Webinar 4:
Use of Industrial Excess Heat in District Heating

Act!onHeat SF1 Time: 1 h 28 min

- Serial 2:
  - Webinar 4
    - Strategical Heating & Cooling planning
    - Group support for municipalities and stakeholders

- Presented by:
  - e-think / Austria
  - TU-Wien / Austria

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Part 1

- Introducction to Excess Heat use, some examples, and extra information

Part 2

- Three differet tools that can be used for the use of Excess Heat in District Heating

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Introduction to Excess Heat

Part I - Excess Heat: what it is, why it is used and how

This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.

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What is Excess Heat?

Excess Heat (EH) is the heat generated by any thermodynamic process whose main objective is manufacturing products or providing services, and which is released in the environment as a by-product.

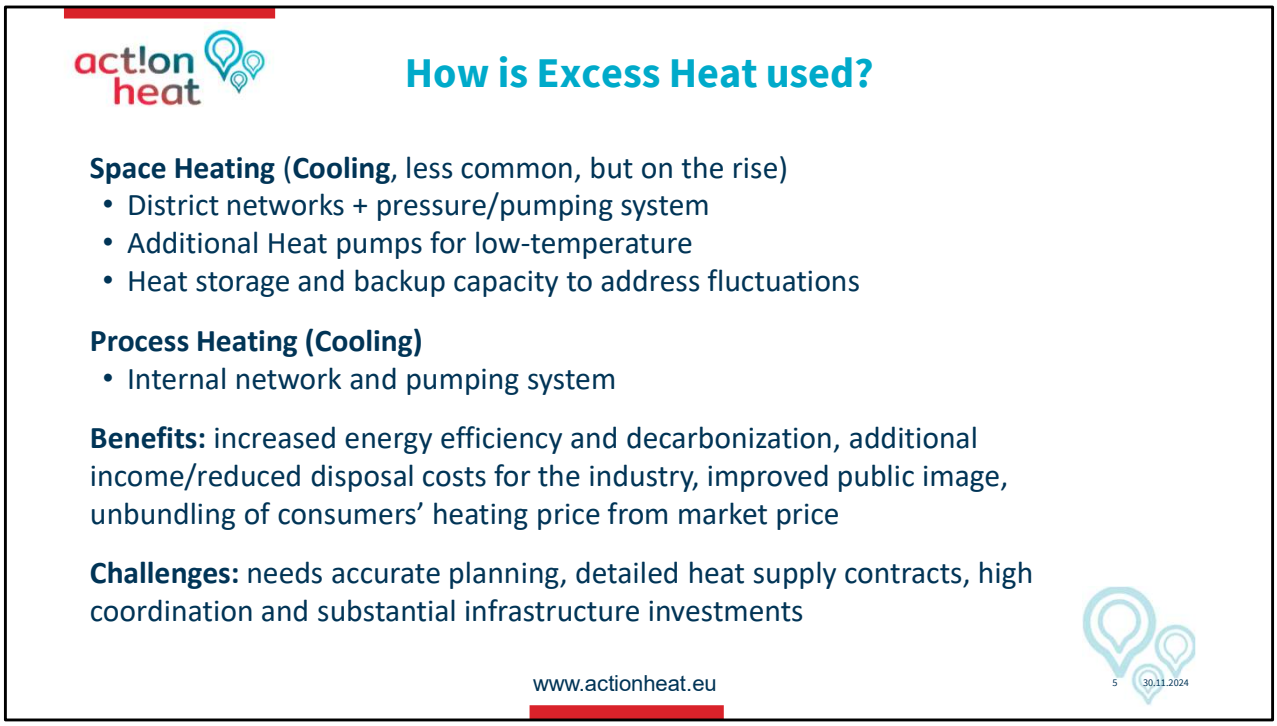
Typical industrial processes that produce excess heat:

- Production: refineries, metallurgy, chemical industry, manufacturing …
- Services: data centres, laundries, cold stores, water management, …
- Waste Disposal: waste incineration, closing material cycles, …
- Energy Conversion: condensation power plants, hydrogen electrolysis, …

Short Introduction to Excess Heat

Which industrial process commonly generated Excess Heat

- Production Processes
- Provision of services
- Process of waste disposal
- Energy conversion plants



How is excess heat commonly used?

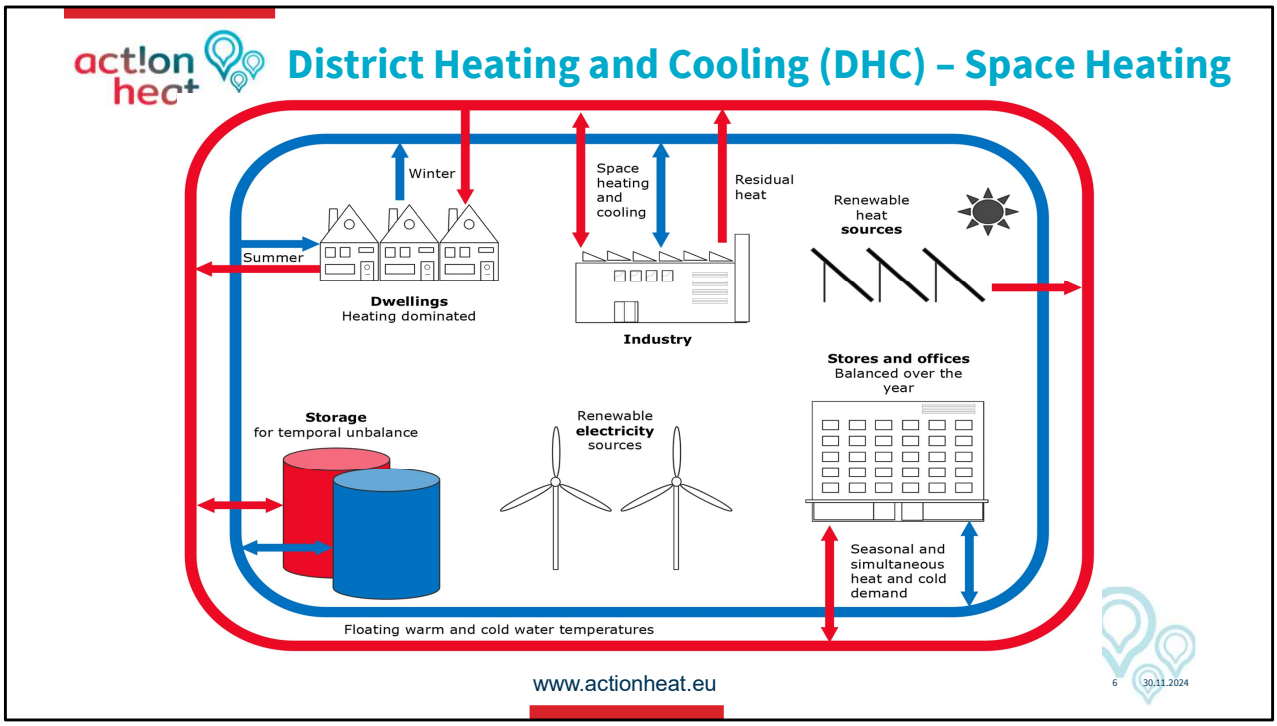
- Space Heating: The heat produced in the plant is distributed externally through different systems. Requires much infrastructure and needs to be planned

- Process Heating: The heat produced is used internally in the plant for other processes or internal Heating and Cooling. A ceramic factory is an example of that becaues it uses the production temperature for its drying process.

Excess heat for cooling is rising and is less common in space heating.

Why use Excess Heat?

Excess heat offers significant economic and environmental benefits for both industries and consumers. However, utilizing excess heat from industrial processes necessitates careful planning and the development of extensive infrastructure to meet the needs of stakeholders.



Elemental parts of a D&C network

- Sources

  Different energy providers: like industries and other electrical renewable energy producers connected to the network

- Storage

  System to store the produced Heating and Cooling

- Consumers

  People living in residential buildings and commercial buildings

Best Practices:
Common heat sources and uses

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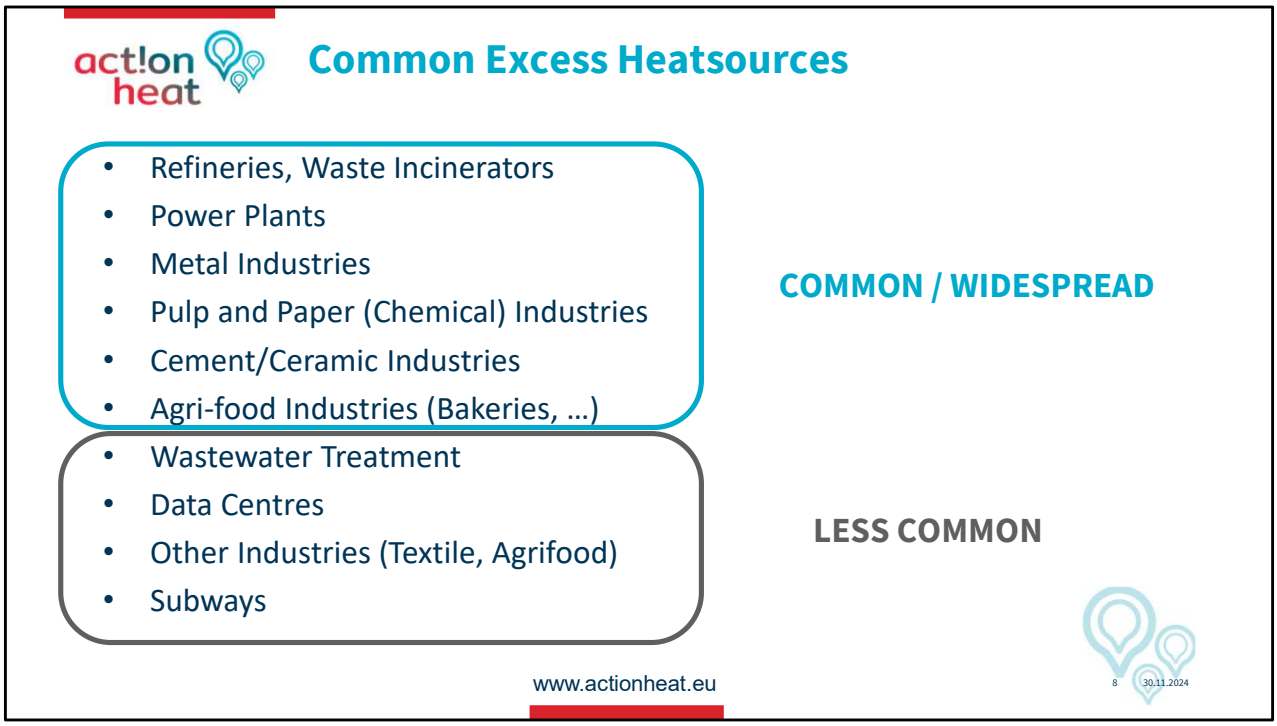
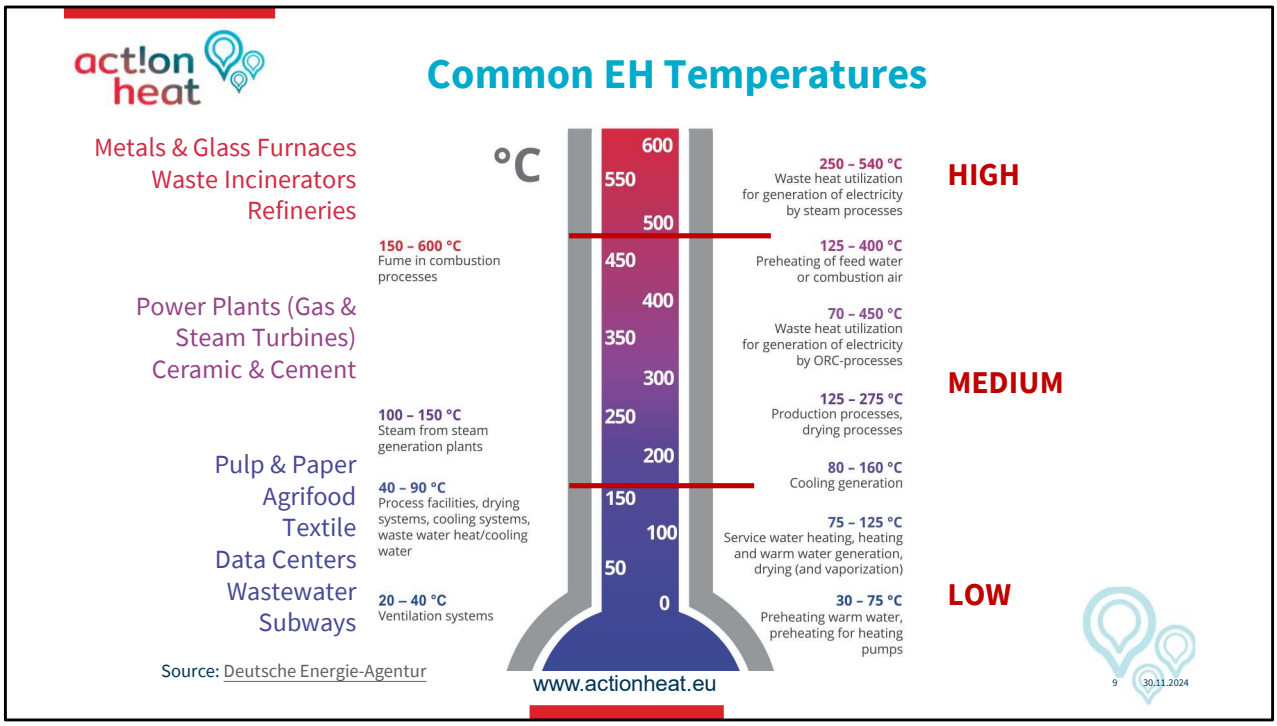


Kind of Excess Heat sources

- High-temperature sources:
  Refinery, Metal, and Cement industries…
- Low-temperature sources:
  Agro-food, wastewater, data centers…

Note: The Excess Heat from waste water treatment plants and data centers will be the object of the next Webinar; therefore, those sources will be shown briefly.



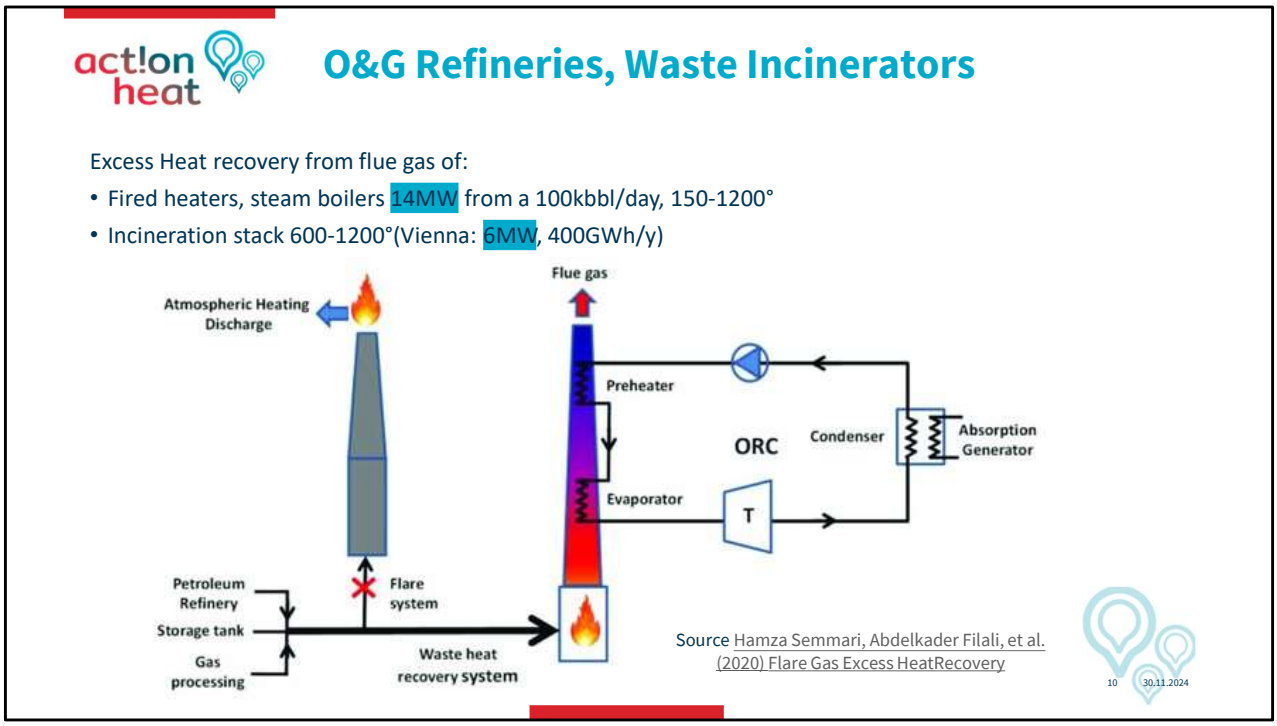
EH temperature industrial ranges

- Low temperatures are everything that is below 100 degrees or max 150 degrees Celsius
- Medium temperature between 160 and 450 degrees
- High temperatures all above 450 degrees

Note: the Industrial temperature of the process is not the temperature of the Excess Heat source. It is lower because of some loss during the process.

In the case of a low-temperature process if the Excess Heat is pretended to be reused, normally Heat Pumps are added to the system to increase the temperature.

Next: some excess heat industries



Incinerator is a High Excess Heat

The Chart shows what happens in each industrial process.

- In this case, the incinerator: The flue gases that excess the incinerator process are reused for a heat exchanger to provide Excess Heat or for an ORC circle

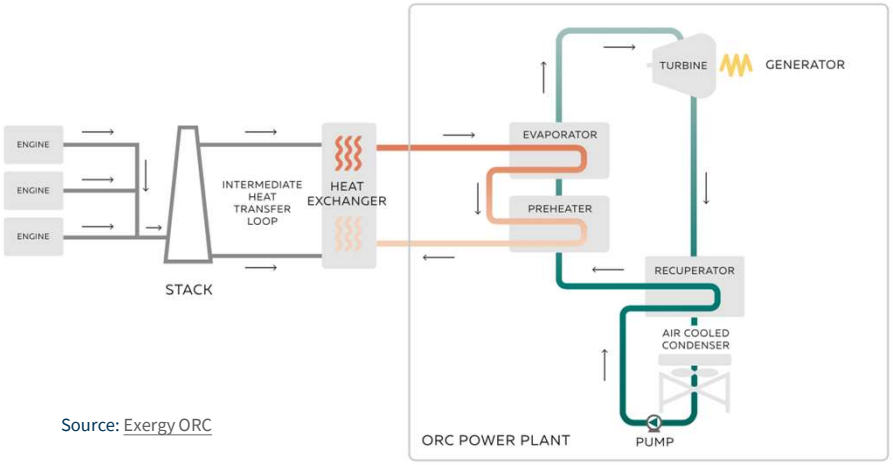
The highlighting shows the typical capacities and temperatures of each industrial process. Each case needs to be distinguished by what could be the potential and the temperature.

- In the case of a refinery: Steam boilers operating with 100 thousand barrels per day and a temperature range between 150 and 1200 grades could be equivalent to 14 megawatts of internal power.

- In the case of an incinerator finding in Vienna: The incinerator stack has temperatures between 600 to 1200 grades, with a power of 6 megawatts.

Power Plants

Excess Heat recovered from flue gas of turbines and steam condenser (150°-1200°, 10-30MW, average supercritical coal plant)



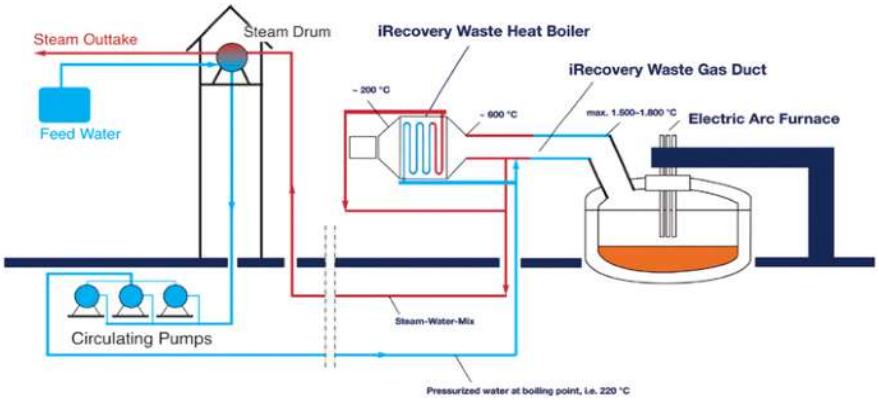
Source: Exergy ORC

Power plans can also have Hight temperatures

Those that are around Europe with a capacity between 10 and 30 megawatts could be considered as a High temperature.

Metal Industries

Project cost:
4-36M€
Capacity:
3-120MW
EH recovered:
1-250 GWh/y
DH Network size:
1-500 km
Distance: 2-8km
EH temperature: up to 200-1200°



Source: Lifeng Zhang, Excess HeatRecovery from Metal Industries

Examples: Thyssenkrupp AG (Duisburg/ Dinslaken), Arcelor Mittal (Saint Chely d'Apcher, Dunquirque)

Metal industries are common sources of Excess Heat.

They can have a capacity between 3 to 12 megawatts, depending on the size

The temperatures are going from 200 to 1200 degrees

Note: the temperatures that are highlighted are the industrial process temperature but not the Excess Heat temperature, which is lower

Pulp and Paper (Chemical) Industries

Project cost: 4-23M€

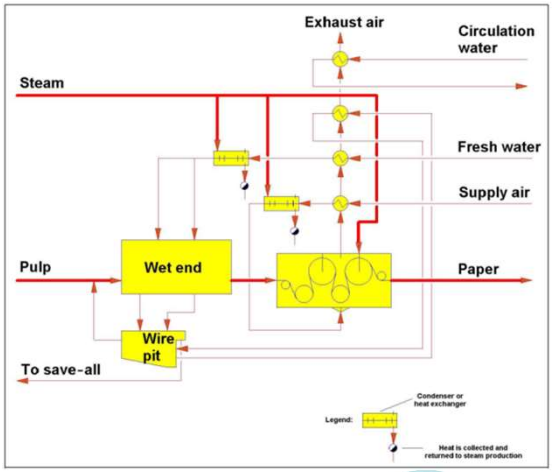
Capacity: 2-35MW

EH recovery:
5-175 GWh/y

DH Network size: 7-1200 km
Distance: 1-7 km from plant

EH temperature: 150-400°from vessels containing pulp, from flue gases of boilers, from sewage water and pulp drying

Examples: Zellstoff Pöls AG (Aichfeld, Austria)



Source: Paper Machine Heat Recovery

Pulp and Peper could be a medium temperature source

The Excess Heat can come from:

- The flue gases of the boilers
- The bases containing the pipe
- The waste water
- The drying process

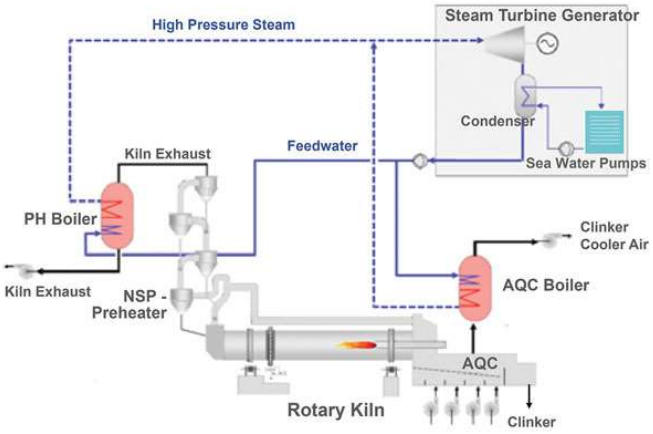
Cement Industries

Project cost: 1-5M€
Capacity: 4-5MW

EH after internal recovery:
4-22 GWh/y

DH Network size: 4-22 km

Distance: 1.5-2km from plant
EH temperature: 300-350°



Source: WHR in a Cement Plant, The international Cement Review

Examples: Kirchdorfer Zementwerk Hofmann, Zementwerk Hatschek, Lafarge Zementwerk Retznei (Austria)

Cement industries are a medium-temperature source.

The chart information shows the development cost for small District Heating networks that were constructed in differet parts of Europe described in the example part.

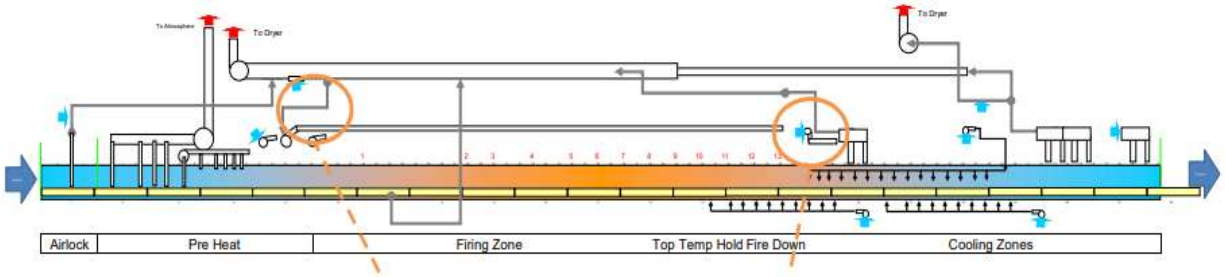
Ceramic Industries

Common heat recovery (150-200°) from roller kilns (750-1800°):

- Self-consumption for spray drying and drying phase
- CHP turbine/generator (~3-5MW) saving 10-50% of heat input

Additional heat recovery from firing roller kiln(s):

- KPM Porcelain - Vattenfall urban DHC, Berlin (110°- 1MWh/y)



2. Flue gas used in preheating 1. Hot flue gas recovered

Source: Weinerberger and Ceramics Federation, The potential for recovering and using surplus heat from industry

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Ceramic Fabric has a Medium temperature EH

The chart shows the recovered temperature of a ceramic industry which is lower than the used during the process but stays considered higher for its reuse.

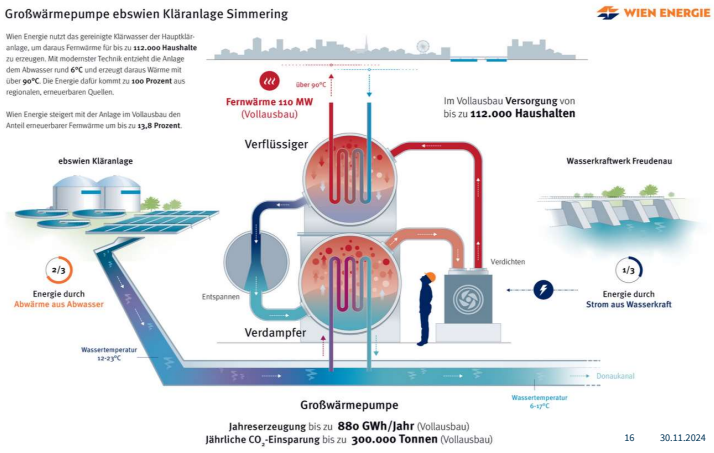
For example, in Berlin exists a ceramic industry supplying the local network with a temperature of 110 degrees with a capacity of I megawatt per hour.

Wastewater after treatment

Implementation example:

- 110 MWt at full capacity with over 90°C flow temperature
- 70 MEUR Investment
- Delta T: ~20-5°C
- 2/3 of energy by waste heat from waste water
- Production: 880 GWh/year

Source: Wien Energie



Wastewater treatment plants are low-temperature sources

Regarding treatment plants, there are two possibilities for recovering Excess Heat.

- The first is before the treatment of the water.
- The second is after the treatment of the water.

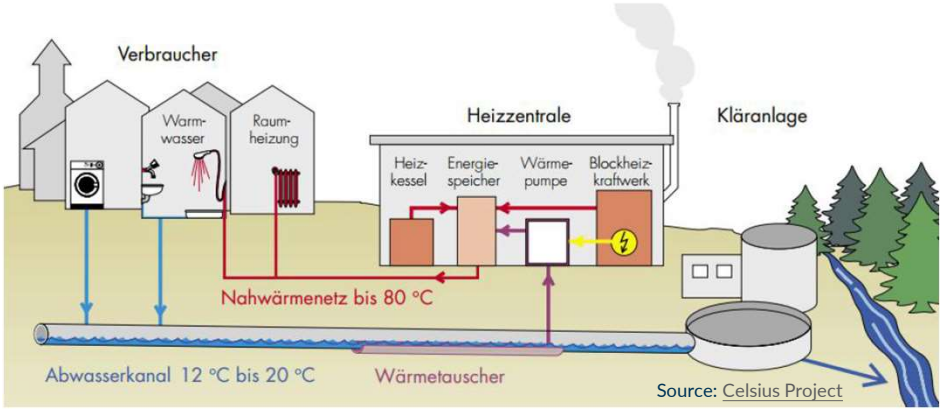
Wastewater before treatment

Example:

Capacity: 243 kW heating - 200 kW cooling (Singen)

Heat pump COP: 3.9 (Singen) Temperatures: ~15°C.

Period: since 2004 (Singen) - GVV Städtische Wohnbaugesellschaft mbH



Waste water before and after treatment are low temperature

The Excess Heat reuse from waste water treatment plants will be explained in detail during the next webinar; here is only to show the places where the EH is recovered.

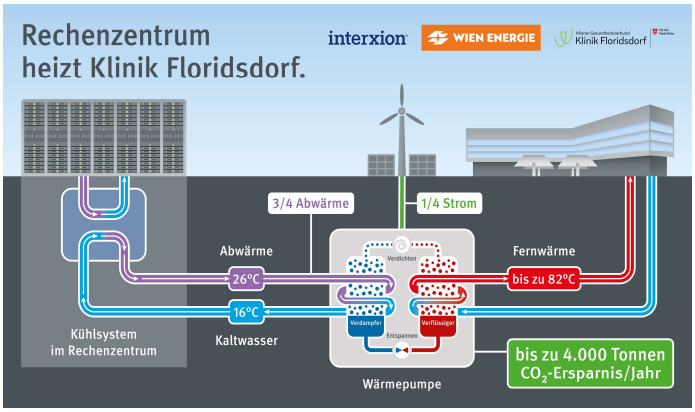
Datacenters

Implementation example:

- 3.5 million € investment

(incl. support from the government)

- Approx. 120,000 servers
- Realization: mid-2023
- Delta T = 10°C
- Total of 3 HP:
- Heating capacity: 3 MWth
- Cooling capacity: 2.1 MW
- Flow: up to 82°C
- ¼ renewable electricity
- 3/4 of the energy by Excess Heatfrom the data center.
- Examples: Val d'Europe (FR), Mäntsälä (FL)



Source: Wien Energie

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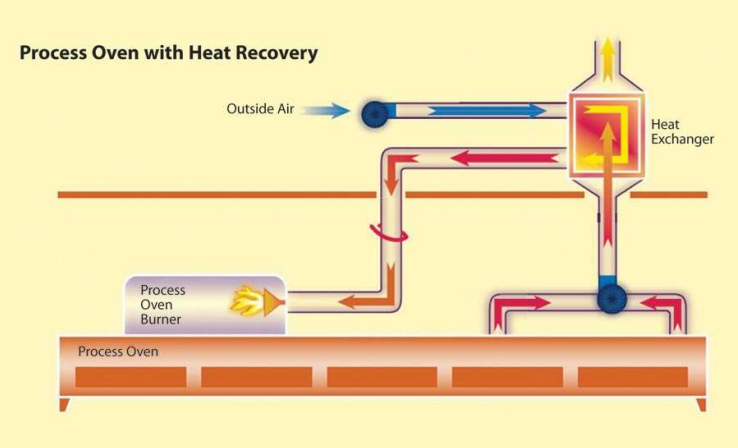
Data centers are low-temperature sources

Normally the use of Excess Heat from low-temperature sources, which is moderate, requires the assistance of a Heat Pump that increases the temperature to reach the desired temperature for the use in a District Network.

Agri-Food Industries

Project cost: 0.5-19M€
Capacity: 0.5-5MW
EH: 2-20 GWh/y
DH Network size: 3-30 km
Distance: up to 8km
EH temperature: 100-250°from flue gases of baking ovens, 20-50° from breweries, distilleries and milk pasteurization
Examples: Manner, Meyer Waffel, Breweries (Puntigamer, Leoben), Tirol Milch



Source: Process Heating, Heat Recovery for Process Efficiency

The agri-food industry is at a low and medium temperature

The Excess Heat from the Baking ovens can be reused:

- Internaly for destilation, fermentation process
- Externally for District Heating reuse

Texile/Laundry Industries

Project cost: 1M€

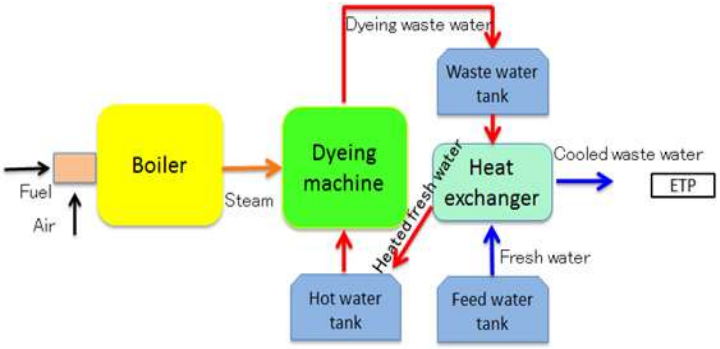
Capacity: 0.5-1MW

WH: 4 GWh/y

DH Network size: 1 km

EH temperature: 60-90° from exhaust hot water (washing machines, dyeing process) and steam (dryers)

Examples: Getzner Textil (Bludenz)



Source: Excess HeatRecovery and Utilization in Textile and Garment Factories

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Textile and Laundry industry are low-temperature sources

Textil industries have a limited production capacity. Nevertheless, the excess heat can be reused, which is normally coming from:

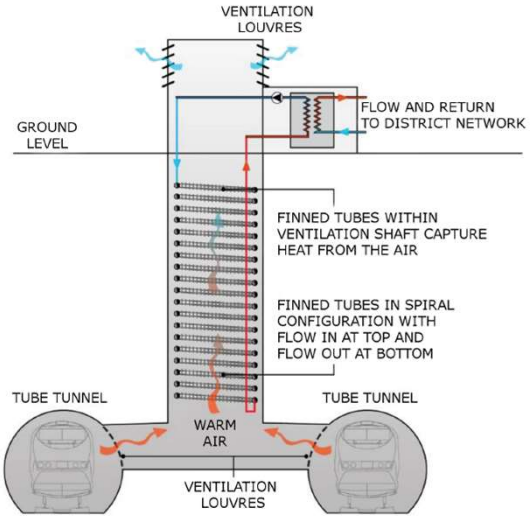
- Washing machines
- Drying process
- The steam of the dryers

Subways

Temperature:
10-30°
(winter / summer)

Capacity: 1MW

Examples: London, Turin, Vienna, …



Source: Celsius Project

Subway is a low-temperature source

The reuse of Excess Heat coming from the subway is a relative new discovery, that can be exploited in the most of the big cities and this is coming normally from:

- Brakes of the trains
- Air circulation on the tunnels

Excess Heat Cadasters: sources mapping, registry set-up, and examples of existing ones

Part I - Excess Heat: what it is, why it is used and how

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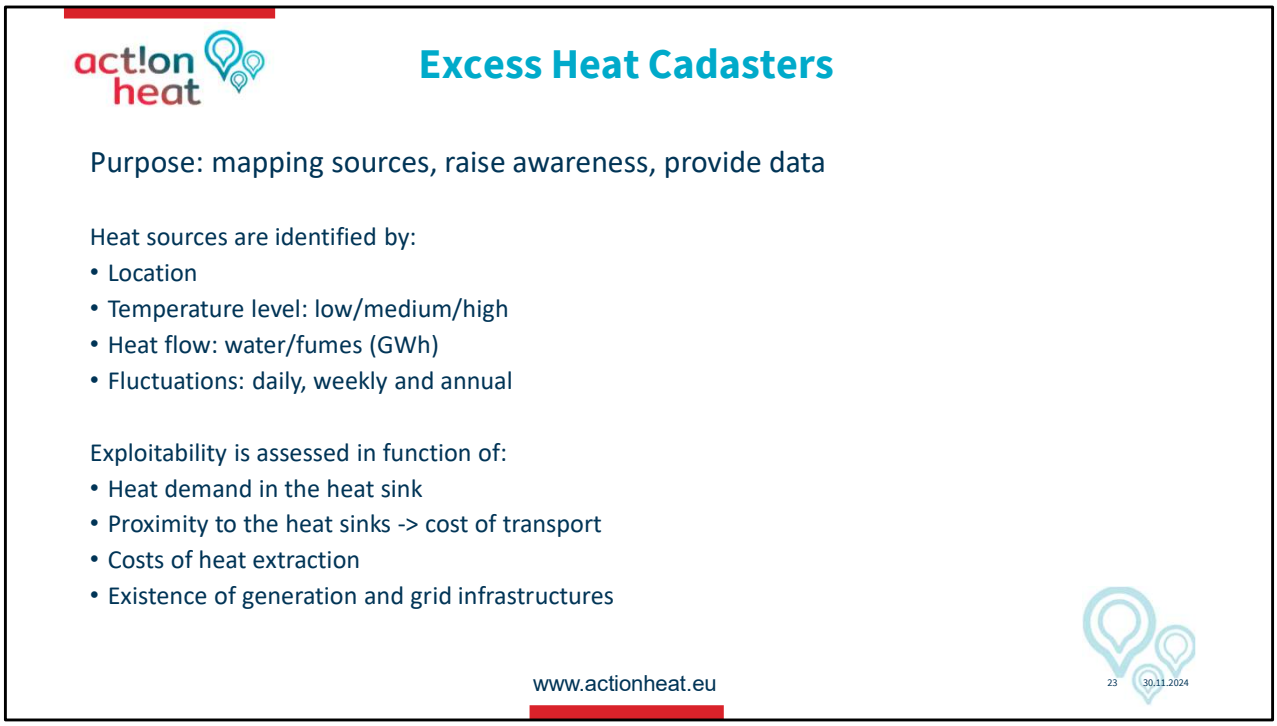


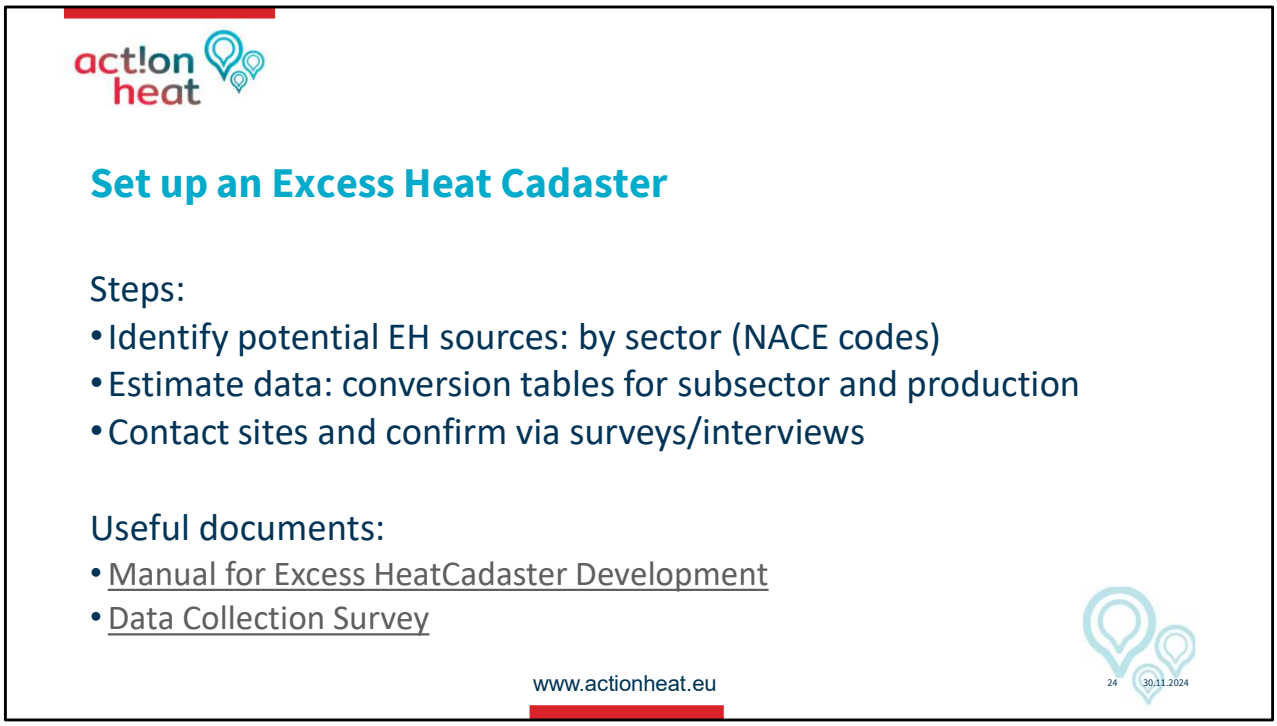
Overview of what is Cadasters

- Excess Heat Cadasters development is increasing.
- Some regions could have similar approaches or different ones.

The main idea with Cadaster is to map sources:

- It helps to be aware of the existence of Excess Heat sources.
- Providing different kinds of data to connect possible suppliers with sinks.

The chart explains how to find Excess Heat sources and exploit them according to their location and operative data.

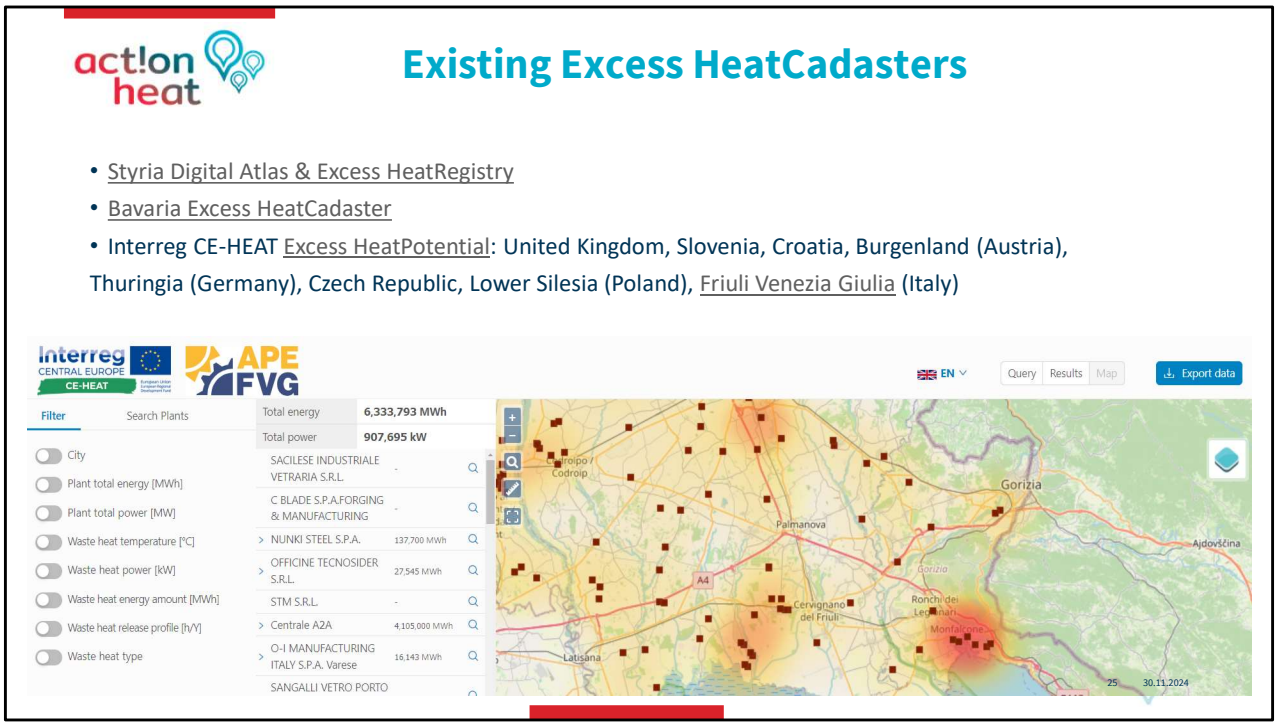


Find a sorces with Cadaster

Look and the industries that you have nearby, remembering that the information could be:

- An outside estimation for the potential EH
- Information provided by the industry

Note: The links can help to find extra information about cadasters and its data collection, and the presentation slide can provide questions in case a participant requires other regions.

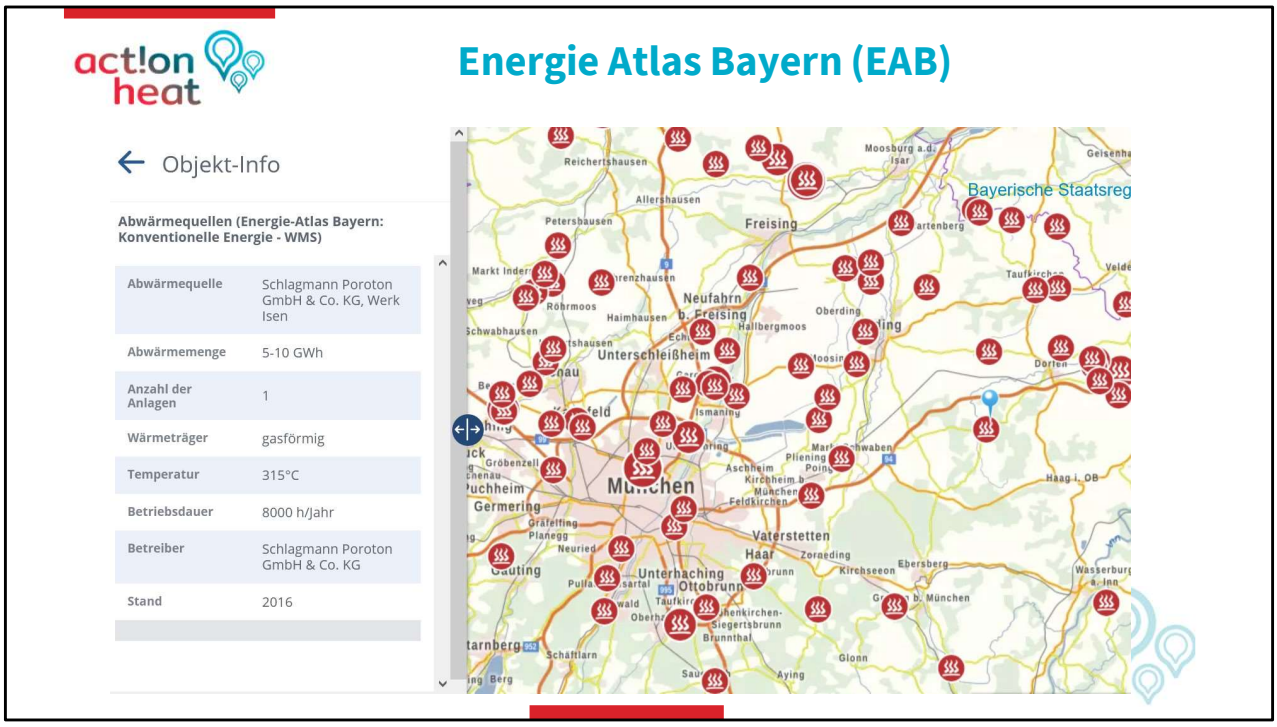


Different Cadasters

The chart shows two different cadasters,

- The Barvarian
- An interactive project with some Cadasters for region of Styria.

First, the Barvarian, was presented.



EAB is in the GIS mapping for Excess Heat and other renewable sources like:

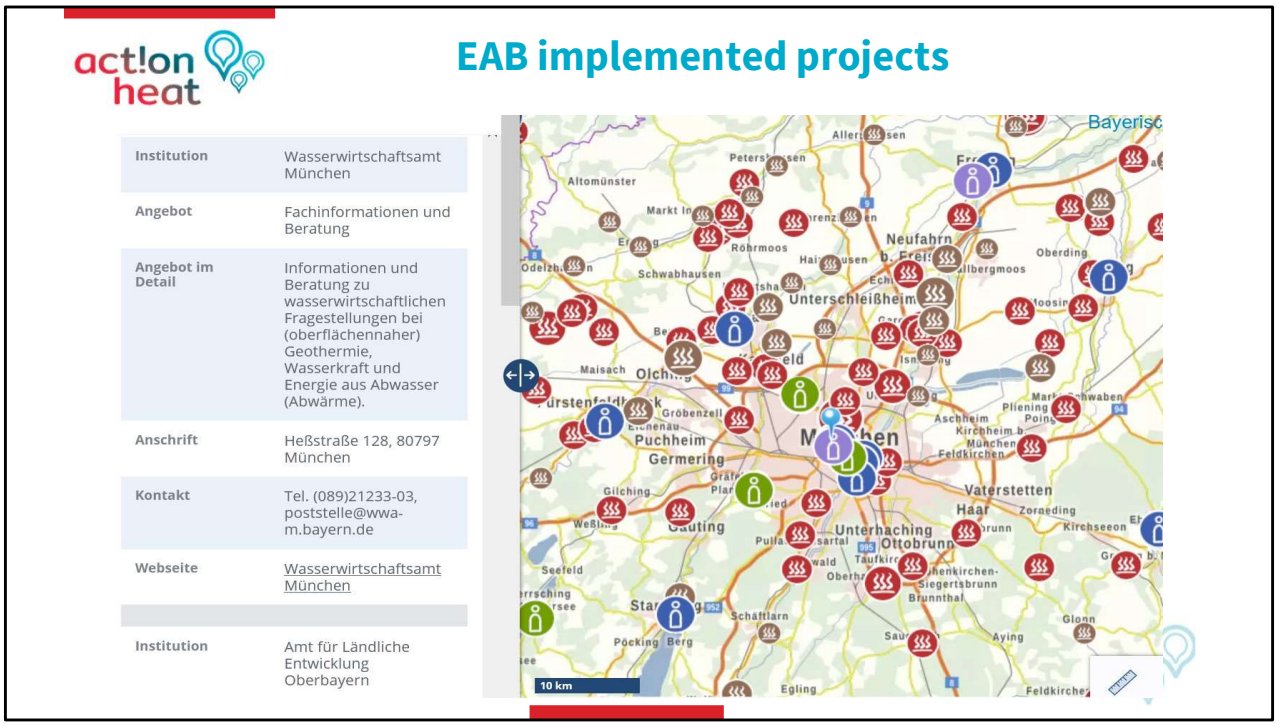
- Geothermal
- Hydropower
- Wind energy
- Biomass

It is possible to go to Excess Heat and open the potential to see all the sources they identify. If you zoom in on the map, you can see where it is, and by clicking on it, you can identify:

Company name: Schlagmann Poroton

- Estimation of Execes Heat potential: 5-10 GWh
- Heat transfer medium: gaseous
- Temperature range: 315°C

- During how many hours in the day is it possible to have that: 8000 h/Jahr



Implemented projects information

On the left side, it is possible to find:

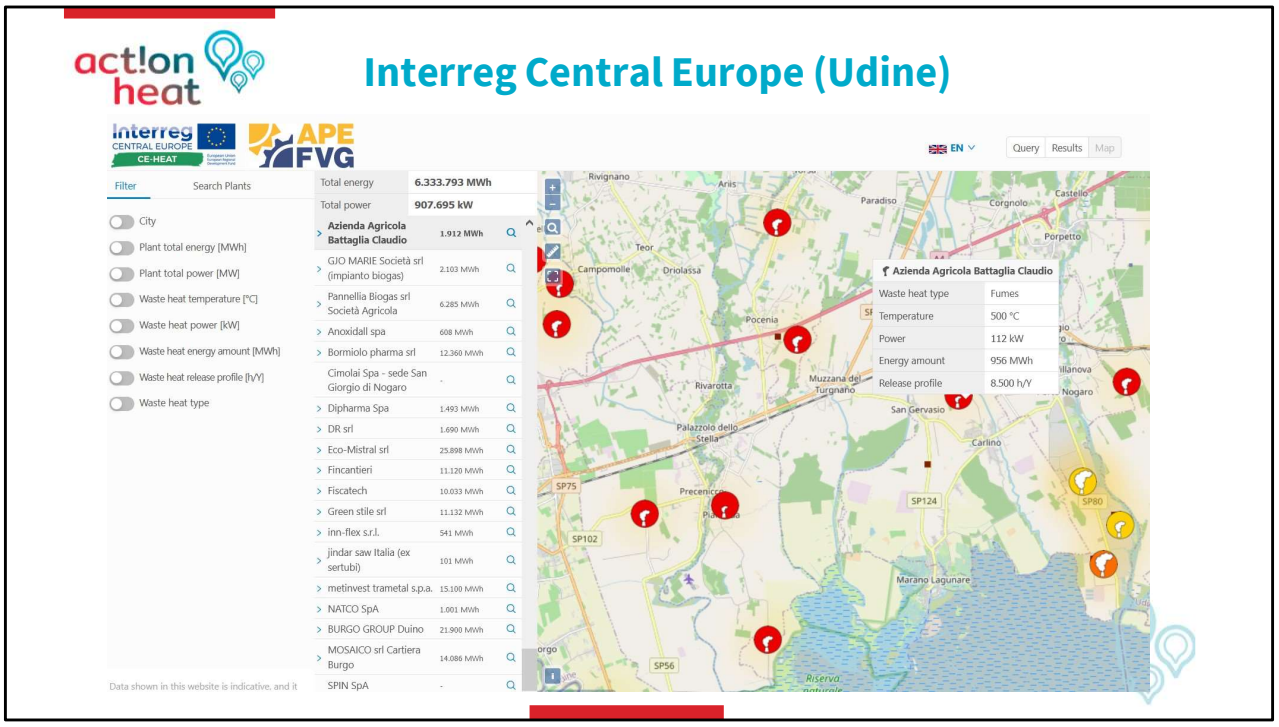
- Waist water potential
- Places where the Excess Heat is already reused

Those implemented projects can help as a significant driver.

A click on the info symbol, it will be possible to see:

- The contact person's data to get in touch and have more information.

Note: they are also heat networks implemented to understand how it mainly supplies one area.



The Interreg project.

It is a central European project for the region of **Udine, Venecia.** In its internet atlas will be possible to visualize the locations for:

- High-temperature Excess Heat potential industries in red
- Medium temperature potential and lower with other colors

If you click on one, it will be possible to see information about:

- The media
- Temperature
- Power
- Energy amount
- How stable

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Excess Heat:
Challenges & Factors of success

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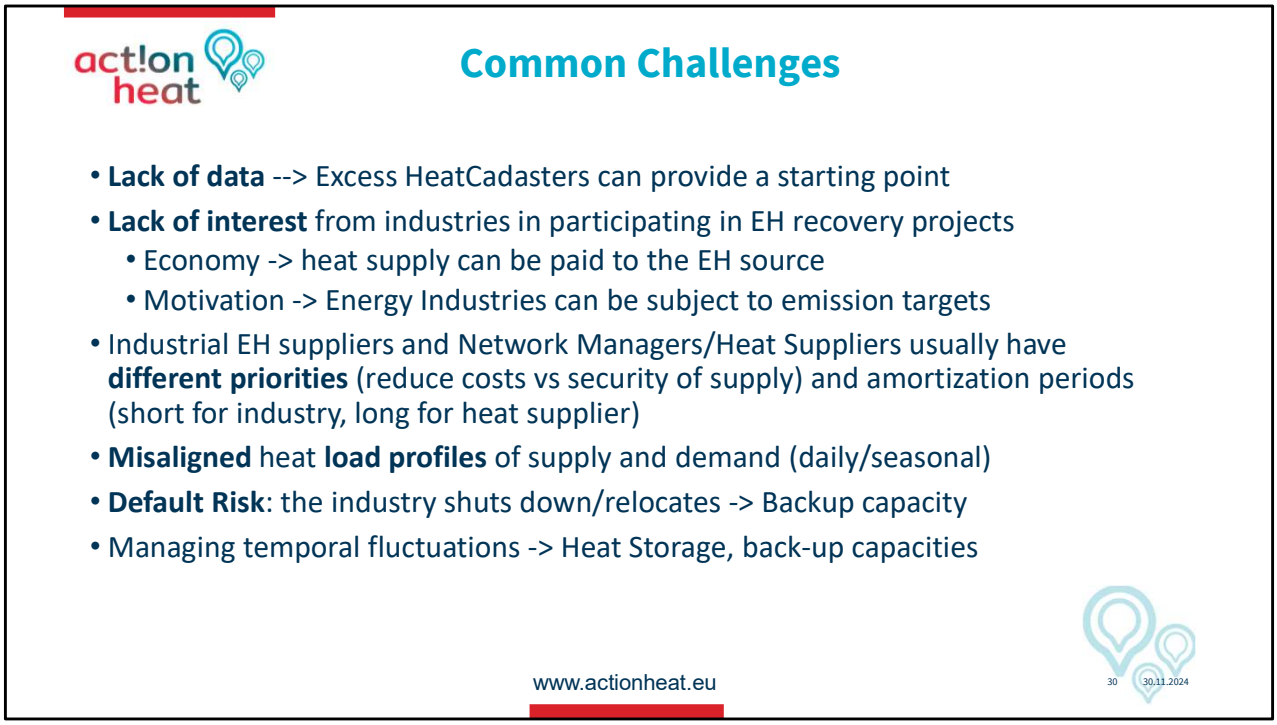


Important challenges

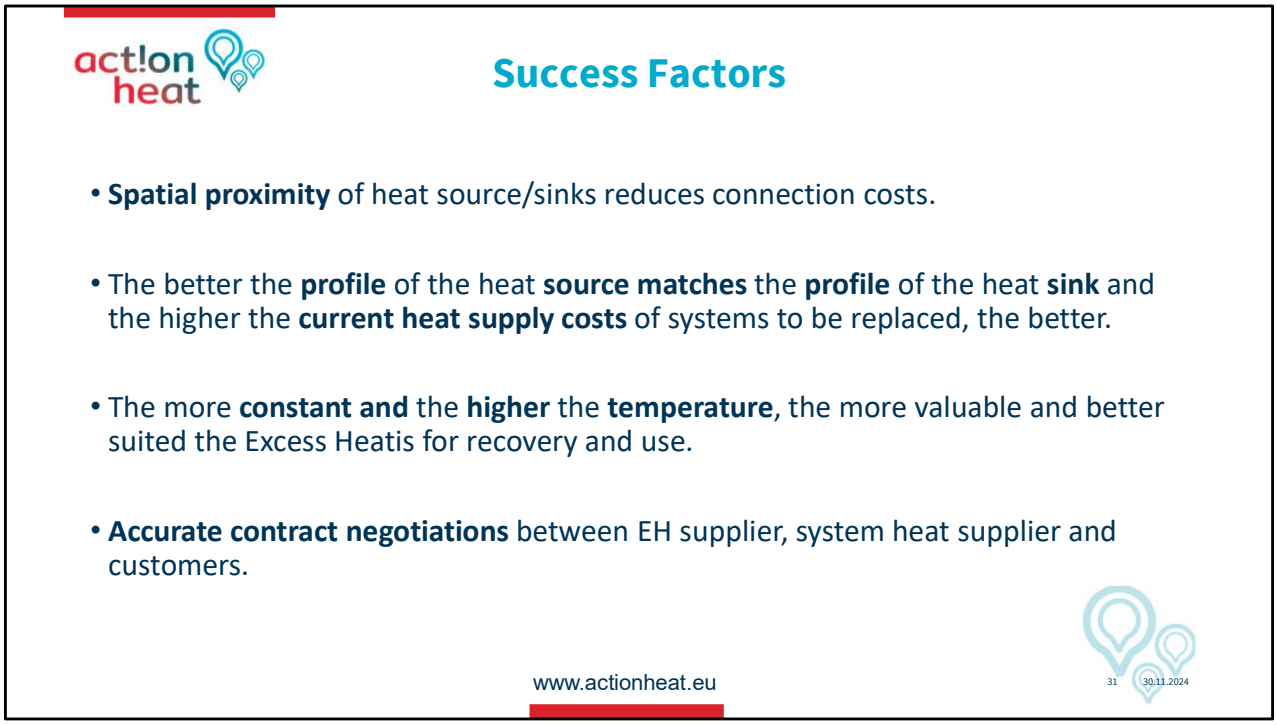
To unify the information for sources and sinks

Contact with the information companies.

Convince companies about the importance because they have other priorities

The connection between companies as suppliers and the demanders.

The company stops working because it is closed.



Important Success Factors

The proximity between suppliers and users helps reduce costs.
In some projects, distances exceeding 20 km are feasible due to the significant availability of excess heat (EH). Systems with consistent and higher temperatures are generally more advantageous.

Additionally, contract templates between sinks and suppliers are now available, streamlining agreements. These templates were offered to participants during the webinar as a resource.

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Discussion - Q&A

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Hotmaps:
EH Layers, CM Add Industry Plant, CM Excess Heat Transport Potential

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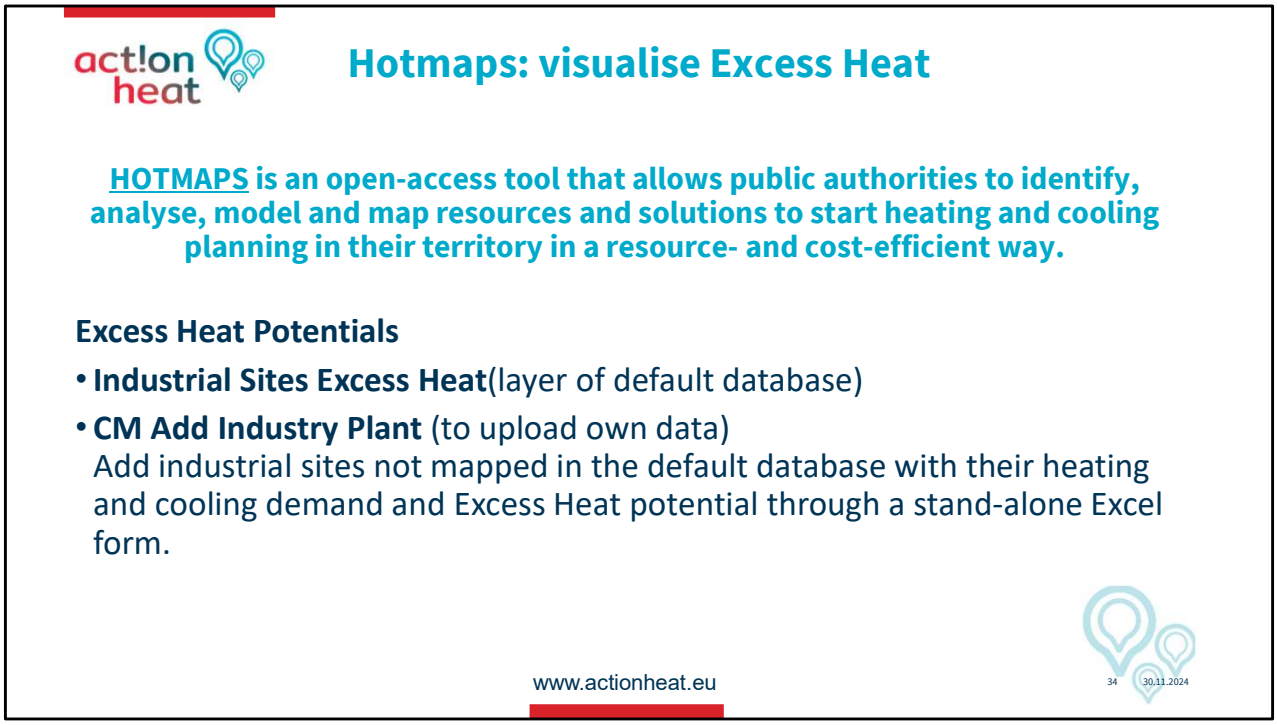


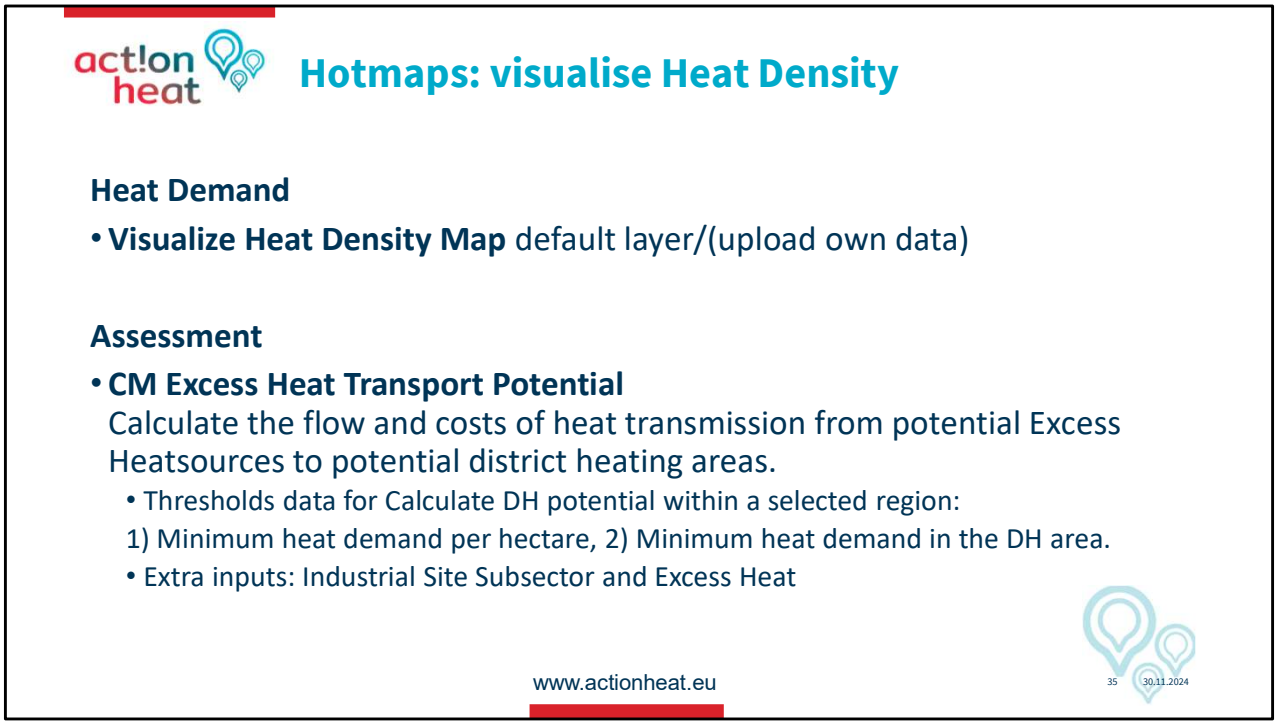
HOTMAPS is an open-access tool built in 2020.

Hotmaps is a platform with several layers and calculation modules, but for this webinar, we will focus on two-specific tools of hot maps.

Has a database that estimates excess heat potential for around 5000 energy-intensive industrial sites in Europe. This means you must find an Industry with excess heat in your territory, but if you don´t find one, you need to start an action-heat plan. Then, the platform will allow you to add an industry plant, uploading some specific data in its calculation module.

How to do that; download a stand-alone Excel form and fill out basic information for the industrial plant, like sector, subsector, the location with coordinates, and an estimation for the production, in case you know it. Of course, If you have more precise information, such as the excess heat and the temperature distribution, it will be better.

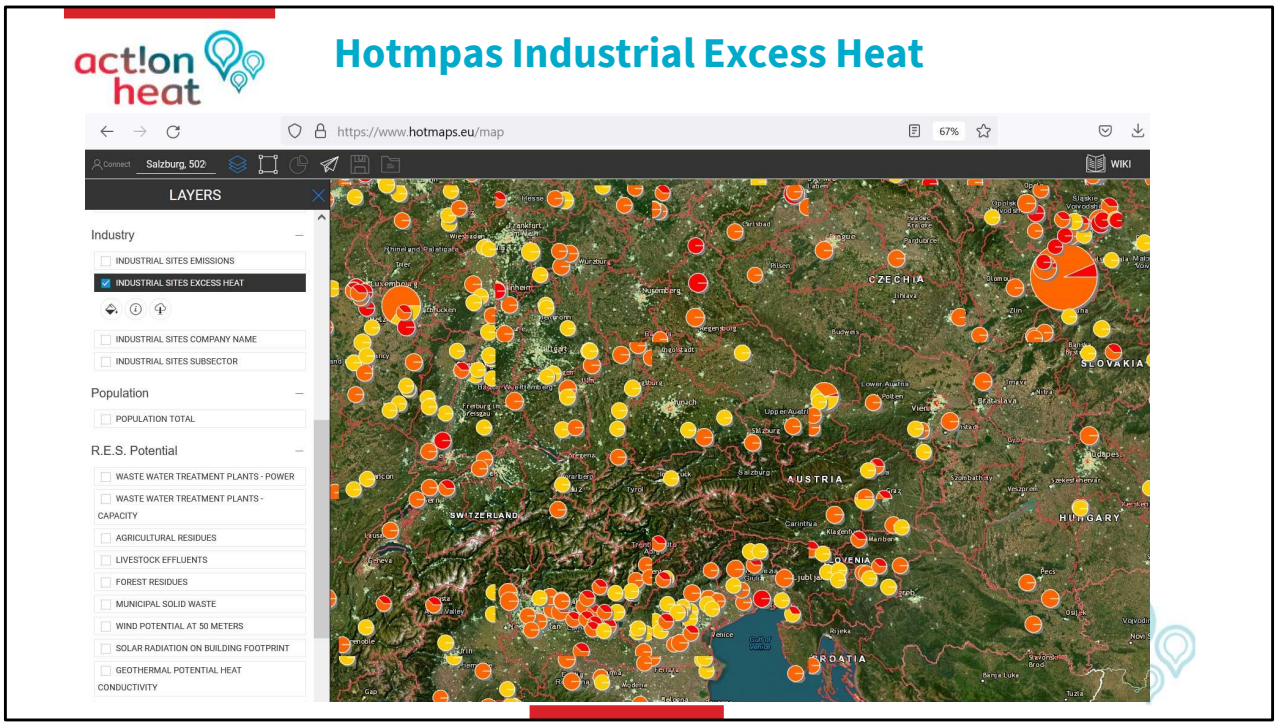
Finally, this Excel has some macros that allow it to be uploaded as a CSV file to add to the program in the database.



Heat demand calculation

The tool allows you to visualize if there is heat demand near the industrial excess heat site you are interested in and helps you calculate the economic potential to build a heating or cooling network and the cost for the distribution from the industry to that network area.

In other words, Hotmaps will help you visualize a specific heat demand area. The excess heat transport potential module will assist you in prioritizing the demand according to the percentage of users to create a district heating network. Then it will help you to calculate the flow and cost of heat transport from the industry source to that district heating network area, as I will show you next.



How does an industrial Excess Heat look in Hotmaps?

1.- Connect to the Hotmaps Toolbox: https://www.hotmaps.eu/map

2.- Search a location with the search bar (top left). In this case, it will be Salzburg

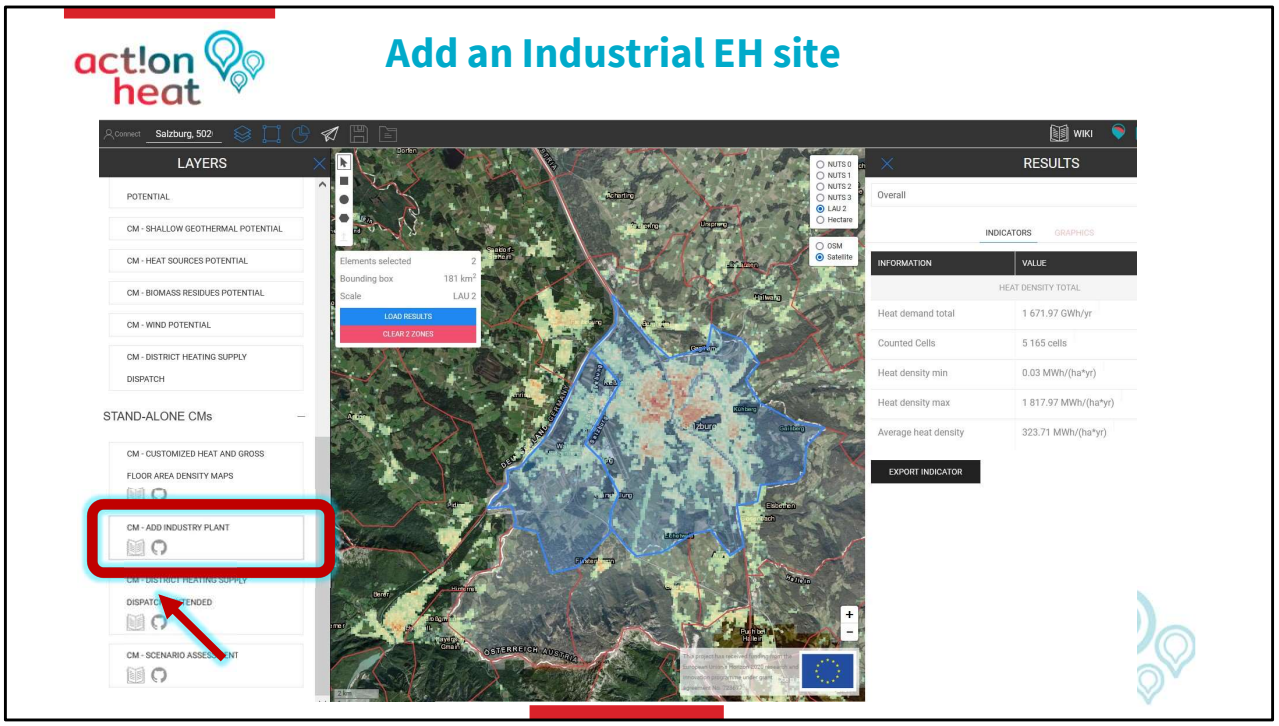
3.- Select the Industrial Sites excess heat layer and click to visualize (low, medium, high excess heat) and zoom out to see more industries:

Low temperature represented in Yellow

Medium temperature represented in Orange

Hight temperature represented in Red

Identify an area with significant heat demand near the industrial site and select it with the polygon at the hectare level.



How to add an industry source:

In case an industry you are looking for is not in the Hotmaps database, you can add one:

1. Search a location with the search bar (top left) giving the name of the place where your plant is located to see if it exists; for the case of this demonstration will be Salzburg.

2. Hotmaps do not show industrial sites in Salzburg, Nevertheless is necessary to select the place on the map at Hectare or NUT level (will appear selected in blue) in that moment, a small window on the left side will appear.

3. Click on the window Load Results to visualize (Heat Demand Total/ Res /Non-Res). The Calculation Modules option will also be open at this moment.

3. Open The Calculation Modules CM function (top left by the layers) and scroll down to find the **CM Add Industry Plant.**

4.-Click on the Wikipedia symbol

CM Add industry plant: click on the wiki link to download the Excel file

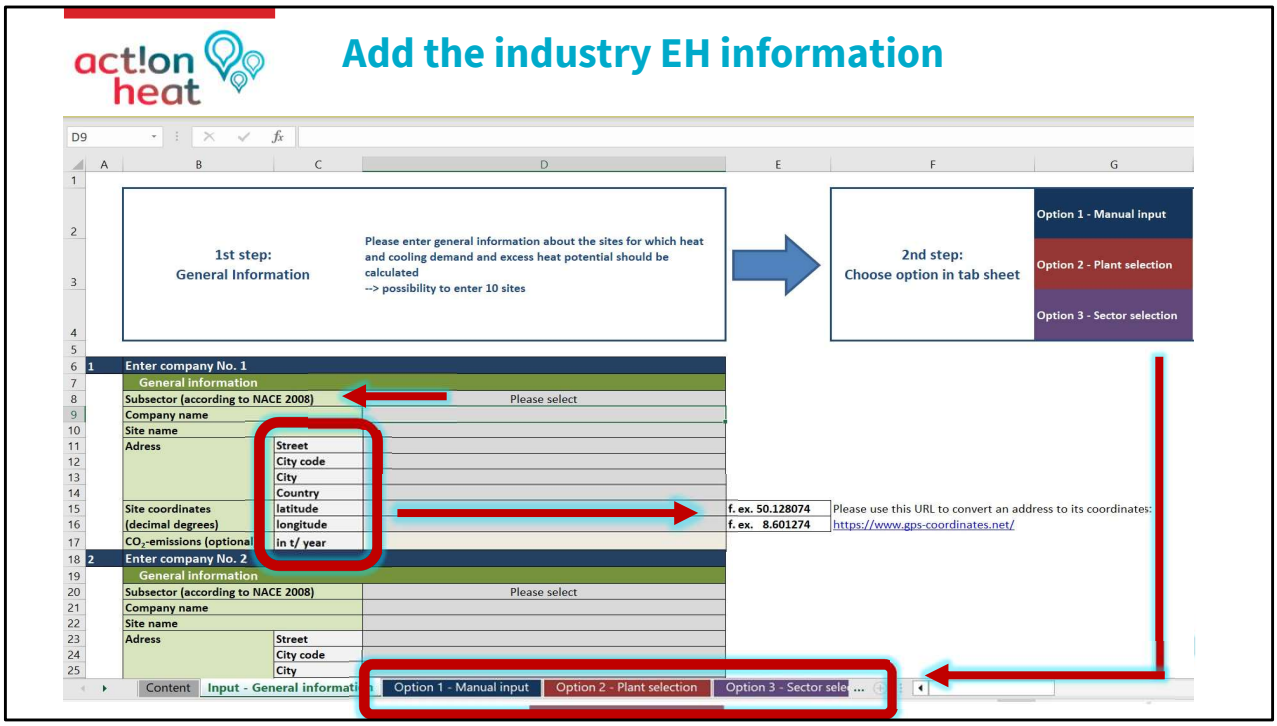
1. The wiki link will be open; scroll down until you find Data input in Excel-tool by users

2. Click on Please download the provided Excel-tool from **HERE**

3. Another window will open; go down to find the icon where to download the Exel

4. Click on it, and decide the place to be discharged in your computer

Note: The instructions for adding industrial Excess Heat data in the Excel sheet CVS format are explained step by step in the first wiki link.



Open the Excel and add the Industry information

1. Populate the general info for the industry. Important data are the subsector and the GPS coordinates to find the industry.

2. For the second step, choose an option and fill in the data on the Excel:

If you know the exact heat demand and supply

If you know only the subsector and annual production

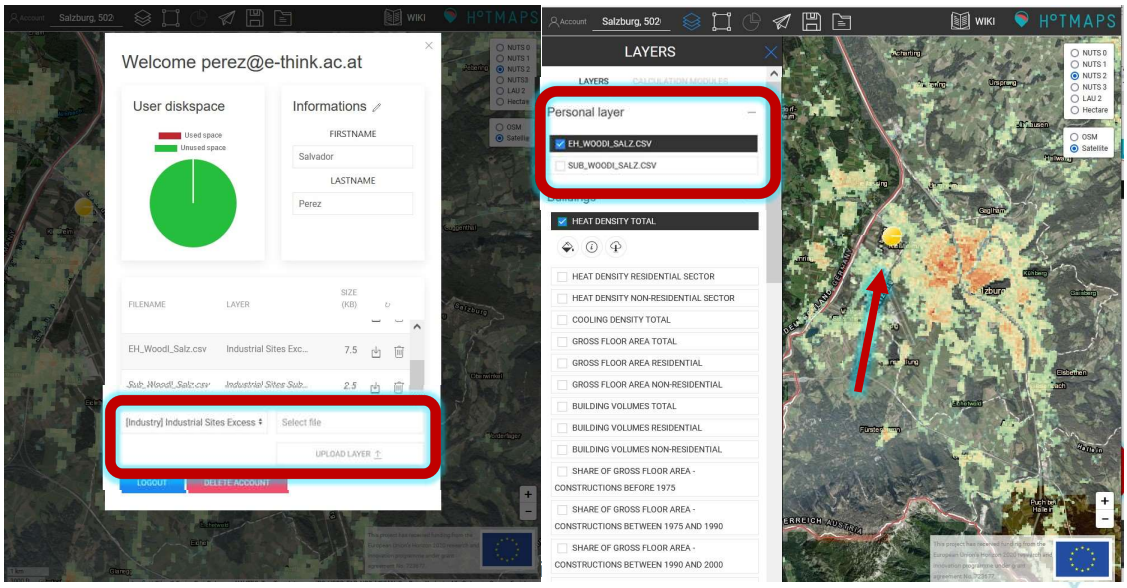
If the subsector is not listed in Option 2 is it possible to add

3. Extract 2 CSV files from the last two sheets (after completing the data)

If you need help to understand read the Wiki link indication.

Note: It is necessary to allow macros when in order to add information and save the CVS data that will be uploaded on the Hotmaps platform.

Visualize the Industry



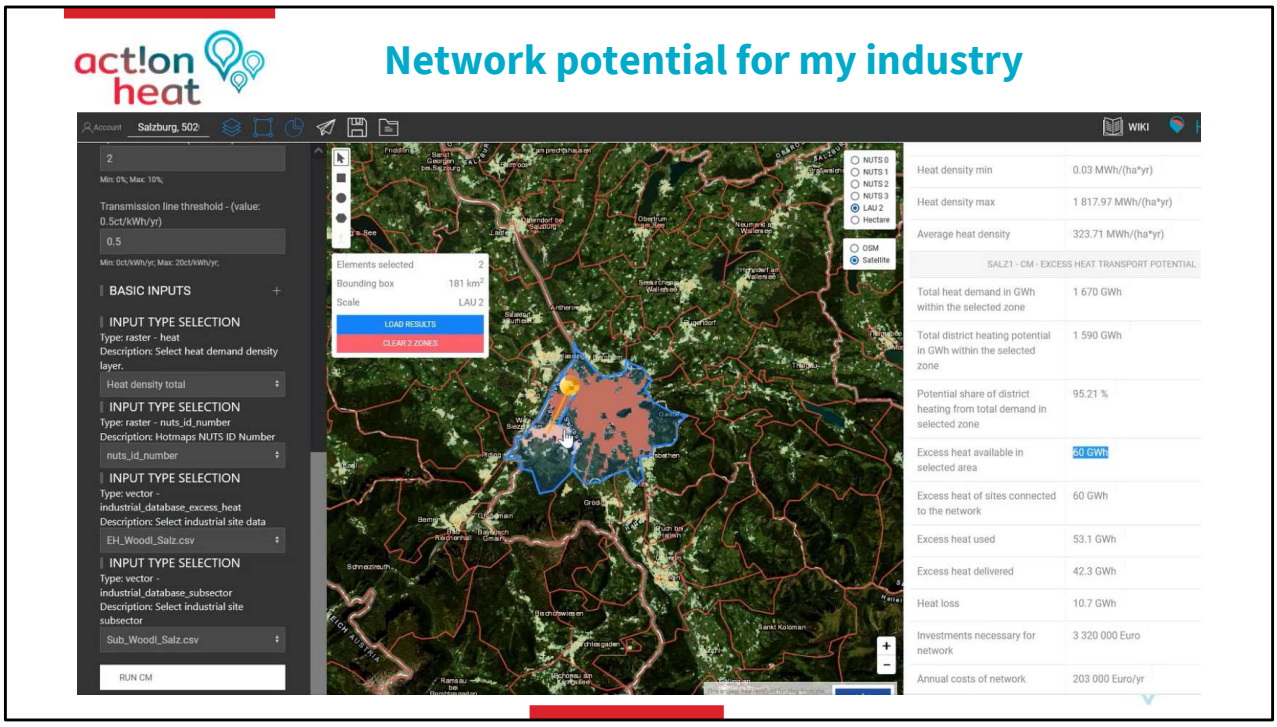
To visualize the new industry on Hotmaps

1. Create a User Account (click on Connect on the top left) and activate your account by clicking on the link in the email you received.

2. Access to your user account, select the kind of file you will ad, in this case, Industry Sites Excess Heat, the localization on your computer, and upload the 2 Excel CSV data.

3. Close the account window, and on the layers will appear two industry sites you add to the list as a personal layer.

4. Click on in and the newly added plant is visualized on the map, with a circle for Excess Heat potential and a triangle for the subsector



Calculate the Excess Heat Transport Potential on Hotmaps

1. Select a place near the industry side on the map at Hectare or NUT level (selection will appear in blue). Load the results in order to visualize the Calculation Mode CM function (on the top left by the layers)

2. Scroll down and go to the CM - Excess Heat Transport Potential and click on it.

3. The Calculation Mode window will be open, and there you can manually change the inputs for your heat demand or leave the default data.

4. It is important to Scroll down again and select the last two input type selection windows to add your own uploaded excess heat and subsector layers.

5. Run CM and assess results. If any potential area is found, it is colored on the map. Otherwise, lower the parameters until you find a potential DH area.

THERMOS and EMB3Rs Demo

Part II - Assess Excess Heat potential exploitation

This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.

www.actionheat.eu

Other Tools: EMB3Rs, THERMOS

THERMOS is a free, web-based **DHC planning software** that analyses **network options including paths, load anchors and connection to single additional buildings** for the deployment of new and upgrade/expansion of existing DHC systems.

EMB3RS is a free web-based **matching-tool** that evaluates the **compatibility of Excess Heat and cold sources and sinks** in industrial processes, energy systems and District Heating and Cooling (DHC), based on the simulation of technical and economic supply-demand scenarios.

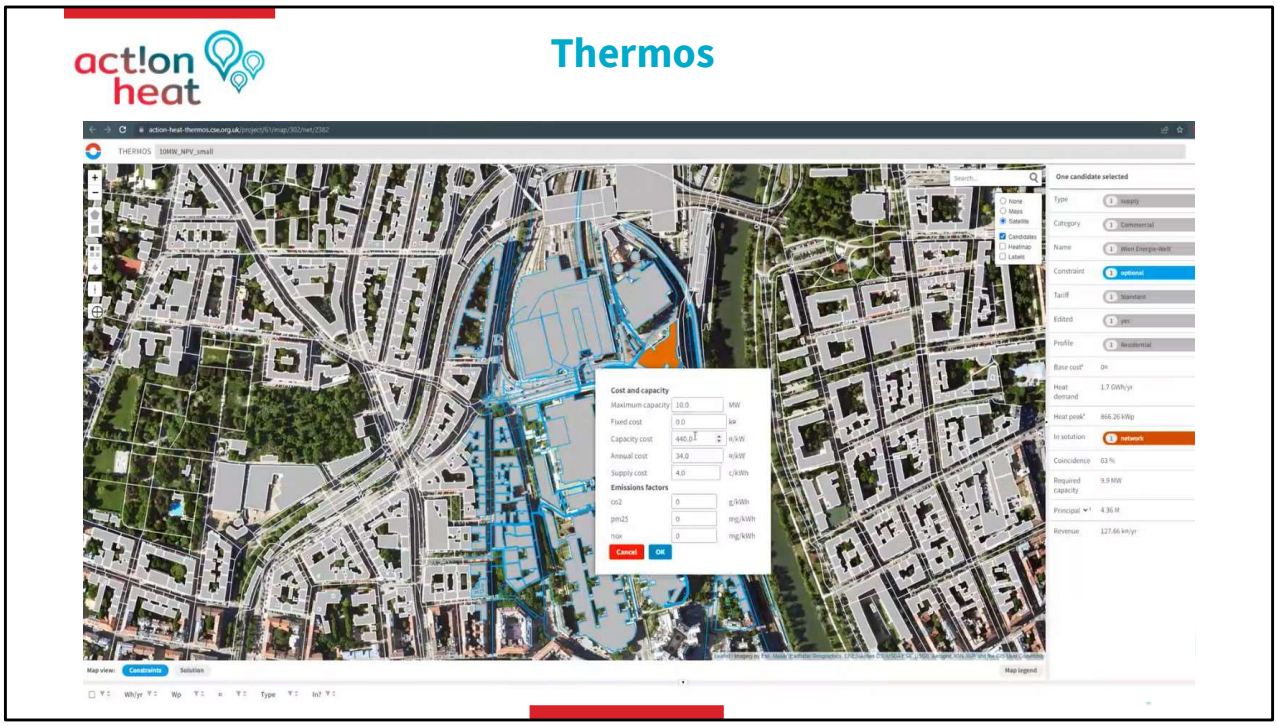
Tools for analysing the use of Excess Heat

THERMOS is a tool used for the support facility 2

- Allows to design a Network for the source to the surroundiong buildings
- Has two parts, one is supply and the other is distribution to the networks

EMB3RS has the main focus to analyse Excess Heat projects,

- The platform matches sources and sinks
- It is more focused on the Excess Heat matching that on the distribution



Tool for the district heating network planning

THERMOS was not only developed for integrating Excess Heat into a district heating network but can also be effectively used for this purpose.

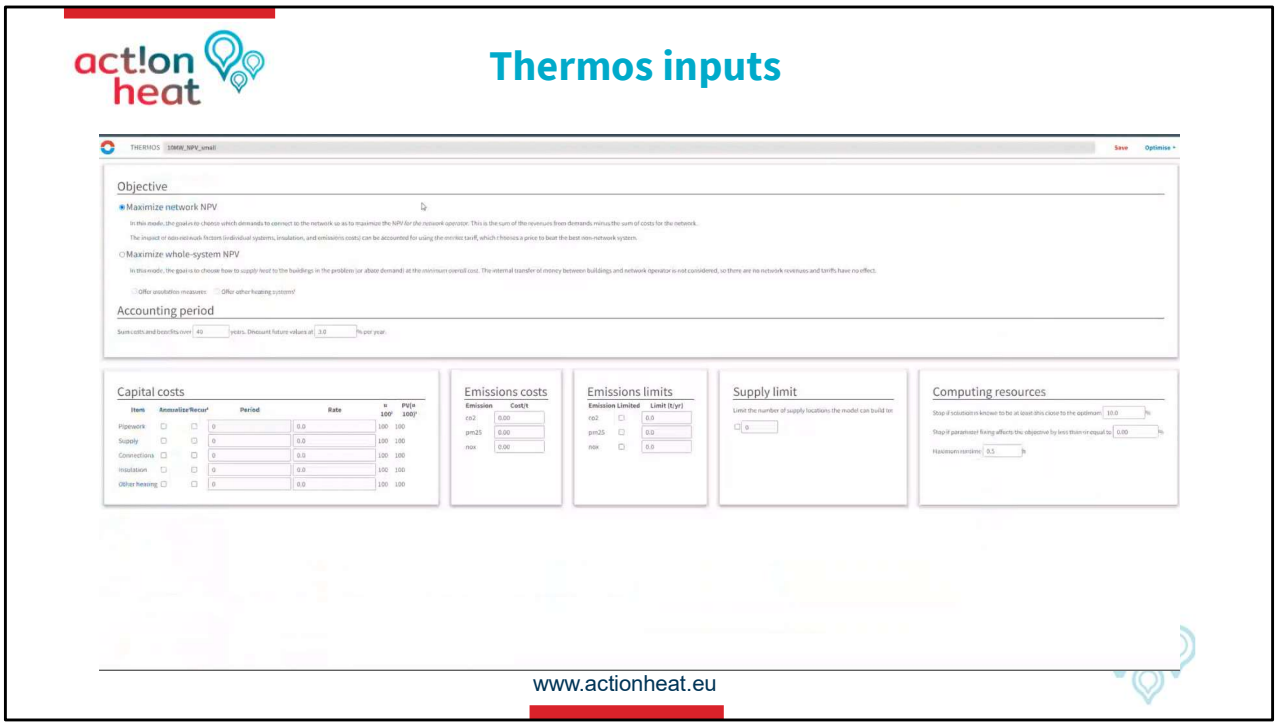
An example was presented to demonstrate the identification of optimal networks for Excess Heat supply:

THERMOS includes default data for demand and various pipe options, facilitating the construction of a regional network.

The example illustrates the creation of a network utilizing excess heat from a waste incineration plant in Vienna.

The incineration plant is represented in orange, along with its internal data, such as capacity, supply costs, and demand.

The blue lines indicate potential candidates that could benefit from the heat source through the construction of a network.



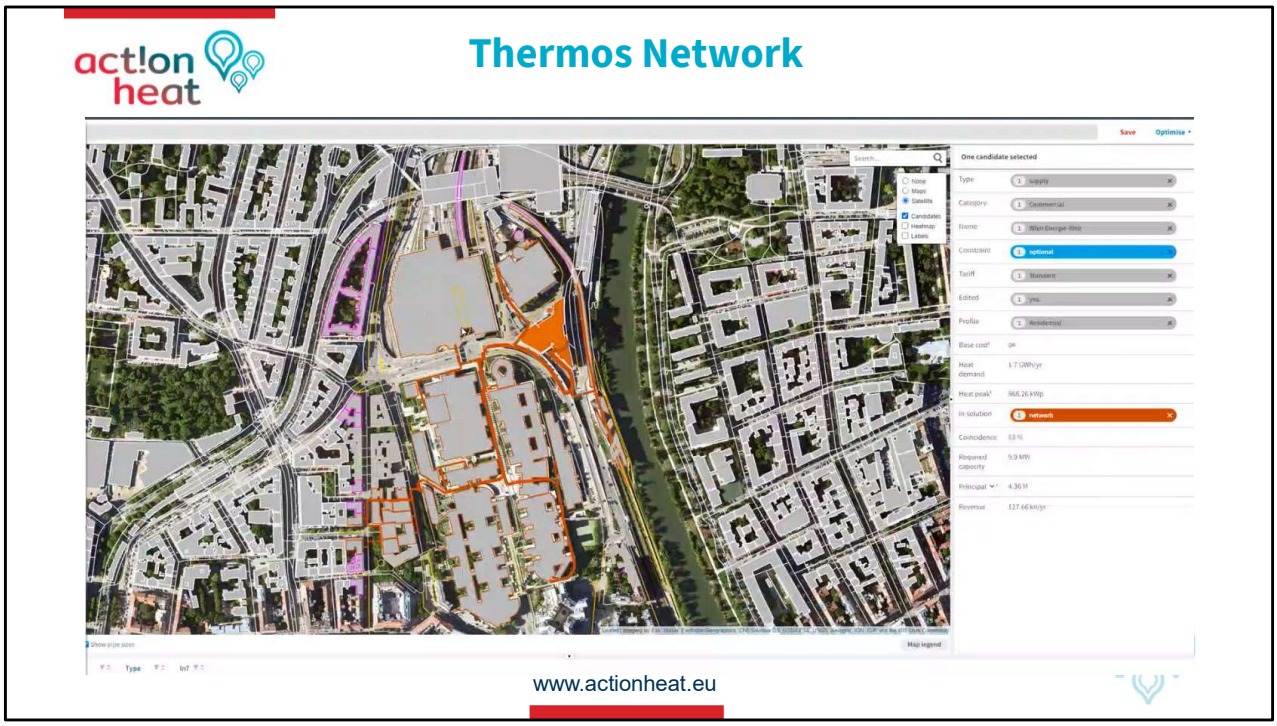
THERMOS allows for the optimization of your network

THERMOS enables you to maximize your network's Net Present Value (NPV) or overall NPV.

It is also possible to operate as an operator aiming to maximize profits by increasing the number of connections to demand points.

From an NPV perspective, the focus is on planning, where the objective is to minimize the overall system cost as much as possible.

The example will demonstrate maximizing the network's NPV to identify which demand points are most optimal to connect within the system.



Running the module provides a visual solution

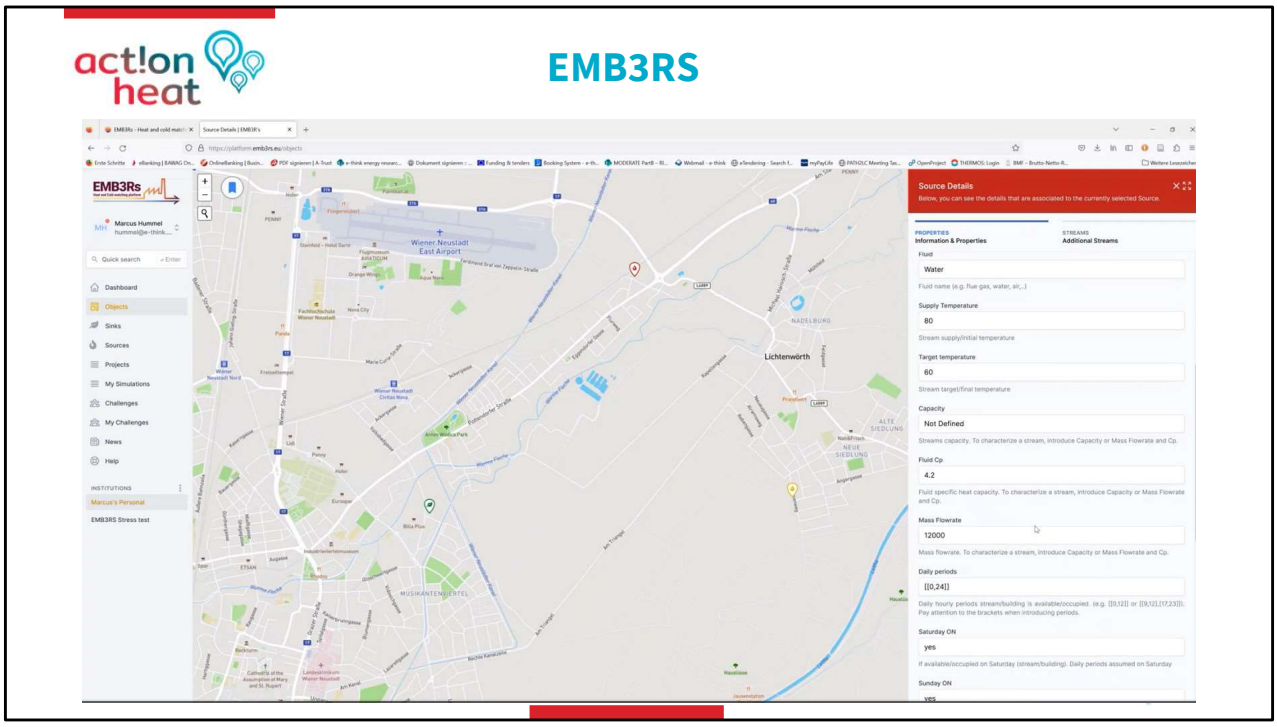
Buildings displayed in orange represent the connected buildings optimized for supply by the source.

In the window on the right side, detailed network information can be viewed based on the solution results.

It is also possible to download a summary of the solution, including the NPV and connection points.

Using preliminary data, the tool offers a preview of how your network could look with the available sources in the region. However, if specific demand and supply data are provided, the network design will be more accurate and detailed.

This tool can also be helpful for policymakers.



EMB3RS is a map-based tool

You need to define your project, territory, and the sources and sinks.

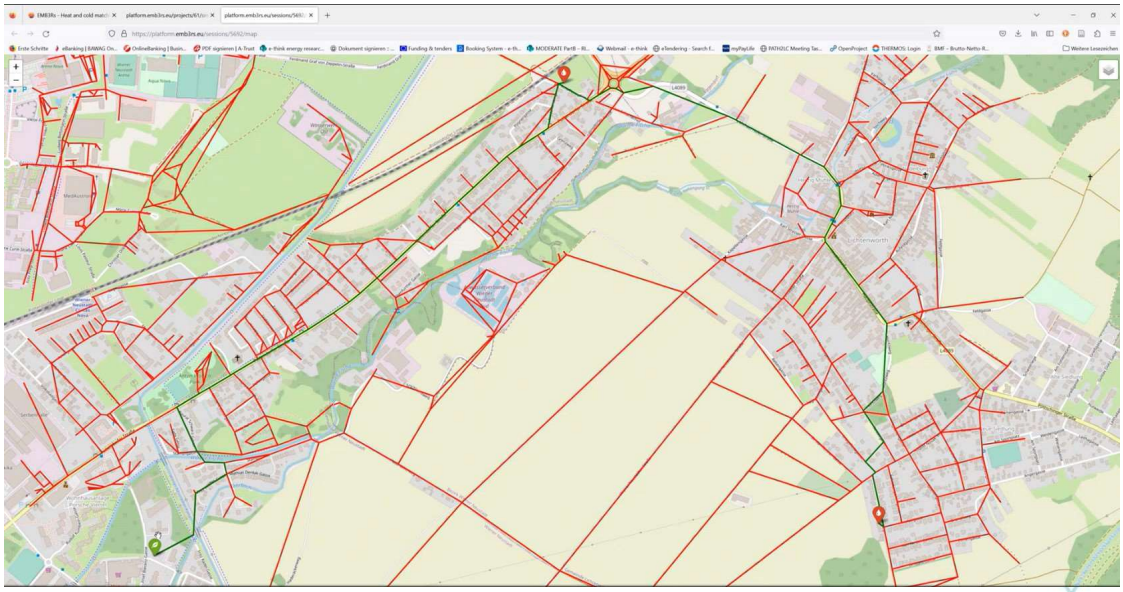
In contrast to Thermos, where buildings are not part of the background, you need to manually enter or upload all your supply and demand points.

The example shows three sources and one sink, and the platform provides options to define the sources and sinks in the template.

The Source Detail allows you to specify the capacity and availability of each source, with the option to define multiple streams per source.

The Sink Detail allows you to set the desired temperature, based on the starting temperature for the district heating system.

EMB3RS Modules



The simulation consists of different modules:

- GIS: Simulates a geographical match to find the shortest connections, calculates the size of the pipes to be installed, and estimates the resulting prices and costs for the entire system.
- Techno-Economic Dispatch Module: Determines which sources can be used and when to supply the sink. It also calculates if extra capacity is required or if storage is needed, and the app can perform the necessary calculations.
- Business Module: Helps calculate ownership details, determining who owns which sources, who supplies which sinks, and the ownership of the network.
- In general, EMB3RS evaluates how well the sources and sinks align and identifies reasonable methods for price discussions. It also considers the value of excess heat in a region based on temperature fluctuations, which can inform pricing discussions for its use.

Discussion – Q&A

Part II - Assess Excess Heat potential exploitation

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act!on heat

Thank you for your attention!

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