sEEnergies

QUANTIFICATION OF SYNERGIES BETWEEN ENERGY EFFICIENCY FIRST PRINCIPLE AND RENEWABLE ENERGY SYSTEMS

D5.3

Online web map application and first set of map layers

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Project

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Executive Summary

The present report describes in overview how the Pan-European Thermal Atlas (Peta) was developed further into a spatial information system for the geography of energy efficiency potentials in the building, transport, and industry sectors, as well as the associated infrastructures. The resulting online atlas allows for visualisation of energy efficiency potentials between sectors in a common mapping environment. The online map can be seen on the Pan-European Thermal Atlas Peta 5.0.1:

https://tinyurl.com/peta5seenergies.

The additions and updates to the Pan-European Thermal Atlas (originally developed for the Heat Roadmap Europe projects) into a cross-sectoral mapping platform necessitated updates to the data layers, the layout, and the documentation. Layers with heat demand data from the building sector were updated, now to include all of the EU28, while a new map layer depicting the possible reduction of specific heat demand in buildings, as a measure of the current energy efficiency potential in this sector, is currently under development but not yet part of this deliverable (see sections 2.2 and 2.4 for further information). This new layer will be added to Peta 5.0.1 as soon as possible.

For the transport and industry sectors, current year energy efficiency potentials were possible to assess and map in the present context. In the transport sector, findings were translated into geographical distributions of potentials and materialise as a set of geospatial map layers. In the industrial sector, energy efficiency in industry has been quantified partly for on-site energy savings, partly for off-site excess heat recovery in district heating systems, and the results have been turned into geographical representations in the form of energy efficiency surfaces.

The Peta online mapping system is prepared to include further layers from future deliverables, such as thermal, gas, and electrical grids. Finally, the mapping of future scenarios will be made available using the present online mapping environment.

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Acronyms & Abbreviations

Term	Description
BioBoost	The BioBoost project
DH	District heating
DHDCC	District heating distribution capital costs
DHS	District Heating System
EHI	European Heating Index
ESM	European Settlement Map
ESRI	Environmental Systems Research Institute
GeoDH	The GeoDH project
HRE4	The Heat Roadmap Europe Project
JRC	Joint Research Centre of the European Commission
NHI	National Heating Index
OSM	Open Streetmap
Peta	Pan-European Thermal Atlas
PSD	Prospective Supply Districts
RE	Renewable energy
ReUseHeat	The ReUseHeat project
sEEnergies	The sEEnergies research project
UA	Urban Area

1 Introduction

The present report is an account of the main outcomes of the sEEnergies-project deliverable defined as D5.3, the Online web map application and first set of map layers.

1.1 How to read this report

The report contents have been limited to mainly describe the web mapping environment and its formal content of layers. The individual layers, the methods behind, the assumptions made, their application and limitations are going to be part of later reports (mainly in D5.7: Spatial models and spatial analytics results, scheduled for project month 30 (February 2022)), with the exception of the transport sector for which a more elaborate account is given here. Abbreviations used in the present report reflect the use of acronyms in the online map, where limited space requires them. It may be advantageous to read the report while browsing the online map. The authors would like to point out that the present report is a snapshot of the work in progress towards a full online mapping environment for all sectors of the energy system.

1.2 Online mapping as an output from the sEEnergies Project

The present deliverable of the sEEnergies project includes the development of an online web map application and the production of a first set of map layers for the current year, i.e. 2015. An online map disseminates the findings of the research, which are of geographical nature. The online map can be used to get a better understanding of the geography of energy efficiency and the synergies across sectoral divides for given locations. A first set of selected layers for the building, transport, and industry sectors describes the present energy use and the current energy efficiency potentials.

The online map can be seen on the Peta 5.0.1: https://tinyurl.com/peta5seenergies.

Layers can be used through ArcGIS Online and downloaded from the sEEnergies Open Data Hub described in D5.4: https://s-eenergies-open-data-euf.hub.arcgis.com/.

2 Extension of the existing Pan-European Thermal Atlas

The Pan-European Thermal Atlas, Peta (Europa-Universität Flensburg et al., 2018), has been developed in the Heat Roadmap Europe project series over the last ten years, from the pre-studies (Connolly et al., 2012); (Connolly et al., 2013), through the Stratego project (Cornelis E et al., 2016), and finally within the H2020 project Heat Roadmap Europe (HRE4) (Persson et al., 2017).

2.1 History and content so far

The Pan-European Thermal Atlas, Peta, has from the beginning been a comprehensive geospatial representation of the European heat sector. Heat demands, a delineation of prospective heat supply districts (Möller et al., 2018), the costs of heat distribution infrastructure (Persson et al., 2019), access to and allocation of excess heat from several sources, as well as available renewable energy sources (Möller et al., 2019), has constituted the core form of the coherent online atlas.

From end-use demand via infrastructures to supply, Peta is a comprehensive information system for the energy sector with focus on heat. It has formed the basis for techno-economic analyses of integrated energy systems and has been available as an online mapping system since 2015 (version 3). In the sEEnergies-Project, it has been decided to extend Peta with geospatial information on energy efficiency and infrastructures in the building, transport, and industry sectors.

2.2 Changes of existing content

- Input data documentation

  Floor areas calculated by means of geo-statistical methods were taken from HRE4 and extended to all of EU28. Input data such as the 100m population grid for Europe (JRC, 2017) and the European Settlement Map (ESM) (JRC, 2017) were validated as it had turned out that data were erroneous for Ireland, where a new population map was prepared using national small-scale statistics and the settlement map was cleaned from background noise. A new version of the ESM (2019, released in 2020) (JRC, 2020) was considered, but disregarded because of incompleteness. The national heating indexes developed in the HRE4 project were adjusted for several locations.

- Heat demand distribution method (changes in comparison to HRE4)

  Because the efficiency potential of buildings depends on their age, a mapping of age classes for built-up areas was prepared. Calculated building stocks were to be distributed by shares of age classes to areas identified by their age of development. Densification factors and rebuilding shares for already developed areas would have to be considered.

  The outcome would have been an age-specific calculation of present heat demands and the geographically explicit saving potentials. The hypothesis is that decarbonisation of heat supply by means of savings in older building stock is more difficult to realise than e.g. through carbon neutral heat supply. At the time of publication of the present report, however, the input data for this sector were not finalised and harmonized. Therefore, HRE4 data and methods were used instead.

- Correction of bugs

  The heat demand calculation of the service sector was updated after fixing a bug. The European Heating Index EHI (Werner, 2006) and the National Heating Index (NHI) were corrected in Slovenia and those countries, which have a considerable population in territories outside the Peta coverage (Azores, Canary Islands etc.).

- Adjustments in derived layers

  The layer District Heating Areas has been developed as part of D5.1 (Fleiter et al., 2020). It replaces the layer Current DH Systems from HRE4.

  Prospective Supply Districts (PSD) were modelled for all of the EU28. The district heating distribution capital costs (DHDCC) on hectare level were calculated for all member states as in HRE4. A revised version of the cost model is expected in D4.5. In addition, as WP4 is still running, further adjustments, and continued development can be expected in other layers. The present report is a snapshot of Peta 5 at the time of writing.

  Renewable heat sources (RE) were taken from HRE4 where feasible. As the allocation of renewable and excess heat depends on the energy systems analyses yet to be done in WP6, these layers will be published as part of the second release (2nd set of map layers, D5.5).

Table 1 shows the changes of the Peta content and current status of version 5.0.1 and the relations to the previously published layers of Peta version 4.3 (final outputs of the Heat Roadmap Europe project in 2019).

Table 1: Overview of changes in the existing Peta content

Layer *or* **Group**	**Status**	**Actions to be undertaken**
Buildings & Thermal Grids		
Cold Demand densities	Peta 4.3	None.
Heat Demand densities	sEEnergies Layer based on HRE4	Update when sEEnergies data is available (WP1).
District Heating Distribution Capital Costs (DHDCC)	sEEnergies Layer based on HRE4	Update with sEEnergies data and methodology update (D4.5).
Current District Heating Systems (DHS)	sEEnergies D5.1 Layer	Update with sEEnergies heat demands.
Prospective Supply Districts (PSDs)	sEEnergies Layer based on HRE4	Update with sEEnergies data.
Recommended District Heating Levels	Not available in Peta 5.0.1	New layer with feedback from scenario analysis (WP6) is to be developed.
Allocated Excess heat	Not available in Peta 5.0.1	Allocated excess heat layer is to be updated with new heat demands, excess heat potentials and existing and potential DH areas.
Non-Industrial Heat Sources		
Geothermal heat	GeoDH / HRE4	A modified layer including economic feasibility interpretation of the GeoDH layers is planned.
Solar thermal DH	Not available in Peta 5.0.1	A complete makeover is required, based on the recommendations from WP6.
Biomass Resources	BioBoost / HRE4	The dataset is to be replaced by data from the S2Biom-Project, pending licence questions.
Heat Synergy Regions	Not relevant anymore	None.
Excess Heat of Wastewater Treatment	ReUseHeat	Datasets needs to be made available on the sEEnergies Open Data Hub.
Excess Heat of Metro Stations	ReUseHeat; Not available in Peta 5.0.1	The updated version (v7) will be uploaded in association with D4.5.
Conventional Excess Heat Activities	HRE4 layer without industrial excess heat activities	Update or new input data for theoretical excess heat potentials of power plants and Waste-to-Energy sites.

2.3 Changes and additions to the online web map application

The web map application has a few innovations compared to Peta 4.3:

- Map content is organised in sectoral groups: Buildings & Thermal Grids, Heat Sources, Industry, and Transport, as also indicated in Table 1. Layers from all sectors can be combined for the visualisation of cross-sectoral synergies. The content of each group can be collapsed for better overview.
- Attribute tables with database content can now be shown in the map.
- A Select function is now available. Features from layers can be selected, statistics can be calculated for the selection, the selected features can be shown in the attribute table and exported in tabular format.
- On the left-hand side, a legend is included that dynamically shows the symbology of activated layers.

The following screenshot, Figure 1, illustrates exemplarily the content of the layer group "Buildings & Thermal Grids": heat and cold demand density layers, current district heating systems information, and the potential to develop district heating infrastructures.

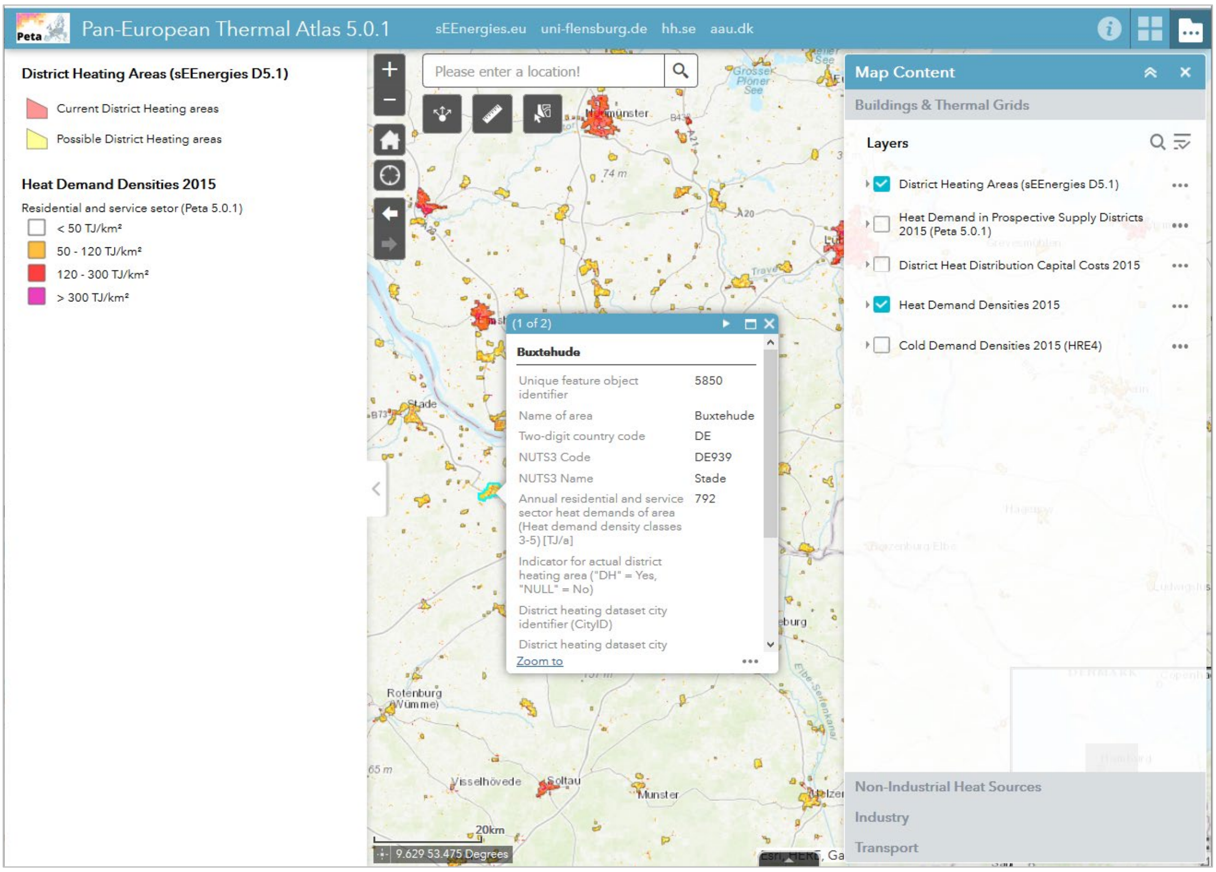


Figure 1: Screenshot from the Peta 5.0.1 with the "Buildings & Thermal Grids" layer group activated

2.4 Building sector

Regarding the energy efficiency potential in the building sector, a map layer depicting the possible reduction of specific heat demand (Joule/capita, alternatively Joule/m^2), as a measure of the current potential, was conceived and planned as a part of this deliverable. Due to two main reasons: unforeseen difficulties to align assumptions relating to the underlying building sector data vs. national level heat demand data (project internal circumstances), and a slight but yet noticeable influence of inertia from the ongoing Covid-19 pandemic (project external circumstances), this has not been possible to establish by the deliverable submission date.

In this respect, the authors would like to add in commentary that our work with this material, similarly with how we have worked together in several previous European research projects, is an iterative process, a “work in progress”, where continuous updates are a natural part of the production of scientific project results. With regards to the building sector energy efficiency potential, the WP5 partners are working closely with WP1 and WP6 partners to resolve this issue as soon as possible where after the corresponding map layer will be produced and uploaded to Peta 5.0.1.

2.5 Transport sector

In relation to the transport sector, layers have been added relating to two different analyses:

- Urban areas have been analysed in relation to cycling
- The potential for e-roads in EU28

Each of these will be presented shortly in section 2.5.1 and 2.5.2.

2.5.1 Urban Area Cycling characterization

The aim of the cycling characterization geographical layer is to assess the potentials for cycling in each Urban Area (UA) as an indicative modelling alternative relative the use of private cars, associated fossil fuels and its potential impact on the transport energy system. The methodology described has basis from the analytical outputs included in the sEEnergies D2.1 report, adjusted to a UA unit and makes use of the indicators already identified in the sEEnergies D5.2 outputs for such level of analysis. The latter since data availability on such specifics on transport is rather scarce. Therefore, the methodology output should be taken as a screening for biking potentials at a European scale.

The analysis exemplified for urban regions described in D2.1 included a certain potentiality for the transport sector efficiency by supplementing policies for improved walking and cycling conditions, when combined with other different measures targeting at lowering private car travels (Næss et al., 2020). In documentation, city infrastructure and morphological indicators such as distance travelled, built environment, urban densification (Næss et al., 2020), physical environmental factors such as functional, safety, aesthetics (Pikora et al. 2003), and geo-environmental and diversified land-use planning indicators (Zayed, 2017), are recurrent when discussing cycling as an alternative way of transport and energy efficiency potential.

The dataset identifies UA with an indicative measure for adoption or increase of cycling modal share and its geographical records create a national overview mapping. Each UA outputs a cycling city readiness indicator followed by a methodology inspired in indexes found in literature and analysing Europe’s most bicycle-friendly cities indicators, such as the ones listed in Copenhagenize 2019 index (Copenhagenize Design Co. 2019).

The dataset combines previous sEEnergies datasets further enriched with statistical data (2011-2018) on transport modal shares and cycling infrastructure. In the model, indicators categorized as in Mobility, Biking terrain and weather conditions, and Infrastructure usage and city layout, from the top ranked cycling cities were evaluated. Later, indicators from previous work packages were merged, transformed, and tailored for assessing cycling potentials at UA level. The model outputs categorized UA by cycling potential both based on score and data coverage. The presented flow chart intends to depict the process followed, see Figure 2.

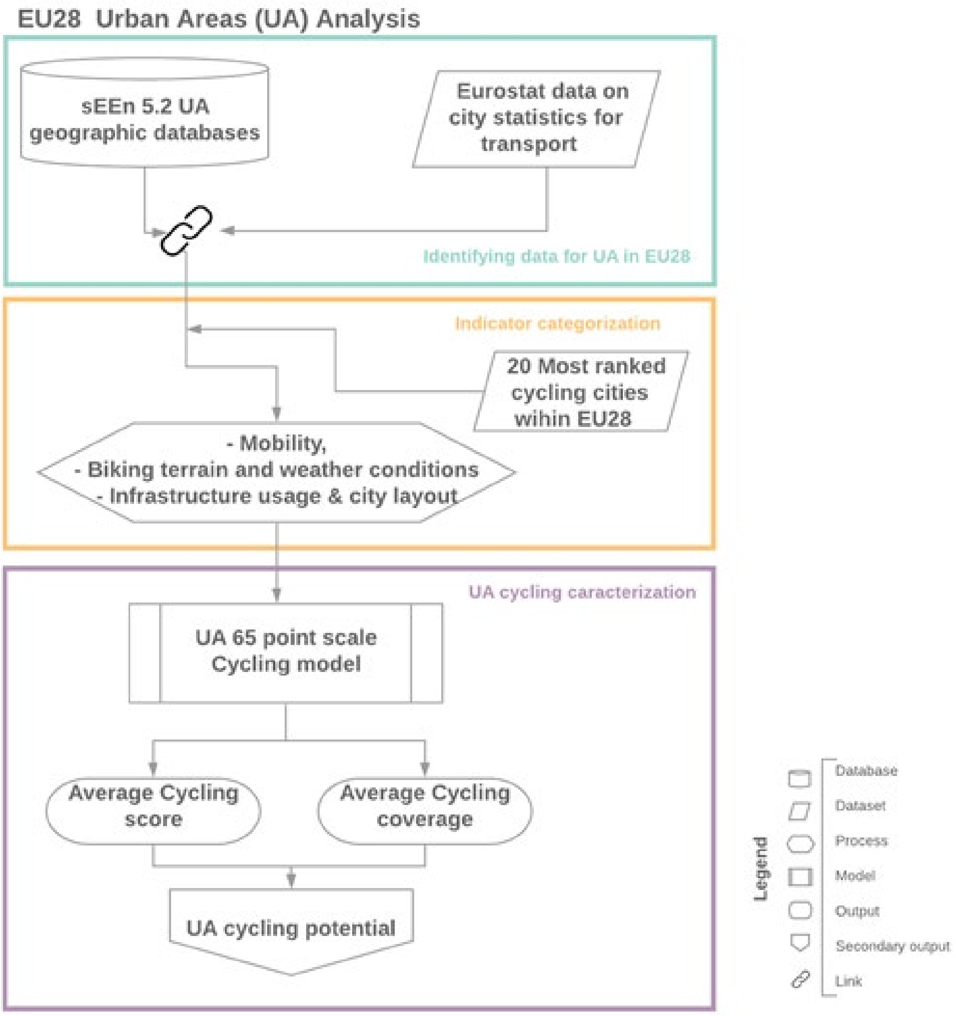


Figure 2: Flow diagram of the process of estimating cycling potentials for urban areas.

The datasets used in the model are the following:

1. Urban areas from D5.2 (Wiechers et al., 2020)
2. UA Climate from D5.2 (Wiechers et al., 2020)
3. UA Slope from D5.2 (Wiechers et al., 2020)
4. UA Demographical attributes from D5.2 (Wiechers et al., 2020)
5. City statistics on Transport 2011-2018 (Nielsen & Moreno, 2020),

Table 2 expands on the indicators that are part of the evaluation criteria with its respective category:

Table 2: Indicators for evaluation of cycling potentials. Count represents the number of UAs where data is available for each indicator, the total number of UAs is 115190. This means that all the indicators with less than 1000 count have less than 1% share of the total number of UAs.

Indicator name	Count	Indicator category
Cars per 1000 inhabitants	764	Mobility
Average time to work	437	Mobility
Average length of work journey by car	236	Mobility
Share of journeys to work by car	490	Mobility
Share of journeys to work by public transport (rail, metro, bus, tram)	491	Mobility
Share of journeys to work by bicycle	486	Mobility
Share of journeys to work by foot	489	Mobility
City Form	115190	Biking terrain and weather conditions
Terrain Slope		Biking terrain and weather conditions
Annual Temperature		Biking terrain and weather conditions
Yearly Precipitation		Biking terrain and weather conditions
City Population Density	115190	Infrastructure usage and city layout
Bike lane share of main road network	376	Infrastructure usage and city layout

The analysis was performed in ESRI's ArcMap 10.7.1 software, using various functions for creating a tailored 65-point scale cycling score model for assessing the UA's cycling potential. The output dataset resulting from this methodology, can be downloaded in the sEEnergies Open Data Hub (Nielsen and Moreno, 2020). Additionally, the layer is available under the Transportation set of layers on the Peta 5.0.1 web-app, a screenshot follows for guiding purposes, see Figure 3.

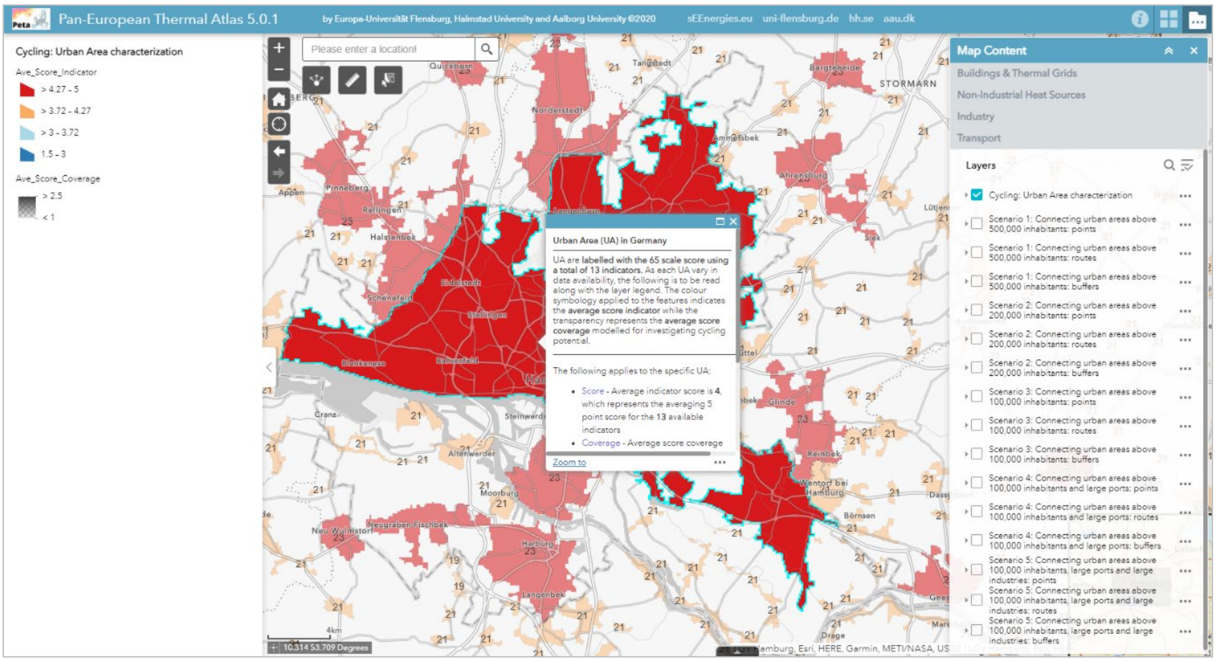


Figure 3: Screenshot from the Peta 5.0.1 with the "Cycling: Urban Area characterization" layer activated.

2.5.2 E-road maps

Please note that parts of the following description are also found in the "D2.3 Report on energy efficiency potentials in the transport sector and conclusions from the developed scenarios" (Mathiesen

BV et al., 2020) as the result of the e-road analysis is used in the D.2.3. However, in this report the focus is on the mapping as opposed to the national e-road lengths and coverages, which can be found in D2.3. In this report the concept of e-roads will be defined as in (Connolly, 2017) and illustrated in Figure 4, where the purpose is to establish an electricity infrastructure that enables trucks to use electricity directly from the electricity grid rather than relying on batteries for their full journey.

Figure 4: Illustration of the e-road concept from Siemens (Siemens, 2020).

The trucks are EVs (Electric Vehicles) and include batteries but can only drive approximately 100 km on battery. By establishing e-roads between the main cities where the trucks can use electricity directly and charge the batteries, the trucks only need a battery large enough to reach the e-roads, instead of the full distance, significantly reducing battery sizes and enables a larger electrification of trucks than what would otherwise be possible.

The aim of the e-road analysis is to assess the potential for e-roads as a solution to electrify trucks used for freight. In this description, the main purpose is to identify different potentials for establishing e-roads on a EU28 scale, by identifying the length of routes (km) and coverage potential (% of population). Due to the large geographic coverage of the analysis, the methodology applied is rather basic. Going into a detailed analysis of transport work on an EU scale would be rather time-consuming.

The basic analysis could be seen as a first attempt to estimate e-road routes on a EU28 scale, which in the future should be supported by more in-depth local analyses, e.g. on country level. That being said, in the analysis five different scenarios are analysed:

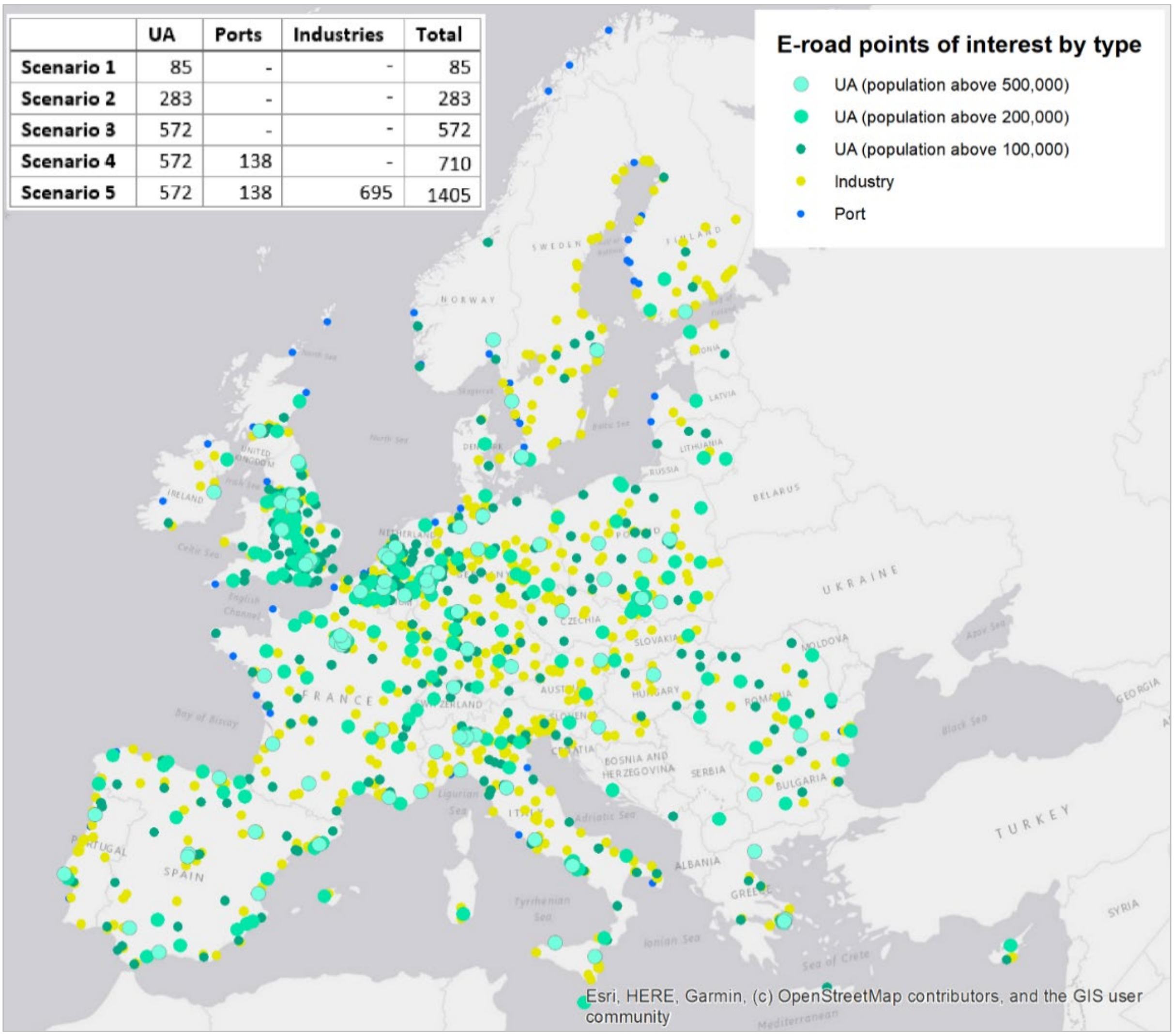
- *Scenario 1 (s1): Connecting cities above 500,000 inhabitants*
- *Scenario 2 (s2): Connecting cities above 200,000 inhabitants*
- *Scenario 3 (s3): Connecting cities above 100,000 inhabitants*
- *Scenario 4 (s4): Connecting cities above 100,000 inhabitants and large ports*
- *Scenario 5 (s5): Connecting cities above 100,000 inhabitants, large ports and large industries*

The first scenario is expected to have the smallest network of e-roads, but also the lowest coverage of the population. By increasing the points of interest (number of cities, ports and industries), the length of e-roads and coverage potential is expected to increase as well. Finally, by having the length of the network, the investment costs in e-road infrastructure can be estimated, which can help to determine the economic feasibility of implementing the different scenarios.

As a point of the departure, five datasets have been used in the analysis:

1. Road network from OpenStreetMap (OpenStreetMap 2020)
2. Urban areas from D5.2 (Wiechers, Möller, and Persson 2020)
3. Industrial sites from D5.1 (Fleiter et al. 2020)
4. Ports from (Maritime Safety Office 2016)
5. Country maps (Eurostat 2020)

Figure 5 shows a map of the points of interest for each of the five scenarios by type. Furthermore, it includes the total number of points that are included in each scenario.



	UA	Ports	Industries	Total
Scenario 1	85	-	-	85
Scenario 2	283	-	-	283
Scenario 3	572	-	-	572
Scenario 4	572	138	-	710
Scenario 5	572	138	695	1405

Figure 5: Points of interest divided by type for the five scenarios. The map includes a table showing the total number of points used in each scenario.

The analysis was performed in ESRI's ArcMap 10.7.1 software with the Network Analyst extension. A tailored model was created for the purpose of assessing the e-road potential.

The method developed uses the following steps:

1. A network dataset was created from the road network from OSM. In this report, the classes: motorway, primary, secondary, and tertiary roads, were used. When making a network dataset, it is important to include enough roads to ensure the connectivity in the network. Furthermore, an impedance was added to each type to make sure that motorways were always highest priority. The following impedances were used: 1 for motorways, 10 for primary road and 20 for all other roads.
2. The network analyst function "Make Closest Facility Layer" was used to find the routes between the points of interest in each scenario. The function finds the route with least impedance from each incident to the three nearest facilities.
3. All the points from a scenario was loaded as incidents
4. The points for the 85 largest UA was loaded as facilities
5. Each route was saved into a combined layer of routes for each scenario.
6. To find the routes without the roads that are within close distance to the points of interest the first and last 5 km of each route, was erased in an alternative version of each scenario named s1e, s2e, s3e, s4e and s5e.
7. The routes for the scenarios were dissolved so that overlapping road segments only were counted once.
8. A straight-line buffer analysis for four different buffer distances (25, 50, 75 and 100 km) was applied to the routes. The justification for using these buffer distances is the assumption that the electric trucks are able to drive approximately 100 km on battery from the e-road. Therefore, if a truck needs to drive somewhere from the e-road and return, without charging the battery, it can go within a 50 km buffer distance. However, due to differences between electric trucks and potential technological development towards more efficient batteries, the 25 km, 75 km and 100 km are included as well.
9. For each buffer area, the population of the intersecting urban areas was summarised on national level.

The output datasets for the points, routes and buffers, resulting from this methodology, can be downloaded in the sEEnergies Open Data Hub (Nielsen and Moreno 2020) at:

https://s-eenergies-open-data-euf.hub.arcgis.com/.

Scenario specific views are shown in below in Figure 6, Figure 7, Figure 8, Figure 9 and Figure 10, below, and also available on the Peta web map:

https://tinyurl.com/peta5seenergies

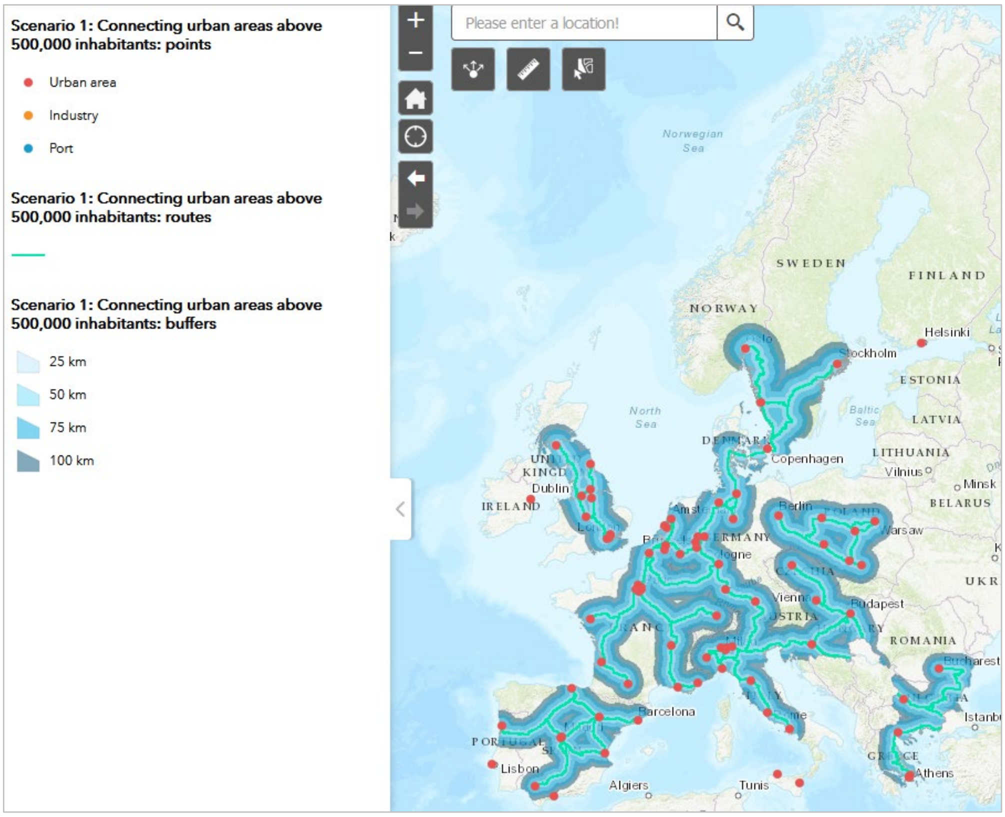


Figure 6: Map of the E-road Scenario 1 result.

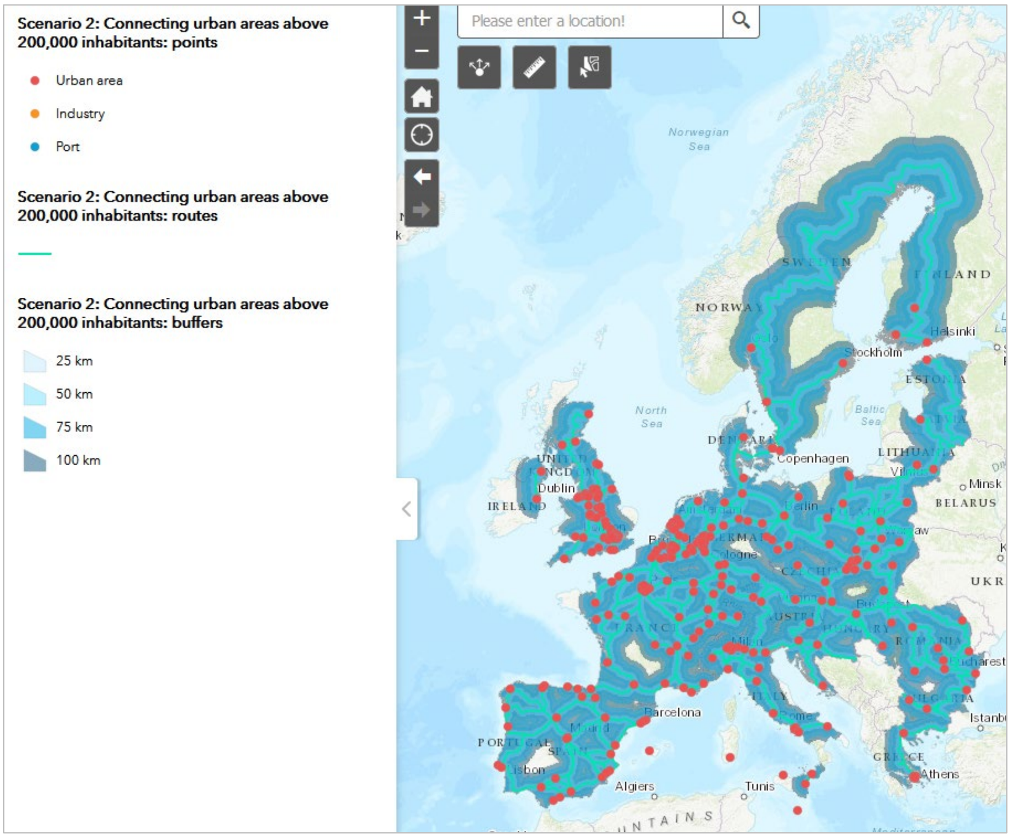


Figure 7. Map of the E-road Scenario 2 result.

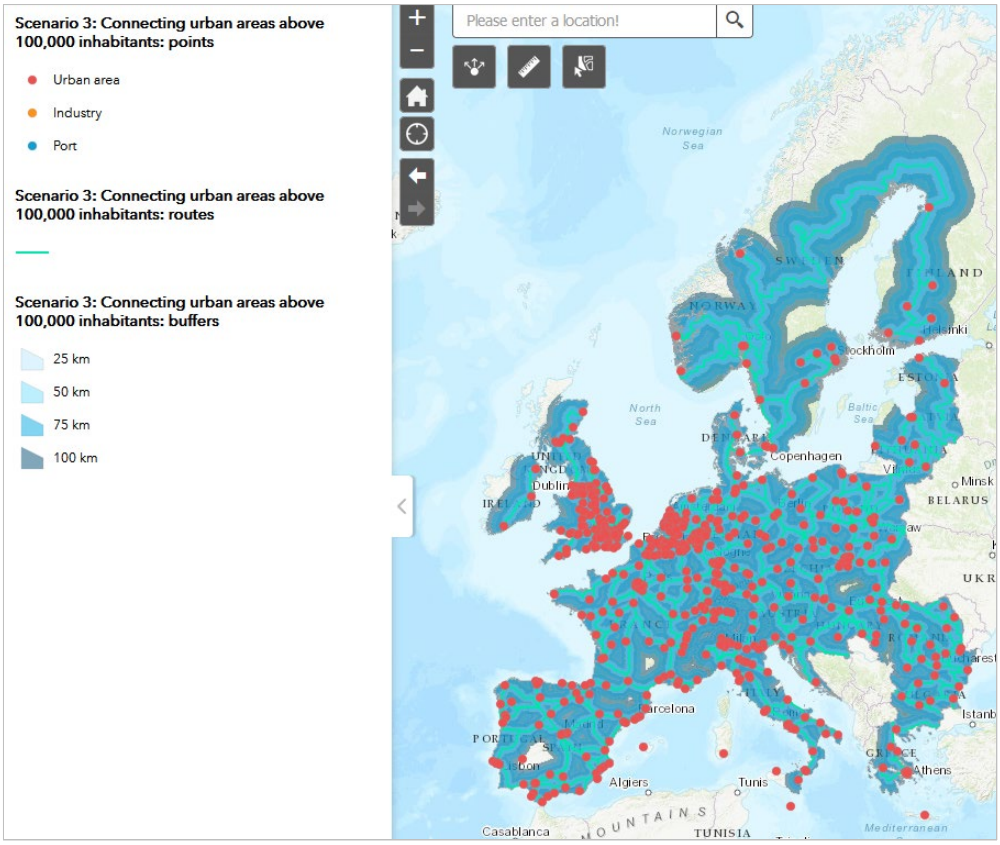


Figure 8: Map of the E-road Scenario 3 result.

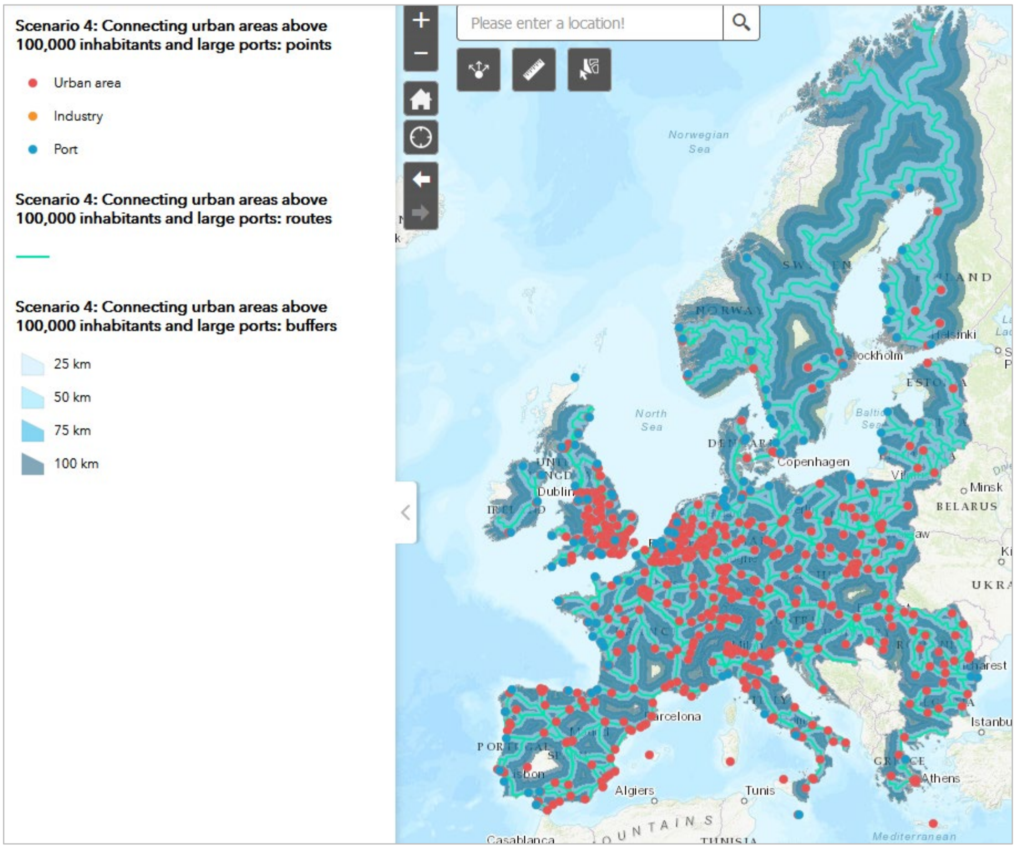


Figure 9: Map of the E-road Scenario 4 result.

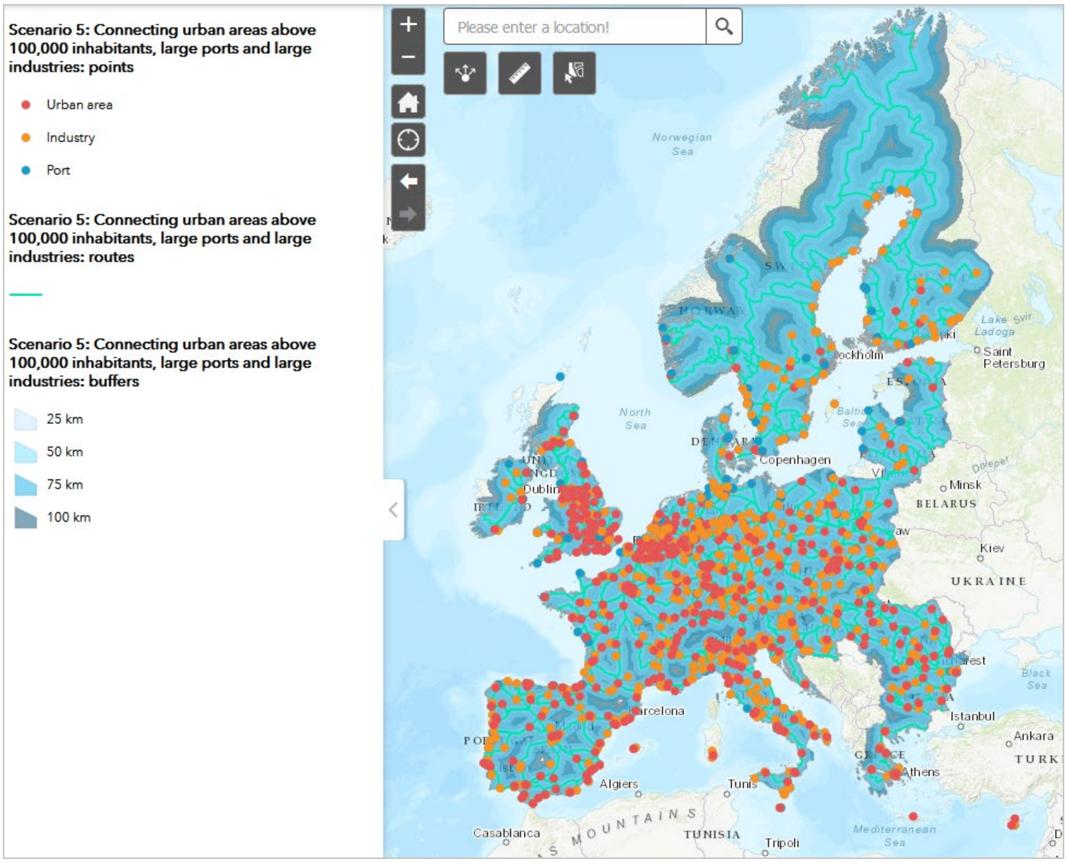


Figure 10: Map of the E-road Scenario 5 result.

2.6 Industry sector

Industrial sites in EU28 within six energy-intensive industrial sectors were described in the sEEnergies D5.1 context (Fleiter et al., 2020). Energy efficiency and excess heat recovery potentials were calculated, resulting in 1,842 georeferenced industrial sites (locations) in total, and 1,608 for which demand, and excess heat data was possible to distinguish. Key attributes for this industrial dataset include e.g.:

- Geographical coordinates
- Company name
- Street Name and Number
- Sector name
- Country Code
- NUTS3 region Code
- Site production
- Annual excess heat volumes

These annual excess heat volumes, exclusively from fuel combustion, were further quantified for three different levels of cooling temperatures (Level 1: 25 degrees Celsius, Level 2: 55 degrees Celsius. and Level 3: 95 degrees Celsius), and for two scenarios: (1) at current rate of internal heat recovery, and (2) at maximum rate of internal heat recovery, see Figure 11 .

For the assessment of the current year energy efficiency potential in industry presented in this report, two different potentials are conceived. The first refers to the on-site energy saving potential if implementing current year Best Available Technologies (BAT) at the whole set of industrial sites for which demand data is available. The demand data refers to site-specific annual electricity and fuel demands, which was established as part of the D5.1 output. The second potential refers to the off-site energy efficiency potential by excess heat recovery to district heating systems, which here corresponds to the aggregated sum of excess heat at Level 3 and scenario 1 (cooling of flue gases to 95 degrees Celsius at current rate of internal heat recovery) available for recovery for current district heating areas (DH-A), as also presented in the D5.1 context.

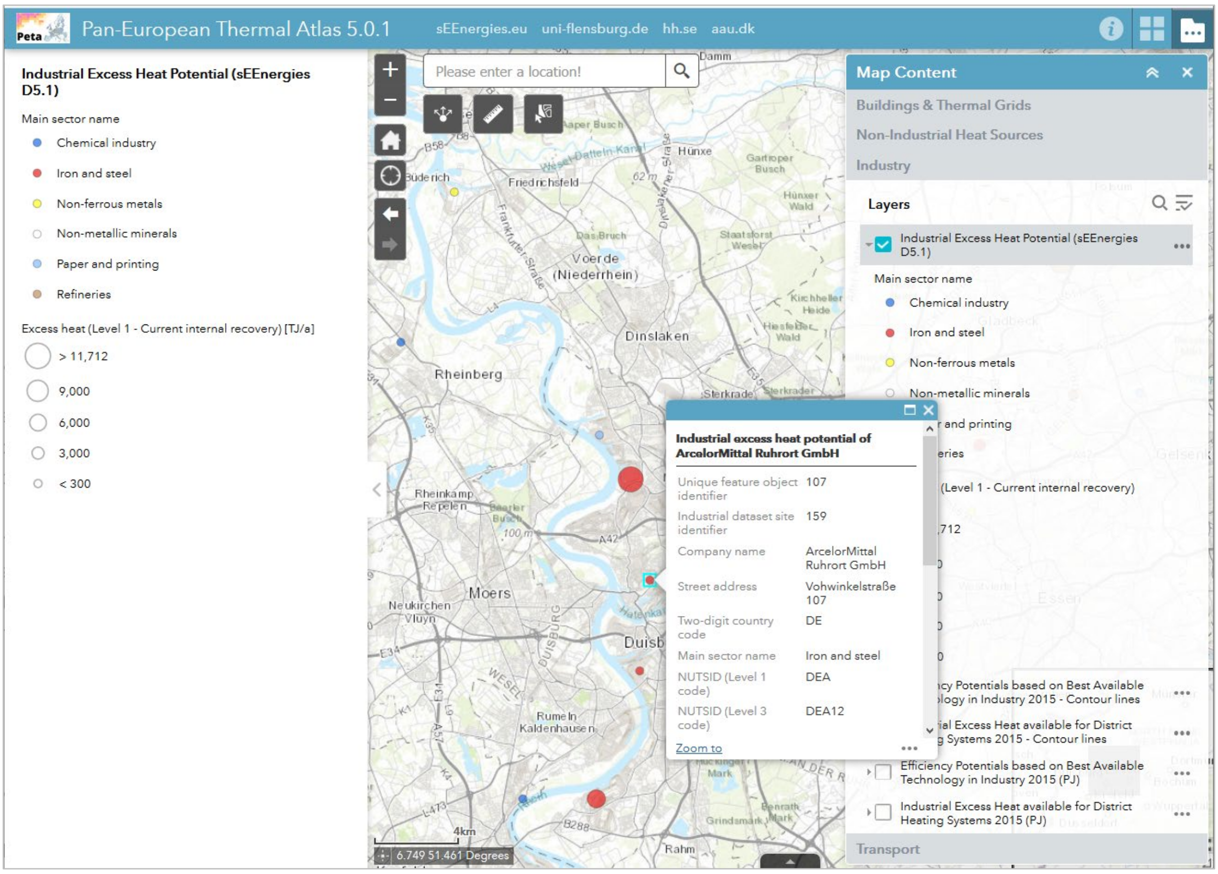


Figure 11: Industrial excess heat potentials at site-level for 1,608 EU-28 industries.

For both of these industrial energy efficiency potentials, a novel way of visualising energy efficiency of point locations across a region is the interpolation to "efficiency surfaces". In the first case, an energy savings surface shows the potential for on-site BAT energy savings in energy intensive industries for the current year as the sum of annual savings in PJ from all industrial sites within 50 km distance of each site, as depicted in Figure 12.

The underlying integer raster dataset for this first industrial potential was created by calculating the annual energy saving potential at each site, as the possible reduction of electricity and fuel demands if implementing current year Best Available Technologies (BAT). Then, by spatial interpolation, the efficiency surface was created as a density map, where the aggregated sum of the annual energy saving potentials from all sites located within 50 km of each single industrial site constitutes the interpolation value field.

The total EU-28 energy saving potential from these industries was found at 1.07 EJ per year, which represents an approximate 14% annual saving relative a total demand at 7.77 EJ for the considered sites) and the highest densities exceed 80 PJ within the used 50 km radius. It should be noted that due to the used interpolation technique (Topo-to-Raster) edge-values may not be fully representative. For better visualisation of this surface, additionally, contour lines have been produced, which may be shown along with the surface or in combination with other layers, as also shown in Figure 12.

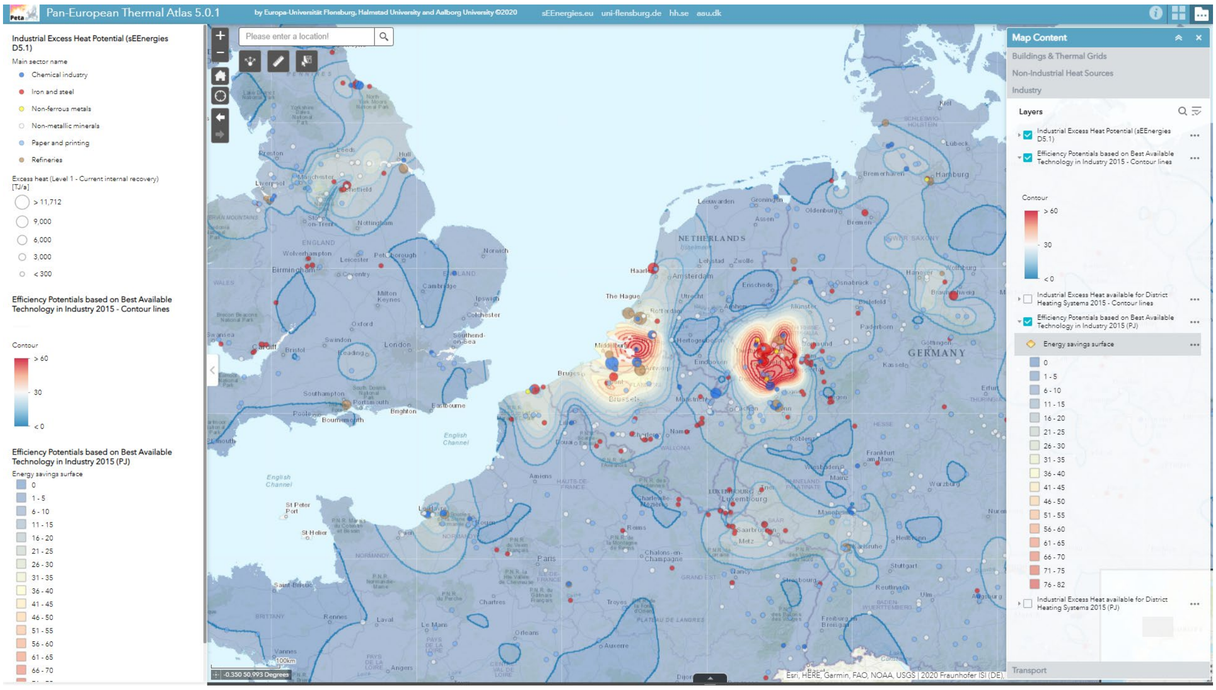


Figure 12: Screenshot illustration from Peta 5.0.1 of the energy efficiency surface and complementing contour layer relating to the on-site energy saving potential if implementing current year Best Available Technologies (BAT) at 1,608 industrial sites with demand data.

In the second case, an excess heat recovery surface shows the utilisation potential of excess heat recovery in district heating systems, supplying residential and service sector buildings, from energy intensive industries for the current year, as shown in the map layer in Figure 13. This layer effectively provides guidance as to what areas in Europe where a pursuit to increase current levels of industrial excess heat recovery may focus first.

The underlying integer raster dataset for this second industrial potential builds upon the sEEnergies D5.1 industry and district heating areas datasets, from which a subset of 866 industrial sites with 1st rank matches to actual (current) district heating areas within 10 km is extracted. From this extracted subset, the potential annual excess heat volumes (Level 3) from on-site fuel combustion per site, see (Fleiter et al., 2020), are aggregated by spatial interpolation.

The result is an "excess heat recovery in district heating systems surface", a density map, where the aggregated sum of annual excess heat potentials from all sites located within 50 km of each single industrial site (as for the first potential) constitutes the interpolation value field. For the upcoming 2nd set of map layers in the sEEnergies project, corresponding outputs are intended which will reflect the conditions anticipated for the future years 2030 and 2050.

The total EU-28 excess heat potential by recovery in district heating systems from these industries was found at 230 PJ per year (which is approximately ten times current levels of industrial excess heat recovery in Europe) and the highest densities reach approximately 25 PJ within the used 50 km radius. Note that due to the used interpolation technique (Topo-to-Raster) edge-values may not be fully representative. For this surface as well, contour lines were generated for better visualisation.

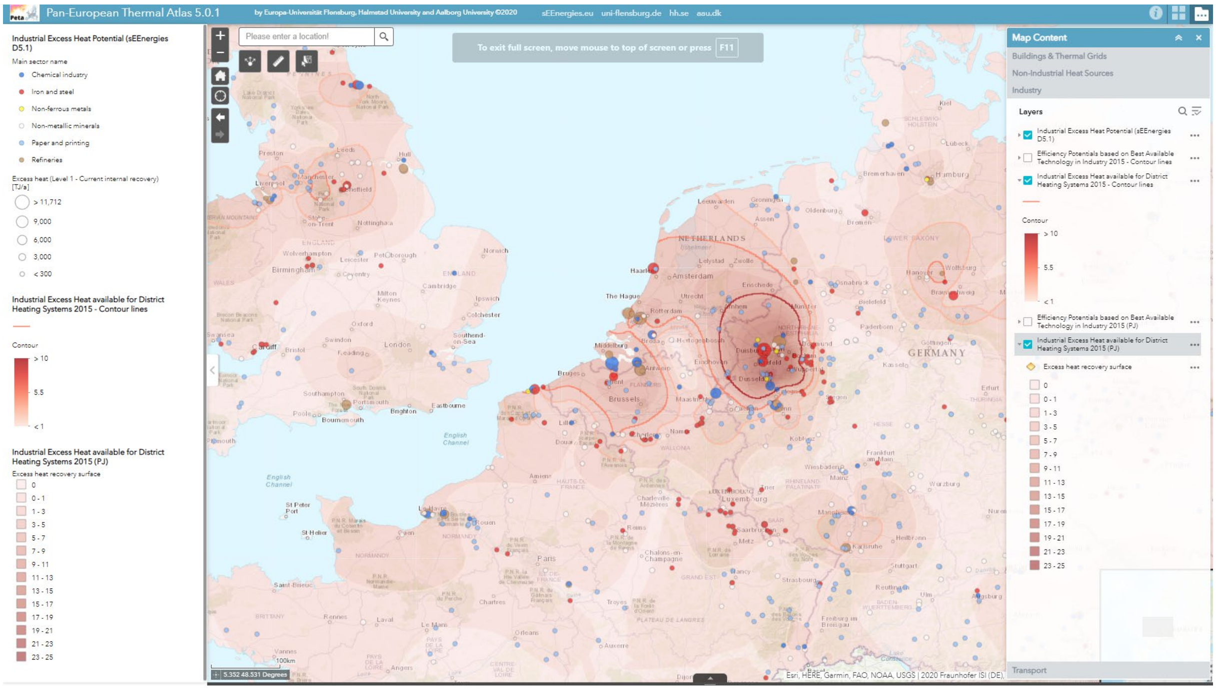


Figure 13: Screenshot illustration from Peta 5.0.1 of the energy efficiency surface and complementing contour layer relating to the off-site energy efficiency potential by excess heat recovery to district heating systems from industrial sites within 10 km of current district heating areas, at Level 3 and scenario 1 (cooling of flue gases to 95 degrees Celsius at current rate of internal heat recovery).

3 Output / Conclusion

The present Peta 5 web-mapping app is a continued development of the Peta information system. It has been extended to other sectors of energy efficiency, such as transport and industry. Downloads of data are now available in the web map app and through the sEEnergies Open Data Hub, which provides additional documentation. Documenting reports are also available on the Zenodo site of the sEEnergies project:

Zenodo: https://zenodo.org/communities/seenergies/?page=1&size=20

sEEnergies project: https://www.seenergies.eu/

4 Outlook

In the forthcoming tasks and deliverables, several additional map layers will be generated. These will subsequently be incorporated in the Peta 5 online maps. D4.5 comprises grids, while D5.5 and D5.6 will include data and layers of future scenarios. Continuously, the mapping solution will be further developed.

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