9.5 Trends for Particulate Matter of size 2.5µm ($PM_{2.5}$)

In 1990, the national total of $PM_{2.5}$ emissions amounted to 0.6kt whereas in 2020 the total $PM_{2.5}$ emissions amounted to 0.4kt. As can be seen in the below figure, the majority of the $PM_{2.5}$ emissions originate from the Energy sector (84%) followed by IPPU (14%) and Agriculture. Waste sector contributions are minimal. A decreasing trend can be observed throughout the time series. Whilst the IPPU sector emissions have remained rather constant during the last 15 years, the energy sector saw a decrease in contributions over the last 10 years.

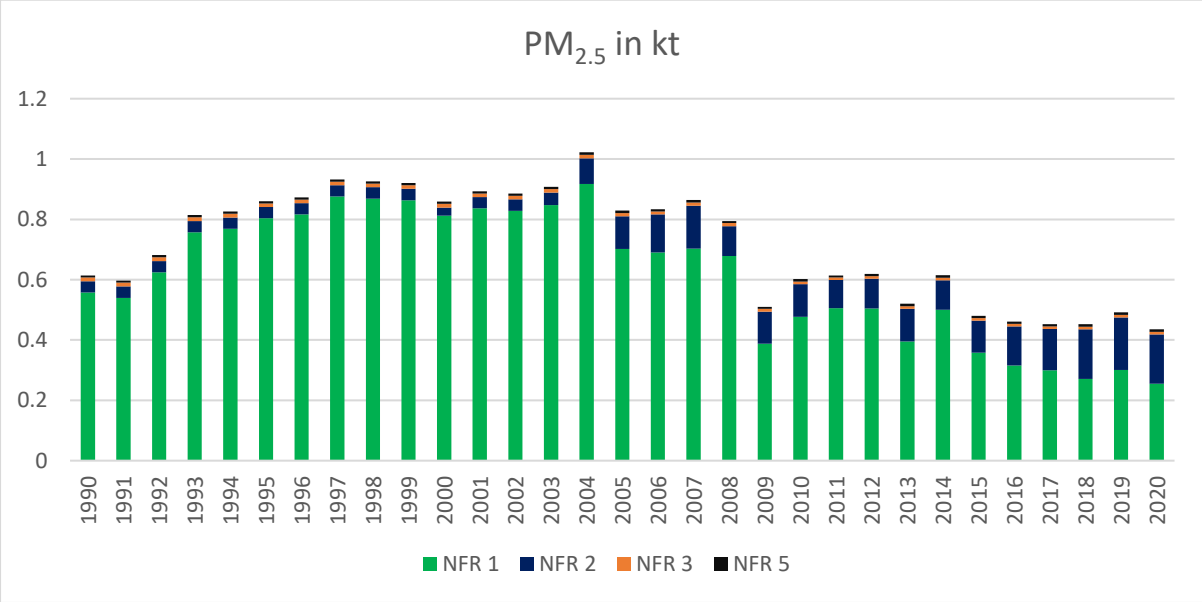

Figure 56: $PM_{2.5}$ emissions throughout the time series from 1990 to 2020. The distribution is classified according to the main NFRs

As part of the Energy Sector the Power Generation sector (1A1a) is the main source for $PM_{2.5}$ emissions, across the time series, with an average of 34% contribution, followed by Road Transport (1A3bi, 1A3bii and 1A3biii) at 12.1%, 5.6% and 6.5% respectively. Throughout the years, the Power Generation sector saw a decrease in the amount of $PM_{2.5}$ emitted particularly as a result of cleaner technology being used and a shift in type of fuel used at the local power station. In fact, a drop in emissions was recorded from 2017 onwards as a result of the decommissioning of the Marsa Power Station and the upgrade of the Delimara Power Station, which was converted to natural gas. The Construction Industry (2A5b) is also considered to be a major contributor particularly over the last few years, superseded only by asphalt road paving (2D3b). The below table provides an overview of the main sectors that contribute most to the total $PM_{2.5}$ emissions for selected years. It is important to note that the term "*Other*" refers to additional sectors, which individually, Malta does not consider as major contributors to the overall $PM_{2.5}$ emissions.

Table 92: Summary of the sectors which contribute the most towards the total $PM_{2.5}$ emissions

NFR Description	1990	2000	2005	2010	2015	2019	2020

1A1a Public electricity and heat production	43.6%	39.9%	51.0%	26.7%	14.8%	1.6%	2.8%
1A3bi Road transport: Passenger cars	16.3%	16.8%	7.3%	8.8%	9.0%	6.7%	5.4%
1A3bii Road transport: Light duty vehicles	2.8%	4.1%	6.7%	9.0%	8.3%	6.7%	5.5%
1A3biii Road transport: Heavy duty vehicles and buses	6.3%	7.4%	5.7%	7.5%	6.3%	4.8%	3.8%
1A3bvi Road transport: Automobile tyre and brake wear	2.2%	3.4%	3.4%	5.3%	7.4%	8.2%	7.5%
1A4ai Commercial/ Institutional: Stationary	8.5%	8.0%	0.8%	1.9%	5.3%	3.8%	5.9%
1A4bi Residential; Stationary	4.0%	2.8%	2.8%	3.9%	7.6%	10.7%	10.1%
1A5b Other, Mobile (recreational boats)	2.5%	7.5%	2.8%	9.9%	7.4%	9.1%	6.9%
2A5b Construction and demolition	4.6%	2.2%	5.5%	4.9%	6.7%	16.2%	10.7%
2D3b Road paving with asphalt	0.6%	0.2%	6.7%	7.7%	11.4%	14.7%	22.5%
2G Other product use	0.9%	0.7%	1.0%	5.4%	3.9%	4.7%	4.3%
Other	7.6%	7.0%	6.4%	9.0%	11.9%	12.8%	14.6%

9.6 The COVID-19 situation

In Mid-March of 2020, Malta recorded the first case of COVID-19 and within a week restrictions were put in place. Although Malta did not go into complete lockdown, changes in road and air traffic were recorded. All international flights were suspended from the 20th of March until the 1st of July of the same year, which led to a substantial reduction in emissions, particularly NO_x, whereby NO_x emissions decreased by more than 50%. As a result of such restrictions, the number of international flights decreased by more than half of those recorded in 2019, however, domestic flights recorded in 2020 were slightly higher than those in 2019. The below figures illustrate the differences between 2019, considered to be – a business as usual year, and 2020 – the year of the pandemic.

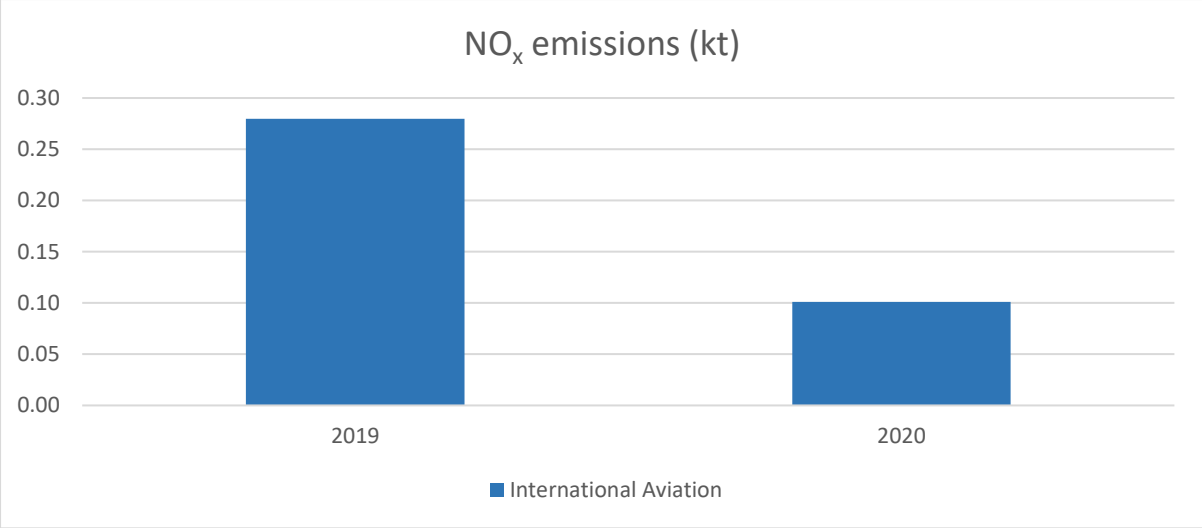

Figure 57: NO_x emissions generated from International aviation for the years 2019 and 2020

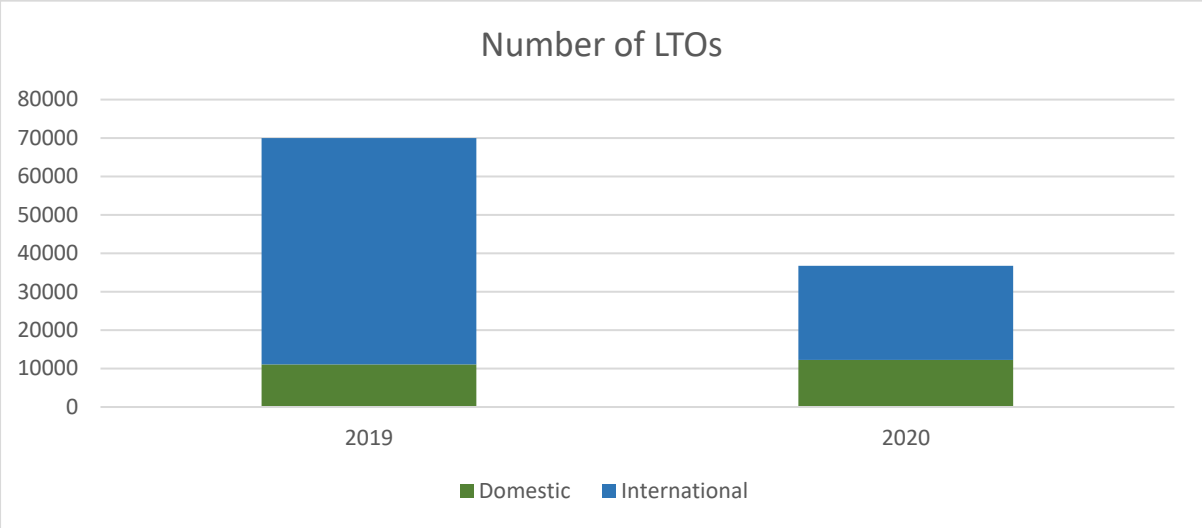

Figure 58: The number of international and domestic landing and take-offs (LTO) recorded in 2019 and 2020

All non-essential outlets were also required to close together with schools. In addition, many private and public employees started working from home and as a result of such restrictions, reductions in traffic and congestion were recorded. 2020 saw a 16% reduction in petrol use and a 22% reduction in diesel use. This led to substantial reductions in NO_x and NMVOCs as is evident in the below figures. In terms of NO_x, the largest difference was recorded in sector 1A3biii (HDVs) with a reduction of 28% followed by 1A3bii (LDVs) at 24% reduction. In the case of NMVOCs, similar trends were experienced, with a reduction of 30% and 28% respectively. On the other hand, gasoline evaporation, increased by 21% between 2019 and 2020.

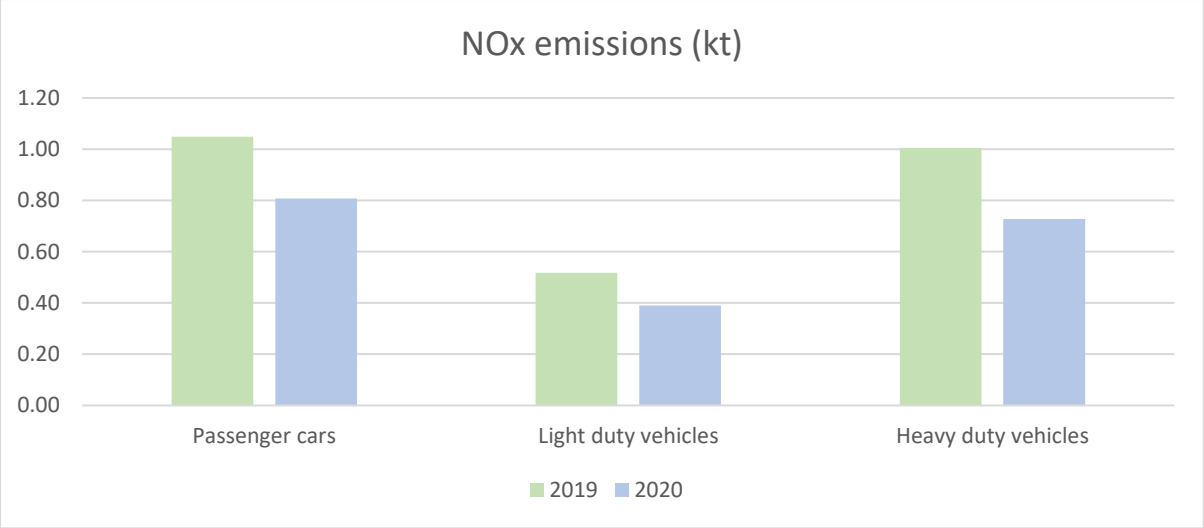

Figure 59: NOx emissions generated from Road Transport for the years 2019 and 2020

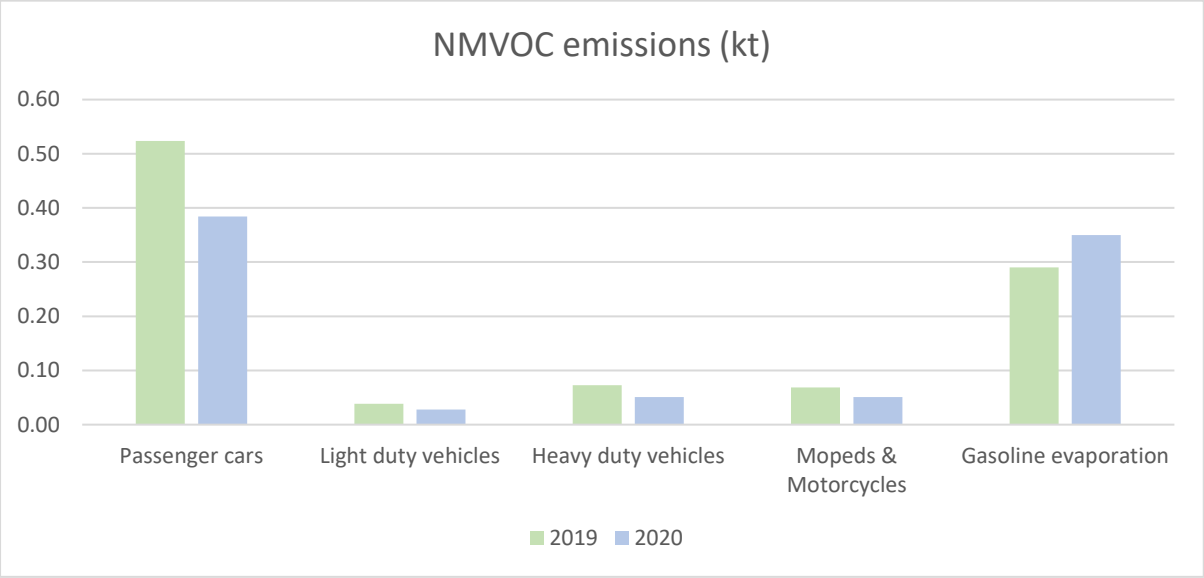

Figure 60: NMVOC emissions generated from Road Transport for the years 2019 and 2020

9.7 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 Sulphur dioxide, Nitrogen oxides, Non-Methane Volatile Organic Compounds, Ammonia and fine Particulate Matter in accordance with the national emission reduction commitments applicable from 2020. As for 2020, new emission reduction commitments have been set out in the revised Gothenburg Protocol, taking the year 2005 as a base year, for each of the five aforementioned main pollutants. The following sub-sections provide an overview of how Malta performed in managing to attain its 2020 emission reduction commitments. In this context, Malta shall not apply for any adjustment procedure as stipulated in the said Directive.

The below table provides a summary of Malta's performance in 2020 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.

Table 93: Malta's performance vis-a-vis the 2020 ceilings

Pollutant	2005 base year (kt)	2020 reporting year (kt)	2020 reduction target	% age deduction from the base year
NO_x	9.83	4.90	42%	50%
NMVOC	3.23	2.16	23%	33%
SO_2	12.12	0.14	77%	99%
NH_3	1.88	1.41	4%	25%
$PM_{2.5}$	0.83	0.44	25%	47%

9.7.1 Nitrogen Oxides (NO_x)

In terms of NO_x, Malta managed to deduct the total pollution contribution by 50% over the 2005 base year emissions. The total NO_x emissions estimated for 2020 were 4.90kt and in order for Malta to be compliant with the 2020 NO_x emissions ceiling the total amount of NO_x emitted by the country had to be 5.7kt or lower. In order for Malta to be in compliance with the 2030 ceilings, a further decrease of 2.84kt of the total NO_x emissions is expected. The below figure illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for NO_x.

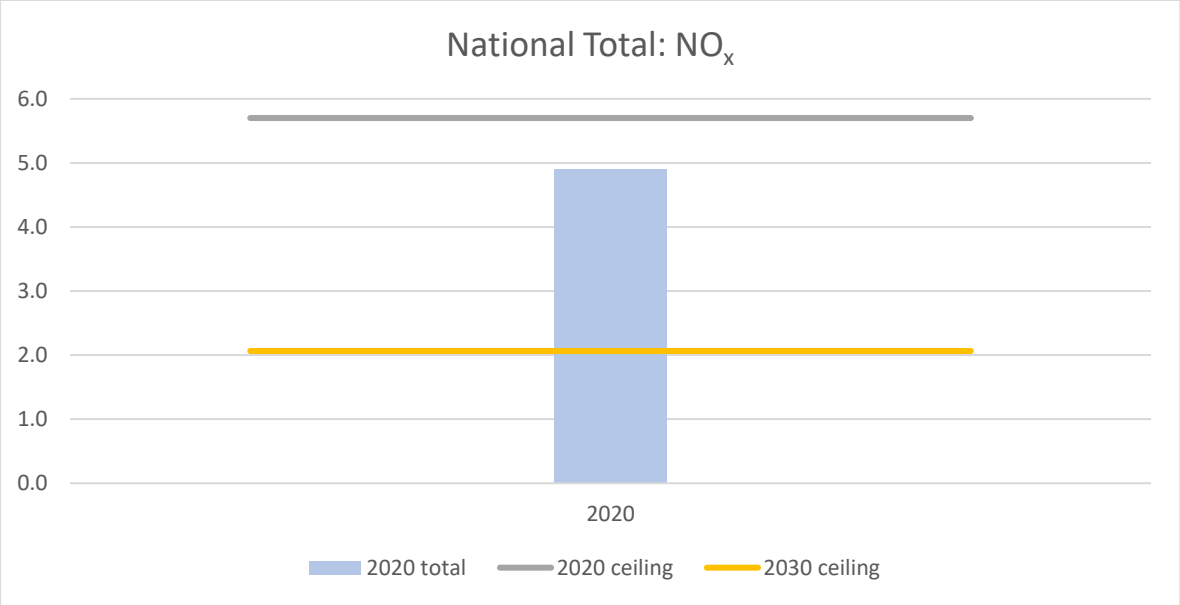

Figure 61: The total amount of NO_x emissions in 2020 compared to the 2020 and 2030 ceilings

9.7.2 Non-Methane Volatile Organic Compounds (NMVOC)

In terms of NMVOCs, Malta managed to deduct the total pollution contribution by 33% over the 2005 base year emissions. The total NMVOCs emissions estimated for 2020 were 2.16kt and in order for Malta to be compliant with the 2020 NMVOCs emissions ceiling the total amount of NMVOCs emitted by the country had to be 2.49kt or lower. As highlighted by the below graph Malta is already in compliance with the 2030 ceilings.

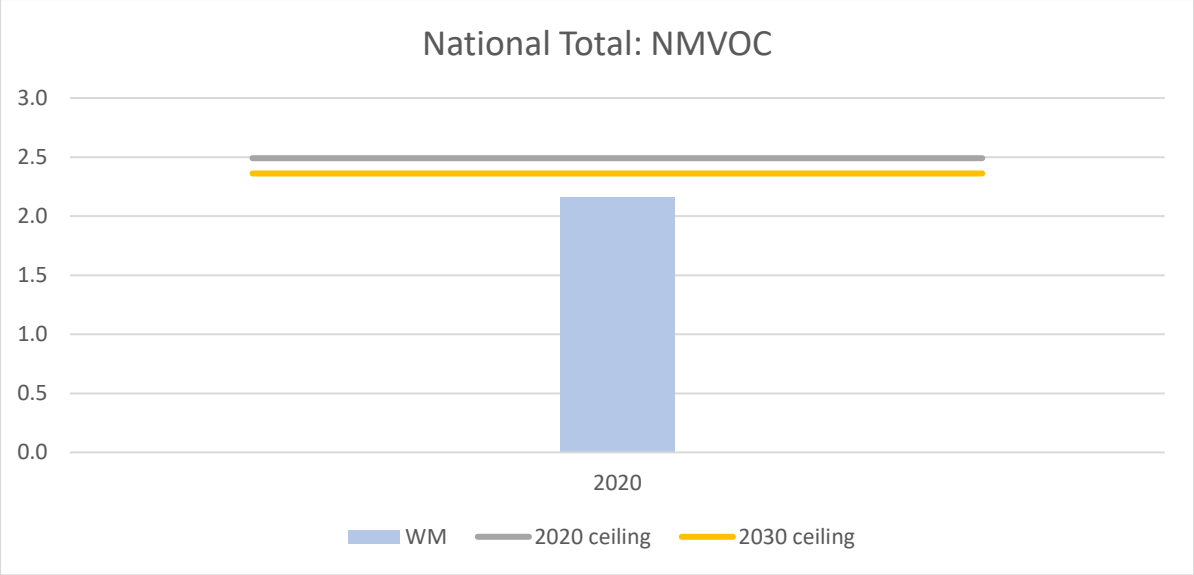

Figure 62: The total amount of NMVOC emissions in 2020 compared to the 2020 and 2030 ceilings

9.7.3 Sulphur dioxide (SO_2)

In terms of SO_2, Malta managed to deduct the total pollution contribution by 99% over the 2005 base year emissions. The total SO_2 emissions estimated for 2020 were 0.14kt and in order for Malta to be compliant with the 2020, SO_2 emissions ceiling the total amount of SO_2 emitted by the country had to be 2.79kt or lower. As highlighted by the below graph Malta is already in compliance with the 2030 ceilings.

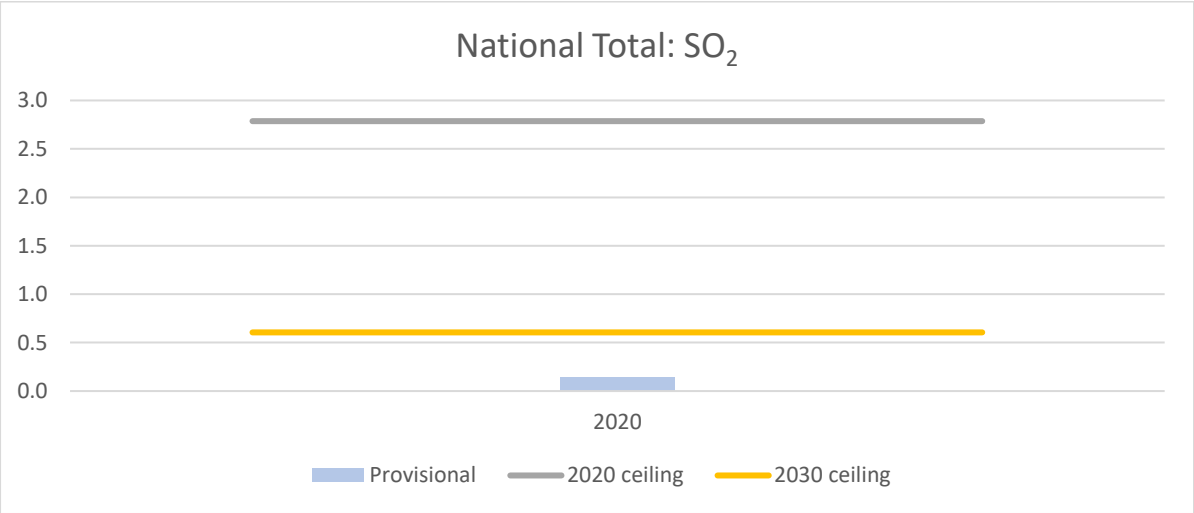

Figure 63: The total amount of SO2 emissions in 2020 compared to the 2020 and 2030 ceilings

9.7.4 Ammonia (NH_3)

In terms of NH_3, Malta managed to deduct the total pollution contribution by 25% over the 2005 base year emissions. The total NH_3 emissions estimated for 2020 were 1.41kt and in order for Malta to be compliant with the 2020 NH_3 emissions ceiling, the total amount of NH_3 emitted by the country had to be 1.81kt or lower. As highlighted by the below graph Malta is already in compliance with the 2030 ceilings, however, it is at risk of exceedance by 0.02kt.

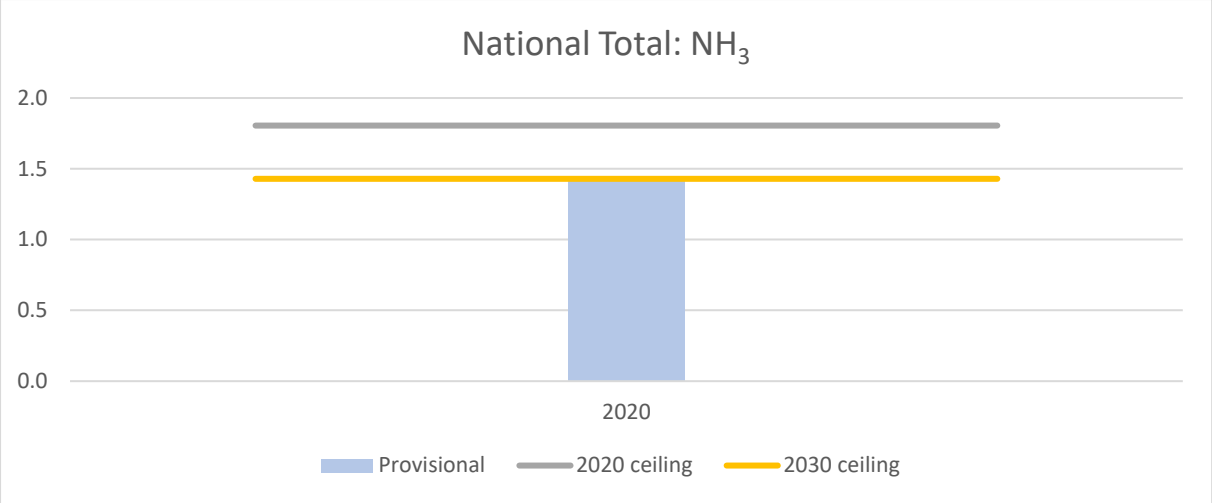

Figure 64: The total amount of NH_3 emissions in 2020 compared to the 2020 and 2030 ceilings

9.7.5 Fine Particulate matter ($PM_{2.5}$)

In terms of $PM_{2.5}$, Malta managed to deduct the total pollution contribution by 47% over the 2005 base year emissions. The total $PM_{2.5}$ emissions estimated for 2020 were 0.44kt and in order for Malta to be compliant with the 2020 $PM_{2.5}$ emissions ceiling the total amount of $PM_{2.5}$ emitted by the country had to be 0.62kt or lower. In order for Malta to be in compliance with the 2030 ceilings a further decrease of 0.02kt of the total $PM_{2.5}$ emissions is expected. The below figure illustrates Malta's current situation vis-à-vis the 2020 and 2030 emission ceilings for $PM_{2.5}$.

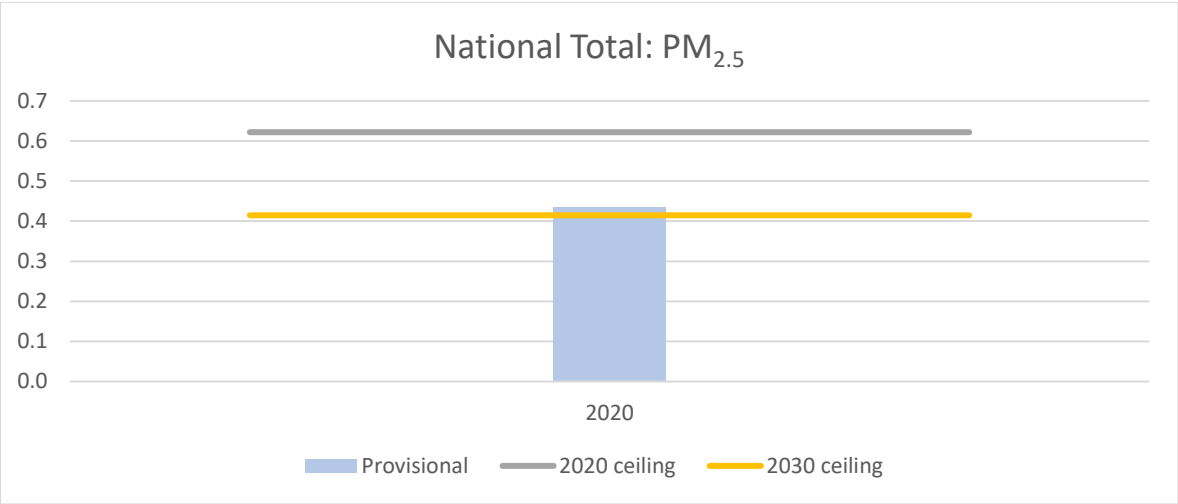

Figure 65: The total amount of $PM_{2.5}$ emissions in 2020 compared to the 2020 and 2030 ceilings

10 Recalculations and Improvements

Chapter Updated: March 2022

For a detailed description of recalculations and improvements considered for every sector refer to the respective chapters.

11 Reporting of Gridded Emissions and LPS

Chapter Updated: March 2022

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 emission and LPS reporting was expected for the 2022 submission for reference year 2020. Gridded emissions and emissions from LPS will be reported in the 2025 submission for reference year 2023.

12 References

Camilleri, R., & Vella, A. J. (2016). Emission Factors for Aerial Pyrotechnics and Use in Assessing Environmental Impact of Firework Displays: Case Study from Malta. *Propellants, Explosives, Pyrotechnics*, 273-280.

European Environment Agency. (2019). *EMEP/EEA air pollutant emission inventory guidebook: Technical guidance to prepare national emission inventories.* Copenhagen: Luxembourg: Publications Office of the European Union.

Galdies, C. (2011). *The Climate of Malta: statistics, trends and analysis, 1951-2010.* Valletta: National Statistics Office.

National Statistics Office (NSO). (2014). *Census of Population and Housing 2011: Final Report.* Valletta: Government Printing Press.

Sustech Consulting. (2008). *Agricultural Waste Management Plan for the Maltese Islands.*

Timmers, V. R., & Achten, P. A. (2016). Non-exhaust PM emissions from electric vehicles. *Atmospheric Environment*, 10-17.

UNECE. (2015). *Guidelines for reporting emissions and projections data under the Convention on Long-range Transboundary Air Pollution.* Geneva: United Nations Economic Commission For Europe.

13 Annex I

The table below presents each pollutant, in Malta's emission inventory, and the sectors, which contribute most to its emission.

Pollutant	NFR	NAME	% share
NOx (as NO_2)	1A4ai	Commercial/Institutional: Stationary	16.2%
	1A3bi	Road transport: Passenger cars	16.0%
	1A1a	Public electricity and heat production	14.9%
	1A3biii	Road transport: Heavy duty vehicles and buses	14.5%
	1A3bii	Road transport: Light duty vehicles	7.8%
	1A3dii	National navigation (shipping)	7.7%
	1A2gvii	Stationary combustion in manufacturing industries and construction	6.8%
NMVOC	1A3bi	Road transport: Passenger cars	14.9%
	1A3bv	Road transport: Gasoline evaporation	13.6%
	2D3d	Coating applications	12.6%
	2D3a	Domestic solvent use including fungicides	11.6%
	3B1a	Manure management - Dairy cattle	6.0%
	1B2av	Distribution of oil products	5.4%
	3B4gii	Manure management - Broilers	4.9%
	1A5b	Other, Mobile (recreational boats)	4.7%
	5A	Biological treatment of waste - Solid waste disposal on land	3.6%
	2H2	Food and beverages industry	3.4%
SOx (as SO_2)	1A1a	Public electricity and heat production	33.1%
	1A4ai	Commercial/Institutional: Stationary	31.4%
	1A2gviii	Stationary combustion in manufacturing industries and construction	8.5%
	1A3dii	National navigation (shipping)	6.3%
	1A5b	Other, Mobile (recreational boats)	5.9%
NH_3	3Da2a	Animal manure applied to soils	39.0%
	3B3	Manure management - Swine	12.3%
	3B4h	Manure management - Other animals	9.5%
	3B1a	Manure management - Dairy cattle	7.9%
	3B1b	Manure management - Non-dairy cattle	7.8%
	3B4gii	Manure management - Broilers	7.6%
$PM_{2.5}$	2D3b	Road paving with asphalt	22.5%
	2A5b	Construction and demolition	10.7%
	1A4bi	Residential: Stationary	10.1%
	1A3bvi	Road transport: Automobile tyre and brake wear	7.5%
	1A5b	Other, Mobile (recreational boats)	6.9%
	1A4ai	Commercial/Institutional: Stationary	5.9%
	1A3bii	Road transport: Light duty vehicles	5.5%
	1A3bi	Road transport: Passenger cars	5.4%
	2G	Other product use	4.3%

	1A3biii	Road transport: Heavy duty vehicles and buses	3.8%
PM_{10}	2D3b	Road paving with asphalt	45.0%
	2A5b	Construction and demolition	28.4%
	1A3bvi	Road transport: Automobile tyre and brake wear	3.8%
	1A4bi	Residential: Stationary	2.8%
	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	2.5%
TSP	2D3b	Road paving with asphalt	61.8%
	2A5b	Construction and demolition	27.8%
BC	1A4ai	Commercial/Institutional: Stationary	19.9%
	1A3bi	Road transport: Passenger cars	16.9%
	1A3bii	Road transport: Light duty vehicles	16.0%
	1A3biii	Road transport: Heavy duty vehicles and buses	9.8%
	1A2gviii	Stationary combustion in manufacturing industries and construction	7.5%
	2G	Other product use	5.9%
	2D3b	Road paving with asphalt	5.8%
CO	1A3bi	Road transport: Passenger cars	65.3%
	1A4cii	Agriculture/Forestry/Fishing: off-road vehicles and other machinery	5.9%
	1A5b	Other, Mobile (recreational boats)	4.9%
	1A4bi	Residential: Stationary	4.5%
Pb	2G	Other product use	45.5%
	1A3bvi	Road transport: Automobile tyre and brake wear	45.1%
Cd	3F	Field burning of agricultural residues	84.0%
Hg	3F	Field burning of agricultural residues	47.6%
	1A1a	Public electricity and heat production	34.8%
As	1A1a	Public electricity and heat production	54.6%
	1A3bvi	Road transport: Automobile tyre and brake wear	16.4%
	3F	Field burning of agricultural residues	7.8%
	1A4ai	Commercial/Institutional: Stationary	4.5%
Cr	1A3bvi	Road transport: Automobile tyre and brake wear	68.2%
	1A4ai	Commercial/Institutional: Stationary	8.7%
	3F	Field burning of agricultural residues	6.6%
Cu	1A3bvi	Road transport: Automobile tyre and brake wear	87.1%
Ni	1A4ai	Commercial/Institutional: Stationary	65.2%
	1A3dii	National navigation (shipping)	6.6%
	1A5b	Other, Mobile (recreational boats)	6.1%
	1A3bvi	Road transport: Automobile tyre and brake wear	5.5%
Se	1A1a	Public electricity and heat production	40.5%
	3F	Field burning of agricultural residues	17.9%
	5C1bv	Cremation	17.3%
	1A3bvi	Road transport: Automobile tyre and brake wear	6.9%
	1A4bi	Residential: Stationary	5.9%
Zn	1A3bvi	Road transport: Automobile tyre and brake wear	50.8%
	1A1a	Public electricity and heat production	10.8%

	1A4ai	Commercial/Institutional: Stationary	9.7%
	2G	Other product use	6.3%
	1A4bi	Residential: Stationary	5.9%
PCDD/PCDF (dioxins/furan)	2G	Other product use	21.4%
	1A4bi	Residential: Stationary	21.4%
	5E	Other waste	18.9%
	1A3bi	Road transport: Passenger cars	16.7%
	3F	Field burning of agricultural residues	9.5%
benzo(a) pyrene	1A4bi	Residential: Stationary	48.4%
	1A4ai	Commercial/Institutional: Stationary	23.5%
	1A3bi	Road transport: Passenger cars	11.7%
benzo(b) fluoranthene	1A4ai	Commercial/Institutional: Stationary	42.4%
	1A2gviii	Stationary combustion in manufacturing industries and construction: Other	27.1%
	1A4bi	Residential: Stationary	18.1%
benzo(k) fluoranthene	1A4ai	Commercial/Institutional: Stationary	69.7%
	1A4bi	Residential: Stationary	11.1%
Indeno (1,2,3-cd) pyrene	1A4bi	Residential: Stationary	41.4%
	1A4ai	Commercial/Institutional: Stationary	21.8%
	1A3bi	Road transport: Passenger cars	17.8%
HCB	5C1bv	Cremation	97.9%
PCBs	1A3dii	National navigation (shipping)	43.5%
	1A5b	Other, Mobile (recreational boats)	40.4%

14 Annex II

Activity data provider	Activity data provided
Eurostat	Fuel share and fuel used Imports/exports of domestic solvents products Imports/exports of paints Imported fireworks and flares Imports/exports of tobacco
Annual Environmental Reports (AERs), Waste Management Facility Reports or direct from private entities	Emission loads Fuel consumption Total waste disposed in landfills Organic fractions entering anaerobic digester Emissions from continuous monitoring
Regulator of Energy and Water Services (REWS)	Sulphur content Fuel blend
Eurocontrol	Emissions of LTOs (2005-2020)
Malta International Airport (MIA)	LTO Cycles (1999-2004)
Transport Malta (TM)	LTO cycles (1990-1998) Trip characteristics (average trip duration and average trip length) Circulation data (average speed and road shares in %)
National Meteorological Office	Minimum monthly temperatures Maximum monthly temperatures Humidity (%) Wind speed
Malta Resources Authority (MRA)	Sulphur content Vehicle stock (1990-2009) Number of animal heads Estimate of synthetic fertilizer application CH_4 emissions
Energy and Water Agency (EWA)	Vehicle stock (2010-2040) Vehicle kilometrage
National Statistics Office (NSO)	Number of dwellings and non-dwellings Number of units Production of home killed meat (1995 to 2020) Fish and seafood landed (1995 to 2020) Production of poultry meat (1995 to 2020) Production of animal feed (2003 to 2020) Production of red wine (2004 to 2020) Production of white wine (2004 to 2020) Production of coffee (2005 to 2020) Agricultural products (1995 to 2020) Number of animal heads Amounts of cow and milk produced Gross Feed Intake (GE) Utilised agricultural area (UAA) Land area by crop type
Planning Authority	Number of dwellings and non-dwellings Number of units
Infrastructure Malta (IM)	Amount of asphalt laid
Armed forces of Malta	Amount of raw material used to manufacture fireworks
Malta Dairy Products (MDP)	Fat content (%) in cow milk
UNFCCC	Volatilised Solids (VS)
FAOSTAT	Land area by crop type
Water Services Corporation (WSC)	Total wastewater treated annually
Civil Protection Department (CPD)	Number of fire reports

15 Annex III

Sector	ID	Recommendation for the issue identified	Number of successive reviews issue not addressed	Status
General	MT-0A-2020-0001	In the 2021 IIR, Malta indicates that an uncertainty assessment has still not been carried out. It is indicated that it will be considered in future submissions. Please provide a status for the implementation and a timeframe for the implementation of the recommendation.	2020, 2021	An uncertainty analysis was carried out for the first time in this submission. This can be found in 3 Uncertainty Analysis
Energy	MT-1A1-2017-0001	The TERT notes with reference to 1A1a, NOX and PM10/PM2.5 that there may be an under-estimate of emissions. This was raised during the 2017, 2018, 2019 and 2020 NECD review. This underestimate may have an impact on total emissions that is above the threshold of significance. The TERT notes that this under-estimate may be because the IED allows plant operators to subtract the uncertainty of measurements equipment from the actual measured emission concentrations. During the 2020 review, Malta stated that it would explain the issue in the IIR but the TERT could not find the specific explanation in the IIR. Please provide further justification for your current estimate and provide a clear explanation or provide a revised estimate that resolves the potential underestimate. You may also wish to provide evidence in case you consider that the impact of the underestimate is below the threshold of significance.	2017, 2018, 2019, 2020, 2021	The operators clarified that they did not subtract the uncertainty from the emission load 4.2.3 Activity Data
Energy	MT-1A1a-2019-0001	The TERT identified a potential over-estimate exceeding the threshold of significance for 1A1a, Pb in years 2005-2016. Therefore, this is a case for a potential technical correction. The TERT notes the discussion already held throughout the review with Malta on the	2019, 2020, 2021	The justification is provided in 4.2.2 Methodology

		difficulties with making a corrected estimate and notes that it is currently not possible for the TERT to provide a numerical emission estimate as a technical correction. The TERT invites Malta to provide revised estimates for this category by 28 July or provide a clear rationale why the emission estimates for total metals currently reported as Pb emissions cannot be allocated into the individual metals or, why the use of a Tier 2 methodology is not appropriate for emission estimation. 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 heavy metals focuses on the years 1990, 2005, 2016-2019 please provide a revised estimate for years 2005 and 2016-2019.		
Energy	MT-1A3b-2021-0001	The TERT thanks Malta for its answer and the new emissions provided. With these new data, the TERT notes that CO, PM10 and BC emissions could be wrong between 2003 and 2009 (as it is shown in the attached file where CO emissions for 1A3bi follow a strange trend). The TERT notes 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 significance. Could Malta provide CO, PM10 and BC emissions between 2003 and 2010?	2021	A justification as to why these underestimations were recorded can be found under section 4.4.3.4 Improvements made to the time series
Energy	MT-1A3bvi-	The TERT identified a potential under-estimate	2021	A justification as to why these

	2021-0001	exceeding the threshold of significance for category 1A3bvi Road transport: Automobile tyre and brake wear and BC in year 2000, 2005 and 2019. 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 review of BC focuses on the years 2000, 2005, 2019 please provide a revised estimate for 2000, 2005, 2019.		underestimations were recorded can be found under section 4.4.3.4 Improvements made to the time series
Energy	MT-1A3bvii-2020-0001	The TERT thanks Malta for its answer. As it was stated in the 2020 review, there is a table in the EMEP/EEA guidebook which gives PAHs emission factors (Table 3.10 p20 of 1A3bvi-ii chapter). Malta wrote last year in its anser that these emissions would be calculated for the 2021 submission. Please explain how reporting will be corrected in the 2022 submission.	2020, 2021	PAHs emissions have been estimated using the methodology in the guidebook and can be viewed under section 4.4.3.6 Source-specific recalculations and assumptions
Energy	MT-1A3dii-2020-0002	The TERT notes with reference to NFR tables and IIR pages 49-55 and category 1A3dii/liquid fuel/PM2.5/all years, that there is a lack of	2020, 2021	Emissions from recreational crafts were removed from NFR 1A3dii and

		transparency regarding the reasons for the change of IEF between 2010 and 2019 (IEF has decrease from 0.086 to 0.049 ktPM2.5/PJ. This was raised during the 2020 NECD review. The TERT is unable to determine whether there is an under or over estimate that may be above the threshold of significance. Please provide further clarification of the decrease of the PM2.5 IEF by providing both activity data and PM2.5 emission factor.		placed under NFR 1A5b. Hence, the Implied EFs will not change across the time series.
Energy	MT-1A4bi-2019-0003	The TERT notes with reference to 1A4bi, biomass, HCB and PCB for 1990-2019 that there may be an under-estimate of emissions. This was raised during the 2019 and 2020 NECD review. This underestimate may have an impact on total emissions that is above the threshold of significance. The TERT notes that this under-estimate may be because HCB and PCB emissions are reported as 'NA' while the Guidebook 2019 provides methodologies. Please provide further justification for your current estimate and provide a clear explanation or provide a revised estimate that resolves the potential underestimate. You may also wish to provide evidence in case you consider that the impact of the underestimate is below the threshold of significance.	2019, 2020, 2021	These emissions are now being reported, as is explained in 4.5.5 Recalculations
Energy	MT-1A4bi-2020-0001	The TERT identified a potential overestimate exceeding the threshold of significance for 1A4bi Residential: Stationary, gasoil, kerosene and LPG in 1990, 2005 and 2016-2019. 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	2020, 2021	The emissions have been recalculated as is explained in 4.5.5 Recalculations

		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 review of POPs focuses on the years 1990, 2005, 2016-2019, please provide a revised estimate for 1990, 2005, 2016-2019.		
Energy	MT-1A4bi-2021-0001	The TERT notes with reference to 1A4bi, BC and 2010-2019 that there may an under-estimate of emissions. This under-estimate may have an impact on total emissions that is above the threshold of significance. The TERT notes that this under-estimate may be because the share of BC on PM2.5 is very low (2019: 0.08%). According to the IIR p. 58, Malta uses a Tier 1 method for 1A4bi. The TERT estimated BC emissions for 2019 from solid biomass (about 70 TJ * 740 g PM2.5 /GJ * 10%) which results to about 0.0052 kt BC emissions while Malta reports 0.0000423 of BC emissions from 1A4bi in 2019 only. The potential under-estimate could be 0.0051 kt BC which is about 5% of the national total 2019. Please provide further justification for your current estimate or provide a revised estimate that resolves the potential under-estimate. You may also wish to provide evidence in case you consider that the impact of the under-	2021	The emissions have been recalculated as is explained in 4.5.5 Recalculations

		estimate is below the threshold of significance.		
Energy	MT-1A4ci-2018-0001	Due to technical errors in the EMRT, this question was not sent during the Q&A part of the review. We would be grateful if you could respond to this question with a revised deadline of 28/07/2021, and we apologise for this complication. The TERT note that emissions of all pollutants are reported as "NO" for source 1A4ci Agriculture/Forestry/Fishing: Stationary for all years. There is no mention of 1A4ci Agriculture/Forestry/Fishing: Stationary in the IIR. Please can Malta confirm that there is no fuel consumption for 1A4ci Agriculture/Forestry/Fishing: Stationary in Malta for any years in the time series? Thank-you.	2018, 2019, 2020, 2021	The emissions are now being reported as 'IE', as per 4.1 Category description.
Energy	MT-1A4cii-2021-0001	The TERT thanks Malta for the answer. The TERT understands that CO emission trend comes from activity data trend and especially gasoline trend. Malta explain the change from 2004 to 2005, but not in 2015 where gasoline consumption is null. Is it planned by Malta to construct a consistent fuel consumption time serie?	2021	Malta makes use of the values provided through the Eurostat Energy Balance.
Energy	MT-1A4ciii-2020-0002	The TERT notes with reference to NFR tables and IIR pages 61 and category 1A4ciii/liquid fuels/all pollutants/2017 that there is a lack of transparency regarding why emissions factor suddenly change between 2016 and 2017. This was raised during the 2020 NECD review. The TERT is unable to determine whether there is an under or over estimate that may be above the threshold of significance. Please provide further clarification of change in IEFs by providing both activity data and used emission factors for time series.	2020, 2021	The emissions have been recalculated as is explained in 4.7.5 Recalculations

IPPU	MT-2A5b-2017-0001	The TERT identified a potential under- estimate exceeding the threshold of significance for 2A5b Construction and demolition, PM2.5 and PM10 in all years. Therefore, this is a case for a potential technical correction. The TERT notes the discussion already held throughout the review with Malta on the difficulties with making a corrected estimate and notes that it is currently not possible for the TERT to provide a numerical emission. The TERT invites Malta to provide revised estimates for this category by 28 July or provide category. 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, 2010, 2015-19 please provide a revised estimate for 2005, 2010, 2015-19.	2017, 2018, 2019, 2020, 2021	The emissions are now being estimated as is explained in 5.2.2 Methodology
IPPU	MT-2B10b-2019-0001	The TERT notes in 2019 and 2020 that Malta reports NMVOC emissions from category 2B10b, but there was still no methodological description in the IIR 2021. Could Malta please provide information on the methodology used?	2019, 2020, 2021	The information available suggests that NMVOC loads emitted from this sector were last updated in 2004 and the activity data used was related to the number of ships. This sector was estimated by previous inventory compilers and the exact methodology used, including

				the activity data and emission factors, to obtain these values are not known.
IPPU	MT-2D3a-2018-0001	The TERT notes during the NECD Review 2019 and 2020, that Malta reports Hg emissions from category 2.D.3.a, but there was no methodological description in the IIR 2021. Could Malta please provide information on the methodology and activity data used, as there is no Tier1 methodology available in the EMEP EEA GB 2019.	2018, 2019, 2020, 2021	This has been resolved since there is no EF for this pollutant in the updated 2019GB.
IPPU	MT-2D3a-2019-0001	The TERT identified a potential over-/under- estimate exceeding the threshold of significance for 2D3a Domestic Solvent Use and NMVOC in all years. Therefore, this is a case for a potential technical correction. The TERT notes the discussion already held throughout the review with Malta on the difficulties with making a corrected estimate and notes that it is currently not possible for the TERT to provide a numerical emission estimate as a technical correction based on a Tier 2 method. The TERT invites Malta to provide revised estimates for this category by 28 July or provide a clear justification for using a Tier 1 method for this key category. 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, 2010, 2015-18 please provide a revised	2019, 2020, 2021	A move from a Tier 1 to a Tier 2 methodology was done for this submission. The emissions are now being estimated as is explained in 5.4.2 Methodology

		estimate for 2005, 2010, 2015-19.		
IPPU	MT-2D3g-2018-0001	For 2D3g Chemical products - asphalt blowing for PAHs emissions from 1990-2019 the TERT notes that the recommendation from 2018 and 2019, has not been implemented. The TERT noted that the notation key for PAHs from asphalt blowing is still reported as "NA", while "NO" would be the appropriate notation key. Please provide information, when this topic will be addressed and whether Malta intends to change the notation key in a future publication or a justification as to why it has not been changed.	2018, 2019, 2020, 2021	The emissions are now being reported as 'NE', as is explained in 5.1 Category overview
IPPU	MT-2D3i-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) for the key category 2D3i for the pollutant(s) Cd and year(s) (1990, 1992-1993, 1995-2009). Please explain why significant recalculations have taken place.	2021	2D3i is no longer calculated since emissions emerging from 4-stroke engine lubricant consumption are included within sector 2G.
IPPU	MT-2H2-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) for the key category 2H2 for the pollutant(s) NMVOC and year(s) (1990). Please explain why significant recalculations have taken place.	2021	This was due to human error.
Agriculture	MT-3B-2017-0005	Could Malta provide in more detail the rational that the nitrogen excretion rates (Nex), which are default values, better represent the national circumstances and could Malta please provide more information on the national expert panel.	2017, 2018, 2019, 2020, 2021	The justification is provided in 6.2.1 source category description
Agriculture	MT-3B1a-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) for the key category 3B1a for the pollutant NMVOC and years 1990-2014. In its IIR Malta does not explain why significant recalculations have taken place. Please provide the rational for the recalculation of the the time series 1990-2014.	2021	The emissions have been recalculated due to a change in the Gross Feed Intake, as is explained in 6.3.5 Recalculations

Agriculture	MT-3B1b-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) category 3B1b for the pollutant NH3 and years 1990-2018. MT states in its IIR (p. 80-81) that NH3 emissions from category 3.B1.b were recalculated through the Manure Management N-flow tool, as provided within the 2019GB. Furthermore Malta informed that the nitrogen excretion for this category have been updated due to the IPCC 2019 refinement. However, could Malta provide in more detail the rational that the updated nitrogen excretion rates (Nex) better represent the national circumstances. Furthermore, MT states in its IIR (p. 83) that the decrease in emissions in the 2021 submission is due to a reduction in the Nex values for this livestock category. However, as presented in its IIR Table 19, the nitrogen excretion rates (Nex) for Non-dairy cattle increased from 0.33 kg N/1000 kg animal mass day-1 to 0.42 kg N/1000 kg animal mass day-1. Could Malta please clarify this inconsistency which could result in an underestimate of emissions.	2021	The justification is provided in 6.3.1 Source category description
Agriculture	MT-3B3-2020-0001	In NECD review 2020 Malta provided activity data for Swine (Sows + Swine - Fattening pigs) related to two findings (MT-3B3-2020-0001 and MT-3B4gi-2020-0001) in two files (3B3 - Swine classification.xlsx and Malta_3B4gi PM2.5.xlsx). The results of a activity data check showed that the activity data used for estimating NH3 and NOx emissions are different to the activity data used for estimating PM emissions. The activity data used for estimating PM emissions are consistent with the data provided to Eurostat (Pig population - annual data [apro_mt_lspig]). Please	2020, 2021	The emissions have been recalculated, as is explained in 6.6.5 Recalculations

		clarify why Malta ist using different activity data sets.		
Agriculture	MT-3B3-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) for the key category 3B3 for the pollutant NH3 and years 1990-2018. MT states in its IIR (p. 76/77) that NH3 emissions from sub-chapter 3B were recalculated through the Manure Management N-flow tool, as provided within the 2019GB. The previous submission also made use of the Tier 2 N-flow tool, however, the EFs for this chapter have been updated due to the IPCC 2019 refinement. A short explanation for using the data of the 2019 Refinement is provided on page 80. However, could Malta provide in more detail the rational that the updated EFs and nitrogen excretion rates (Nex) better represent the national circumstances.	2021	The justification is provided in 6.6.1 Source category description.
Agriculture	MT-3Da2a-2021-0001	The TERT notes that significant recalculations have been applied (>10% change) for the key category 3Da2a for the pollutant NH3 and years 1990-2018. Please explain why significant recalculations have taken place. MT states in ist IIR (p. 88) that recalculations are based on the use of TIER 2 Manure management N-flux tool using the activity data and EF reported under 3B. The previous submission also made use of the Tier 2 N-flow tool, however, the EFs for this chapter have been updated due to the IPCC 2019 refinement. However, could Malta provide in more detail the rational that the updated	2021	The justification is provided in 6.13.2.1 Source category description.

		nitrogen excretion rates (Nex) better represent the national circumstances.		
Agriculture	MT-3De-2017-0001	The TERT notes In the NECD review 2020 Malta provided an extract of the 3De model (Agriculture 3De.xlsx) In a follow-up question Malta explained that a proportioned to the ratio dm/ha in MRA and EMEP guidebook was used due to the fact that the mean yield of wheat in kg DM ha–1 differs. However, in the NIR 2021 of Malta (page 209/2010) is stated that the approximate yield (in terms of weight of dry matter per hectare) is country specific for wheat, barley and sulla and potato. Could Malta please clarify this inconsistency?	2017, 2018, 2019, 2020, 2021	The mean yield for barley and sulla could not be used, since these are not categories under the 2019, as can be observed in Table 77.
Agriculture	MT-3Df-2019-0001	The TERT identified a potential under-estimate exceeding the threshold of significance for 3Df Use of pesticides and HCB in 1990, 2005, 2016-2019, since they are reported as NE. Therefore, this is a case for a potential technical correction. The TERT notes the discussion already held throughout the review with Malta on the difficulties with making a corrected estimate and notes that it is currently not possible for the TERT to provide a numerical emission estimate as a technical correction based on a Tier 1. The TERT invites Malta to provide revised estimates for this category by 28 July or provide a clear justification for reporting NO. A first approach could be to use the FAO information for e.g. Insecticides–Chlorinated Hydrocarbons combined with expert judgment on the share of individual pesticide listed in	2019, 2020, 2021	No activity data is currently available to estimate emissions from this sector.

		the EMEP/EEA GB 2019. 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 heavy metals and POPs focuses on the years 1990, 2005, 2016-19 please provide a revised estimate for 1990, 2005, 2016-19.		
Agriculture	MT-3F-2019-0003	The TERT notes that Malta provided in submission 2020 (2020 further updated submission on 16 Nov 2020) estimates for NOx, MVOC, SOx, NH3, CO for the activity 3F: Field Burning of Agricultural Residues. In 2021, Malta provided in the NFR table, constant value for all years, for NOx, MVOC, SOx, NH3, CO. For BC the notation key NE is reported and for all other pollutants the notation key NA is used. The TERT further notes that in the IIR Chapter 3F: Field Burning of Agricultural Residues (page 90) no information on the methodological approach, emission factors and activity data are provided. Could Malta please clarify how the reported emissions were estimated and on why the other pollutants (list the pollutants) were was not estimated when emission factors exist for these pollutants in Table 3-1 of the 2019 EMEP/EEA GB. Finally could Malta please provide to the TERT details on the planned improvements for this activity.	2019, 2020, 2021	The emissions have been recalculated, as is explained in Source-specific recalculations 6.13.5.5.

Waste	MT-5C1bv-2021-0001	The TERT notes that the PM2.5 estimate for category 5C1bv Cremation for the year(s) 2009, 2012, 2013, 2014, 2015, 2016, 2018, 2019 is smaller than the estimate for BC, which is not expected. Please provide an explanation for why PM2.5 estimates are smaller than BC, and if appropriate, provide a corrected estimate or confirm how this will be addressed in the 2022 submission. The TERT notes that the PM2.5 estimate for category 5C1bv Cremation for the year(s) 2009, 2012, 2013, 2014, 2015, 2016, 2018, 2019 is smaller than the estimate for BC, which is not expected. Please provide an explanation for why PM2.5 estimates are smaller than BC, and if appropriate, provide a corrected estimate or confirm how this will be addressed in the 2022 submission.	2021	The justification is provided in 7.4.2 methodology.