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A geographical database of Infrastructures in Europe

A contribution to the knowledge base of the LUISA modelling platform

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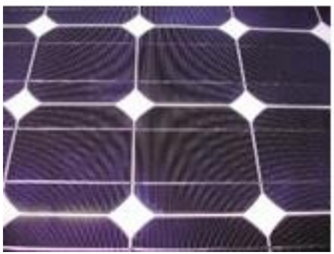


Joint Research Centre

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A geographical database of Infrastructures in Europe

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Joint Research Centre
Institute for Environment and Sustainability
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Abstract

Infrastructures are the facilities and systems that provide essential services for the functioning of an organization, city, region, country and therefore society as a whole. Often the term refers to physical facilities which society uses to work effectively such as transport, energy, water, communication networks, but also industrial production facilities, and social facilities such as schools, hospitals and residential areas, or even defence and safety facilities. **Some infrastructures are considered 'critical'** because their destruction or disruption by natural or man-made disasters could compromise significantly the functioning of economy and society and their security.

Detailed inventories of infrastructures in Europe are essential for various purposes and applications. These inventories should be as complete as possible, covering ideally all infrastructure typologies and describe both their characteristics and precise location. Geographical Information Systems (GIS) are the most adequate tools to construct and manage geographical databases of infrastructures. Such geo-databases are indispensable to assess risk to infrastructures and draft plans for their protection. In addition, these databases could be used for urban and regional planning and for modelling of land use, transport, energy and economy.

The ultimate objective of this work was to produce a geographical database of infrastructures in Europe that is ready to use thus enabling analyses for various purposes and applications at the JRC. Moreover, this work is **a contribution to the knowledge base of the Land Use-based Integrated Sustainability Assessment (LUISA) modelling platform**, which is used to assess territorial impacts of EU policies and investments. The database was aimed to cover as many sectors as possible, a wide geographical extent (EU28 + EFTA) at high spatial resolution.

The work did not aim at producing new data but rather seeking, assembling and preparing data from existing, disparate data sources (see table 1). In a first stage, the availability of infrastructure geographical layers within and outside JRC was checked. Data from various open and proprietary sources were collected to build a geo-database storing both the location and key attributes of each infrastructure in vector and raster formats. The assets addressed include **transport infrastructures** (e.g. roads, railways, ports, and inland waterways), **energy** (production and transport), **industry** (heavy industries and water and waste treatment), **social** (public health and education facilities) and **world heritage sites**, totalling 37 types or subtypes of infrastructures. A set of factsheets was constructed to describe and map the geographical distribution of infrastructures in Europe (chapter 3 of this report).

The geo-database will be maintained and updated whenever appropriate by the JRC and it can be accessed upon request.

Table 1. List of main geographical data sources used.

Name of dataset / source	Data source type	Sectors served
PLATTS	Proprietary	Energy
UNESCO	Public	Heritage
European Pollutant Release and Transfer Register (E-PRTR)	Public	Industry
Global Energy Observatory	Public	Industry
Teleatlas	Proprietary	Social
Geographical Information System of the European Commission (GISCO)	Institutional (EC)	Social, Transport
Open Street Map (OSM)	Voluntary Geographical Information	Social, Transport
CORINE Land Cover	Public	Transport
UNECE	Public	Transport

1. Introduction

1.1 Main concepts: infrastructure and critical infrastructure

Infrastructures are the facilities and systems that provide essential services for the functioning of an organization, city, region, country and therefore society as a whole. Transport, energy, water and communication networks and facilities are considered basic infrastructures that society uses to work effectively. In a broader account, industrial production facilities and social facilities such as schools and hospitals or even the residential building stock could be considered essential infrastructures. Infrastructure can be either privately or publicly owned and operated.

Many governments worldwide acknowledge the existing of infrastructures which are particularly critical to the functioning of a country. In the United States of America, for example, the Department of Homeland Security provides strategic guidance and coordinates efforts to promote the security and resilience of critical infrastructures, defined as the infrastructure that "provides the essential services that underpin American society and serve as the backbone of [the] nation's economy, security, and health". A total of 16 critical infrastructure sectors have been identified composing "the assets, systems, and networks, whether physical or virtual (…) that their incapacitation or destruction would have a debilitating effect" on security, economy, public health and safety, or any combination thereof[1]. The sectors include energy, transportation, industry, water, defence, health, food, finance, information and communication.

In Europe, the Council Directive 2008/114/EC has defined 'critical infrastructure' as "an asset, system or part thereof (…) which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in a Member State as a result of the failure to maintain those functions". The destruction or disruption of critical infrastructure could be the result of natural or man-made disasters, terrorism, criminal activity or malicious behaviour. The EU has the objective of reducing the vulnerabilities of critical infrastructure and increasing their resilience. At the European Commission, the Directorate General for Migration and Home Affairs coordinates efforts regarding the protection of critical infrastructures, often in conjunction with other DGs, and with the technical and scientific support of the JRC (European Commission 2013a).

1.2 Scope and objectives of the work

Detailed inventories of infrastructures in Europe are essential for various purposes and applications. These inventories should be as complete as possible, covering ideally all infrastructure typologies and describe both their characteristics and precise location. Geographical Information Systems (GIS) are the most adequate tools to construct and manage geographical databases of infrastructures. Such geo-databases are indispensable to assess risk to infrastructures and draft plans for their protection as well

[1] Department of Homeland Security of the United Stated of America, http://www.dhs.gov

as managing emergency situations. In addition, these databases could be used for plenty of other purposes such as urban and regional planning and for mapping and modelling of land use, transport, economy and energy.

The ultimate objective of this work was to produce a geographical database of infrastructures in Europe that is ready to use thus enabling analysis for various purposes and applications at the JRC. The database was aimed to cover as many sectors as possible, a wide geographical extent (EU28 + EFTA) at a high spatial resolution. The work, however, did not include the production of new data but rather seeking and assembling data gathered from multiple but disparate data sources. The herein report documents the work conducted to collect, prepare and store spatially-explicit data. The work resulted in the setup of a geographical database of 37 types or subtypes of infrastructures. The final list of infrastructures depended strongly on data availability and included broadly the following major sectors: transport, energy, industrial, environmental and social infrastructures.

1.2.1 LUISA modelling platform

The infrastructure geo-database here described adds significantly to the knowledge base used by the LUISA (Land Use-based Integrated Sustainability Assessment) modelling platform. The LUISA is a JRC-based modelling platform designed to support policy DGs of the European Commission by assessing territorial impacts of European policies. It provides a vision of possible future and quantitative comparison between policy options. It includes a computation dynamic spatial model which simulates future land use and human activity changes based on: macro-drivers (e.g. economy, demography, climate, etc.), local biophysical, socio-economic and neighbourhood factors, and policies. The platform accommodates multi-policy scenarios so that several interacting and complementary dimensions of the EU are represented.

Land change models are a key means for understanding how humans are reshaping the Earth’s surface in the past and present, for forecasting future landscape conditions, and for developing policies to manage our use of resources and the environment at scales ranging from an individual parcel of land in a city to vast expanses of forests around the world (National Research Council 2013). However, these models are as good as their main built-in algorithms as well as input datasets. LUISA relies strongly on current land use patterns, population distribution and stock and location of various types of infrastructure. The infrastructure spatial layers compiled by this work comply with the characteristics required by LUISA:

- EU-wide (ideally pan-European) coverage;
- Geographically referenced to bring information together and infer relationships from diverse sources;
- Consistency and quality of data nomenclature to allow cross-country/region comparison;
- Adjustable spatial and thematic resolutions to resolve local features and provide continental patterns.

For more information on the LUISA modelling platform, refer to Lavalle et al. (2011), Batista e Silva et al. (2013), Lavalle et al. (2014), and LUISA's website[2].

1.2.2 Assessment of climate risks to critical infrastructures

The constructed infrastructure geo-database was already used by an applied research project conducted by the JRC at the request of DG CLIMA on "Resilience of large investments and critical infrastructures in Europe to climate change" (CCMFF)[3]. The CCMFF project aimed at providing insight on current and future impacts of climate extremes on the present stock of critical infrastructures in Europe and on regional investments under the EU Cohesion Policy for the 2007-2013 programming period. The project performed the first comprehensive multi-hazard and multi-sector risk assessment for Europe under climate change to identify the most vulnerable and impacted regions and sectors in Europe throughout the 21st century. The methodology applied integrated a set of coherent, high-resolution climate hazard projections, a detailed harmonized representation of sectorial physical assets, productive systems and investments, and estimates of their sensitivity based on surveyed expert opinion and literature review. The three components were linked with observed climate disaster damages in order to derive quantitative estimates of risk under current and future climate conditions (Forzieri et al. 2015).

The risk framework of analysis comprehends three components: hazard, exposure and sensitivity or vulnerability. Hazard relates to the probability of occurrence of a natural or human-induced physical event with potentially harmful to humans or assets. Exposure is the presence of people or assets that could be adversely affected by a damaging natural or human-induced physical event. Sensitivity of vulnerability is the propensity or predisposition of assets to be adversely affected. In the CCMFF project, exposure was assessed by identifying the infrastructures in Europe, their characteristics and precise geographical location. Such assessment relied on the compilation described in the herein report.

1.2.3 Structure of the report

Chapter 2 describes the methodology used to collect, prepare and store the infrastructures data layers, and lists all the specific infrastructure types collected and respective data sources. Chapter 3 contains one factsheet per each main infrastructure typology. Each factsheet includes a short description of the infrastructure typology and a map with their spatial distribution across Europe. Annexes complement this report with further technical information such as the name files of the constructed geographical database and aspects regarding classification correspondences between data sources and validation checks.

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[2] LUISA, https://ec.europa.eu/jrc/en/luisa

[3] AA 071303/2012/630715//CLIMA.C.3 – JRC 32971-2012 NFP

2. Methodology

2.1 Data collection

A significant part of this work was devoted to collecting detailed geospatial information of existing critical infrastructures. It became quite clear from the early stages of the project that information on infrastructures in Europe was limited and scattered, with different sources available for different infrastructure types, or with different data sources providing data for the same infrastructure type.

A first decision concerned the sectors for which we were mostly interested in. Given the definitions of infrastructure and critical infrastructure presented in section 1 of this report, the following sectors have been preselected: transport, energy, industry, and social. Then we set up a logical sequence of steps (methodology) to guide the data collections process. The following steps were followed:

1. Seek of available data sources;
2. Analysis of the characteristics of the available data sources;
3. Selection of the most adequate data sources;
4. Data extraction;
5. Data preparation and storage.

The first step was therefore to seek and list the existing data sources for each infrastructure type. An initial research looked at the availability of data on infrastructures already within databases owned or at use by the JRC, and then other data sources were sought. This was followed by an analysis and evaluation of the main characteristics of each data source. The selection of the most adequate data sources was governed by the following criteria:

- Geographical coverage. European data sources were preferred over national and worldwide sources to avoid, respectively, inconsistent data and low resolution levels;
- Data completeness. The highest stated or perceived data completeness was preferred;
- Data consistency. Data sources with transparent and consistent mapping/reporting methodologies;
- Spatial resolution. the highest possible;
- Data update. the most recent;
- Within-sector thematic coverage. Data sources which included data on the most infrastructure types within a sector.

We came across both private and public data sources. The GISCO, or the Geographical Information System of the Commission, is managed by Eurostat, and it is available for all services of the Commission. It contains, among many other themes, infrastructure elements such as transport networks and social infrastructure.

One private data source was the PLATTS database which focuses on energy infrastructures. It has been acquired by the European Commission and was therefore at the disposal of the JRC for internal use. It is the most complete data source for energy in existence. The TeleAtlas database focuses primarily on transport, but also contains other useful elements such as points of interest corresponding to infrastructures. Like the PLATTS, the TeleAtlas database has been acquired by the European Commission and was therefore at the disposal of the JRC for internal use.

On the other hand, more and more open and/or public geographical databases are available. The European Pollutant Release and Transfer Register (E-PRTR) is maintained and freely disseminated by the European Environmental Agency (EEA), and allowed us to retrieve information on large industries. We have also carried a straightforward quality check of the E-PRTR database to better grasp the degree of spatial accuracy of the database (see annex IV). The CORINE Land Cover (CLC) is also a publicly available data source, managed and distributed by the EEA. It contains the location and shape of airports, ports, as well as industrial and commercial facilities. A drawback of CLC is its minimum mapping unit of 25 ha and no distinction between industrial and commercial sites.

Finally, we have mined data from the Open Street Map (OSM), which offers a wealth of information on transport, but also on social infrastructures. The OSM is a voluntary geographical information project which is an interesting alternative to proprietary data sources, but as drawbacks it is less structured, and mixes a large variety of completion and accuracy levels depending on the geographical area.

The selected data sources allowed us to determine the single infrastructure typologies that could be retrieved. Table 2 lists the covered sectors, the individual infrastructure types and the data sources used. In table 2 each main sector is displayed with a unique colour. The main sectors are therefore: Energy, Heritage, Industry, Social and Transport. Energy is further split in energy production and energy transport. The 'heritage' sector was included and corresponds essentially to the UNESCO's World Heritage sites. Although heritage sites do not fall easily into the definition of infrastructures, they are usually valuable assets for the regions which contain them, and important poles of attraction of tourism and other activities.

Data was therefore extracted from the above mentioned sources, and then various GIS pre-processing operations were carried in order to harmonize (e.g. project to ETRS89-LAEA coordinate system and projection), organize and store the wealth of collected data. The constructed geo-database consists of a set of layers in a vector format, each one representing one infrastructure type covering the EU and EFTA countries. Depending on the infrastructure type, additional attributes were available to describe entities. For instance, in the case of energy infrastructure layers, the installed capacity of each power plant, the diameter of gas pipelines and the voltage of the electricity grid are key attributes that describe each entity. Each vector layer was also converted to multiple raster layers at different resolutions (cell sizes).

In section 2.2 more details are provided regarding the storage and organization of the infrastructures geo-database.

Table 2. List of infrastructures includes in this study, sources used and reference dates.

	Layer groups	Data layer	Data sublayer	Update	Source
Energy Production	Non-Renewable Energy Power plants	Coal power plants		2013	PLATTS
		Gas power plants		2013/30	
		Nuclear power plants		2013/30	
		Oil fired power plants		2013/30	
	Renewable Energy Power plants	Biomass		2013/30	
		Hydro geothermal		2013/30	
		Solar		2013/30	
		Wind		2013/30	
Energy Transport	Energy transport	Electricity network	Transmission	2013/30	
			Distribution	2013/30	
		Gas pipelines	Small diameter	2013/30	
			Medium diameter	2013/30	
			Large diameter	2013/30	
Heritage	Unesco world herigate sites	Unesco world herigate sites		2014	UNESCO
Industry	Industry and waste/water treatment	Chemical industry		2013	EPRTR
		Metal industry		2013	
		Mineral industry	Mineral Plants	2013	
			Extraction sites	2013	

		Waste/water treatment		2013	
	Refineries	Refineries		2010	Global Energy Observatory
Social	Social Facilities	Education facilities		2014	Open Street Map, Tele Atlas, GISCO
		Health facilities		2014	
Transport	Airports & Ports	Airports		2004-13	CORINE Land Cover, GISCO and Eurostat
		Ports		2004-13	
	Inland waterways	Inland waterways		2013	GISCO and UNECE
	Urban Transport	Urban Transport	Bus stations	2014	Open Street Map
			Bus stops	2014	
			Funicular	2014	
			Subway	2014	
			Tram lines	2014	
			Tram stops	2014	
	Rail and Roads network	Railways	Light Rails	2014	OSM and ancillary data (ESRI, EGM and GISCO)
			Narrow gauge	2014	
			Railways	2014	
		Rail and Roads network	Local Roads	2014	
			National Roads	2014	
			Motorways	2014	

2.2 Data storage and organization

Due to the high number of final outputs a systematic method for classifying data was required in order to provide a unique identifier to each output (individual layer). Datasets were structured and stored in a custom geo-database in the following way:

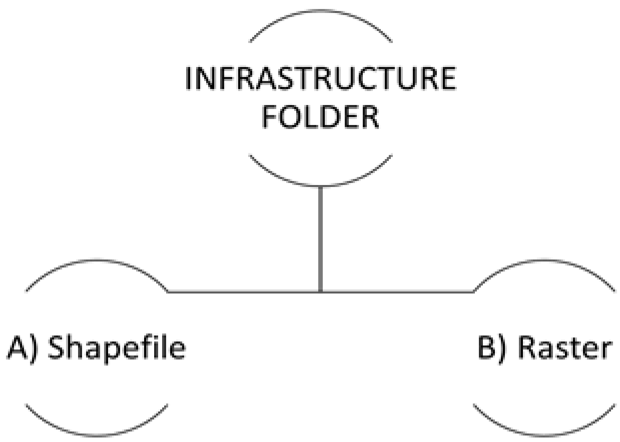


Figure 1 Main structure of the final geo-database.

The main folder contains a "layer group" subdivision (see table 2) which represents the 1st hierarchy level. The infrastructure folder (see figure 1) was named accordingly to each "layer group" field through a distinct acronym. For instance: EP for Energy production, ET for Energy Transport, etc.

The second hierarchy level contains a list of Shape and Raster files named appropriately to an established data nomenclature (See Figure 2a and 2b).

In greater detail, the A) Shapefile section has the following characteristics:

- One shapefile was produced for each layer group subdivision. This number will be double when the data layers also contains a time coverage for 2030 (planned infrastructures).
- Shapefiles are type line or point corresponding to which features are being represented.
- Shapefiles will only have the most relevant attributes fields. These fields are: name, identifier and any other field used to group them. The rest of attributes fields were removed.
- Data was re-projected to ETRS 1989_LAEA with Geographic Coordinate System: GCS_ETRS_1989.
- Geometry problems were checked and corrected when needed.

For the B) Raster division:

- Four raster files, one for each set spatial resolution: 100 meters, 1 000 meters, 2 500 m. and 25 000 meters, were produced for each layer group subdivision classified by one unit of measure.

- There are three possible units of measure: count (number of spatial entities), length (number of meters of each line within one cell) and quantity (number of any other quantifiable component). Therefore, the number of outputs will be multiplied by 1, 2 or 3 according to how many units are represented by that specific layer/sublayer.
- The number of raster files will be double when the data layers also contain a time coverage for 2030 (planned infrastructures).
- Data was re-projected to ETRS 1989_LAEA with Geographic Coordinate System: GCS_ETRS_1989.
- TR5C_100 (National Roads) and TR5B_1000 (Motorways) layers were both used as a reference for "Spatial extent" and "Snap raster" processing options respectively to produce consistent raster files of 100 and 1 000 meters cell size.

ARC GIS 10.1® software was used to convert the original Shapefiles into Raster files with different spatial resolutions. Spatial analyst, and specifically conversion tools through ArcTool Box were used mainly to convert the data between different formats.

Shapefile was principally the original data source format. Pre-processing tasks such as data cleaning, georeferencing, clipping and geometric correction were required.

The Shape to Raster file conversion depended on the data source type. From shapefiles type point was considered:

- The number of spatial entities within each pixel size through the "count" cell assignment method.
- "Sum" cell assignment method of the quantifiable unit, if available. For example, megawatts field for power plants or criterions accomplished field for cultural sites within each pixel size resolution.

From shapefiles type line was captured:

- The sum of all lines within each pixel size resolution through the "Maximum combined length" cell assignment method. This analysis was carried out in cases as Gas pipelines and Electricity transmission lines.

Two geoprocessing tools were used sequentially in ARC GIS® software to convert the files:

1) "Point/line to Raster" tool: it creates Raster files with 100 and 1 000 meters cell size. This tool coverts a feature class containing point or lines to a raster image dataset.
2) "Aggregate" tool: it generates Raster files with 5 000 and 25 000 meters cell size. This tool generates a reduced resolution version of a raster. Raster files previously created were used as a reference to generate the other raster files.

The conversion processes generated certain issues to mention:

- Duplicity of geometries. Some infrastructures such as oil fired and gas fired power plants were found to be allocated in in the same installation. The decision here was always to preserve the thematic information as separate infrastructures even though they share the same spatial location.

- Different classification field. For instance, biomass layer was retrieved through the fuel field (biomass) instead of the primary mover field (e.g. gas, oil, pumped storage, etc.). This fact caused also duplicity of geometries.
- Not all the data layers had a time coverage for 2030. The ones with this attribute were categorized as planned infrastructures.
- Spatial entities classified as "Cancelled infrastructures" were removed.

A good data nomenclature system is essential to organize and keep track of the large number of final outputs produced. A full and more comprehensive list of outputs are presented in annexes I and II.

The outputs were stored and named in line with the following data nomenclature: "XXXX_YYYY.shp" for Shapefiles and "XXXX_YYYY_WWWWW_Z.tif" for Raster files format.

The shapefile data nomenclature is the union of:

Sector	Key	SLayer	Year	Format
XX	*X*	*X*	*YYYY*	*TIF*

Figure 2a. Shapefile data nomenclature

Sector:	It is the Sector acronym e.g. EP for Energy Production, etc.
Key:	It is a numbered list to categorize the layers
Slayer:	It is an alphabetic list to categorize the sublayer/s within each layer
Year:	Dataset update: 2.010/13/14 and 2030
Unit:	Unit of measure: C=Count, Q=Quantity and L=Length

Raster data nomenclature is the sum of:

Sector	Key	SLayer	Year	Resolution	Unit	Format
XX	*X*	*X*	*YYYY*	*WWWWW*	*Z*	*TIF*

Figure 2b. Raster file data nomenclature

Layer group:	It groups the data layers
Layer:	The specific layer/s of each layer group
Sublayer:	The specific sublayer/s of each layer subdivision.
Sector:	It is the Sector acronym e.g. EP for Energy Production, etc.

Key:	It is a numbered list to categorize the layers
Slayer:	It is an alphabetic list to categorize the sublayers
Year:	Dataset update: 2010/13/14 and 2030
Resolution:	Grid cell size in meters: 100, 1 000, 5 000 and 25 000 meters
Unit:	Unit of measure: C=Count, Q=Quantity and L=Length

The complete list of vector and raster files generated in this work are displayed in the annexes I and II.

3. Infrastructure factsheets

A fact sheet format was chosen to convey the data in a standard, concise and communicative way. The colour symbology defined in the table 2 was used to help the reader to distinguish between layer sectors.

The layout is structured in the following manner:

1st page: Layer description.

- Heading title at the top of the page: emphasizes the sector name and sector acronym.
- Folder tree on the left side: shows the data layer group and data sublayers groups.
- Title at the top centre: highlights the data layer group.
- Brief layer description in the middle of the page to the left: summarizes the data layer with its definition, its content and the source provider.
- Infrastructure image in the middle to the right: visualizes the data infrastructures.
- “Coverage” box, in the left centre: plots the presence/absence of the combined data layers and sublayers within Europe per country.
- “Available descriptor” box in the middle to the right: defines the data units.
- “Data source” box, in the right centre: outlines the data source providers along with its versions.
- “Period of content” box, in the middle to the right: bounds the temporal coverage.
- “Completeness” mark at the bottom left: describes the data completeness with the number of points/lines for each layer and its correspondent sublayers.
- “Spatial accuracy” mark at the bottom centre: gives details of spatial accuracy level, scale resolution and visual verifications executed.
- “Any other issues” mark, right at the bottom: adds relevant information not mentioned before.
- Tags at the bottom of the page: summarizes the fact sheet through a tag list.

2nd and successive pages: Map layer.

- Reference layer at the upper left: contains the data layer sector acronym plus the assigned key number (See figures 2a and 2b above).
- Title, right at the top: identifies the data sector.
- Map in the middle of the page: draws the current infrastructures in a European scale.
- Legend at the bottom: contains the symbology of each data layer and/or sublayers plotted in the map along with the EU and non-EU country boundaries.

3.1 Energy production infrastructures

EP

Energy Production

NON RENEWABLE ENERGY POWER PLANTS

- 1 Coal
- 2 Gas
- 3 Nuclear
- 4 Oil fired

Non Renewable Power Plants

A power station is an industrial facility for the generation of electric power. Non-renewable energy comes from sources that will run out or will not be replenished in our lifetimes—or even in many, many lifetimes.

The Non Renewable power plants here included comprise these power stations that burn fossil fuels such as coal, oil, and natural gas or use nuclear power to generate electricity.

The Platts generating stations dataset contains point features representing power generating facilities in Europe. Although a power plant may have multiple generators, or units, the generating stations dataset represents all units at a plant as one feature. Detailed attribute information associated with the generating station dataset includes fuel types and operational status among others.

Power plants operating

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities

QUANTITY: Net capacity (Megawatts)

DATA SOURCE

PLATTS (2013)

DATE OF CONTENT

- 2013 - Current Infrastructures
- 2030 - Planned Infrastructures

COMPLETENESS

This group of data layers comprises a total amount of 2.986 points. Separately, each layer is represented differently:

- Coal power plants: 458 points
- Oil power plants: 386 points
- Gas Power plants: 2.086 points
- Nuclear power plants: 74 points

No major incompleteness issues were found

SPATIAL ACCURACY

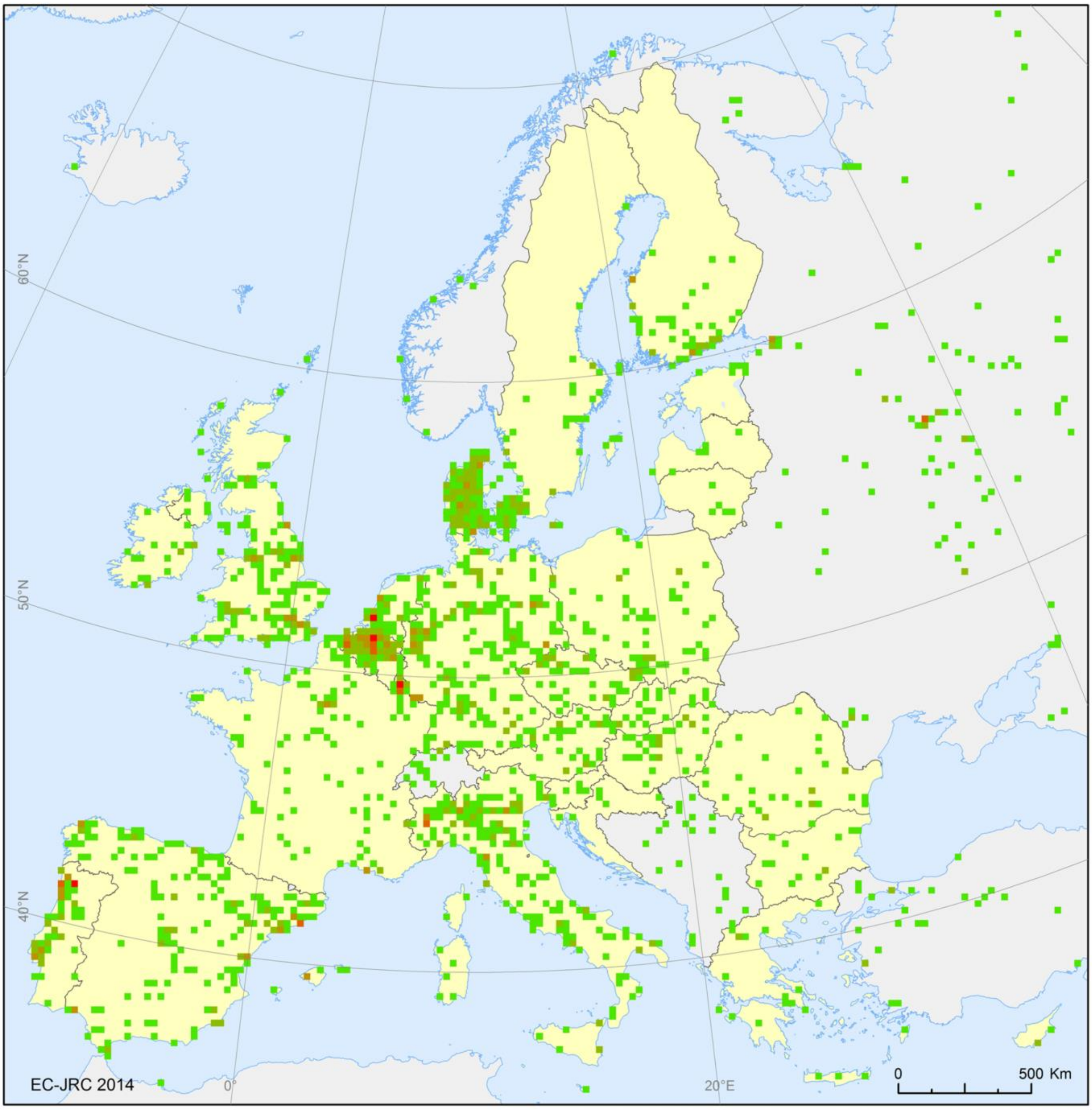
The dataset is intended for small scale applications only as 1:1.000.000 – 1:50.000.000. That means a coarse scale resolution

However, a visual inspection revealed in many cases a higher accuracy level than the one stated by the data provider

ANY OTHER ISSUES

Not found

ENERGY PRODUCTION | NON RENEWABLE | 2013 - 2030 | PAN-EUROPEAN | COUNT - QUANTITY



Key current infrastructures in Europe

Number of Non-Renewable Power plants grid (5km cell size)

1 - 2
2 - 5
5 - 10
10 - 15
15 - 24

EU country boundaries
EU-28
Non EU territories

ER

Energy Production

RENEWABLE ENERGY POWER PLANTS

- 1 Biomass
- 2 Hydro Geothermal
- 3 Solar
- 4 Wind

Renewable Power Plants

A power station is an industrial facility for the generation of electric power. Renewable energy are obtained from sources that are virtually inexhaustible and replenish naturally over small time scales relative to the human life span.

The Renewable power plants here included captures the energy from the wind, the sun and Earth. These are biomass, hydro-geothermal, solar and wind power plants.

The Platts generating stations dataset contains point features representing power generating facilities in Europe. Although a power plant may have multiple generators, or units, the generating stations dataset represents all units at a plant as one feature. Detailed attribute information associated with the generating station dataset includes fuel types, prime movers, and operational status.

Wind farms offshore

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities

QUANTITY: Net capacity (Megawatts)

DATA SOURCE

PLATTS (2013)

DATE OF CONTENT

- 2013 - Current Infrastructures
- 2030 - Planned Infrastructures

COMPLETENESS

This group of data layers comprises a total amount of 5.692 points. Separately, each layer is represented differently:

- Biomass power plants: 126 points
- Water power plants: 4.147 points
- Solar Power plants: 143 points
- Wind power plants:1.276 points

Solar power plants are not represented extensively

SPATIAL ACCURACY

The dataset is intended for small scale applications only as 1:1.000.000 – 1:50.000.000. That means a coarse scale resolution

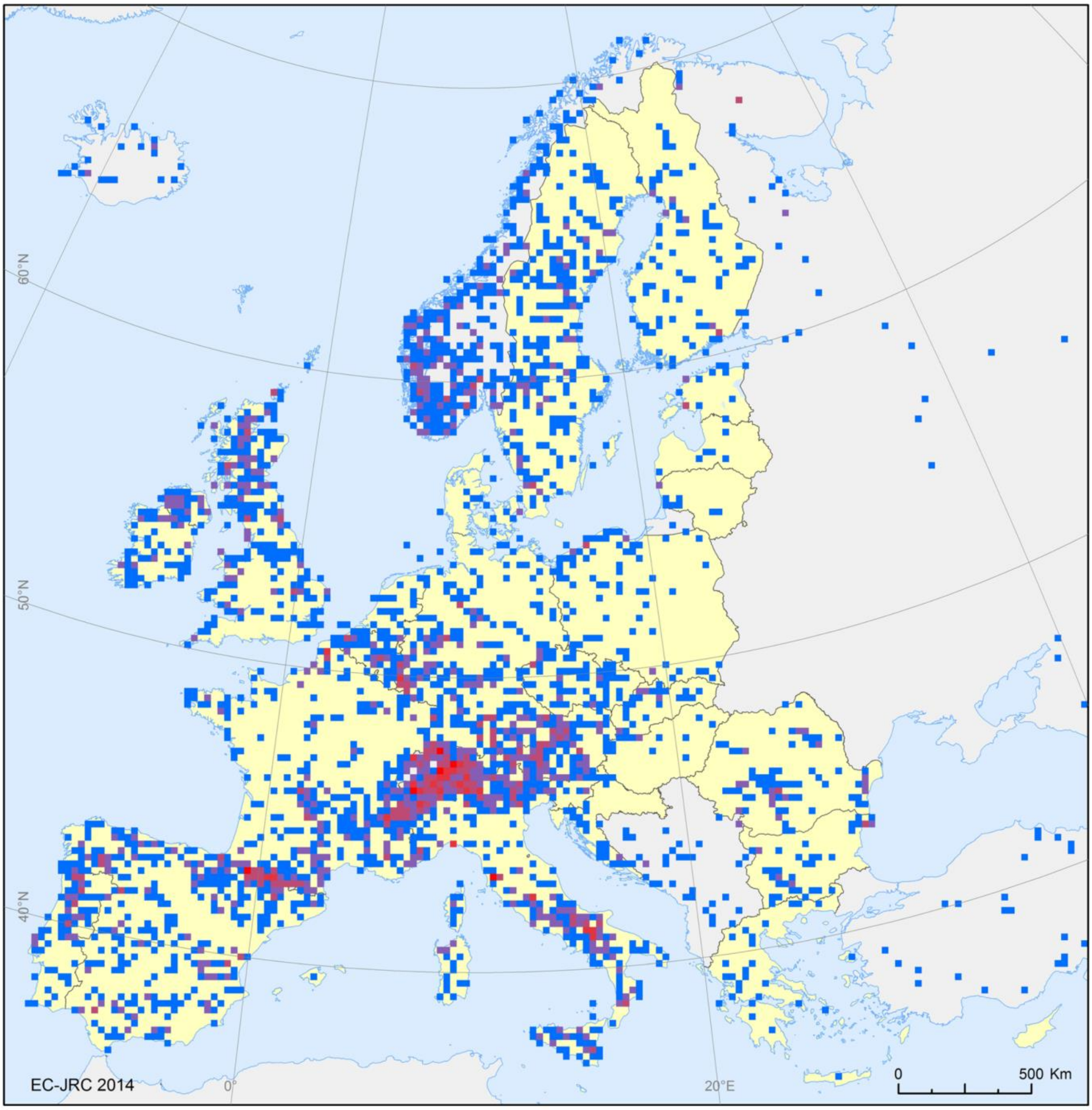
Nevertheless, a visual inspection revealed in many cases a higher accuracy level than the one stated by the data provider

ANY OTHER ISSUES

Not found

ENERGY PRODUCTION | RENEWABLE | 2013 - 2030 | PAN-EUROPEAN | COUNT & QUANTITY

Renewable energy power plants



Key current infrastructures in Europe

Number of Renewable Power plants grid (5km cell size)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 15
- 15 - 22

EU country boundaries

EU-28

Non EU territories

3.2 Energy transport

ET Energy Transport

- ENERGY TRANSPORT
  - 1 Electricity network
    - a-Transmission
    - b-Distribution
  - 2 Gas pipelines
    - a-Large diameter
    - b-Medium diameter
    - c-Small diameter

Energy Transport

The efficient and effective movement of energy from producing to consumption regions requires an extensive and elaborate transportation system. The Energy transport layer includes the infrastructures 1) to carry the electricity from power plants to electrical substations (Transmission) and between substations and customers (Distribution) 2) to transport gas from the wellheads to the final customer through a complex network of different diameter pipelines.

Platts Gas Pipeline dataset contains polyline objects representing natural gas pipelines in Europe (data include company name, diameter, status and length).

Platts Electricity network polyline dataset represents electricity transmission lines in Europe, including all AC lines of 220kV and above, as well as lower voltage lines that are part of the main transmission system (eg: 110kV, 132kV, 150kV) and DC cables of significant market importance.

Electricity lines

COVERAGE

AVAILABLE DESCRIPTORS

LENGTH (Km): Maximum combined length within each cell

DATA SOURCE

PLATTS (2013)

PERIOD OF CONTENT

- 2013 - Current Infrastructures
- 2030 - Planned Infrastructures

COMPLETENESS

This group of data layers contains a total amount of 72.047 lines, that correspond to 1.208.091 km. Separately, each layer is represented differently:

- Electricity network: 42.659 lines = 773.865 Km
  - ⇒ Transmission lines: 33.211 = 391.190 Km
  - ⇒ Distribution lines: 9.448 = 382.675 Km
- Gas pipelines: 29.388 lines = 434.226 Km
  - ⇒ Small diameter: 18.331 = 132.285 Km
  - ⇒ Medium diameter 7.806 = 88.177 Km
  - ⇒ Large diameter: 3.251 = 213.764 Km

SPATIAL ACCURACY

The dataset is intended for small scale applications only as 1:1.000.000 – 1:50.000.000. That means a coarse scale resolution

Nonetheless, a visual inspection revealed in many cases a higher accuracy level than the one stated by the data provider

ANY OTHER ISSUES

Not found

ENERGY TRANSPORT | ELECTRICITY & GAS | 2013 - 2030 | PAN-EUROPEAN | LENGTH

Electricity network

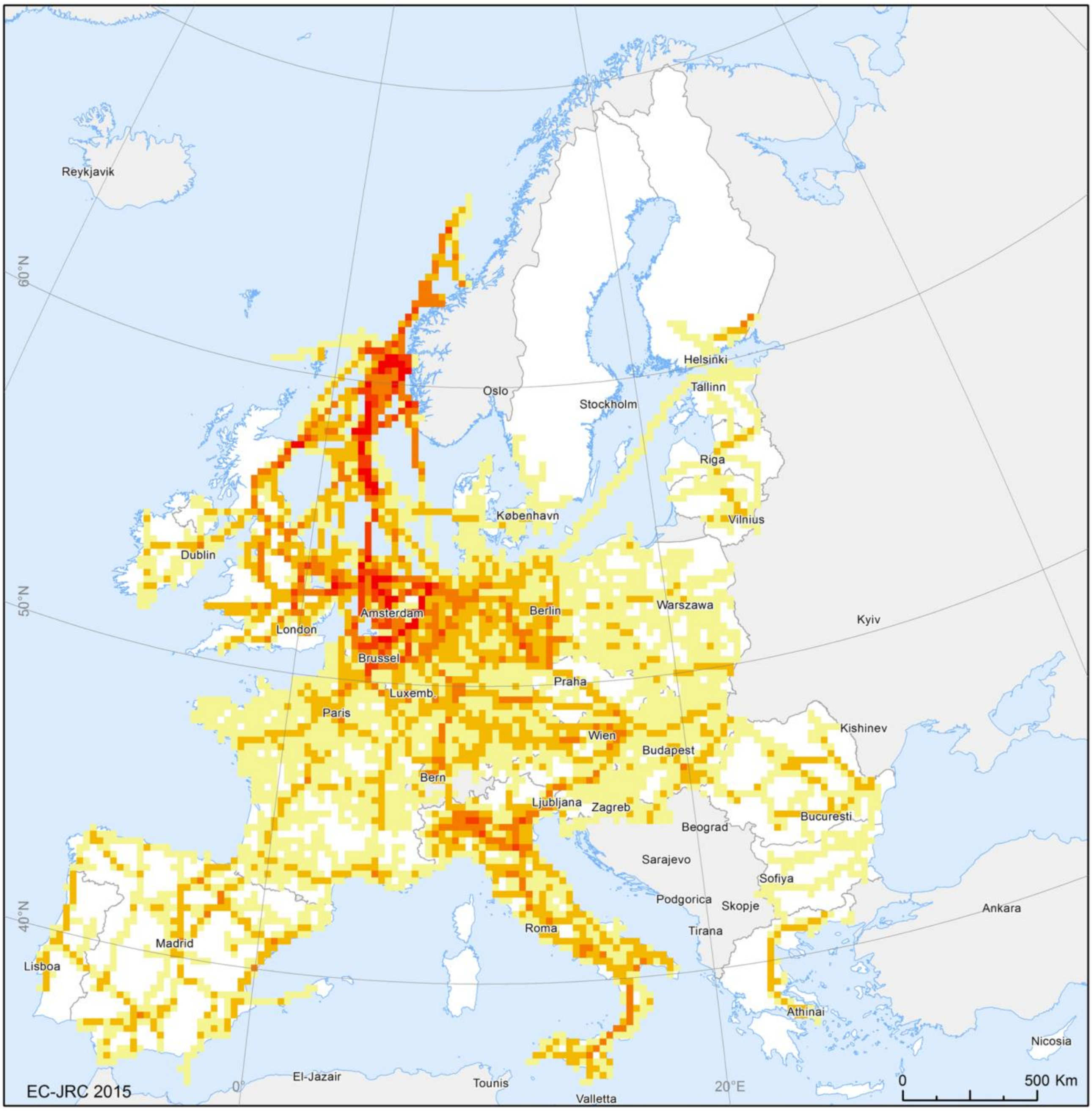
Key current infrastructures in Europe

Electricity transmission and distribution lines (25km Grid)

Length (meters)

- 1 - 30
- 30 - 100
- 100 - 200
- 200 - 300
- > 300
- Non Eu territories

Gas pipelines



Key current infrastructures in Europe

Gas pipelines (25km Grid)

Diameter (inches)

- 10 - 100
- 100 -300
- 300 - 600
- 600 - 1000
- > 1000
- Non Eu territories

3.3 Heritage

HE

Heritage

UNESCO CULTURAL SITES

Unesco Cultural Sites

A World Heritage Site is a place that is listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as of special cultural or physical significance.
From the full World Heritage List, cultural heritage properties are only compiled here and refers to monuments, groups of buildings and sites with historical, aesthetic, archaeological, scientific, ethnological or anthropological value.
For each entity, it is included mainly : Name (as listed by the World Heritage Committee), Location (city and region of site), Area (size of property and buffer zone), UNESCO data (the site's reference number; the year the site was inscribed on the World Heritage List; the criteria it was listed under) and Description (brief description of the site).

The Alhambra (Granada), an Unesco cultural site

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities
QUANTITY: Number of cultural criterions accomplished

DATA SOURCE

UNESCO (2014)

DATE OF CONTENT

- 2014 - Current Infrastructures

COMPLETENESS
This data layer group encompasses a total amount of 346 points

The dataset excludes natural and mixed sites. It has a European scope

SPATIAL ACCURACY
In this data layer group, a visual inspection revealed a very precise location with inexistent o very few meters spatial displacement

ANY OTHER ISSUES
Not found

HERITAGE	UNESCO SITES	2014	PAN-EUROPEAN	COUNT - QUANTITY

Unesco Cultural Sites

Key current infrastructures in Europe

UNESCO world heritage sites

Cultural sites — EU country boundaries — EU-28 — Non EU territories

3.4 Industry

IN

Industry

INDUSTRY AND WASTE/WATER TREATMENT

- 1 Chemical Industry
- 2 Metal Industry
- 3 Mineral Industry
  - a-Mineral Plants
  - b-Extraction sites
- 4 Water treatment

Industry & Water treatment

Industries are key infrastructures within the economy of each country as it produce goods and services.
E-PRTR register contains annual data reported by some 28.000 industrial facilities covering 65 economic activities within nine industrial sectors across European Union member states and EFTA countries.
Here, it is referred to metal, mineral, chemical and waste water management industries.
These facilities are present under E-PRTR dataset if its capacity and/or pollutant release or transfer waste-off-site exceed certain threshold.
For each facility, information is provided concerning the amounts of pollutant releases to air, water and land as well as off-site transfers of waste and of pollutants in waste water from a list of 91 key pollutants.

Chemical plants

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities

DATA SOURCE

EPRTR (2013). The European Pollutant Release and Transfer Register (E-PRTR) is the Europe-wide register that contains data on the main pollutant releases to air, water and land of about 28,000 industrial facilities

DATE OF CONTENT

The second report in 2013 covers 2011 data, and data will continue to be updated on an annual basis with each report covering emission from two years previous

COMPLETENESS

The data layer group is completed with a total amount of 18.321 points. Separately, each layer is represented differently:

- Chemical industry: 2.820 points
- Metal industry: 4.449 points
- Mineral industry 29.388 points
  - ⇒ Mineral plants: 1.426 points
  - ⇒ Extraction sites 716 points
- Water treatment: 8.910 points

SPATIAL ACCURACY

Medium scale resolution

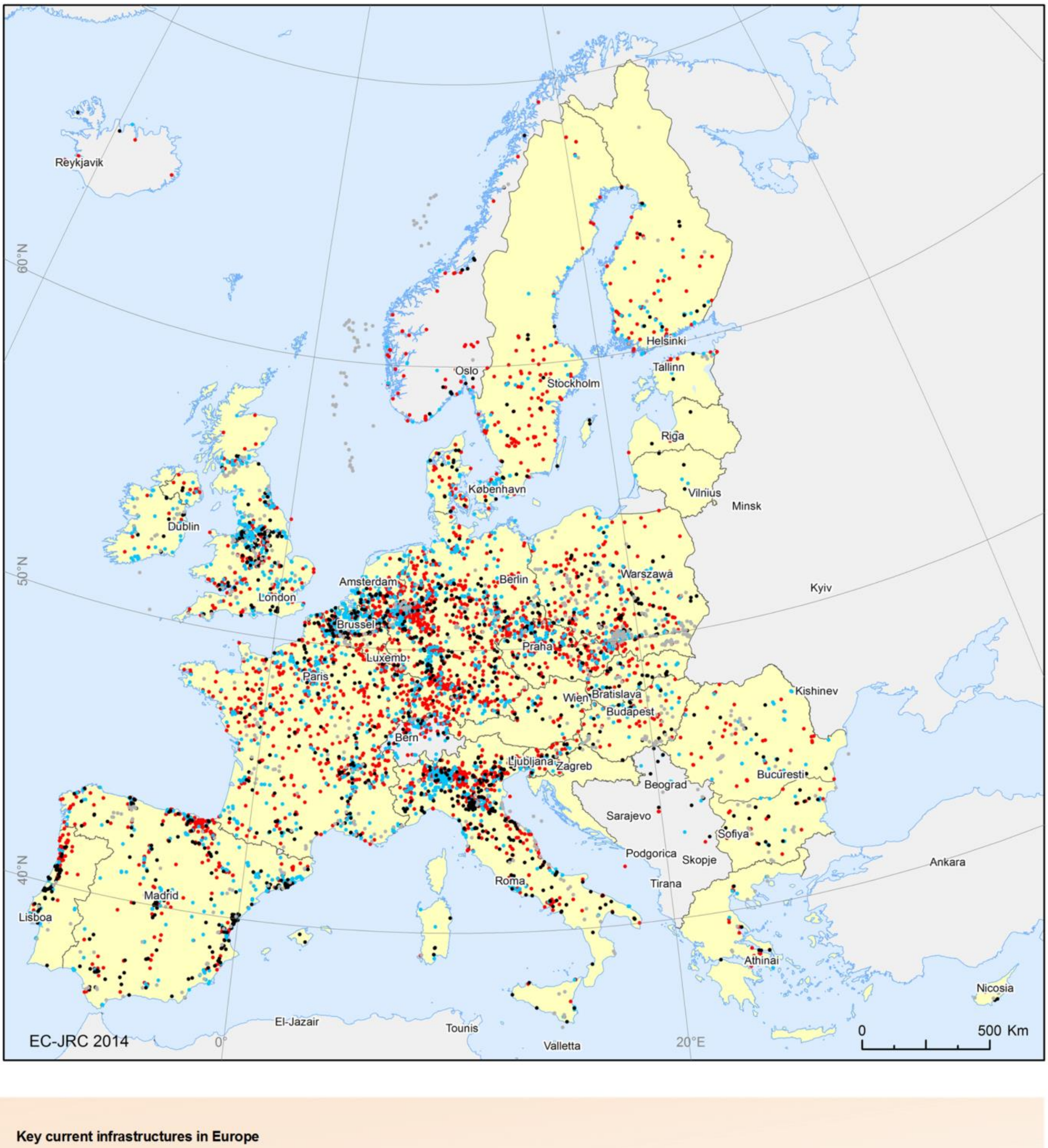
Specifically, a first visual analysis in Google Earth detected that most industries are not precisely located with a 600 meter average displacement error

ANY OTHER ISSUES

Not found

INDUSTRY	INDUSTRY & WATER	2013	PAN-EUROPEAN	COUNT

Chemical/Metal/Mineral Industry

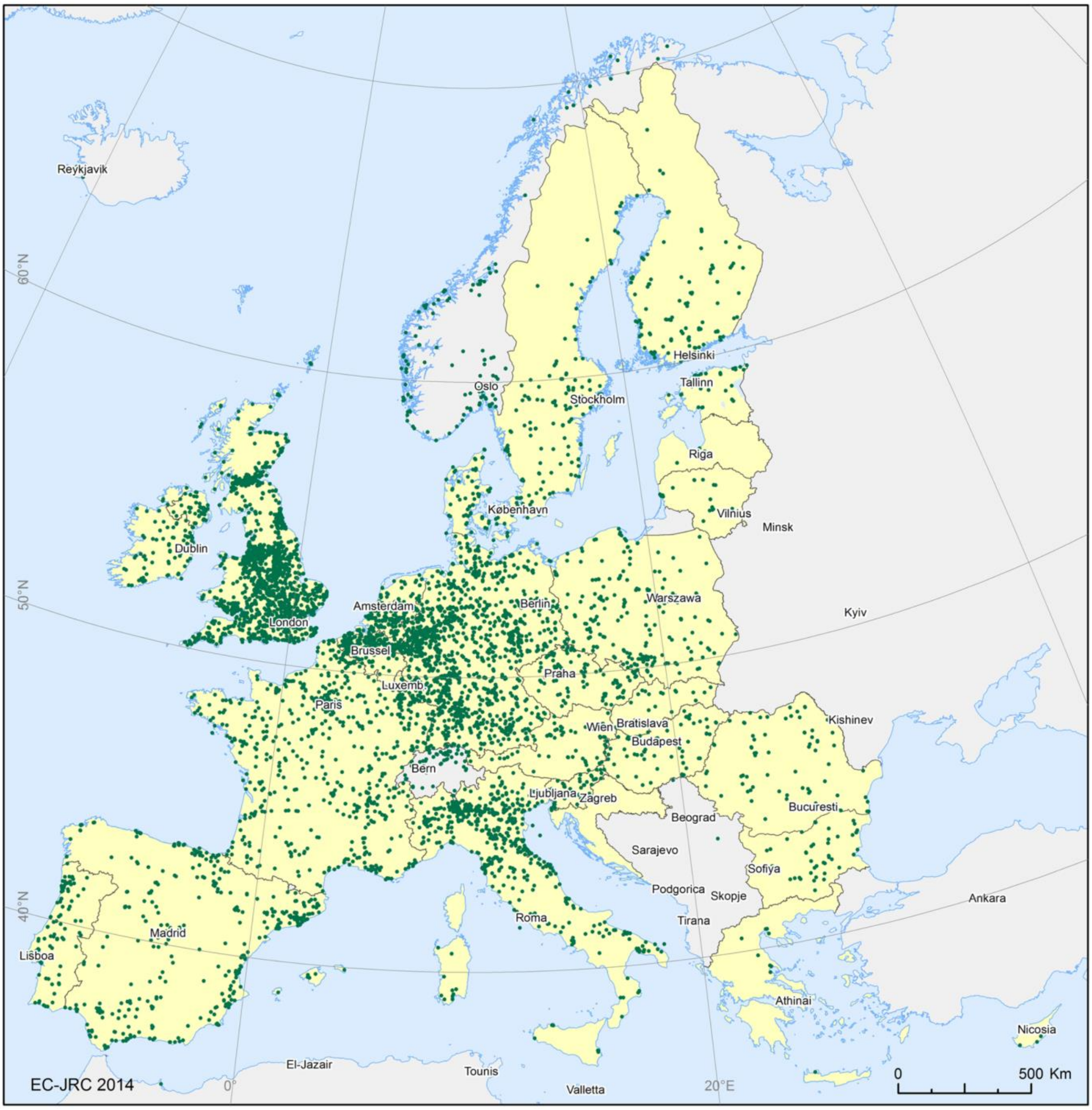


Key current infrastructures in Europe

Industries

Chemical Industries · Mineral plants · Extraction sites · Metal Industries · EU country boundaries · EU-28 · Non EU territories

Waste and water treatment



Key current infrastructures in Europe

Waste and water treatment

• Waste and water treatment — EU country boundaries — EU-28 — Non EU territories

IN

Industry

REFINERIES

Refineries

An oil or petroleum refinery is an industrial process plant where crude oil is processed and refined to produce useable products such as gasoline for cars, jet fuel for airplanes, diesel for trucks and trains, propane and butane for home heating and barbecues, and fuel oils, coke, and certain chemicals for industrial use.
These refineries run very complex processes and are typically large, sprawling industrial complexes with extensive piping running throughout.
Dataset contains these manufacturers of refined petroleum product in an European scale.
Information is provided by Global Energy Observatory (GEO) through a set of free interactive databases and tools built collaboratively by public users.

Refinery

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities

DATA SOURCE

Global Energy Observatory (GEO,2015)

DATE OF CONTENT

- 2010 - Current Infrastructures

COMPLETENESS
This data layer group covers a total amount of 121 points

SPATIAL ACCURACY
Fine scale resolution

A visual inspection revealed that the refineries are precisely placed with no displacement error

ANY OTHER ISSUES
Not found

Refineries

Key current infrastructures in Europe

Industry

Refineries — EU country boundaries — EU-28 — Non EU territories

3.5 Social

SO

Social facilities

SOCIAL FACILITIES

1 Education facilities

2 Health facilities

Social Facilities

Social facilities are places where a range of public services are provided by any national, regional o local government organization for its citizens, including health care and education.

The social facilities here included are education and health related. The outputs are expressed in terms of population potentially served by each facility.

Open Street Map is a collaborative project to create a free editable map of the world. It has a geographically diverse user-base, due to emphasis of local knowledge and ground truth data along with satellite/aerial imagery, GPS, etc. to create and maintain data about roads, railways and much more over the world. Tele Atlas is a company which delivers digital maps and other dynamic content for navigation and location-based services, and provides data used in a wide range of mobile and Internet map applications.

Geographical information system of the Commission (GISCO) is a permanent service of Eurostat that answers the needs of Eurostat and the EC for geographical information at the level of the European Union (EU), its Member States and regions.

Hospitals are well-known health facilities

COVERAGE

AVAILABLE DESCRIPTORS

QUANTITY: Potentially served population

DATA SOURCE

Open Street Maps, Tele Atlas and GISCO (2014)

DATE OF CONTENT

- 2014 - Current Infrastructures

COMPLETENESS

The group data layer is completed with a total amount of 612.251 points Separately, each layer is represented differently:

- Education facilities: 507.466 points
- Health facilities: 104.785 points

SPATIAL ACCURACY

OSM does not provide a value of positional accuracy

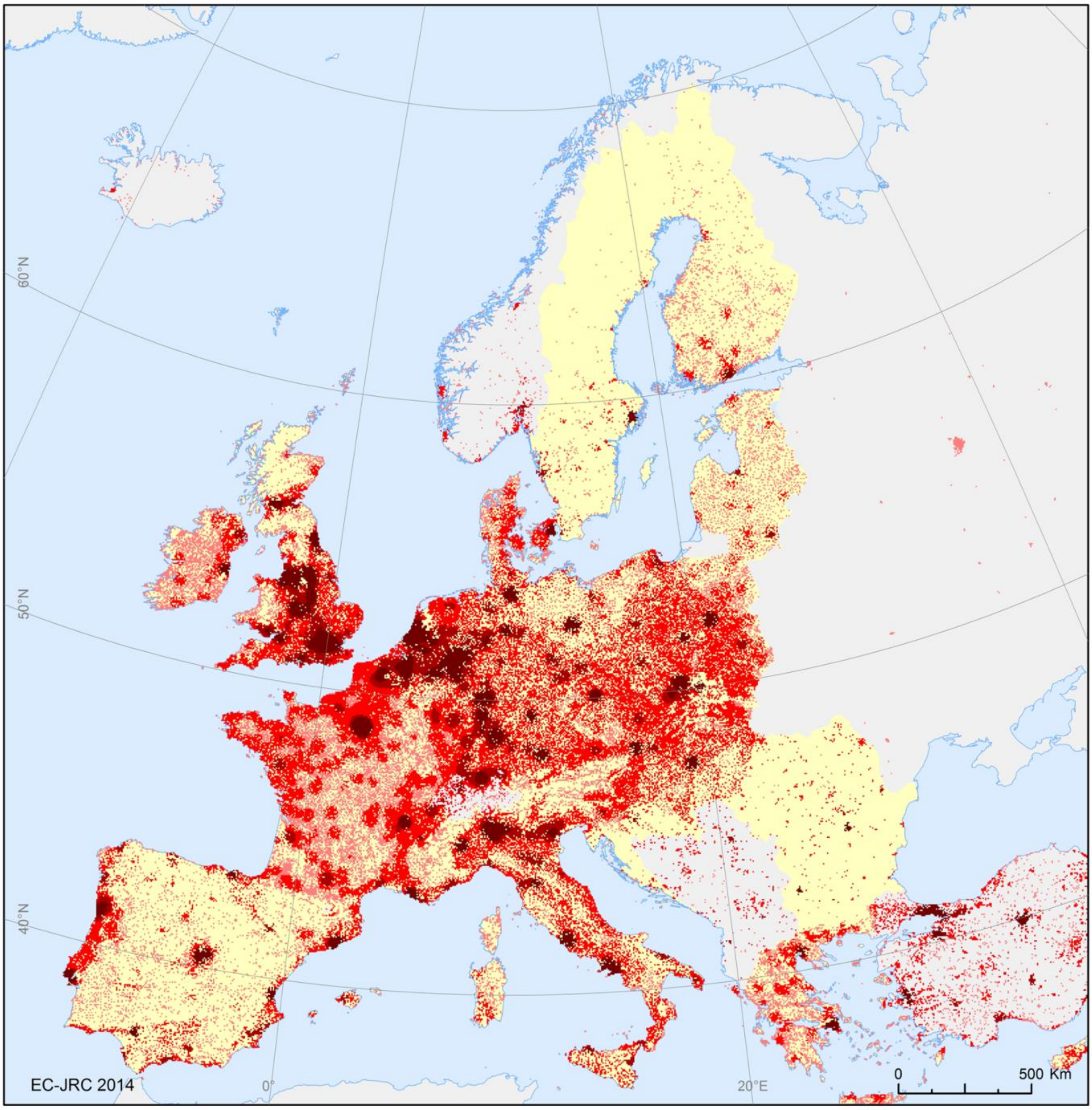
Spatial accuracy is defined by the greatest spatial resolution used of 10 meters by cell

ANY OTHER ISSUES

Not found

SOCIAL | SOCIAL FACILITIES | 2014 | PAN-EUROPEAN | QUANTITY

Education facilities



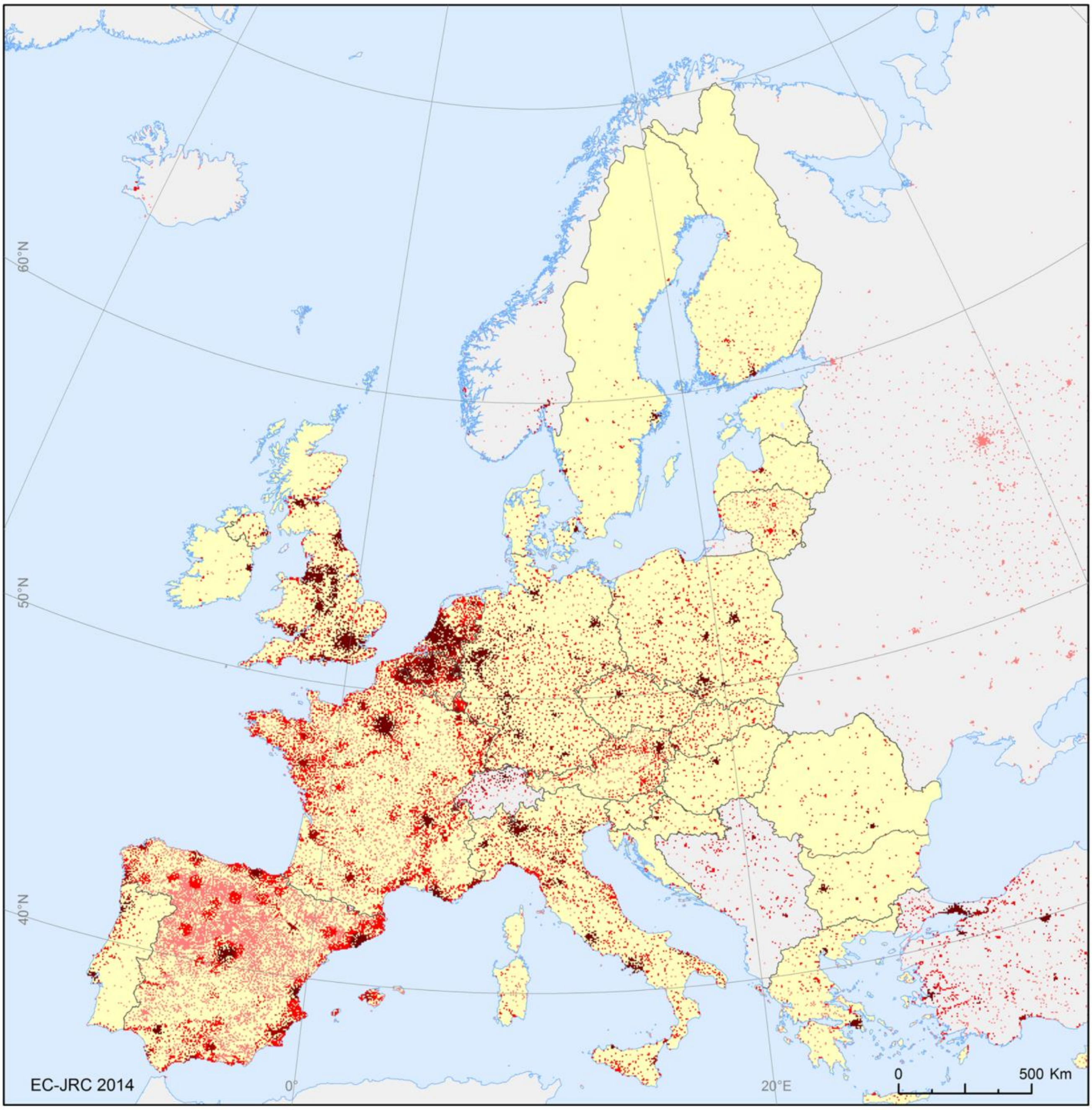
Key current infrastructures in Europe

Education facilities

Potentially served population — EU country boundaries — EU-28 — Non EU territories

- < 100 k
- 100 k - 500 k
- 500 k - 1,000 k
- > 1000 k

Health facilities



Key current infrastructures in Europe

Health facilities

Potentially served population — EU country boundaries — EU-28 — Non EU territories

- < 100 k
- 100 k - 500 k
- 500 k - 1,000 k
- > 1000 k

3.6 Transport

TR

Transport

AIRPORTS AND PORTS

1 Airports

2 Ports

Airports & Ports

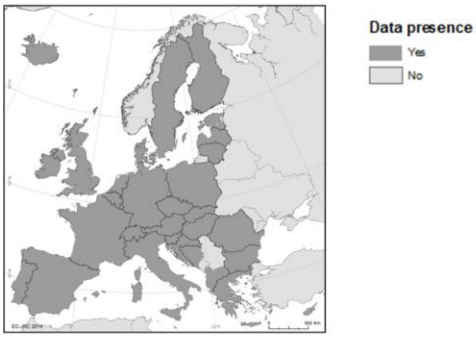
An airport is a location where aircrafts take off and land. An airport consists of a landing area, which comprises an aerially accessible open space and often includes adjacent utility buildings such as control towers, hangars and terminals. A port is a location on a coast or shore containing one or more harbors where ships can dock and transfer people or cargo to or from land.

GISCO Airports & Ports is a geographical dataset developed by the European Commission, the European Environment Agency together with its member countries, based on Corine Land Cover 2000 and Eurocontrol data.

This dataset contains information concerning the average number of passenger traffic and freight carried (Airports), goods handled and passengers embarked/disembarked (Ports) from 2004 to 2013.

Up, plane in the air. Down, Marine port

COVERAGE



AVAILABLE DESCRIPTORS

COUNT: Number of entities (Airports and Ports)
QUANTITY: Number of passengers (Airports) and Average tonnage per year (Ports)

DATA SOURCE

CORINE Land Cover, GISCO and Eurostat (2004-2013)

DATE OF CONTENT

- 2004–2013 - Current Infrastructures

COMPLETENESS

This group data layer is completed with a total amount of 1.965 points. Separately, each layer is represented as follow:

- Airports: 1.361 points
- Ports: 604 points

SPATIAL ACCURACY

The dataset is intended for small scale applications only as 1:1 000 000

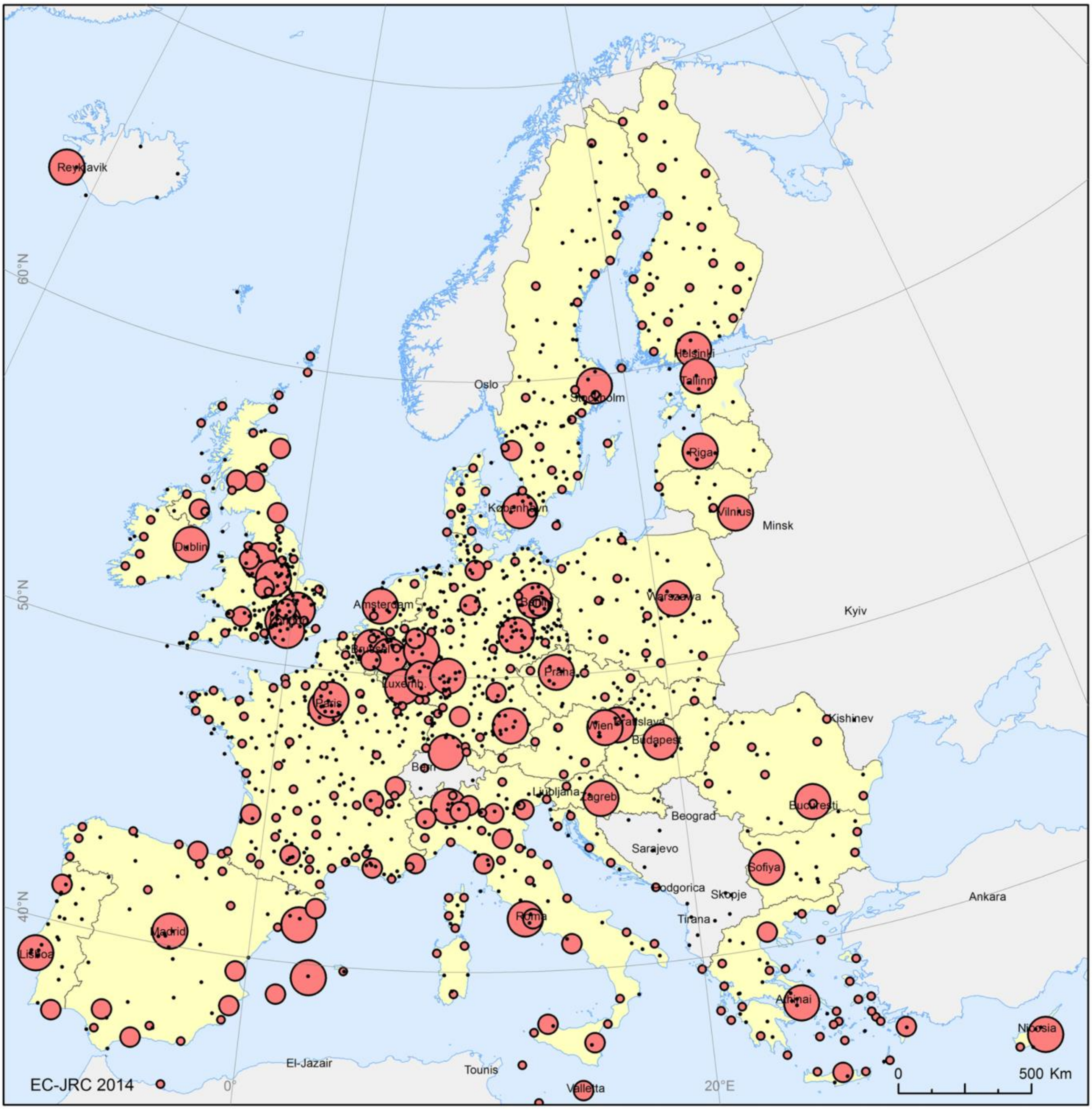
A number of processing steps were concerned with data quality. Airports and ports were most closely checked. Points from the lower-reliability supplemental sources were most likely to be deleted if there was any reason to doubt their validity. Manual correction of some particularly obvious positional or attribute errors also occurred during data preparation

ANY OTHER ISSUES

Not found

TRANSPORT | AIRPORTS & PORTS | 2004 - 2013 | PAN-EUROPEAN | COUNT & QUANTITY

Airports



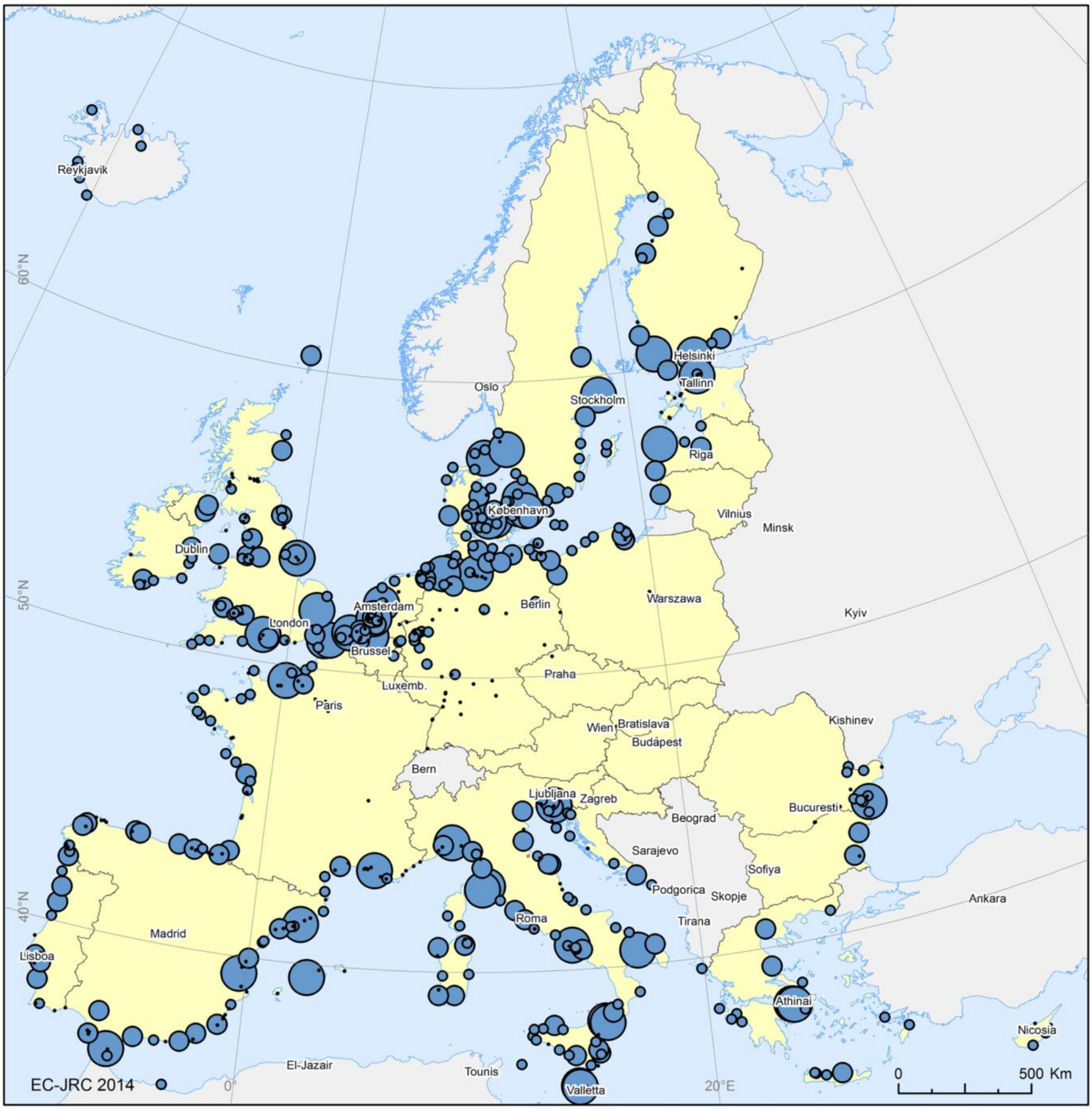
Key current infrastructures in Europe

Airports

- Airfields
- Low importance
- Medium importance
- High importance

EU country boundaries | EU-28 | Non EU territories

Ports



Key current infrastructures in Europe

Ports

- Very small size
- Low importance
- Medium importance
- High importance

EU country boundaries | EU-28 | Non EU territories

TR

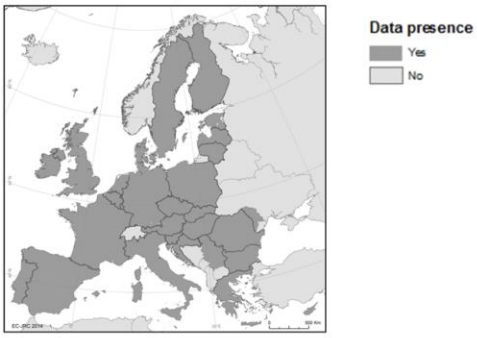
Transport

Inland Waterways

Inland waterways are rivers, canals, lakes or other stretch of water suitable for navigation which an amount of transport is performed each year.
Here, it is included all navigable inland waterways open for public navigation in Europe. Data is classified by its length in kilometers.
Inland waterway transport plays an important role for the transport of goods in Europe. More than 37.000 kilometers of waterways connect hundreds of cities and industrial regions. Some 20 out of 27 Member States have inland waterways, 12 of which have an interconnected waterway networks.
Datasets are provided by Geographical information system of the Commission (GISCO) and United Nations Economic Commission for Europe (UNECE) repository.

Inland waterways

COVERAGE



AVAILABLE DESCRIPTORS

LENGTH (Km): Maximum combined length within each cell

DATA SOURCE

GISCO and UNECE (2013)

DATE OF CONTENT

- 2013 - Current Infrastructures

COMPLETENESS

The data layer group is completed with a total amount of 19.729 lines that corresponds to 43.715 km

SPATIAL ACCURACY

The dataset is planned for coarse scale resolutions

However, a visual inspection revealed a good accuracy level

ANY OTHER ISSUES

Not found

Inland waterways

Key current infrastructures in Europe

Inland waterways

Navigable waterways — EU country boundaries — EU-28 — Non EU territories

RAIL AND ROADS NETWORK

Rails & Roads Network

Rails and roads represent essential public transportation infrastructures which permits either vehicular movement od flow of some commodity.
Dataset are here categorized according to their functions and capacities. Roads grouped as motorways, national roads and local roads. Railways are classified as light rails, narrow gauge and proper railways.
Dataset source is an aggregation of different data providers where OSM is used to retrieve the geometry features and EGM, ESRI and Tele Atlas are intended to implement/validate the OSM data classification.


Rail and roads network

COVERAGE

AVAILABLE DESCRIPTORS

LENGTH (Km): Maximum combined length within each cell

DATA SOURCE

Open Street Maps (OSM), Euro Global Map (EGM v. 6.0), ESRI and Tele Atlas (2014)

DATE OF CONTENT

- 2014 - Current Infrastructures

COMPLETENESS

The data layer group is completed with a total amount of 3.172.049 lines corresponding to 3.599.354 km Separately, each layer is represented differently:

- Rails: 1.063.237 lines = 533.443 km.
- Roads: 2.108.812 lines = 3.065.911 km

Data completeness is good but dataset content classification between countries is not consistent

SPATIAL ACCURACY

OSM does not provide a value of positional accuracy

Spatial accuracy is defined by the greatest spatial resolution used of 10 meters by cell

ANY OTHER ISSUES

Some counties such as Bulgaria, Slovenia, Estonia and Portugal were classified properly using other data different than OSM

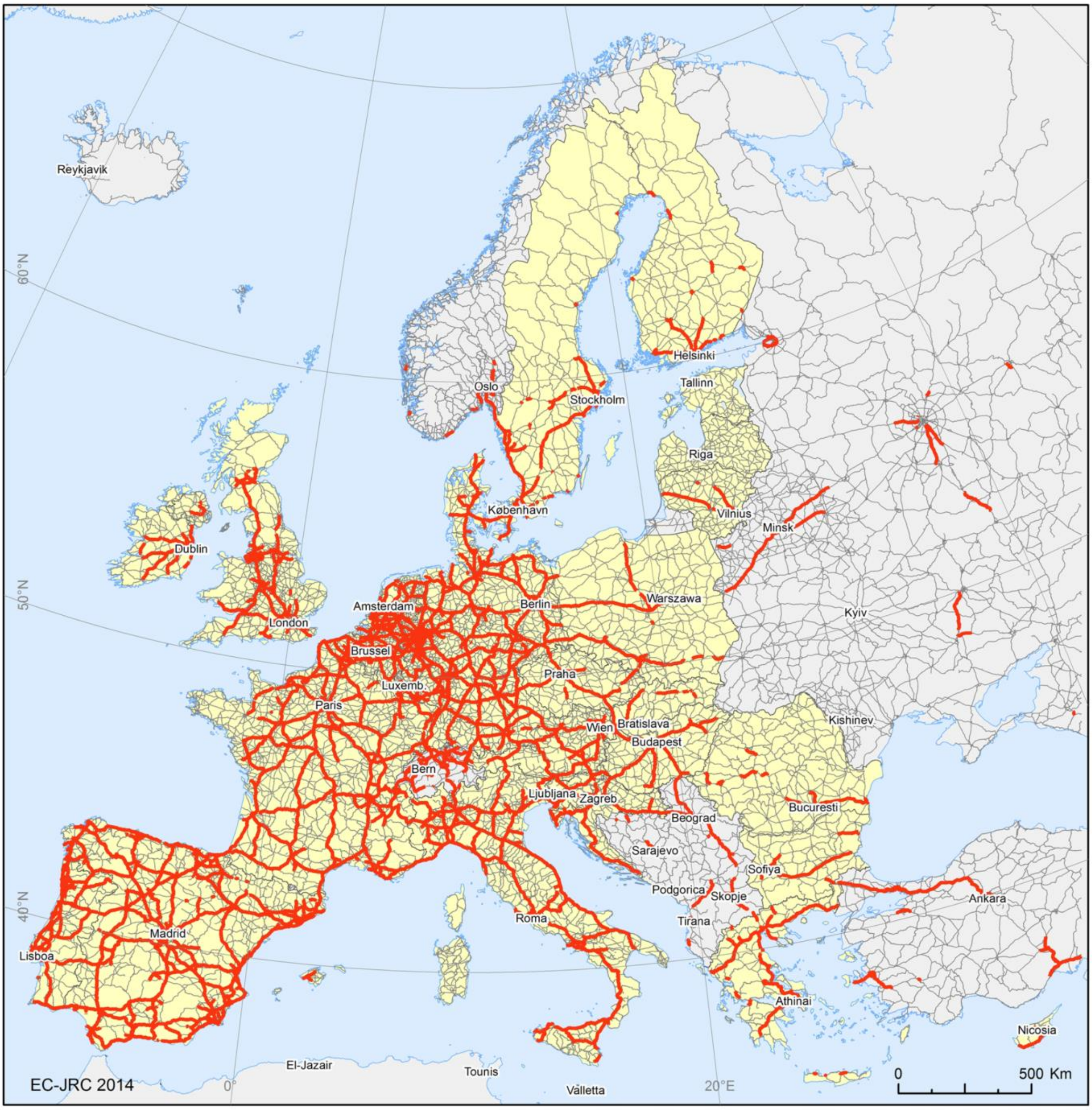
Railways

Key current infrastructures in Europe

Railways

Railways — EU country boundaries — EU-28 — Non EU territories

Roads



Key current infrastructures in Europe

Roads

Motorways — National Roads — EU country boundaries — EU-28 — Non EU territories

TR

Transport

URBAN TRASPORT

- A Bus station
- B Bus stop
- C Funicular
- D Subway
- E Tram lines
- F Tram stops

Urban Transport

A large majority of European citizens live in an urban environment, with over 60% living in urban areas of over 10.000 inhabitants. They live their daily lives in the same space, and for their mobility share the same infrastructure. Urban transport systems are vital to the economic functioning of cities through their provision of accessibility for goods and commuters as well as welfare of the population.

Urban transport refers to the transportation in city area of all types, private and public, individual and mass mainly carried out on urban roads or subways/ tramways.

Dataset encompass urban means of transport such as bus stations/stops, funiculars, subways and tram lines/stops.

Dataset is a sum of several data providers in order to maximize the number of inputs and spatial coverage.

Bus as a mean of urban transport

COVERAGE

AVAILABLE DESCRIPTORS

COUNT: Number of entities

DATA SOURCE

Open Street Maps, ESRI, EGM and GISCO (2014)

DATE OF CONTENT

- 2014 - Current Infrastructures

COMPLETENESS

This data layer group is completed with a total amount of 1.128.270 features. Separately, each layer is represented differently:

- Bus stations: 9.279 points
- Bus stops: 966.802 points
- Funicular: 346 lines = 177 km
- Subway: 22.827 lines = 6.428 km.
- Tram lines:99.042 lines = 13.727 km
- Tram stops: 29.974 points

SPATIAL ACCURACY

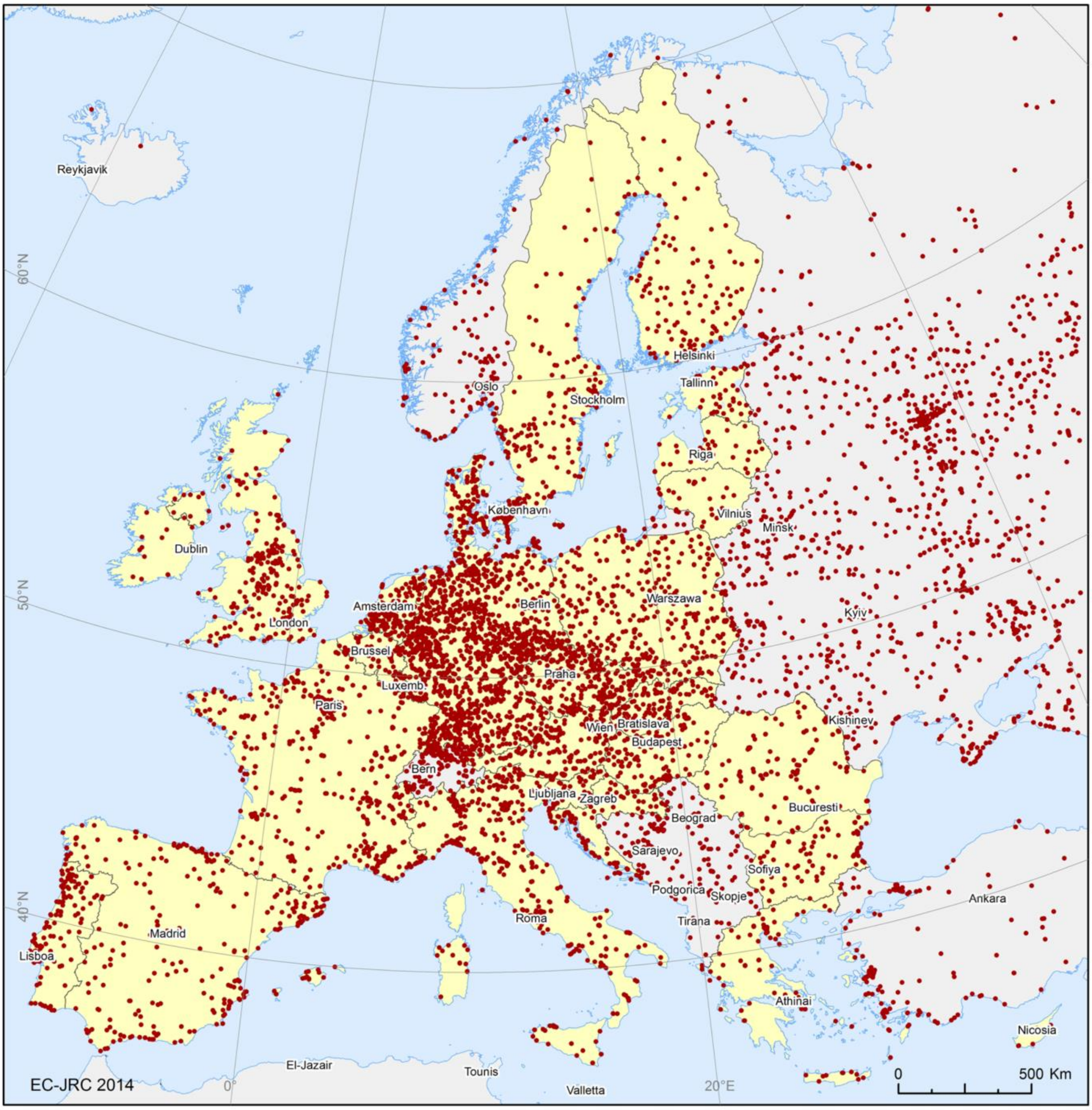
OSM does not provide a value of positional accuracy

Spatial accuracy is defined by the greatest spatial resolution used of 10 meters by cell

ANY OTHER ISSUES

Not found

Bus stations

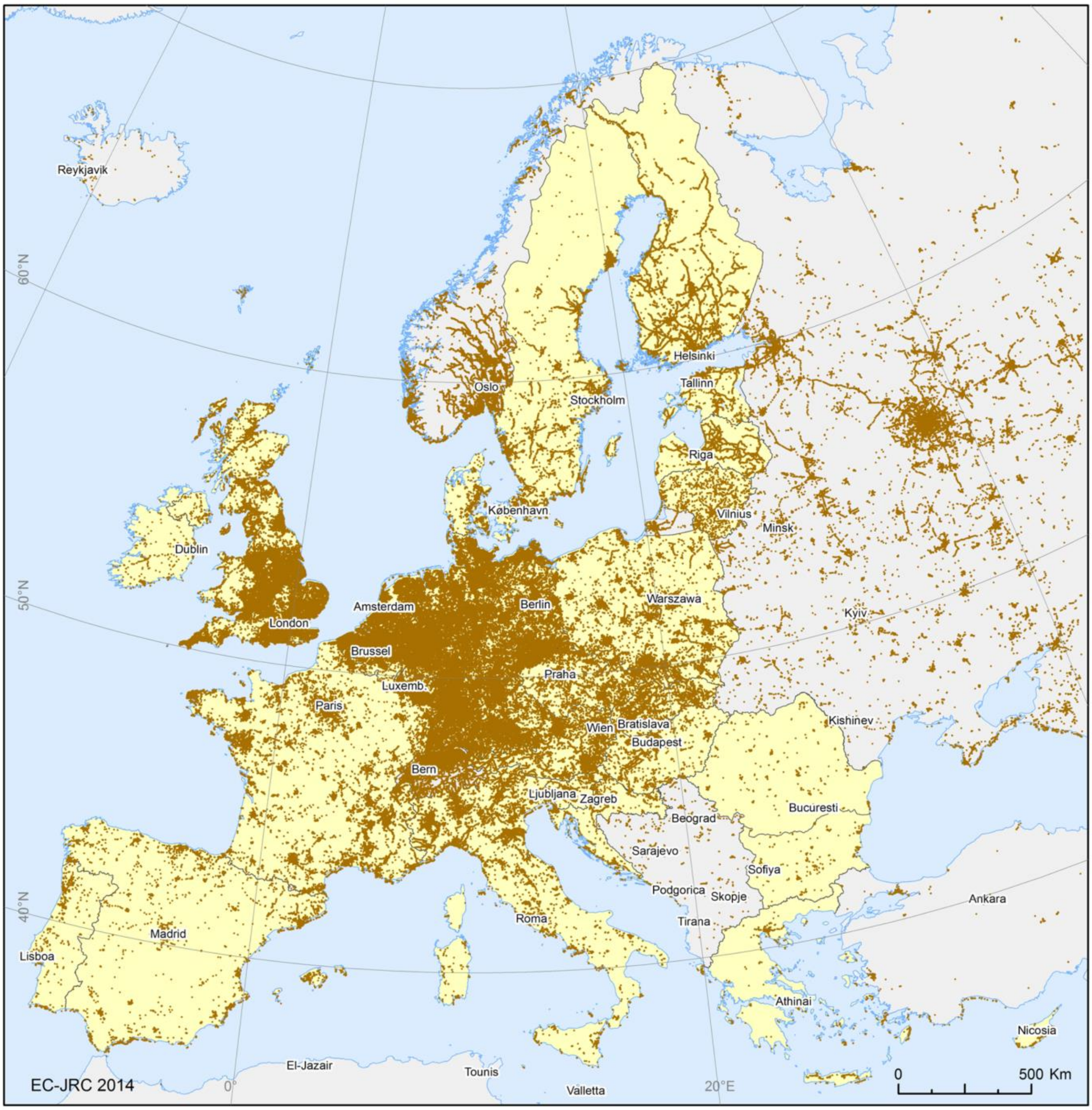


Key current infrastructures in Europe

Urban Transport

Bus stations — EU country boundaries — EU-28 — Non EU territories

Bus stops



Key current infrastructures in Europe

Urban Transport

Bus stops — EU country boundaries — EU-28 — Non EU territories

Funicular/Subway lines

Key current infrastructures in Europe

Urban Transport

Funicular — Subway — EU country boundaries — EU-28 — Non EU territories

Tram stops

Key current infrastructures in Europe

Urban transport

Tram stops — EU country boundaries — EU-28 — Non EU territories

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Data sources

Environmental Systems Research Institute (ESRI). It is an international supplier of Geographic Information System (GIS) software, web GIS and geodatabase management application.

European Pollutant Release and Transfer Register (E-PRTR). It is the Europe-wide register that contains data on the main pollutant releases to air, water and land of about 28,000 industrial facilities.

Eurostat. Provides statistics for the European Union countries and regions.

Geographical Information System at the Commission (GISCO). It is a Eurostat service which promotes and stimulates the use of GIS within the European Statistical System and the Commission.

Global Energy Observatory (GEO). It is a set of free interactive databases and tools built collaboratively by public users.

Open Street Maps (OSM). It is a collaborative project to create a free editable map of the world. It has a geographically diverse user-base, due to emphasis of local knowledge and ground truth data along with satellite/aerial imagery, GPS, etc. to create and maintain spatial data.

PLATTS (2014). It is a leading global provider of energy, petrochemicals and metals information. European Commission – DG Energy is an authorized users of PLATTS data through the contract ENER/2010/A2/33.

TeleAtlas (2014). It is a company which delivers digital maps and other dynamic content for navigation and location-based services, and provides data used in a wide range of mobile and Internet map applications.

United Nations Economic Commission for Europe (UNECE, 2014). It is a multilateral platform that facilitates greater economic integration and cooperation among its member countries and promotes sustainable development and economic prosperity.

United Nations Educational, Scientific and Cultural Organization (UNESCO, 2014). Unesco World heritage list: cultural sites. http://whc.unesco.org/en/list/

Euro Global Map (EGM). It is a 1:1 million scale topographic open source dataset covering 45 countries and territories in the European region.

List of abbreviations and acronyms

CLC Corine Land Cover

EC European Commission

EEA European Environment Agency

EFTA European Free Trade Association

EGM Euro Global Map

EP Energy Production

E-PRTR European Pollutant Release and Transfer Register

ER Energy Production for Renewables

ET Energy Transport

ETRS European Terrestrial Reference System

EU European Union

GCS Geographic coordinate system

GDP Gross Domestic Product

GIS Geographical Information Systems

GISCO Geographical Information System at the COmmission

GVA Gross Value Added

ha Hectares

HE Heritage

IN Industry

JRC Joint Research Centre

LAEA Lambert Azimuthal Equal-Area Projection

LAU Local Administrative Units (LAU-1 – level1; LAU-2 – level2)

LUISA Land Use Integrated Sustainability Assessment platform

m meters

NUTS Nomenclature of Territorial Units for Statistics

OSM Open Street Maps

SO Social

TR Transport

UNECE United Nations Economic Commission for Europe

UNESCO United Nations Educational, Scientific and Cultural Organization

WGS World Geodetic System

Annex I: List of vector layers and their file names

Layer	Sublayer	Sector	Key	SLayer	Year	File name
Coal power plants		EP	1	A	2013	EP1A_2013.SHP
		EP	1	A	2030	EP1A_2030.SHP
Gas power plants		EP	2	A	2013	EP2A_2013.SHP
		EP	2	A	2030	EP2A_2030.SHP
Nuclear power plants		EP	3	A	2013	EP3A_2013.SHP
		EP	3	A	2030	EP3A_2030.SHP
Oil power plants		EP	4	A	2013	EP4A_2013.SHP
		EP	4	A	2030	EP4A_2013.SHP
Biomass		ER	1	A	2013	ER1A_2013.SHP
		ER	1	A	2030	ER1A_2030.SHP
Hydro geothermal		ER	2	A	2013	ER2A_2013.SHP
		ER	2	A	2030	ER2A_2030.SHP
Solar		ER	3	A	2013	ER3A_2013.SHP
		ER	3	A	2030	ER3A_2030.SHP
Wind		ER	4	A	2013	ER4A_2013.SHP
		ER	4	A	2030	ER4A_2030.SHP
Electricity transmission	Electricity distribution lines	ET	1	A	2013	ET1A_2013.SHP
		ET	1	A	2030	ET1A_2030.SHP
	Electricity transmission lines	ET	1	B	2013	ET1B_2013.SHP
		ET	1	B	2030	ET1B_2030.SHP
Gas pipelines	Gas pipelines large diameter	ET	2	A	2013	ET2A_2013.SHP
		ET	2	A	2030	ET2A_2030.SHP
	Gas pipelines medium diameter	ET	2	B	2013	ET2B_2013.SHP
		ET	2	B	2030	ET2B_2030.SHP
	Gas pipelines small diameter	ET	2	C	2013	ET2C_2013.SHP
		ET	2	C	2030	ET2C_2030.SHP
Unesco cultural sites		HE	1	A	2014	HE1A_2013.SHP
Chemical industry		IN	1	A	2013	IN1A_2013.SHP
Metal industry		IN	2	A	2013	IN2A_2013.SHP
Mineral industry	Mineral plants	IN	3	A	2013	IN3A_2013.SHP
	Extraction sites	IN	3	B	2013	IN3B_2013.SHP
Waste/water treatment		IN	4	A	2013	IN4A_2013.SHP
Refineries		IN	5	A	2010	IN5A_2010.SHP
Education facilities		SO	1	A	2014	SO1A_2014.SHP
Health facilities		SO	2	A	2014	SO2A_2014.SHP
Airports		TR	1	A	2013	TR1A_2013.SHP
Ports		TR	2	A	2013	TR2A_2013.SHP
Inland waterways		TR	3	A	2013	TR3A_2013.SHP
Railways	Light rails	TR	4	A	2014	TR4A_2014.SHP
	Narrow gauge	TR	4	B	2014	TR4B_2014.SHP
	Railways	TR	4	C	2014	TR4C_2014.SHP
Roads	Local roads	TR	5	A	2014	TR5A_2014.SHP
	Motorways	TR	5	B	2014	TR5B_2014.SHP
	National roads	TR	5	C	2014	TR5C_2014.SHP

Urban transport	Bus station	TR	6	A	2014	TR6A_2014.SHP
	Bus stop	TR	6	B	2014	TR6B_2014.SHP
	Funicular	TR	6	C	2014	TR6C_2014.SHP
	Subway lines	TR	6	D	2014	TR6D_2014.SHP
	Tram lines	TR	6	E	2014	TR6E_2014.SHP
	Tram stop	TR	6	F	2014	TR6F_2014.SHP

Annex II: List of raster layers and their file names

Layer	Sublayer	Sector	Key	SLayer	Year	Resolution	Unit	File name
Coal power plants		EP	1	A	2013	100	C	EP1A_2013_00100_C.TIF
		EP	1	A	2013	1000	C	EP1A_2013_01000_C.TIF
		EP	1	A	2013	5000	C	EP1A_2013_05000_C.TIF
		EP	1	A	2013	25000	C	EP1A_2013_25000_C.TIF
		EP	1	A	2013	100	Q	EP1A_2013_00100_Q.TIF
		EP	1	A	2013	1000	Q	EP1A_2013_01000_Q.TIF
		EP	1	A	2013	5000	Q	EP1A_2013_05000_Q.TIF
		EP	1	A	2013	25000	Q	EP1A_2013_25000_Q.TIF
		EP	1	A	2030	100	C	EP1A_2030_00100_C.TIF
		EP	1	A	2030	1000	C	EP1A_2030_01000_C.TIF
		EP	1	A	2030	5000	C	EP1A_2030_05000_C.TIF
		EP	1	A	2030	25000	C	EP1A_2030_25000_C.TIF
		EP	1	A	2030	100	Q	EP1A_2030_00100_Q.TIF
		EP	1	A	2030	1000	Q	EP1A_2030_01000_Q.TIF
		EP	1	A	2030	5000	Q	EP1A_2030_05000_Q.TIF
		EP	1	A	2030	25000	Q	EP1A_2030_25000_Q.TIF
Gas power plants		EP	2	A	2013	100	C	EP2A_2013_00100_C.TIF
		EP	2	A	2013	1000	C	EP2A_2013_01000_C.TIF
		EP	2	A	2013	5000	C	EP2A_2013_05000_C.TIF
		EP	2	A	2013	25000	C	EP2A_2013_25000_C.TIF
		EP	2	A	2013	100	Q	EP2A_2013_00100_Q.TIF
		EP	2	A	2013	1000	Q	EP2A_2013_01000_Q.TIF
		EP	2	A	2013	5000	Q	EP2A_2013_05000_Q.TIF
		EP	2	A	2013	25000	Q	EP2A_2013_25000_Q.TIF
		EP	2	A	2030	100	C	EP2A_2030_00100_C.TIF
		EP	2	A	2030	1000	C	EP2A_2030_01000_C.TIF
		EP	2	A	2030	5000	C	EP2A_2030_05000_C.TIF
		EP	2	A	2030	25000	C	EP2A_2030_25000_C.TIF
		EP	2	A	2030	100	Q	EP2A_2030_00100_Q.TIF
		EP	2	A	2030	1000	Q	EP2A_2030_01000_Q.TIF
		EP	2	A	2030	5000	Q	EP2A_2030_05000_Q.TIF
		EP	2	A	2030	25000	Q	EP2A_2030_25000_Q.TIF
Nuclear power plants		EP	3	A	2013	100	C	EP3A_2013_00100_C.TIF
		EP	3	A	2013	1000	C	EP3A_2013_01000_C.TIF
		EP	3	A	2013	5000	C	EP3A_2013_05000_C.TIF
		EP	3	A	2013	25000	C	EP3A_2013_25000_C.TIF
		EP	3	A	2013	100	Q	EP3A_2013_00100_Q.TIF
		EP	3	A	2013	1000	Q	EP3A_2013_01000_Q.TIF
		EP	3	A	2013	5000	Q	EP3A_2013_05000_Q.TIF
		EP	3	A	2013	25000	Q	EP3A_2013_25000_Q.TIF
		EP	3	A	2030	100	C	EP3A_2030_00100_C.TIF
		EP	3	A	2030	1000	C	EP3A_2030_01000_C.TIF
		EP	3	A	2030	5000	C	EP3A_2030_05000_C.TIF
		EP	3	A	2030	25000	C	EP3A_2030_25000_C.TIF

			EP	3	A	2030	100	Q	EP3A_2030_00100_Q.TIF
			EP	3	A	2030	1000	Q	EP3A_2030_01000_Q.TIF
			EP	3	A	2030	5000	Q	EP3A_2030_05000_Q.TIF
			EP	3	A	2030	25000	Q	EP3A_2030_25000_Q.TIF
Oil power plants			EP	4	A	2013	100	C	EP4A_2013_00100_C.TIF
			EP	4	A	2013	1000	C	EP4A_2013_01000_C.TIF
			EP	4	A	2013	5000	C	EP4A_2013_05000_C.TIF
			EP	4	A	2013	25000	C	EP4A_2013_25000_C.TIF
			EP	4	A	2013	100	Q	EP4A_2013_00100_Q.TIF
			EP	4	A	2013	1000	Q	EP4A_2013_01000_Q.TIF
			EP	4	A	2013	5000	Q	EP4A_2013_05000_Q.TIF
			EP	4	A	2013	25000	Q	EP4A_2013_25000_Q.TIF
			EP	4	A	2030	100	C	EP4A_2030_00100_C.TIF
			EP	4	A	2030	1000	C	EP4A_2030_01000_C.TIF
			EP	4	A	2030	5000	C	EP4A_2030_05000_C.TIF
			EP	4	A	2030	25000	C	EP4A_2030_25000_C.TIF
			EP	4	A	2030	100	Q	EP4A_2030_00100_Q.TIF
			EP	4	A	2030	1000	Q	EP4A_2030_01000_Q.TIF
			EP	4	A	2030	5000	Q	EP4A_2030_05000_Q.TIF
			EP	4	A	2030	25000	Q	EP4A_2030_25000_Q.TIF
Biomass			ER	1	A	2013	100	C	ER1A_2013_00100_C.TIF
			ER	1	A	2013	1000	C	ER1A_2013_01000_C.TIF
			ER	1	A	2013	5000	C	ER1A_2013_05000_C.TIF
			ER	1	A	2013	25000	C	ER1A_2013_25000_C.TIF
			ER	1	A	2013	100	Q	ER1A_2013_00100_Q.TIF
			ER	1	A	2013	1000	Q	ER1A_2013_01000_Q.TIF
			ER	1	A	2013	5000	Q	ER1A_2013_05000_Q.TIF
			ER	1	A	2013	25000	Q	ER1A_2013_25000_Q.TIF
			ER	1	A	2030	100	C	ER1A_2030_00100_C.TIF
			ER	1	A	2030	1000	C	ER1A_2030_01000_C.TIF
			ER	1	A	2030	5000	C	ER1A_2030_05000_C.TIF
			ER	1	A	2030	25000	C	ER1A_2030_25000_C.TIF
			ER	1	A	2030	100	Q	ER1A_2030_00100_Q.TIF
			ER	1	A	2030	1000	Q	ER1A_2030_01000_Q.TIF
			ER	1	A	2030	5000	Q	ER1A_2030_05000_Q.TIF
			ER	1	A	2030	25000	Q	ER1A_2030_25000_Q.TIF
Hydro geothermal			ER	2	A	2013	100	C	ER2A_2013_00100_C.TIF
			ER	2	A	2013	1000	C	ER2A_2013_01000_C.TIF
			ER	2	A	2013	5000	C	ER2A_2013_05000_C.TIF
			ER	2	A	2013	25000	C	ER2A_2013_25000_C.TIF
			ER	2	A	2013	100	Q	ER2A_2013_00100_Q.TIF
			ER	2	A	2013	1000	Q	ER2A_2013_01000_Q.TIF
			ER	2	A	2013	5000	Q	ER2A_2013_05000_Q.TIF
			ER	2	A	2013	25000	Q	ER2A_2013_25000_Q.TIF
			ER	2	A	2030	100	C	ER2A_2030_00100_C.TIF
			ER	2	A	2030	1000	C	ER2A_2030_01000_C.TIF
			ER	2	A	2030	5000	C	ER2A_2030_05000_C.TIF
			ER	2	A	2030	25000	C	ER2A_2030_25000_C.TIF

		ER	2	A	2030	100	Q	ER2A_2030_00100_Q.TIF
		ER	2	A	2030	1000	Q	ER2A_2030_01000_Q.TIF
		ER	2	A	2030	5000	Q	ER2A_2030_05000_Q.TIF
		ER	2	A	2030	25000	Q	ER2A_2030_25000_Q.TIF
Solar		ER	3	A	2013	100	C	ER3A_2013_00100_C.TIF
		ER	3	A	2013	1000	C	ER3A_2013_01000_C.TIF
		ER	3	A	2013	5000	C	ER3A_2013_05000_C.TIF
		ER	3	A	2013	25000	C	ER3A_2013_25000_C.TIF
		ER	3	A	2013	100	Q	ER3A_2013_00100_Q.TIF
		ER	3	A	2013	1000	Q	ER3A_2013_01000_Q.TIF
		ER	3	A	2013	5000	Q	ER3A_2013_05000_Q.TIF
		ER	3	A	2013	25000	Q	ER3A_2013_25000_Q.TIF
		ER	3	A	2030	100	C	ER3A_2030_00100_C.TIF
		ER	3	A	2030	1000	C	ER3A_2030_01000_C.TIF
		ER	3	A	2030	5000	C	ER3A_2030_05000_C.TIF
		ER	3	A	2030	25000	C	ER3A_2030_25000_C.TIF
		ER	3	A	2030	100	Q	ER3A_2030_00100_Q.TIF
		ER	3	A	2030	1000	Q	ER3A_2030_01000_Q.TIF
		ER	3	A	2030	5000	Q	ER3A_2030_05000_Q.TIF
		ER	3	A	2030	25000	Q	ER3A_2030_25000_Q.TIF
Wind		ER	4	A	2013	100	C	ER4A_2013_00100_C.TIF
		ER	4	A	2013	1000	C	ER4A_2013_01000_C.TIF
		ER	4	A	2013	5000	C	ER4A_2013_05000_C.TIF
		ER	4	A	2013	25000	C	ER4A_2013_25000_C.TIF
		ER	4	A	2013	100	Q	ER4A_2013_00100_Q.TIF
		ER	4	A	2013	1000	Q	ER4A_2013_01000_Q.TIF
		ER	4	A	2013	5000	Q	ER4A_2013_05000_Q.TIF
		ER	4	A	2013	25000	Q	ER4A_2013_25000_Q.TIF
		ER	4	A	2030	100	C	ER4A_2030_00100_C.TIF
		ER	4	A	2030	1000	C	ER4A_2030_01000_C.TIF
		ER	4	A	2030	5000	C	ER4A_2030_05000_C.TIF
		ER	4	A	2030	25000	C	ER4A_2030_25000_C.TIF
		ER	4	A	2030	100	Q	ER4A_2030_00100_Q.TIF
		ER	4	A	2030	1000	Q	ER4A_2030_01000_Q.TIF
		ER	4	A	2030	5000	Q	ER4A_2030_05000_Q.TIF
		ER	4	A	2030	25000	Q	ER4A_2030_25000_Q.TIF
Electricity transmission	Electricity distribution lines	ET	1	A	2013	100	L	ET1A_2013_00100_L.TIF
		ET	1	A	2013	1000	L	ET1A_2013_01000_L.TIF
		ET	1	A	2013	5000	L	ET1A_2013_05000_L.TIF
		ET	1	A	2013	25000	L	ET1A_2013_25000_L.TIF
		ET	1	A	2030	100	L	ET1A_2030_00100_L.TIF
		ET	1	A	2030	1000	L	ET1A_2030_01000_L.TIF
		ET	1	A	2030	5000	L	ET1A_2030_05000_L.TIF
		ET	1	A	2030	25000	L	ET1A_2030_25000_L.TIF
	Electricity transmission lines	ET	1	B	2013	100	L	ET1B_2013_00100_L.TIF
		ET	1	B	2013	1000	L	ET1B_2013_01000_L.TIF
		ET	1	B	2013	5000	L	ET1B_2013_05000_L.TIF
		ET	1	B	2013	25000	L	ET1B_2013_25000_L.TIF

		ET	1	B	2030	100	L	ET1B_2030_00100_L.TIF
		ET	1	B	2030	1000	L	ET1B_2030_01000_L.TIF
		ET	1	B	2030	5000	L	ET1B_2030_05000_L.TIF
		ET	1	B	2030	25000	L	ET1B_2030_25000_L.TIF
Gas pipelines	Gas pipelines large diameter	ET	2	A	2013	100	L	ET2A_2013_00100_L.TIF
		ET	2	A	2013	1000	L	ET2A_2013_01000_L.TIF
		ET	2	A	2013	5000	L	ET2A_2013_05000_L.TIF
		ET	2	A	2013	25000	L	ET2A_2013_25000_L.TIF
		ET	2	A	2030	5000	L	ET2A_2030_05000_L.TIF
		ET	2	A	2030	25000	L	ET2A_2030_25000_L.TIF
	Gas pipelines medium diameter	ET	2	B	2013	100	L	ET2B_2013_00100_L.TIF
		ET	2	B	2013	1000	L	ET2B_2013_01000_L.TIF
		ET	2	B	2013	5000	L	ET2B_2013_05000_L.TIF
		ET	2	B	2013	25000	L	ET2B_2013_25000_L.TIF
		ET	2	B	2030	5000	L	ET2B_2030_05000_L.TIF
		ET	2	B	2030	25000	L	ET2B_2030_25000_L.TIF
	Gas pipelines small diameter	ET	2	C	2013	100	L	ET2C_2013_00100_L.TIF
		ET	2	C	2013	1000	L	ET2C_2013_01000_L.TIF
		ET	2	C	2013	5000	L	ET2C_2013_05000_L.TIF
		ET	2	C	2013	25000	L	ET2C_2013_25000_L.TIF
		ET	2	C	2030	5000	L	ET2C_2030_05000_L.TIF
		ET	2	C	2030	25000	L	ET2C_2030_25000_L.TIF
Unesco cultural sites		HE	1	A	2014	100	C	HE1A_2014_00100_C.TIF
		HE	1	A	2014	1000	C	HE1A_2014_01000_C.TIF
		HE	1	A	2014	5000	C	HE1A_2014_05000_C.TIF
		HE	1	A	2014	25000	C	HE1A_2014_25000_C.TIF
		HE	1	A	2014	100	Q	HE1A_2014_00100_Q.TIF
		HE	1	A	2014	1000	Q	HE1A_2014_01000_Q.TIF
		HE	1	A	2014	5000	Q	HE1A_2014_05000_Q.TIF
		HE	1	A	2014	25000	Q	HE1A_2014_25000_Q.TIF
Chemical industry		IN	1	A	2013	100	C	IN1A_2013_00100_C.TIF
		IN	1	A	2013	1000	C	IN1A_2013_01000_C.TIF
		IN	1	A	2013	5000	C	IN1A_2013_05000_C.TIF
		IN	1	A	2013	25000	C	IN1A_2013_25000_C.TIF
Metal industry		IN	2	A	2013	100	C	IN2A_2013_00100_C.TIF
		IN	2	A	2013	1000	C	IN2A_2013_01000_C.TIF
		IN	2	A	2013	5000	C	IN2A_2013_05000_C.TIF
		IN	2	A	2013	25000	C	IN2A_2013_25000_C.TIF
Mineral industry	Mineral plants	IN	3	A	2013	100	C	IN3A_2013_00100_C.TIF
		IN	3	A	2013	1000	C	IN3A_2013_01000_C.TIF
		IN	3	A	2013	5000	C	IN3A_2013_05000_C.TIF
		IN	3	A	2013	25000	C	IN3A_2013_25000_C.TIF
	Extraction sites	IN	3	B	2013	100	C	IN3B_2013_00100_C.TIF
		IN	3	B	2013	1000	C	IN3B_2013_01000_C.TIF
		IN	3	B	2013	5000	C	IN3B_2013_05000_C.TIF
		IN	3	B	2013	25000	C	IN3B_2013_25000_C.TIF
Waste/water treatment		IN	4	A	2013	100	C	IN4A_2013_00100_C.TIF
		IN	4	A	2013	1000	C	IN4A_2013_01000_C.TIF

		IN	4	A	2013	5000	C	IN4A_2013_05000_C.TIF
		IN	4	A	2013	25000	C	IN4A_2013_25000_C.TIF
Refineries		IN	5	A	2010	100	C	IN5A_2010_00100_C.TIF
		IN	5	A	2010	1000	C	IN5A_2010_01000_C.TIF
		IN	5	A	2010	5000	C	IN5A_2010_05000_C.TIF
		IN	5	A	2010	25000	C	IN5A_2010_25000_C.TIF
Education facilities		SO	1	A	2014	100	Q	SO1A_2014_00100_Q.TIF
		SO	1	A	2014	1000	Q	SO1A_2014_01000_Q.TIF
		SO	1	A	2014	5000	Q	SO1A_2014_05000_Q.TIF
		SO	1	A	2014	25000	Q	SO1A_2014_25000_Q.TIF
Health facilities		SO	2	A	2014	100	Q	SO2A_2014_00100_Q.TIF
		SO	2	A	2014	1000	Q	SO2A_2014_01000_Q.TIF
		SO	2	A	2014	5000	Q	SO2A_2014_05000_Q.TIF
		SO	2	A	2014	25000	Q	SO2A_2014_25000_Q.TIF
Airports		TR	1	A	2013	100	C	TR1A_2013_00100_C.TIF
		TR	1	A	2013	1000	C	TR1A_2013_01000_C.TIF
		TR	1	A	2013	5000	C	TR1A_2013_05000_C.TIF
		TR	1	A	2013	25000	C	TR1A_2013_25000_C.TIF
Ports		TR	2	A	2013	100	C	TR2A_2013_00100_C.TIF
		TR	2	A	2013	1000	C	TR2A_2013_01000_C.TIF
		TR	2	A	2013	5000	C	TR2A_2013_05000_C.TIF
		TR	2	A	2013	25000	C	TR2A_2013_25000_C.TIF
		TR	2	A	2013	100	Q	TR2A_2013_00100_Q.TIF
		TR	2	A	2013	1000	Q	TR2A_2013_01000_Q.TIF
		TR	2	A	2013	5000	Q	TR2A_2013_05000_Q.TIF
		TR	2	A	2013	25000	Q	TR2A_2013_25000_Q.TIF
Inland waterways		TR	3	A	2013	100	L	TR3A_2013_00100_L.TIF
		TR	3	A	2013	1000	L	TR3A_2013_01000_L.TIF
		TR	3	A	2013	5000	L	TR3A_2013_05000_L.TIF
		TR	3	A	2013	25000	L	TR3A_2013_25000_L.TIF
Railways	Light rails	TR	4	A	2014	100	L	TR4A_2014_00100_C.TIF
		TR	4	A	2014	1000	L	TR4A_2014_01000_L.TIF
		TR	4	A	2014	5000	L	TR4A_2014_05000_L.TIF
		TR	4	A	2014	25000	L	TR4A_2014_25000_L.TIF
	Narrow gauge	TR	4	B	2014	100	L	TR4B_2014_00100_L.TIF
		TR	4	B	2014	1000	L	TR4B_2014_01000_L.TIF
		TR	4	B	2014	5000	L	TR4B_2014_05000_L.TIF
		TR	4	B	2014	25000	L	TR4B_2014_25000_L.TIF
	Railways	TR	4	C	2014	100	L	TR4C_2014_00100_L.TIF
		TR	4	C	2014	1000	L	TR4C_2014_01000_L.TIF
		TR	4	C	2014	5000	L	TR4C_2014_05000_L.TIF
		TR	4	C	2014	25000	L	TR4C_2014_25000_L.TIF
Roads	Local roads	TR	5	A	2014	100	L	TR5A_2014_00100_L.TIF
		TR	5	A	2014	1000	L	TR5A_2014_01000_L.TIF
		TR	5	A	2014	5000	L	TR5A_2014_05000_L.TIF
		TR	5	A	2014	25000	L	TR5A_2014_25000_L.TIF
	Motorways	TR	5	B	2014	100	L	TR5B_2014_00100_L.TIF
		TR	5	B	2014	1000	L	TR5B_2014_01000_L.TIF

		TR	5	B	2014	5000	L	TR5B_2014_05000_L.TIF
		TR	5	B	2014	25000	L	TR5B_2014_25000_L.TIF
	National roads	TR	5	C	2014	100	L	TR5C_2014_00100_L.TIF
		TR	5	C	2014	1000	L	TR5C_2014_01000_L.TIF
		TR	5	C	2014	5000	L	TR5C_2014_05000_L.TIF
		TR	5	C	2014	25000	L	TR5C_2014_25000_L.TIF
Urban transport	Bus station	TR	6	A	2014	100	C	TR6A_2014_00100_C.TIF
		TR	6	A	2014	1000	C	TR6A_2014_01000_C.TIF
		TR	6	A	2014	5000	C	TR6A_2014_05000_C.TIF
		TR	6	A	2014	25000	C	TR6A_2014_25000_C.TIF
	Bus stop	TR	6	B	2014	100	C	TR6B_2014_00100_C.TIF
		TR	6	B	2014	1000	C	TR6B_2014_01000_C.TIF
		TR	6	B	2014	5000	C	TR6B_2014_05000_C.TIF
		TR	6	B	2014	25000	C	TR6B_2014_25000_C.TIF
	Funicular	TR	6	C	2014	100	C	TR6C_2014_00100_C.TIF
		TR	6	C	2014	1000	C	TR6C_2014_01000_C.TIF
		TR	6	C	2014	5000	C	TR6C_2014_05000_C.TIF
		TR	6	C	2014	25000	C	TR6C_2014_25000_C.TIF
	Subway lines	TR	6	D	2014	100	C	TR6D_2014_00100_C.TIF
		TR	6	D	2014	1000	C	TR6D_2014_01000_C.TIF
		TR	6	D	2014	5000	C	TR6D_2014_05000_C.TIF
		TR	6	D	2014	25000	C	TR6D_2014_25000_C.TIF
	Tram lines	TR	6	E	2014	100	C	TR6E_2014_00100_C.TIF
		TR	6	E	2014	1000	C	TR6E_2014_01000_C.TIF
		TR	6	E	2014	5000	C	TR6E_2014_05000_C.TIF
		TR	6	E	2014	25000	C	TR6E_2014_25000_C.TIF
	Tram stop	TR	6	F	2014	100	C	TR6F_2014_00100_C.TIF
		TR	6	F	2014	1000	C	TR6F_2014_01000_C.TIF
		TR	6	F	2014	5000	C	TR6F_2014_05000_C.TIF
		TR	6	F	2014	25000	C	TR6F_2014_25000_C.TIF

Annex III: PLATTS AND E-PRTR metadata and classification

A comparison between two data sources, PLATTS and EPRTR, was executed in order to, first, understand data structure of each data source and, second, deliver an output by merging/combining both datasets.

First we show the main characteristics of each database, so the reader can get an insight into the content and organization of the datasets:

PLATTS:

- PLATTS is a leading global provider of energy, petrochemicals and metals information. European Commission – DG Energy is an authorized users of PLATTS data through the contract ENER/2010/A2/33.
- Dataset is intended for scale applications only as 1:1 000 000 – 1:5 000 0000. That means a small and coarse scale resolution.
- Period of content: 2013.
- Coverage: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, FYR of Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Lichtenstein, Kosovo pursuant UNSCR 1244, Cyprus, Iceland (FYR Macedonia is sometimes included).
- Geographic Coordinate Reference: GCS_WGS_1984.
- It is composed of 13 Shapefiles mainly referred to Energy, and subsequently, Gas, Electricity and Power stations.

E-PRTR:

- The European Pollutant Release and Transfer Register (E-PRTR) is the Europe-wide register that contains data on the main pollutant releases to air, water and land of about 28 000 industrial facilities
- Medium-coarse scale resolution. A first visual analysis in Google Earth detected that most industries are not precisely located with a 500 meter average displacement error.
- Data are reported annually by more than 30 000 industrial facilities covering 65 economic activities across Europe.
- Period of content: The second report in 2013 covers 2011 data, and data will continue to be updated on an annual basis with each report covering emission from two years previous.
- The E-PRTR covers the 27 EU Member States as well as Iceland, Liechtenstein, Norway, Serbia and Switzerland.
- Coverage: European Union Member States and Iceland, Liechtenstein, Norway, Serbia and Switzerland.
- Geographic Coordinate Reference: GCS_WGS_1984.
- It is made up of two geodatabases. While one is purely descriptive with 13 tables, the other one plots spatially the industries. The information is grouped in 9 Industrial sectors: 1) energy 2) production and processing of metals 3) mineral

industry 4) chemical industry 5) waste and waste water management 6) paper and wood production and processing 7) intensive livestock production and aquaculture 8) animal and vegetable products from the food and beverage sector, and 9) other activities.

Second, the data structure is presented in greater detail. For PLATTS dataset, the following table summarizes its content:

Table 1: PLATTS dataset structure.

Layer name	Feature type	Summary	Relevant fields	Map reference
EN_PLATTS_eu_ehold_region	Polygon	Electric Transmission zones	*Platts_id:* Platts unique identifier*, *Area_Sqkm* (scale in km)	1
EN_PLATTS_eu_ester_region	Polygon	Low voltage distribution network	*Platts_id, Area_Sqkm*	2
EN_PLATTS_eu_garea_region	Polygon	Gas production regions	*Gas_Area:* Gas production area name, *Area_Sqkm*	3
EN_PLATTS_eu_gcom_point	Point	Gas compressor stations	*S_name:* Storage name *Status*: Op (Operational), Pl (Planned), Co (under construction) Cn (cancelled)	4
EN_PLATTS_eu_gfac_point	Point	Gas facilities	*F_type* : Facility type (Delivery type, Transfer station. Dispatch, etc) *Status:* Op, Pl, Co and Cn	5
EN_PLATTS_eu_gsint_point	Point	Gas interconnection points	*From oper* :Operator of originating pipeline, *To_oper* Operator of receiving pipeline *Max_flow*: Maximum flow rate nm^3/hour	6
EN_PLATTS_eu_gstor_point	Point	Gas storage	*S_desc*: Storage description (LNG, Acquifer, Salt cavern, Depleted field, Unknown) *Status:* Op, Pl, Co and Cn *Wk_vol:* Working gas volume in I0^6 nm^3, *Pk_w:* peak withdrawal capacity in I0^6 nm^3/day, *Pk_i:* Peak Injection Capacity in I0^6 nm^3/day *TPA*: Third party access (Negotiated, regulated, Hybrid, Unknown)	7
EN_PLATTS_eu_intcn_point	Line	Cross-border interconnection lines	*Voltage* (0-750 KV), *MVA:* Capacity in MVA (52-4000), *Line_num:* Lines number (1-17), *Shape_leng* *From_C_Id:* Source company , *From_S_Id:* Source substation , *From_O_Id:* Source operator *To_C_Id:* Receiving company , *To_S_Id:* Receiving substation, *To_O_Id:* Receiving operator	8
EN_PLATTS_eu_lngim_point	Point	Liquified natural gas terminal	*Imp_ex:* Import (gasification) or Export (liquefaction) terminal type *Proposed*: Operational and development status (Cn, Co, Pl, Op, etc) *A_regas:* Annual regasifcation capacity in billion m^3, *Max_hrly:* Maximum hourly regasification capacity in 10^{3}m^3 per hour, *Stor_cap:* Storage capacity in 10^{3}m^3	9
EN_PLATTS_eu_pipe_polyline	Line	Natural gas pipelines	*Diamater:* pipeline diameter to scale in inches, *Length_km:* pipeline segment to scale in km *Status* (Op, Pl, Co and Cn) and *Quality:* Gas quality description	10
EN_PLATTS_eu_plant_point	Point	Power generating stations	*Prim_pm*: Primary prime mover (Solar, Geothermal, Wind turbine, Nuclear, etc) *Op_np_cap:* Operating nameplate capacity in MW, *Op_Su_cap:* Operating net capacity in MW *Prim_fuel* Primary fuel (Natural gas,fuel oil, water, wind, etc), *Sec fuel*: Secondary fuel *Heat_rate*: Nominal heat rate (in Btu/Kwh), *Zone:* Transmission zone, *Tier* (Euro1 or Euro2)	11
EN_PLATTS_eu_subs_point	Point	Electricity substations	*Max_volt* Maximum voltage of lines connected (0-1500), *Num_lines*: lines connected (1-49)	12
EN_PLATTS_eu_trnsl_polyline	Line	Electric Transmission lines	*Voltage:* Line voltage in KV (10-1500), *Volt_cat*: Voltage category in KV (220-500) *Num_lines*: Number of lines (1-9), *Status*: Op, Pl, Co and Cn, *Length_Km* (scale in Km) *From_S_Id*: Identifier for source substation, *To_S_Id:* Identifier for receiving substation	13
EN_PLATTS_eu_weather_point	Points	Weather stations	No relevant for this study	-

*Most of the layers include fields for Identifiers, company/operator/country/location names and area/length in m2/mi2/km2. These fields were excluded above to simplify the table but could be taken into account for further analysis.

For E-PRTR dataset, the resulting table was shaped:

Table 2: E-PRTR Dataset structure

Layer name	Feature type	Classification 1st level	Classification 2nd level
EPRTRFacilities_v5.1_KML_WGS84.gdb	Point	1) Energy Sector	1.(a) Mineral oil and gas refineries
			1.(b) Gasification and liquefaction
			1.(c) Thermal power stations and other combustion installations
			1.(d) Coke ovens
			1.(e) Coal rolling mills
			1.(f) Manufacture of coal products and solid smokeless fuel
		2) Production and processing of metals	
		3) Mineral industry	
		4) Chemical industry	
		5) Waste and waste water management	
		6) Paper and wood production processing	
		7) Intensive livestock production and aquaculture	
		8) Animal and vegetable products from the food and beverage sector	
		9) Other activities	

Thematic, spatial overlap and complementariness was slightly found between both datasets. Even though the aim of both databases are dissimilar, it is noticed some thematic similarity:

Table 3: E-PRTR matches with PLATTS

EPRTR	2) Production and processing of metals		No match	PLATTS
	3) Mineral industry		No match	
	4) Chemical industry		No match	
	5) Waste and waste water management		No match	
	6) Paper and wood production processing		No match	
	7) Intensive livestock production and aquaculture		No match	
	8) Animal and vegetable products from the food and beverage sector		No match	
	9) Other activities		No match	

Table 4: PLATTS similarities with E-PRTR

EPRTR	2) Production and processing of metals		No match	PLATTS
	3) Mineral industry		No match	
	4) Chemical industry		No match	
	5) Waste and waste water management		No match	
	6) Paper and wood production processing		No match	
	7) Intensive livestock production and aquaculture		No match	
	8) Animal and vegetable products from the food and beverage sector		No match	
	9) Other activities		No match	

Dataset	Classification 1st level	Classification 2nd level	Classification	Dataset
EPRTR	1) Energy Sector	No comparable*	Electric Transmission zones	PLATTS
		No comparable	Low voltage distribution network	
		No comparable	Gas production regions	
		No match	Gas compressor stations	
		No match	Gas interconnection points	
		No match	Gas storage	
		No comparable	Cross-border interconnection lines	
		No comparable	Natural gas pipelines	
		No comparable	Electric Transmission lines	

From the tables show above, it is determined that PLATTS provides a more complete and detailed Energy related dataset than E-PRTR. However, E-PRTR offers a wider register with larger number of facilities not only related to the Energy sector but nine industrial sectors. Although it is observed that both datasets provide too much and unnecessary thematic information for our scope of work.

With the goal of providing cleat and effective outputs, the following methodology was defined:

- PLATTS database is selected as the base dataset for the "Energy industries". Basically, the layers "Power stations", "Liquefied natural gas terminal" and "Electricity substations" will be used to display all the energy related installations. The energy sectors are composed by:
  - Renewable energy: Hydro, Solar, Geothermal steam turbines, pumped storage and Wind turbines categories from "Power stations" layer.
  - No Renewable: Gas combustion turbine, combined cycle, internal combustion classes from "Power stations" layer. Moreover, "Liquefied natural gas terminal" layer and nuclear field from "Power stations" layer are also added here.

- E-PRTR geodatabase is used then as he reference dataset to display the rest of industries. Principally, the classes no related to Energy, that run from 2) Production and processing of metals to 9) other activities, are combined to create the final list of outputs (See table 5). The list of layers used from E-PRTR are:
  - Metal Industry. It comes originally from the "Production and processing metal" subdivision. It is classified within "Industry and waste/water treatment" sector.
  - Mineral Industry: Mineral plants and extraction sites are extracted from the "Mineral Industry" subdivision.
  - Chemical Industry. It is included within the "Industry and waste/water treatment" sector.
  - Waste and waste water management: It is added to the "Industry and waste/water treatment" sector.

Table 5: Comprehensive list of outputs generated from E-PRTR and PLATTS

Output	Classification 1st level	Classification 2nd level	Layer Output	Source dataset
INDUSTRIES	1) Energy Sector	Hydro plants	Hydro-Geo sublayer in "Renewable Energy"	PLATTS
		Geothermal plants		
		Solar plants	Solar sublayer in "Renewable Energy"	
		Steam turbines	Biomass sublayer in "Renewable Energy"	
			Coal sublayer in "Non-Renewable Energy"	
		Wind turbines	Wind sublayer in "Renewable Energy"	
		Nuclear stations	Nuclear sublayer in "Non-Renewable Energy"	
		Gas installations	Gas sublayer in "Non Renewable Energy"	
		Gas pipelines	Gas pipelines sublayer in "Energy Transport"	
		Electricity lines	Electricity network layer in "Energy Transport"	
		Oil as pimary fuel	Oil sublayer in "Non Renewable Energy"	
	2) Production and processing of metals	Subdivisions are not relevant for our scope of work	Metal industry in "Industry & waste/water treatment"	EPRTR
	3) Mineral industry		Mineral plants and extraction sities in "Industry & waste/water treatment"	
	4) Chemical industry		Chemical industry in "Industry & waste/water treatment"	
	5) Waste and waste water management		Waste/Water sublayer in "Industry & waste/water treatment"	
	6) Paper and wood production processing		*No used / No output*	
	7) Intensive livestock production and aquaculture		*No used / No output*	
	8) Animal and vegetable products		*No used / No output*	
	9) Other activities		*No used / No output*	

Annex IV: Spatial accuracy of E-PRTR

The aim of this work was to conduct an assessment of spatial accuracy of the location of industrial facilities in the E-PRTR dataset. The following options were taken to carry the quality check exercise:

- The base layer corresponds to E-PRTR and the ground truth data comes from Google Earth® satellite imagery.
- 5 countries scattered over Europe represented the sample: Spain, Italy, Finland, Romania and Germany.
- 50 points were selected randomly for each country, where all types of industry were eligible and so, represented.

Methodologically, a visual analysis was performed. The main workflow followed this order:

1. First, a visual identification and comparison by displaying E-PRTR place marks on Google Earth satellite imagery is completed.
2. Second, If Google Earth satellite imagery is not conclusive due to low resolution, no imagery availability, important displacement, etc. Google Street view is used to assist the exercise.
3. Third, if the right industry position is still unclear, the company name is searched through the Google Earth search engine.
4. Fourth, a location field coming from Facility report table, within E-PRTR database, is introduced into Google Earth search engine to check the possible industry location.
5. With all the possible information, we identify the real industry location if possible.
6. Within Google Earth Imagery, we click on the rule tool. We draw a line between both locations in order to measure the existing displacement. If there is no displacement we update the field distance with a "0" value.
7. Once all the points are validated, a statistical analysis is carried out to calculate the distance attribute by country.

The results for the 5 countries visually analysed are shown in the following table:

Table 1. Spatial accuracy check results.

	Detected	Missing	Outliers	Right location	Minimum distance (m)	Maximum distance (m)	Mean (m)	Standard deviation (m)
SPAIN	47	3	1	9	10	4,827	465	989
ITALY	45	5	2	27	150	3,353	1,088	1,078
ROMANIA	44	6	0	27	100	2,800	423	638
GERMANY	48	2	2	27	45	2,890	683	913
FINLAND	48	2	0	26	40	1,000	286	282
TOTAL (250)	232 (92,8%)	18 (7,2%)	5	116 (46,4%)	69	3010	589	780

It is concluded from the results shown above that:

- A high percentage of the installations were detected: 92.8%.
- Almost half of the total number of points were placed on the exact location: 46.4%.
- The average distance ranged from 69 to 3 010 meters.
- The mean distance between points was 589 meters with a standard deviation of 780 meters.
- Overall, a cell size smaller than 1000 meters is not appropriate to display E-PRTR data. A cell size of 1000 meter corresponds to a map scale of 1/2.000.000 using Waldo Tobler's rule.

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