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Hotmaps - Open source platform and open data set on heating and cooling in EU28



H°TMAPS

www.hotmaps-project.eu

INTERNATIONALE ENERGIEWIRTSCHAFTSTAGUNG
IEWT 2019
VIENNA

LIVE DEMONSTRATION BY MICHAEL HARTNER



Inhalt



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- 📍 Einleitung – Hotmaps Projekt
- 📍 Live demo
- 📍 Zusammenfassung und Lessons learned



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The Hotmaps project develops a toolbox that supports heating and cooling mapping and planning processes. Website: www.hotmaps-project.eu



Development of a toolbox that will be:

- **User-driven:** developed in collaboration with pilot areas
- **Open source:** the developed tool will run without requiring any other commercial tool or software and the code will be accessible
- **EU-28 compatible:** the tool will be applicable for cities in all 28 EU Member States

The experts behind the project: 17 partners combining scientific institutions and pilot areas for developing and testing the tool



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Hotmaps toolbox – Inhalt

Evaluation of heat load and availability of supply – up to hourly resolution

Go to place...

LAYERS

Buildings

HEAT DENSITY TOTAL

HEAT DENSITY RESIDENTIAL SECTOR

HEAT DENSITY NON-RESIDENTIAL SECTOR

GROSS FLOOR AREA TOTAL

GROSS FLOOR AREA RESIDENTIAL

GROSS FLOOR AREA NON RESIDENTIAL

BUILDING VOLUMES TOTAL

BUILDING VOLUMES RESIDENTIAL

BUILDING VOLUMES NON-RESIDENTIAL

R.E.S. Potential

Industrial

Population

Res Potential

Elements selected 4

Scale LAU 2

LOAD RESULTS

CLEAR 4 ZONES

NUTS 0 NUTS 1 NUTS 2 NUTS 3 LAU 2 Hectare OSM Satellite

Thermal Power Energymix over year

Heat Demand

heat comp. heat pump waste heat 40°
CHP waste treatment waste
CHP steam turbine (medium) straw
heat boiler wood chips
heat boiler natural gas

Time in Hours

10 km 5 mi

Leaflet | Tiles © Esri – Esri, DeLorme, NAVTEQ, TomTom, Intermap, iPC, USGS, FAO, NPS, NRCan, GeoBase, Kadaster NL, Ordnance Survey, Esri Japan,

RESULTS

SUMMARY ENERGY STATISTICS

YEAR MONTH DAY

Heat load profiles

2010

Heat Power (MW)

Min Max Average

January February March April May June July August September October November December

Duration curve

Heat Power (MW)

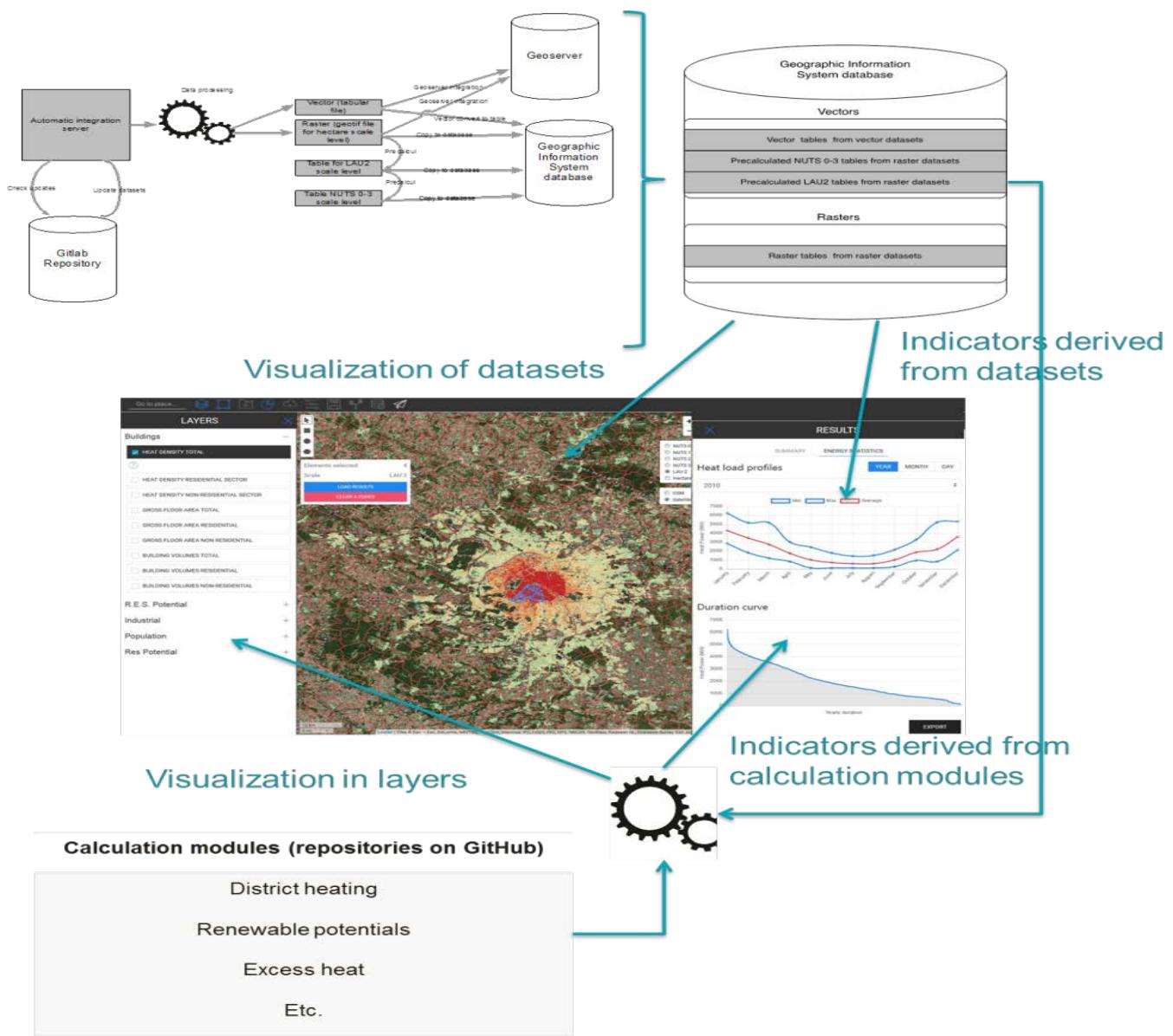
Yearly duration

EXPORT



Struktur und Konzept des Tools

Calculation modules
Front end
Default database





Live demo

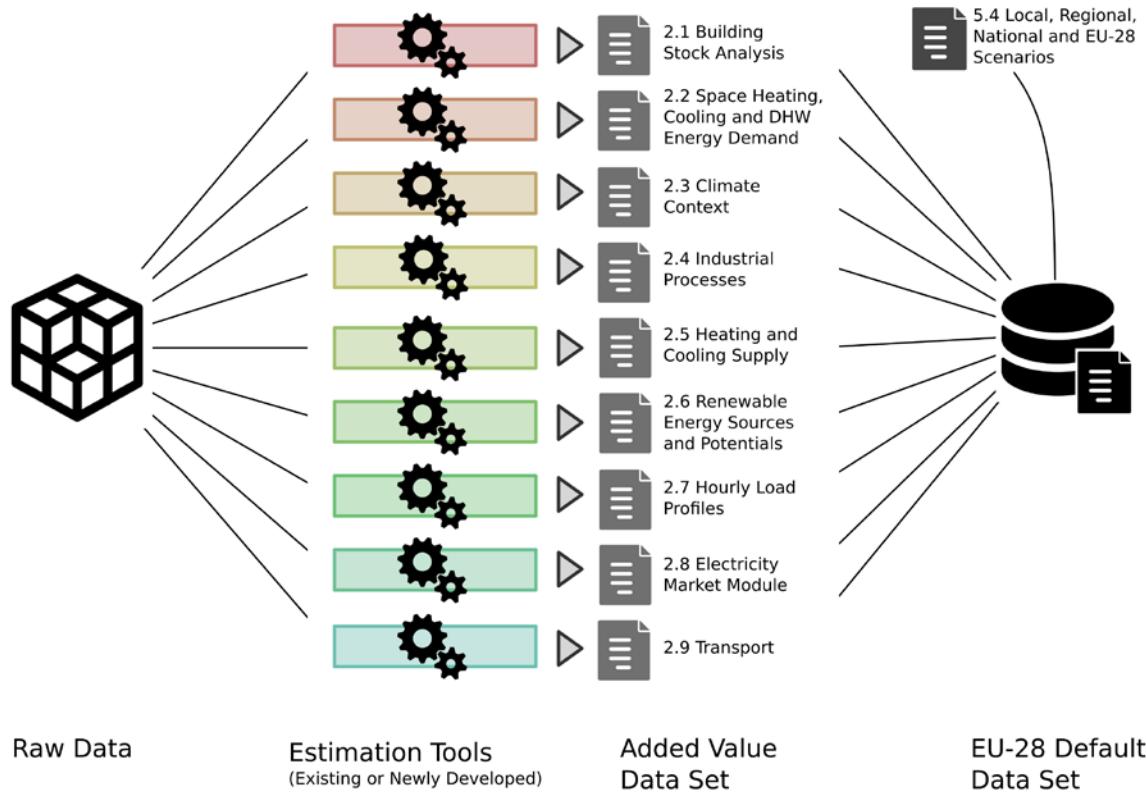


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1. Inhalt Mapping – welche Layer/Datensätze sind verfügbar?
2. Mapping auf unterschiedlicher geographischer Auflösung - EU28 to Hektar level
3. Relevante Indikatoren
4. Calculation modules in der Toolbox



Open EU – 28 dataset



- Verfügbar unter:
<https://gitlab.com/hotmaps>
 - D2.3 WP2 Report – Open Data Set for the EU28:
<http://www.hotmaps-project.eu/library/>



Hotmaps toolbox

- Work in progress..... Beta version to be released early 2019 –
for more information or to register as a beta user please
contact: info@hotmaps-project.eu

The screenshot shows the Hotmaps toolbox software interface. On the left, there is a 'LAYSERS' panel with two sections: 'Buildings' and 'R.E.S. Potential'. Under 'Buildings', 'HEAT DENSITY TOTAL' is checked. Under 'R.E.S. Potential', 'WASTE WATER TREATMENT PLANTS POWER' is checked. The main area is a map of Vienna and surrounding regions, with numerous yellow and orange dots representing data points. A callout box on the map indicates 'Elements selected 1' and 'Scale NUTS 3'. To the right of the map is a 'RESULTS' panel with tabs for 'INDICATORS' and 'GRAPHICS'. The 'INDICATORS' tab shows a bar chart titled 'Heat energy carrier' comparing oil, gas, heat pump, and district heating percentages across years 2012, C.M. Renovation, C.M. DH extension, 2020, 2035, and 2050.

| Year | Oil (%) | Gas (%) | Heat pump (%) | District heating (%) |
|-------------------|---------|---------|---------------|----------------------|
| 2012 | ~95 | ~5 | 0 | 0 |
| C.M. Renovation | ~90 | ~10 | 0 | 0 |
| C.M. DH extension | ~60 | ~20 | ~10 | ~10 |
| 2020 | ~60 | ~20 | ~10 | ~10 |
| 2035 | ~30 | ~20 | ~10 | ~40 |
| 2050 | ~15 | ~20 | ~10 | ~60 |

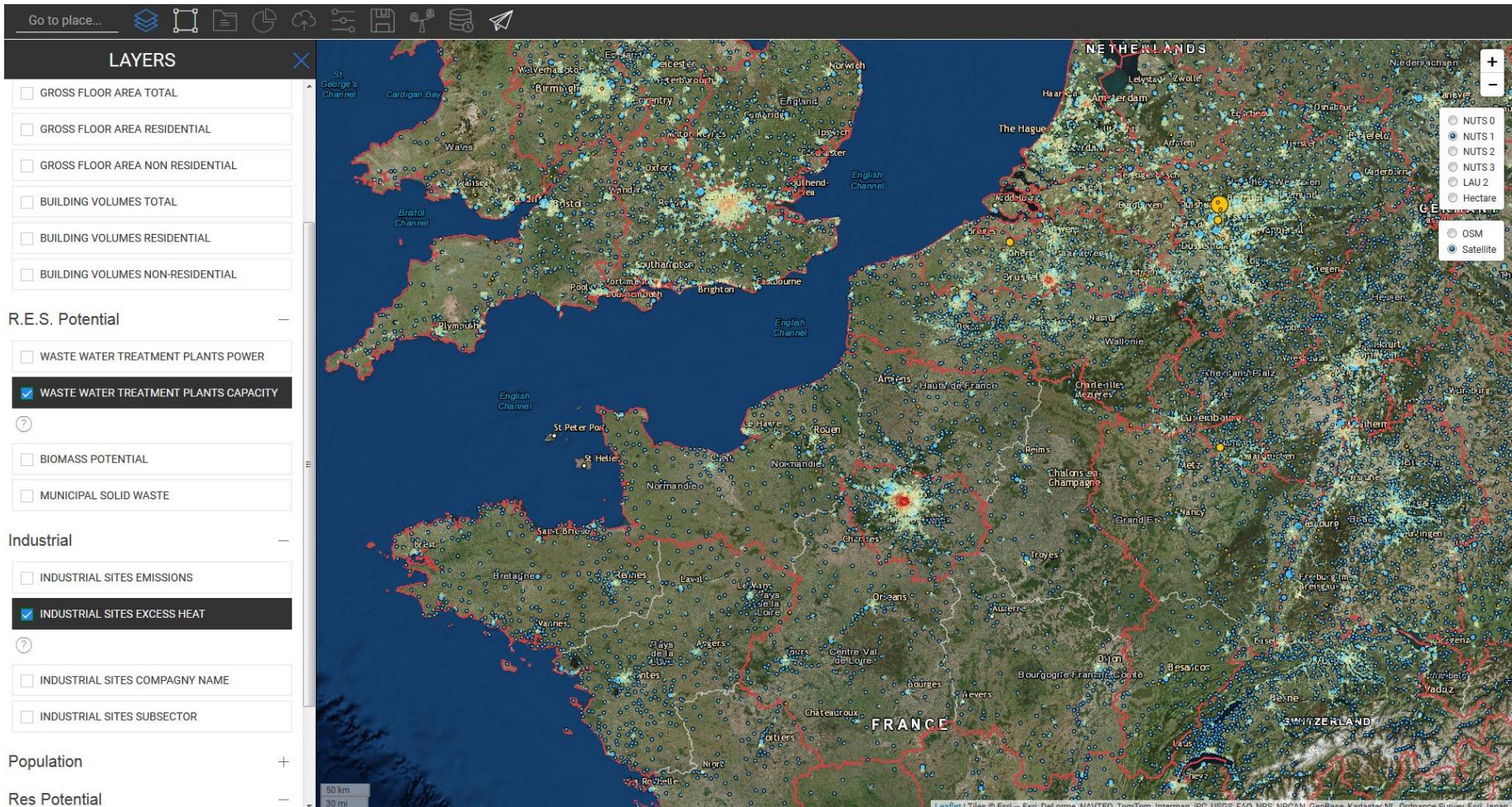


1) Content of mapping



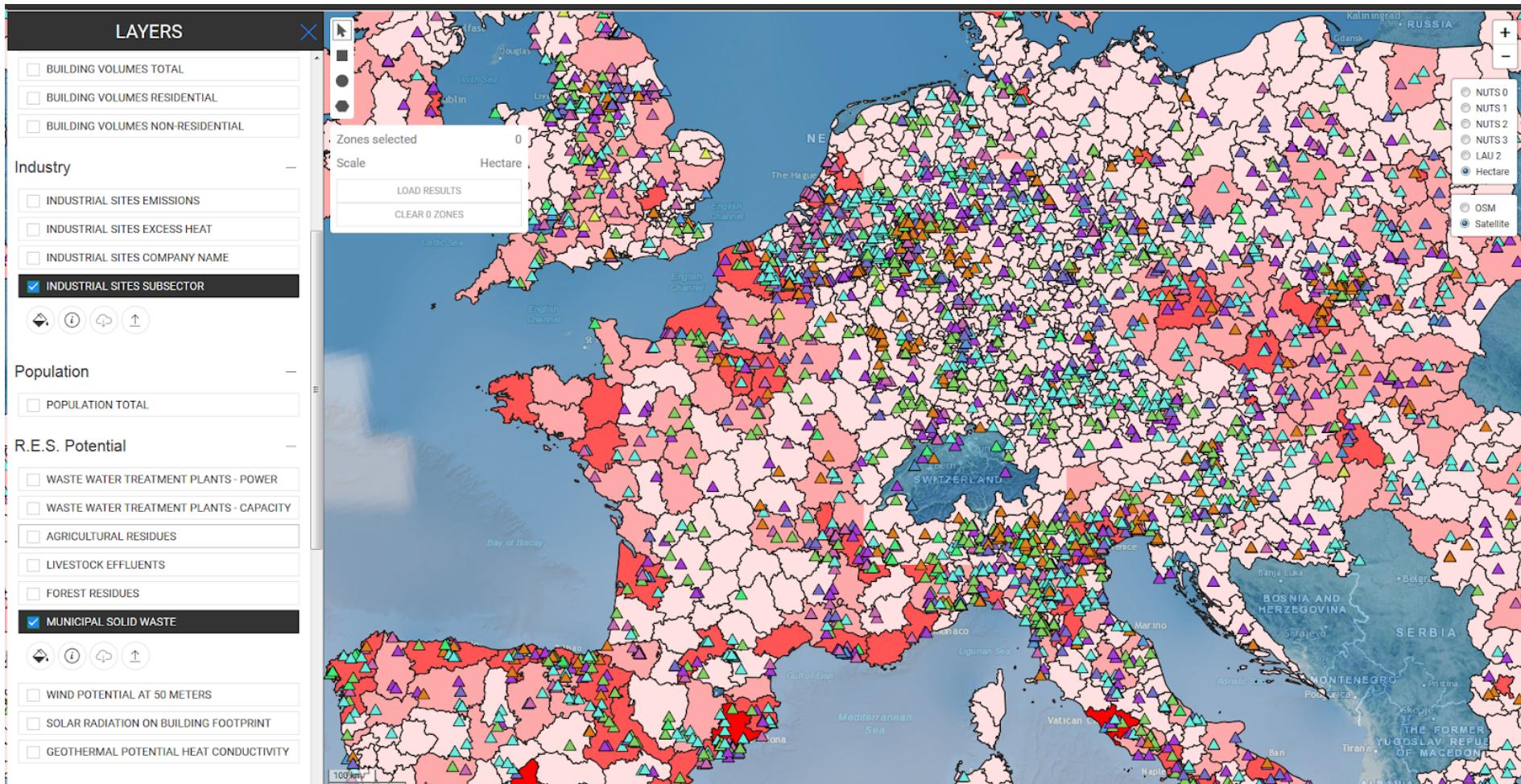
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EU – 28 mapping of heat demand and heat supply resources





1) Content of mapping

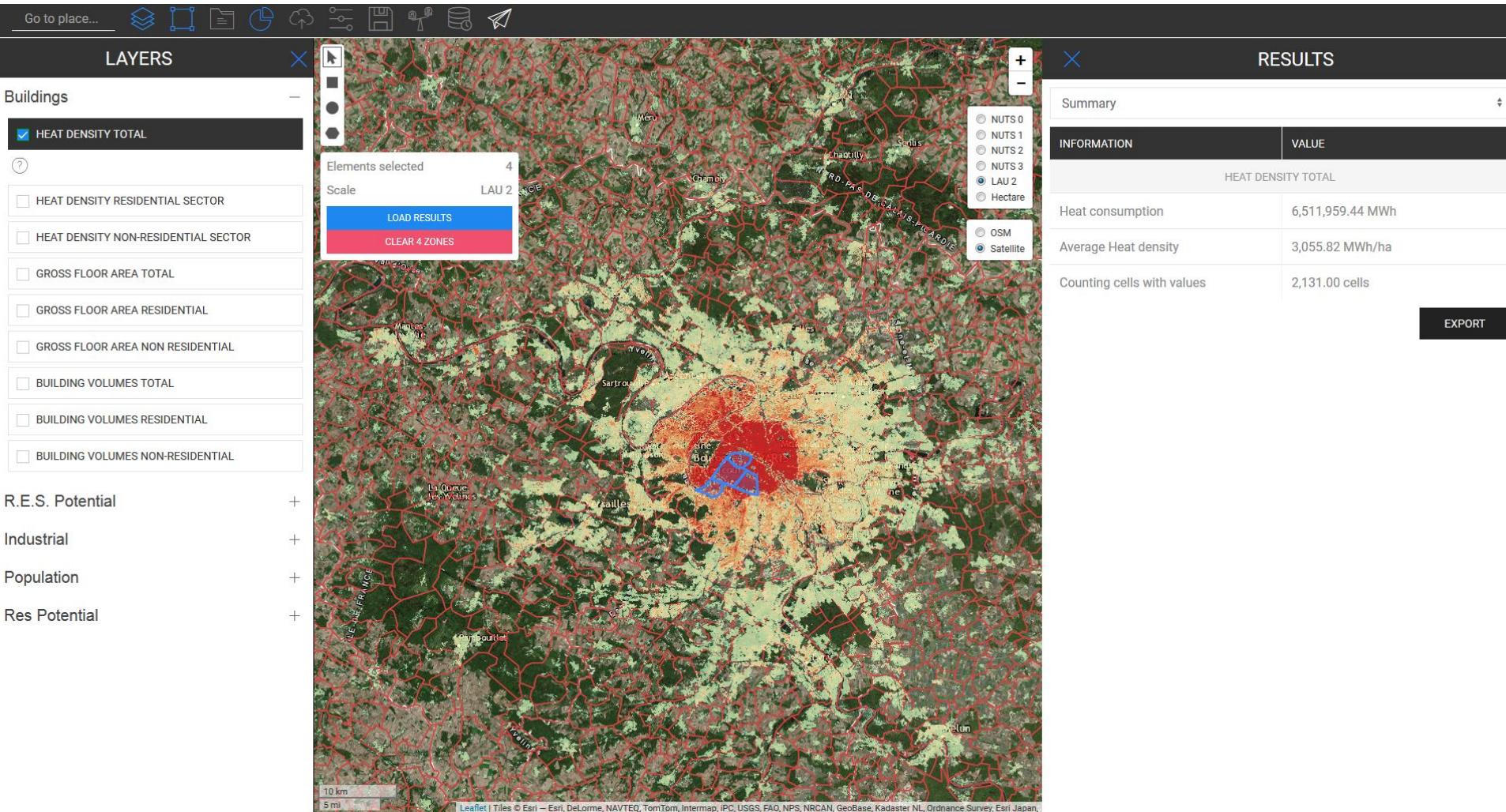




2) Mapping on zoom different levels



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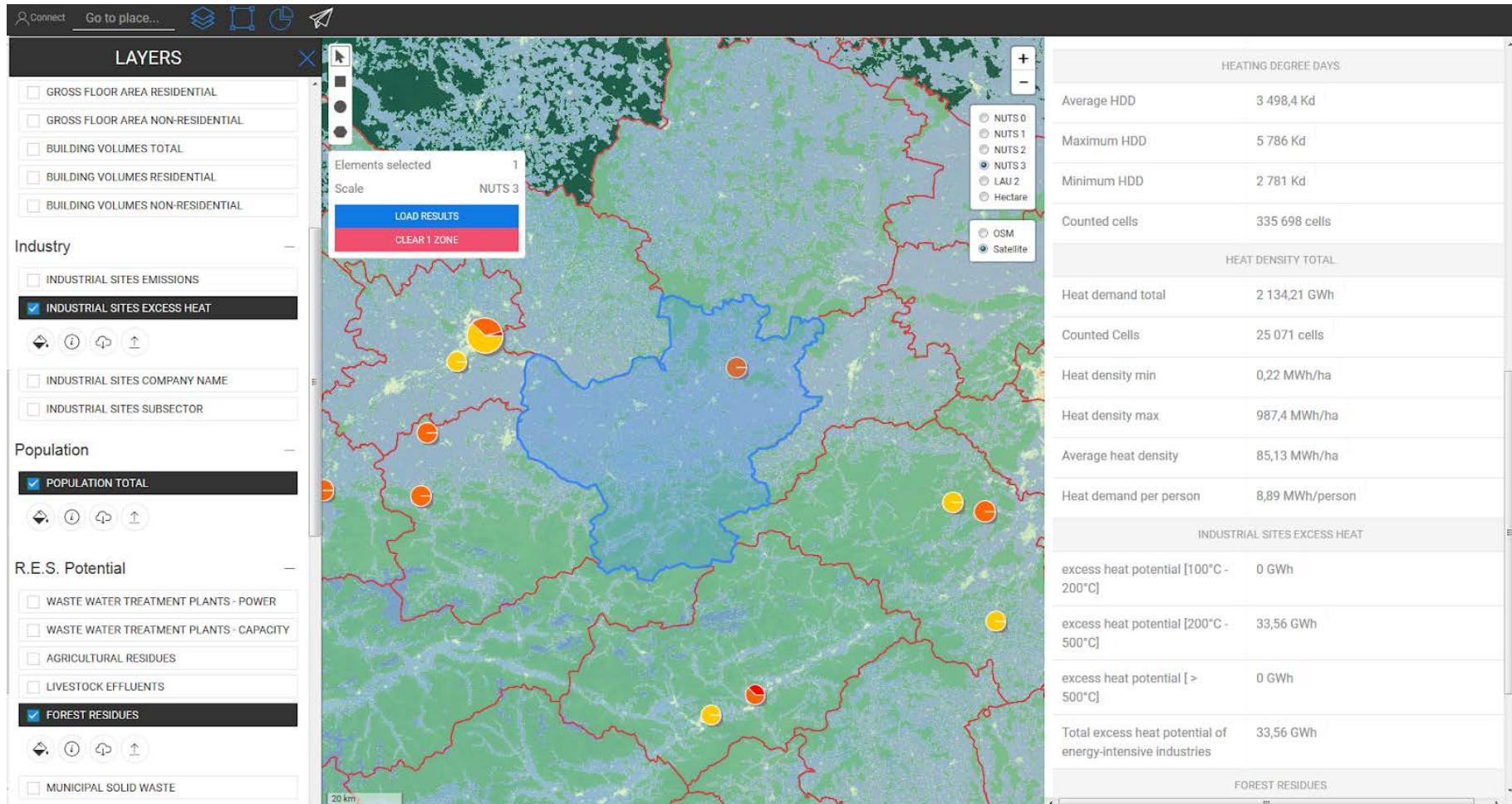
3) Get valuable indicators

The screenshot displays a GIS application interface with the following components:

- Layers Panel:** On the left, a sidebar titled "LAYERES" lists various data categories with checkboxes:
 - HEAT DENSITY TOTAL
 - HEAT DENSITY RESIDENTIAL SECTOR
 - HEAT DENSITY NON-RESIDENTIAL SECTOR
 - GROSS FLOOR AREA TOTAL
 - GROSS FLOOR AREA RESIDENTIAL
 - GROSS FLOOR AREA NON RESIDENTIAL
 - BUILDING VOLUMES TOTAL
 - BUILDING VOLUMES RESIDENTIAL
 - BUILDING VOLUMES NON-RESIDENTIAL
- Map View:** The central area shows a satellite map of a region with a dense network of red lines representing administrative boundaries (NUTS 0 to LAU 2). A small white callout box in the center of the map indicates "Elements selected 4" and "Scale LAU 2". Buttons for "LOAD RESULTS" and "CLEAR 4 ZONES" are also present. The map includes place names like Meru, Chemy, Martilly, Sartrouville, and Bourg-la-Reine.
- Legend:** A legend on the right side identifies symbols for NUTS levels (0-3, LAU 2, Hectare), OSM, and Satellite data.
- Scale Bar:** A scale bar at the bottom left shows distances of 10 km and 5 mi.
- Attribution:** A small text at the bottom left credits "Leaflet | Tiles © Esri – Esri, DeLorme, NAVTEQ, TomTom, Intermap, IPC, USGS, FAO, NPS, NRCAN, GeoBase, Kadaster NL, Ordnance Survey, Esri Ja...
- Results Panel:** On the right, a "RESULTS" section contains:
 - A "Heat load profiles" chart for 2010 showing Heat Power (MW) from January to December. It includes three lines: Min (blue), Max (red), and Average (dark red).
 - A "Duration curve" chart showing Heat Power (MW) versus Yearly duration, with a single blue line.
 - Navigation tabs for "SUMMARY" and "ENERGY STATISTICS".
 - Filtering options for "YEAR", "MONTH", and "DAY".
 - An "EXPORT" button at the bottom right.

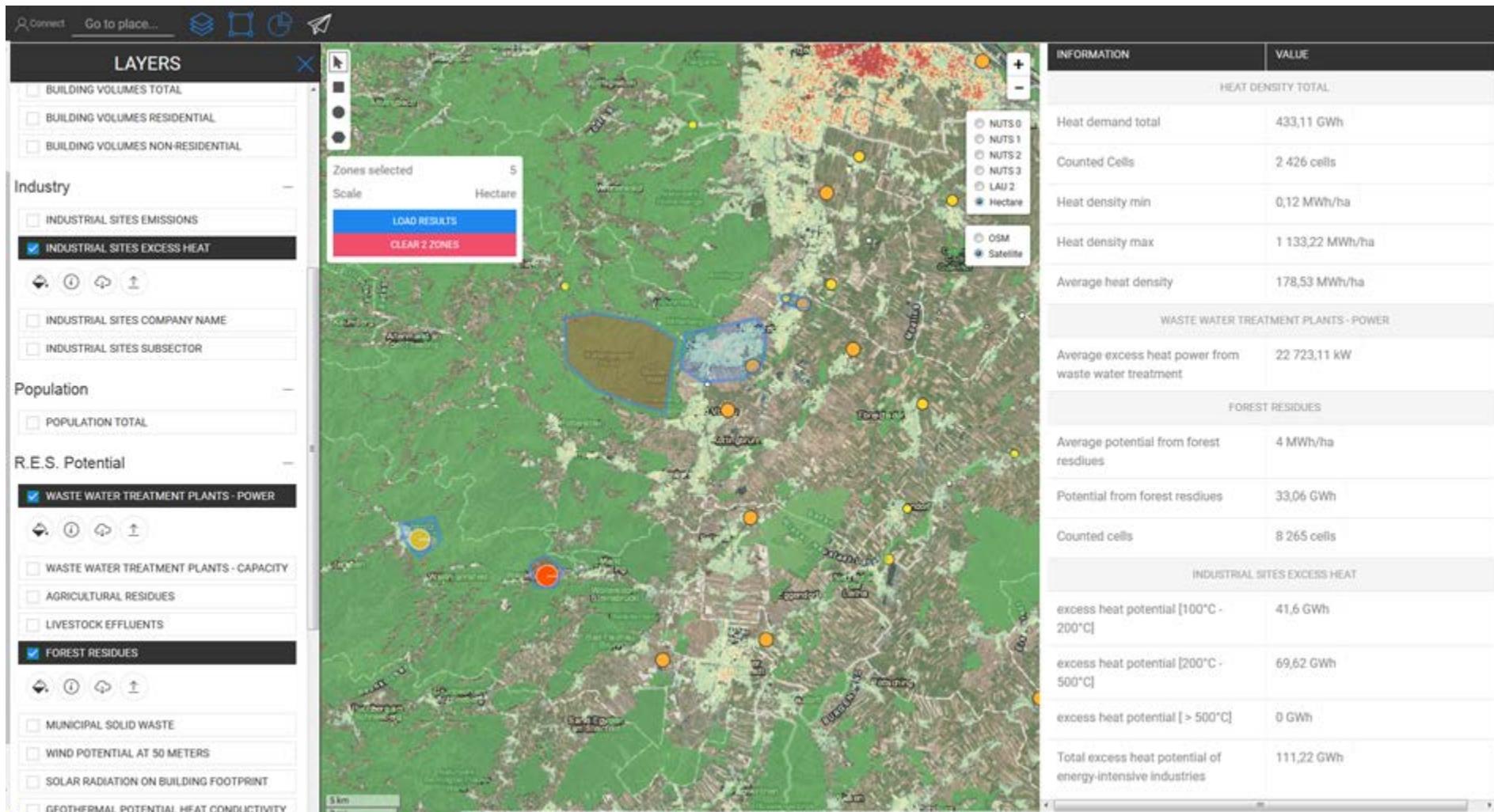


3) Get valuable indicators





3) Get valuable indicators

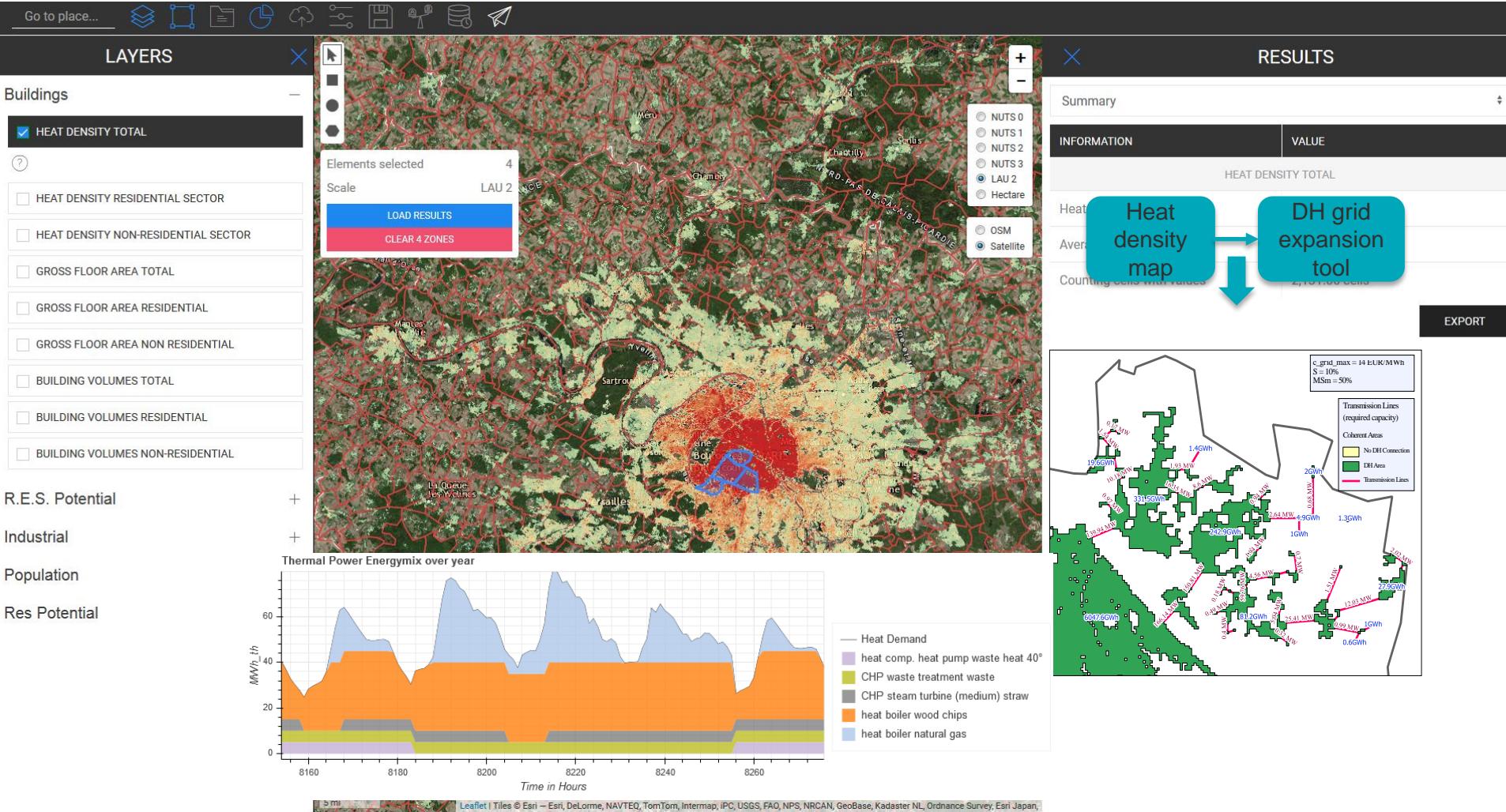




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4) Final stage: Adding calculation modules

Evaluation of heat load and availability of supply – up to hourly resolution





4) Final stage: Adding calculation modules

Connect Go to place...

District Heating Potential

Name of calculation module session

This computation module calculates district heating potential within the selected region. As output, a layer for the potential areas are shown. Click on the regions to get their corresponding potential. Within the indicator/graph window, relevant indicators and charts regarding DH potential within the selected zone and potentials in sub-zones are illustrated.

INPUTS

Min. heat demand in hectare - (value: 250MWh/ha)
250
Min: 0MWh/ha; Max: 1000MWh/ha;

Min. heat demand in a DH area - (value: 20GWh/year)
20
Min: 0GWh/year; Max: 500GWh/year;

INPUT TYPE SELECTION

Type: heat

Heat density total

RUN CM

10 km 5 mi

Elements selected 1 Scale NUTS 3

LOAD RESULTS CLEAR 1 ZONE

Label:4 Potential 553.79 GWh

NUTS 0 NUTS 1 NUTS 2 NUTS 3 LAU 2 Hectare OSM Satellite

Heat Power [M] 20000
15000
10000
5000
0
Yearly duration

District Heating Potential

Potential (GWh/year)

DH Area Label

1 2 3 4 5 6 7 8 9 10 11

District Heating Potential

Heat Demand Vs. DH Potential (GWh/year)

Annual heat demand DH potential

3500
3000
2500
2000
1500
1000
500
0

EXPORT

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Lessons learned

- Tool funktioniert
- Großer Schritt von eigenen Modellen zu Modellen für End-User
- Komplexität reduzieren (ursprüngliche Idee war zu ambitioniert)
- Daten und Datenstrukturen sind eng mit Tool verbunden – Hotmaps default EU-28 dataset ist sehr wertvoll
- Großer Koordinationsaufwand – data/models/IT-infrastructure/user needs
- Arbeit Open source tool ist sehr motivierend
- Open data ist ein großer Vorteil des Projekts



Project team



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Scientific partners



TECHNISCHE
UNIVERSITÄT
WIEN
Vienna | Austria



Hes-SO

Haute Ecole Spécialisée
de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences and Arts
Western Switzerland



Pilot areas for developing and testing the tool



Bistrita Municipality



donostiasustapena
fomento sansebastián

DONOSTIAKO GARAPEN EKONOMIKOA



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Heat Density Maps: Methodology

NUTS 0 – Level

Statistical Data:

- Population
- Building stock characteristics
 - Number of buildings
 - Number of dwellings
 - Net floor area of dwellings
- Energy consumption per energy carrier

Calculate data / data from literature:

- Useful energy demand (energy needs)

NUTS 3 - Level

Distribution of NUTS 0 data to NUTS 3 level:

Based on the results of the project: Territories and low-carbon economy [Eston Locate, 2017] using

Statistical data:

- Population
- Building stock characteristics
 - Number of buildings and dwellings per building type
 - Net floor area of dwellings, share per construction period
- Value added per sectors

Calculate data:

- Heating degree days

Hectare (100x100m) Level

Distribution of NUTS 3 data to Hectare level:

Population

- Population on 1km² and 250x250 level,
population per LAU2 (LAU1) region
- Corine land use data (hectare level)
- European Settlement Map (10x10 m level)

Value added

- Estimated gross domestic product 2006 in
the 119 000 LAU2 of the ESPON Area [JRC,
2011].
- Corine land use data (hectare level)
- European Settlement Map (10x10 m level)

Average energy needs per gross floor area indicator

- Ratio of hectare grid cell value to NUTS 3
value
- Surface-to-volume ratio based on OSM data (shape
data)
- Heating and Cooling degree days based on European
digital elevation model (38x38 m grid)
- Share per construction period based on Global
Human Settlement

Heated Gross Floor Area

Residential buildings

- Population
- Average floor area per capita (NUTS 3)

Non-Residential buildings

- Population, value added
- Openstreetmap database (hectare level)
- Heated residential gross floor area

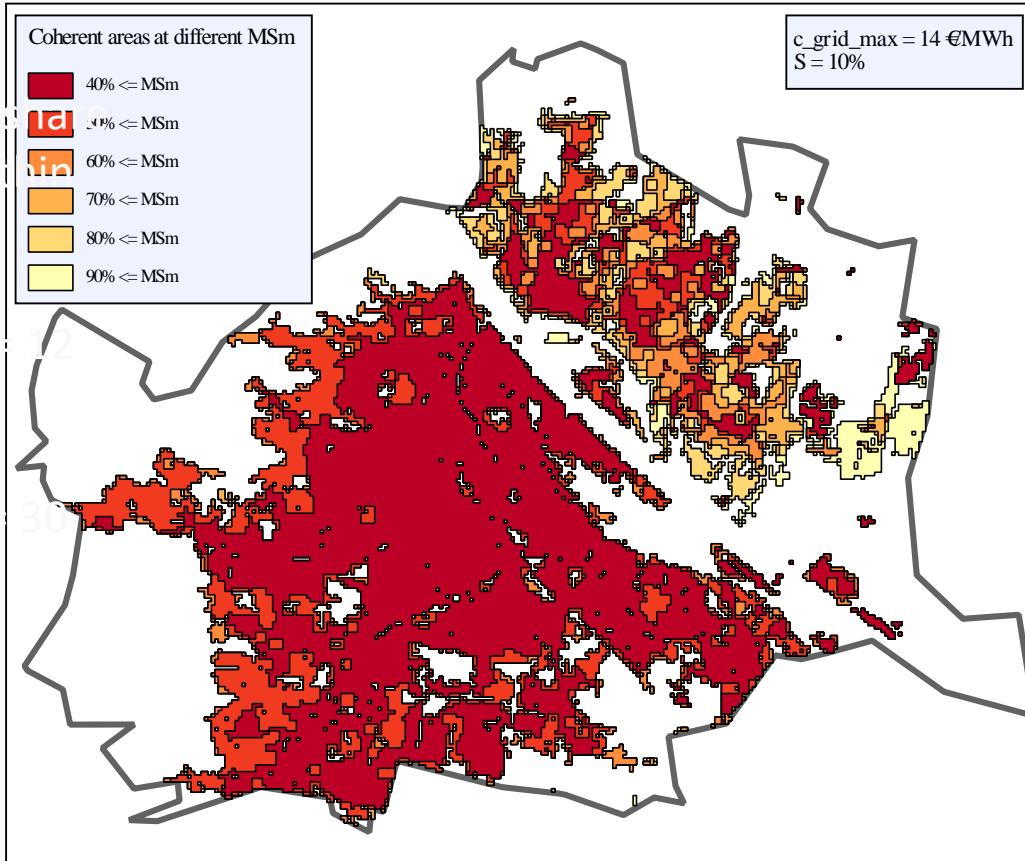
Building Volume

- Heated gross floor area x 3m

Heat density map

- 1) Heated gross floor area
- 2) Energy needs (useful energy
demand) per gross floor area
indicator
- 3) Energy needs per hectare level

Coherent areas under different market share





Results:

Coherent areas under different accumulated energy saving

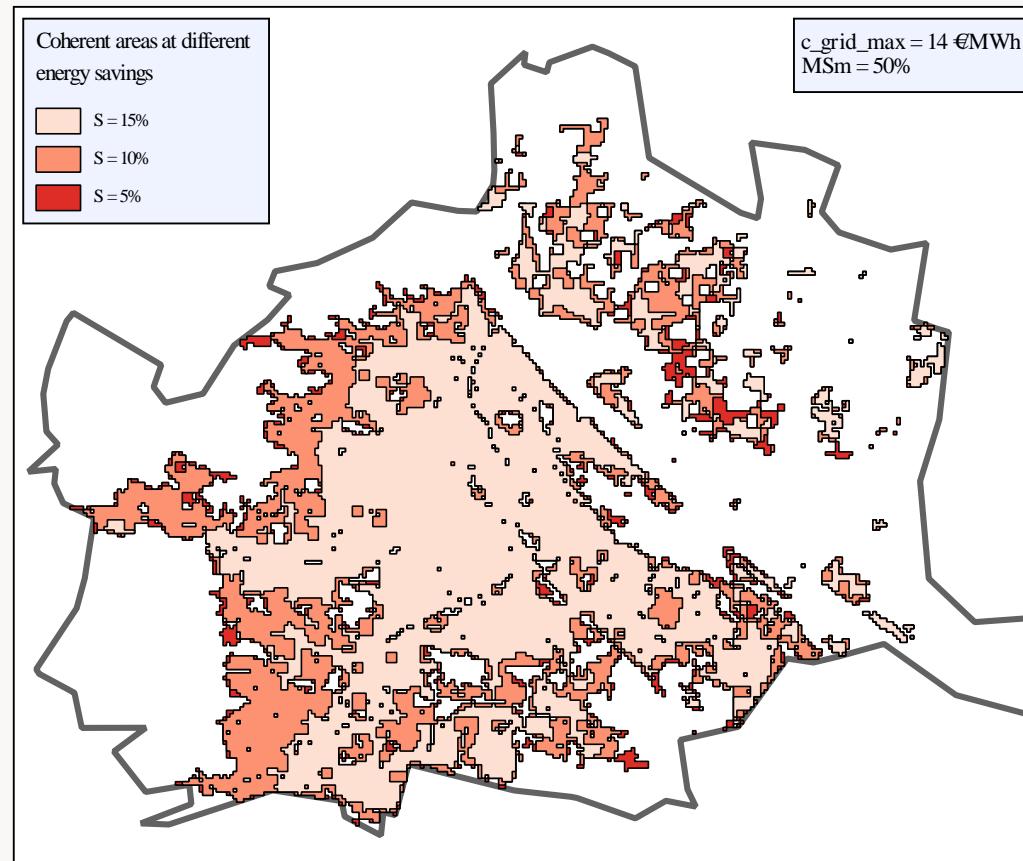


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Investment period = 12 years

Discount rate = 5%

Depreciation time = 30 years





Results:

Economic coherent areas & transmission lines



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