Design & development of Industry Residential/Commercial & Other services module

(WP5 Task 5.2.4)

June - 2019

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1 FINALITY OF THE REPORT

1.1 Objectives and expected results

This document reports about the WP5 Task 5.2.4 Design & development of Industry Residential/Commercial & Other services module. The module integrates in the overall model the industrial, residential, commercial and institutional emissions sources. In particular its scope is to:

- Develop a specific tool to evaluate emissions using existing industrial emissions data (EMEP, E-PRTR, others) and EMEP/EEA Emission inventory Guidebook;
- Develop a specific tool to estimate emissions from small combustion in residential, commercial and institutional sector.

2 SPECIFICATIONS OF MODELLING TOOL SET

2.1 Emissions Inventory

The tool set module produces a specific emissions inventory for Industrial, Residential/ Commercial and & Other services sources.

2.1.1 Pollutants

The main air pollutants included in the tool are nitrogen oxides (NO_x) and suspended particles with diameter less than 10μ (PM_{10}).

2.1.2 Sources category

Emission sources are generally classified as point, area and line sources. Point sources are stationary sources whose emissions exceed some fixed thresholds, fixed depending on the aim of the inventory. In order to compile city/region inventory in ClairCity, stationary emission sources with total annual emissions with at least one pollutant emissions exceeding 100 Mg/year, are considered as Large Point Sources (LPS).

Emissions from LPS can be convoyed in stacks or fugitive. When emissions are emitted by stacks, emission characteristics (gas temperature and volume and stack height) are necessary for air quality modelling.

2.2 Industrial sources

For industrial sources emissions, a specific tool has been developed to include all the

emissions from the European Pollutant Release and Transfer Register (E-PRTR)[1] facilities and national and local Registers or emissions inventories (national, regional and local scale). Where specific facilities are individuated that don't have known emissions data, ad hoc estimates are obtained using available information and emission factors from EMEP/EEA Guidebook[2]. The emissions have been geographically allocated by coordinate of emission source. When data on single facility are not know emissions are evaluated from statistical sources as area sources and allocated using land cover maps.

Large Point Sources have been individuated and reported, source by source, with emissions and characteristics of emissions. Large Point Sources are defined as sources that emits more than 100 Mg of NO_x or PM_{10}.

2.3 Residential, commercial and institutional sector

2.3.1 Emission modeling

The IRC tool:

- evaluates emissions at most detailed administrative territorial units' level,
- uses emission factors from EMEP/EEA Guidebook,
- calculates emissions as:

$$E = A_{ij} F_{ij}$$

where:

- A_{ij} is the indicator of the activity i in the territorial unit j,
- F_{ik} is the emission factor of pollutant k for activity i (expressed in grams per unit of activity).

For small combustion in residential, commercial and institutional sector emissions have been evaluated using emission factors from EMEP/EEA Guidebook and specific activity level.

2.3.2 Emission factors

In Table 1 the fuel combustion air pollutants emission factors used are reported[3].

Table 1 – Residential, Commercial & Institutional Air pollutant Emission Factors

Fuel	Nitrogen oxides [gNO_x/GJ]	Particle Matter with diameter less than 10µ [gPM_{10}/GJ]
Boilers – Natural gas	42	0,2
Boilers – LPG	40	2
Boilers – Gas/Diesel Oil	69	1,5
Boilers – Wood	80	480
Fireplaces – Wood	50	840
Stoves – Wood	50	760
Energy Efficient Fireplaces – Wood	80	380

[1] European Pollutant Release and Transfer Register (E-PRTR)
[2] EMEP/EEA(2016), Air pollutant emission inventory guidebook
[3] EMEP/EEA(2016), Air pollutant emission inventory guidebook,1.A.4 Small combustion

Table 1 – Residential, Commercial & Institutional Air pollutant Emission Factors

Fuel	Nitrogen oxides [gNO_x/GJ]	Particle Matter with diameter less than 10μ [gPM_{10}/GJ]
Energy Efficient Stoves – Wood	80	380
Advanced Fireplaces – Wood	95	95
Advanced Stoves – Wood	95	95
Pellets Stoves – Wood	80	29
Boilers - Hard Coal	158	225
District Heating Boilers - Natural gas	89	0.89
District Heating Boilers – Wood	81	155
District Heating Boilers – Hard Coal	209	7.7

2.4 Territorial domains

The Air Pollutant Emissions are evaluated in the city domains defined as follow for the territorial units' classes reported in Table 2.

Table 2 – Territorial domains

City/region partner	Lower level subdivision
Bristol	LSOA
Amsterdam	Buurt
Ljubljana	Naselje
Sosnowiec	Gminas
Genoa	Census Sections
Aveiro	Freguesia

The Bristol modelling domain (red box) is reported in Figure 1, with boundary of LSOA belonging to the domain (yellow areas), Amsterdam modelling domain (red box) is reported in Figure 2, with boundary of Buurt belonging to the domain (yellow areas), Ljubljana modelling domain (red box) is reported in Figure 3 with boundary of Občine belonging to the domain (yellow areas), Sosnowice modelling domain (red box) is reported in Figure 4 with boundary of Gminas belonging to the domain (yellow areas) while Liguria Region (Genoa area) modelling domain (red box) is reported in Figure 5 with boundary of Census Sections subdivision belonging to the domain (yellow areas), Liguria Region (Genoa area) modelling domain (red box) is reported in Figure 5 with boundary of Census Sections subdivision belonging to the domain (yellow areas) while modelling domain (red box) is reported in Figure 6 with boundary of Freguesia subdivision belonging to the domain (yellow areas).

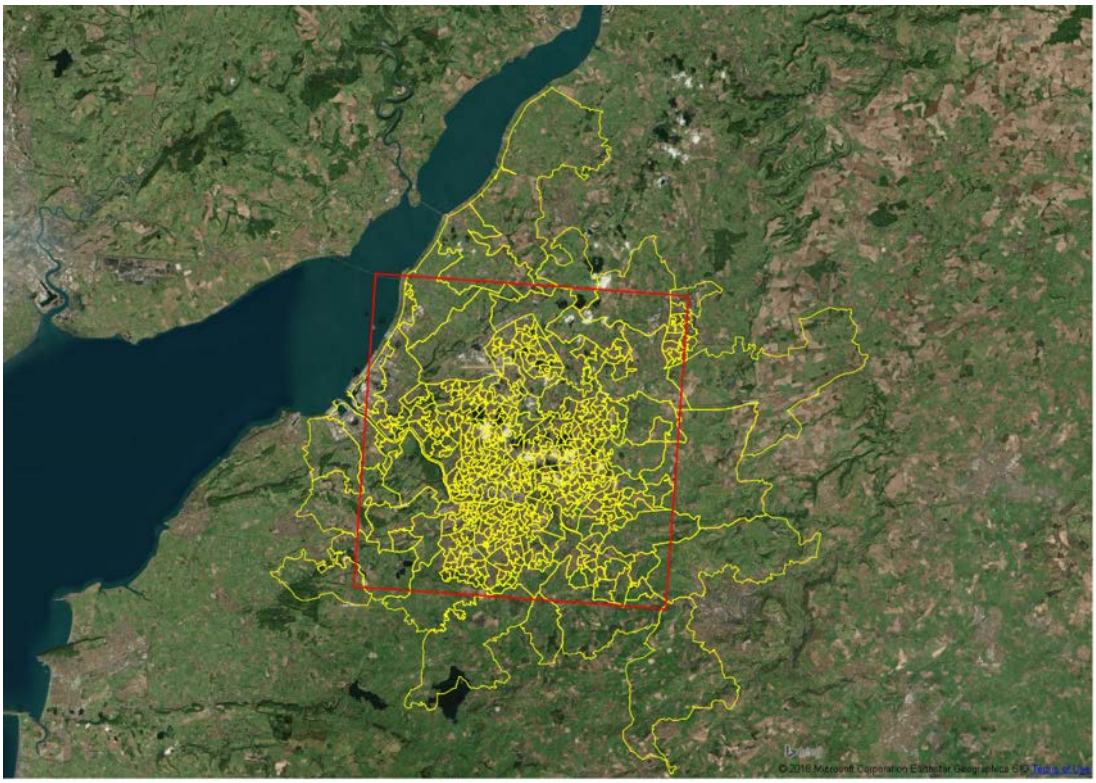

Figure 1 – Bristol domain with LSOA subdivision

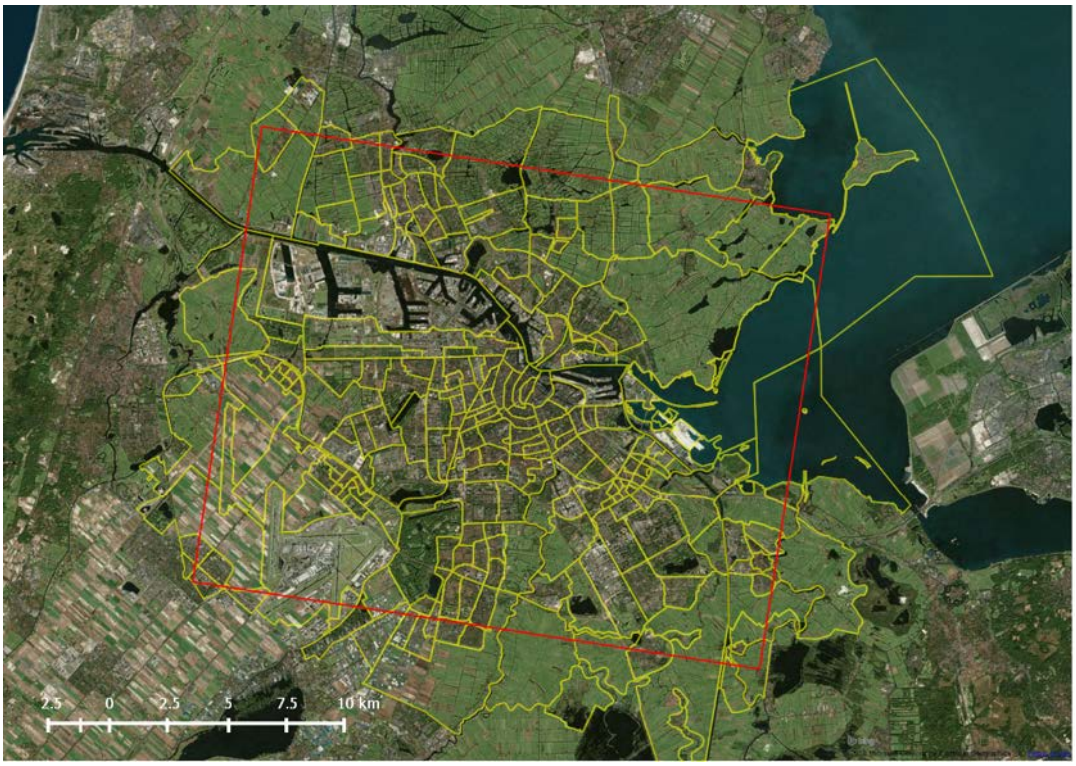

Figure 2 – Amsterdam domain with Buurt subdivision

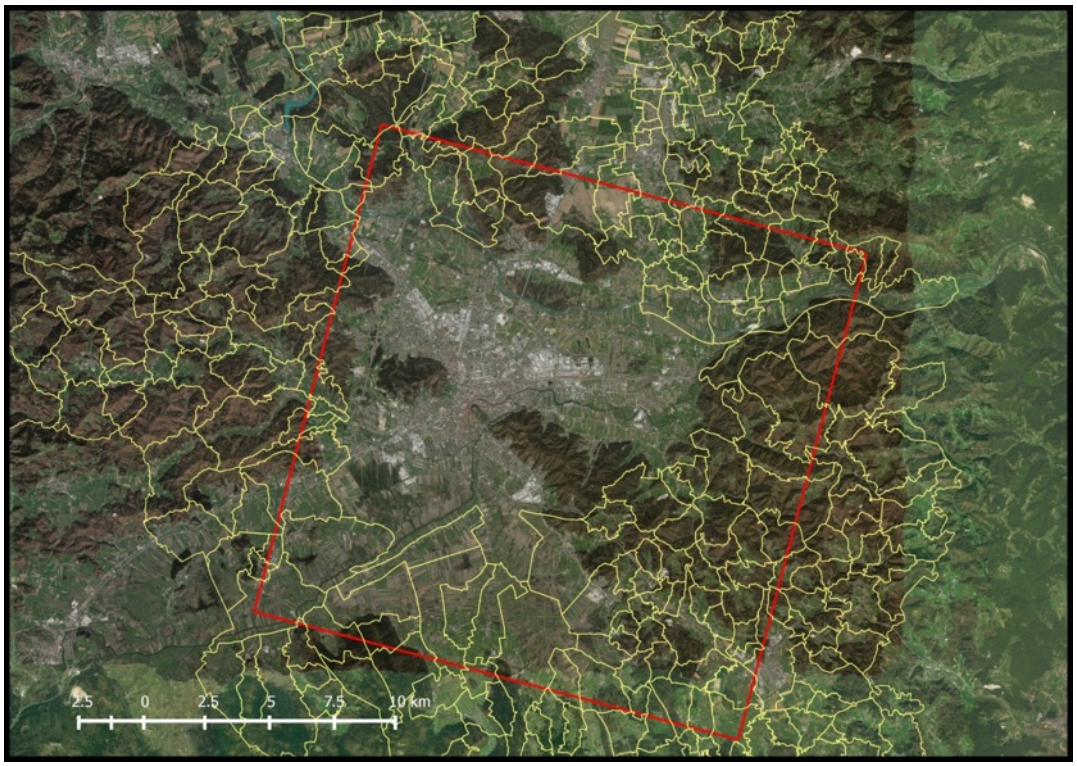

Figure 3 – Ljubljana domain with Naselje subdivision

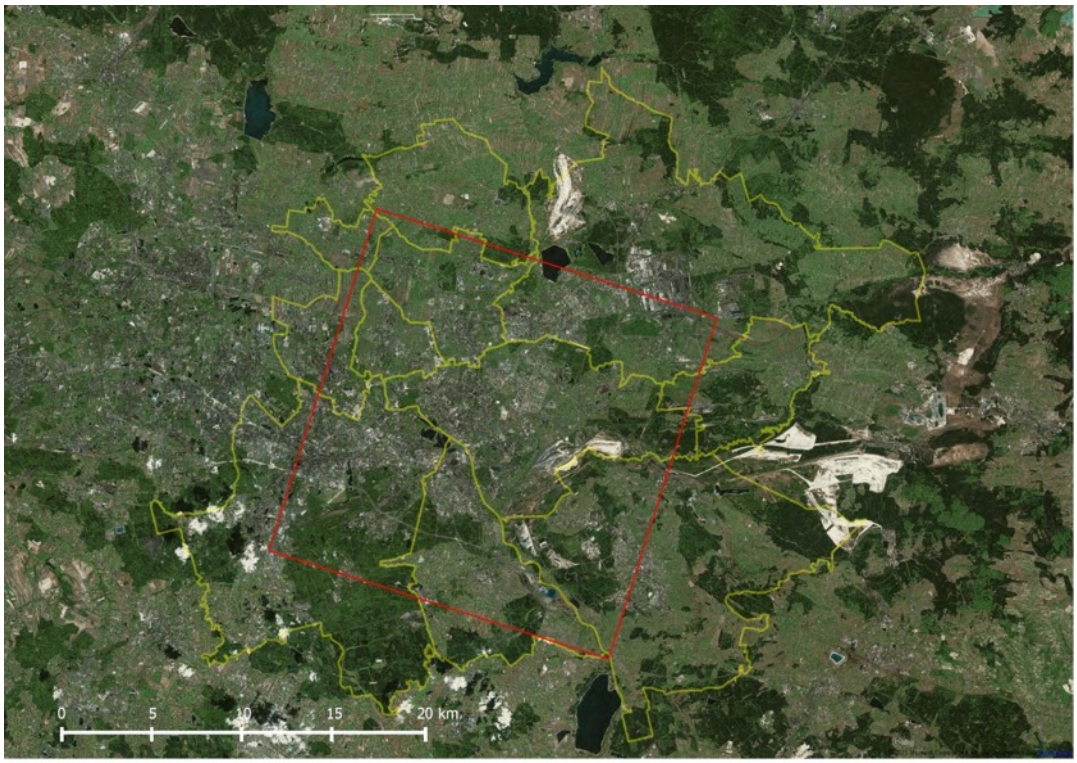

Figure 4 – Sosnowiec domain with Gminas subdivision

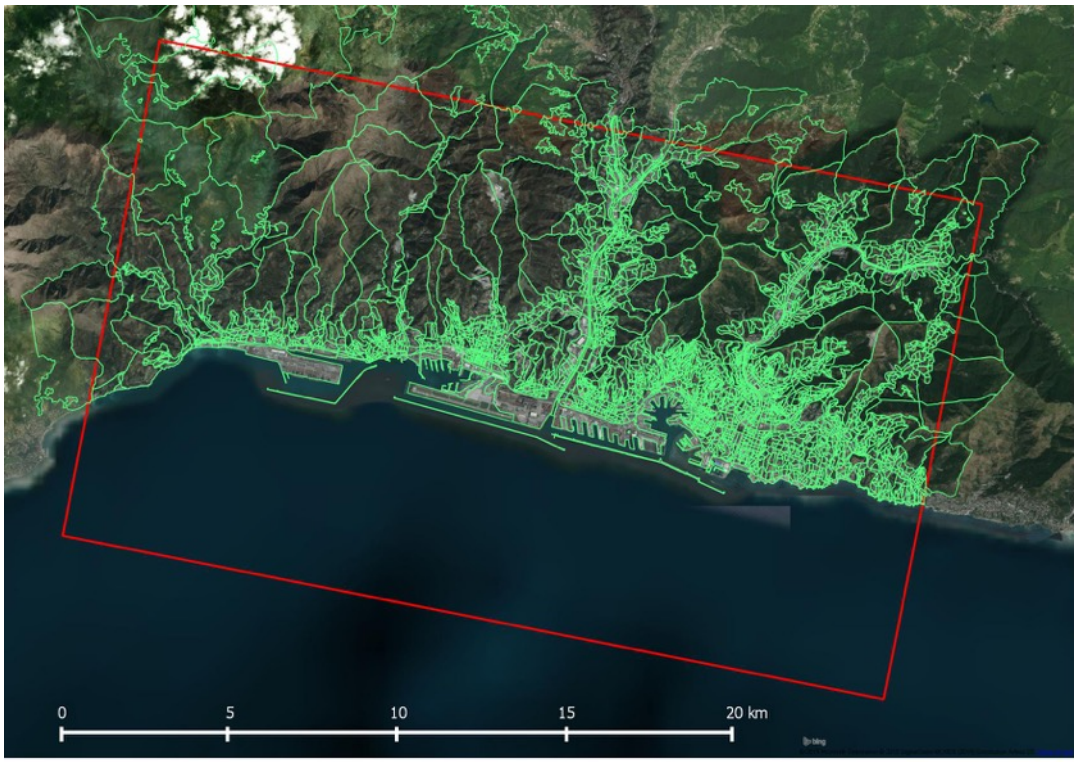

Figure 5 – Liguria Region (Genoa area) domain with Census Sections subdivision

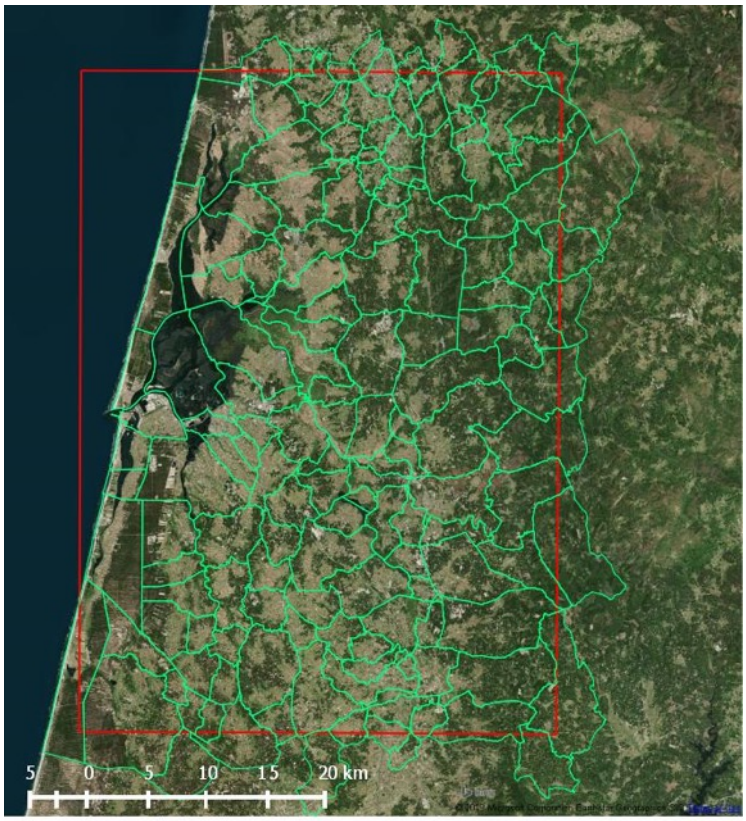

Figure 6 – (red box) with Freguesia subdivision

2.5 Classification of activities and fuels for emission estimates

The module needs, as an input, data on fuel consumptions in residential and commercial sectors, detailed by technologies (boilers, fireplaces, stoves, …) and fuels as in the following Table 3.

Table 3 – Variable used to evaluate emissions in industrial, residential and commercial sector

Code	Name
020131A0	Commercial Combustion plants (boilers) (2110 - Hard Coal) [Mg]
020131F0	Commercial Combustion plants (boilers) (3220 - LPG) [Mg]
020131I0	Commercial Combustion plants (boilers) (3260 - Gas/Diesel Oil) [Mg]
020131M1	Commercial Combustion plants (boilers) (4100 - Natural gas) [Mm3]
020401A0	Commercial Combustion plants (district heating) (2110 -Hard Coal)
020401M1	Commercial Combustion plants (district heating) (4100 - Natural gas)
020401N0	Commercial Combustion plants (district heating) (5541 - Solid biomass) [Mg]
020220A0	Residential Combustion plants (boilers) (2110 - Hard Coal) [Mg]
020220F0	Residential Combustion plants (boilers) (3220 - LPG) [Mg]
020220I0	Residential Combustion plants (boilers) (3260 - Gas/Diesel Oil) [Mg]
020220M1	Residential Combustion plants (boilers) (4100 - Natural gas) [Mm3]
020220N0	Residential Combustion plants (boilers) (5541 - Solid biomass) [Mg]
020221N0	Residential Fireplaces (5541 - Solid biomass) [Mg]
020222N0	Residential Advanced Fireplaces (5541 - Solid biomass) [Mg]
020223N0	Residential Conventional Stoves (5541 - Solid biomass) [Mg]
020224N0	Residential Advanced Stoves (5541 - Solid biomass) [Mg]
020226N0	Residential Energy Efficient Fireplaces (5541 - Solid biomass) [Mg]
020402A0	Residential Combustion plants (district heating) (2110 - Hard Coal)
020402M1	Residential Combustion plants (district heating) (4100 - Natural gas)
020402N0	Residential Combustion plants (district heating) (5541 - Solid biomass)

2.6 Data evaluation on domains and subdomains

Air Pollutant emissions are evaluated on defined subdomains. When data are available only in aggregate figures (overall domain) or at national level, they are allocated to subdomains using a “proxy” variable available at subdomains level. The data know at domain or national level are evaluated on subdomains using a lot of proxy variables known at the subdomains level to allocate overall values on a subdomain’s basis. Proxy variables allow obtaining information on a certain spatial resolution assuming that it is known for larger spatial resolutions.

When data are available at city/region domain, data at subdomain level is evaluated using the following equation:

$$A_i = A * P_i / \Sigma_i P_i$$

where: A_i and P_i are the values of variable A and proxy variable P in the subdomain i, and A is the total of variable A in the domain.

When data are available at national level, data at subdomain level is evaluated using the following equation:

$$A_i = (A * Q_d / \Sigma_d Q_d) * P_i / \Sigma_i P_i$$

where: A_i and P_i are the values of the variable A and proxy variable P in the subdomain i, Q_d is the values of the proxy variable Q in domain d, and A is the national value of proxy variable A.

3 BASELINE RESULTS

In the following the data collection, evaluation procedures and results are detailed for Bristol (par. 3.1), Amsterdam (par. 3.2), Ljubljana (par. 3.3), Sosnowiec (par. 3.4), Liguria Region (Genoa Area) (par. 3.5) and (par. 3.6).

3.1 Bristol

3.1.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 4);
- Residential and commercial sources (Table 5);
- Wood statistics (Table 6);
- Aggregate fuel consumptions data subdivision (Table 7);
- LSOA disaggregation variables (Table 8).

Table 4 – Methodology and source of data for Bristol emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference
Industrial sector	Single facility	UK Department for Environment Food & Rural Affairs	Emissions from NAEI large point sources	http://naei.beis.gov.uk/data/map-large-source

Table 5 – Methodology and source of data for Bristol fuel consumptions evaluation - Residential and services sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Field	Disaggregation variable
Residential sector	Natural Gas	Level 3 (LSOA)	UK Department for Business, Energy & Industrial Strategy	Lower and Middle Super Output Areas gas consumption 2018 update	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/676340/LSOA_domestic_gas_2015.xlsx	Consumption (kWh)	None
	Wood	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	56% of Column M (Bioenergy & Waste) [see Share of wood on biomass in Table 6 for technology spit]	households not connected to the gas network (Table 8)
	LPG	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	10% of Column D (Petroleum; domestic) [see Table 7 for percentage]	households not connected to the gas network (Table 8)
	Gasoil	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	90% of Column D (Petroleum; domestic) [see Table 7 for percentage]	households not connected to the gas network (Table 8)
	Coal	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	Columns J+L (Coal+ Manufactured Solid Fuels; domestic) [see Table 7 for percentage]	households not connected to the gas network (Table 8)
Service	Natural gas	Level 2	UK Department for	Lower and Middle	https://www.gov.uk/governme	Consumption (kWh) 42%	Employees

sector		(MSOA)	Business, Energy & Industrial Strategy	Super Output Areas gas consumption 2018 update	nt/uploads/system/uploads/attachment_data/file/676344/MSOA_non_dom_gas_2015.xlsx	[see Table 7 for percentage]; totals at LA level obtained as sum from MSOA data are directly allocated to LSOA (°)	(Table 8)
	LPG	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/statistical-data-sets/estimates-of-non-gas-non-electricity-and-non-road-transport-fuels-at-regional-and-local-authority-level	30% of Column F+G (Petroleum; Public Administration + Commercial) [see Table 7 for percentage]	Employees (Table 8)
	Gasoil	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	70% of Column F+G (Petroleum; Public Administration +Commercial) [see Table 7 for percentage]	Employees (Table 8)
	Wood	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	Negligible share of Column M (Bioenergy & Waste) [see Share of wood on biomass in Table 6 for percentage]	Value=0 no disaggregation
	Coal	Level 1,5 (LA)	UK Department for Business, Energy & Industrial Strategy	Residual fuel consumption at regional and local authority level	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/647698/residual_fuels_2005-2015.xlsx	Columns I (Coal; Industrial & Commercial) [Commercial share 1,5%; see Table 7 for percentage]	Employees (Table 8)

(°) if MSOA data are used to evaluate LSOA a bias is introduced due to different distribution industry/services in different MSOA

Table 6 – Methodology and source of data for Bristol fuel consumptions evaluation – Wood statistics

Variable	Data availability	Sources	Publication	Reference	Note
Share of wood on biomass	Level 1,5 (LA)	Ricardo Energy & Environment	Personal communication		The following share is evaluated: wood domestic 20%. In commercial sector only, wood wastes and plant biomass assumed included in point sources and globally negligible
Technologies split	Level 3 (National)	UK Department for Business, Energy & Industrial Strategy	Summary results of the domestic wood use survey Table 2.7 Final energy calculation	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576953/Summary_Tables_Domestic_Wood_Survey.xlsx	On the basis of available data, the following shares are evaluated: conventional stoves 16%, high efficiency stoves 17%, advanced stoves 13%, conventional fireplaces 43%, high efficiency fireplaces 4%, advanced fireplaces 4%, boilers 4%.

Table 7 – Methodology and source of data for Bristol fuel consumptions evaluation – Aggregate fuel consumptions data subdivision

Energy vector	Data availability	Source	Publication	Reference	Note
Natural Gas	Level 3 (National)	UK Department for Business, Energy & Industrial Strategy	Digest of UK Energy Statistics: natural gas: commodity balances (DUKES 4.1)	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632524/DUKES_4.1.xls	On the basis of available data, the following share is evaluated: SERVICES Natural gas 42%, industrial 52%, others (agriculture, miscellaneous) 6%
LPG, Gasoil	Level 3 (National)	UK Department for Business, Energy & Industrial Strategy	Digest of UK Energy Statistics: Petroleum products: commodity balances (DUKES 3.2-3.4)	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632507/DUKES_3.2-3.4.xls	On the basis of available data, the following shares are evaluated: SERVICES LPG 30% Gasoil 70% (in gasoil we include also an 8% of fuel oil) RESIDENTIAL LPG 10% Gasoil 90% (in gasoil kerosene is included).
Coal	Level 3 (National)	UK Department for Business, Energy & Industrial Strategy	Digest of UK Energy Statistics: : solid fuels and derived gases: commodity balances (DUKES)	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632497/DUKES_2.4.xls	On the basis of available data, the following shares are evaluated for Coal: SERVICES 1,5% INDUSTRIAL 98,5%

Table 8 – Methodology and source of data for Bristol fuel consumptions evaluation – LSOA disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Fields
Households not connected to the gas network	Level 3 (LSOA)	UK Department for Business, Energy & Industrial Strategy	Lower and Middle Super Output Areas gas consumption 2018 update	https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/676466/LSOA_domestic_nongas_2016.xlsx	Estimated number of households not connected to the gas network
Employees	Level 3 (LSOA)	UK Office for National Statistics	All people aged 16 to 74 in employment the week before the Census Occupation by industry 2011 Occupies	https://www.nomisweb.co.uk/census/2011/ks605uk	Geography All of the following: 2001 super output areas - lower layer Cell SERVICE SECTOR Table CAS039 Occupation by industry select columns • G Wholesale and retail trade; repair of motor vehicles and motor cycles • H Transport and storage • I Accommodation and food service activities • J Information and communication • K Financial and insurance activities • L Real estate activities • M Professional, scientific and technical activities • N Administrative and support service activities • O Public administration and defense; compulsory social security • P Education • Q Human health and social work activities • R, S, T, U Other INDUSTRIAL SECTOR select columns

Table 8 – Methodology and source of data for Bristol fuel consumptions evaluation – LSOA disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Fields
					• B Mining and quarrying • C Manufacturing • D Electricity, gas, steam and air conditioning supply • E Water supply; sewerage, waste management and remediation activities • F Construction The table provides information that classifies usual residents aged 16 to 74 in employment the week before the census by the industry in which they work, for United Kingdom as at census day, 27 March 2011.
Properties with heating fuel oil	LSOA	The non-gas map	Kiln for Affordable Warmth Solutions, in conjunction with the Department for Business, Energy and Industrial Strategy	https://www.nongasmap.org.uk	Heating fuel oil

3.1.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by LSOA. In detail are reported:

- Bristol LSOA Residential, Commercial & Institutional NO_x emissions for all sectors and fuel (Figure 7),
- Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 8),
- Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions from biomass use (Figure 9),
- Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions from hard coal use (Figure 10),
- Bristol Industry NO_x emissions (Figure 11)
- Bristol Industry PM_{10} emissions (Figure 12).

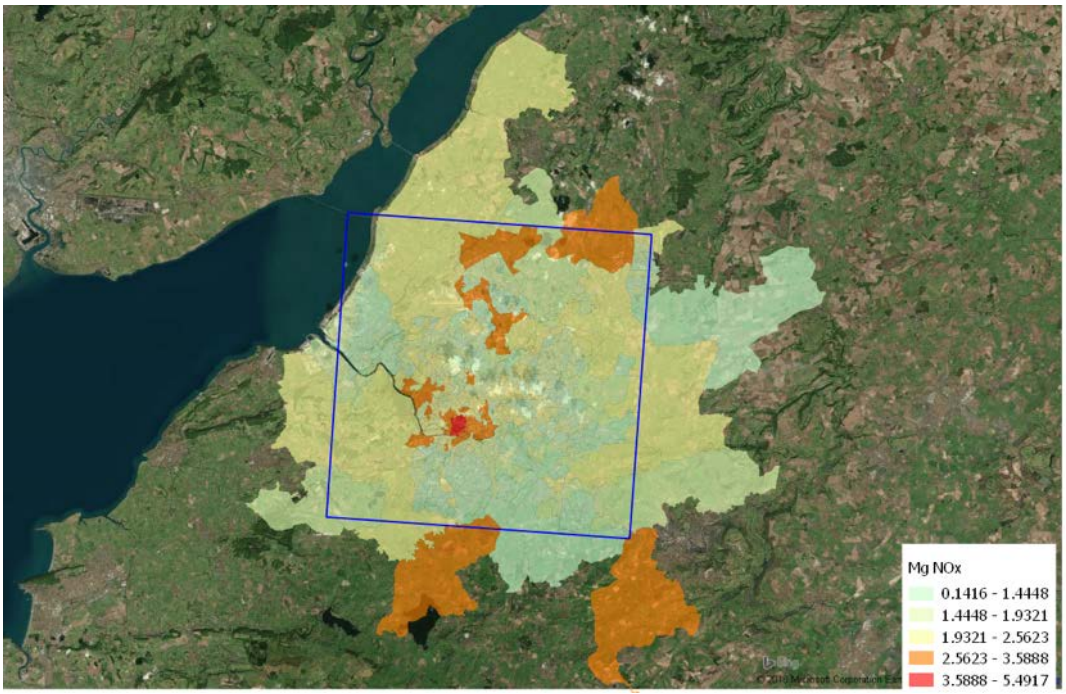

Figure 7 – Bristol LSOA Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

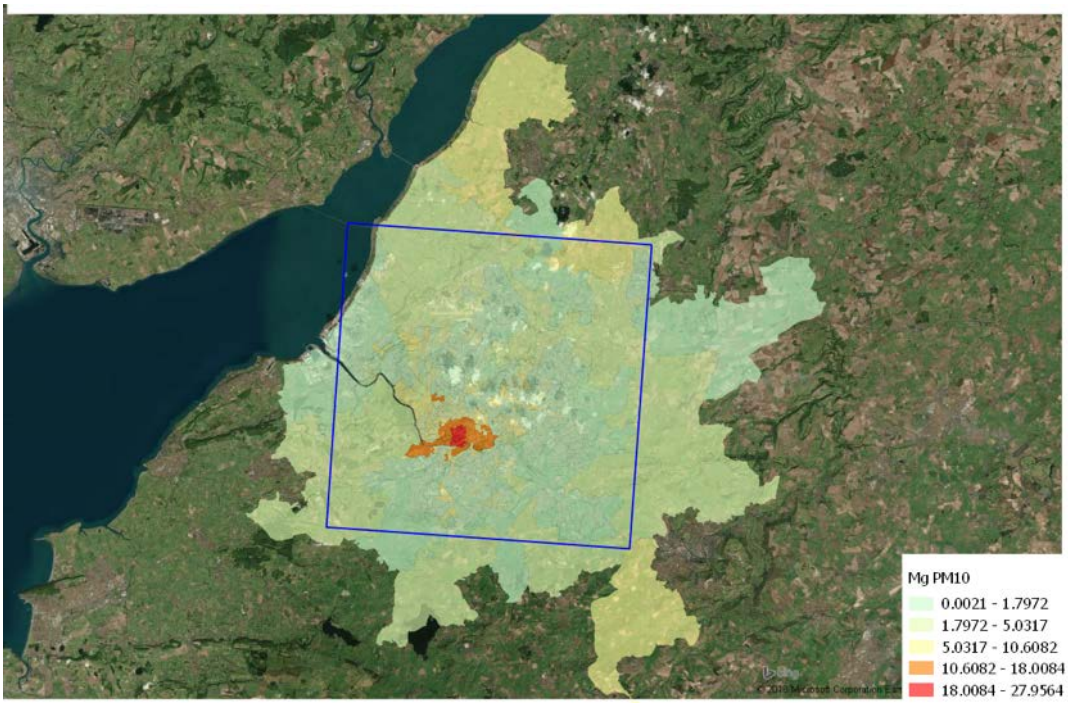

Figure 8 – Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

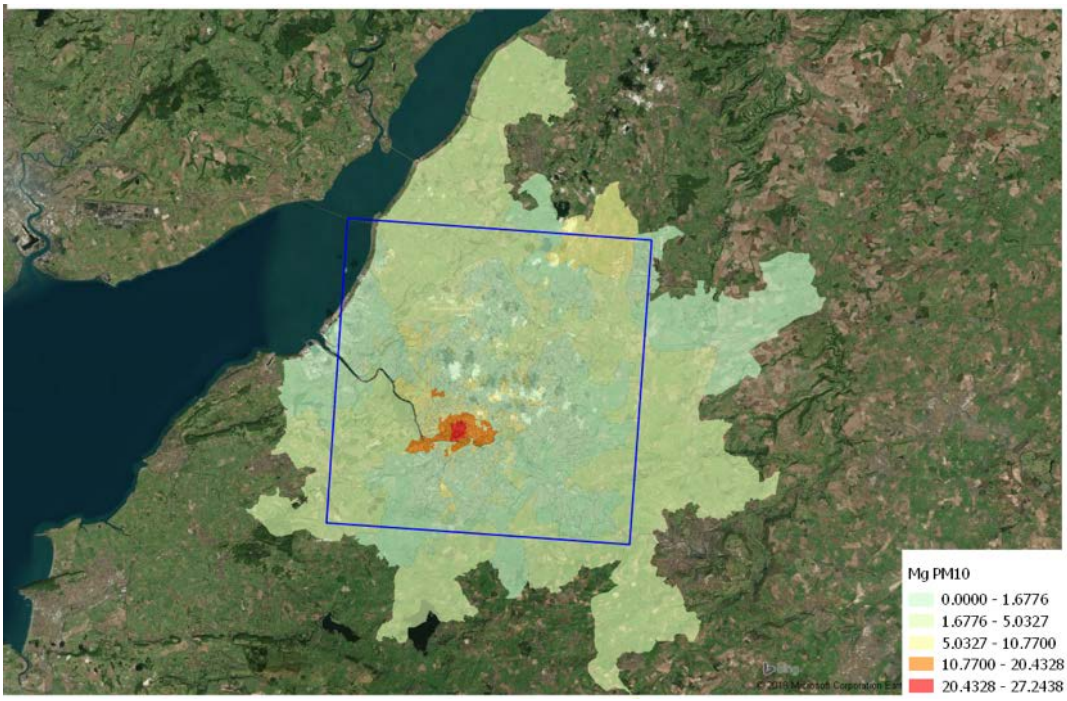

Figure 9 – Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions – biomass

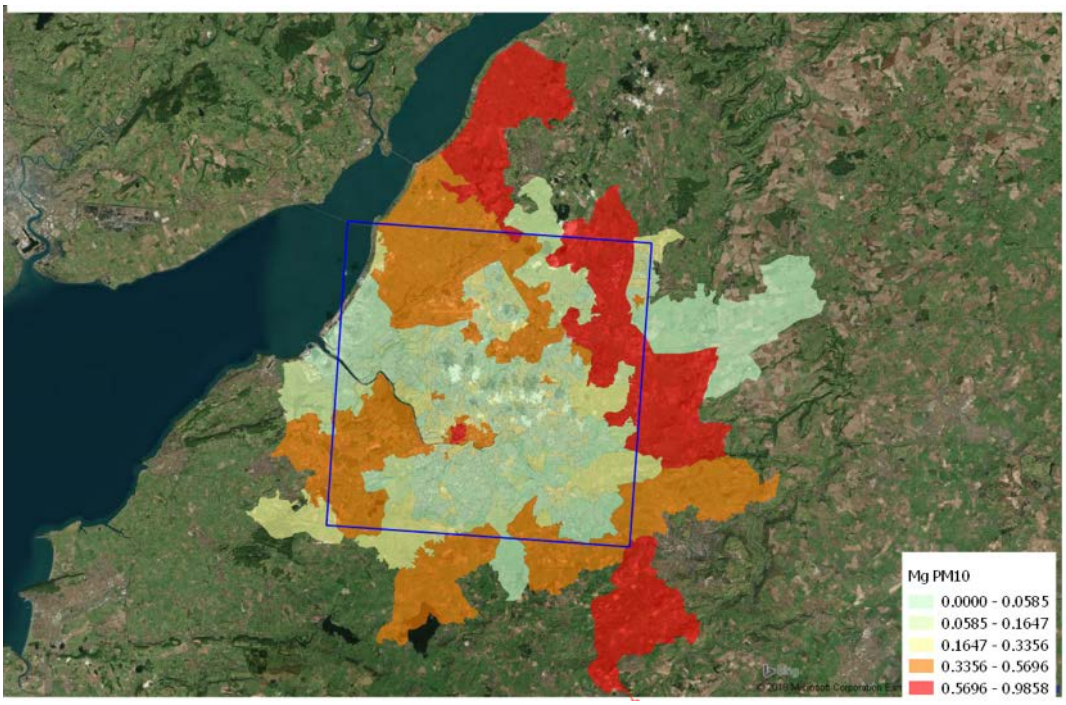

Figure 10 – Bristol LSOA Residential, Commercial & Institutional PM_{10} emissions – hard coal

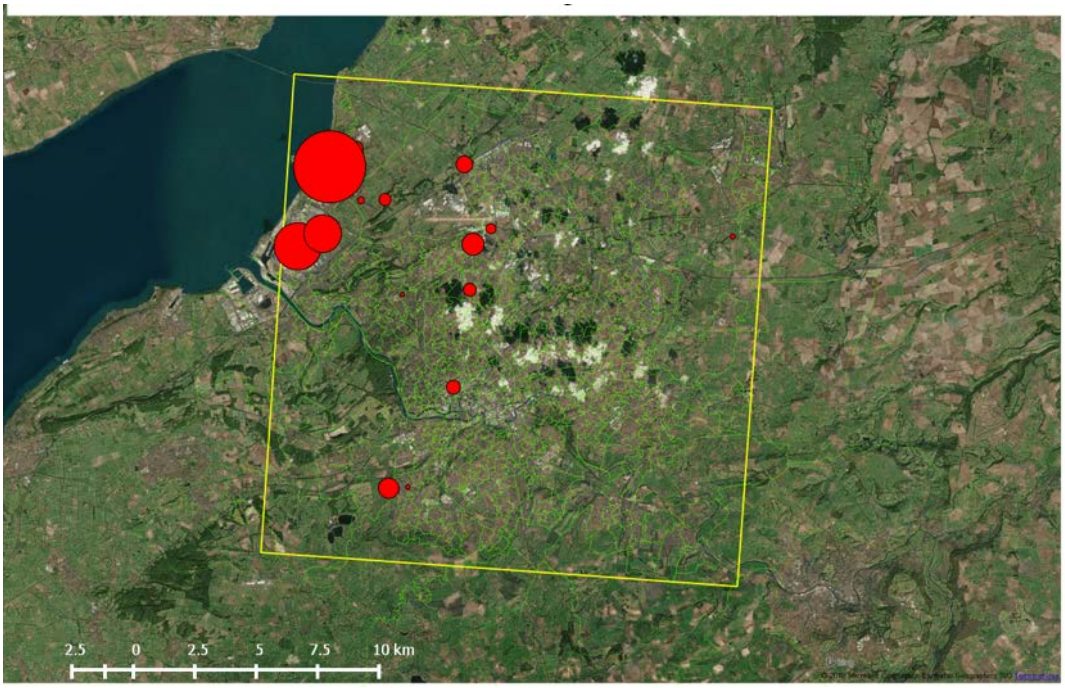

Figure 11 – Bristol Industry NO_x emissions

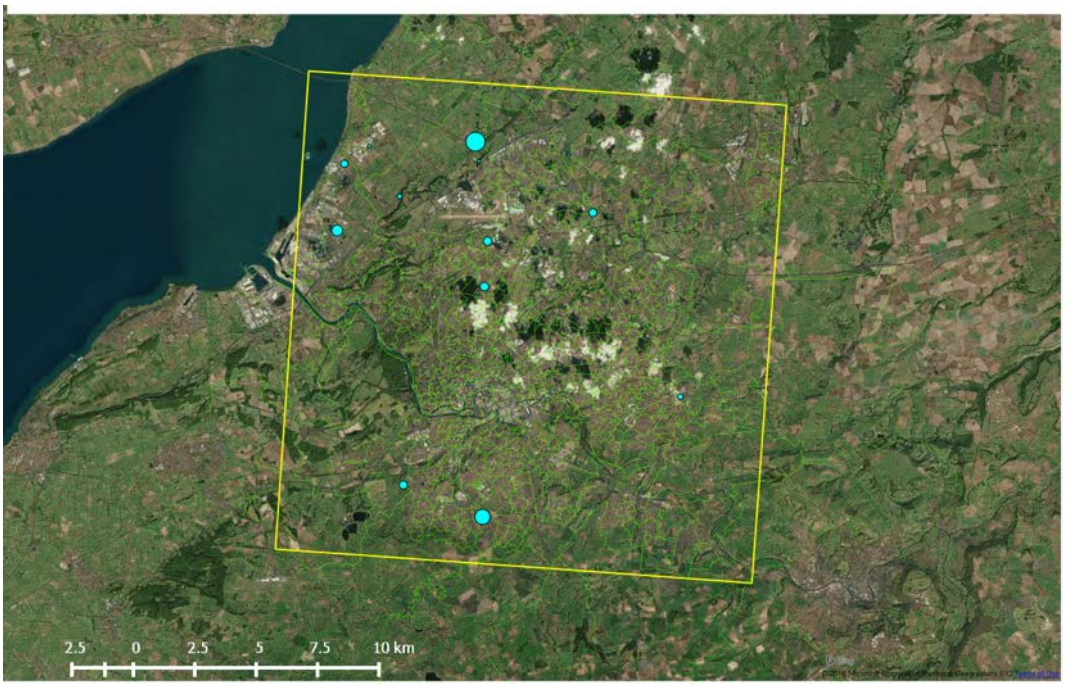

Figure 12 – Bristol Industry PM_{10} emissions

Finally, in the following Figure 13 and Figure 14 the emissions for the different activities & fuels in the only City of Bristol MSOA are reported.

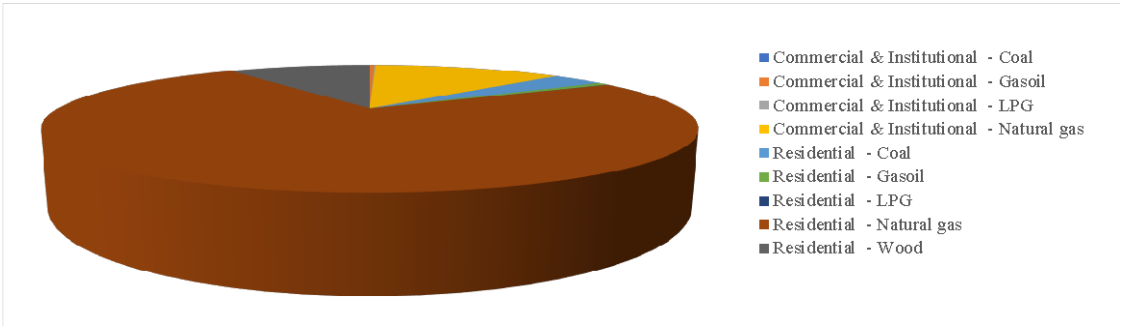

Figure 13 – City of Bristol MSOA Residential, Commercial & Institutional NO_x emissions

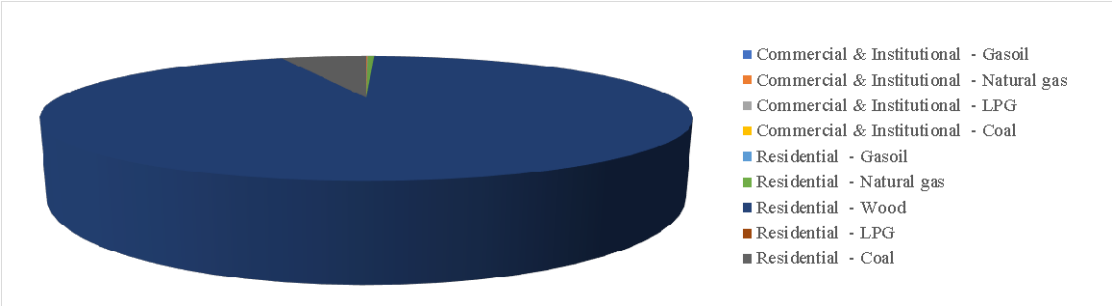

Figure 14 – City of Bristol MSOA Residential, Commercial & Institutional PM_{10} emissions

3.2 Amsterdam

3.2.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 9)
- Residential and commercial sources (Table 10)
- Wood statistics (Table 11);
- Buurt disaggregation variables (Table 12).

Table 9 – Methodology and source of data for Amsterdam emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference
Industrial sector	Single facility	Emissieregistratie		https://emissieregistratie.nl

Table 10 – Methodology and source of data for Amsterdam fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Field	Disaggregation variable
Residential sector	Natural Gas	Level 3 (Buurt)	CBS	Wijk - en buurtkaart 2015	https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische%20data/wijk-en-buurtkaart-2015	G_GAS_TOT*WONINGEN where: [G_GAS_TOT]: Average total natural gas consumption [WONINGEN]: Housing stock	None
	Wood	Level 2 (Gemeente)	RIVM	Klimaatmonitor	https://klimaatmonitor.databank.nl/dashboard/	Wood burning stoves dwellings hern. heat [TJ] (see Share of wood on biomass in Table 11 for technology spit)	Population (Table 12)
	LPG	Level 1 (National)	CBS	Energy balance sheet supply consumption	https://opendata.cbs.nl/statline/portal.html?_la=en&_catalog=CBS&tableId=83140ENG&_theme=1028	Topic: households Period: 2015 Energy commodities: LPG	Population (Table 12)
	Gasoil	Level 1 (National)	CBS	Energy balance sheet supply consumption	https://opendata.cbs.nl/statline/portal.html?_la=en&_catalog=CBS&tableId=83140ENG&_theme=1028	Topic: households Period: 2015 Energy commodities: Heating and other gas oil	Population (Table 12)
Service sector	Natural gas	Level 2 (Gemeente)	RIVM	Klimaatmonitor	https://klimaatmonitor.databank.nl/dashboard/	Gas use commercial Services [m3] + Gas use Public Services [m3]	Services Companies number (Table 12)
	Wood	Level 1	CBS	Energy balance	https://opendata.cbs.nl/statl	Topic: services waste and repairs	Services

Table 10 – Methodology and source of data for Amsterdam fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Field	Disaggregation variable
		(National)		sheet supply consumption	ine/portal.html?_la=en&_catalog=CBS&tableId=83140ENG&_theme=1028	Period: 2015 Energy commodities: Solid and liquid biomass	Companies number (Table 12)
	LPG	Level 1 (National)	CBS	Energy balance sheet supply consumption	https://opendata.cbs.nl/statline/portal.html?_la=en&_catalog=CBS&tableId=83140ENG&_theme=1028	Topic: services waste and repairs Period: 2015 Energy commodities: LPG	Services Companies number (Table 12)
	Gasoil	Level 1 (National)	CBS	Energy balance sheet supply consumption	https://opendata.cbs.nl/statline/portal.html?_la=en&_catalog=CBS&tableId=83140ENG&_theme=1028	Topic: services waste and repairs Period: 2015 Energy commodities: Heating and other gas oil	Services Companies number (Table 12)

Table 11 – Methodology and source of data for Amsterdam fuel consumptions evaluation – Wood statistics

Variable	Data availability	Sources	Publication	Reference	Note
Technologies split	Level 3 (National)	CBS	Houtverbruik bij huishouden (Wood consumption in households)	https://www.cbs.nl/-/media/imported/documents/2010/18/2010-houtverbruik-bij-huishoudens-art.pdf?la=nl-nl	On the basis of available data, the following shares are evaluated: stoves 55% fireplaces 45%. Using national EMEP PM_{10} data the following shares are derived: traditional 30% advanced 70%.) Service sector allocated to boilers.

Table 12 – Methodology and source of data for Amsterdam fuel consumptions evaluation – Buurt disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Fields

Table 12 – Methodology and source of data for Amsterdam fuel consumptions evaluation – Buurt disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Fields
Population	Level 3 (Buurt)	CBS	Wijk-en buurtkaart 2015	https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische%20data/wijk-en-buurtkaart-2015	AANT_INW (Number of inhabitants)
Services Companies number	Level 3 (Buurt)	CBS	Wijk-en buurtkaart 2015	https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische%20data/wijk-en-buurtkaart-2015	[A_BED_GI]+[A_BED_HJ]+[A_BED_KL]+[A_BED_MN]+[A_BED_RU] where: [A_BED_GI]: Number of companies and catering trade [A_BED_HJ]: Number of companies in transport, information, communication [A_BED_KL]: Number of firms financially property [A_BED_MN]: Number of companies in business services [A_BED_RU]: Number of companies in culture, recreation, other
Industry Companies number	Level 3 (Buurt)	CBS	Wijk-en buurtkaart 2015	https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische%20data/wijk-en-buurtkaart-2015	[A_BED_BF]: Number of companies in industry and energy

3.2.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by Buurt. In detail are reported:

- Amsterdam Buurt Residential, Commercial & Institutional NO_x emissions for all sectors and fuel (Figure 15),
- Amsterdam Buurt Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 16),
- Amsterdam Buurt Residential, Commercial & Institutional PM_{10} emissions from biomass use (Figure 17),
- Amsterdam Industry NO_x emissions (Figure 18),
- Amsterdam Industry PM_{10} emissions (Figure 19).

Figure 15 – Amsterdam Buurt Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

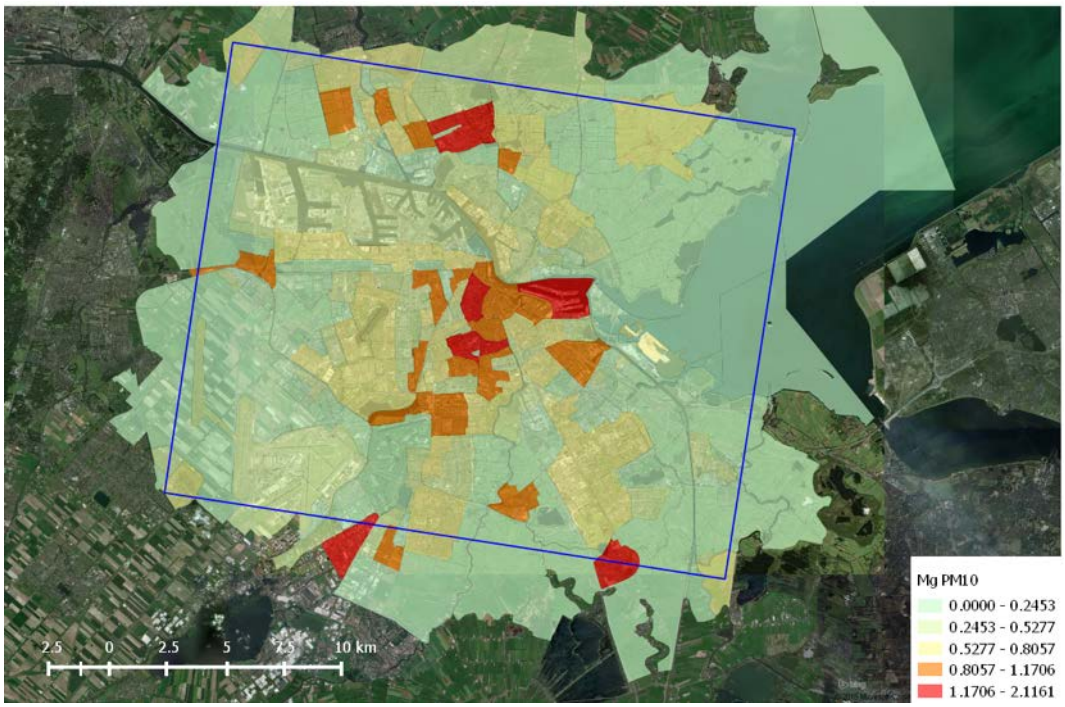

Figure 16 – Amsterdam Buurt Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

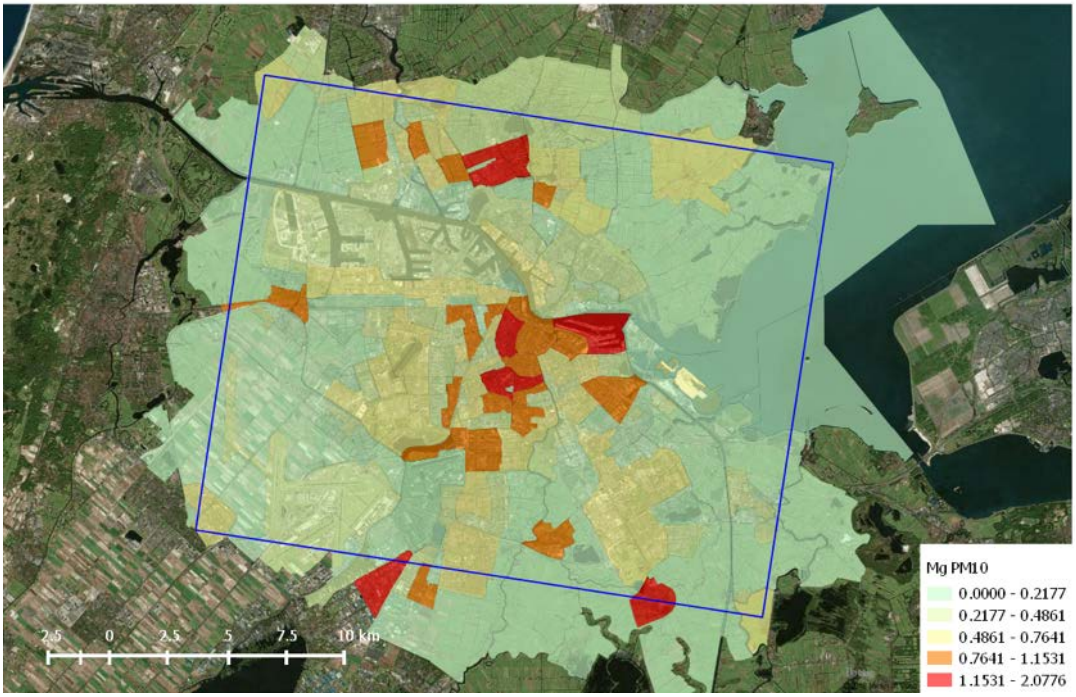

Figure 17 – Amsterdam Buurt Residential, Commercial & Institutional PM_{10} emissions – biomass

Figure 18 – Amsterdam Industry NO_x emissions

Figure 19 – Amsterdam Industry PM_{10} emissions

Finally, in the following Figure 20 and Figure 21 the emissions for the different activities & fuels in the only *Amsterdam Geemente* are reported.

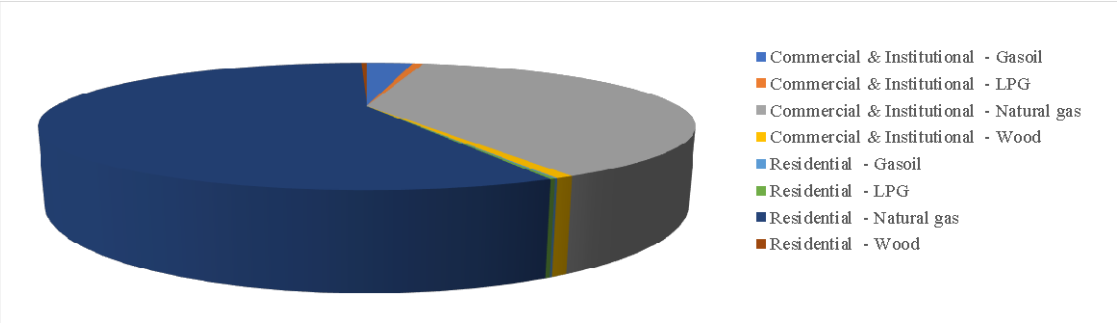

Figure 20 – Amsterdam Geemente Residential, Commercial & Institutional NO_x emissions

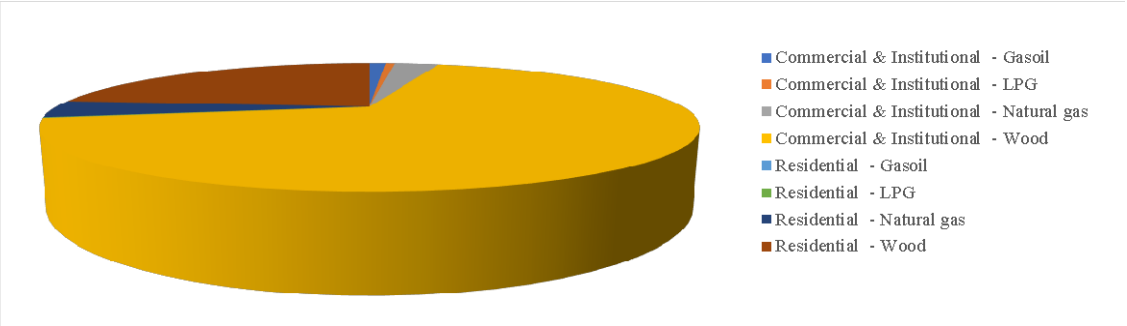

Figure 21 – Amsterdam Geemente Residential, Commercial & Institutional PM_{10} emissions

3.3 Ljubljana

3.3.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 13);
- Residential and commercial sources (Table 14);
- Wood statistics (Table 15);
- Naselje disaggregation variables (Table 16).

Table 13 – Methodology and source of data for Ljubljana fuel consumptions/emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference	Disaggregation variable
Industrial sector	Single facility	EIONET	Reporting Obligations Database (ROD), Deliveries for National Emission Ceiling Directive (NECD) - Large point source (LPS) emissions data by source category (GNFR) Slovenia NECD 2017 Report LPS emissions 2007 2015	http://cdr.eionet.europa.eu/si/eu/nec_revised/lps/envwox5ng	None (Point sources)
Industrial sector	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Corine Land Cover for industrial plants and direct allocation for not point sources energy transformation plants

Table 14 – Methodology and source of data for Ljubljana fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Disaggregation variable
Residential sector	Natural Gas	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	Wood	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National	Republika Slovenija,	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/	Population

Table 14 – Methodology and source of data for Ljubljana fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Disaggregation variable
		for all other areas	Ministrstvo za Infrastrukturo		energetska_bilanca/ebrs_2015.pdf	
	LPG	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	Gasoil	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	Coal	Level 2 (Občine) only for Ljubljana	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
Service sector	Natural Gas	Level 2 (Občine)	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population

Table 14 – Methodology and source of data for Ljubljana fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Disaggregation variable
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	Wood	Level 2 (Občine)	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	LPG	Level 2 (Občine)	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population
	Gasoil	Level 2 (Občine)	EnerGisSolution	Energy Balance And Emission Estimation - City Of Ljubljana (MOL) (Project version: 2016.MOL.1996-2015) Table EB-A: Energy Balance	http://www.energis-solutions.com/en/EB-Ljubljana-MOL/energy-balance	Population
		Level 1 National for all other areas	Republika Slovenija, Ministrstvo za Infrastrukturo	Portal Energetike: Energetska Bilanca Republik Eslovenije - Zaleto 2015	http://www.energetika-portal.si/fileadmin/dokumenti/publikacije/energetska_bilanca/ebrs_2015.pdf	Population

Table 15 – Methodology and source of data for Ljubljana fuel consumptions evaluation – Wood statistics

Variable	Data availability	Sources	Publication	Reference	Note
Technologies split	Level 1 (National)	Slovenian Environment Agency	Slovenia's Informative Inventory Report 2017. 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, Ljubljana, March 2017	http://cdr.eionet.europa.eu/si/un/clrtap/iir/envwmaww/Slovenia_IIR__2017.pdf	In the year 2015 there were 67 % conventional boilers burning wood and similar wood waste, 12 % advanced / ecolabelled stoves and boilers burning wood, 5 % pellet stoves and boilers burning wood pellets, 1 % open fireplaces burning wood, 15 % conventional stoves burning wood and similar wood waste

Table 16 – Methodology and source of data for Ljubljana fuel consumptions evaluation – Naselje disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Note
Population	Level 3 (Naselje)	Statistical Office of the Republic of Slovenia	SI-Stat Database	https://pxweb.stat.si/pxweb/Dialog/varval.asp?ma=05C5004E&ti=&path=../Database/Demographics/05_population/10_Number_Population/25_05C50_Population_naselja/&lang=1	Population by large and 5-year age groups and sex, settlements, Slovenia, annually
Industrial areas coverage	Level 3 (Naselje)	Copernicus Land Monitoring Service	CORINE Land Cover	https://land.copernicus.eu/pan-european/corine-land-cover	A GIS query has been used to evaluated the coverage of industrial area on each Naselje and industrial emissions are allocated to the area based on dimension of area itself.

3.3.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by Naselje. In detail are reported:

- Ljubljana Naselje Residential, Commercial & Institutional NO_x emissions for all sectors and fuel (Figure 22),
- Ljubljana Naselje Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 23),
- Ljubljana Naselje Residential, Commercial & Institutional PM_{10} emissions from biomass use (Figure 24),
- Ljubljana Industry NO_x area emissions (Figure 25),
- Ljubljana Industry PM_{10} area emissions (Figure 26),
- Ljubljana Industry NO_x point emissions (Figure 27),
- Ljubljana Industry PM_{10} point emissions (Figure 28).

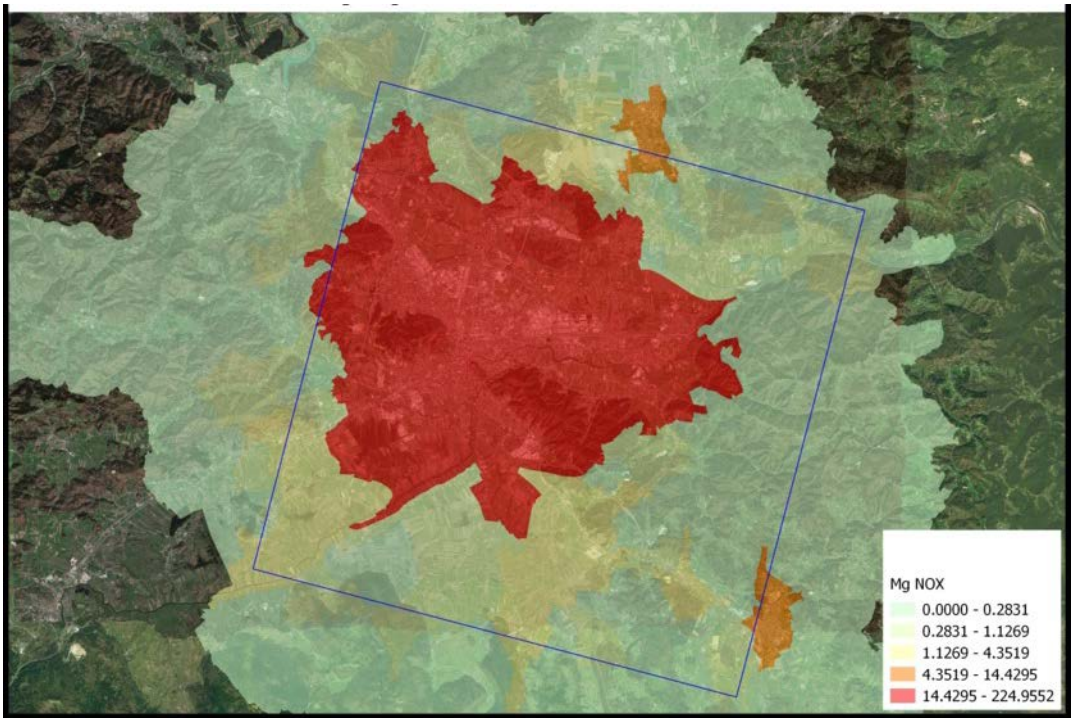

Figure 22 – Ljubljana Naselje Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

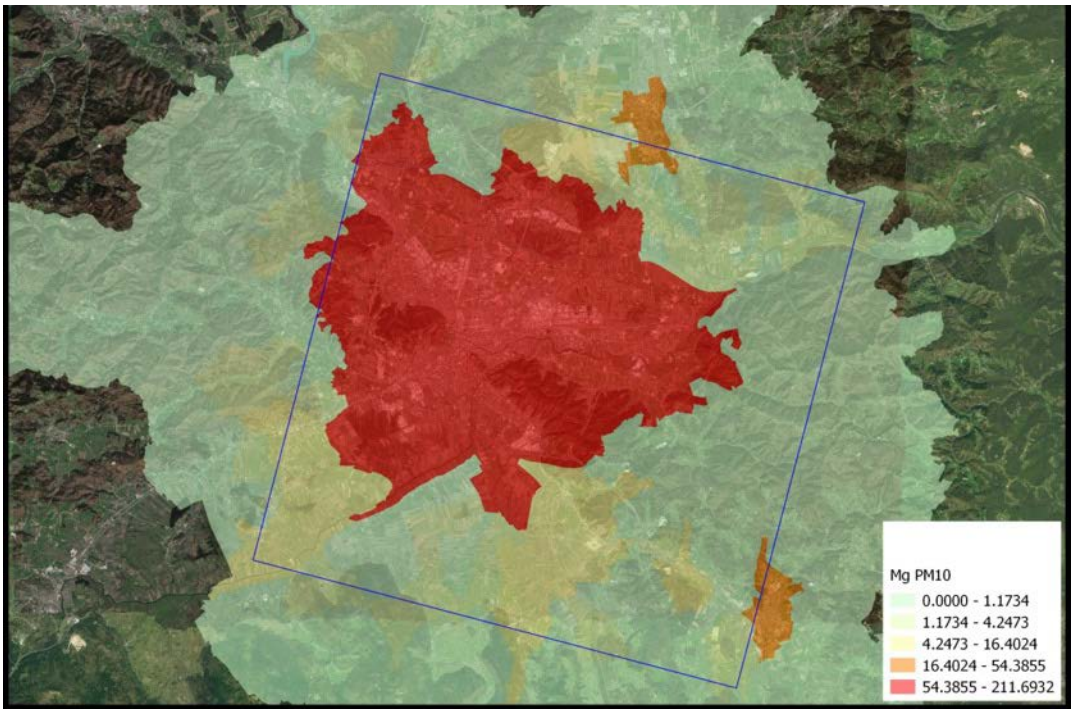

Figure 23 – Ljubljana Naselje Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

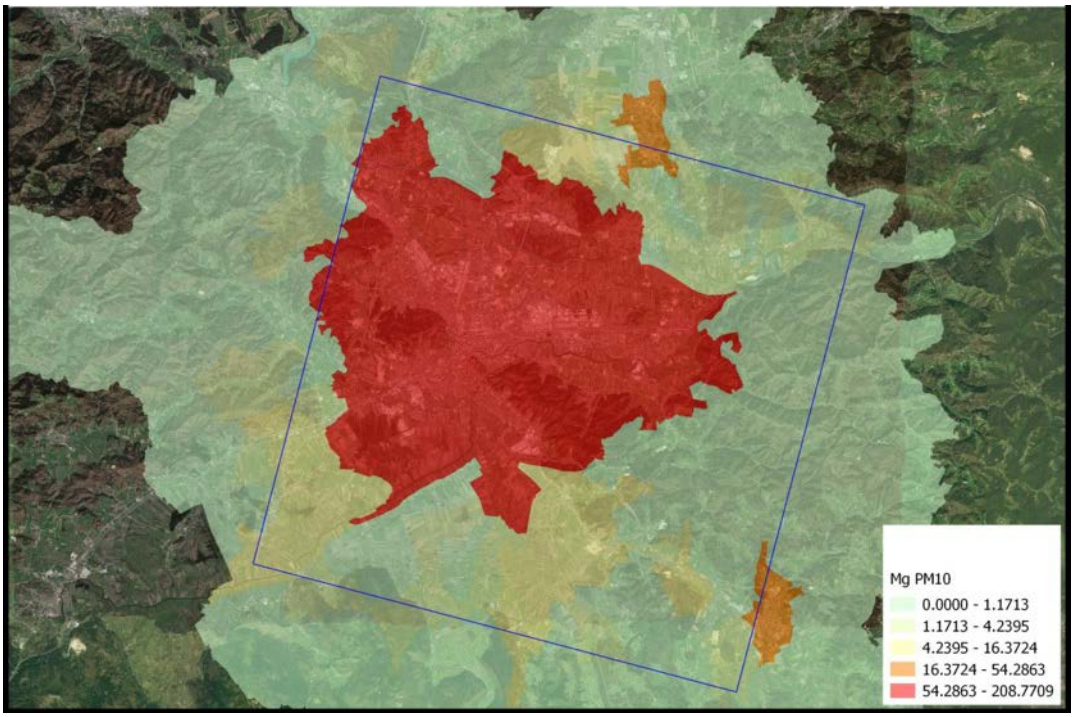

Figure 24 – Ljubljana Naselje Residential, Commercial & Institutional PM_{10} emissions – biomass

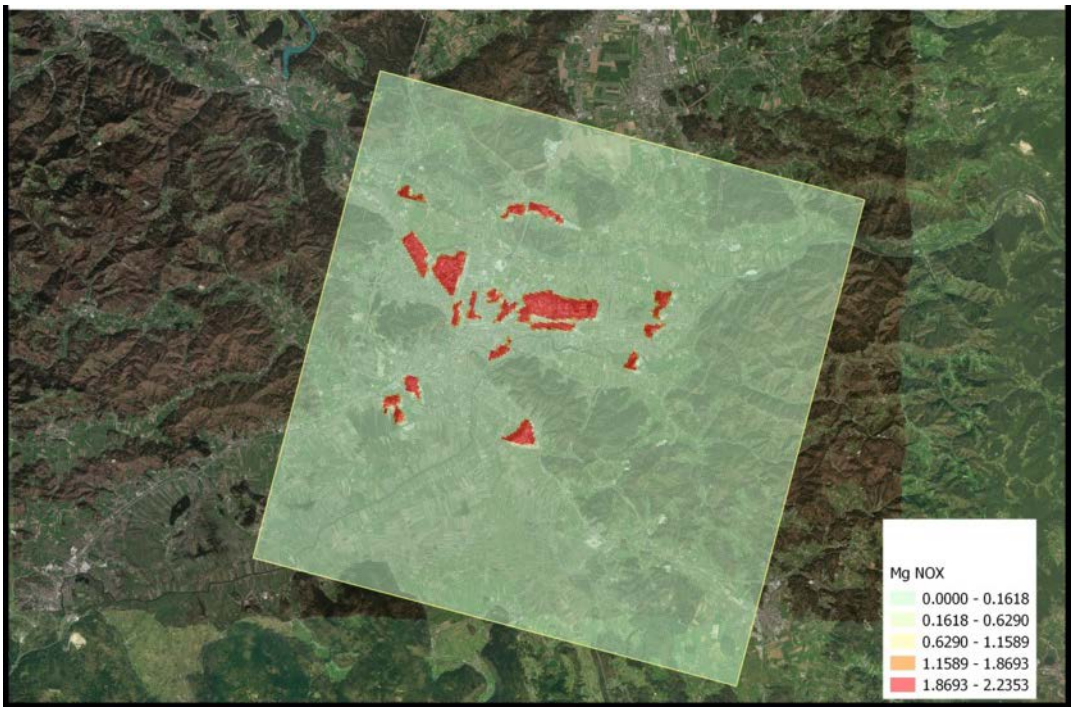

Figure 25 – Ljubljana Industry Sector NO_x area emissions

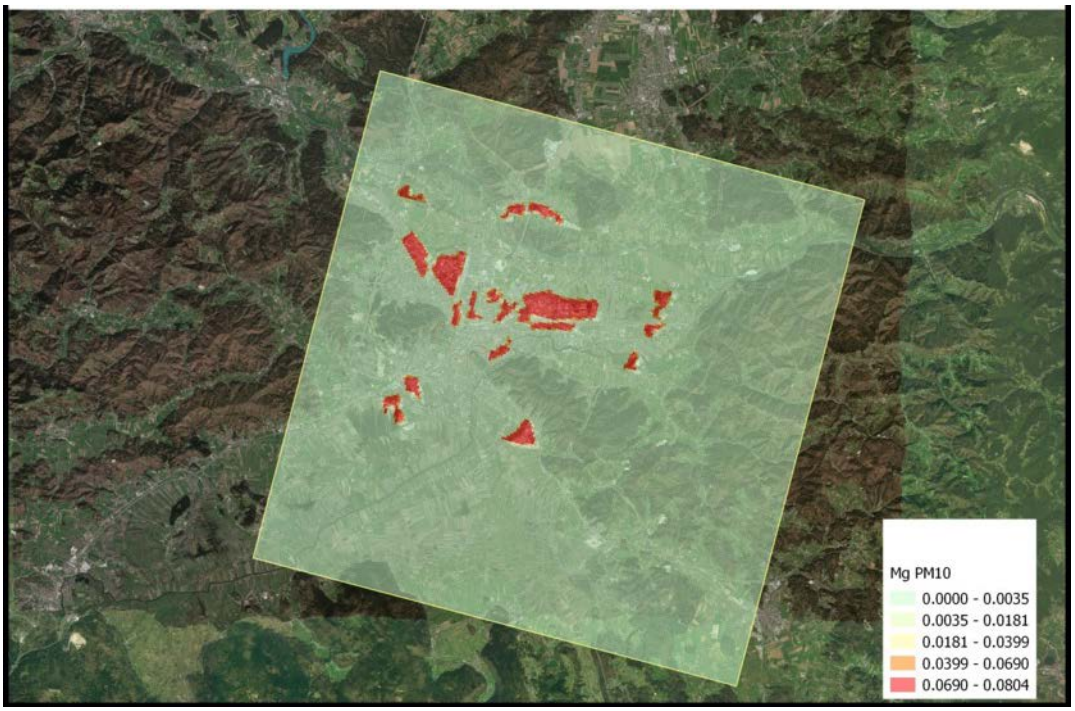

Figure 26 – Ljubljana Industry Sector PM_{10} area emissions

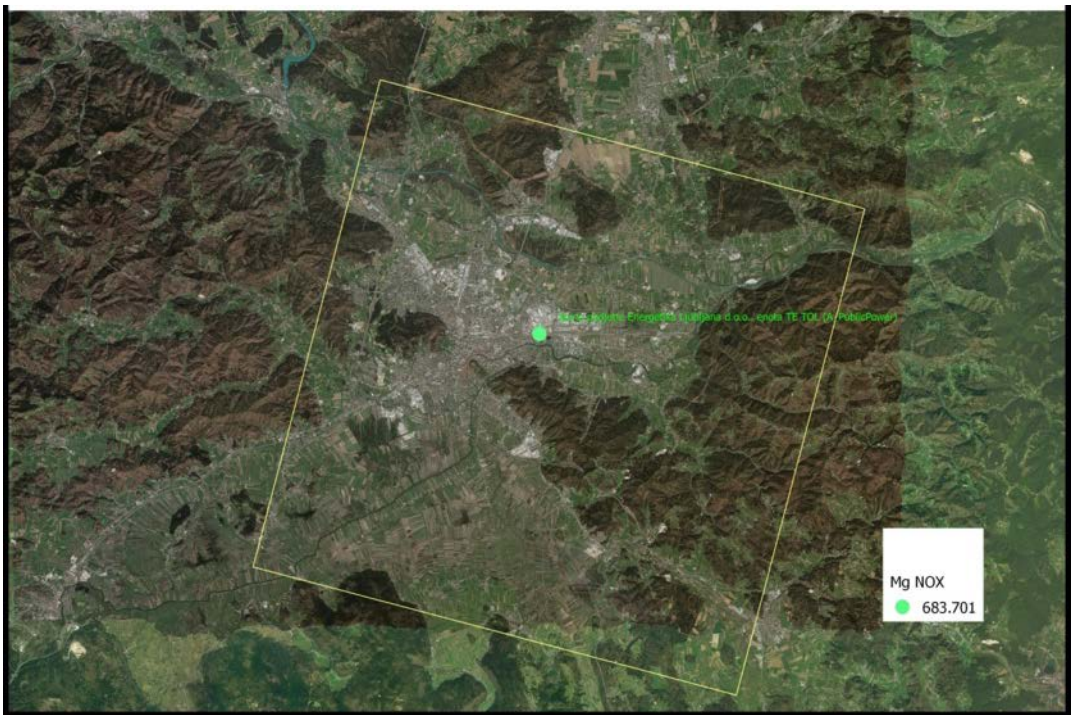

Figure 27 – Ljubljana IRC Industry NO_x point emissions

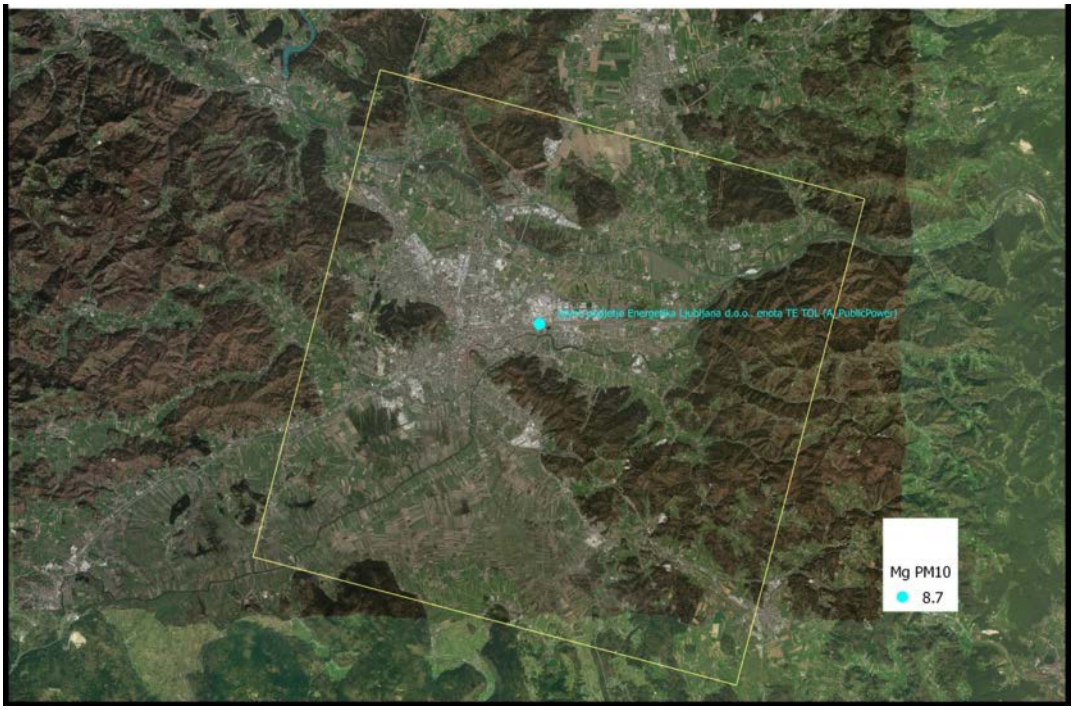

Figure 28 – Ljubljana IRC Industry PM_{10} point emissions

Finally, in the following Figure 29 and Figure 30 the emissions for the different activities & fuels in the only *Ljubljana Občine* are reported.

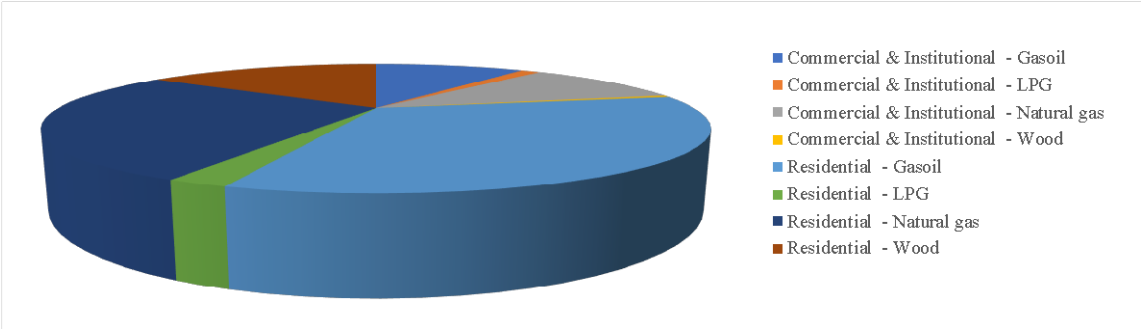

Figure 29 – Ljubljana Občine Residential, Commercial & Institutional NO_x emissions

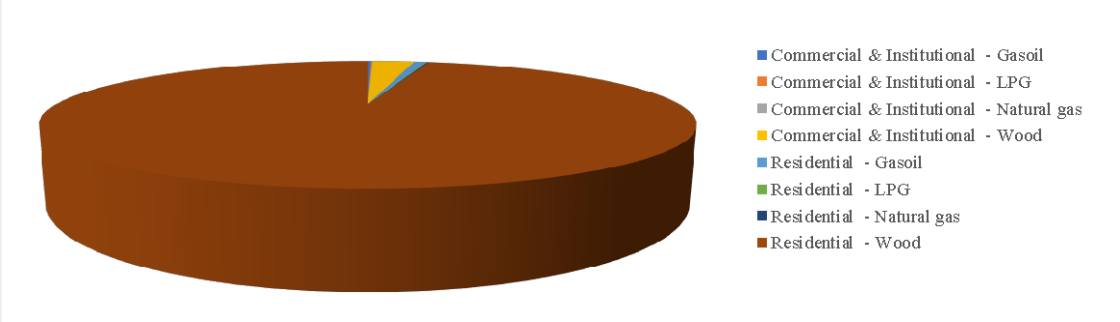

Figure 30 – Ljubljana Občine Residential, Commercial & Institutional PM_{10} emissions

3.4 Sosnowiec

3.4.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 17);
- Residential and commercial sources (Table 18);
- Wood statistics (Table 19);
- Gminy disaggregation variables (Table 20).

For heating networks (district heating) we assume the following split between fuels, using national figures excluding waste derived fuels more territorial specific[4]: coal (89%), natural gas (7%), wood (4%).

[4] Statistics Poland, Energy statistics in 2015 and 2016. Table 8 (13). Public Thermal Plants - Heat Generation

Table 17 – Methodology and source of data for Sosnowiec fuel consumptions/emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference	Disaggregation variable
Industrial sector	Single facility	EIONET	Reporting Obligations Database (ROD), Deliveries for National Emission Ceiling Directive (NECD) - Large point source (LPS) emissions data by source category (GNFR) Poland NECD 2017 Report LPS emissions 2007 2015	http://cdr.eionet.europa.eu/pl/eu/nec_revised/lps/envwql3ba/Annex_VI_LPS_2015_POL__TSP.xls	None (Point sources)

Table 18 – Methodology and source of data for Sosnowiec fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
Residential sector	Natural Gas	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 2. Zużycie gazu ziemnego	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		Population
	Heat[5]	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewod	Główny Urząd	Zużycie paliw i nośników energii w 2015 roku, Tab. 6. Zużycie ciepła	https://stat.gov.pl/obszary-tematyczne/srodowisko-		Population

[5] For heating networks (district heating) we assume the following split of fuel, using national figures excluding waste derived fuels more territorial specific: coal (89%), natural gas (7%), wood (4%).

Table 18 – Methodology and source of data for Sosnowiec fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
		ztwa) for all other Gminy	Statystyczny		energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		
	Wood	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej dla Miasta Sosno - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 6. Zużycie ciepła	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html	Only data from district heating	Population
	LPG	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tabl. 3. Zużycie gazu ciekłego (zużycie s)	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html	Only data from district heating	Population
	Gasoil	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewod	Główny Urząd	Zużycie paliw i nośników energii w 2015 roku, Tabl. 4. Zużycie lekkiego oleju	https://stat.gov.pl/obszary-tematyczne/srodowisko-	Only data from district heating	Population

Table 18 – Methodology and source of data for Sosnowiec fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
		ztwa) for all other Gminy	Statystyczny	opałowego	energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		
	Coal	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 1. Zuż gla kamiennego	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		Population
Service sector	Natural Gas	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 2. Zużycie gazu ziemnego	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		Population
	Heat[6]	Level 3 (Gminy)	Urzędu Miasta	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%201	2013 to 2015 with Wojewodztwa	None

[6] For heating networks (district heating) we assume the following split of fuel, using national figures excluding waste derived fuels more territorial specific: coal (89%), natural gas (7%), wood (4%).

Table 18 – Methodology and source of data for Sosnowiec fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
		only for Sosnowiec	Sosnowiec	- życie energii w roku 2013	1.09.2015%20a.pdf	data	
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 6. Zużycie ciepła	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		Population
	Wood	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 6. Zużycie ciepła	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html	Only data from district heating	Population
	LPG	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tabl. 3. Zużycie gazu ciekłego (zuż)	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html	Only data from district heating	Population
	Gasoil	Level 3 (Gminy)	Urzędu Miasta	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%201	2013 to 2015 with Wojewodztwa	None

Table 18 – Methodology and source of data for Sosnowiec fuel consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
		only for Sosnowiec	Sosnowiec	- życie energii w roku 2013	1.09.2015%20a.pdf	data	
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tabl. 4. Zużycie lekkiego oleju opałowego	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html	Only data from district heating	Population
	Coal	Level 3 (Gminy) only for Sosnowiec	Urzędu Miasta Sosnowiec	Energoekspert. Kompleksowy Plan Gospodarki Niskoemisyjnej - życie energii w roku 2013	http://www.sosnowiec.pl/_upload/PGN%20Sosnowiec%2011.09.2015%20a.pdf	2013 to 2015 with Wojewodztwa data	None
		Level 2 (Wojewodztwa) for all other Gminy	Główny Urząd Statystyczny	Zużycie paliw i nośników energii w 2015 roku, Tab. 1. Zuż gla kamiennego	https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/zuzycie-paliw-i-nosnikow-energii-w-2015-roku,6,10.html		Population

Table 19 – Methodology and source of data for Sosnowiec fuel consumptions evaluation – Wood statistics

Variable	Data availability	Sources	Publication	Reference	Note
Technologies split	Level 1 (National)	Central Statistical Office	Energy consumption in households in 2012, 2014	https://stat.gov.pl/download/gfx/portalinformacyjny/en/defaultaktualnos	Central heating boilers, used to produce heat and warm water, were found in 41.3% of households using solid fuels. The single-function boilers were used in 31.9% of households using solid fuels. The most traditional

				ci/3304/2/2/1/energy_consumption_in_households_in_2012.pdf	heating devices, such as stoves in rooms (mostly made of tiles), were used in 19.2% of households. 7% of households using solid fuels had fireplaces, usually with closed insert. In the remaining 0.6% of households, solid fuel fired cooking stoves were the only heating devices. We assume boilers for district heating and traditional stoves for the remaining appliances in residential sectors while we assume boilers in overall services appliances

Table 20 – Methodology and source of data for Sosnowiec fuel consumptions evaluation – Gminy other than Sosnowiec disaggregation variables

Variable	Data availability	Sources	Publication	Reference	Fields
Population	Level 3 (Gminy)	Główny Urząd Statystyczny	Ludność w gminach według stanu w dniu 31.12.2011 r. - bilans opracowany w oparciu o wyniki NSP 2011	http://stat.gov.pl/download/cps/rde/xbcr/gus/LUD_bilans_ludnosci_31-12-2011.xls	Population total by Gminy (Sheet Slaskie column Ogolem)

3.4.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by Gminas. In detail are reported:

- Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions for all sectors and fuels (Figure 31)
- Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 32),
- Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions from solid biomass (Figure 33),
- Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions from solid biomass (Figure 34),
- Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions from hard coal (Figure 35),
- Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions from hard coal Sosnowiec (Figure 36),
- Industry NO_x point emissions (Figure 37),
- Sosnowiec Industry PM_{10} point emissions (Figure 38).

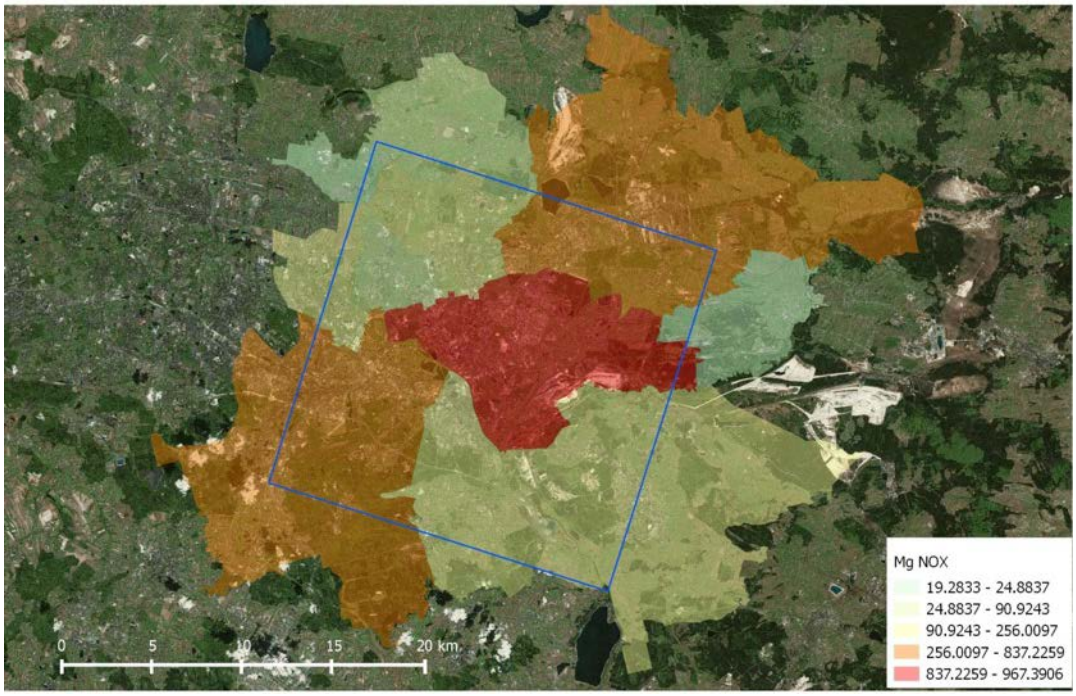

Figure 31 – Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

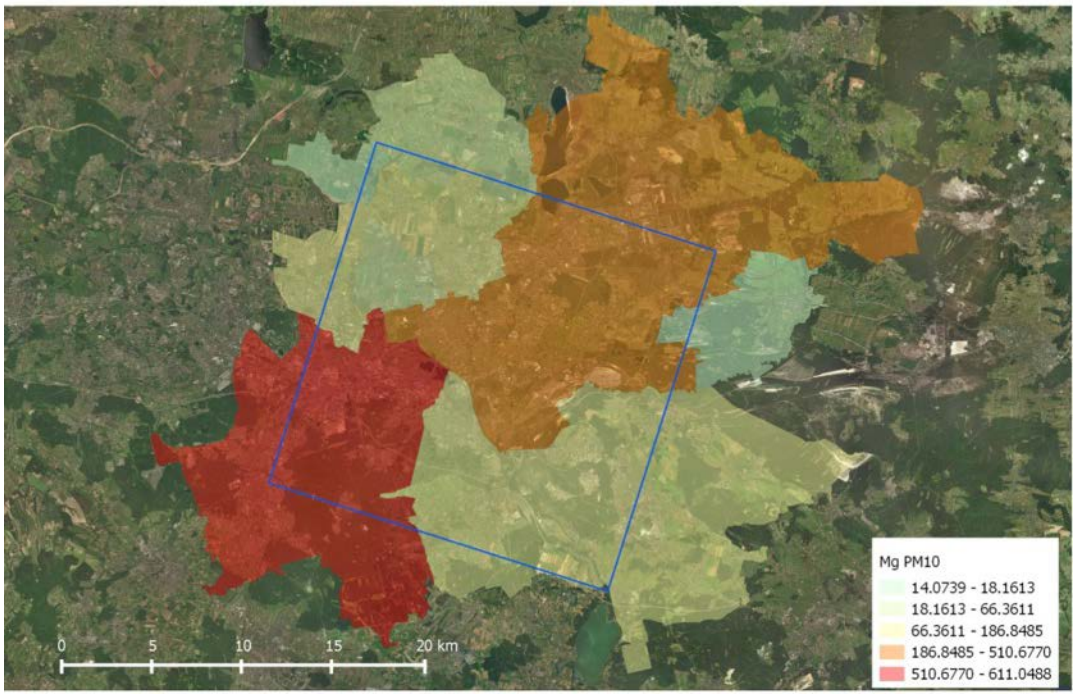

Figure 32 – Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

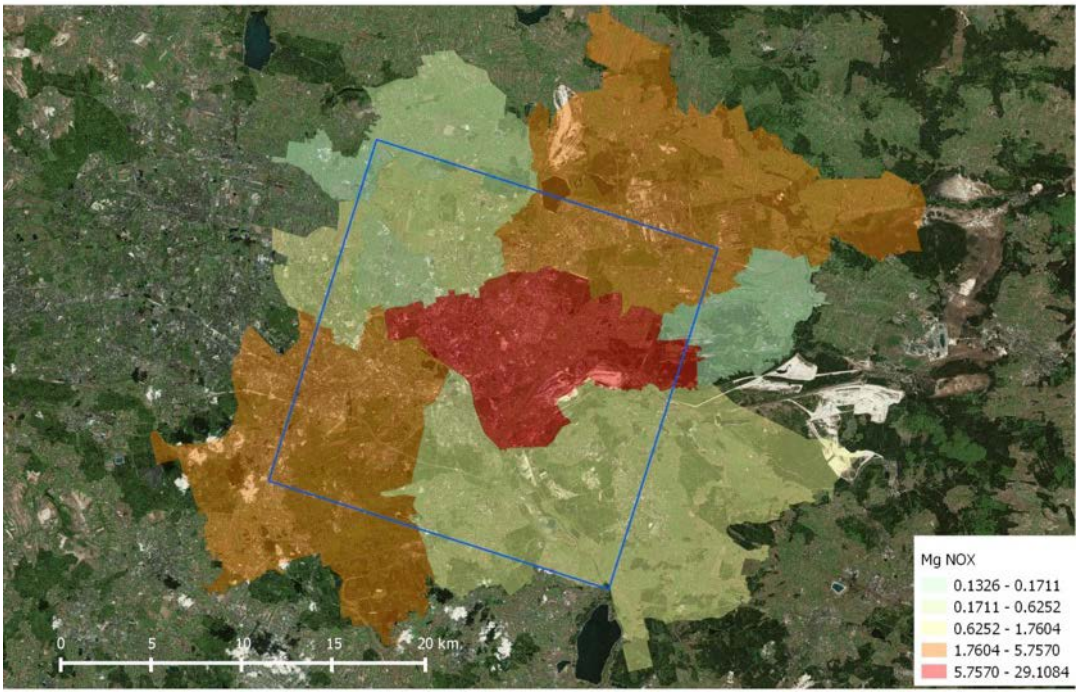

Figure 33 – Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions – solid biomass

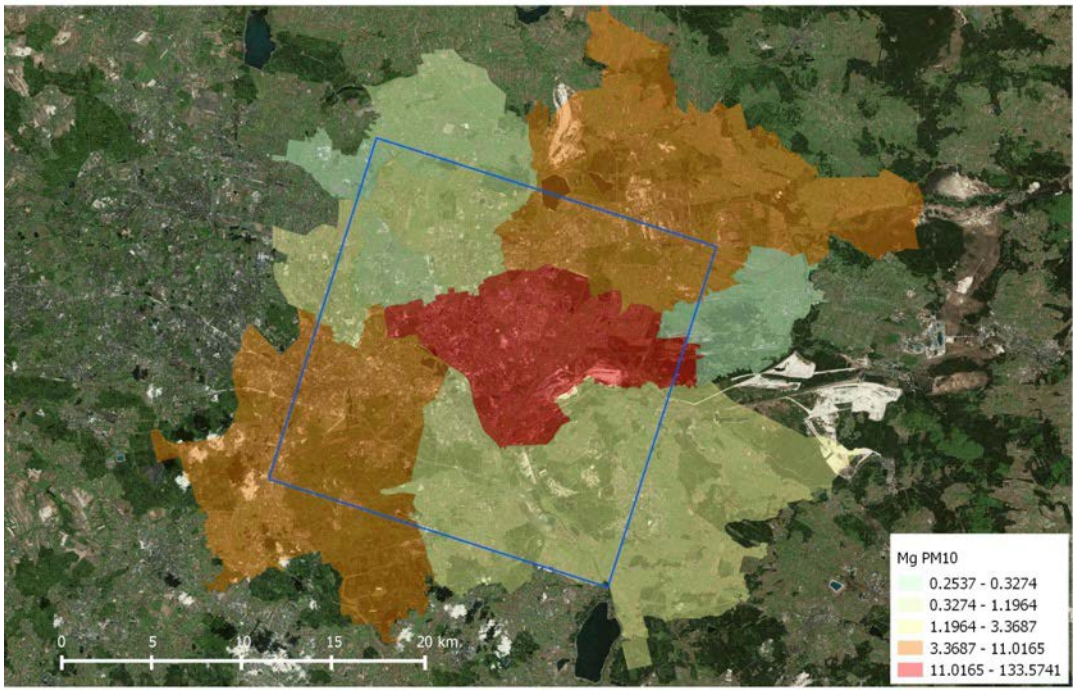

Figure 34 – Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions – solid biomass

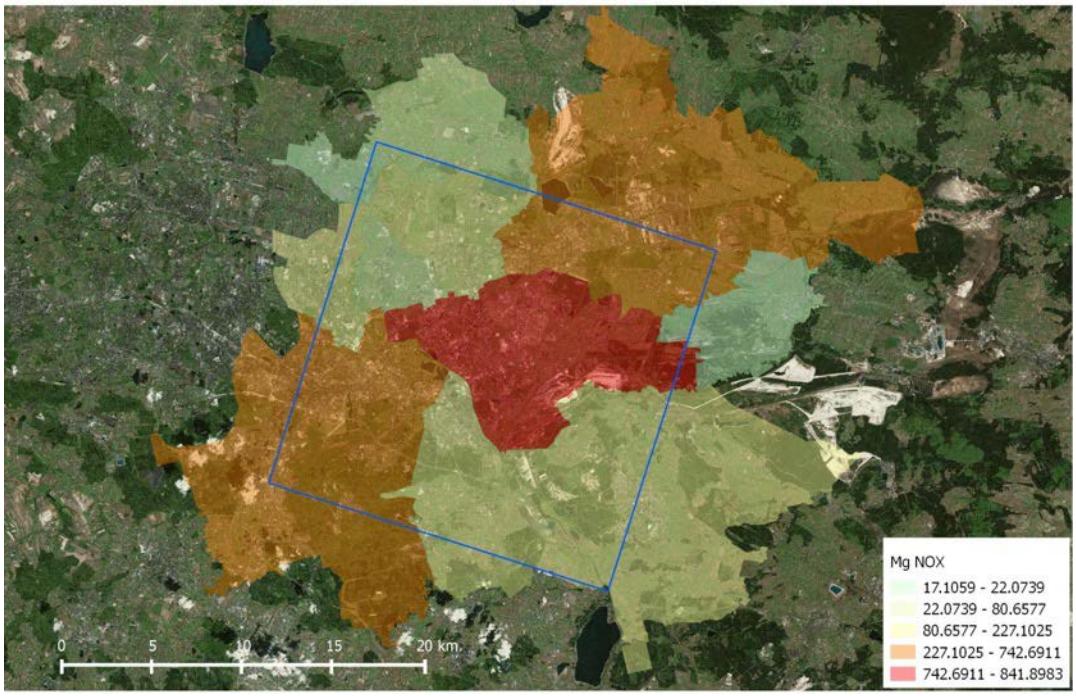

Figure 35 – Sosnowiec Gminy Residential, Commercial & Institutional NO_x emissions – hard coal

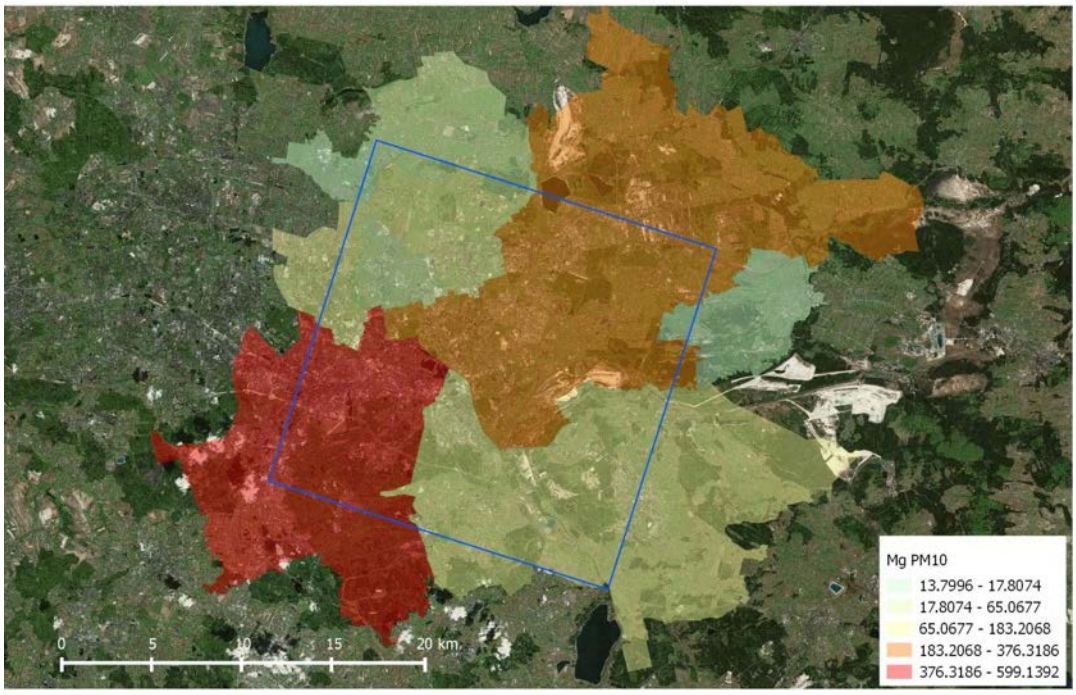

Figure 36 – Sosnowiec Gminy Residential, Commercial & Institutional PM_{10} emissions – hard coal

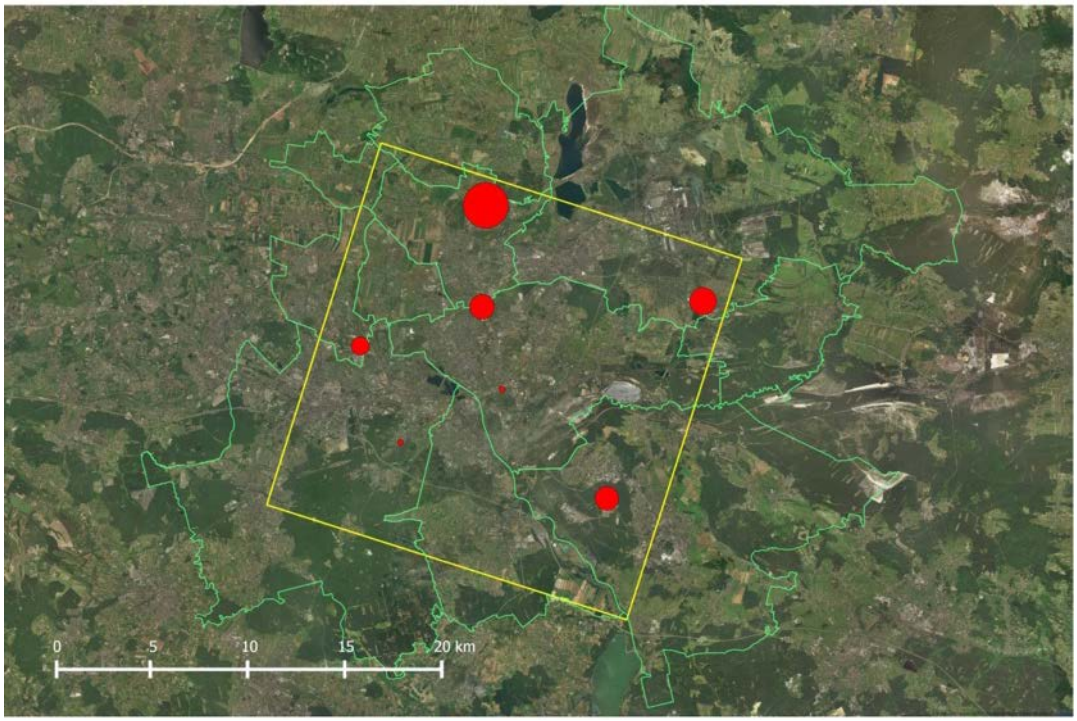

Figure 37 – Sosnowiec IRC Industry NO_x point emissions

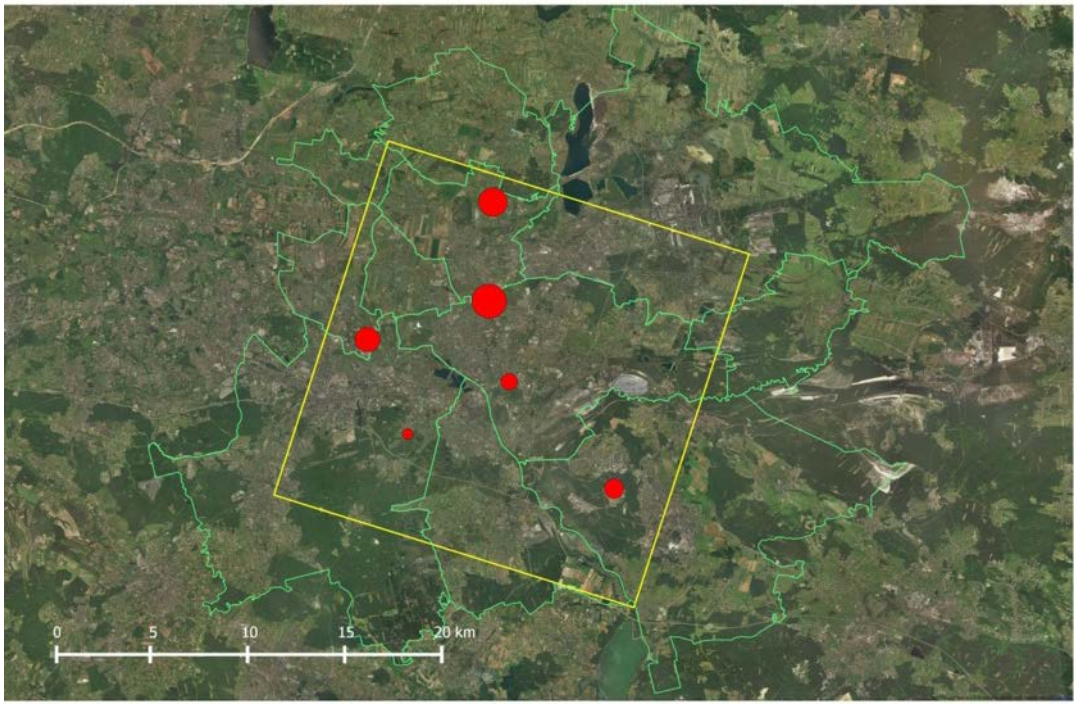

Figure 38 – Sosnowiec IRC Industry PM_{10} point emissions

Finally, in the following Figure 39 and Figure 40 the emissions for the different activities & fuels in the only *Sosnowiec Wojewodztwa* are reported.

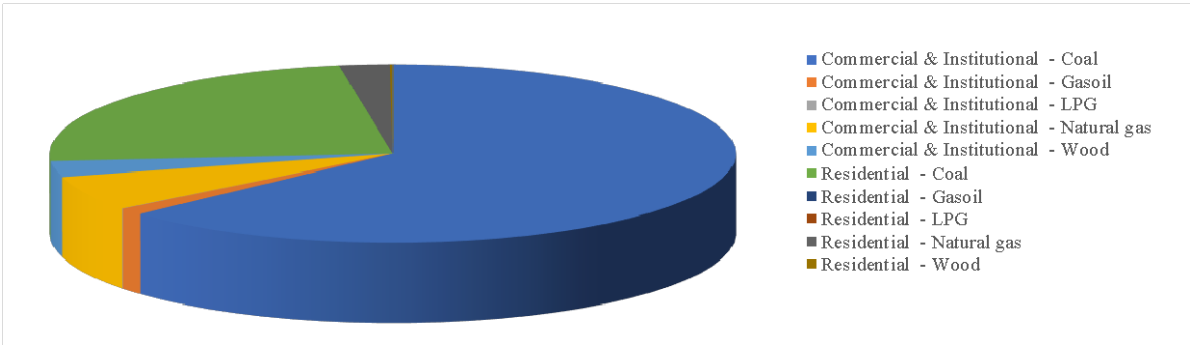

Figure 39 – Sosnowiec Wojewodztwa Residential, Commercial & Institutional NO_x emissions

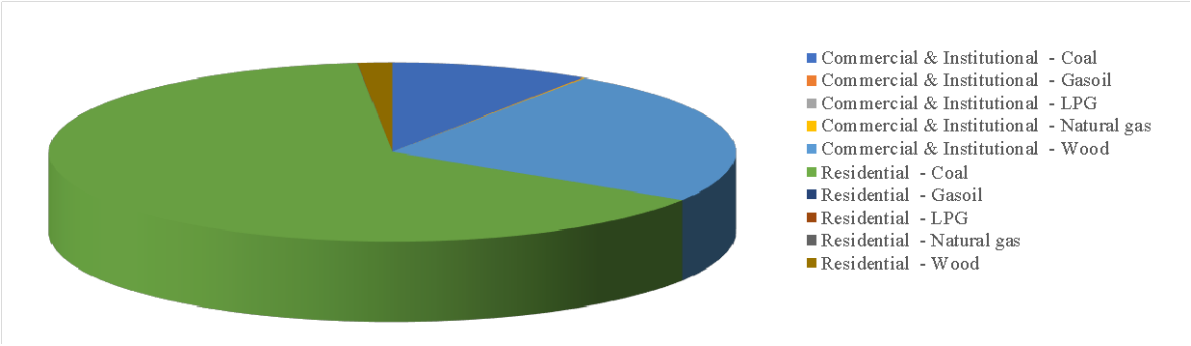

Figure 40 – Sosnowiec Wojewodztwa Residential, Commercial & Institutional PM_{10}

emissions

3.5 Liguria Region (Genoa Area)

3.5.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 21);
- Residential and commercial sources (Table 22);
- Wood statistics (Table 23);
- Residential fuel energy demand (Table 24);
- Sezione di censimento disaggregation variables (Table 25).

Table 21 – Methodology and source of data for Liguria Region (Genoa Area) fuel consumptions/emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference	Note	Disaggregation variable
Industrial sector point sources	Single facility	Regione Liguria	Data on emissions and on plant/stacks characteristics extracted from Regione Liguria Emission Inventory	http://www.banchedati.ambienteinliguria.it/index.php/aria/inventario-emissioni-in-atmosfera?_ga=2.89868251.1763133517.1551799487-742064735.1539778117		None (Point sources)
Industrial sector – other than point sources and natural gas	Single facility	Regione Liguria	Data on emissions extracted from Regione Liguria Emission Inventory	http://www.banchedati.ambienteinliguria.it/index.php/aria/inventario-emissioni-in-atmosfera?_ga=2.89868251.1763133517.1551799487-742064735.1539778117	Allocated to 1kmx1km grid	None (Point sources)
Industrial sector – natural gas	Level 2 (Comune)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Allocated to 1kmx1km grid	Land Cover Industrial & Commercial areas

Table 22 – Methodology and source of data for Liguria Region (Genoa Area) consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
Residential sector	Natural Gas	Level 2 (Comune)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Original data from regional gas distributors	Dwelling area (Table 25)
	Wood	Level 1 (Regione)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Data at level 1 (regione) allocated to Level 2 with energy demand (Table 24)	Dwelling area (Table 25)
	LPG	Level 1 (Regione)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Aggregated Residential & Service sector data at level 1 (regione) splitted with national (level 0) figure and then allocated to Level 2 with energy demand (Table 24)	Dwelling area (Table 25)
	Gasoil	Level 1 (Regione)	Regione Liguria	Regional Energy	https://www.regione.liguria.it/giunta/26-servizi-	Aggregated Residential & Service sector data at level 1 (regione) splitted with national (level 0) figure and	Dwelling area (Table 25)

Table 22 – Methodology and source of data for Liguria Region (Genoa Area) consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
				Balance 2016	online/14414-bilancio-energetico-regionale.html	then allocated to Level 2 with energy demand (Table 24)	
Service sector	Natural Gas	Level 2 (Comune)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Original data from regional gas distributors	Employees (Table 25)
	Wood	Single facility	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Original data from Gestore dei Servizi Energetici GSE S.p.A.	None
	LPG	Level 1 (Regione)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Aggregated Residential & Service sector data at level 1 (regione) splitted with national (level 0) figure and then allocated to Level 2 with employees (Table 25)	Employees (Table 25)
	Gasoil	Level 1 (Regione)	Regione Liguria	Regional Energy Balance 2016	https://www.regione.liguria.it/giunta/26-servizi-online/14414-bilancio-energetico-regionale.html	Aggregated Residential & Service sector data at level 1 (regione) splitted with national (level 0) figure and then allocated to Level 2 with employees (Table 25)	Employees (Table 25)

Table 23 – Methodology and source of data for Liguria Region (Genoa Area) fuel consumptions evaluation – Wood statistics

Variable	Data availability	Sources	Publication	Reference	Note
Technologies split	Level 1 (Liguria Region)	ISTAT ENEA	ISTAT I consumi energetici delle famiglie ENEA Rapporto Energia Ambiente (2005)	https://www.istat.it/it/files/2014/12/Tabelle_appendice_consumi_energetici.zip http://old.enea.it/produzione_scientifica/pdf_volumi/V06_01Analisi_05.pdf	On the basis of available data the following shares are evaluated: traditional 85% and advanced 15% (ISTAT); fireplaces (2/3) and stoves (1/3) (ENEA) Service sector allocated to boilers.

Table 24 – Methodology and source of data for Liguria Region (Genoa Area) residential energy demand evaluation –

Variable	Data availability	Sources	Publication	Reference	Note
Energy demand	Level 2 (Comune)	ISTAT	ISTAT, Censimento Popolazione ed Abitazioni, Abitazioni con impianto di riscaldamento per tipo di combustibile o energia che alimenta l'impianto di riscaldamento)	http://dati-censimentopopolazione.istat.it/Index.aspx?DataSetCode=dica_alloggi	Energy demand (F) of each comune is computed as:
		ENEA	Tabella dei gradi/giorno dei Comuni italiani raggruppati per Regione e Provincia	http://efficienzaenergetica.acs.enea.it/doc/dpr412-93_allA_tabellagradigiorno.pdf	where *j* fuel, *i* comune, N number of dwelling, S average area of occupied dwellings, G degres days, D volume dispersion coefficient

Table 25 – Methodology and source of data for for Liguria Region (Genoa Area) level 3 fuel consumptions evaluation

Variable	Data availability	Sources	Publication	Reference	Fields
Dwelling area	Level 3 (CensusSection)	ISTAT	Censimento della popolazione e delle abitazioni 2011	http://www.istat.it/storage/cartografia/variabili-censuarie/dati-sce_2011.zip	Average area of occupied dwellings
Industrial sector employees	Level 3 (CensusSection)	ISTAT	Censimento dell'industria e dei servizi, 2011	http://www.istat.it/storage/cartografia/variabili-censuarie/dati-cpa_2011.zip	Field ADDETTI with field ATECO3 <=400
Service sector employees	Level 3 (CensusSection)	ISTAT	Censimento dell'industria e dei servizi, 2011	http://www.istat.it/storage/cartografia/variabili-censuarie/dati-cpa_2011.zip	Field ADDETTI with field ATECO3 >400

3.5.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by Sezione Censuaria . In detail are reported:

- Liguria Region (Genoa Area) Residential, Commercial & Institutional NO_x emissions for all sectors and fuels (Figure 41)
- Liguria Region (Genoa Area) Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 42),
- Liguria Region (Genoa Area) Residential, Commercial & Institutional PM_{10} emissions from solid biomass (Figure 43),
- Liguria Region (Genoa Area) Industry NO_x point emissions (Figure 44),
- Liguria Region (Genoa Area) Industry NO_x area emissions (Figure 45).

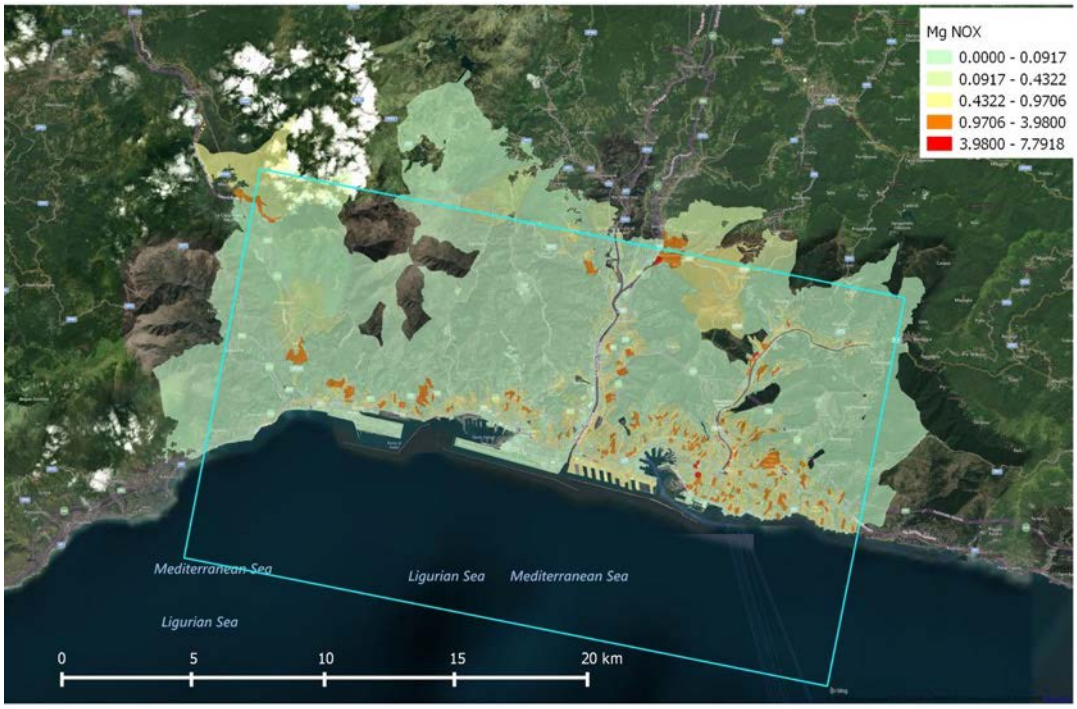

Figure 41 – Liguria Region (Genoa Area) Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

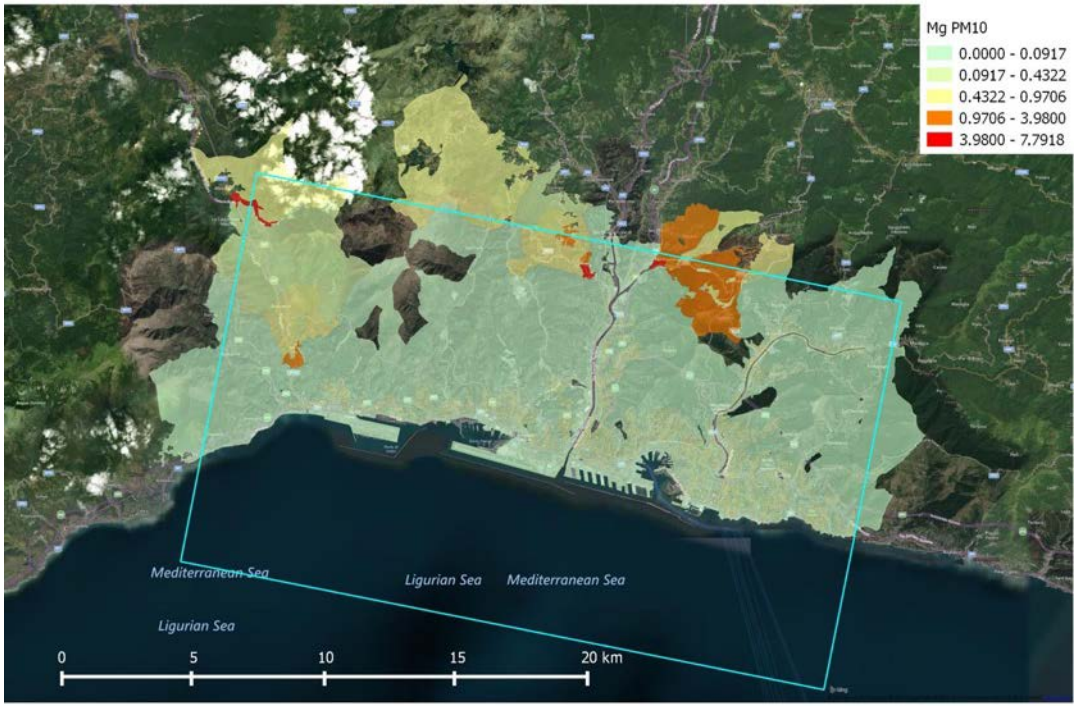

Figure 42 – Liguria Region (Genoa Area) Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

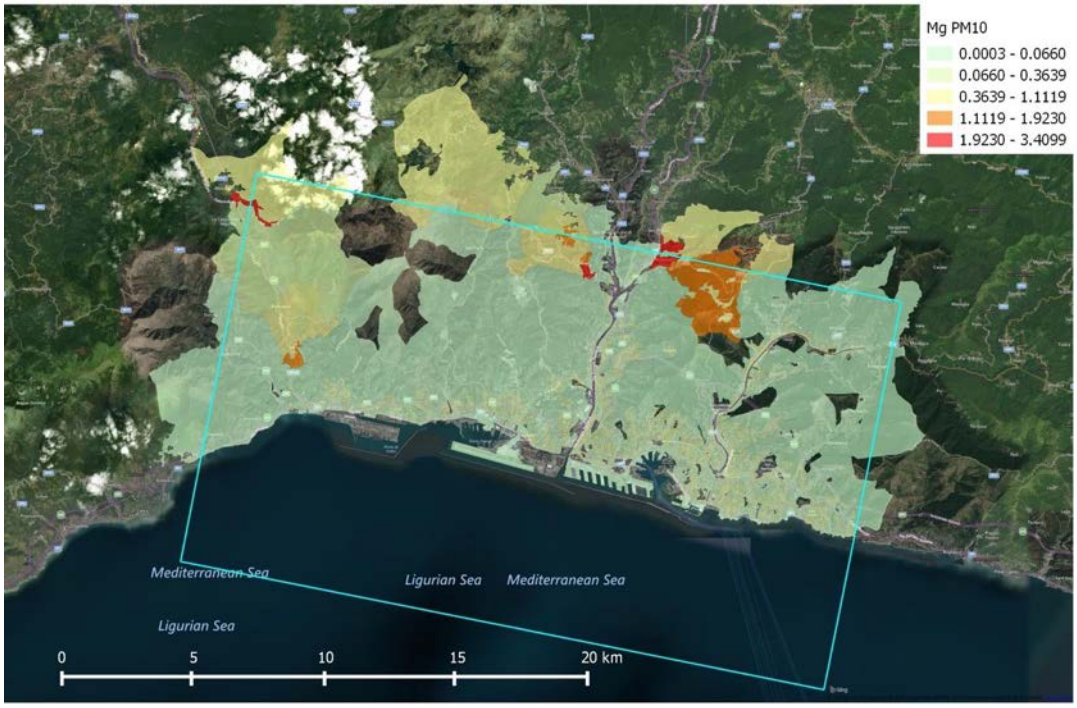

Figure 43 – Liguria Region (Genoa Area) Residential, Commercial & Institutional PM_{10} emissions – solid biomass

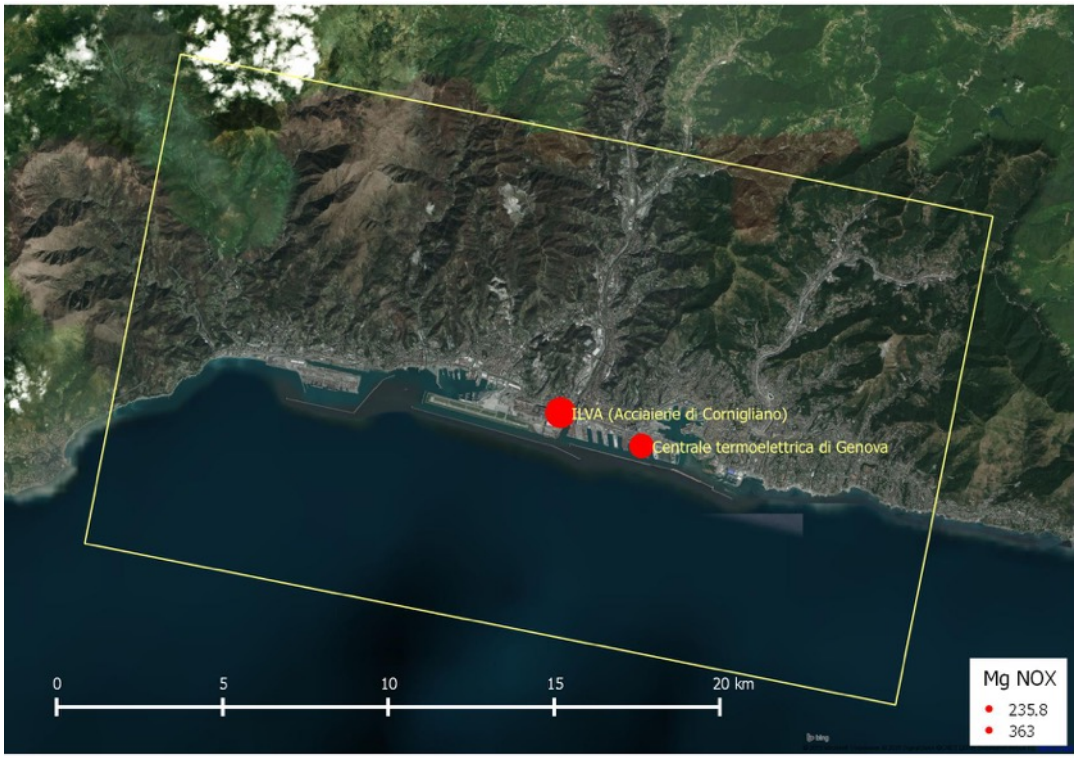

Figure 44 – Liguria Region (Genoa Area) Industry NO_x point emissions

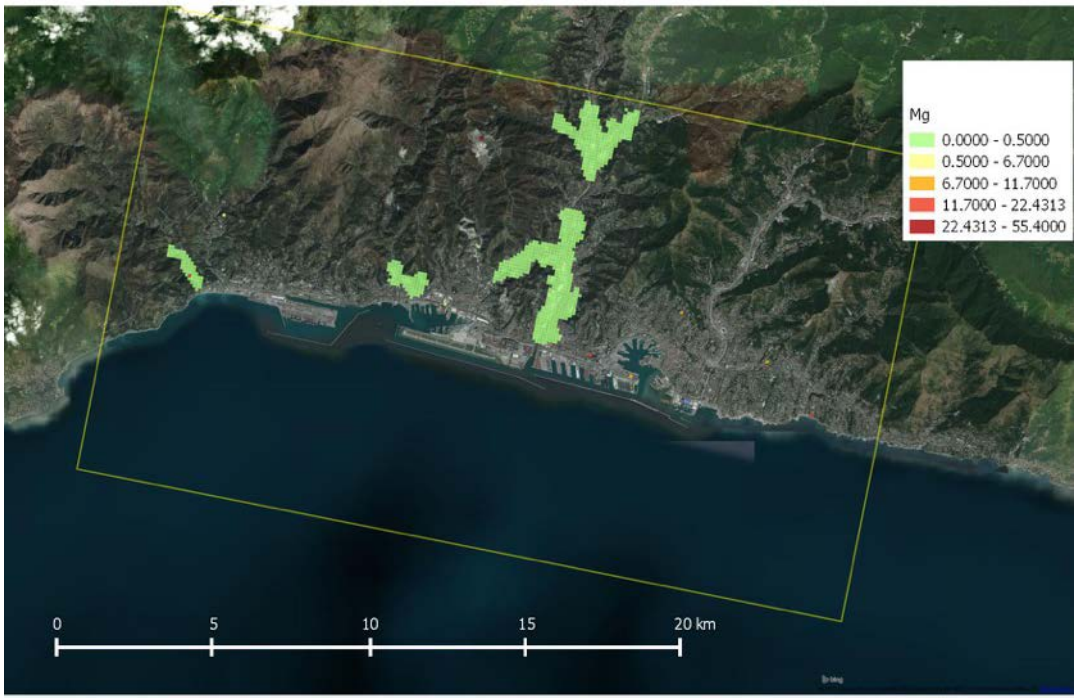

Figure 45 – Liguria Region (Genoa Area) Industry NO_x area emissions

Finally, in the following Figure 46 and Figure 47 the emissions for the different activities &

fuels in the only *Genova Comune* are reported.

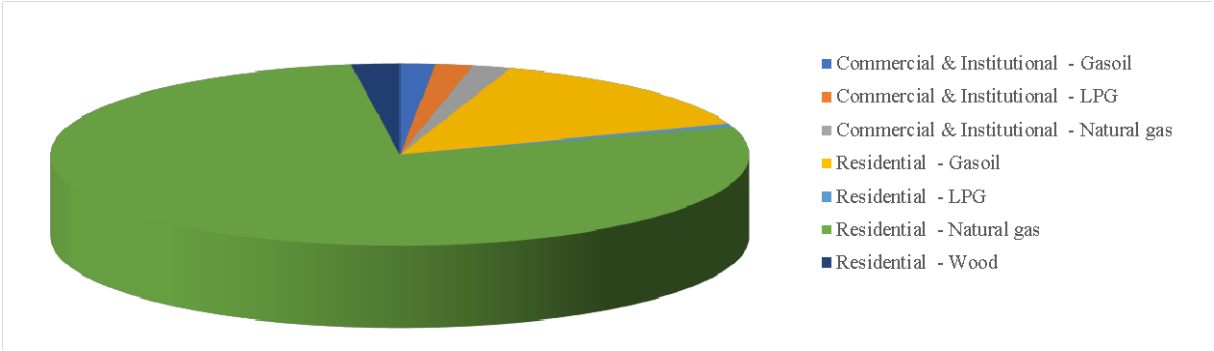

Figure 46 – Liguria Region Genoa Comune Residential, Commercial & Institutional NO_x emissions

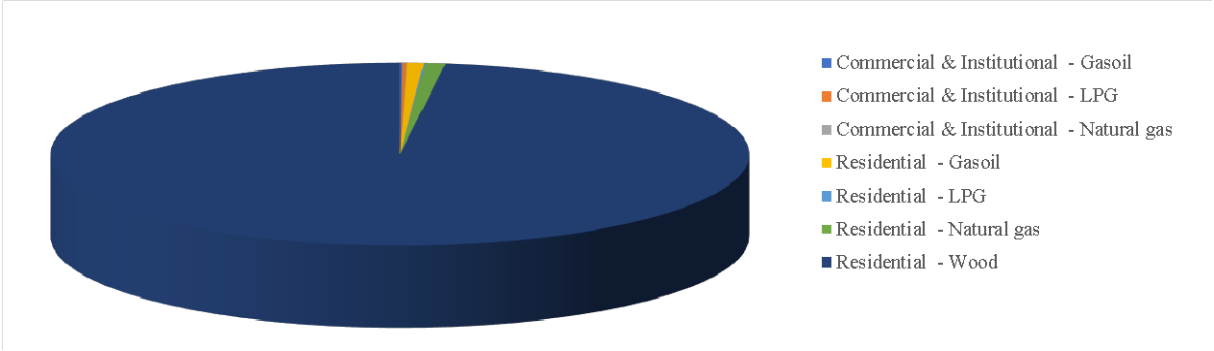

Figure 47 – Liguria Region Genoa Comune Residential, Commercial & Institutional PM_{10} emissions

3.6 Aveiro Region

3.6.1 Data retrieval and fuel consumptions evaluation

The following tables document the methodology and data used for:

- Industrial sources (Table 26);
- Residential and commercial sources (Table 27);
- Freguesia disaggregation variables (Table 28).

Note that we use Freguesia subdivision at time of 2011 census.

Table 26 – Methodology and source of data for Aveiro Region fuel consumptions/emissions evaluation - Industrial sources

Activity	Data availability	Source	Publication	Reference	Note	Disaggregation variable
Industrial sector point sources	Single facility	EEA	European Pollutant Release and Transfer Register (E-PRTR)	https://prtr.eea.europa.eu/#/facilitylevels		None (Point sources)
Industrial sector – point and area sources	Single facility	PACOPAR	Painel Consultivo Comunitário do Programa Atuação Responsável® de Estarreja		Source with emissions less than 100 Mg allocated to 1kmx1km grid	None (Point sources)
Industrial sector – area sources	Gridded	University of Aveiro (UA)			Data elaborated by UA using national inventory and land use	Corine land cover

Table 27 – Methodology and source of data for Aveiro Region consumptions evaluation - Residential and commercial sources

Activity	Energy vector	Data availability	Source	Publication	Reference	Note	Disaggregation variable
Residential sector	Natural Gas	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Dwelling total area (Table 28)
	Wood	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Dwelling total area (Table 28)
	LPG	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Dwelling total area (Table 28)
	Gasoil	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Dwelling total area (Table 28)
	Charcoal	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Dwelling total area (Table 28)
Service sector	Natural Gas	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Employees (Table 28)
	Wood	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Employees (Table 28)
	LPG	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Employees (Table 28)

	Gasoil	Level 1 (National)	-Geral de Energia e Geologia	ENERGIA em Portugal 06-03-2017	http://www.dgeg.gov.pt?cr=15697		Employees (Table 28)

Table 28 – Methodology and source of data for for Aveiro Region level 3 fuel consumptions evaluation

Variable	Data availability	Sources	Publication	Reference	Fields
Dwelling numbers and area	Level 3 (Freguesia)	Instituto Nacional de Estatistica	Censos 2011	https://censos.ine.pt/xportal/xmain	Number of dwelling by fuel and technology*Average area of dwelling For wood combustion technologies the following association was defined: *Aquecimento central* with *boiler*, *Aquecimento nao central - lareira aberta* with *conventional fireplaces*, *Aquecimento nao central - recuperador de calor* with *advanced stoves*, *Aquecimento nao central* with *conventional stoves*
Service sector employees	Level 3 (Freguesia)	Instituto Nacional de Estatistica	Censos 2011	https://censos.ine.pt/xportal/xmain	

3.6.2 Air Pollutants Emissions results

In the following maps the main results for NO_x and PM_{10} emissions are reported by freguesia. In detail are reported:

- Aveiro Region Residential, Commercial & Institutional NO_x emissions for all sectors and fuels (Figure 48)
- Aveiro Region Residential, Commercial & Institutional PM_{10} emissions for all sectors and fuels (Figure 49),
- Aveiro Region Residential, Commercial & Institutional PM_{10} emissions from solid biomass (Figure 50),
- Aveiro Region Industry NO_x point emissions (Figure 51),
- Aveiro Region Industry PM_{10} point emissions (Figure 52)
- Aveiro Region Industry NO_x diffuse area emissions (Figure 53),
- Aveiro Region Industry PM_{10} diffuse area emissions (Figure 54).

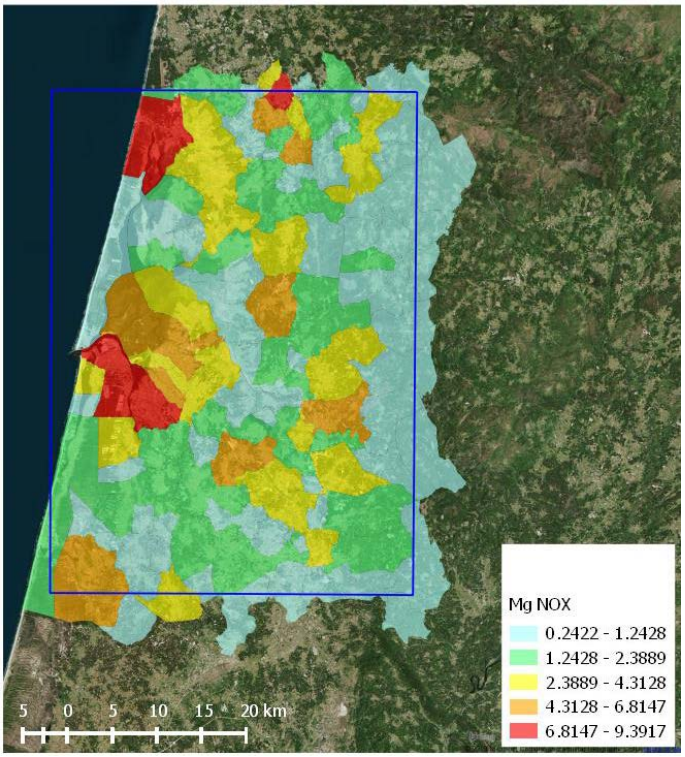

Figure 48 – Aveiro Region Residential, Commercial & Institutional NO_x emissions – all sectors and fuels

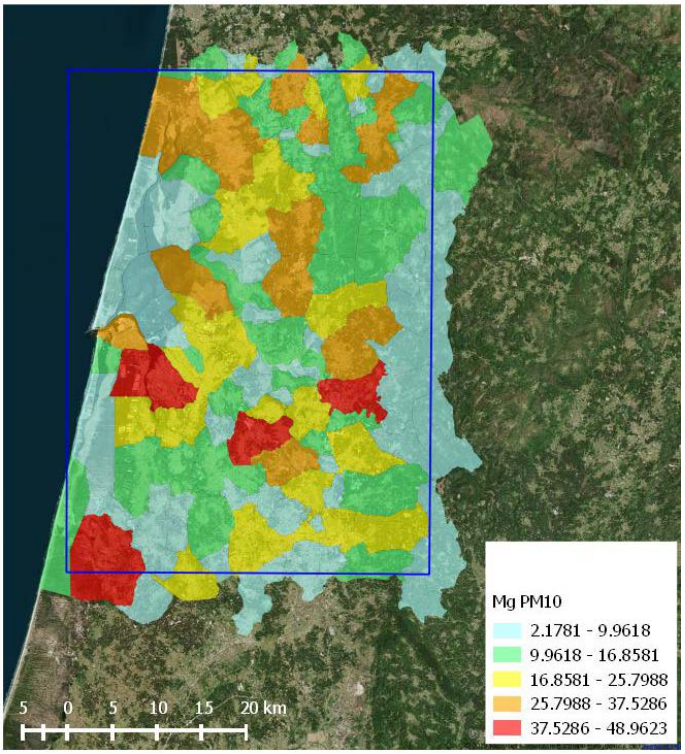

Figure 49 – Aveiro Region Residential, Commercial & Institutional PM_{10} emissions – all sectors and fuels

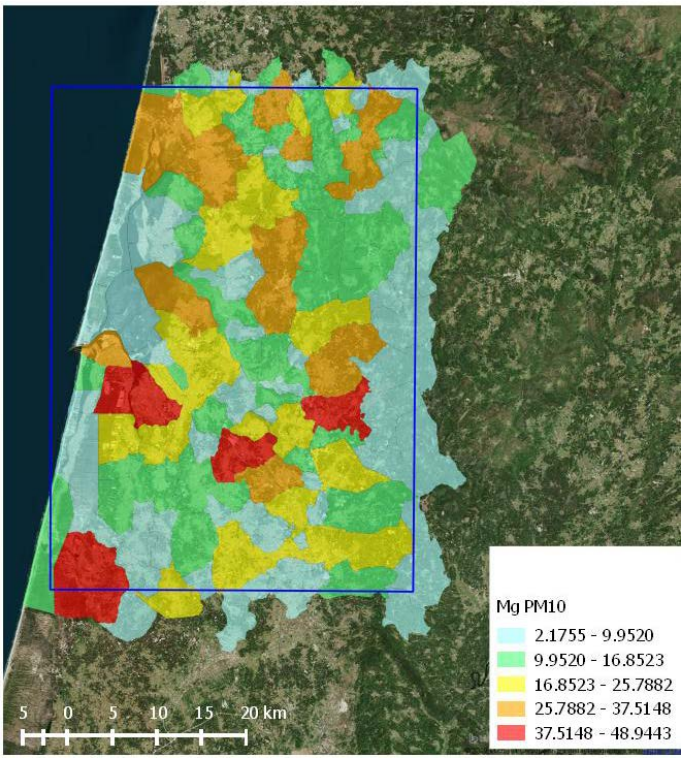

Figure 50 – Aveiro Region Residential, Commercial & Institutional PM_{10} emissions – solid biomass

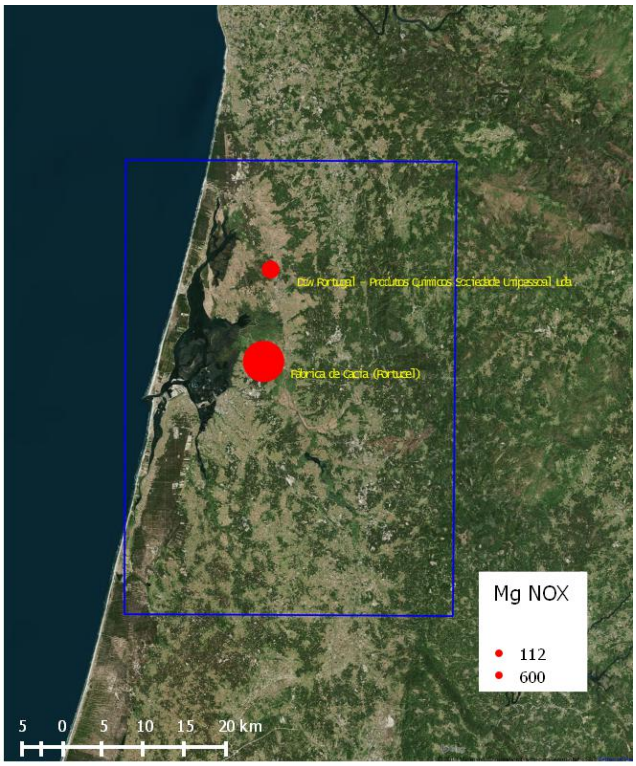

Figure 51 – Aveiro Region Industry NO_x point emissions

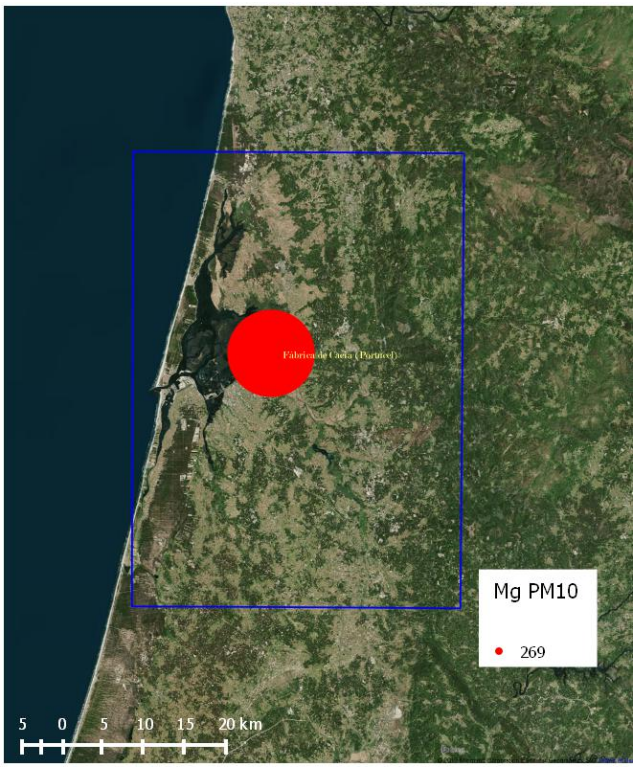

Figure 52 – Aveiro Region Industry PM_{10} point emissions

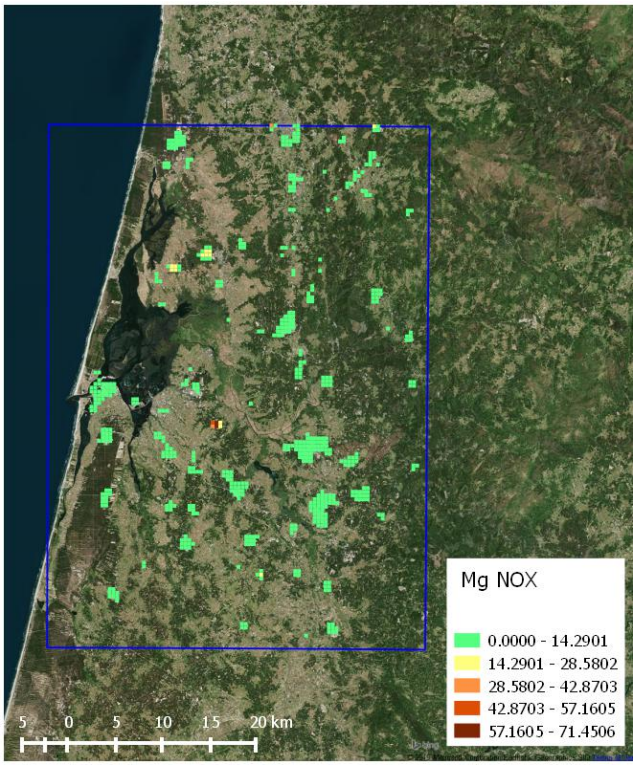

Figure 53 – Aveiro Region Industry NO_x diffuse area emissions

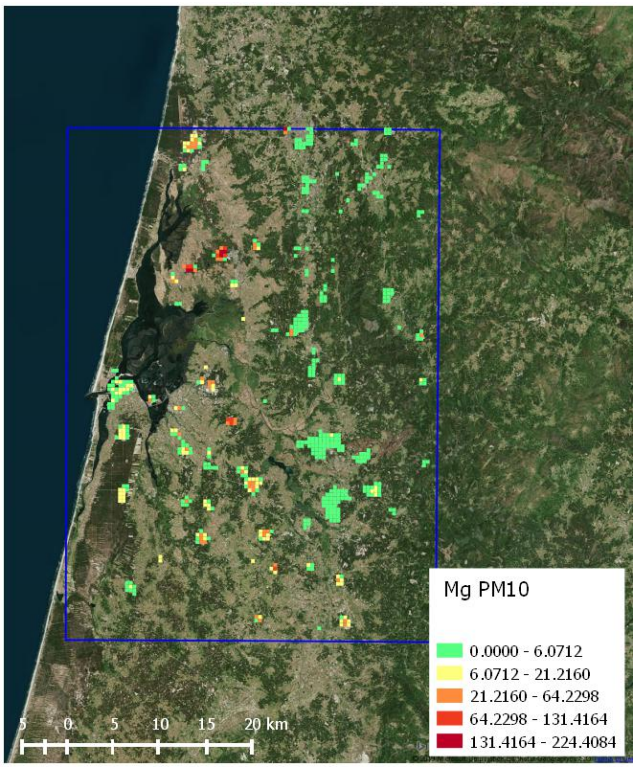

Figure 54 – Aveiro Region Industry PM_{10} diffuse area emissions

Finally, in the following Figure 55 and Figure 56 the emissions for the different activities & fuels in the *Aveiro Region* are reported.

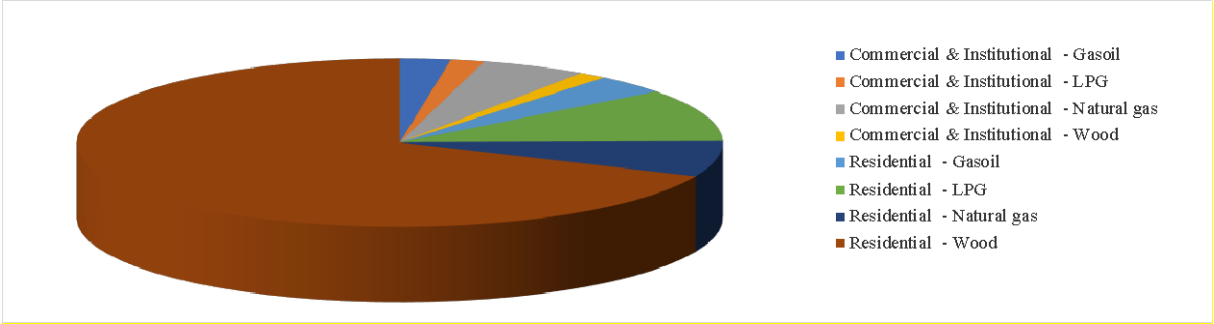

Figure 55 – Aveiro Region Residential, Commercial & Institutional NO_x emissions

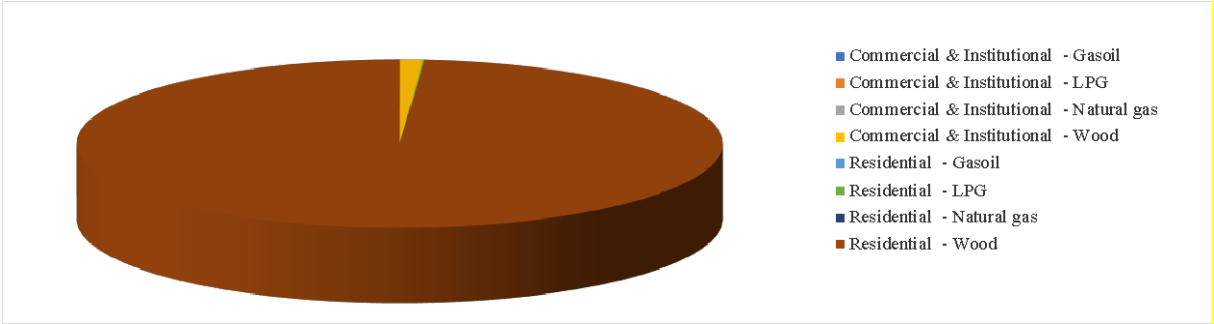

Figure 56 – Aveiro Region Residential, Commercial & Institutional PM_{10} emissions