Guidance for group support

Project acronym	**Act!onHeat**
GA no	**101033706**
Full title according to GA	**Guidance documents developed for group support**
WP, Deliverable #	**WP3, Deliverable 3.3**
Version	**1.0**
Dissemination level	**Public**
Deliverable lead	**e-think energy research**
Authors	**Marcus Hummel, e-think energy research** **Bernhard Mayr, e-think energy research** **Salvador Perez, e-think energy research** **Aadit Malla, TU Wien** **Mostafa Fallahnejad, TU Wien**
Reviewers	**Andrea Frank-Stocker, e-think energy research** **Ali Aydemir, Fraunhofer ISI**

Act!onHeat has received funding from the EU Horizon 2020 programme under Grant Agreement No 101033706

Content

1 Introduction

This document outlines the content of the nine webinars conducted as part of the Act!onHeat project within Support Facility 1 (SF1). Detailed notes for each webinar are provided below the respective presentation slides, offering explanations and context for the material presented.

The group support webinars offered valuable insights and fostered peer learning among Act!onHeat project participants, helping municipalities and regions enhance their heating and cooling planning. The table below provides an overview of the nine webinars, including topics, participant numbers, dates, durations, and links to each session's guideline document.

Table 1 Overview of the webinars

#	Topic and content	Nr. participants	Date and duration
W1	**Data for municipal heating and cooling planning** W1 explored data accessibility challenges in H&C planning, emphasizing data handling and the use of the Hotmaps platform to support strategic policy development and implementation.	7 – 10	03.11.2022 09:00 – 11:00
W2	**Development of a data inventory for heat planning** W2 covered dynamic data inventories and heat atlases for H&C planning, highlighting data resolution, geospatial visualization, validation, and strategies to address data gaps and prioritize planning zones for implementation.	7 - 10	17.11.2022 13:00 – 15:00
W3	**The use of Hotmaps for strategic heat planning** W3 presented the Hotmaps platform, a free tool for H&C strategy development, showcasing its features, use cases, and limitations for energy and climate planning.	4 - 7	06:12.2022 13:00 – 15:00
W4	**Use of Industrial Excess Heat (EH) for district heating** W4 explored reusing industrial excess heat for district H&C, covering industry types, mapping projects, planning tools, and applications like Hotmaps for cost and infrastructure planning.	6 - 13	05.06.2023 12:00 – 13:30
W5	**Using EH from data centers for heating buildings** W5 examined data centers as EH sources for district heating, emphasizing urban locations to reduce recovery costs and the use of heat pumps with European heating networks.	8 - 14	13.06.2023 12:00 – 13:30
W6	**The use of excess heat from wastewater treatment plant** W6 The webinar highlighted low-temperature wastewater, boosted by heat pumps, as a sustainable and cost-effective solution for district H&C, benefiting municipalities environmentally and economically.	3 - 10	27.06.2023 12:00 – 13:30
W7	**Geothermal in District heating** W7 highlighted geothermal energy as a low-emission, flexible, and region-specific solution for sustainable DHC systems.	5-13	13.03.24 10:00–12:00
W8	**Space Cooling– demands, potential reduction, and sustainable supply opportunities** W8 examined Europe's rising cooling demand, highlighting energy reduction measures, system efficiency, and EU policies driving sustainable cooling for decarbonization.	8-10	17.06.2023 11:00 – 12:00
W9	**Existing heat planning policies in Europe-overview and selected examples** W9 detailed Europe's EED heat planning policies, emphasizing efficient systems, strategic zoning, public engagement, and alignment with decarbonization goals.	8-15	11.10.2024 11:00 – 12:00

2 Documentation of the Webinars

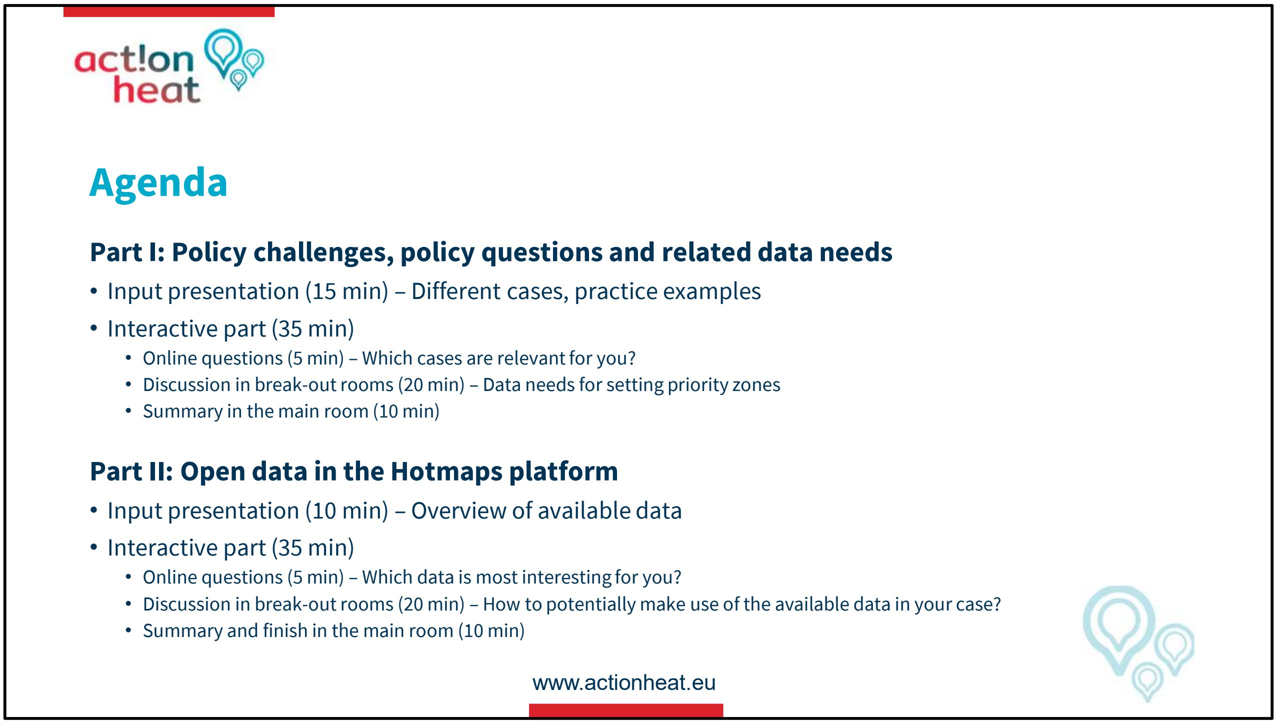
Webinar 1:
Data for municipal heating and cooling planning

Act!onHeat SF1 Time: 150 min

- Serial 1:
  - Webinar 1
    - Strategical Heating & Cooling planning
    - Group support for municipalities and stakeholders

Presented by:

- TU Wien / Austria
- e-think / Austria



The quality of data available largely defines the depth in which a strategic heating plan can be developed. The webinar focuses on the data needed for developing a heating and cooling plan, what is already available with the municipalities, and what proxy data can be used in case of unavailability.

Part I:

- Discussion on defining the different policy-level questions to be answered for the development of the heating and cooling plan and the respective data requirements.

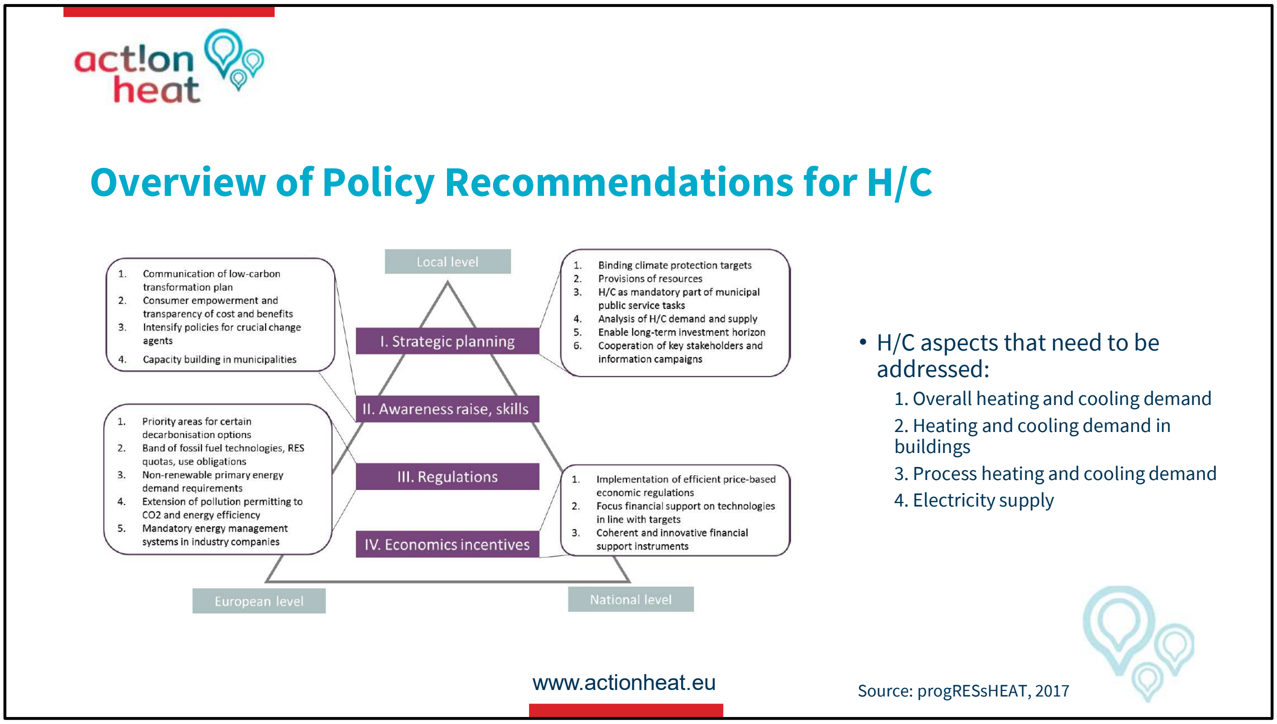
Part II:

- Overview of the open-source data available in the Hotmaps database and discussion on its potential application for the development of strategic heating and cooling plans.

PART I

Policy challenges, questions and data needs

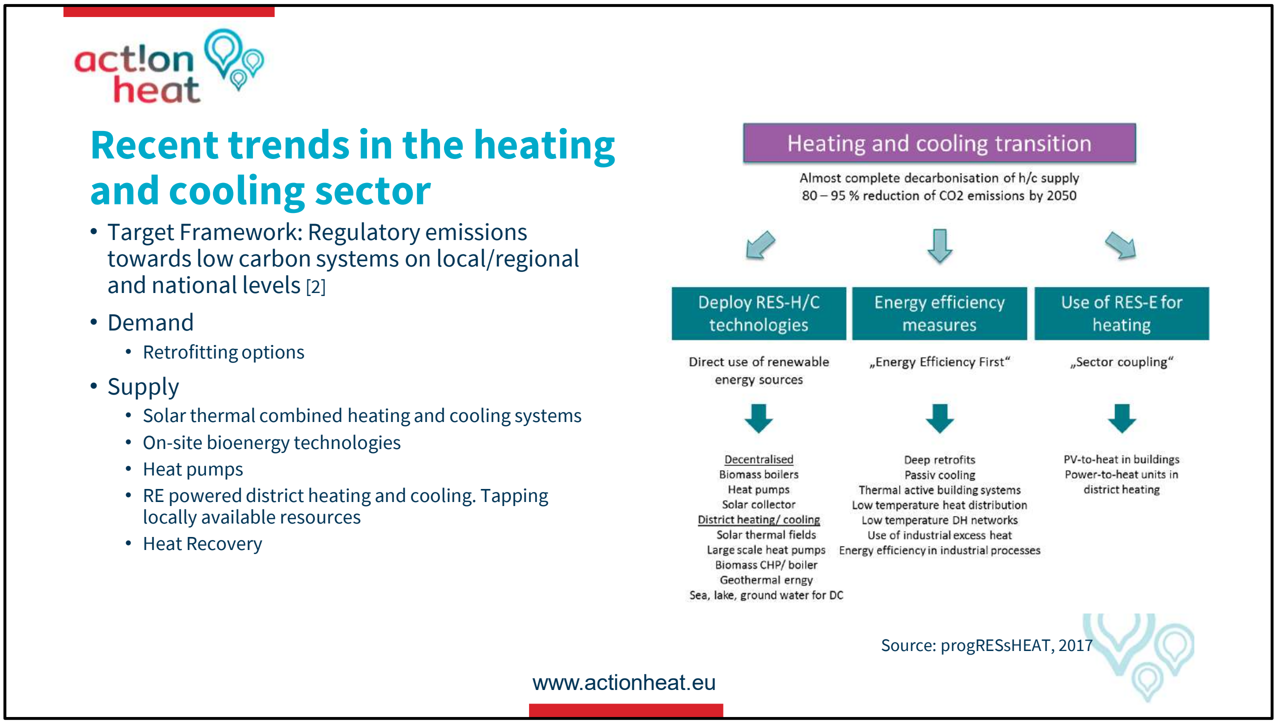
www.actionheat.eu



- To provide policy recommendations to support policymakers to develop and implement an appropriate technology at the local and regional level

- Policy recommendations can be set up on three geographic levels covering the four aspects

- Local-level data is also important for national-level planning. Therefore, iterative planning on a local level is needed. However, national planning needs to have a more global perspective, and local planning considers these aspects [3. pg.53].



- Recent trends in the heating and cooling sector are directed towards the three aspects of target framework, demand reduction, and diversifying the supply portfolio with improved integration of renewable energy.

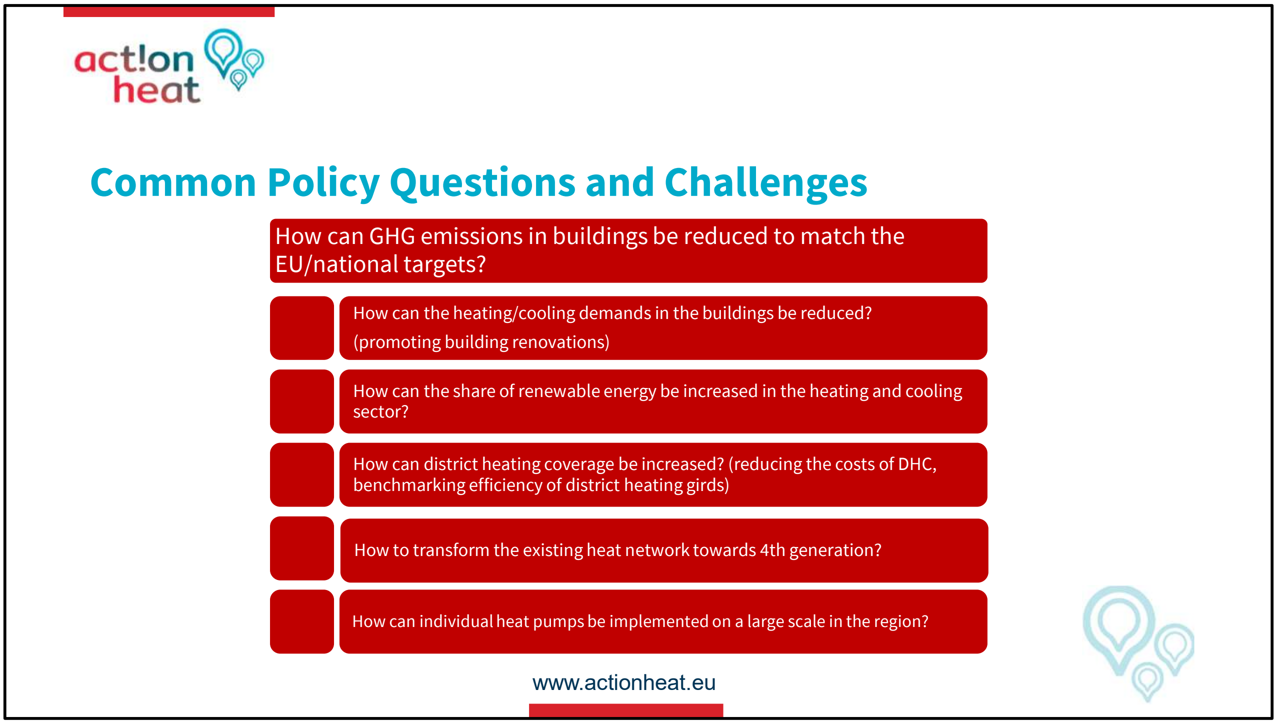
- The main aspects of the heating and cooling planning process include the following steps:

  - Preparation and orientation
    - Collection of Data

  - Quantitative Analysis

  - Prioritization and decision

  - Implementation and Monitoring



The Process of Defining the Policy Questions

- Questions need to be practical

What is a policy question?

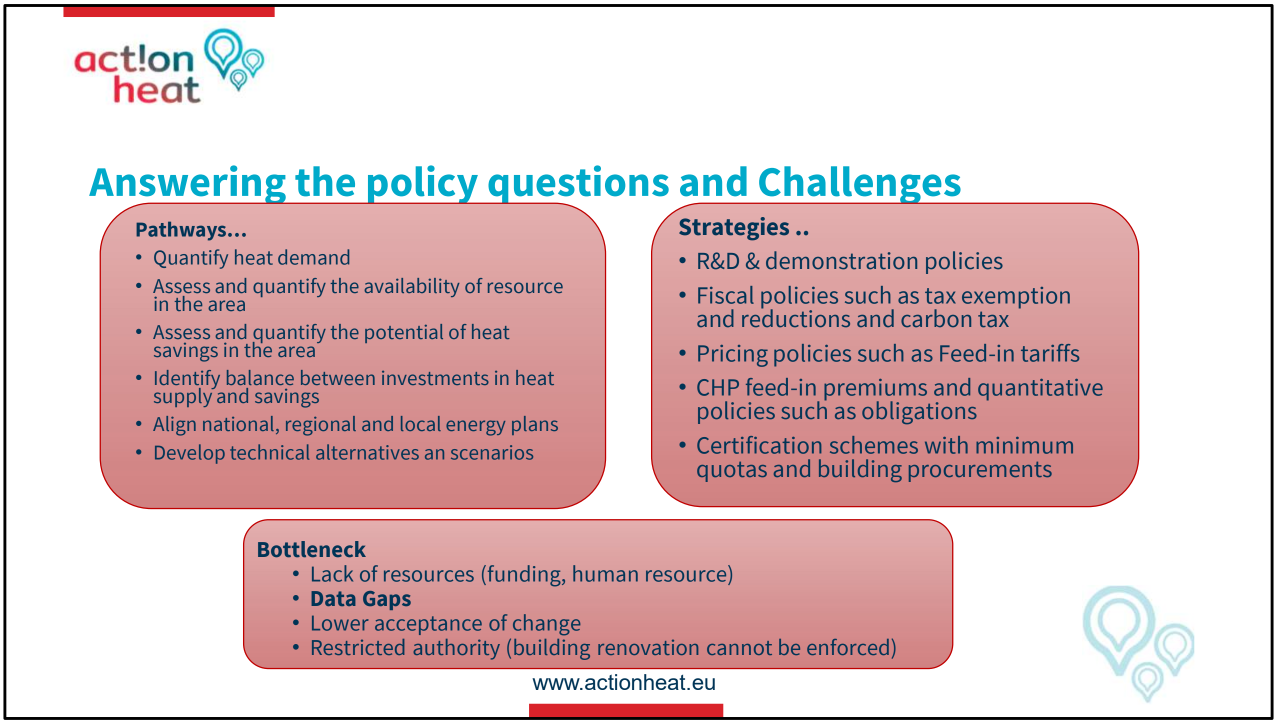
- Policy questions focus on the actions rather than the acquisition of knowledge
- Practical questions
- The answer is a statement that says what needs to be done… (should answer the "how" question)
- Many underlying research questions need to be answered to address the policy question in an informed manner.

Formulating a policy question:

- Problem Setting
- Policy Formulation
- Scenario Analysis
- Decision Making

Better collection of public data under GDPR constraints. Tracking the consumption patterns

Link policy questions to energy efficiency obligations (EEO) according to the EEED



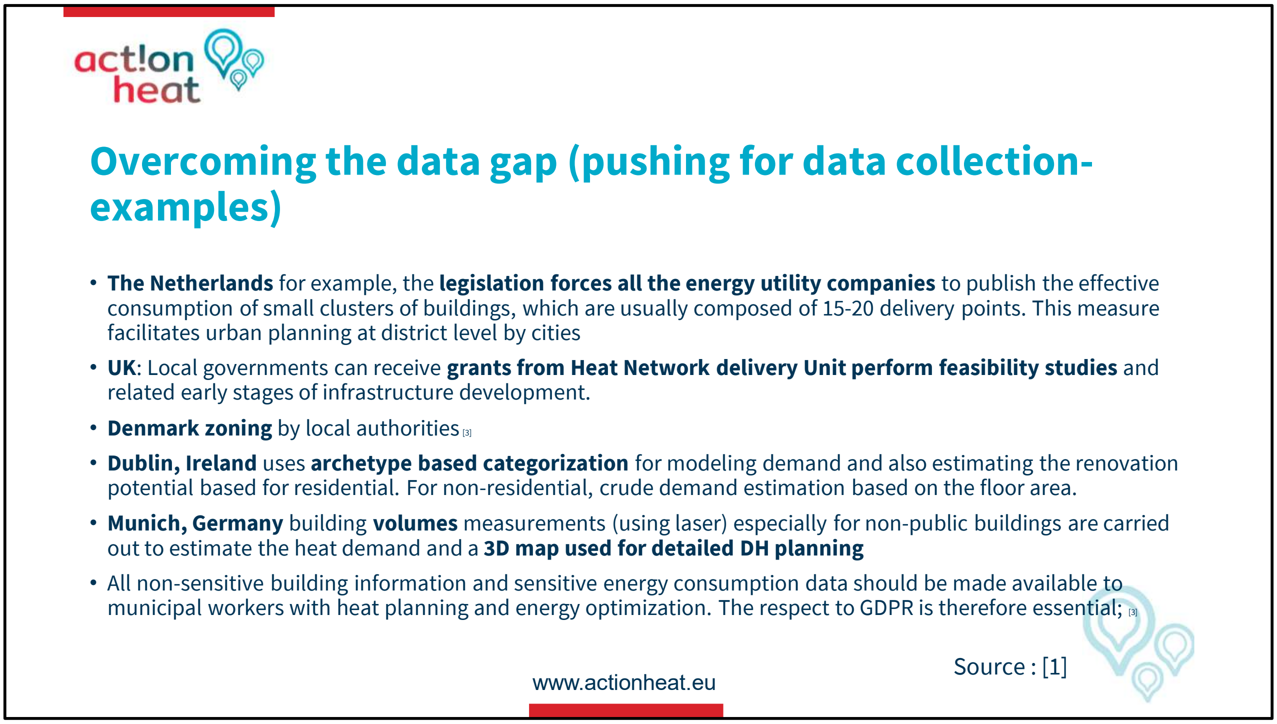
Answering the policy questions requires the definition of concrete pathways and a detailed definition of strategies to achieve the targets.

Obstacles for strategies of decarbonization:

- Economic barriers [technology costs, fuel prices, sensitivity, lack of economizing of scale)
- Structural barriers (slit incentives, lack of supply change)
- Technical barriers (suitability of building stock and lack of supply technologies)
- Psychological barriers (lack of awareness, hassle factor)
- Lack of data
- Need for policy mix including regulatory, economic, and other complementary policies [3]

The availability of data is a significant bottleneck that has been identified for this step based on experience and discussions with the relevant local authorities.

This presentation aims to discuss and highlight measures to overcome these bottlenecks.



A collaborative effort is needed from national, regional, and local authorities to fill this gap in data.

[3] pg 53.

Local-level data is also essential for national-level planning. Therefore, iterative planning on a local level is needed. However, national planning needs a more global perspective, and regional planning considers these aspects.

Case 1: Strategic Decision Making

Area	Objective	Data Used
EU – all MS	**Objective**: Improve database on current and potential future demand and supply for H/C **Activity**: Mapping H/C current and future demand and scenario for supply until 2030 (Fraunhofer ISI et al. 2017)	• heating demand on a national level split up to different building archetypes • heating and cooling energy demand for different industries (national) • National GDP, employment, investment costs, benefits- baseline) • existing subsides for H&C in place • current national level energy mix • solar thermal potential (national)
EU – selected MS	**Objective**: Develop efficient and effective policy instruments for driving implementation of nZEB standard, find replicable solutions for different countries in the EU **Activity**: Policy evaluation and optimisation for developing strategies to uptake nZEBs (TUW-EEG,2016)	• information regarding market development and characteristics of nZEBs was collected • renovation activities and quantity on national level • national level building stock data
National level	**Objective**: Provide a scenario of full decarbonisation of EU heating and cooling until 2050 **Activity**: A scenario of an EU with net-zero greenhouse gas emissions and its implications (UBA 2019)	• Baseline emission data • Total residential GFA • Specific heating and cooling demand for residential (average)
Regional / local level	**Objective**: Develop local and regional H&C strategies **Activity**: Hotmaps – Open-Source Tool for mapping and planning in Heating and Cooling	• Hectare level data on heat and cold demand generated for all EU-27, updated with local data based on estimated demand in buildings for case studies • Estimation of resource potentials based on EU studies and other local studies • Costs and prices from national level discussed with stakeholders

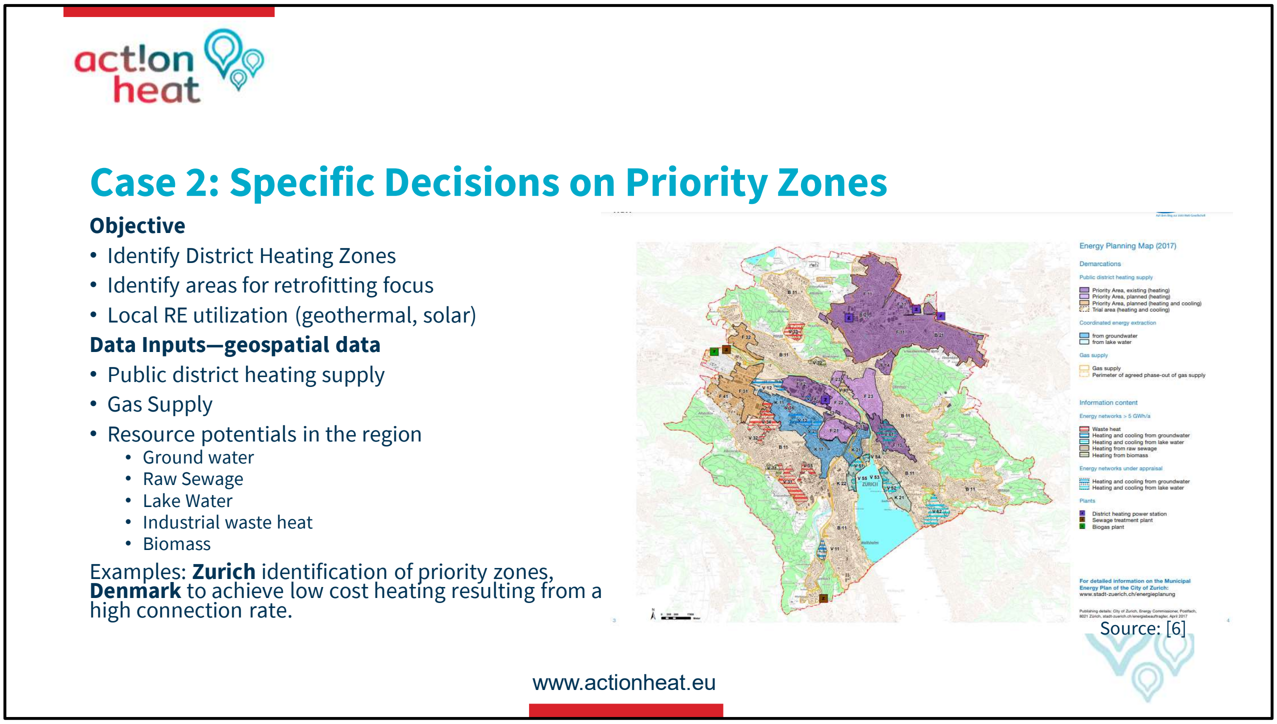
Based on the type of policy questions being answered, the overall strategic heating and cooling planning process is categorized into the 4 cases discussed in the current and following slides.

Strategic policy decision requires a clear long-term vision. This vision can be developed/assessed based on technical scenarios, which in turn require reliable data.

Preparation of Municipal Energy Plan

- Step 1: Political willingness
- Step2: Stakeholder engagement at an early stage
- Step3: Defining the policy questions
- Step 4: Define long-term goals to be achieved
- Step 5: Mapping à data on municipality consumption to develop a reference scenario; Data on the demand, potential resource mapping, building energy performance, energy performance in buildings
- Step 6: Analysis step Reanalyzes the initial steps to re-confirm decarbonization goals and visions and prioritize the decarbonization opportunities**[technology costs]** for developing the vision and goals based on which scenarios are developed
- Step 7: Analyze the extent of the national framework and address the discrepancies with the national framework; Respect GDPR [3]

Input data comprise the main drivers, policy parameters, structural information, and a massive set of technology parameters, including behavioral assumptions [4]



- Data reliability at a level that allows not only informed policy decisions but also ensures that the decision holds in case a party decides to challenge the district heating zone in court.
- Ideally, compare calculated/estimated data with (normalized) measured consumption data.

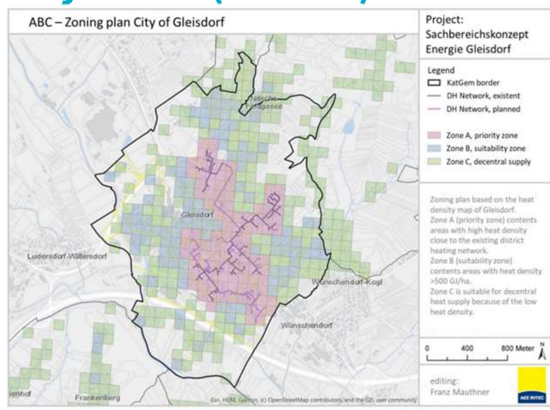
act!on heat

Case 2: Specific Decisions on Priority Zones (contd..)

- Combining urban planning and energy planning- Spatial Energy Planning an innovative tool
- Data collection included:
  - Geoinformation systems
  - Spatial datasets
  - Local energy requirements

Results provided overview on

- State of renovation in buildings
- Distribution and type of heating systems
- Energy source used
- Demand and emissions in the area
- suitability and priority areas for district heating supply
- potentials for the expansion and integration of biomass, heat pumps, solar thermal and PV systems, waste heat utilization



Source [8]

www.actionheat.eu

The results provide an overview of the optimal level of measures to be implemented based on the geographical location

act!on heat

Case 3: Detailed technical design of network

City	Jelgava	Berlin	Alba Iulia
Scale	Entire City	16 buildings	Few neighboring buildings
Objectives	Reduce CO2 emissions and increase energy efficiency and RE supply.	Phase out coal powered district heating by 2030	Reduce building Energy demand
Data used (Source; Type)	• Building footprint (OSM; Public) • Network Path (OSM; Public) • LIDAR (Municipality; Private) • Building demand (Thermos Default) • Heating Tariff (Heating Service Provider; Public) • Pipe costs (Fortum and external experts; Private)	• Building footprint (Data from district heating provider; Private) • Network Path (OSM; Public) • LIDAR (Berlin Lidar Data) • Building demand (Calculation based on VDI 2067; Private) • Heating Tariff (Heating Service Provider; Private) • Pipe costs (Thermos Default Data)	• Building footprint (OSM; Public) • Network Path (OSM; Public) • Building demand (Thermos Default) • Heating Tariff (Real data; Private) • Pipe costs (Thermos data; Public)

Source: [5]

www.actionheat.eu

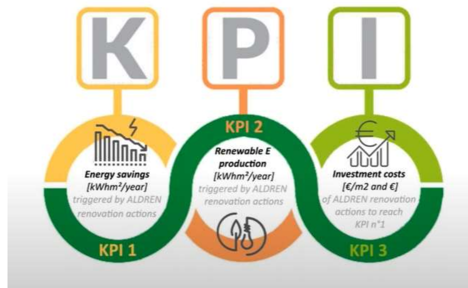
Three distinct case studies demonstrate how varying levels of data availability and quality can significantly influence the final analysis and outcomes. Each case underscores the importance of tailoring the approach based on the data at hand.

The technical design process involves developing a customized layout and determining appropriate pipe sizes for the network. This step is highly case-specific, as it depends on the unique requirements and constraints of each scenario. Comprehensive guidance is provided in **SF2** within the **Act!on Heat** project.

act!on heat

Case 4: Deploy Building Renovation Passports

- The ALDREN BRP as a tool:
  - To inform and motivate building owners/investors to undertake renovation
  - By which the government can bring tangible support to customers
  - Common European Solution
- Components of the BRP
  - LogBook: collection of data to better inform owners about current technical energy
  - RenoMap: Tailored renovation roadmap to reach desired energy performance levels
- B-log is a digital repository that includes building's (ownership, building design, materials used, structures, installations, systems, adaptations, investment, operational and maintenance costs, health and safety, performance indicators, certifications, etc.)→provides accessible comparative analysis

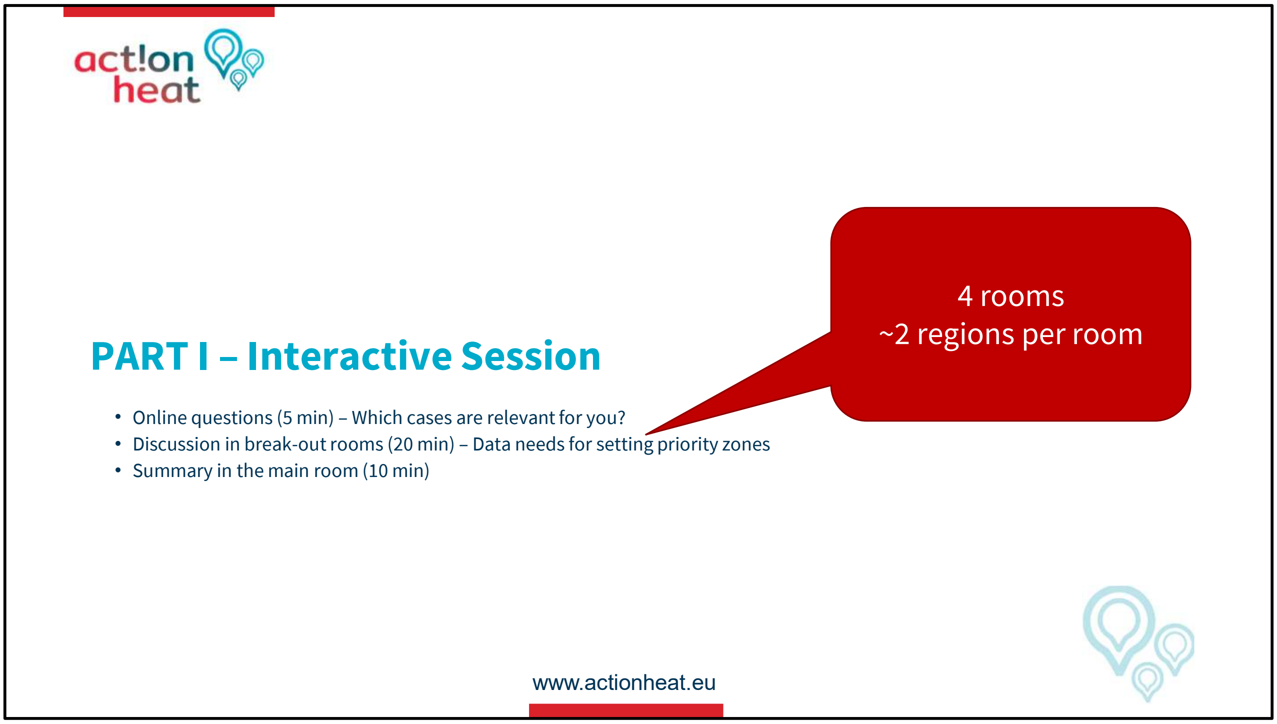


Source: [7]

www.actionheat.eu

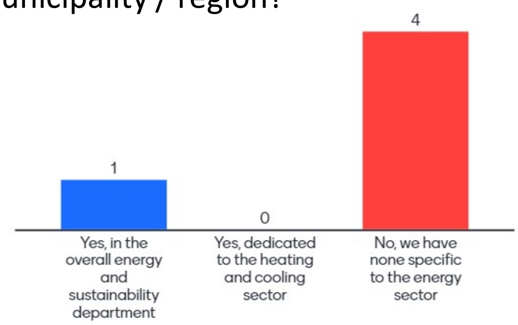
The development of the building renovation passport enables the tracking of the existing status of the buildings and allows better planning and investment in the renovation strategies.

One such example of successful implementation of the building renovation passport: The ALDREN BRP core concept consists in the dual element of the passport: the ALDREN BuildLog and the ALDREN RenoMap, which make the passport a complementary tool to the EPC with the aim to increase owners' awareness about the current technical energy performance status of their building and support them for its regular daily operation, coupled with a tailored made renovation roadmap which provides an assessment of three main KPIs represented in Figure above.

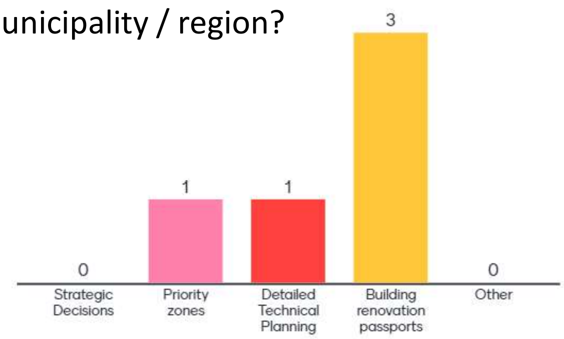


A mention-meter poll was presented to see which of the cases were of most interest to the applicants.

Are there dedicated human resources / departments for data collection and processing in your municipality / region?



Which policy question category do you see as the most fitting area for immediate intervention in your municipality / region?



action heat

	Case 1: Strategic decisions	Case 2: Setting priority zones	Case 3: DH technical planning	Case 4: building renovation passports
Data on existing heat / cold demand	• Regional energy balance (aggregated) • Hectare level data for assessing district heating potentials • (Calculated / measured demand data on single building level)	• Calculated demand data on single building level • Calculated demand data validated with measured consumption data		

Costs of heat distribution / DH vs. individual supply	• Estimation on hectare level based in heat demand density, gross floor area
	• Comparison of DH supply costs with individual supply costs
		• Estimation of heat distribution costs:
		  • Estimation based on type of district
		  • Estimation on hectare level based in heat demand density, gross floor area
		  • Estimation based on street level
		  • Account for location of currently existing network
		• Comparison of DH supply costs with individual supply costs
		  • for a single area vs. for entire city
		  • Using estimations of future prices vs. current prices
		  • …		

Data on resource potentials (renewable energy [RE] and heat sources)	• Total RE potential in the region available • Profiles for solar irradiance, temperatures of heat sources, …	• Location of potential resources and estimation based on literature study • Potential estimation based on measurements and (pre-feasibility studies) • Mix of both		
Data on demand reduction potentials	• Costs and potentials for heat demand savings in different building archetypes	• Costs and potentials for heat demand savings in different building archetypes allocated over the city area • …		

www.actionheat.eu

The table was filled with the inputs from the participants. The columns show the 4 cases, the rows represent the categories of data required. Efforts were made to identify the specific data required for each case, leveraging the expertise and experience of the participants.

act!on heat

PART II

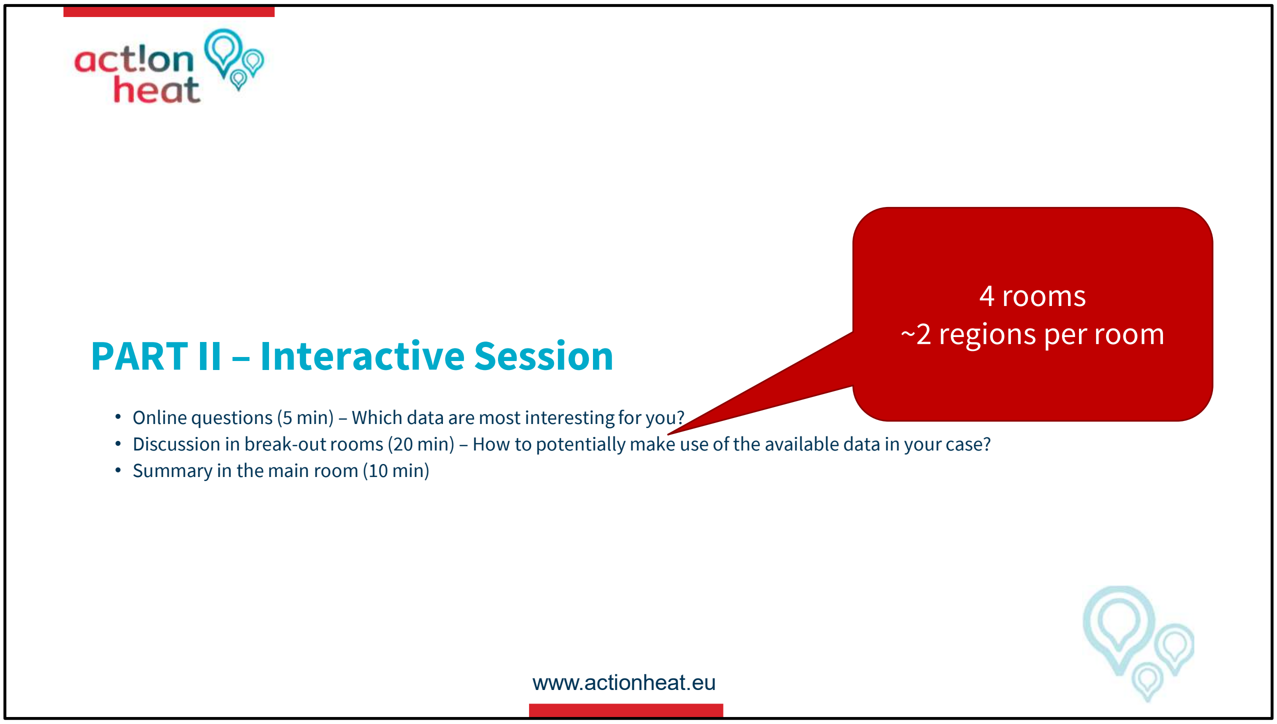
Open data in the Hotmaps platform

www.actionheat.eu

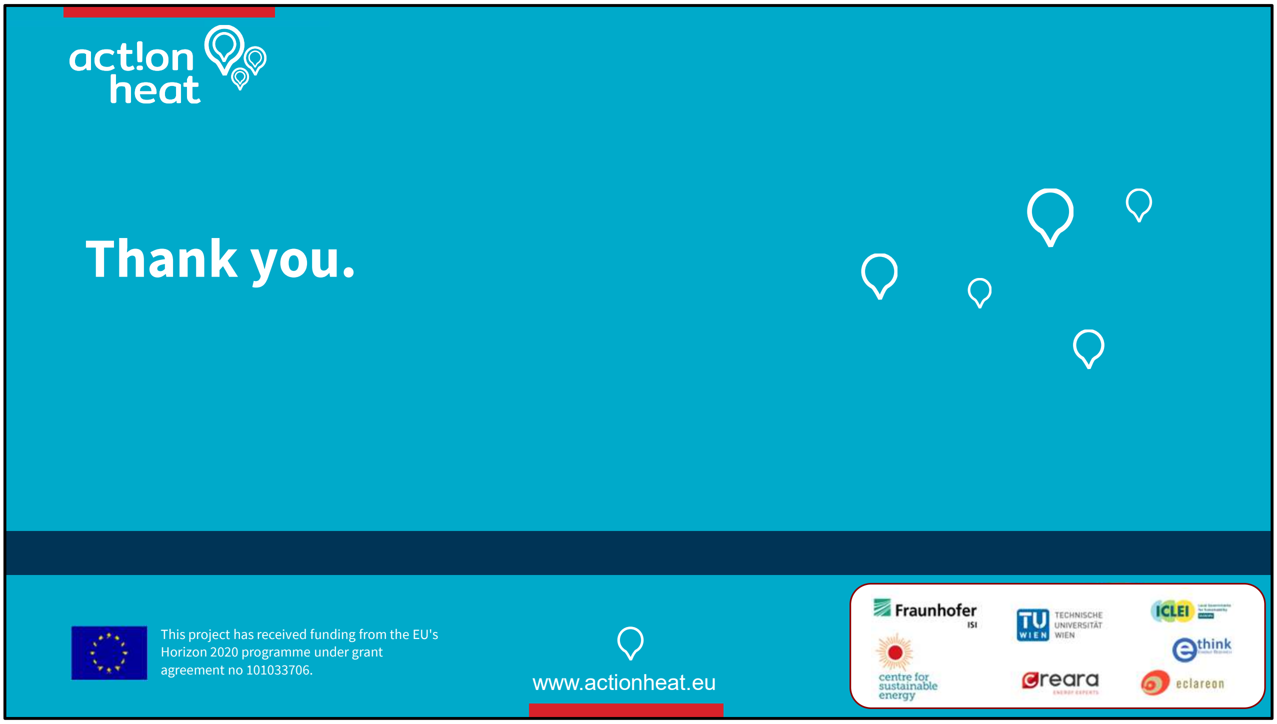
	Case1: Strategic Planning	Case 2: Setting Priority Zones	Case 3: DH Technical Planning	Case 4: Building Passports
Data on existing heat cold demand	• Heat demand and gross floor area density maps (default) • database on existing building stock in EU countries (spec. energy demand, construction, …) • hourly heat load profiles for NUTS2 regions (residential, tertiary, industrial)	• database on existing building stock in EU countries (spec. energy demand, construction, …) • (hourly heat load profiles for NUTS2 regions (residential, tertiary, industrial))	• database on existing building stock in EU countries (spec. energy demand, construction, …) • (hourly heat load profiles for NUTS2 regions (residential, tertiary, industrial))	
Costs of heat distribution / DH vs. individual supply	• Heating technology data (costs, efficiencies, lifetime, …) • Hourly electricity prices for 2040, 2050 for full decarbonisation pathways (different scenarios, at NUTS0 level)	• Heating technology data (costs, efficiencies, lifetime, …) • Hourly electricity prices for 2040, 2050 for full decarbonisation pathways (different scenarios, at NUTS0 level)	• Hourly electricity prices for 2040, 2050 for full decarbonisation pathways (different scenarios, at NUTS0 level)	
Data on resource potentials	• wastewater treatment plants • biomass residues • (industrial excess heat locations) • benchmark data industry (demand and excess heat) • shallow geothermal potential • solar thermal and PV on rooftop or standalone	• wastewater treatment plants • biomass residues • benchmark data industry (demand and excess heat) • (shallow geothermal potential) • (solar thermal and PV on rooftop or standalone)		
Data on demand reduction potentials	• scenarios for heat demand reduction at local level based on national level scenarios			

www.actionheat.eu

Here the same table is shown but the cells are filled with data that is available within the Hotmaps dataset. These can be used as proxy data for the planning process, but the use of locally available data is highly recommended wherever possible for higher accuracy and reliable results.



Based on the inputs of the participants, no concrete structure, regulation or granularity on the data needs for the different cases could be identified. Thus, to conclude, the implementation of the energy plan is largely influenced by the local political structure. If favorable political environment is set in place the implementation of plans can be carried out with minimal data availability.



act!on heat
Thank you.
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu
Fraunhofer ISI
TU WIEN TECHNISCHE UNIVERSITÄT WIEN
ICLEI
think
centre for sustainable energy
creara
eclareon

Sources

[1] https://decarbcitypipes2050.eu/2021/07/22/the-data-driven-future-of-heat-planning/

[2] https://www.odyssee-mure.eu/events/workshops/vienna/heating-policies-policy-brief.pdf

[3] literature-Policy support for heating and cooling decarbonization

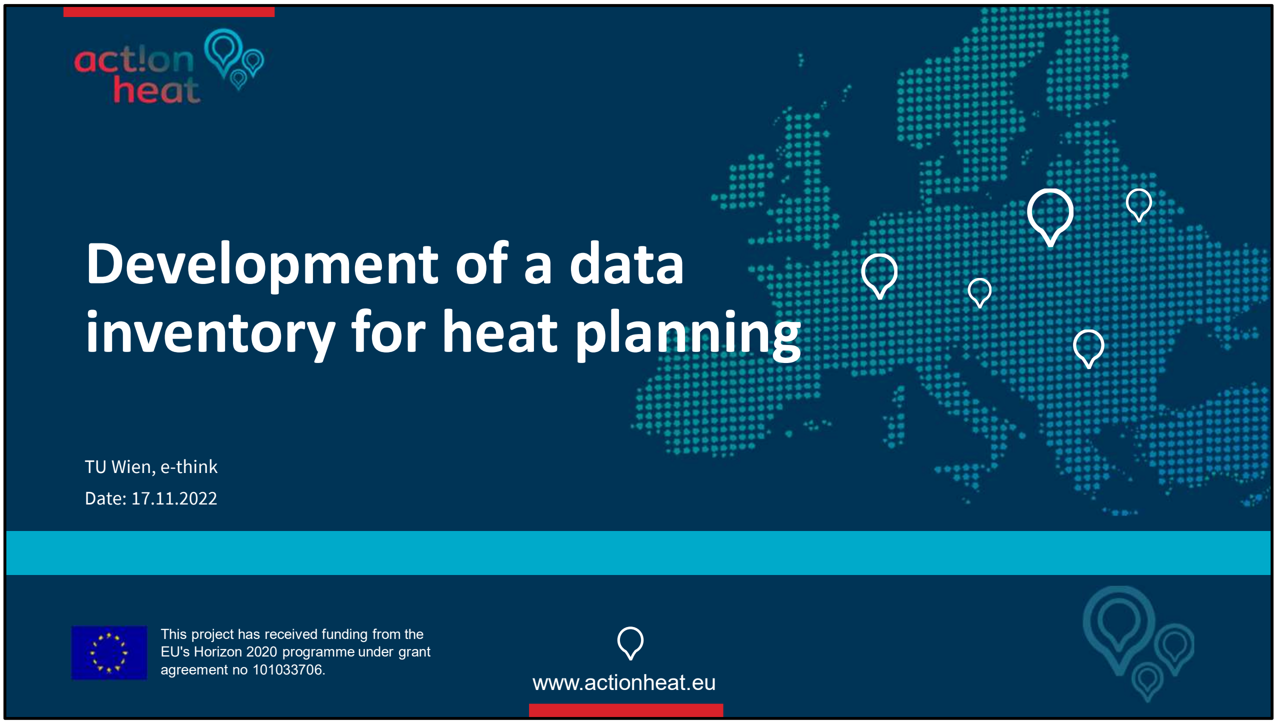
[4] Renewable space heating under the revised renewable energy directive

[5] https://www.thermos-project.eu/fileadmin/user_upload/THERMOS_City_Case_Studies_Oct2020.pdf

[6] Energy Planning Map, City Zurich, 2017

[7] https://aldren.eu/building-renovation-passport/

[8] https://www.researchgate.net/publication/337758104_Urban_energy_modelling_as_a_basis_for_future-oriented_city_planning

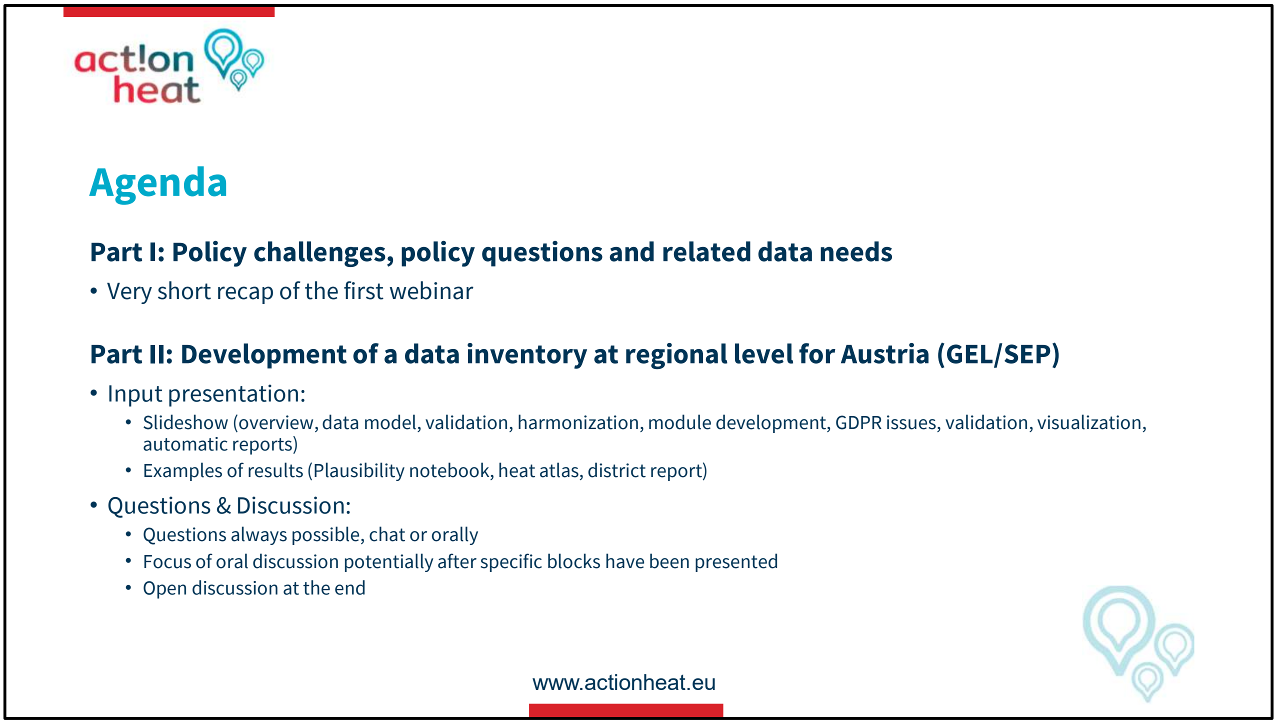


Webinar 2:
Development of a data inventory for heat planning

Act!onHeat SF1 — Time: 154 min

- Serial 1:
  - Webinar 2
    - Strategical Heating & Cooling planning
    - Group support for municipalities and stakeholders

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



Part 1

- Recapitulation of Webinar 1:
    - Heating & Cooling policy parameters for strategical planning.

Part 2

- Presentation of Austria data inventory developed at the regional level.
    - Platform that joins together many data sources, with the idea to use it for Heating & Cooling planning at different levels for decision-making.

PART I

Policy challenges, questions and data needs

www.actionheat.eu

act!on heat

Case 1: Strategic Decision Making

Area	Objective	Data Used
EU – all MS	**Objective**: Improve database on current and potential future demand and supply for H/C **Activity**: Mapping H/C current and future demand and scenario for supply until 2030 (Fraunhofer ISI et al. 2017)	• heating demand on a national level split up to different building archetypes • heating and cooling energy demand for different industries (national) • National GDP, employment, investment costs, benefits- baseline) • existing subsides for H&C in place • current national level energy mix • solar thermal potential (national)
EU – selected MS	**Objective**: Develop efficient and effective policy instruments for driving implementation of nZEB standard, find replicable solutions for different countries in the EU **Activity**: Policy evaluation and optimisation for developing strategies to uptake nZEBs (TUW-EEG,2016)	• information regarding market development and characteristics of nZEBs was collected • renovation activities and quantity on national level • national level building stock data
National level	**Objective**: Provide a scenario of full decarbonisation of EU heating and cooling until 2050 **Activity**: A scenario of an EU with net-zero greenhouse gas emissions and its implications (UBA 2019)	• Baseline emission data • Total residential GFA • Specific heating and cooling demand for residential (average)
Regional / local level	**Objective**: Develop local and regional H&C strategies **Activity**: Hotmaps – Open-Source Tool for mapping and planning in Heating and Cooling	• Hectare level data on heat and cold demand generated for all EU-27, updated with local data based on estimated demand in buildings for case studies • Estimation of resource potentials based on EU studies and other local studies • Costs and prices from national level discussed with stakeholders

Four different cases

Case 1

For solid policy decisions access to data is necessary:

- Strategic policy decision requires having a clear long-term vision.
- This vision can be developed/assessed based on technical scenarios, which in turn require data (reliable data..)

The strategic decision can be at different levels:

- European Union (EU)
- Member State (MS)
- National
- Regional

The levels determine the direction and extent of the decisions.

Case 2: Specific Decisions on Priority Zones

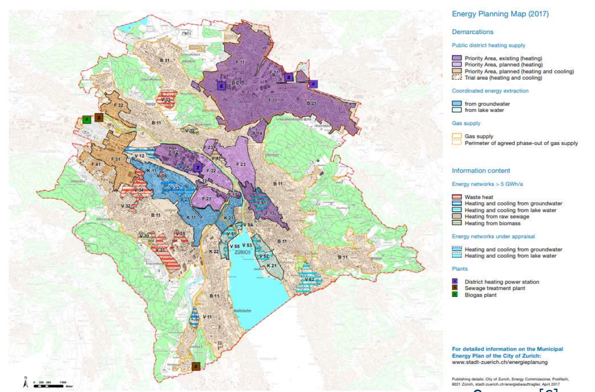
Objective

- Identify District Heating Zones
- Identify areas for retrofitting focus
- Local RE utilization (geothermal, solar)

Data Inputs—geospatial data

- Public district heating supply
- Gas Supply
- Resource potentials in the region
  - Ground water
  - Raw Sewage
  - Lake Water
  - Industrial waste heat
  - Biomass

Examples: **Zurich** identification of priority zones, **Denmark** to achieve low cost heating resulting from a high connection rate.



Source: [6]

www.actionheat.eu

Case 2

Priority of zones is needed for policy.

- Different zones should be compared.
  - Data reliability on a level not only allows solid policy decisions, but also assures holding a decision in case district heating in a zone is challenged in a court.
  - Ideally, compare calculated/estimated data with (normalized) measured consumption data.

act!on heat

Case 3: Detailed technical design of network

City	Jelgava	Berlin	Alba Iulia
Scale	Entire City	16 buildings	Few neighboring buildings
Objectives	Reduce CO2 emissions and increase energy efficiency and RE supply.	Phase out coal powered district heating by 2030	Reduce building Energy demand
Data used (Source; Type)	• Building footprint (OSM; Public) • Network Path (OSM; Public) • LIDAR (Municipality; Private) • Building demand (Thermos Default) • Heating Tariff (Heating Service Provider; Public) • Pipe costs (Fortum and external experts; Private)	• Building footprint (Data from district heating provider; Private) • Network Path (OSM; Public) • LIDAR (Berlin Lidar Data) • Building demand (Calculation based on VDI 2067; Private) • Heating Tariff (Heating Service Provider; Private) • Pipe costs (Thermos Default Data)	• Building footprint (OSM; Public) • Network Path (OSM; Public) • Building demand (Thermos Default) • Heating Tariff (Real data; Private) • Pipe costs (Thermos data; Public)

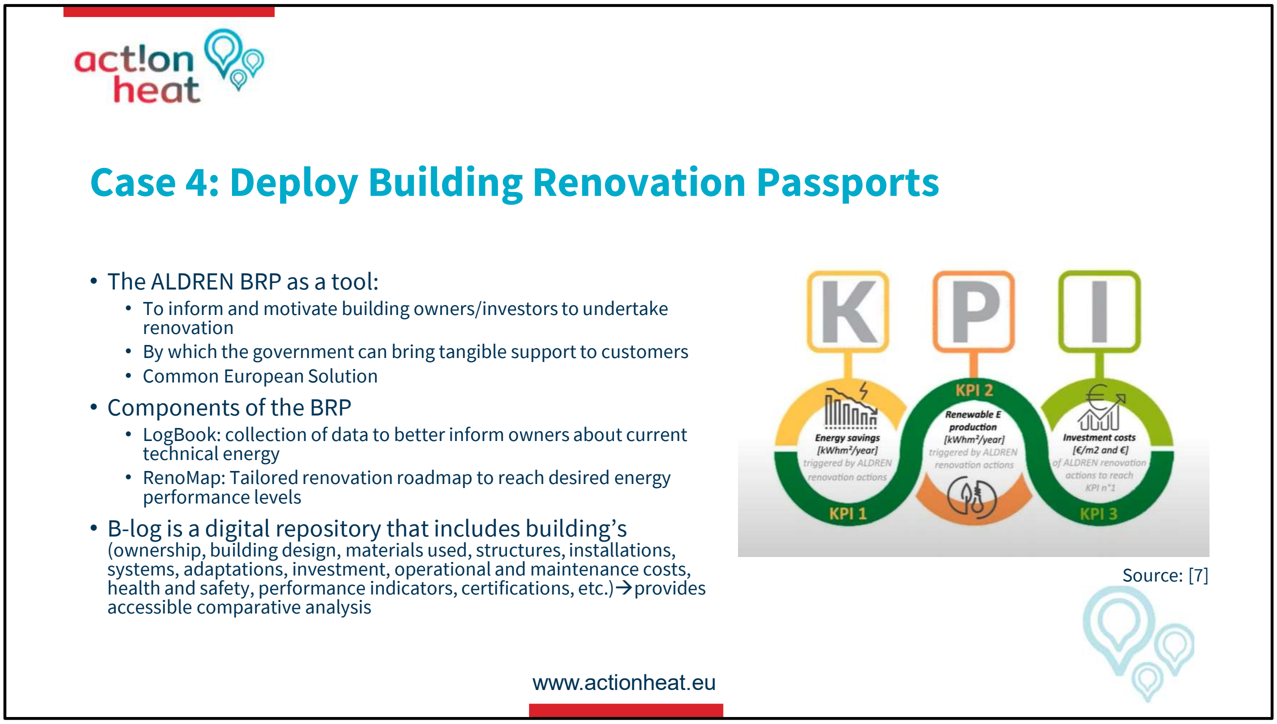
Source: [5]

www.actionheat.eu

Case 3

Technical design is needed for policy.

- Comparison of design for different development projects
  - Scale:
    - Shows how a district heating network in a specific area looks like.
  - Objectives:
    - Depending on the time projection of the policy
  - Data:
    - Different levels of data affect the final analyses and results



Case 4

Specifications of (building-related) local conditions are needed for a policy.

- Single building level
    - Data collection of single buildings for policy development
- The ALDREN BRP:
    - The core concept consists of the building renovation passport (BRP): ALDREN LogBook and the ALDREN RenoMap, which make the BRP a sort of complementary tool to the EPC to increase owners' awareness about the technical energy performance of their building and support them for regular daily operations, coupled with a tailored made renovation roadmap which provides an assessment of three main KPIs as shown in the Figure.

	Case 1: Strategic decisions	Case 2: Setting priority zones	Case 3: DH technical planning	Case 4: building renovation passports
Data on existing heat / cold demand	• Regional energy balance (aggregated) • Hectare level data for assessing district heating potentials • (Calculated / measured demand data on single building level)	• Calculated demand data on single building level • Calculated demand data validated with measured consumption data		

Costs of heat distribution / DH vs. individual supply	• Estimation on hectare level based in heat demand density, gross floor area
	• Comparison of DH supply costs with individual supply costs
		• Estimation of heat distribution costs:
		  • Estimation based on type of district
		  • Estimation on hectare level based in heat demand density, gross floor area
		  • Estimation based on street level
		  • Account for location of currently existing network
		• Comparison of DH supply costs with individual supply costs
		  • for a single area vs. for entire city
		  • Using estimations of future prices vs. current prices
		  • …		

Data on resource potentials (renewable energy [RE] and heat sources)	• Total RE potential in the region available • Profiles for solar irradiance, temperatures of heat sources, …	• Location of potential resources and estimation based on literature study • Potential estimation based on measurements and (pre-feasibility studies) • Mix of both		
Data on demand reduction potentials	• Costs and potentials for heat demand savings in different building archetypes	• Costs and potentials for heat demand savings in different building archetypes allocated over the city area • …		

www.actionheat.eu

Hotmaps has default data sets that can be used to start Heating & Cooling planning.

- Data for existing Heating & Cooling demand.
- Data on the cost of heat distribution vs. individual supply
- Data on resource potential
- Demand reduction potential

And can be applied for:

- Case 1: Strategic decisions (explained in Webinar 1)
- Case 2: Priority zones (explained in Webinar 1)
- Case 3: Technical planning
- Case 4: Building renovation

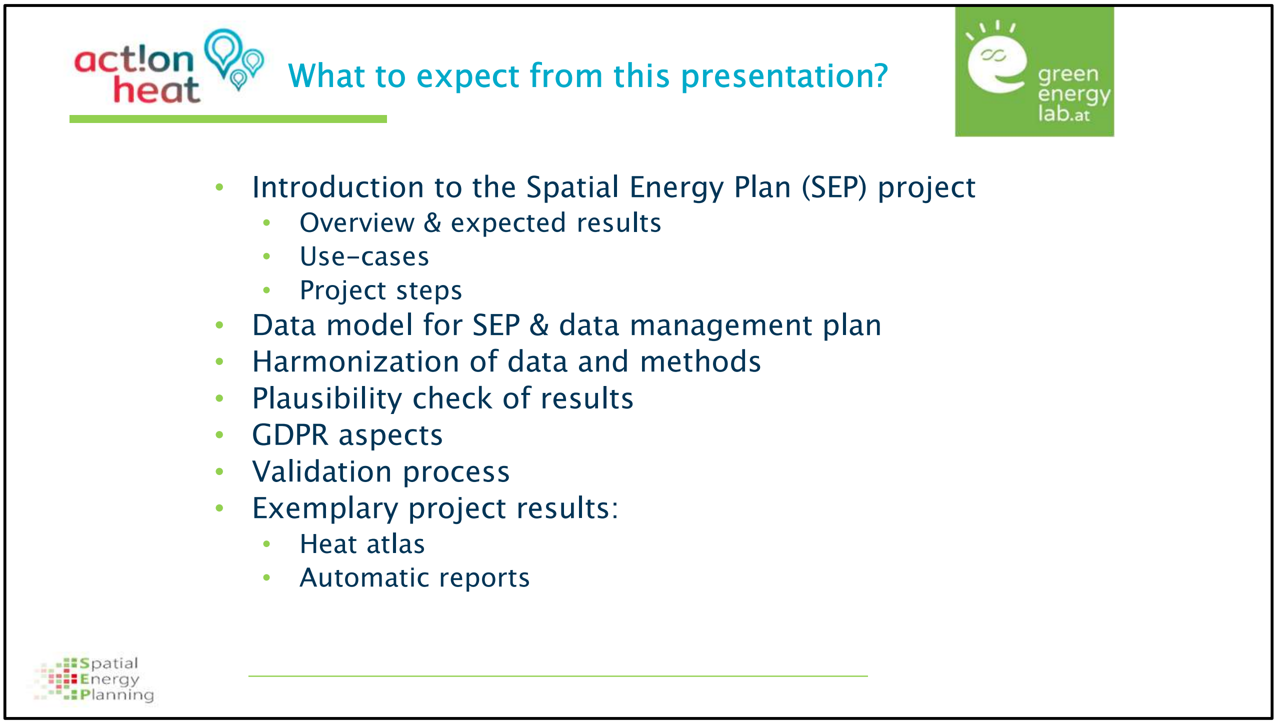
PART II

Development of a data inventory at regional level for Austria (GEL/SEP)

www.actionheat.eu

Experiences from other projects

- Project: Spatial Energy Planning (SEP) – An Austrian flagship project in heating and cooling planning in three Federal States of Vienna, Styria and Salzburg
- Objective of the presentation: Share experiences about Heating and Cooling planning in other regions.



Relevant information for the presentation

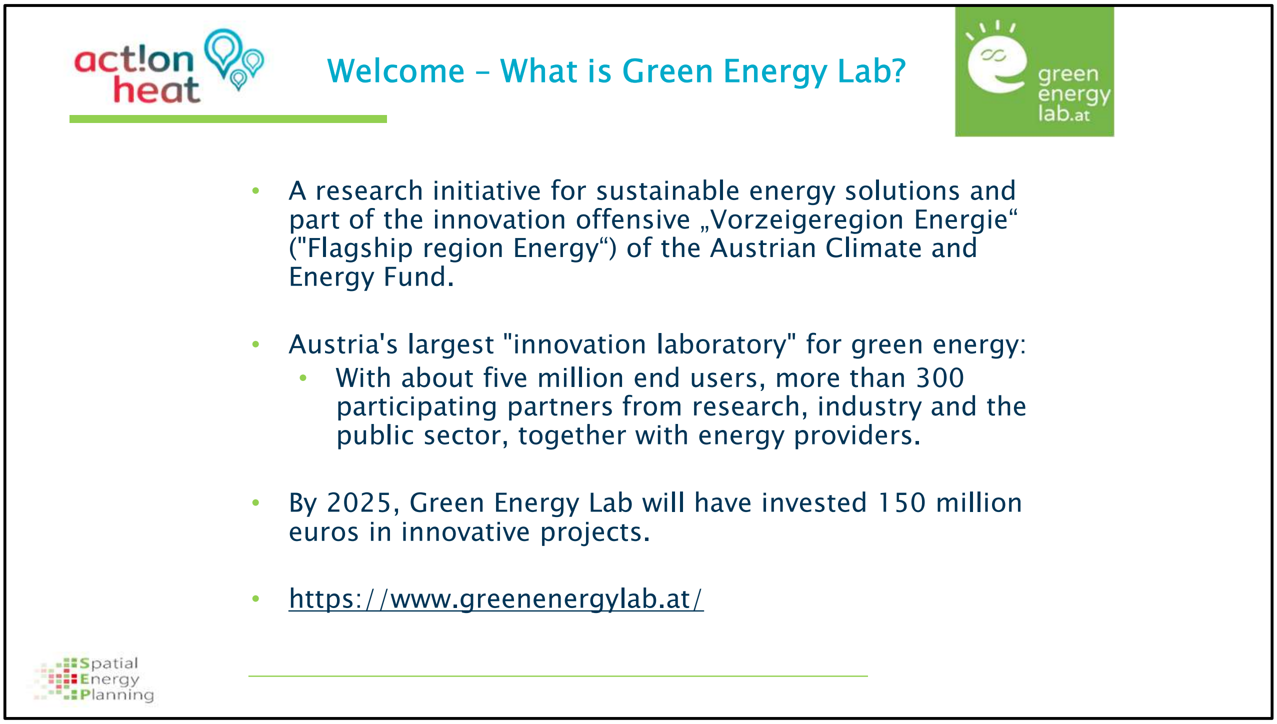
Overview of the expectation

- Expected result of the project
- The use cases
- Expectations of the Stakeholders and steps to meet the expectations

Overview of the steps:

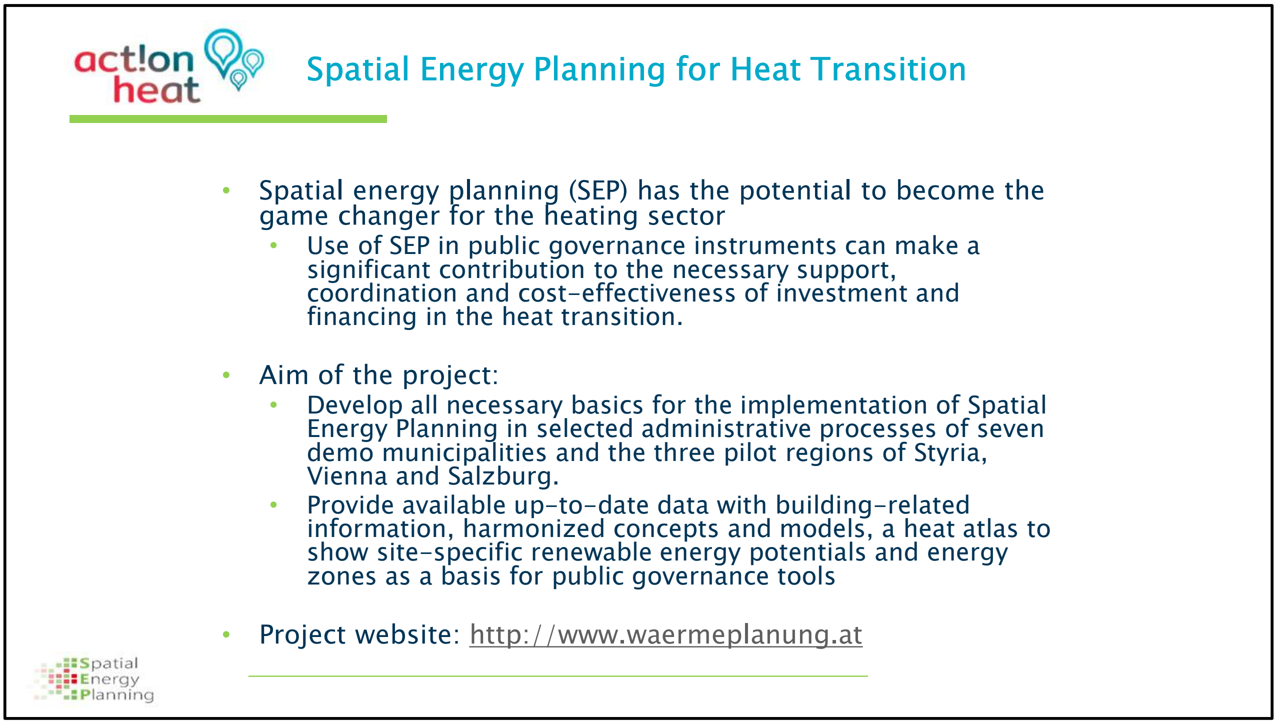
- Data model and DMP
- Harmonization of the data and methodology
- Plausibility check
- GDPR aspects
- Validation process

Exemplary project results
- Heat atlas
- Automatic reports



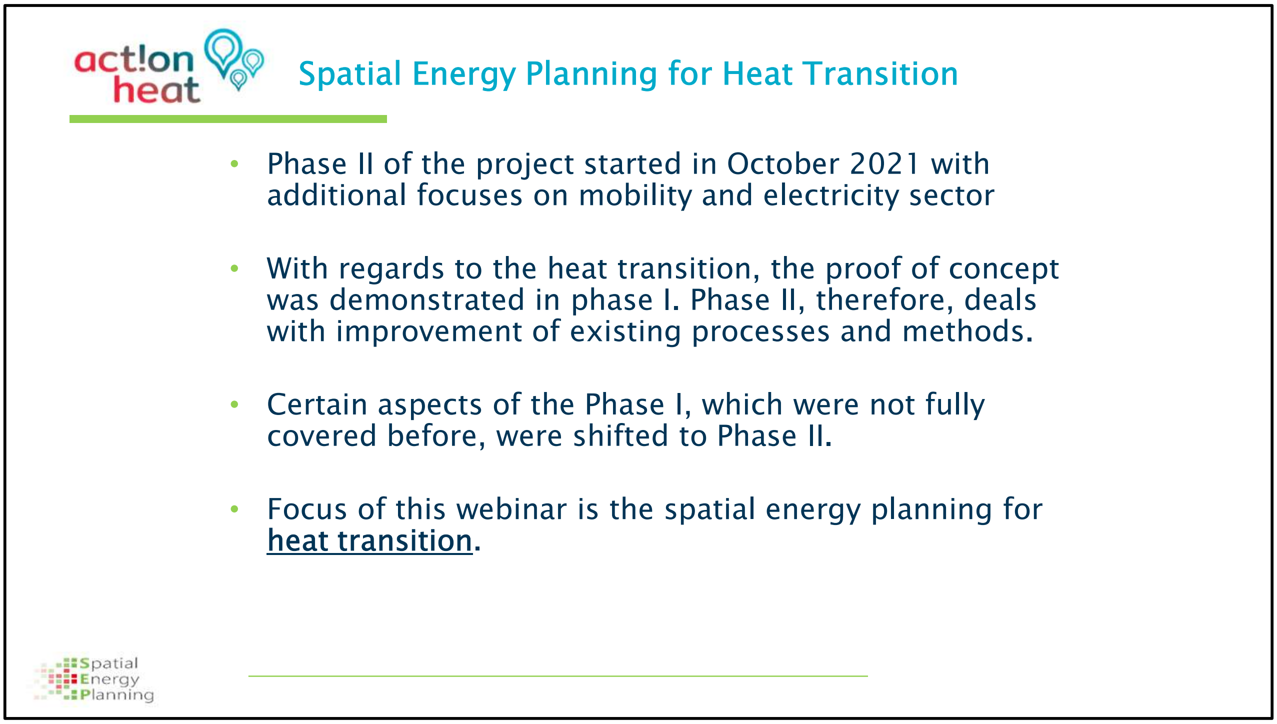
Green Energy Lab: Spatial Energy Planning (GEL-SEP)

- What is Green Energy Lab:
  - A research initiative for sustainable energy solutions and part of the innovation offensive „Vorzeigeregion Energie“ ("Flagship region Energy“) of the Austrian Climate and Energy Fund.
  - Austria's largest "innovation laboratory" for green energy:
    - With about five million end users, more than 300 participating partners from research, industry and the public sector, together with energy providers.
  - By 2025, Green Energy Lab will have invested 150 million euros in innovative projects.



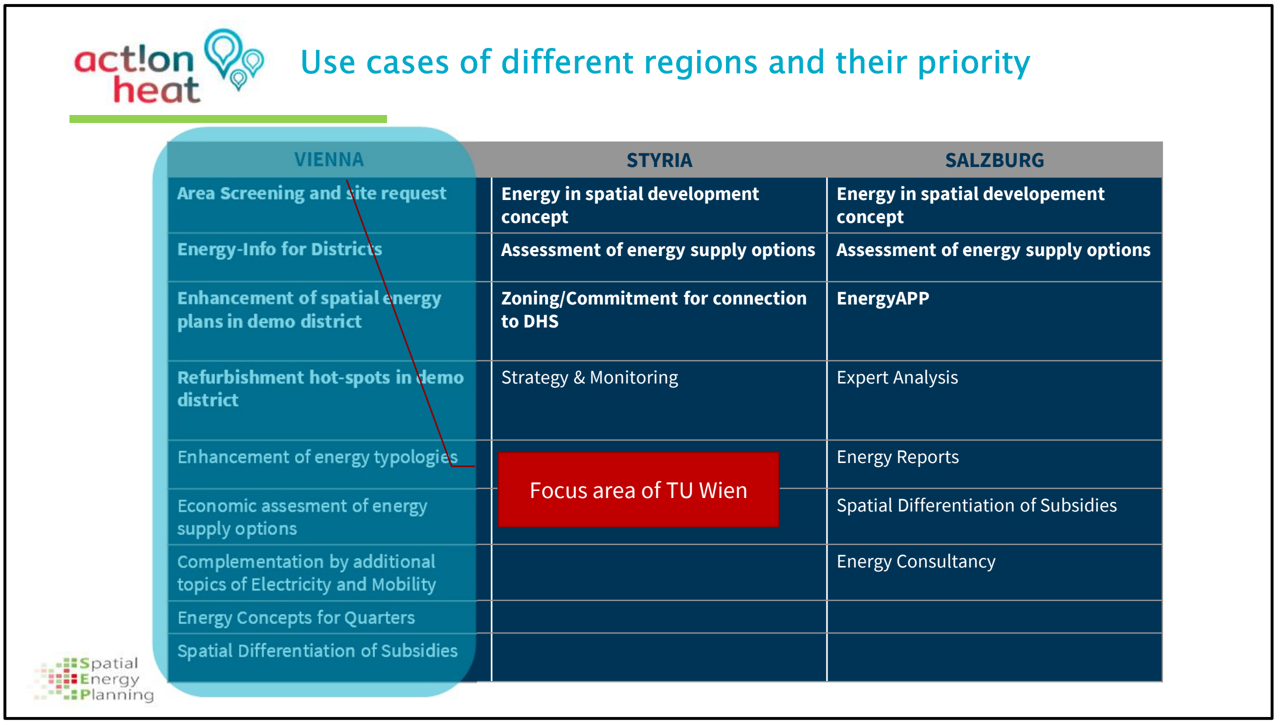
Spatial Energy Planning for Heat Transition

Besides the content of the slide, further information can be extracted from the project website: http://www.waermeplanung.at



The project started in 2018

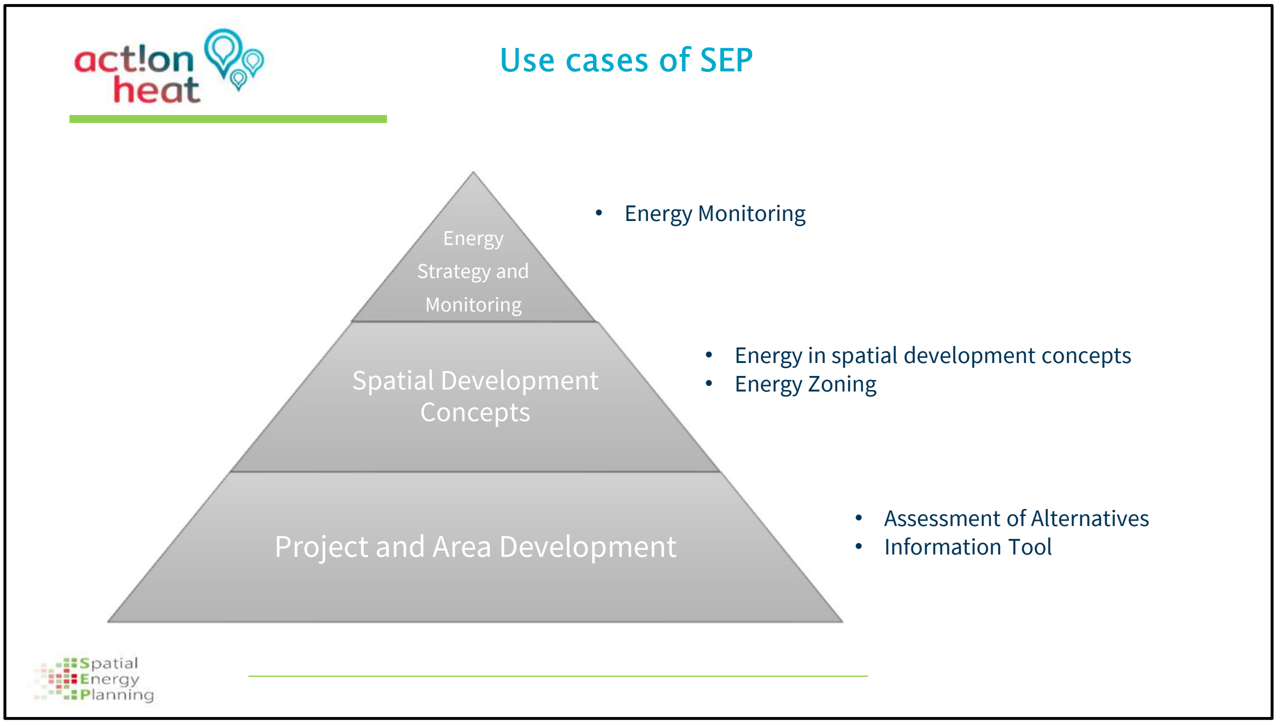
- The project started in 2018 and currently is run in its second phase.
- First phase of the project dealt with heat transition and partially is followed in the second phase.
- Focus of this webinar is the heat transition part.



VIENNA	STYRIA	SALZBURG
Area Screening and site request	**Energy in spatial development concept**	**Energy in spatial developement concept**
Energy-Info for Districts	**Assessment of energy supply options**	**Assessment of energy supply options**
Enhancement of spatial energy plans in demo district	**Zoning/Commitment for connection to DHS**	**EnergyAPP**
Refurbishment hot-spots in demo district	Strategy & Monitoring	Expert Analysis
Enhancement of energy typologies		Energy Reports
Economic assesment of energy supply options		Spatial Differentiation of Subsidies
Complementation by additional topics of Electricity and Mobility		Energy Consultancy
Energy Concepts for Quarters		
Spatial Differentiation of Subsidies		

Users of the project

- Public authorities were the focus group of the study.
- TU Wien was in charge of the authorities of Vienna.
- The table shows the user needs and expectations from the project.



Pyramid of SEP user cases

The pyramid shows the importance and priorities in SEP.

Energy Strategy and Monitoring:

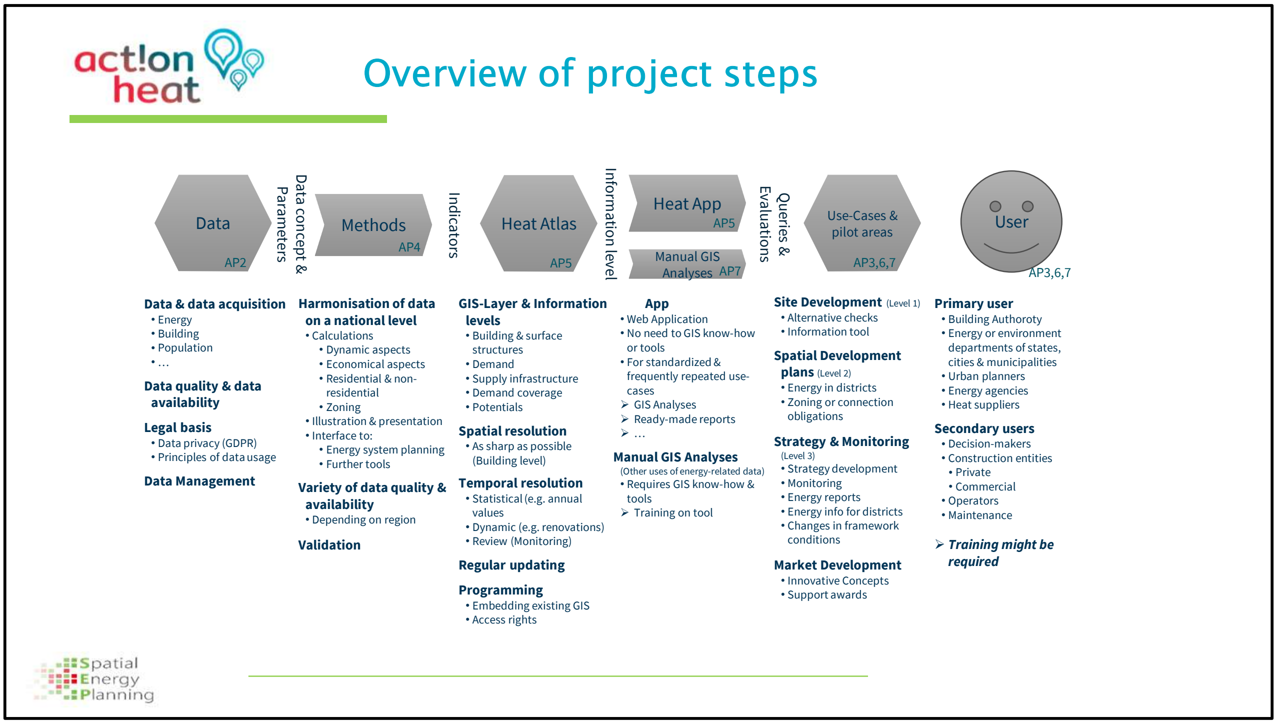
- Analyze the status of Heating and Cooling demand in an area and what the plans are there.

Spatial Development and concepts:

- Discover which areas could be relevant for district heating and if it is possible to define district heating zones.

Project and Area Development:

- Provide information to assist or give alternatives to the stakeholders.



To answer the use cases questions:

Several steps were developed, starting with data and ending with user needs.

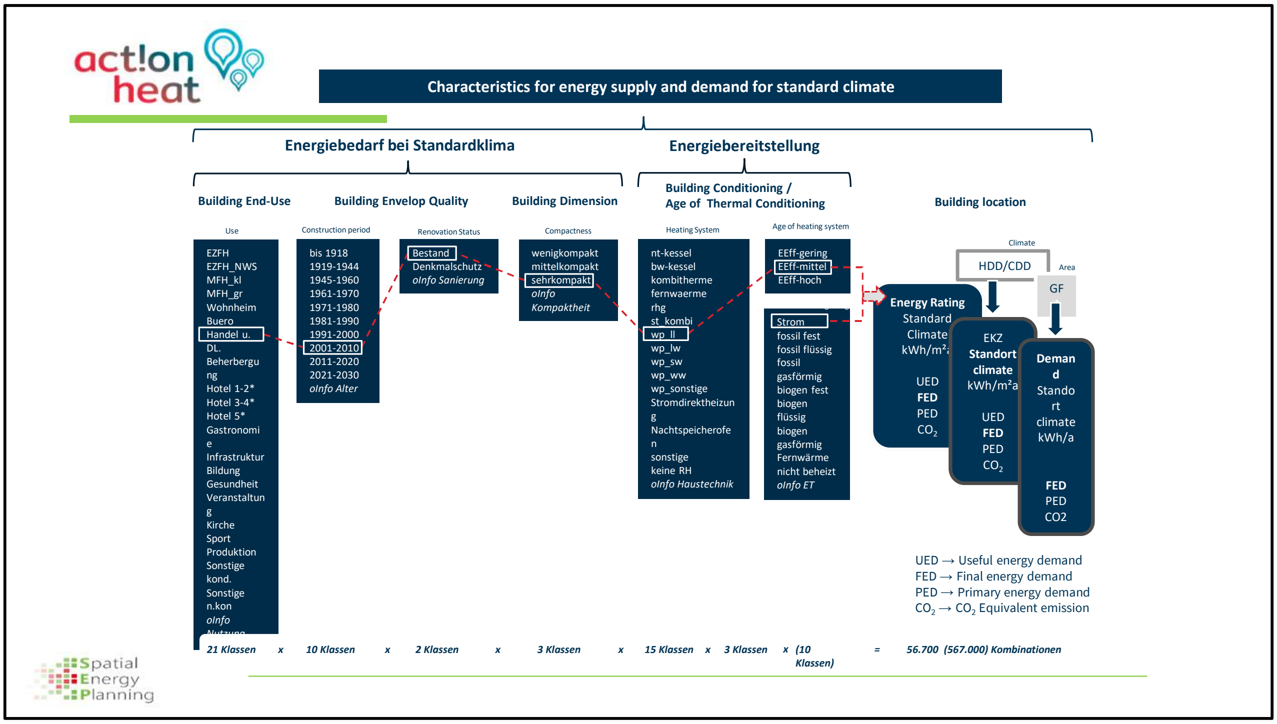
- Data: All relevant information for the state‘s Energy Planning.
  Different resolutions and formats, legal parameters to use them, and data quality was understood and compere to know how to update and join together.

- Methodology: Develop a methodology to use the data for the user‘s interest. Considering different background data in different states, the method should harmonize data. To use the data, the method should provide also a harmonized outputs.

- Heat Atlas: The data were ordered and visualized for the users.
  Different data were shown for different uses in different forms. Different accessibility levels can be defined.

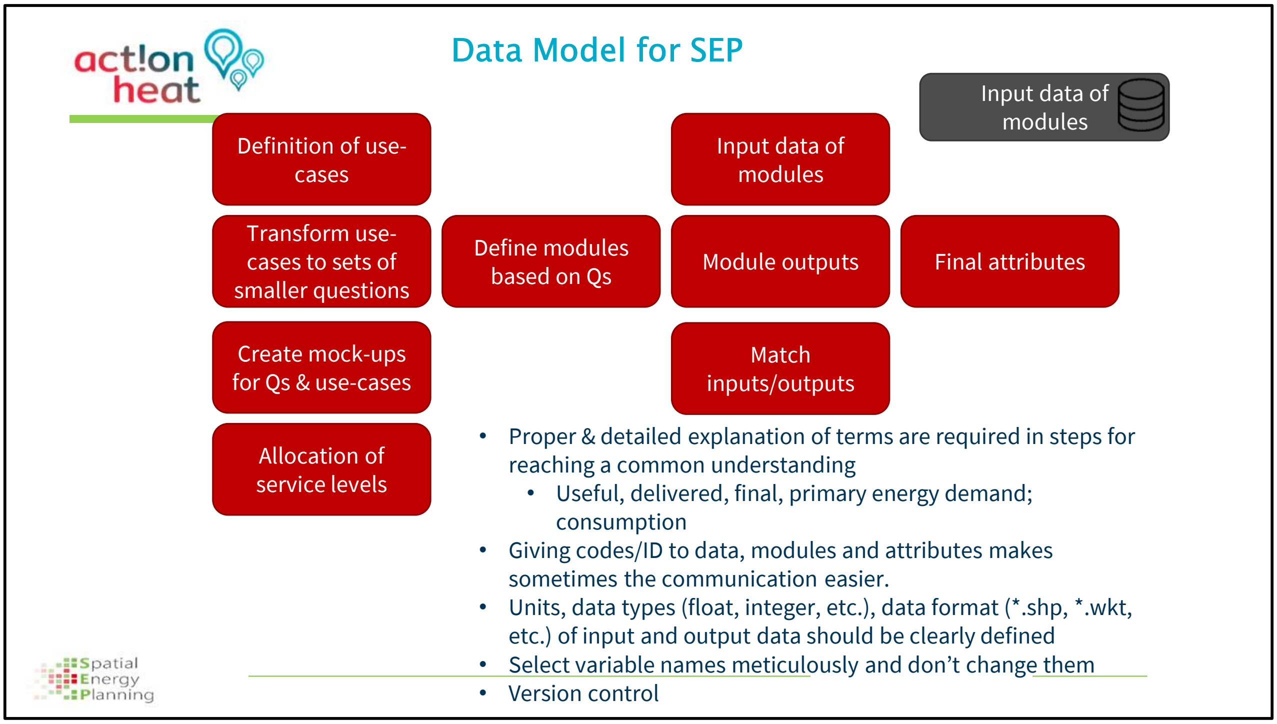
- Heat App: Application to generate standard reports.

- Use cases and users: can be defined for different parts and functionalities in Heat Atlas and Heat App.

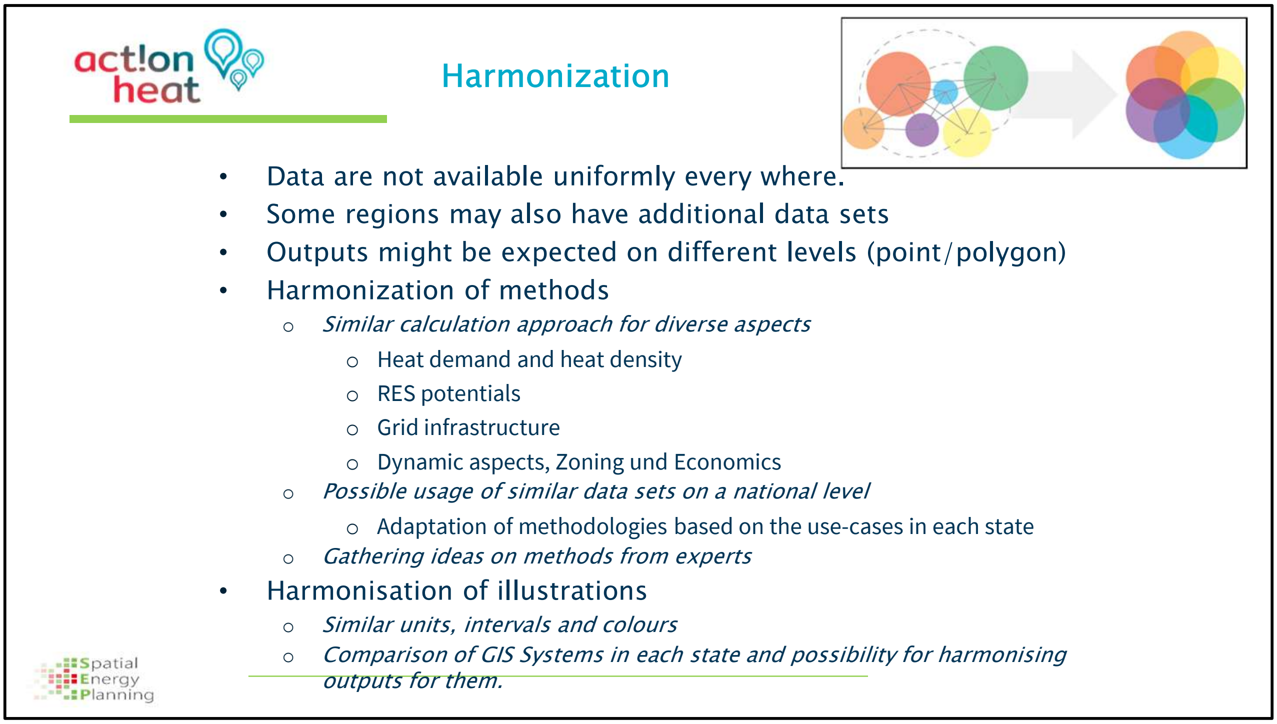


How to know the energy demand?

Wide range of data sets needs to be combined to come up with the estimation of heat demand in a building.



Data model to answer the user needs and cover use-cases



Importance of the harmonization of results

It is necessary to harmonize the input/output data, approach, and results presentation.

This will bring interoperability and common understanding of the outcomes.

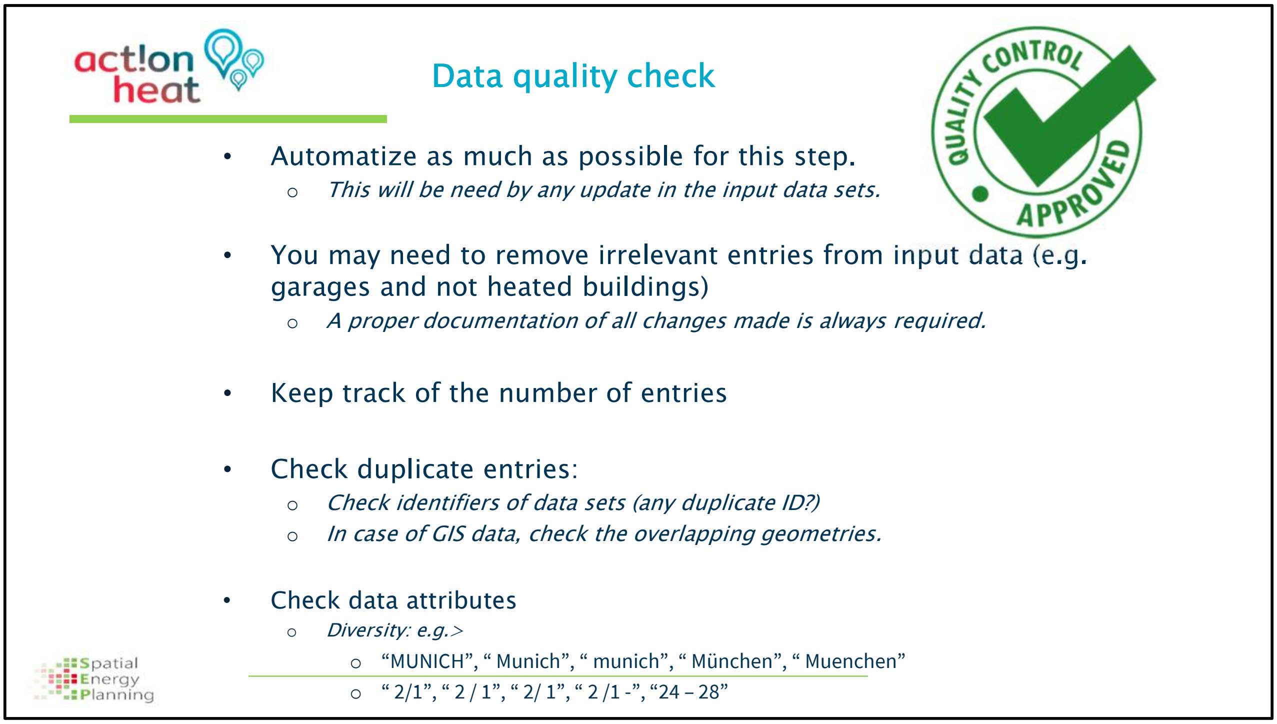
Data Management

- A data management plan would help to structure the whole data processes.
  - *Data inventory:*
    - Where to save all data?
    - Metadata (Data package)
  - *Naming conventions:*
    - How to name the files in the database so that they can be easily findable?
  - *Data Formats*
  - *Spatial and temporal resolutions*
  - *License*

Credit: Image: WrightStudio - stock.adobe.com

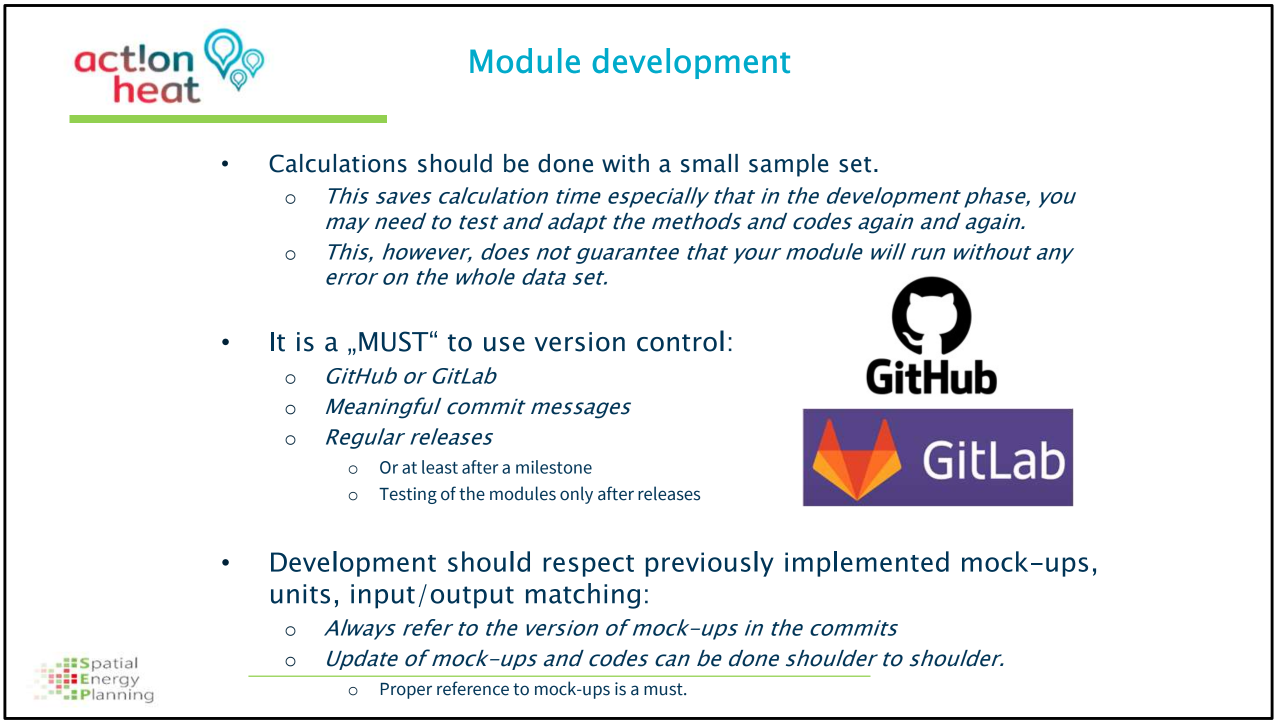
Spatial Energy Planning

Data management plan contributes in structuring the data processing and can help to save available resources.



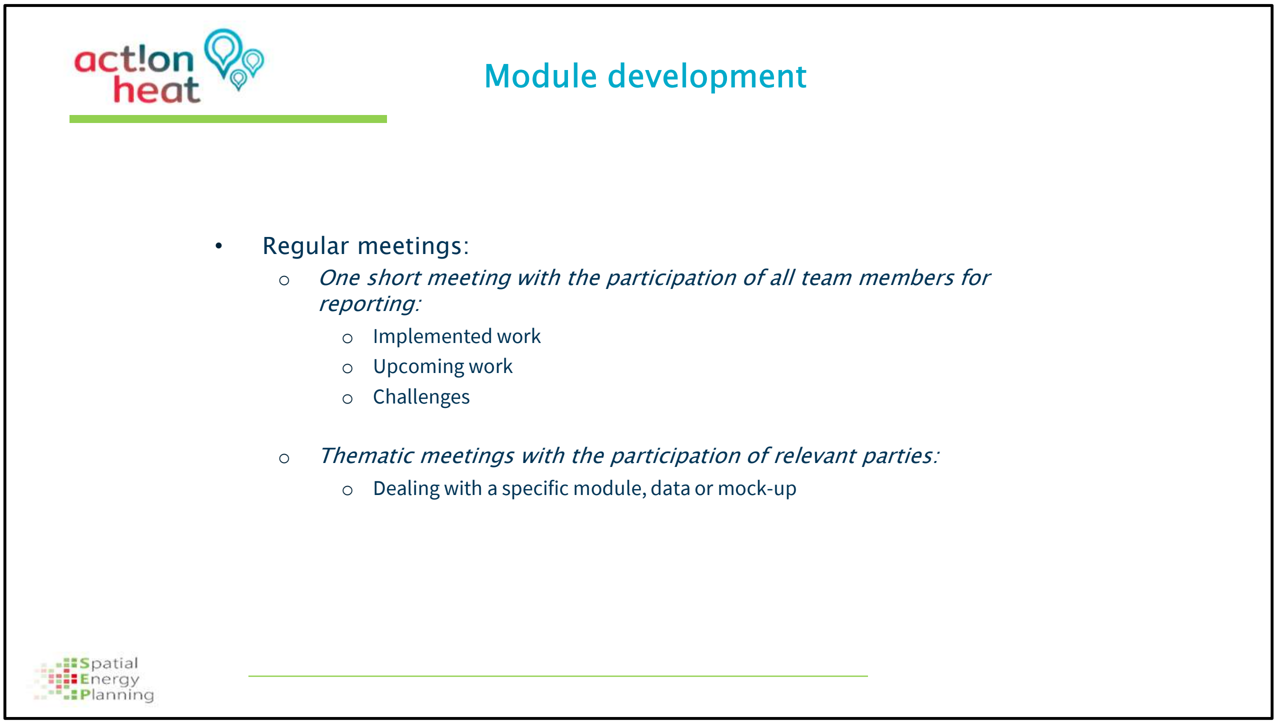
Garbage in -> Garbate out

Not only the methodology and output results should be proofed, but, more importantly, the input data has to be checked for any possible mistakes.



Good practice for developing modules:

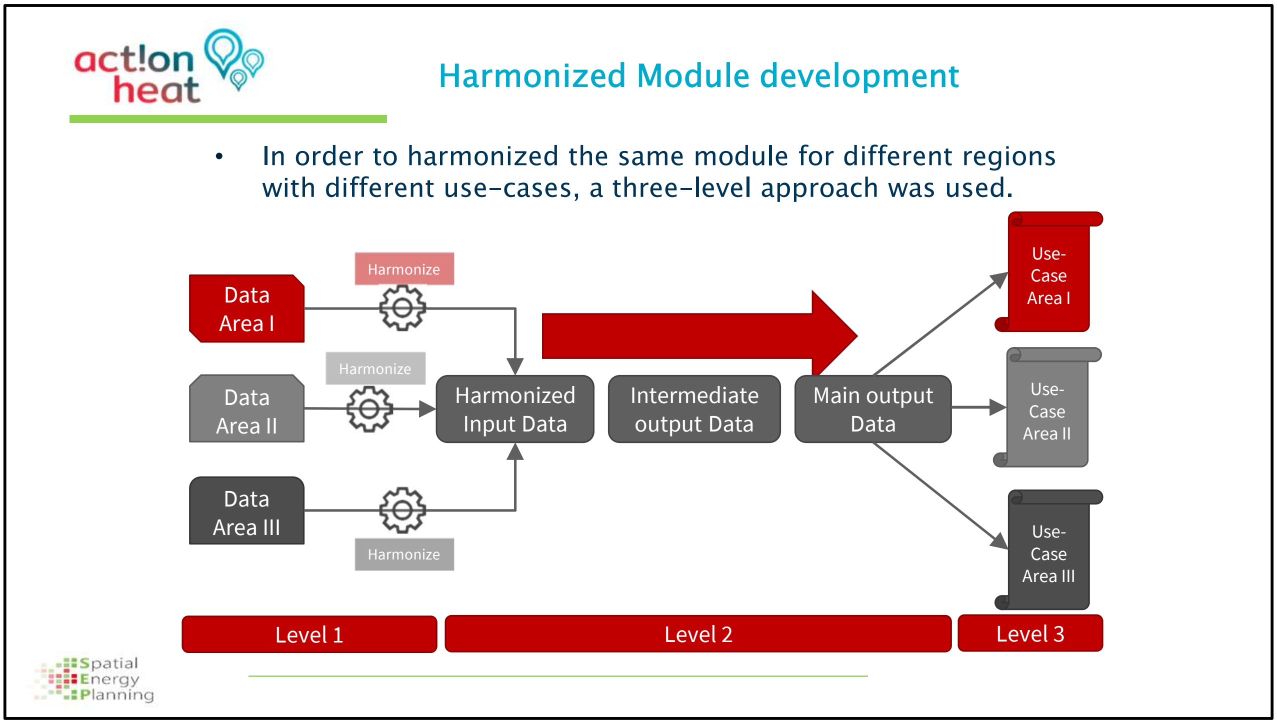
- Run your module on a small sample set of data to check the functionalities and once smaller errors were resolved, apply the tool to a larger data set.
- Version controlling in tool development is a must. Provide regular releases as you advance.
- Mock-ups helps to bring everyone to the same level of understanding.



Common understanding

Necessary for the module development phase:

- Regular group meeting update
- Discussion about problems in meetings
- Understanding other approaches
- Specific topics/problems can be addressed bilaterally in smaller round of people

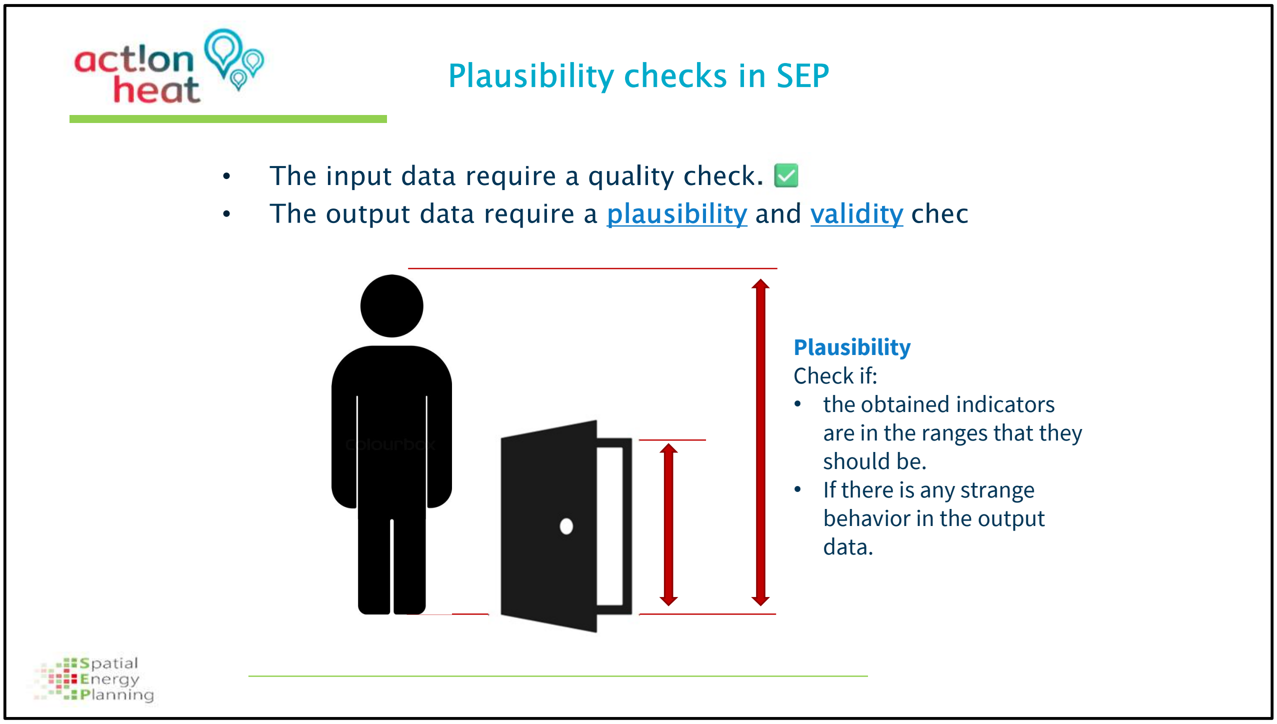


Harmonization of the module development

Level 1
Generate harmonized data out of different data sets.

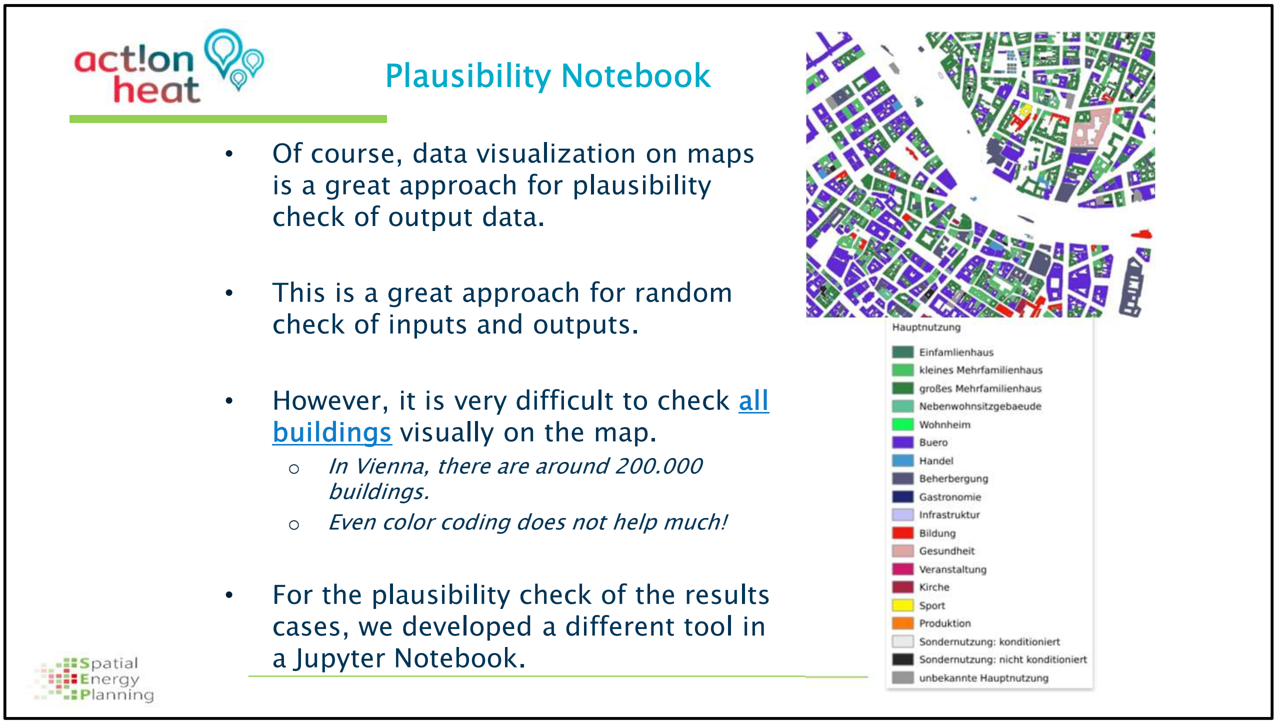
Level 2
Apply same methodology on the data

Level 3
Address the use-cases in the outputs



Plausibility checks

Before validating the outputs, they should be checked for plausibility.

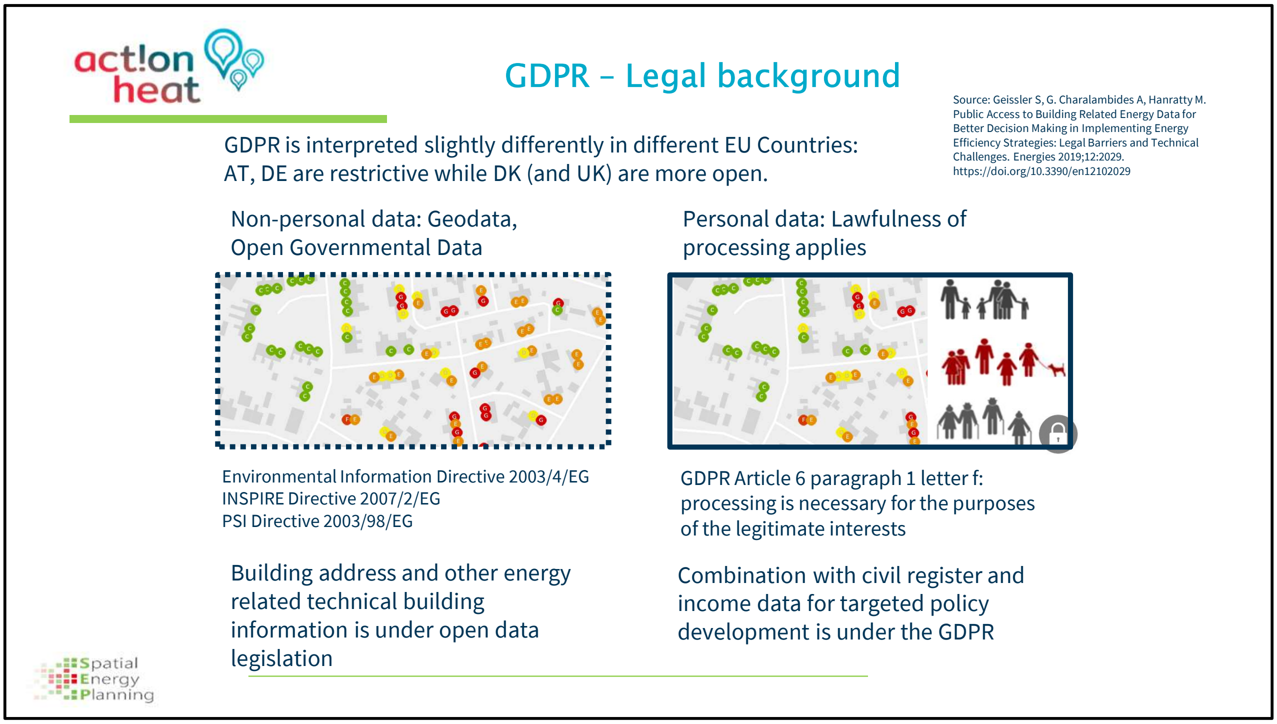


Approach to visualize data

TU Wien developed a tool to generate graphics dynamically.

This was implemented in a Jupyter Notebook.

Thanks to the dynamic development approach, the notebook could be kept brief, but still very rich.

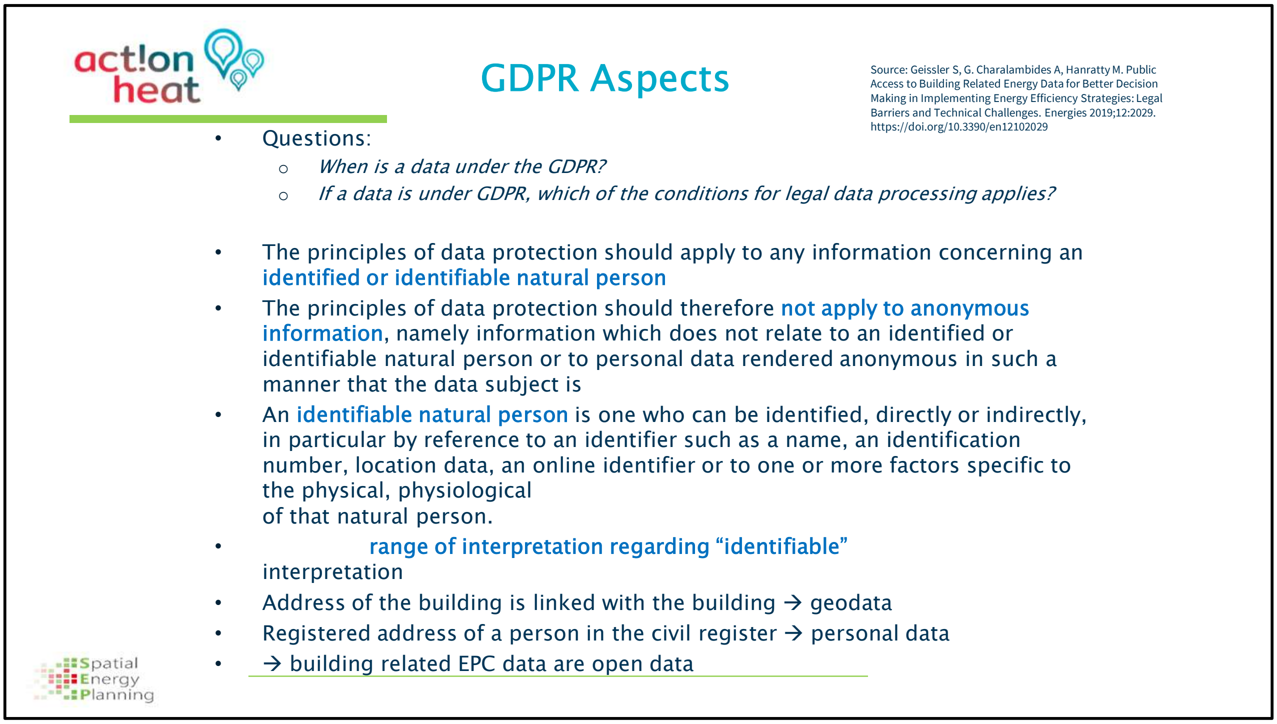


GDPR

The interpretation of the General Data Protection Regulation GDPR differs in European countries.

- Some are more restrictive, like Austria
- Some more open, like Denmark

Building-related information is not part of GDPR; when combined with other data, it is considered protected data. Nevertheless, it can still be used in some instances.



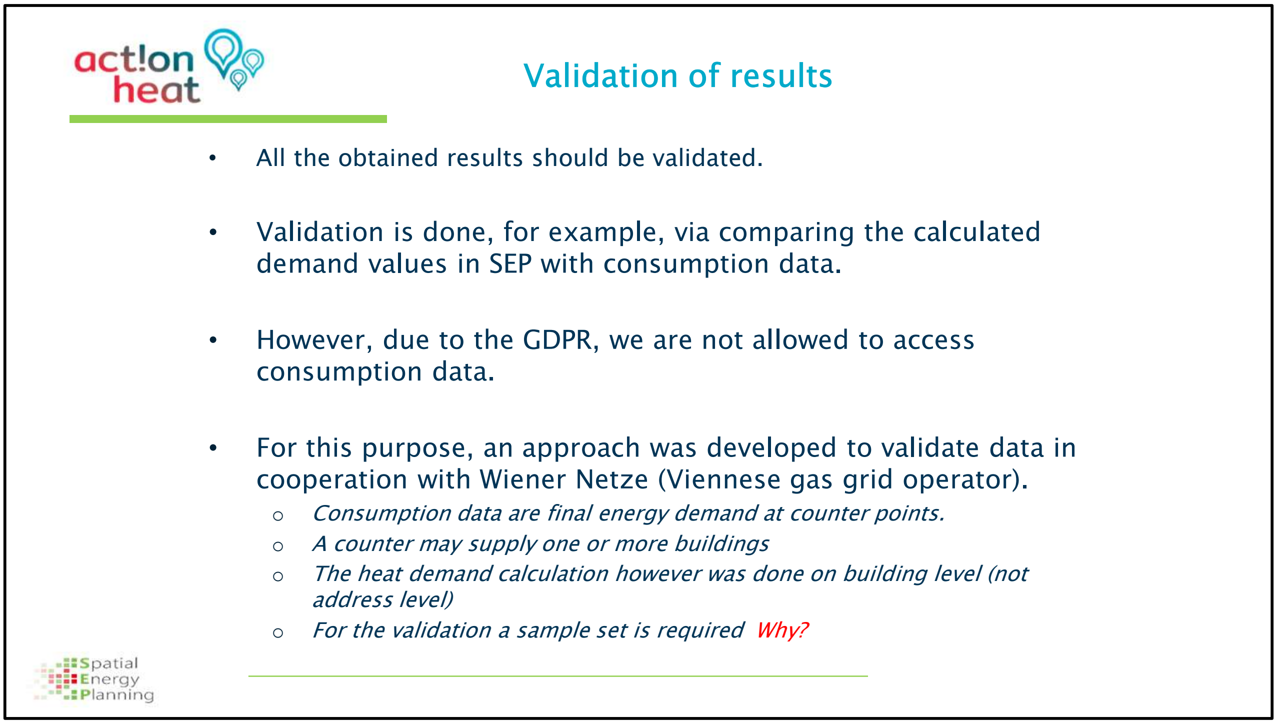
GDPR Aspects

In general:

- GDPR does not apply to the building data.

In particular:

- Each country has interpretation parameters for personal data.
- If you have personal identifiable data, then this data is protected.

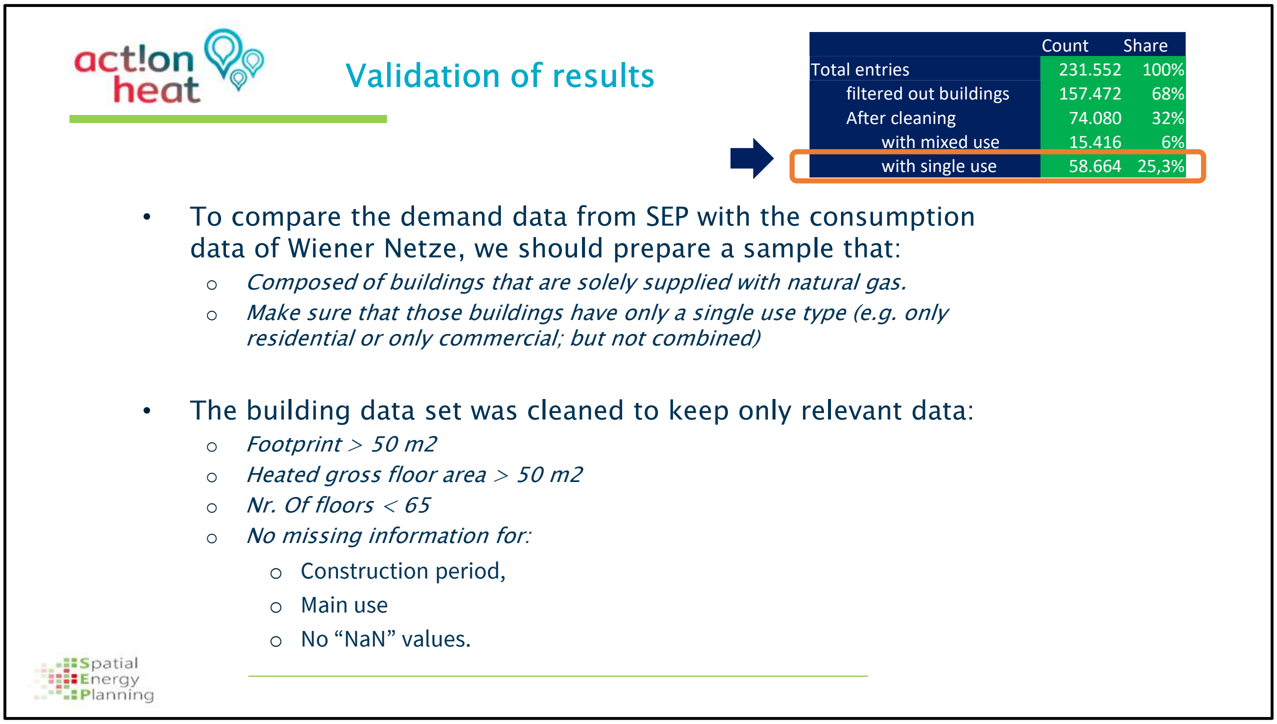


Validation of results

Following the plausibility checks, the outputs should be validated as well.

In Austria, heat supplier companies do not provide consumption data of their customers due to the GDPR.

In such cases, alternative, less-accurate approaches needs to be developed.



Validation of results

For the validation of data, constructive cooperation with all relevant parties, especially the energy suppliers and grid operators is necessary.

In this slide and the next few ones, the steps for the validation of results of SEP tools are presented.

In this process, the Wiener Netze, the gas grid operator in Vienna, was involved.

Validation of results – Classification

PARAMETER FOR CLASSIFICATION	UNIQUE CASES
CONSTRUCTION PERIOD	10
USE	14
RENOVATION STATUS	3
FOOTPRINT	5
COMBINATIONS	2100

- The 2100 combinations are not existing the the data set.
  - *Only 76 combinations with more than 100 entries*
  - *Only 219 combinations with more than 10 entries*
  - *Only 318 combinations with more than 5 entries*
    - From which 26 combinations with just 5 entries

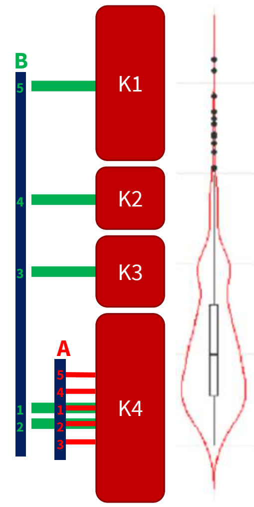
Spatial
Energy
Planning

act!on heat

Validation of results – Classification

- Sample ID X:
  - Construction period CP1, Use type U1, Renovation status R1, Footprint F1
  - Use natural break algorithm for breaking the entries under ID X to 4 categories
  - Sample Set A:
    - Find the category with highest number of entries.
    - Selection of median and 4 of its immediate neighbours
  - Stichprobe Set B:
    - Selection of Median of each category
    - 2 entries from largest category

Sample ID X
(heated GFA - distribution)



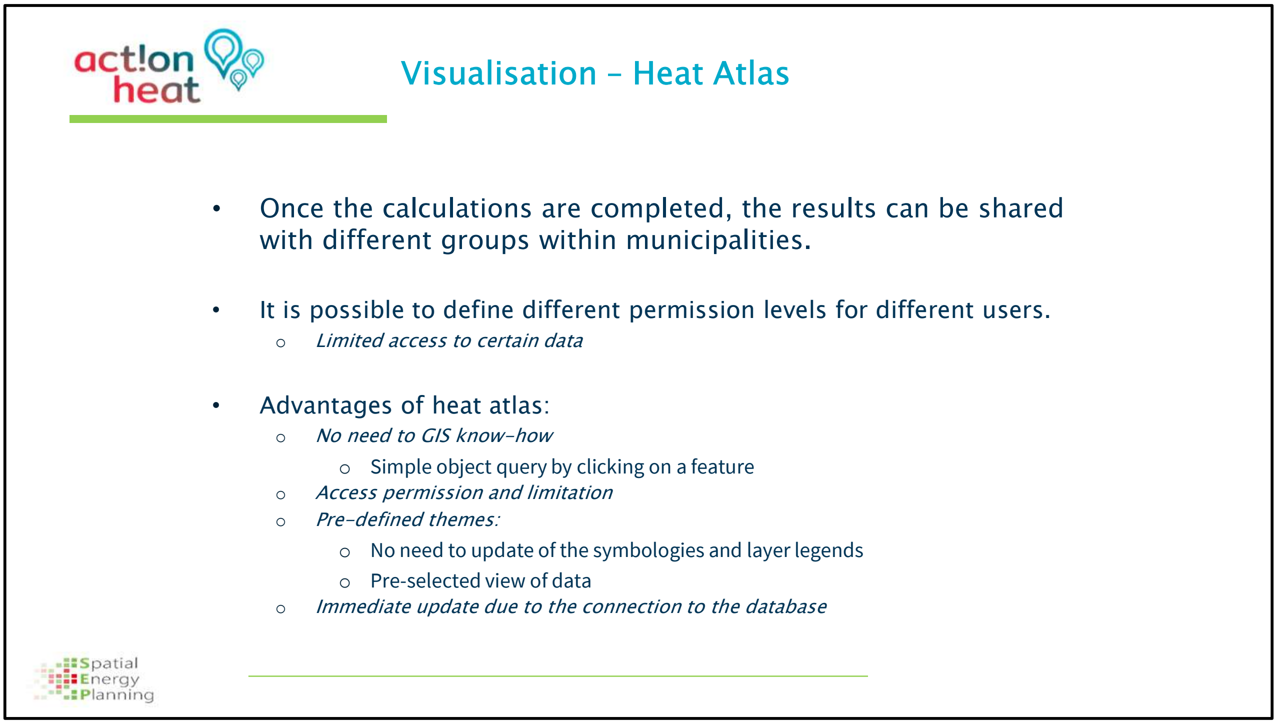
Spatial Energy Planning

Validation of results – join and aggregate

- The selected entries of each class (building polygons) should join the gas counters (address points).
- Calibration on HDD is required afterwards.

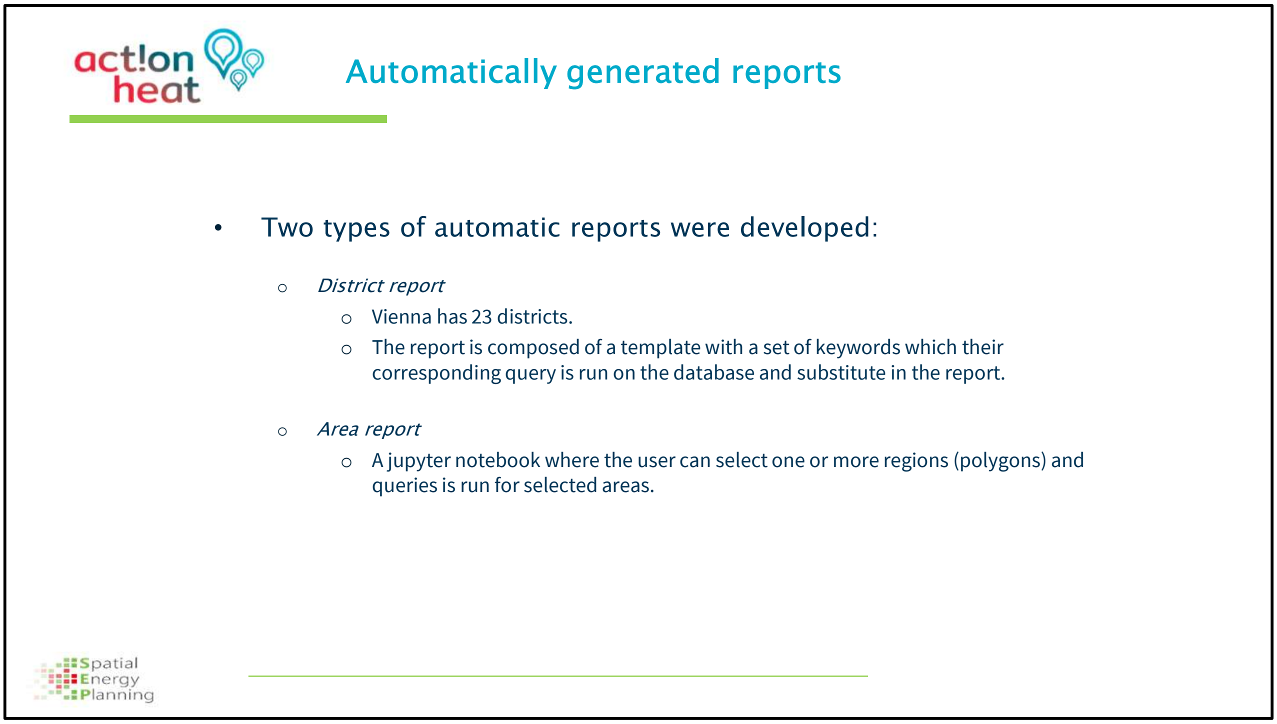
Sample ID	Sample Set	Building ID	Wiener Netze Identifier	Demand [MWh]
1	A	BWID0	OLAVID0	D0
1	A	BWID1	OLAVID1	D1
1	A	BWID2	OLAVID2	D2
1	A	BWID3	OLAVID3	D3
1	A	BWID4	OLAVID4	D4
1	B	BWID5	OLAVID5	D5
1	B	BWID6	OLAVID6	D6
1	B	BWID7	OLAVID7	D7
1	B	BWID8	OLAVID8	D8
1	B	BWID9	OLAVID9	D9
...	...	...	...	...

Sample ID	Sample Set	Agg. demand (SEP) [MWh]	Agg. Consumption (Wiener Netze) [MWh]						
			2015	2016	2017	2018	2019	2020	2021
1	A	X	X1	X2	X3	X4	X5	X6	X7
1	B	Y	Y1	Y2	Y3	Y4	Y5	Y6	Y7
...	...	...	...	...	...	...	...	...	...



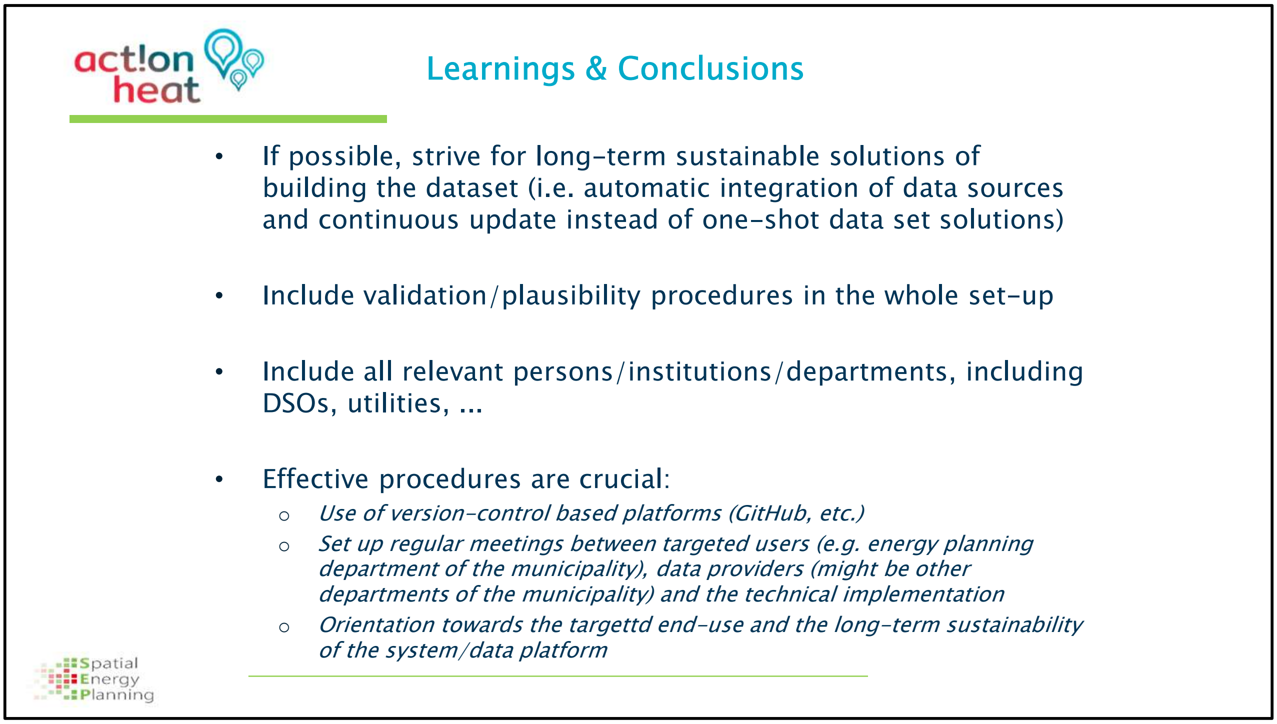
Heat Atlas as output

Once the calculations are completed, and all necessary plausibility and validity checks were finished, the results can be shared with different groups within municipalities



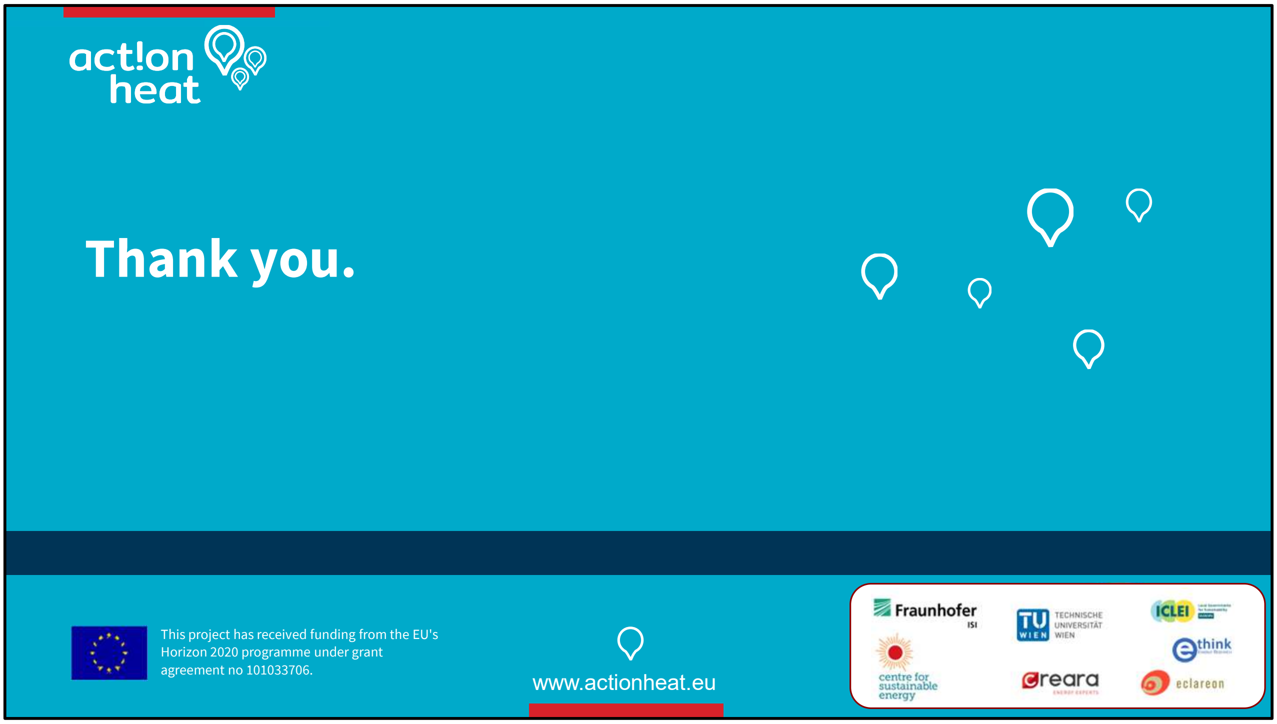
Automatically generated reports

The idea is that police makers can access the information to monitor different zones or areas without dealing with the knowledge of codes, data, or methodology.



Lessens learned from the SEP project

As stated in the slide.


act!on heat
Thank you.
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu
Fraunhofer ISI
TU WIEN
TECHNISCHE UNIVERSITÄT WIEN
ICLEI
e think
centre for sustainable energy
creara
eclareon

Webinar 3:
The use of Hotmaps for stategic heat planning

Act!onHeat SF1 — Time: 1 h 19 min

- Serial 1:
  - Webinar 3
    - Strategical Heating & Cooling planning
    - Group support for municipalities and stakeholders

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

Part 1

- Recapitulation of Webinars 1-2

Part 2

- Preview to Hotmaps.

Part 3

- Live introduction to the Hotmaps tool

Part 4

- Interactive use of Hotmaps with participants

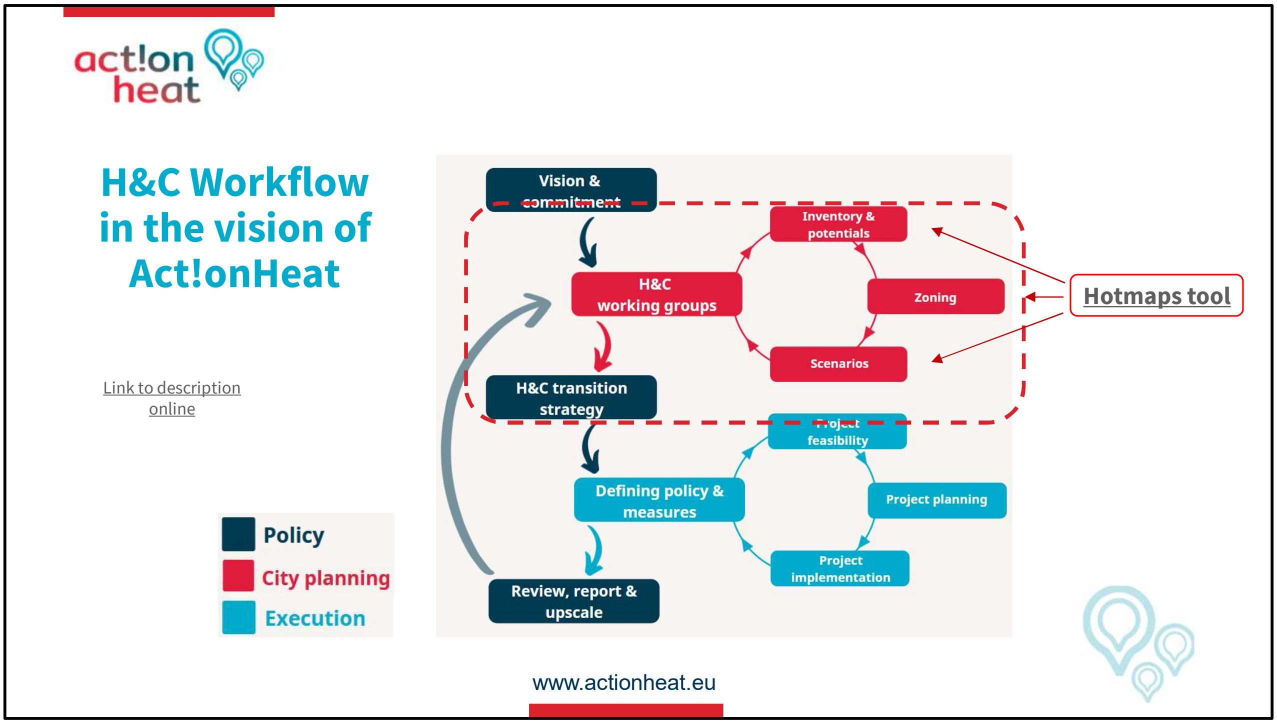
Part 5

- Extra information for own learning process

PART I

Strategic heat planning in the vision of Act!onHeat

www.actionheat.eu



Act!onHeat Workflow

- Focus on City planning

Policy
- Necessary to know EU targets to achieve them *(Visualization of needs).*

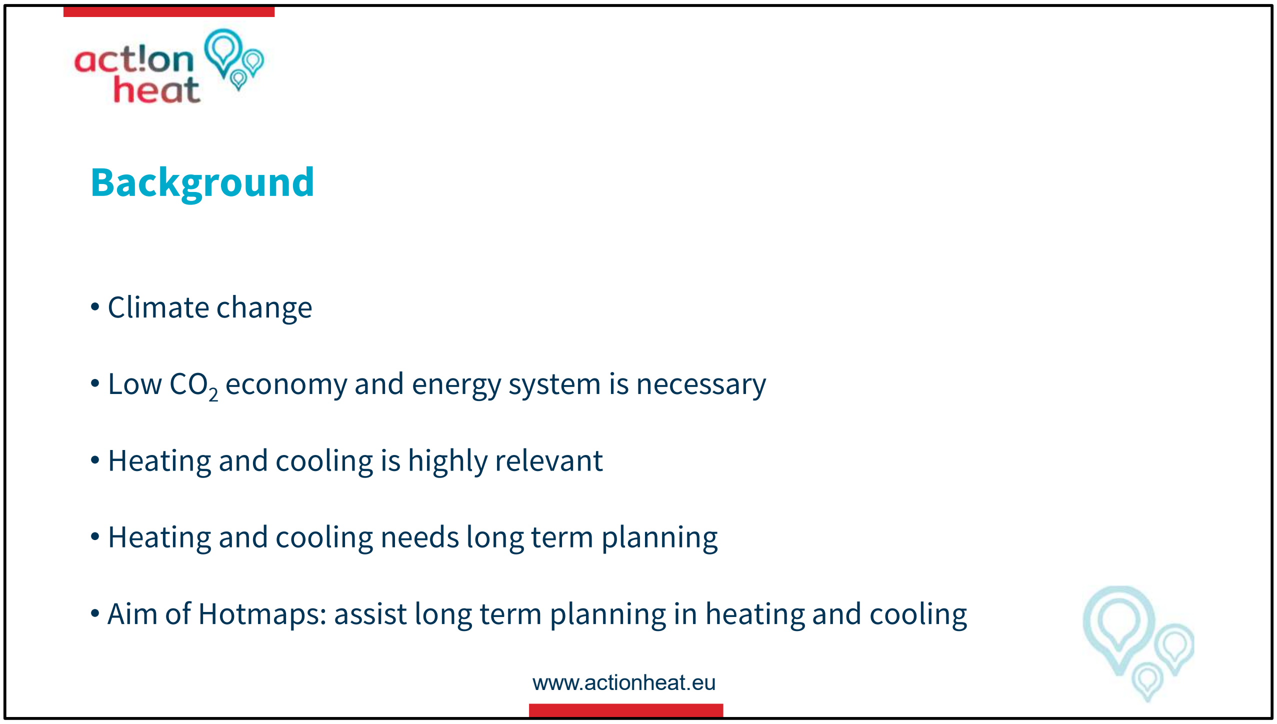
City planning
- Hotmaps can help to prioritize the zoning and requirements *(Overwie situation).*

Execution
- Group participation in project implementation steps *(Division of activities).*

PART II

The Hotmaps Platform

www.actionheat.eu



What we can do against the **climate change** crises

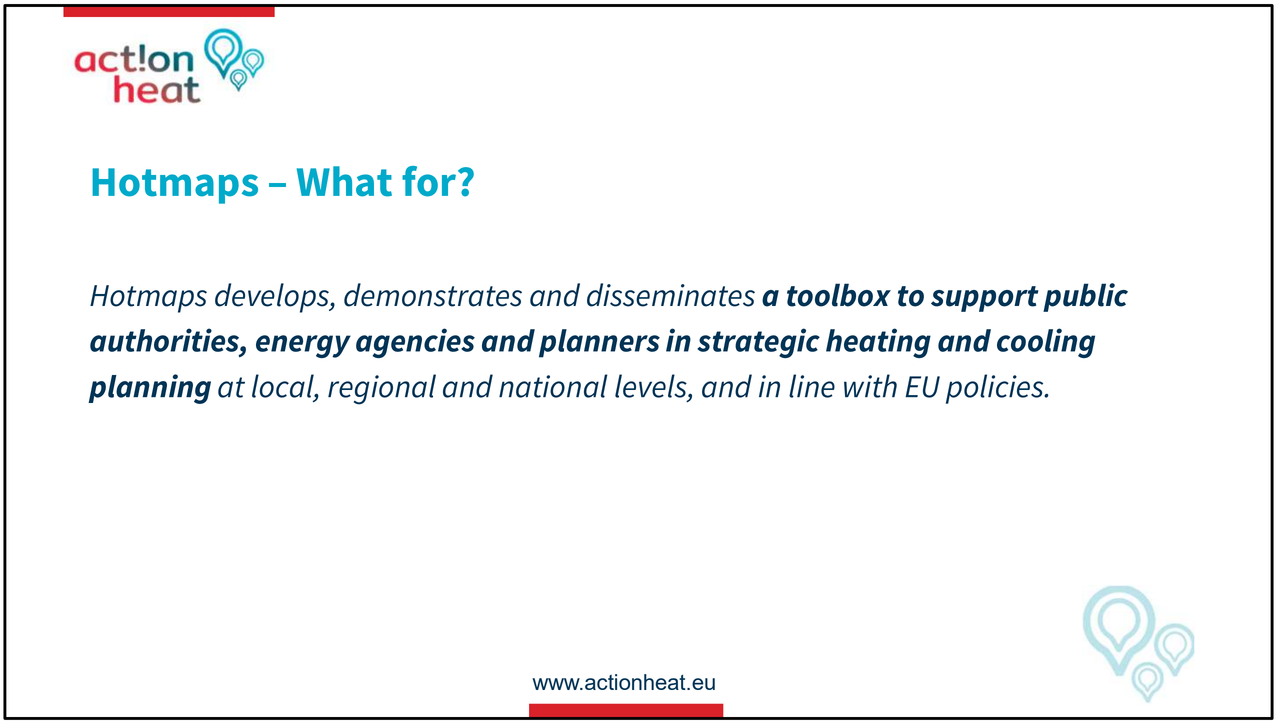
- **CO_2 reduction:**
  For example, using less fossil fuels for Heating and Cooling.

How can we do that?

- **Changenging H&C systems**
  Which requires a transitory plant for old to new alternatives.

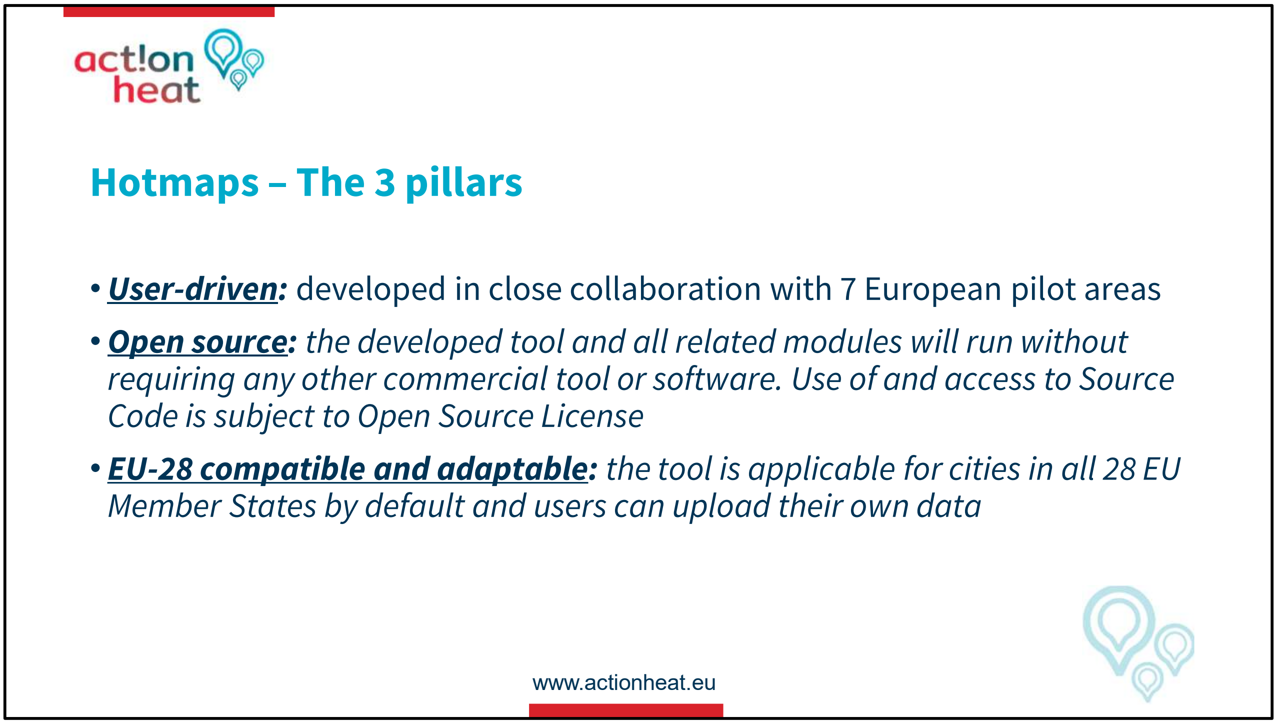
How started?

- Hotmaps assist **long-term planning**
  A tool for H&C visualization for municipalities or stakeholders.



Hotmaps objective

The tool will be used for Act!onheat project as a part of support facility 1 to help authorities or stakeholders quickly estimate the heat and cooling regional demand.

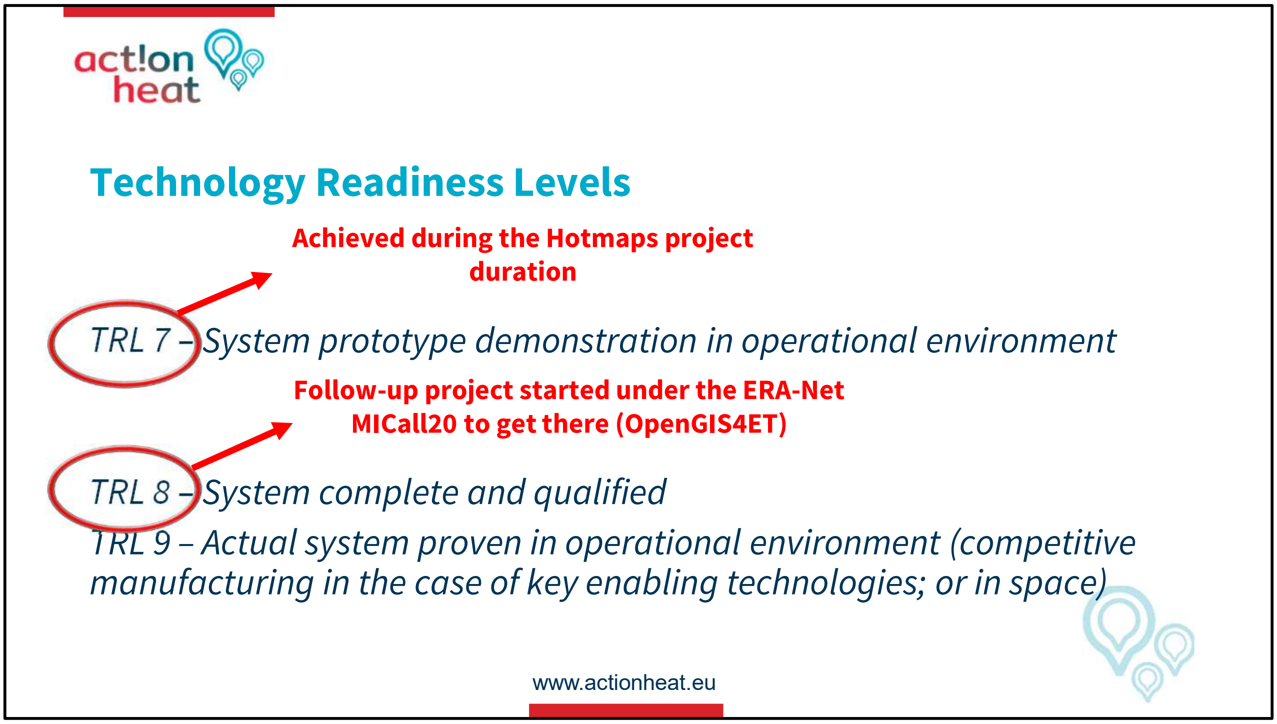


Hotmaps fundamental development

User-driven:
- Collaboration of different countries in developing.

Open source:
- Free for use and continue developing.

EU-28:
- Whit EU reliable database for 28 countries.



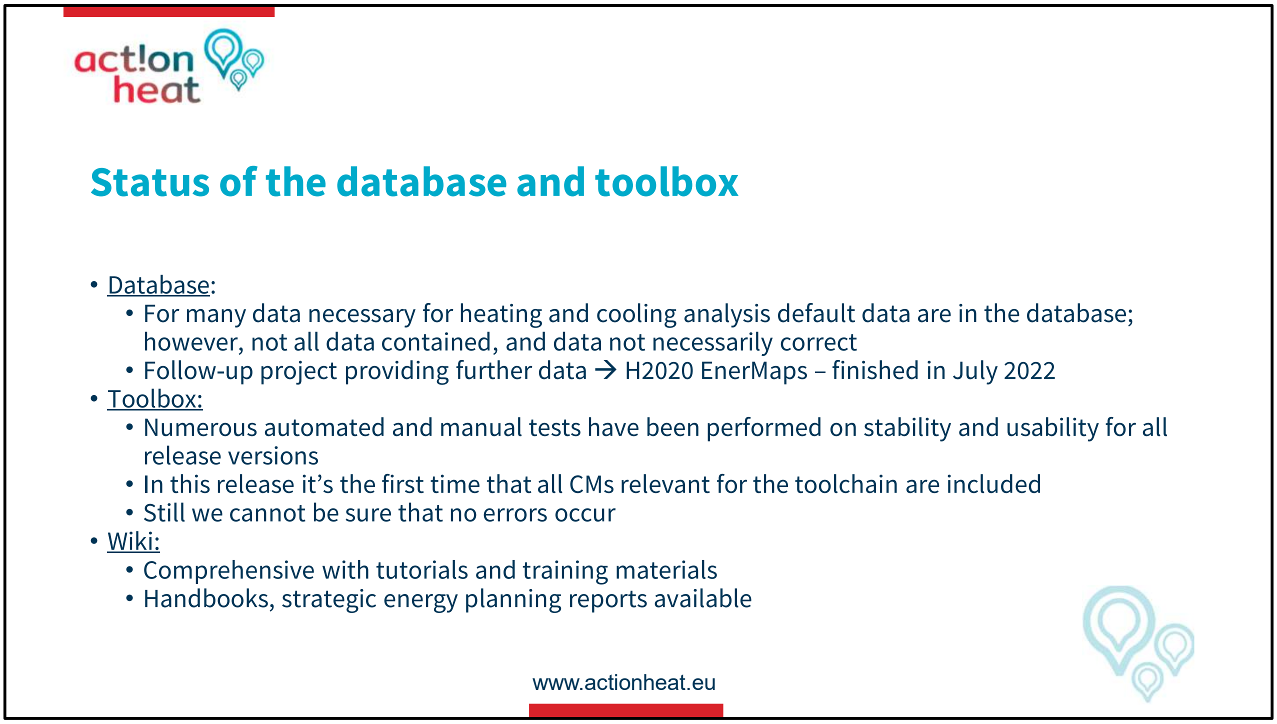
Tecnology Readiness Level (TRL)

- Indicator of how ready is a software for the market

Hotmas has a readiness level of 7

- Feedback on the tool are in implemented process for level 8, which will be complete in 2024

- The final intention is to achieve a Technological Readness level of 9

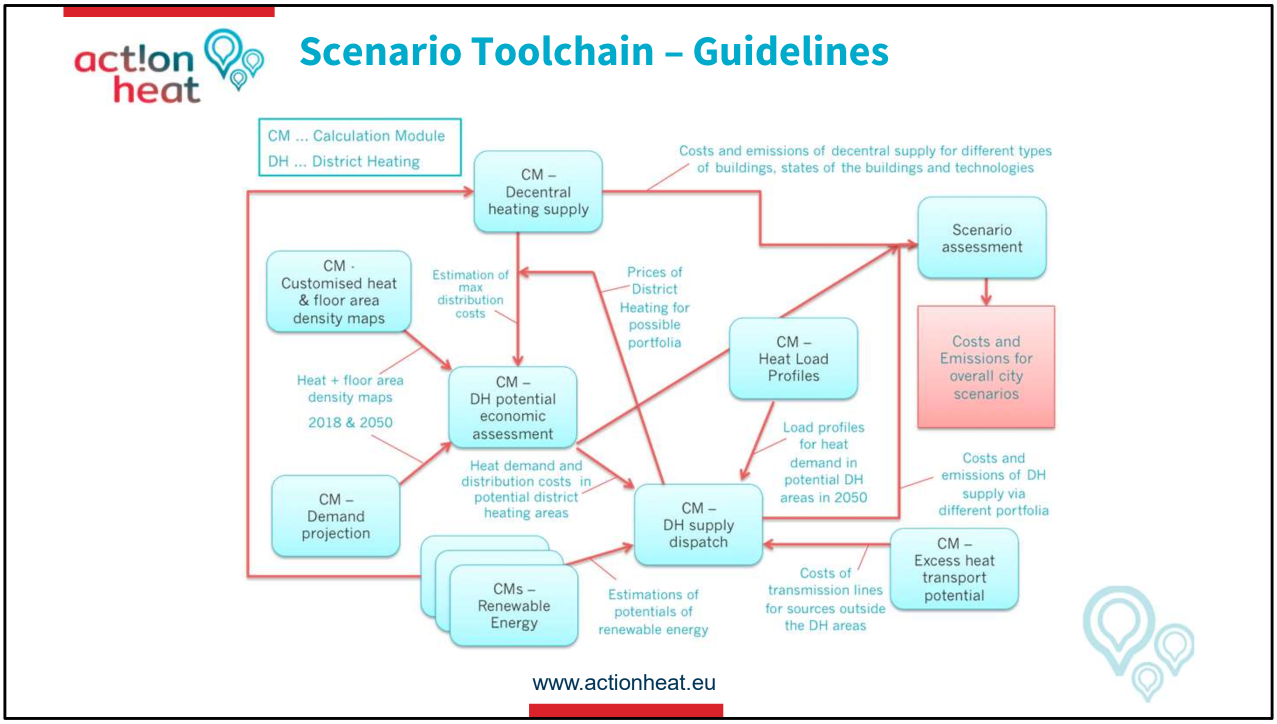


Hotmaps database status

Data:
Statistical data change with time and are not 100% accurate. But if required, it is also possible to check the developed calculation methodology in the Wiki link.

Toolbox:
It is possible to find errors in the platform when using it; if that happens, press control F5 to reload.

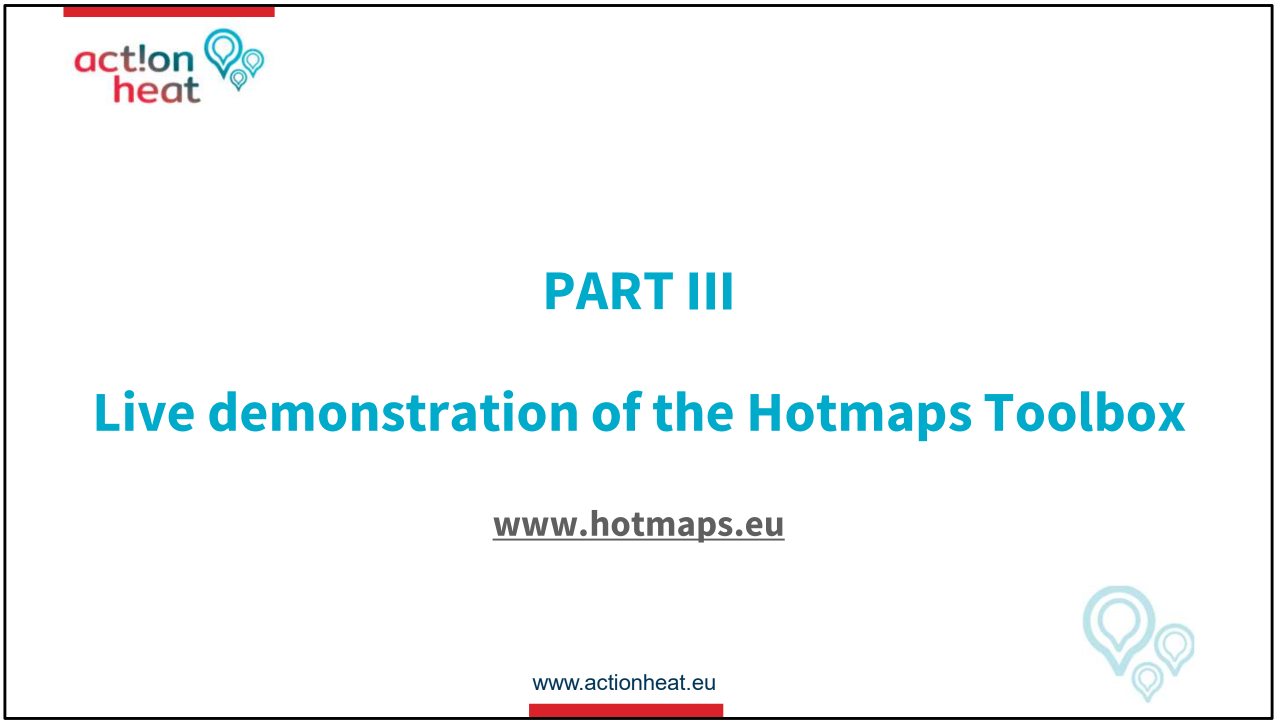
Wiki:
It is possible to find extra explanation information for the tool and its use, but it must also be completed.



Hotmaps Calculation Modules CM

- CM could be used independently:
  The illustration shows how different calculation modules can be used to analyze different aspects of the heating and cooling system and research questions. Furthermore, it also shows how the calculation modules can be used as a chain of tools to derive scenarios for heating and cooling in certain areas.

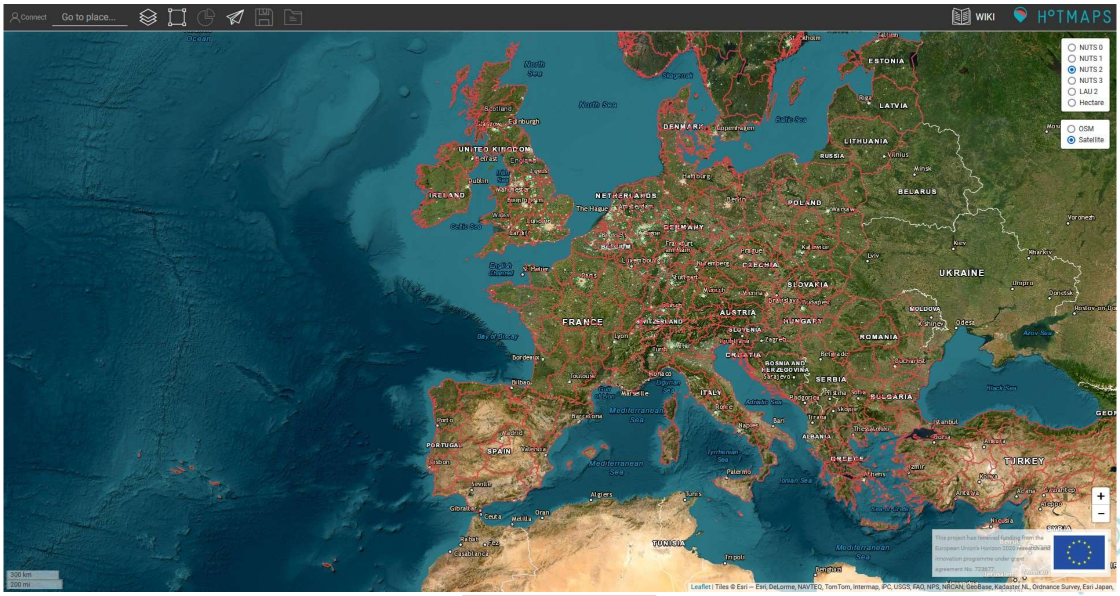
- CM are combined to generate another model:
  The main idea is to combine CM in different ways to create another CM more complex combination. Nevertheless, all of them are a combination of different statistical data.



This part of the Webinar was shown online going to: www.hotmaps.eu

Note:
The next slides are not part of the original presentation. Those were added with the intention to continue explaining this part of the Webinar because the tool was shown online. During the next part of this document, the platform will be described step-by-step, showing images toked from the internet to follow the demonstration for this part of the Webinar explanation.

Hotmas Internet site

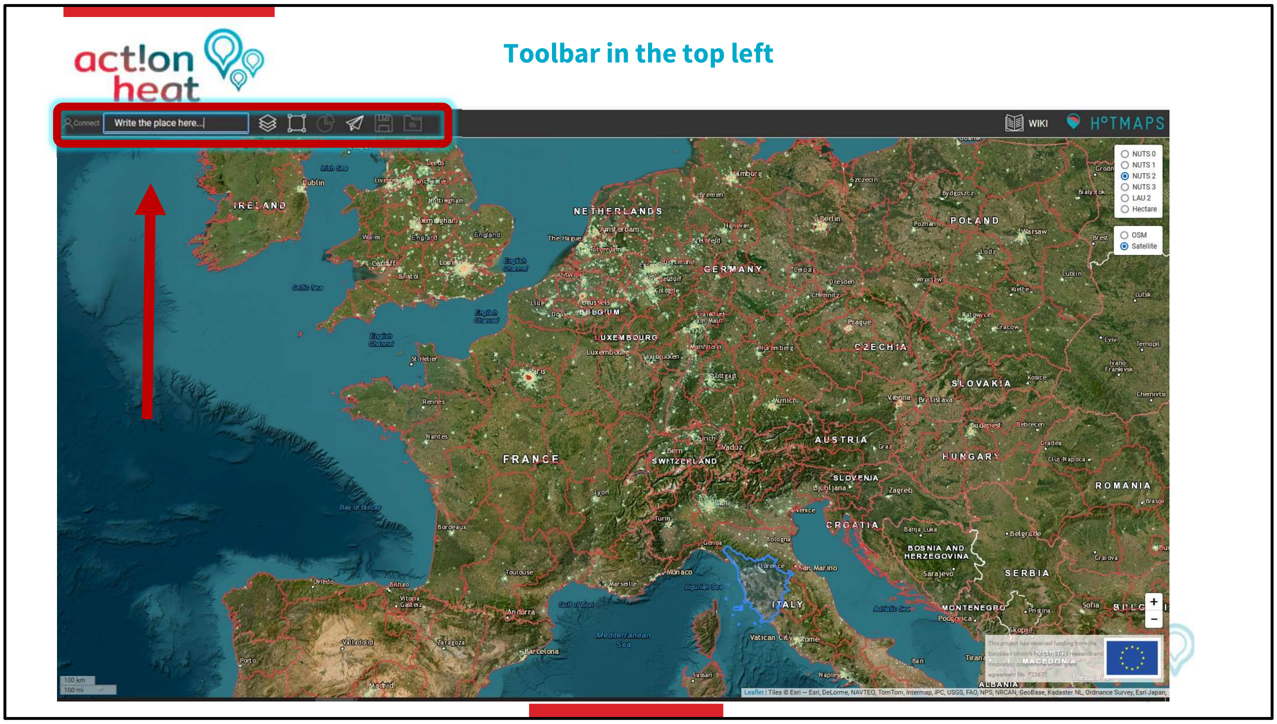


Vizualization of Hotmaps and explanation

1. Enter the website and accept the terms and conditions.
   It will open a map of Europe.

2. Zooming in/out and moving on the map is possible.
   To visualize a specific area in the browser.

3. Pictographic interactive parts on the top left and top/downright sites.
   To activate the function on the tool.



Pictographic icons or windows in the top left

First icon: Connect
- Allow you: To register on the platform to use specific functions.

Second window: localization
- Allows you to go to a specific region. Taping the name of the place.

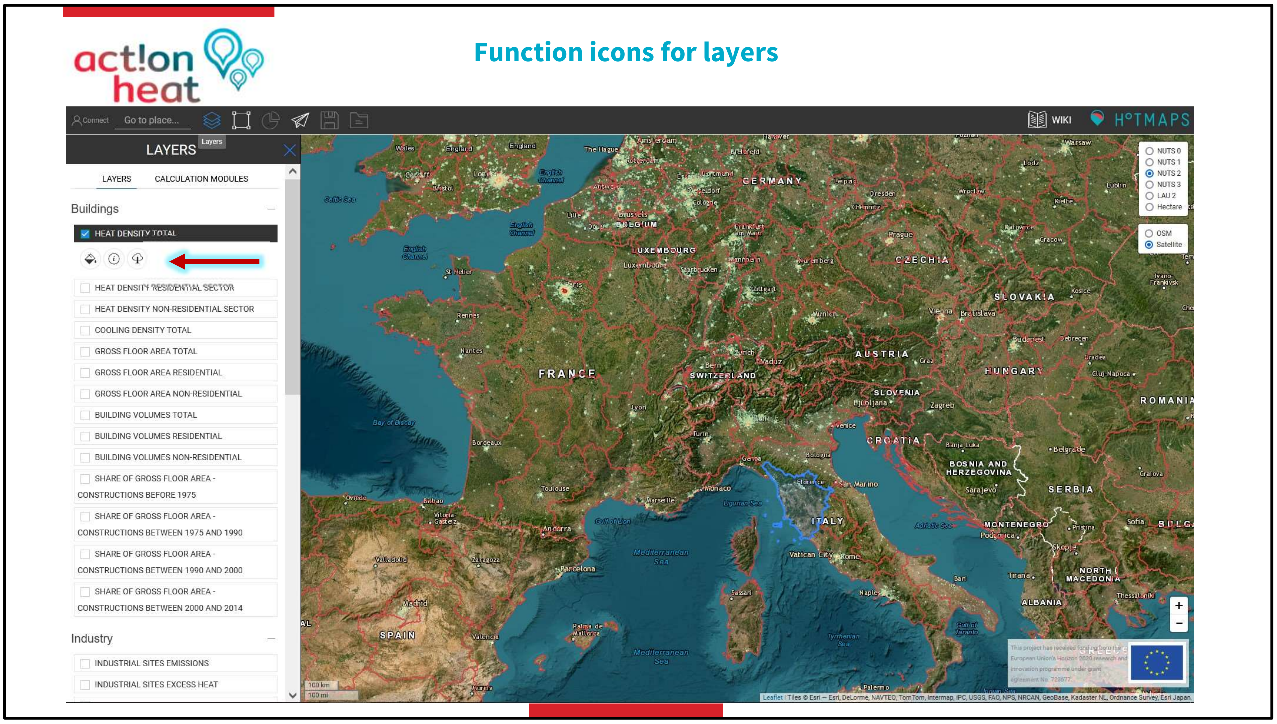
Third icon: Layers
- Allows you to activate visualization of different H&C Parameters.

Fourd icon: Selection
- Allow you to select a specific region on the map to work whit.

Fifth icon: Results
- Allows you to close and open the result window.

Sixth icon: Feedback
- Allows you to write a comment to the developers for issues.

Seventh and eighth icons: Save and Folder
- Allows you to save your calculations and find them in a specific folder.



Leyers functions and description

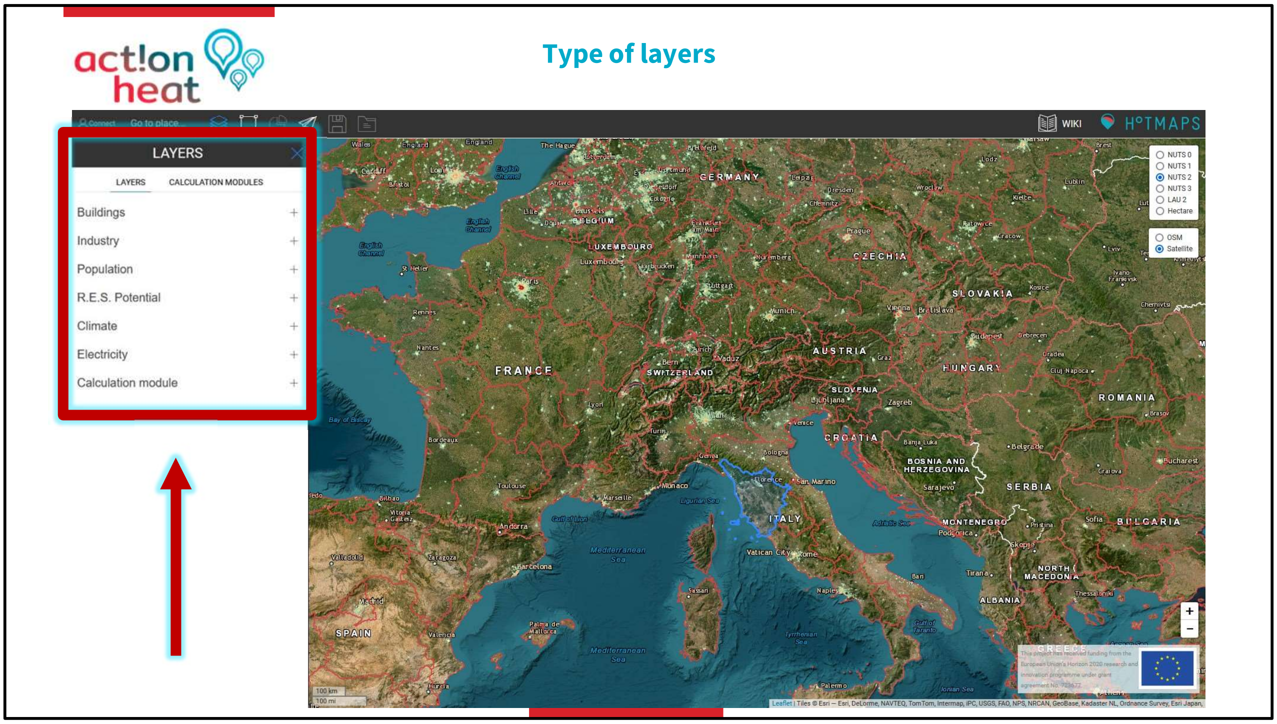
Go to the layer and click on it.

- Allows you to activate the layer function and the next iconic possibilities:

- Icon one: Symbology
  Allows you to know the parametrical color description on the layer

- Icon tow: Infomation
  Allows you to address you to extra information about the layer

- Icon tree: Download
  Allows you to download default data set



Different kinds of layers and its visualization

Buildings. Is a Rasta Layer RL that indicates building volume or a construction area and the heat cooling demand for residential and not residential areas.

Industry. Is a Vector Layer VL that shows you specific information about industries like excess heat and carbon emissions

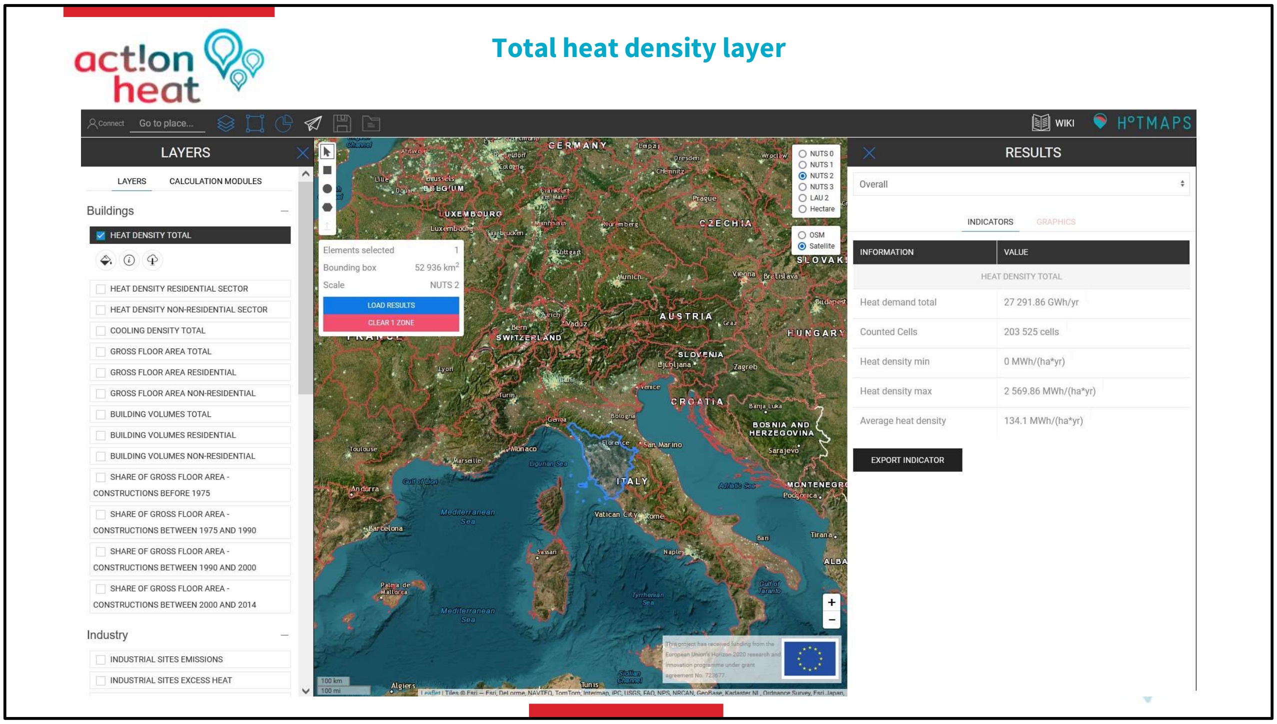
Population. VL that shows you the total population in a selected area,

Renewable Energy Sources R.E.S Potential. RL that shows you energy potentials like solar radiation, wind, or Fores residues.

Climates. RL that shows you temperature percentage like cooling or heating days, wind speed, or solar radiation.

Electricity. VL shows you the electricity CO_2 emission in a country average

Calculation Modes. RL and VL layers that are combined to give more specific information. This layer will only open if you select an area and load results.



To visualize layer results, it is necessary to select a specific area.

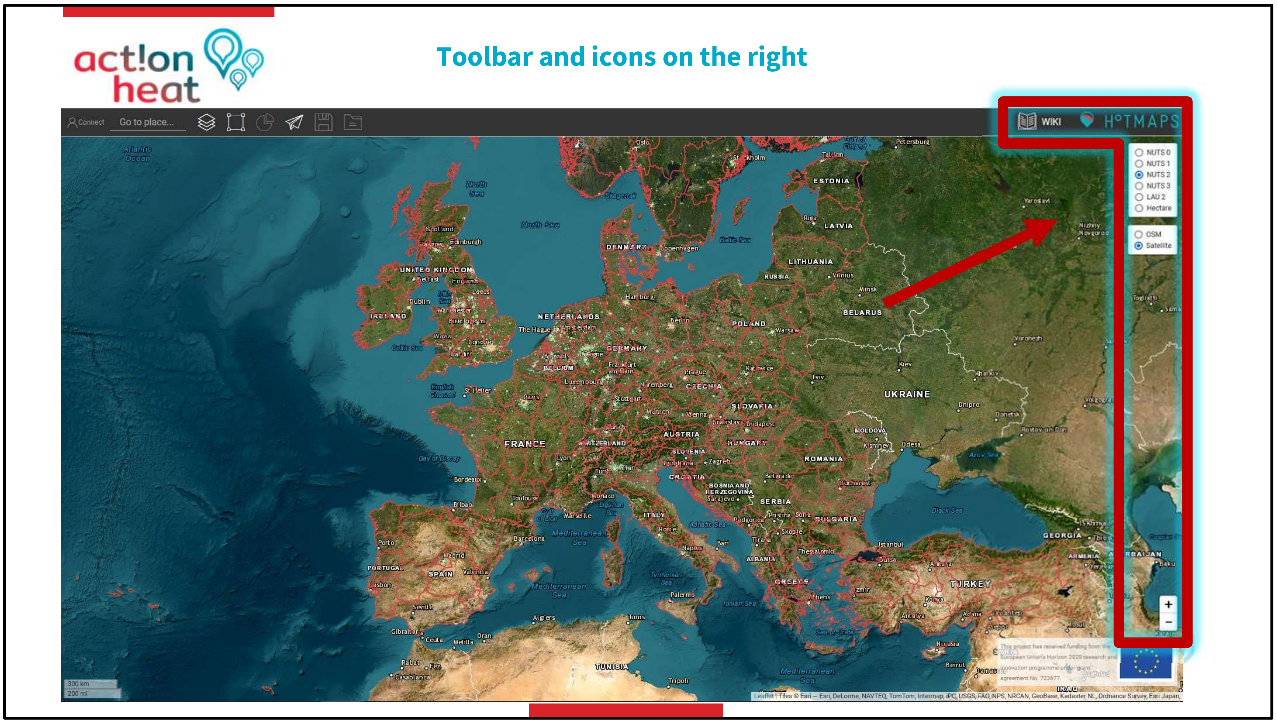
Example:

1.- Selection: Specific area on the map.
Visualization: That area will appear in another color, like blue.

2.- Selection: Specific layer, for example; HEAT DEMAND TOTAL
Visualization: A box right to the layer will appear whit information about the selected zone with the number of elements selected. Bounding box. Scale. and the possibility of Loading results or Clear the zone.

3.- Selection: The box color blue, and LOAD RESULTS
Visualization: A RESULT box at the right of the window appears and will show you the results of the selected layer according to that area; for the HEAT DEMAND TOTAL layer, you will observe the Heat demand total. Counted cells. Heat density min and max., and Average heat density.

Note: The CALCULATION MODULES will be open only following the steps already mentioned; select a specific area, and load the results for some layer.



Pictographic icons or windows on the right side

On the top

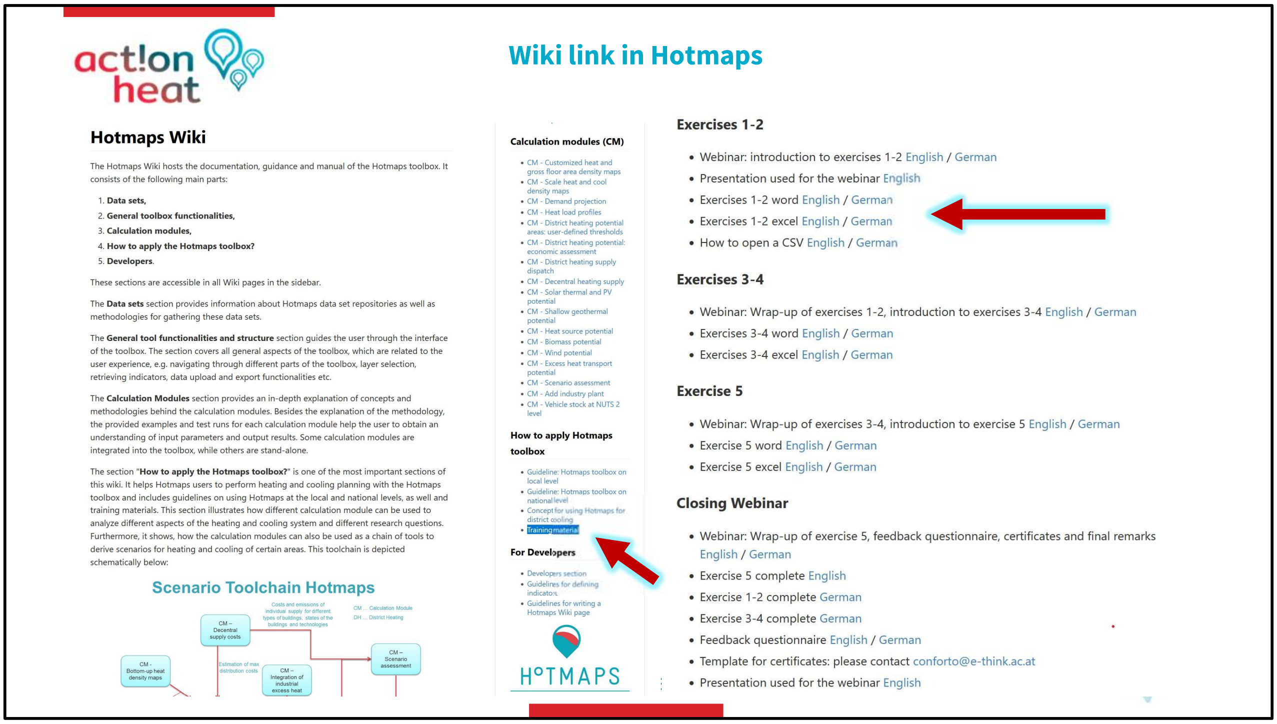
First icon top: Wiki
- Allows you to open a Hotmaps general explanation.

Second icon top: HOTMAPS
- Allows you to open the project development homepage.

On the side

First window side: NUTS and Hectare
- Allows you to change the territorial unit division on the map.

Second icon bottom side: Zoom
- Allows you to zoom in or out on the map window.



What the Hotmaps Wiki contains:

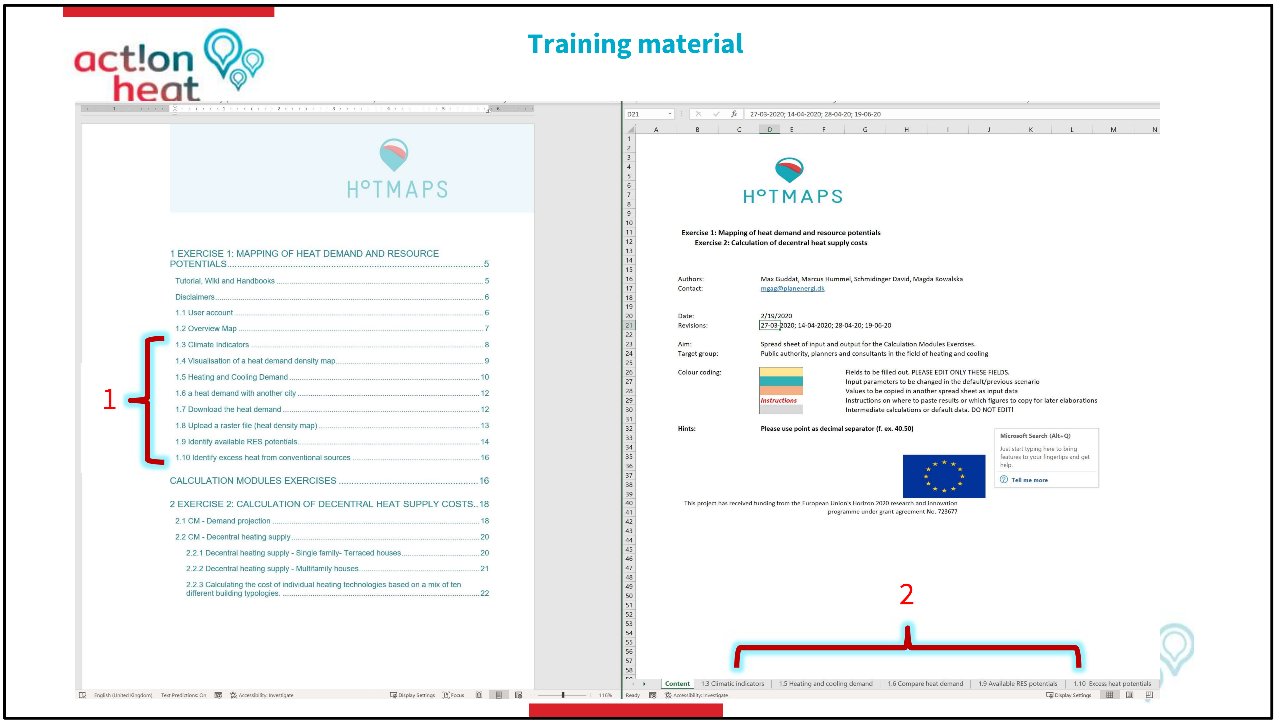
1.Data sets
2.General toolbox functionalities
3.Calculation modules
4.How to apply the Hotmaps toolbox?
5.Developers

Wiki explains how the data are generated in Hotmaps and how the tool could be used through the next elements:

Introduction: Explain each of the elements from the tool
Functionalities: Explain general toolbar information
Methods: Explain how the functions and modules are calculated.
Guidelines: How to use Hotmaps
Training material: Exercises to improve your knowledge
Developers: How to improve the tool

For the webinar:

First, click on **Traning material** and then scroll down to **Exercises 1-2** and download the Word and the Excel format.

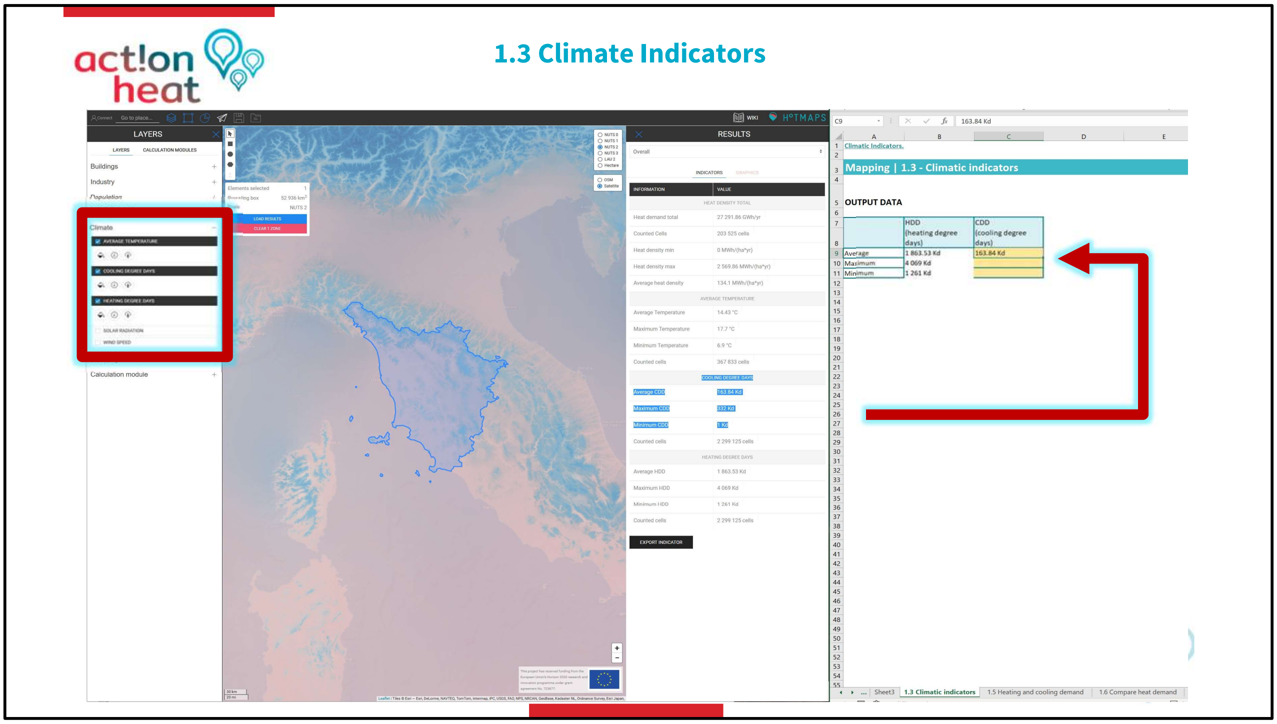


Training material: Download and open **Word and Excel** exercise **documents**.

The Hotmaps explanation list of the exercises with the number 1 on the Word document is used to understand how to fill out the Excel sheet marked with the number 2.

Word 1	Excel 2
1.3 Climate Indicators	1.3 Climatic Indicators
1.5 Heating and Cooling Demand	1.5 Heating and Cooling demand
1.6 a heat demand whit another city	1.6 Compara heat demand
1.9 Identify available RES potentials	1.9 Available RES potentials
1.10 Identify EH from Conv. Sources	1.10 Excess Heat (EH) potentials
2.1 Demand projection	2.1 Demand projection
2.2.1 Decentral heating supply-Single fam.	2.2.1 Decentral heating supply
2.2.2 Decentral heating supply-Multifam.	2.2.2 Decentral heating supply
2.2.3 Calculating heating tec. on ten dif. building typologies	2.2.3 Decentral heating supply

Note: The data to fill the Excel table will be found on the Hotmaps plataform; follow the instructions.



The Excel data can be found on the Hotmaps platform:

Word 1	Excel 2
1.3 Climate Indicators	**1.3 Climatic Indicators**
1.5 Heating and Cooling Demand	1.5 Heating and Cooling demand
1.6 ….	1.6 ….

For example, for **Climate Indicators:**

1.- Go to Hotmaps layers and choose **Climate**

2.- Select an area of interest and click on it.

3.- Select the climate indicators that you are looking for from Exel:
Average temperature
Cooling degree days
Heating degree days

4.- **LOAD RESULTS** from an interest area whit specific parameters according to the interest municipality area for H&C planning.

5.- Fill out the results from Hotmaps in your Excel sheet to complete the exercise.

PART IV

Individual exercise

www.actionheat.eu

act!on heat

Individual exercise

1. Open the toolbox in your browser (firefox or chrome preferred) -> www.hotmaps.eu
2. Enter the name of the region you are interested in in the search field
3. Select the level of detail (NUTS 0 - NUTS3, LAU2, Hectar)
4. Activate the layer „HEAT DENSITY RESIDENTIAL“ and „GROSS FLOOR AREA RESIDENTIAL“
5. Select the region of interest in your desired level of detail by clicking on the shape
6. Click on the button “LOAD RESULTS” to receive the results-> write down the results
7. Click on the tab “CALCULATION MODULES”
8. Select the CM “CM - District heating potential areas: user-defined thresholds”
9. Define a threshold for min. heat demand in hectare
10. Click “RUN CM” to receive the potential share of district heating from total demand in selected zone

www.actionheat.eu

For the participants:

The participant needs to follow the instruction, open the Hotmaps tool, and complete the exercise. The intention is that they start to familiarise themselves with the tool.

The decision to perform the calculation should remain flexible and tailored to each specific case.
Users were provided with a 10-minute window to transition between discussion and tool testing.

Wiki:is the starting point for strategic Heating and Cooling planning.

Act!on heat offers as a part of its support package the possibility to make an appointment and receive workshops making an appointment.

act!on heat

Thank you.

TU Wien, e-think

Date: 17.11.2022

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

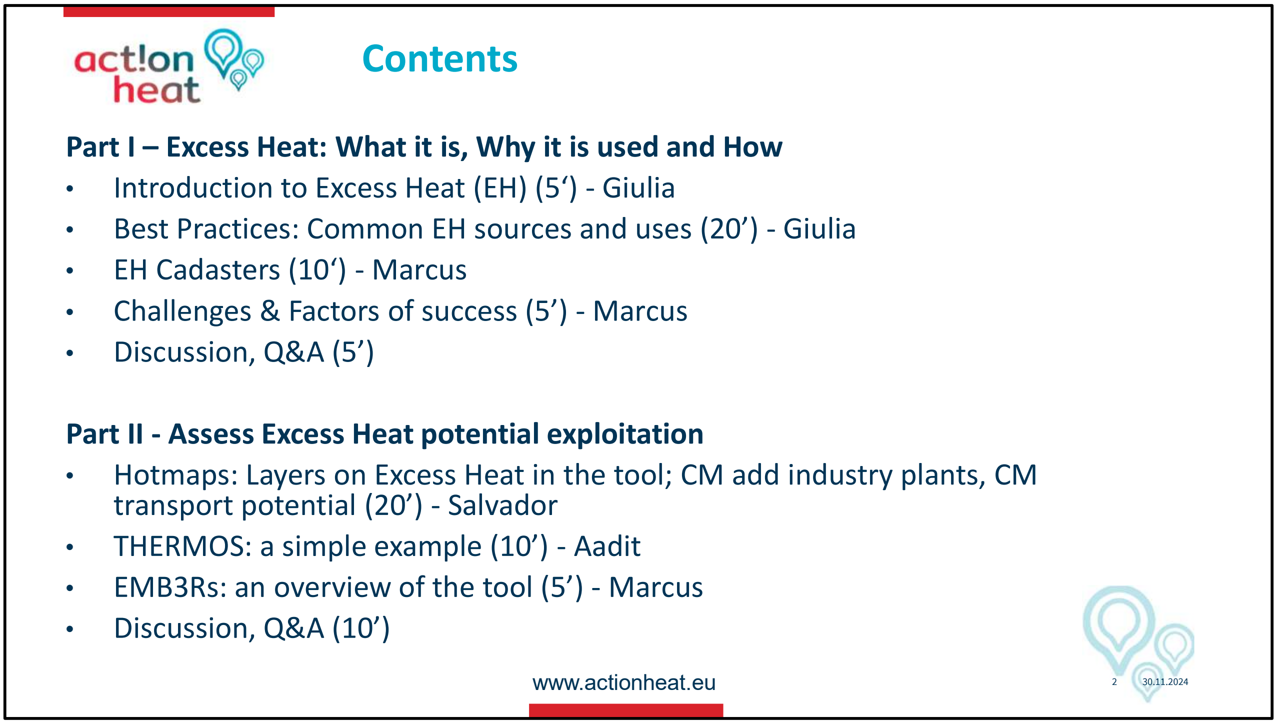
www.actionheat.eu

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



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

act!on heat

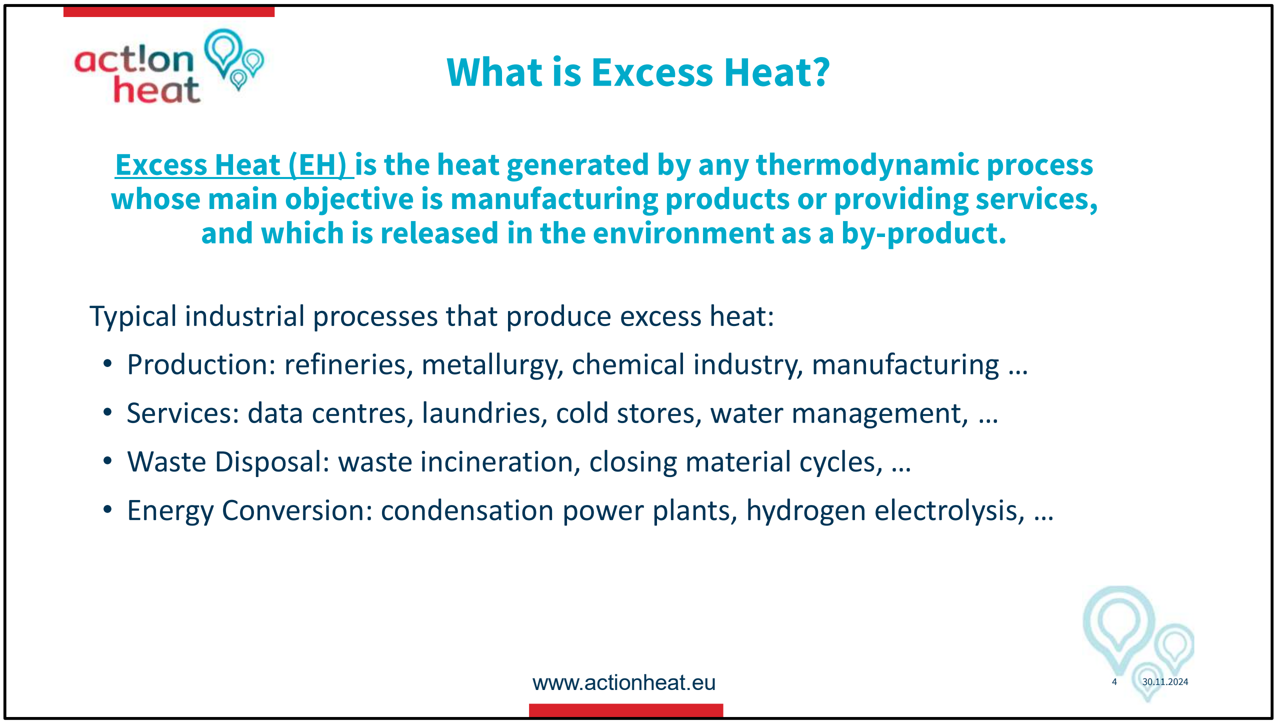
Introduction to Excess Heat

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.

www.actionheat.eu

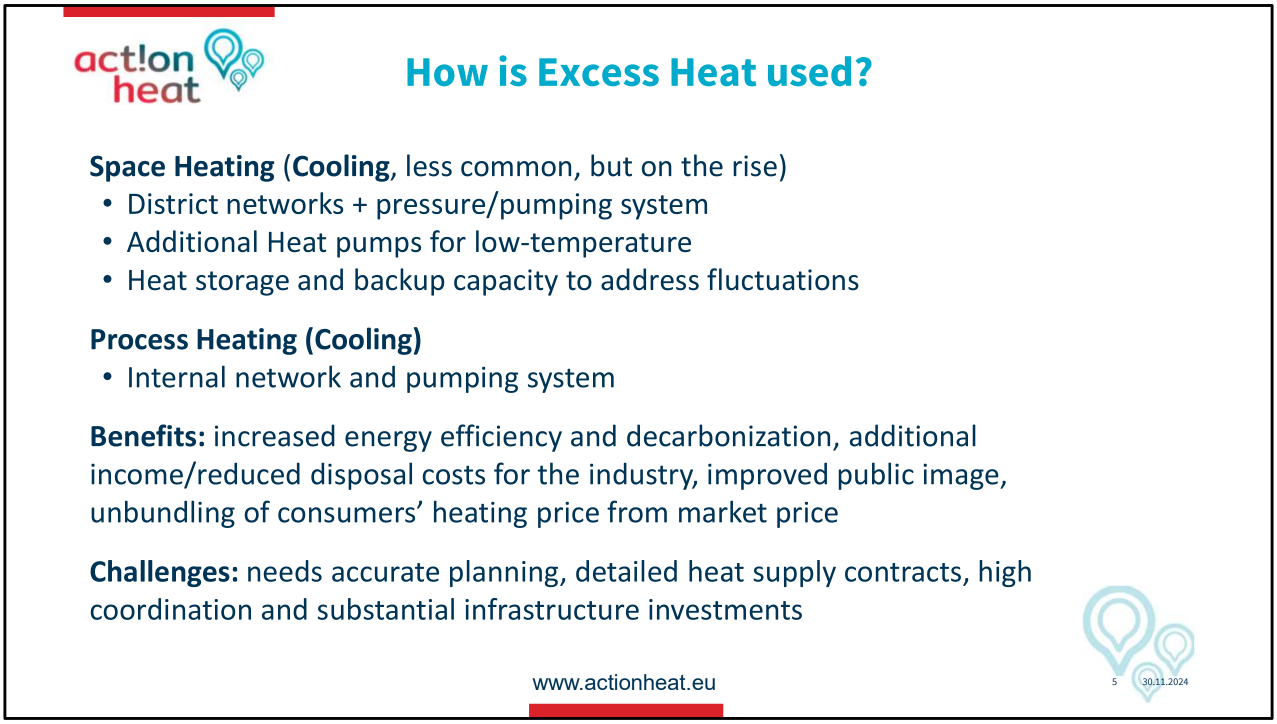
Fraunhofer ISI
TU Wien Technische Universität Wien
ICLEI
centre for sustainable energy
creara
e-think
eclareon



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?

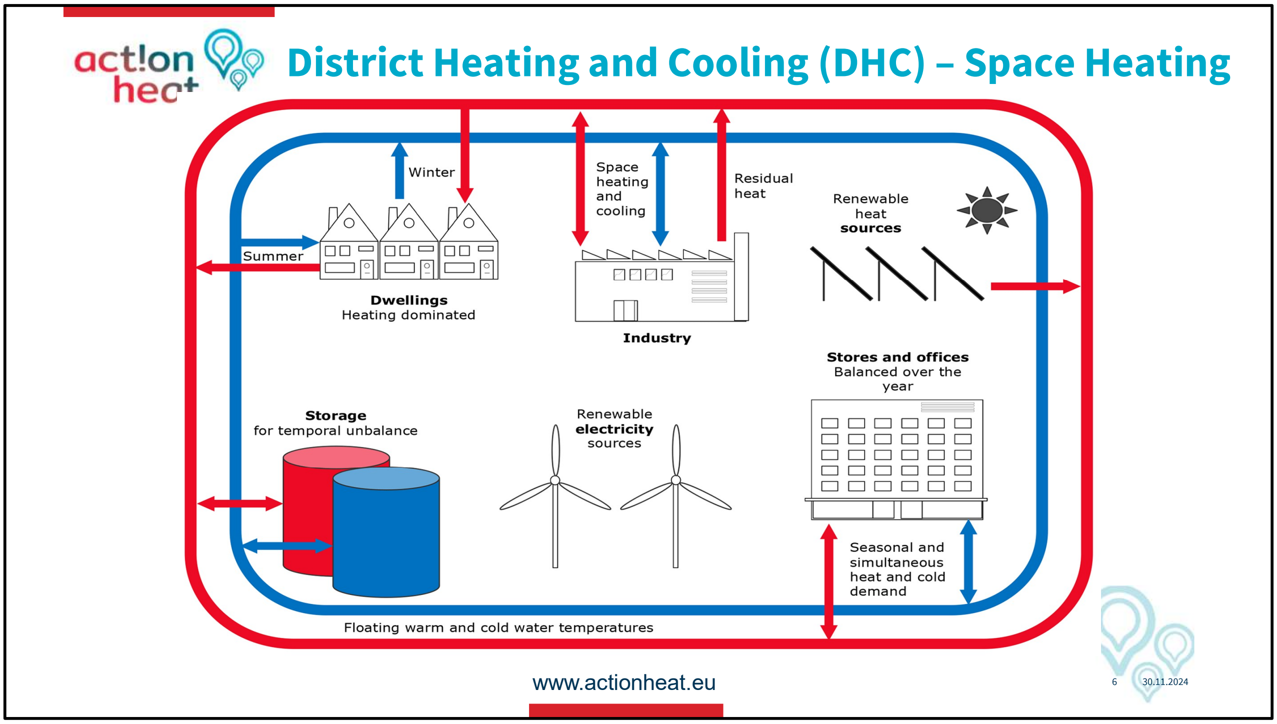
- Space Heating: The heat produced in the plant is distributed externally through different systems. Requires much infrastructure and needs to be planned

- 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

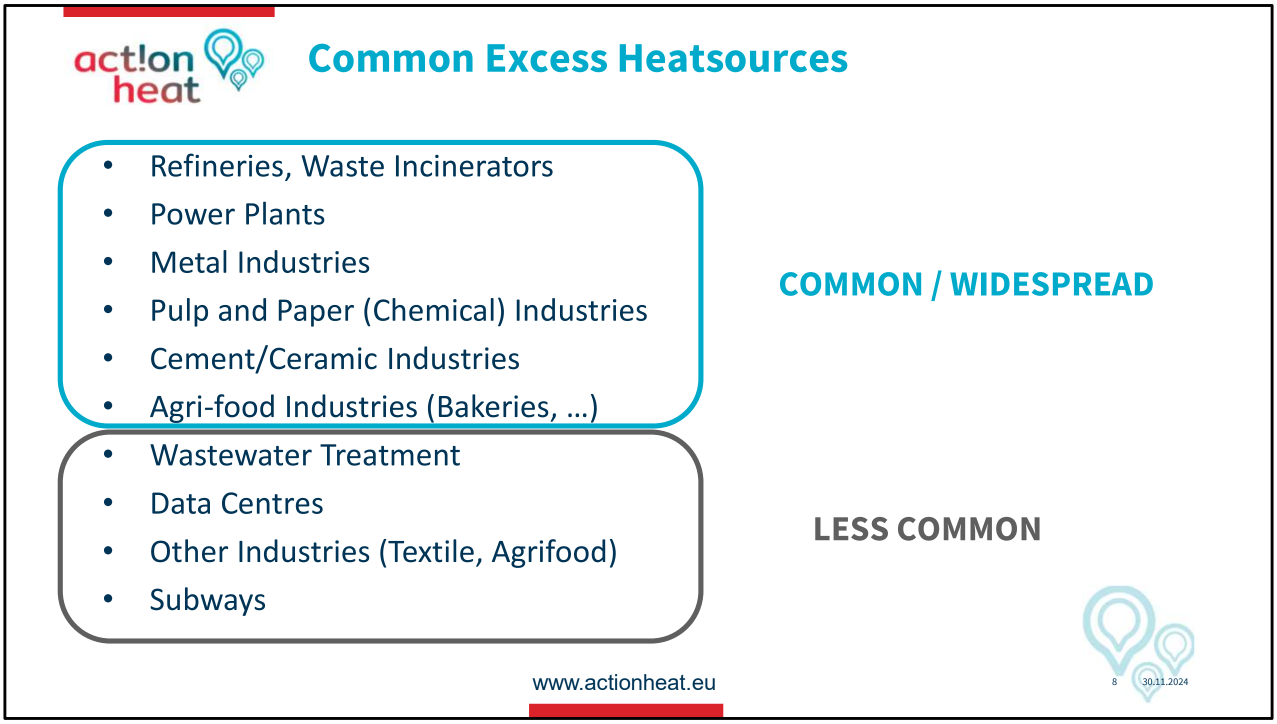
act!on heat

Best Practices:
Common heat sources and uses

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.

www.actionheat.eu

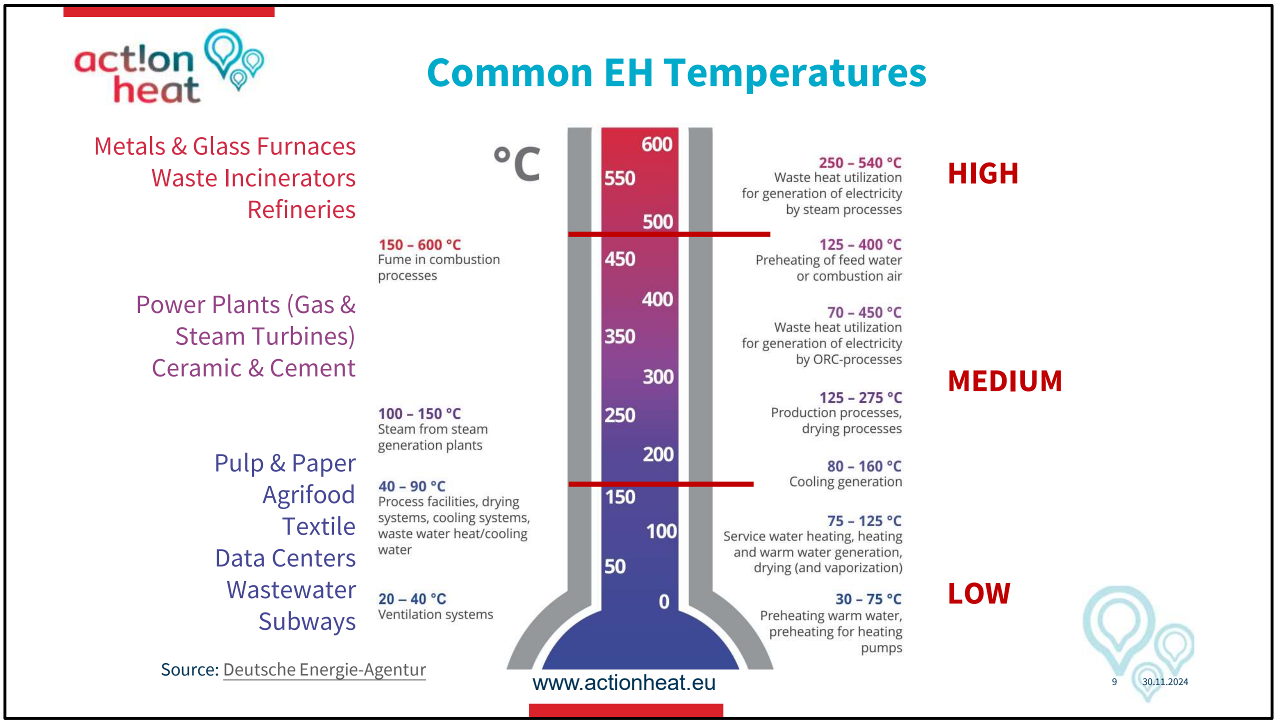


Kind of Excess Heat sources

- 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.



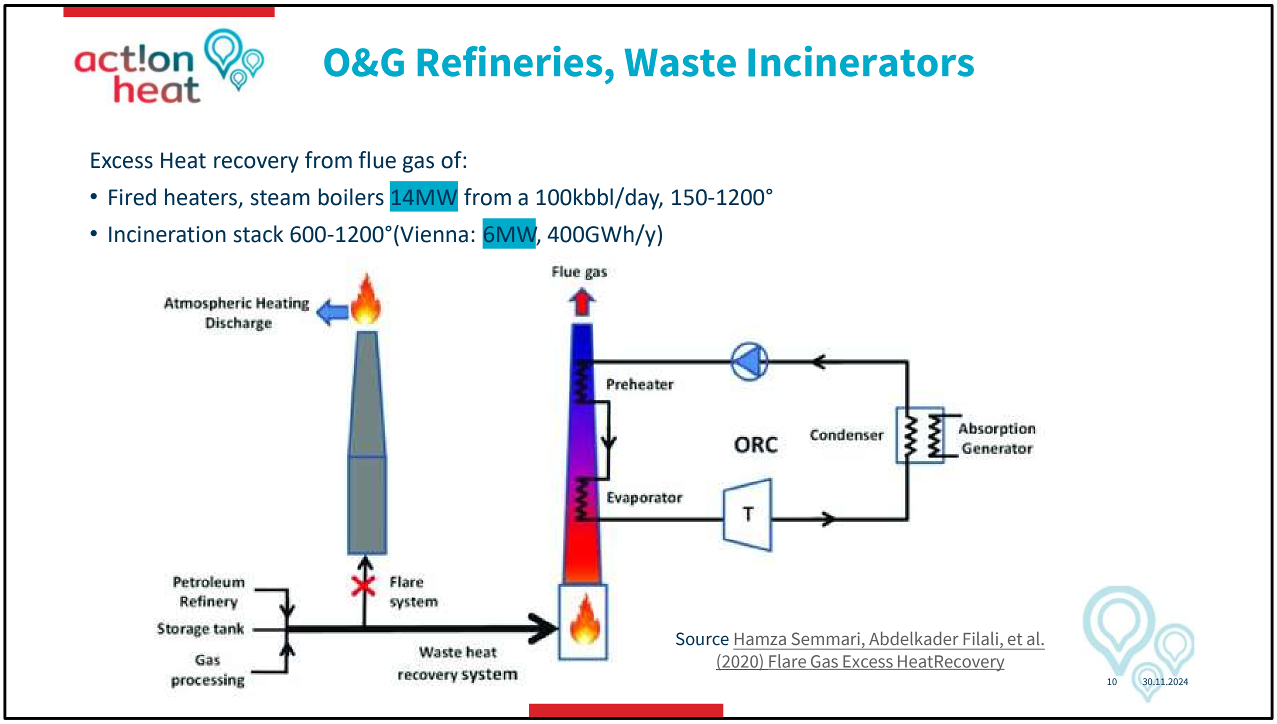
EH temperature industrial ranges

- 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

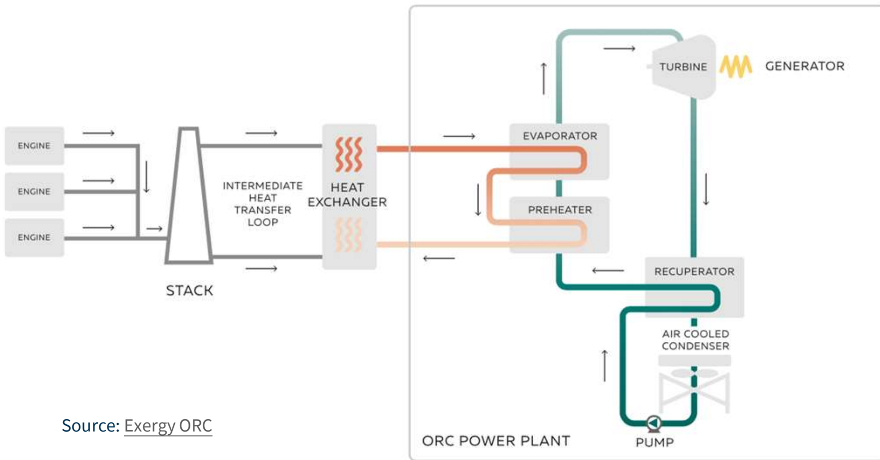
The highlighting shows the typical capacities and temperatures of each industrial process. Each case needs to be distinguished by what could be the potential and the temperature.

- 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

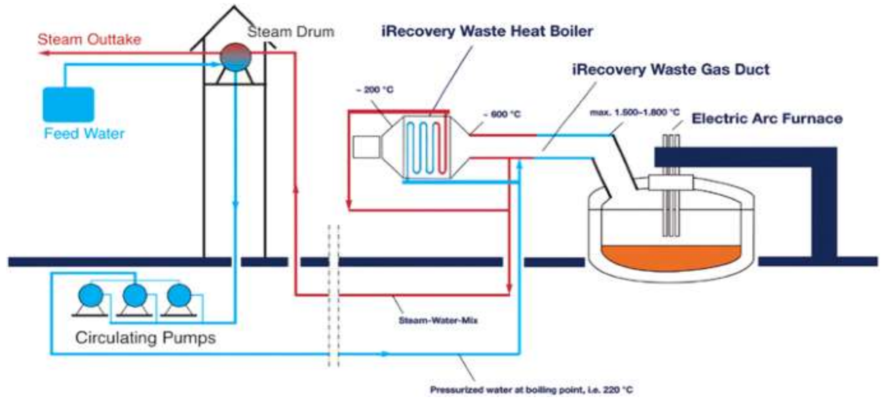
11 30.11.2024

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)

www.actionheat.eu

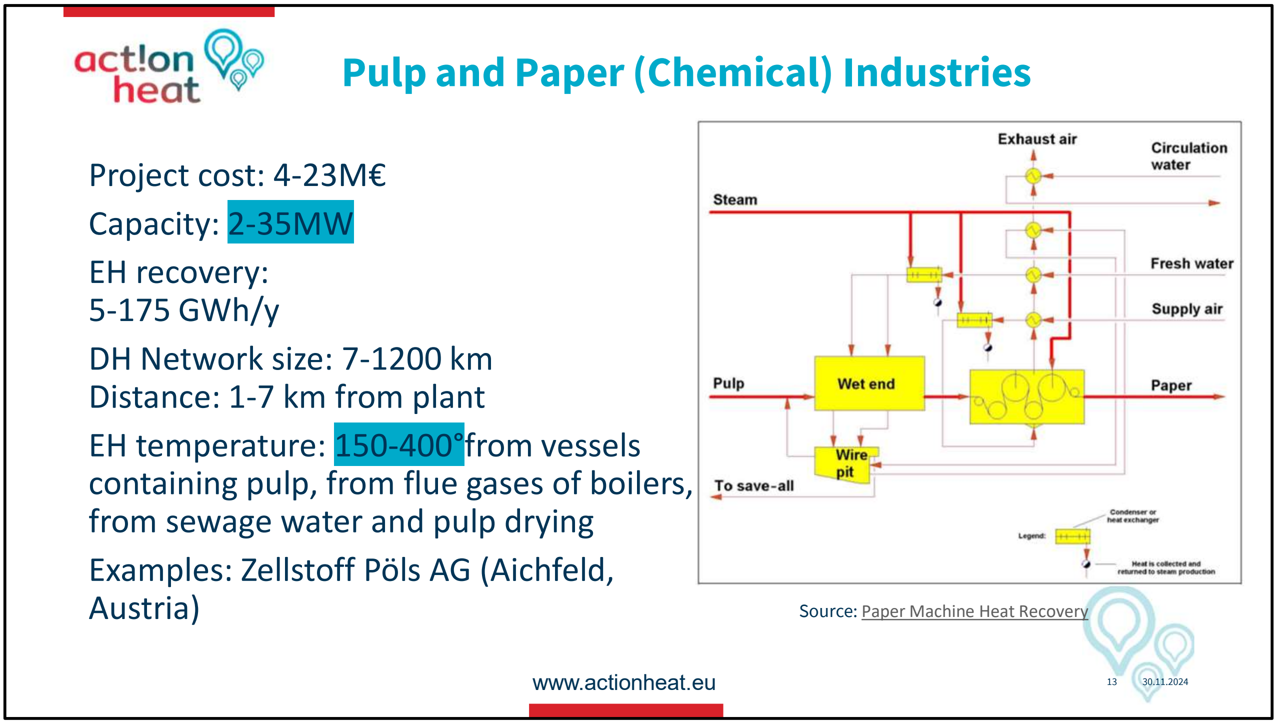
12 30.11.2024

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 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

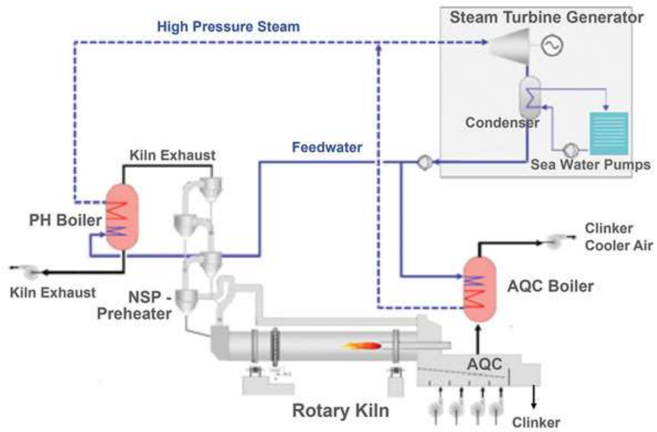
Cement Industries

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°



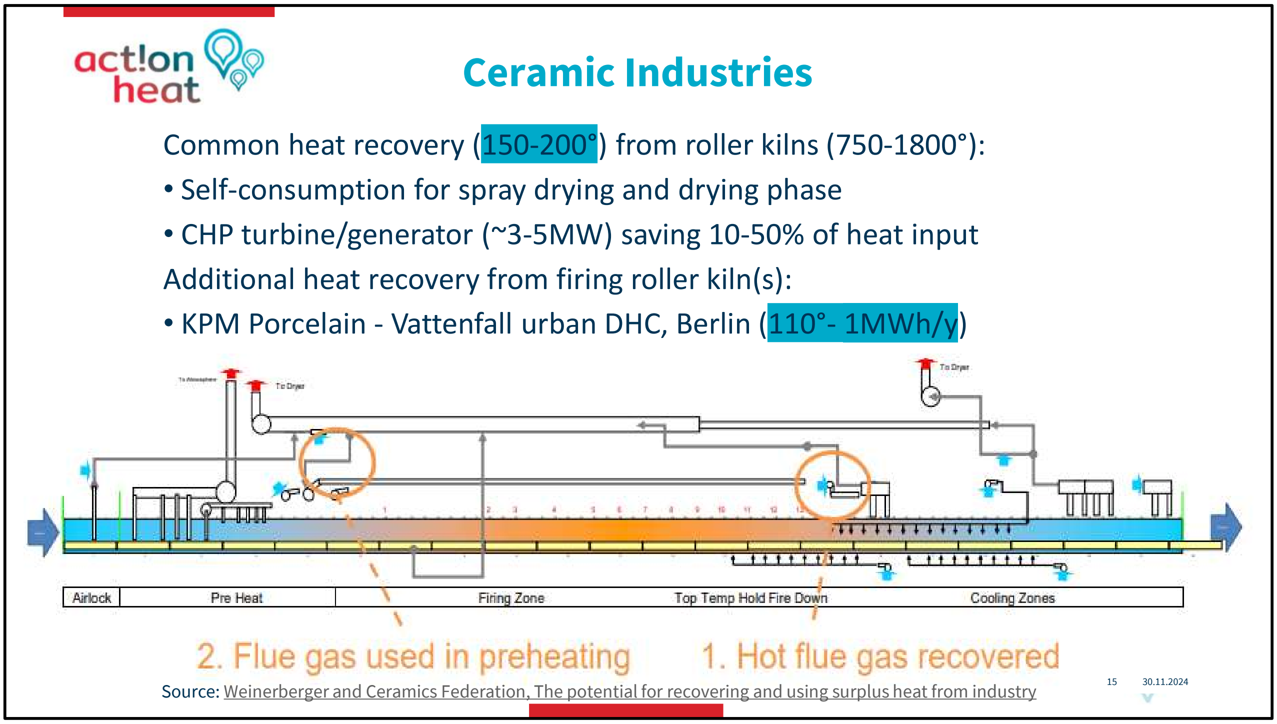
Source: WHR in a Cement Plant, The international Cement Review

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

www.actionheat.eu 14 30.11.2024

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 Fabric has a Medium temperature EH

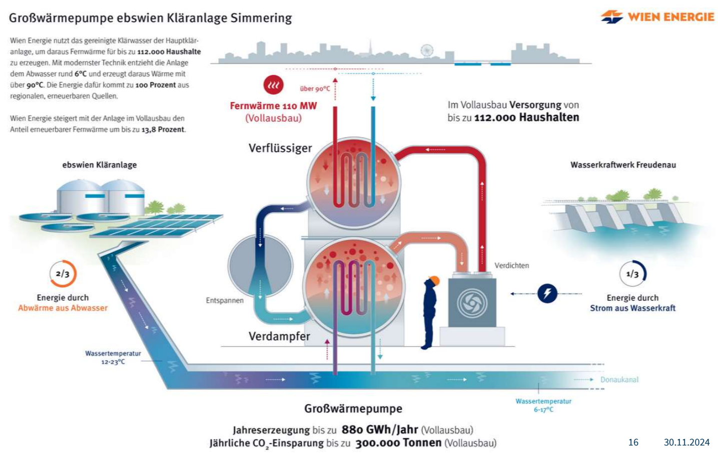
The chart shows the recovered temperature of a ceramic industry which is lower than the used during the process but stays considered higher for its reuse.

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

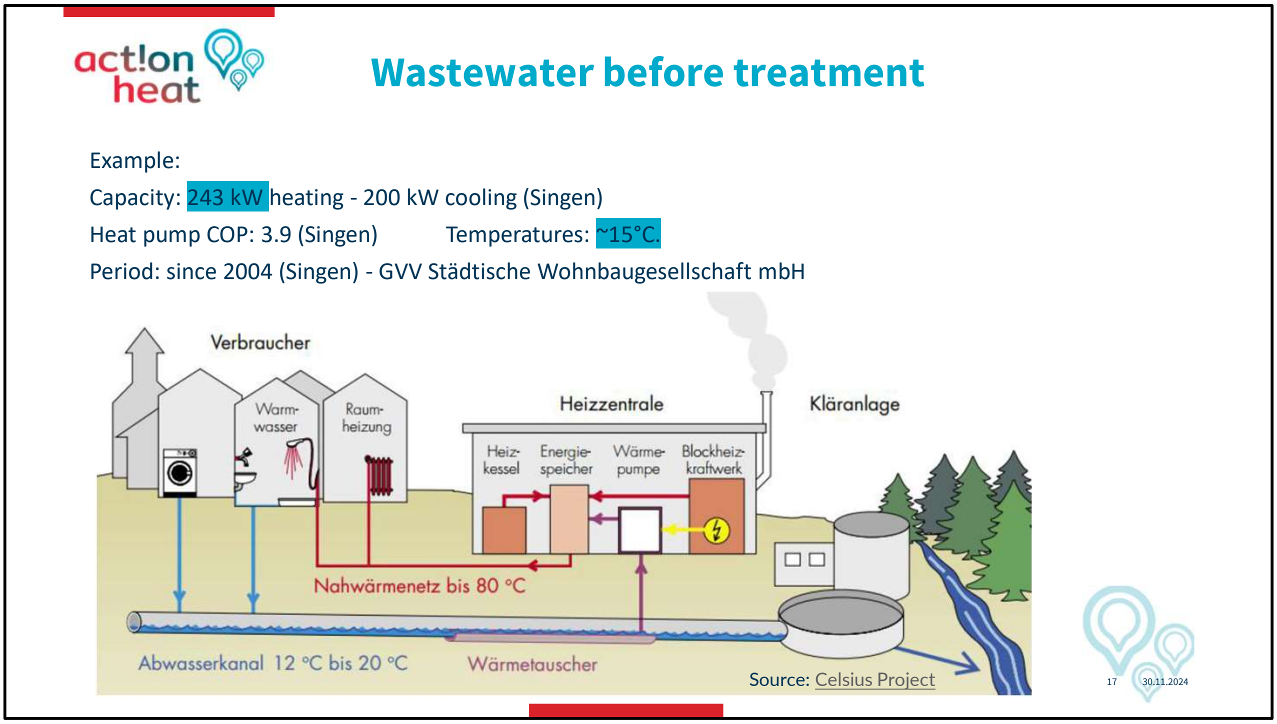


Source: Wien Energie

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.



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.

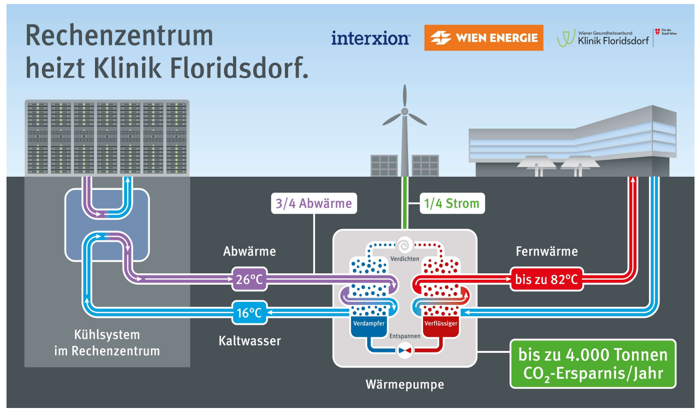
Datacenters

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

www.actionheat.eu

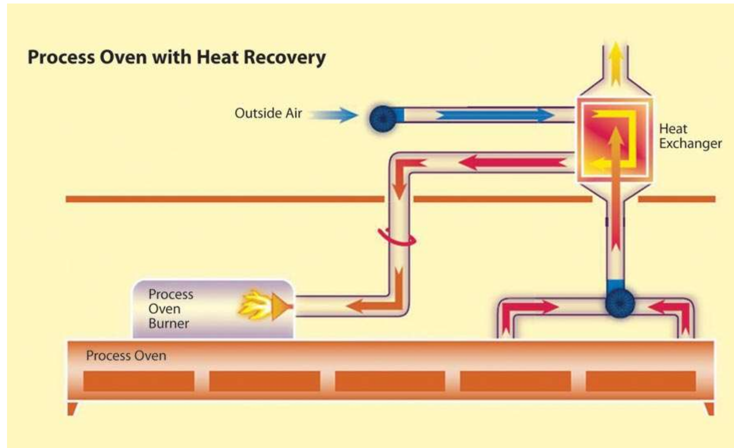
18 30.11.2024

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

www.actionheat.eu 19 30.11.2024

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

act!on heat

Texile/Laundry Industries

Project cost: 1M€

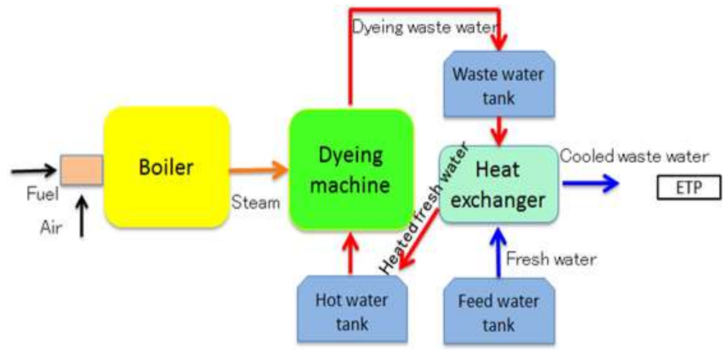
Capacity: 0.5-1MW

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

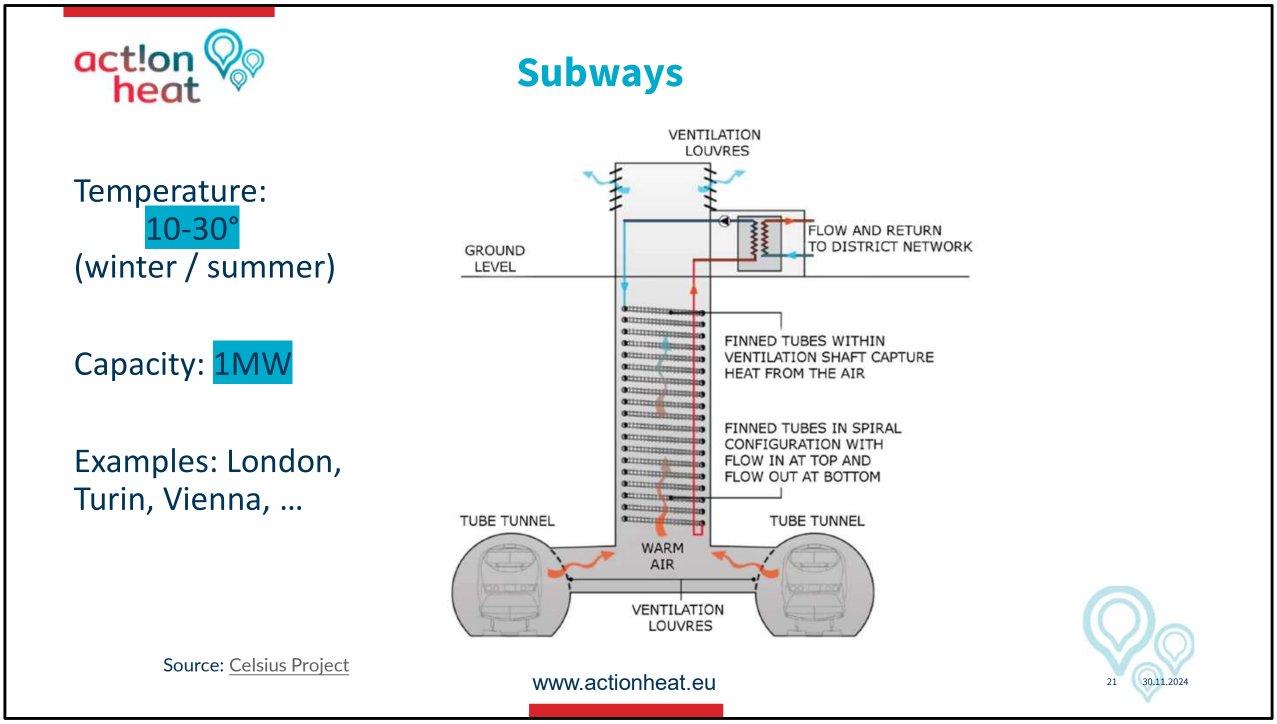
www.actionheat.eu

20 30.11.2024

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



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:

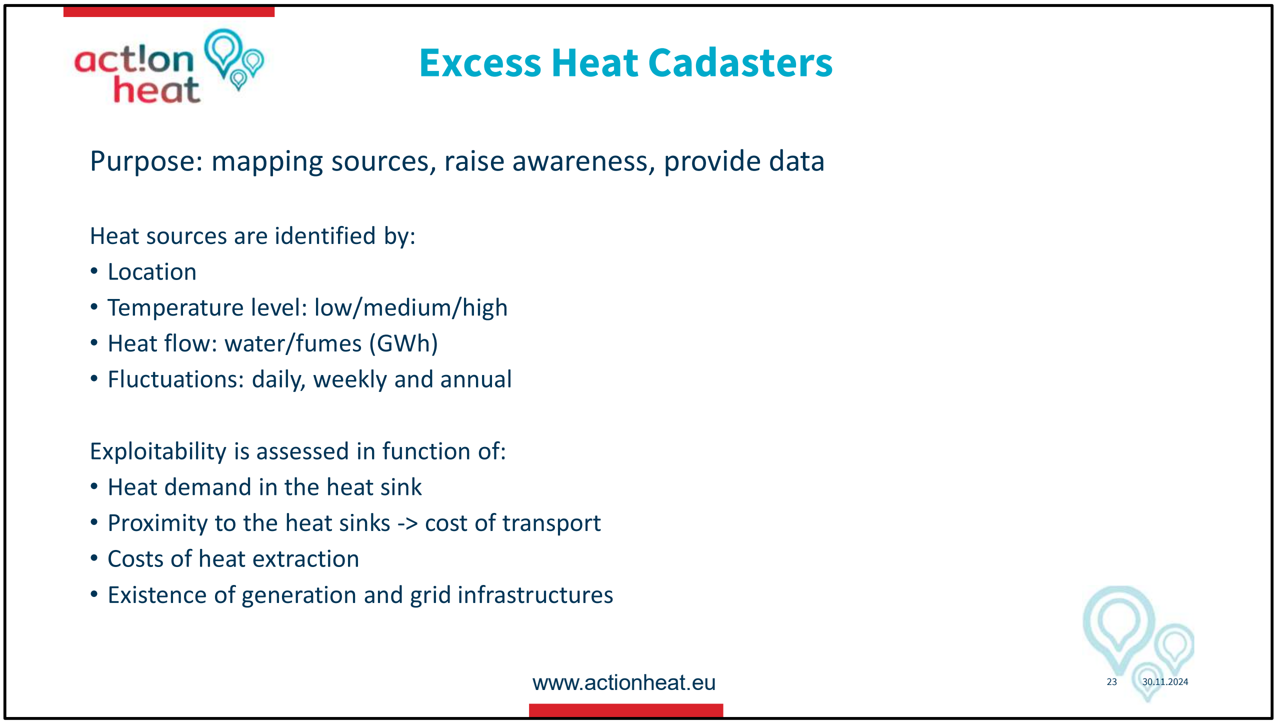
- Brakes of the trains
- Air circulation on the tunnels

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

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

www.actionheat.eu



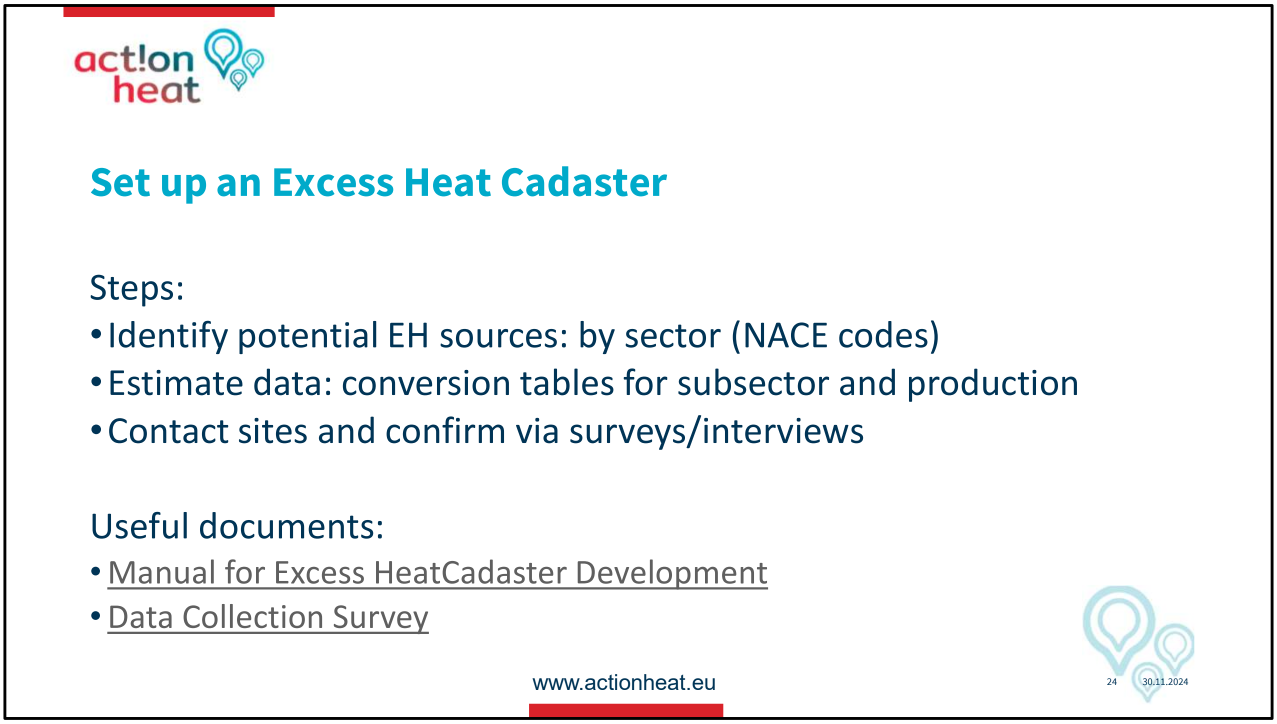
Overview of what is Cadasters

- 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.

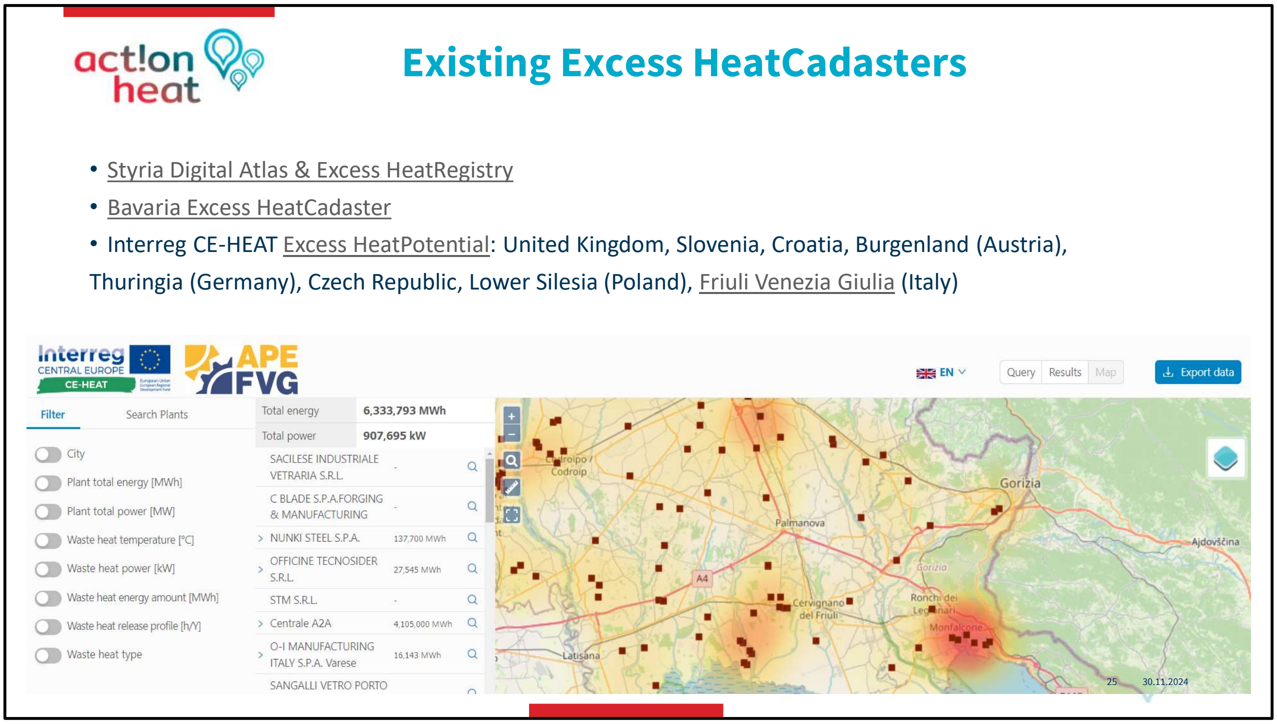


Find a sorces with Cadaster

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.

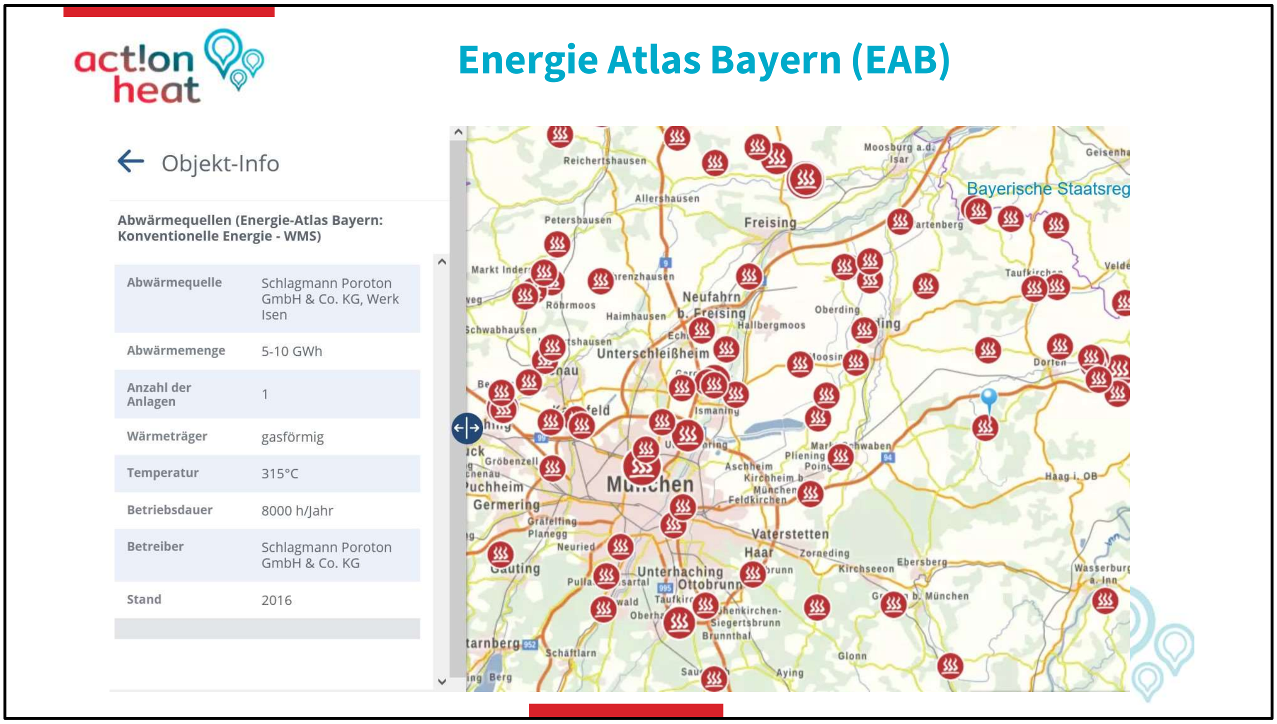


Different Cadasters

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:

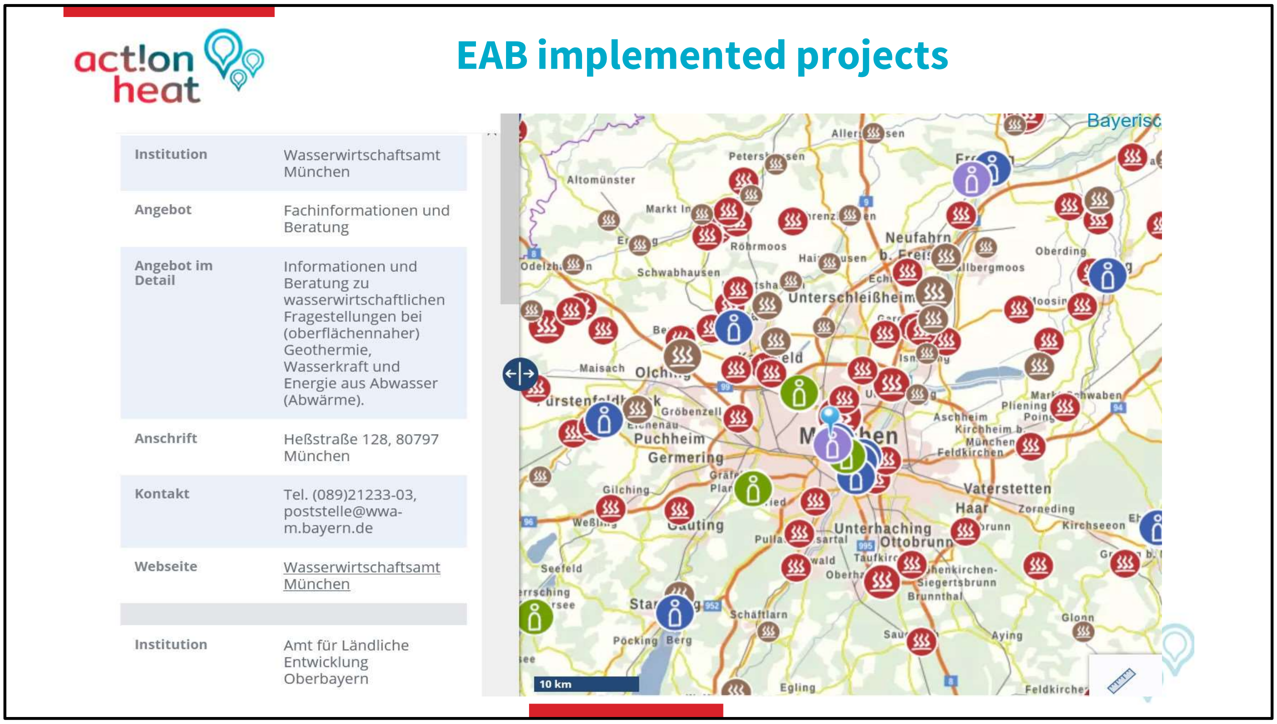
- Geothermal
- Hydropower
- Wind energy
- Biomass

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:

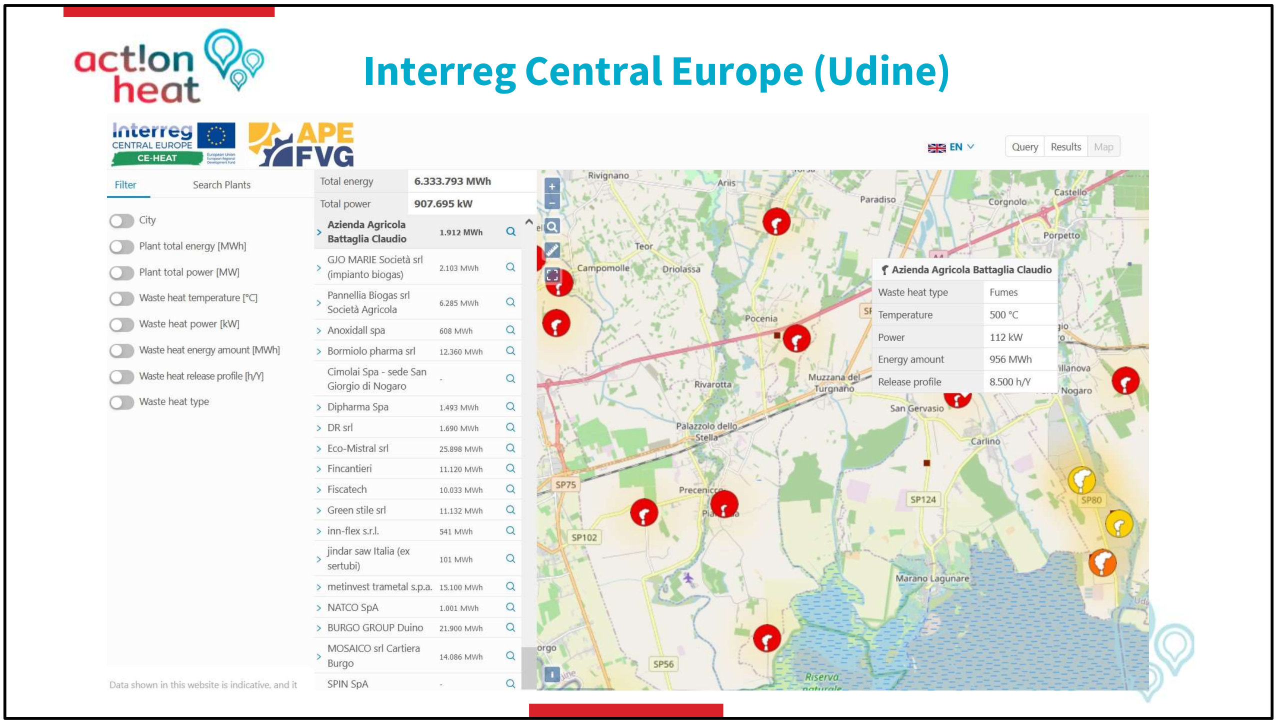
- Waist water potential
- Places where the Excess Heat is already reused

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.



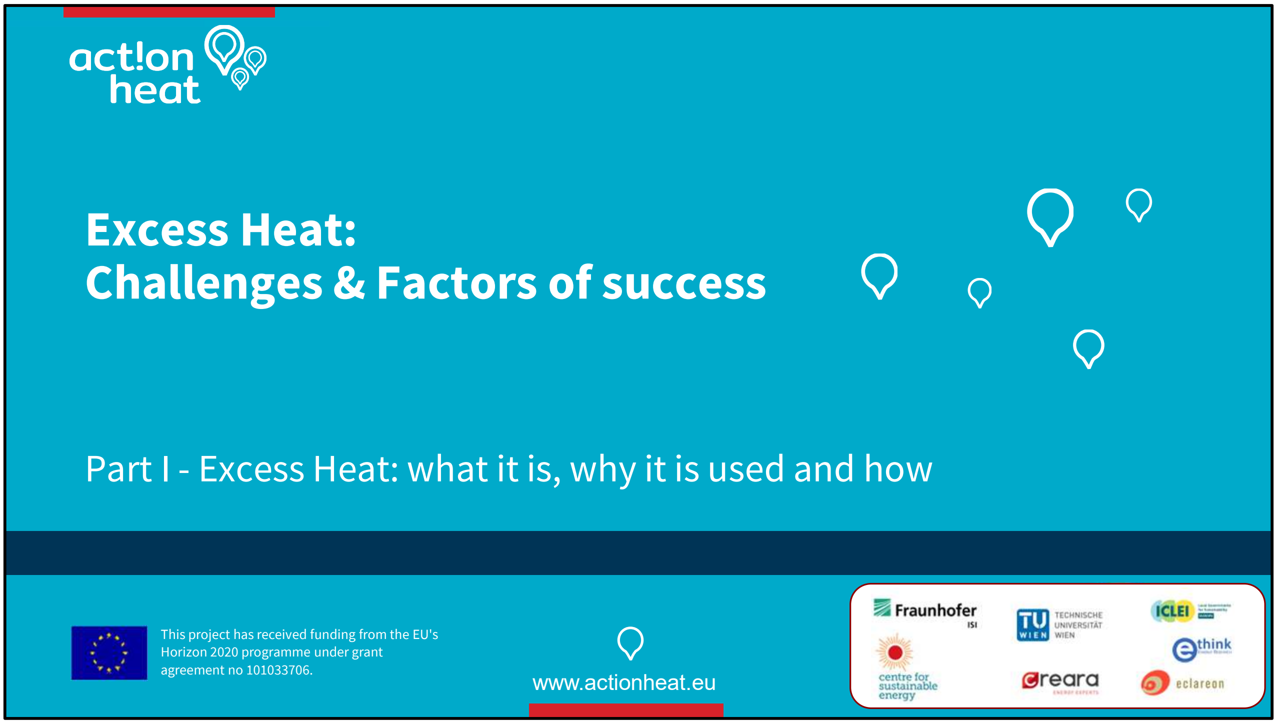
The Interreg project.

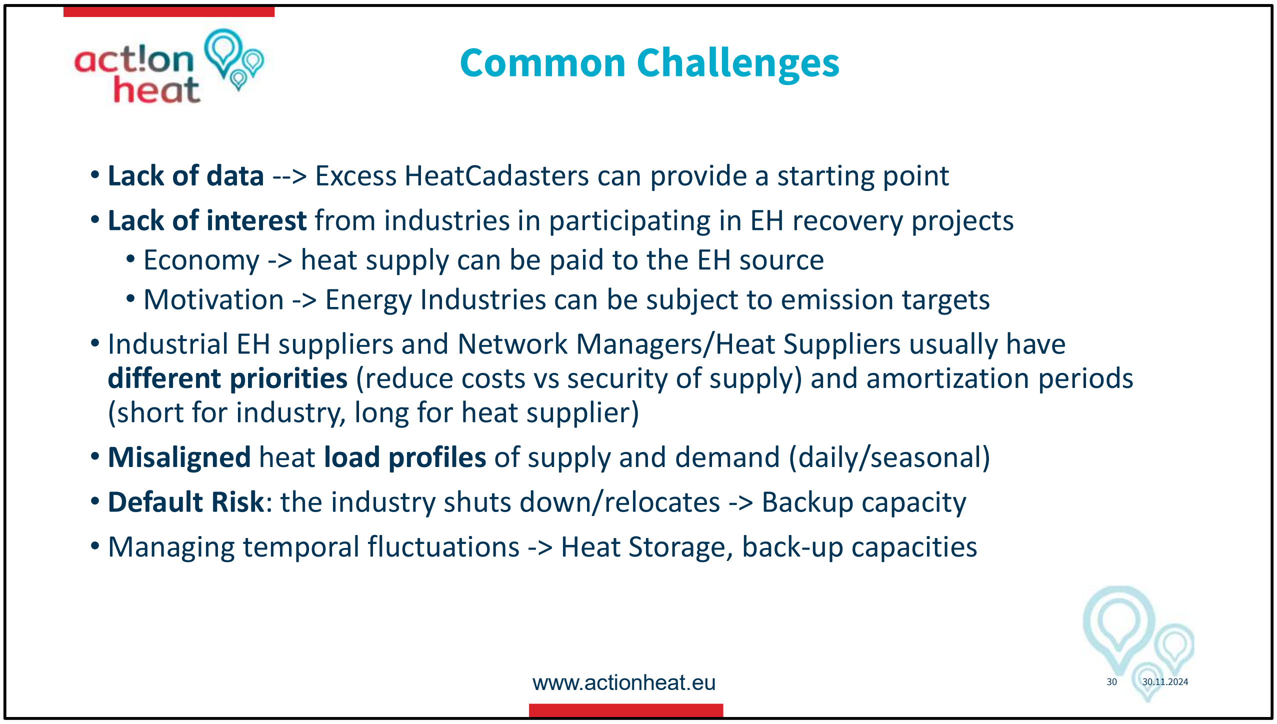
It is a central European project for the region of **Udine, Venecia.** In its internet atlas will be possible to visualize the locations for:

- 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


act!on heat
Excess Heat:
Challenges & Factors of success
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.
www.actionheat.eu
Fraunhofer ISI
TU WIEN TECHNISCHE UNIVERSITÄT WIEN
ICLEI
centre for sustainable energy
creara
ethink
eclareon



Important challenges

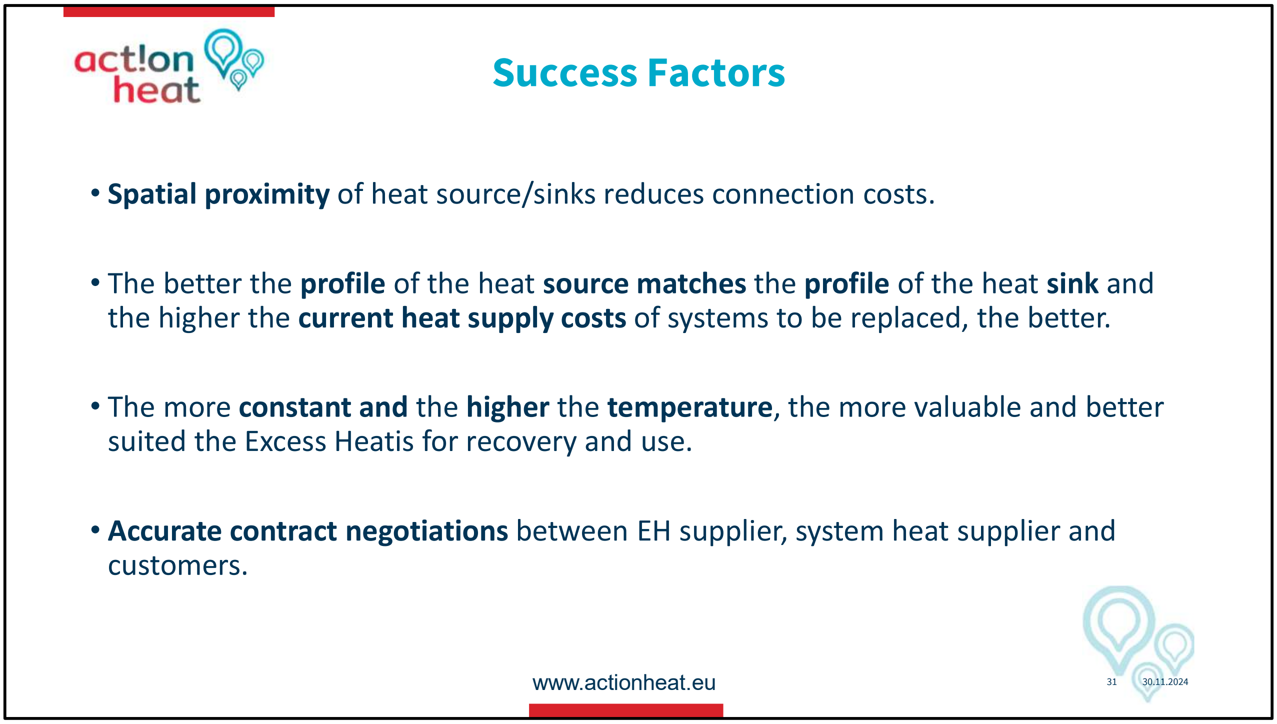
To unify the information for sources and sinks

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.

act!on heat

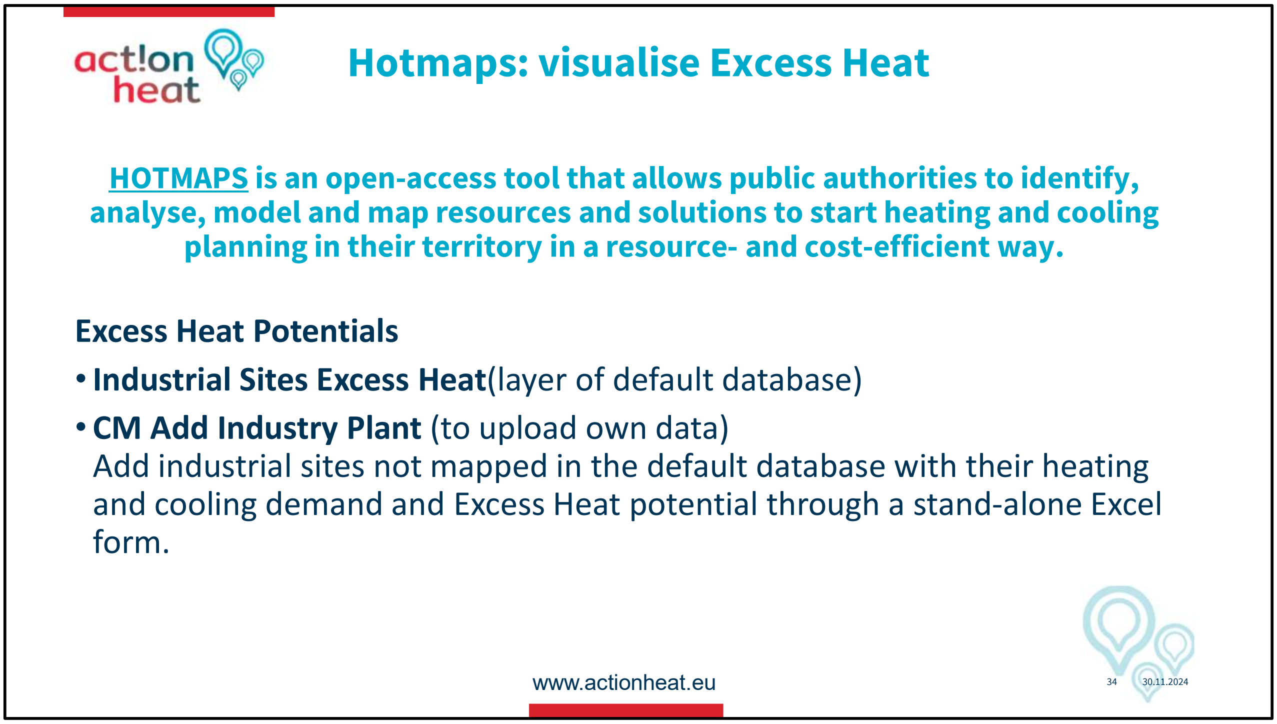
Discussion - Q&A

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.

www.actionheat.eu


act!on heat
Hotmaps:
EH Layers, CM Add Industry Plant,
CM Excess Heat Transport Potential
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



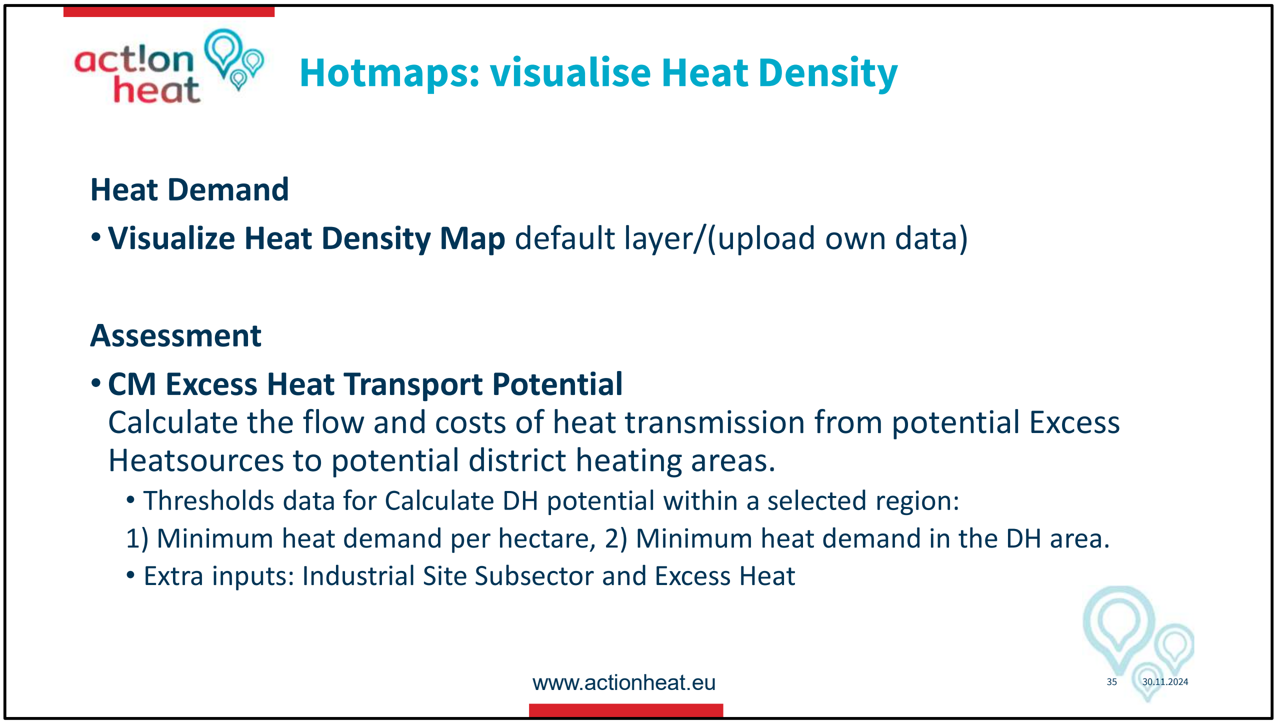
HOTMAPS is an open-access tool built in 2020.

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.

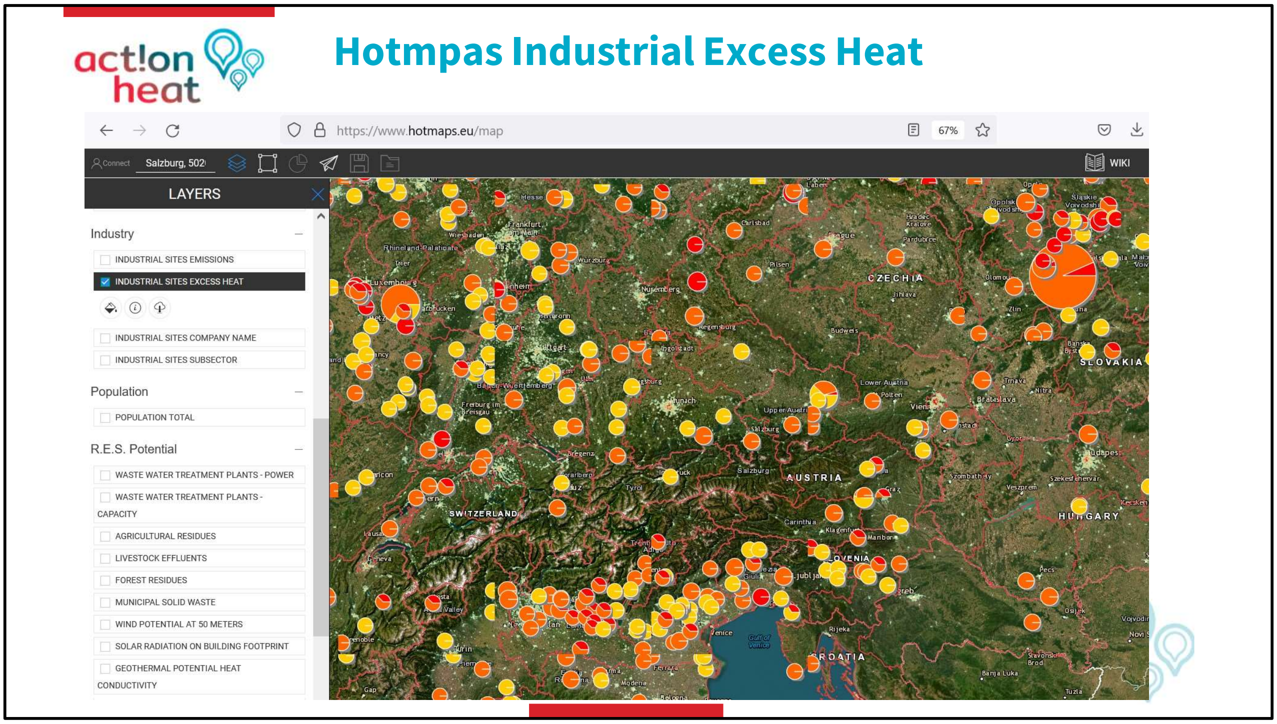
Finally, this Excel has some macros that allow it to be uploaded as a CSV file to add to the program in the database.



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

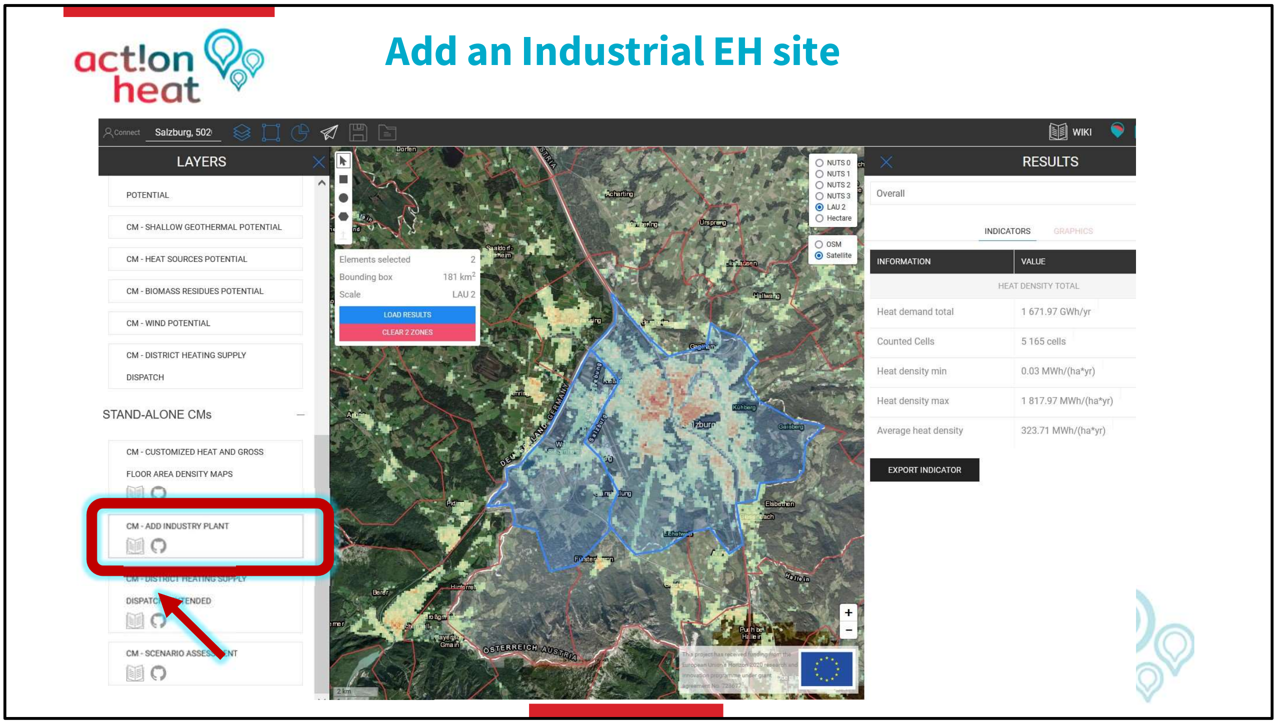
3.- Select the Industrial Sites excess heat layer and click to visualize (low, medium, high excess heat) and zoom out to see more industries:

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

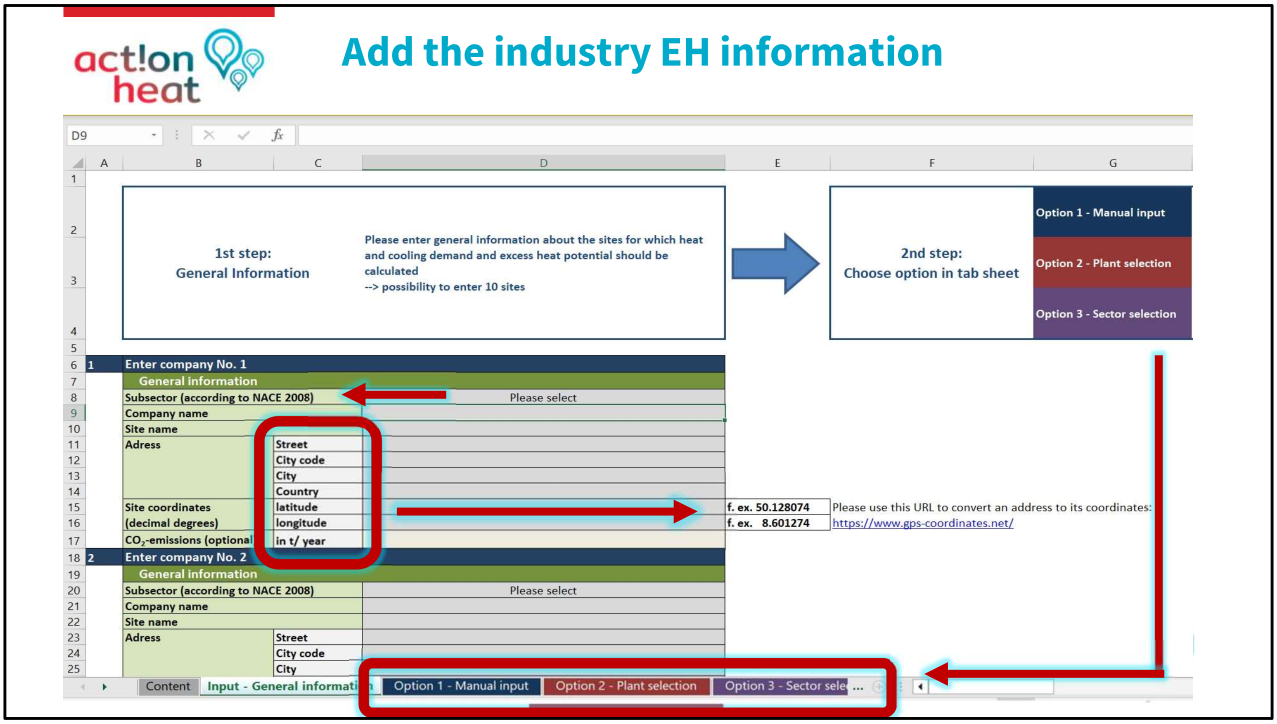
1. The wiki link will be open; scroll down until you find Data input in Excel-tool by users

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

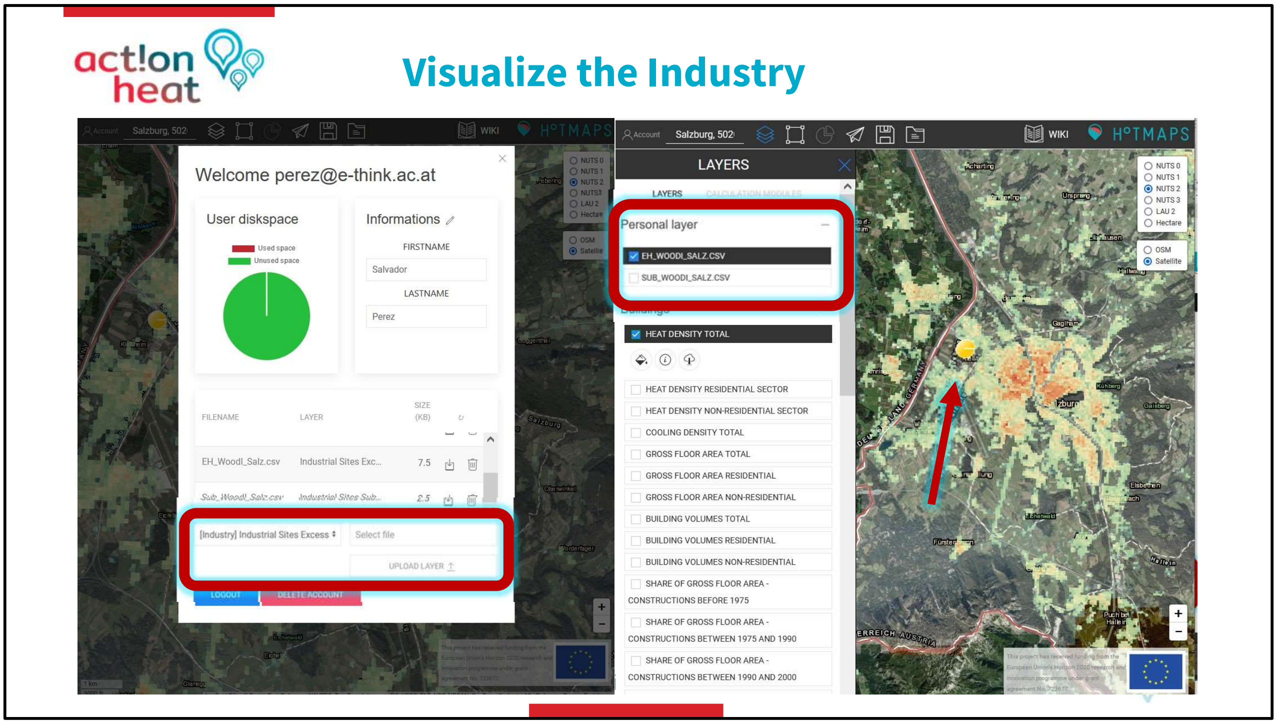
If you know only the subsector and annual production

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.



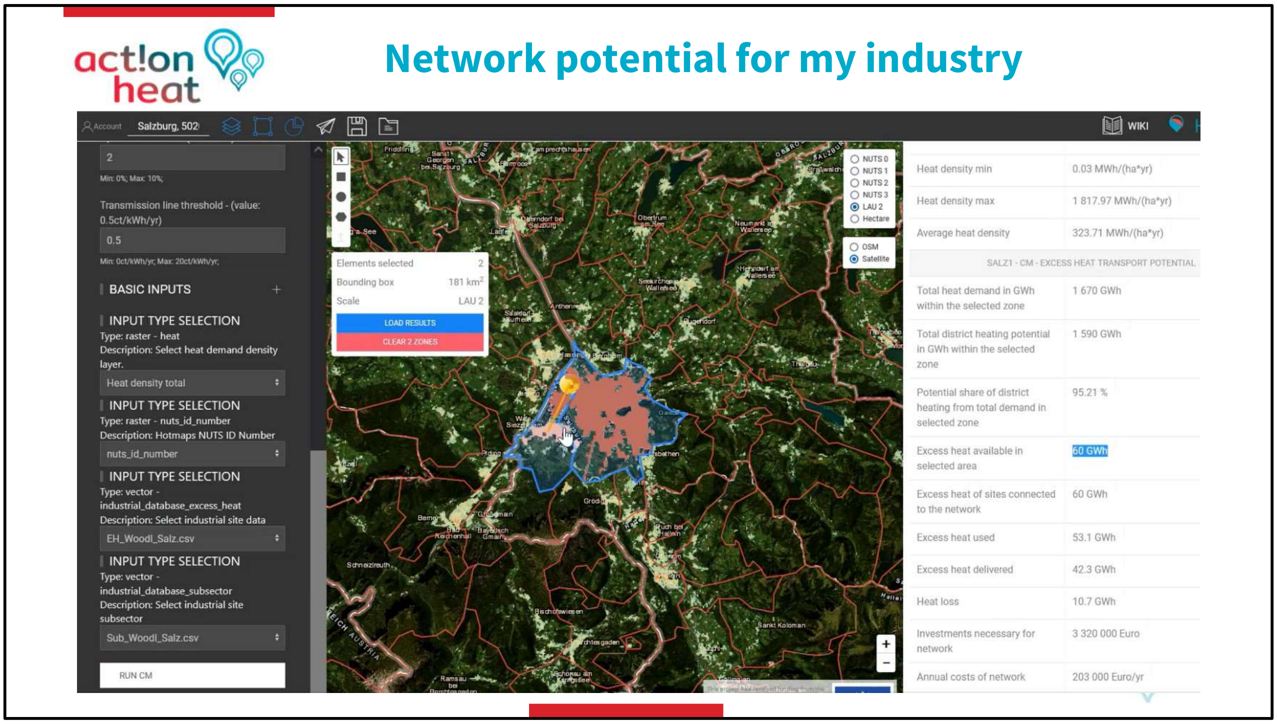
To visualize the new industry on Hotmaps

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.

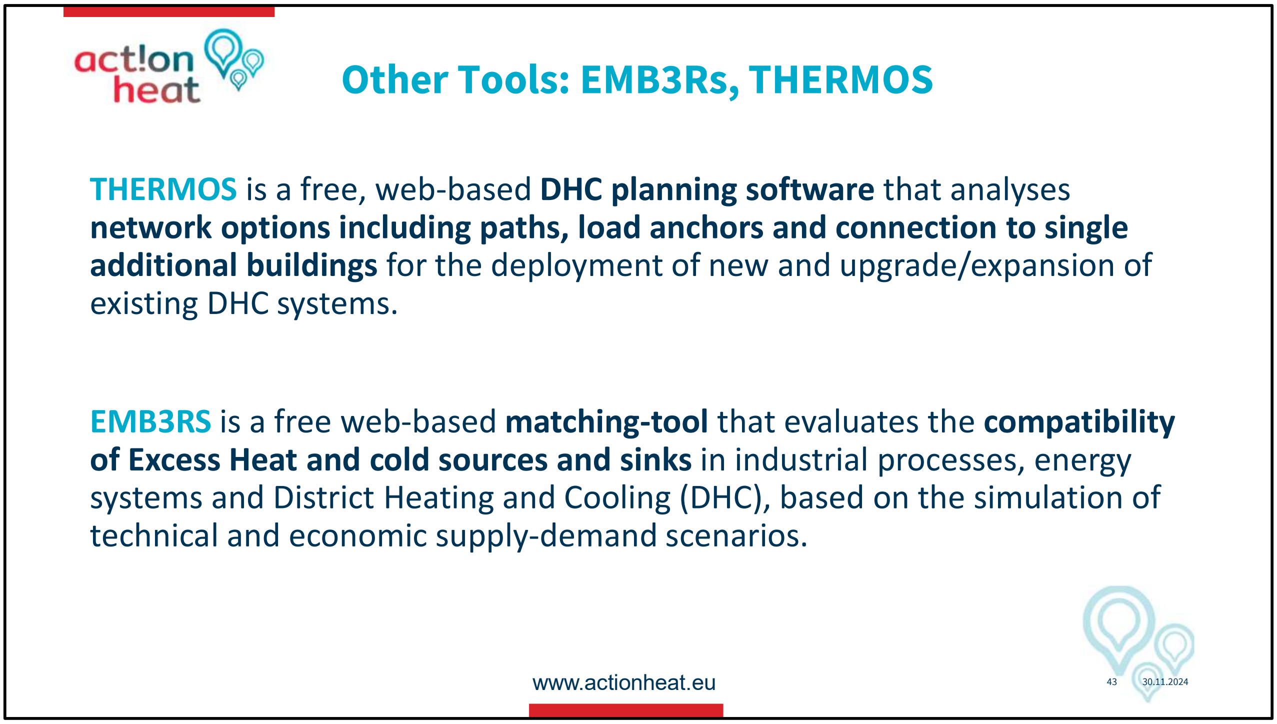
act!on heat

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



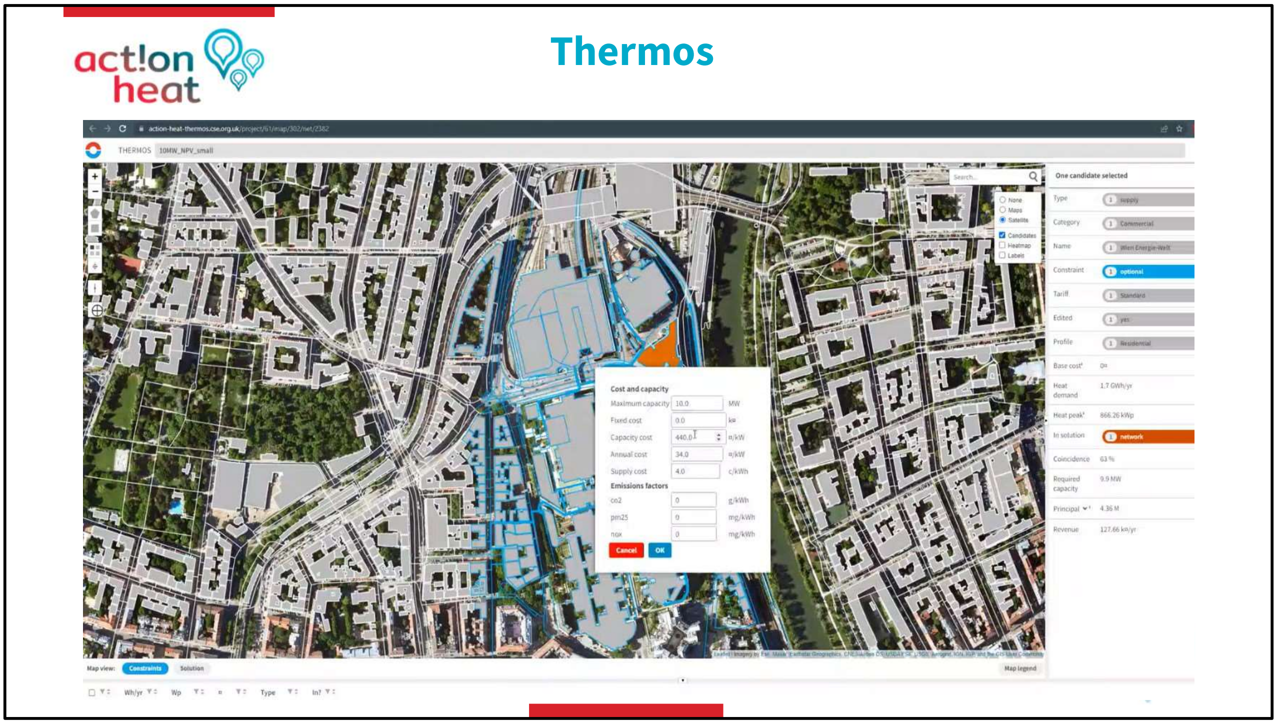
Tools for analysing the use of Excess Heat

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.

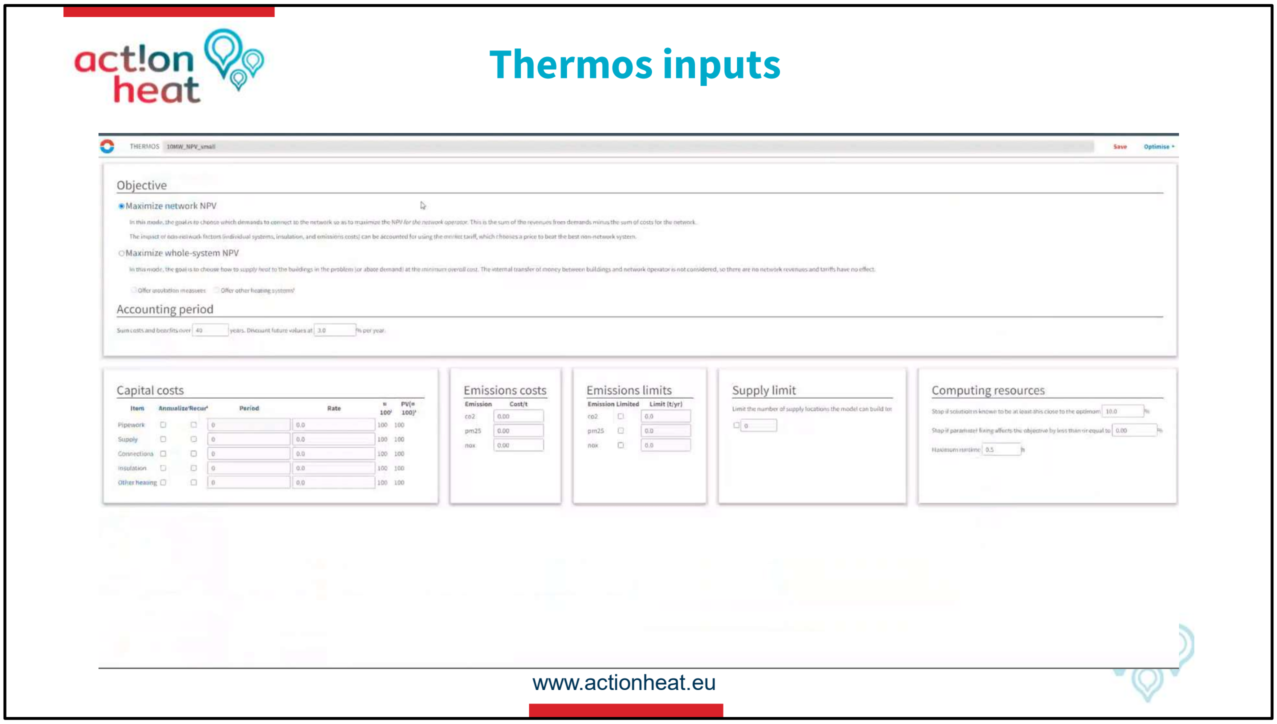
An example was presented to demonstrate the identification of optimal networks for Excess Heat supply:

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.



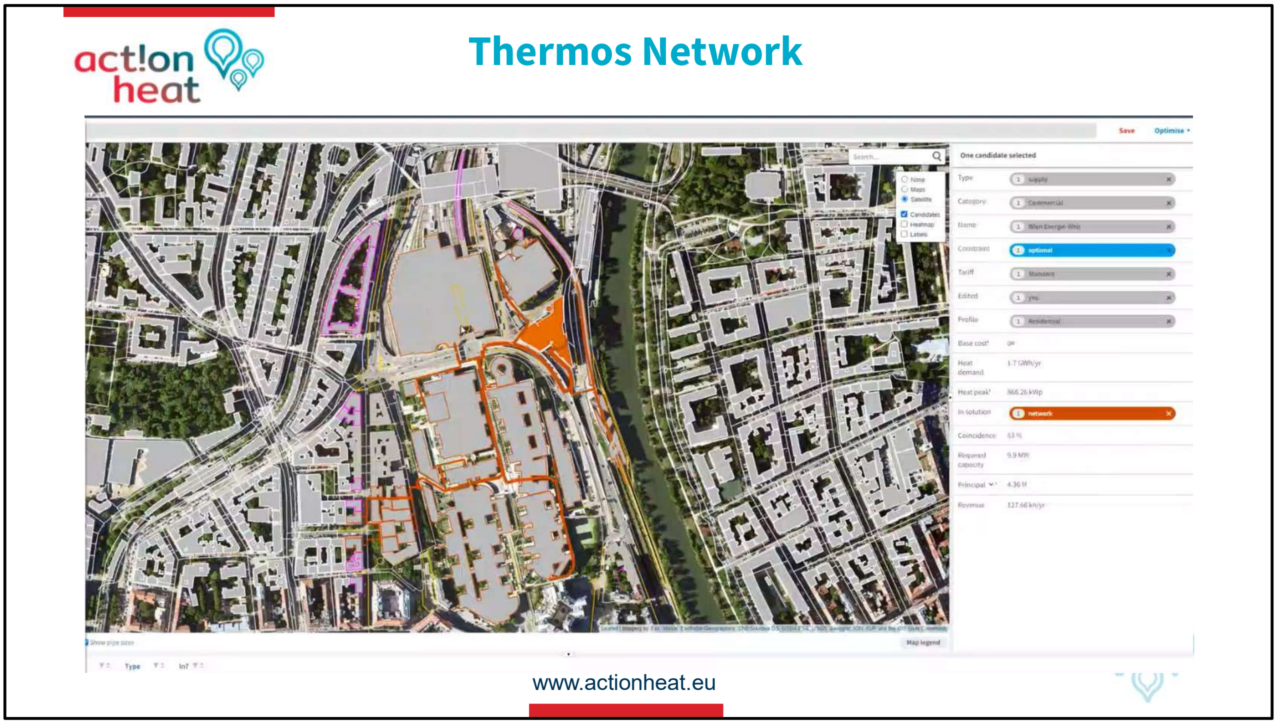
THERMOS allows for the optimization of your network

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.

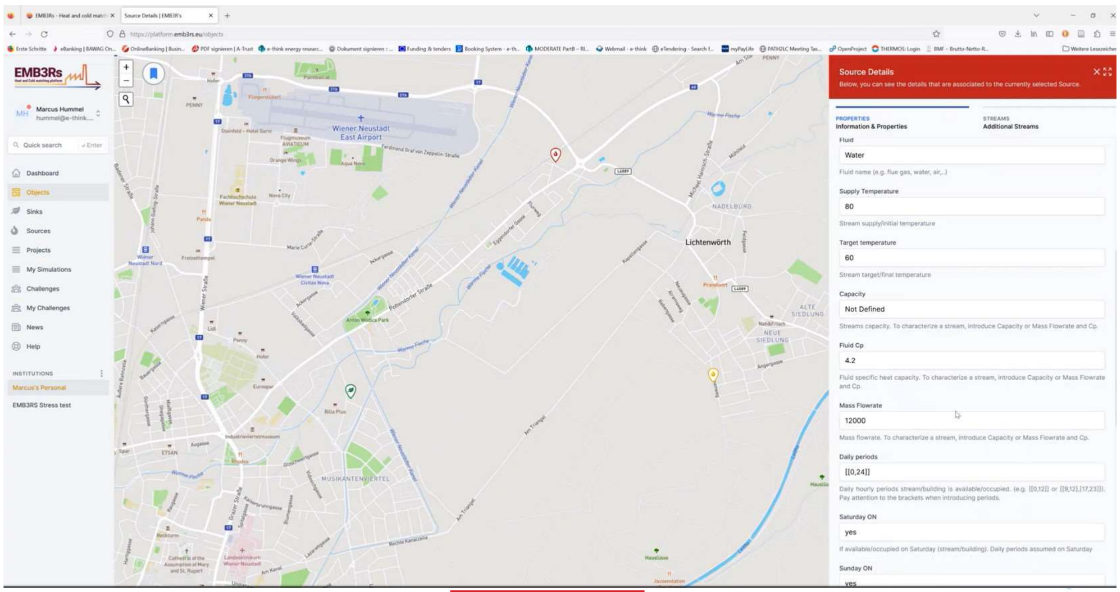
In the window on the right side, detailed network information can be viewed based on the solution results.

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



EMB3RS is a map-based tool

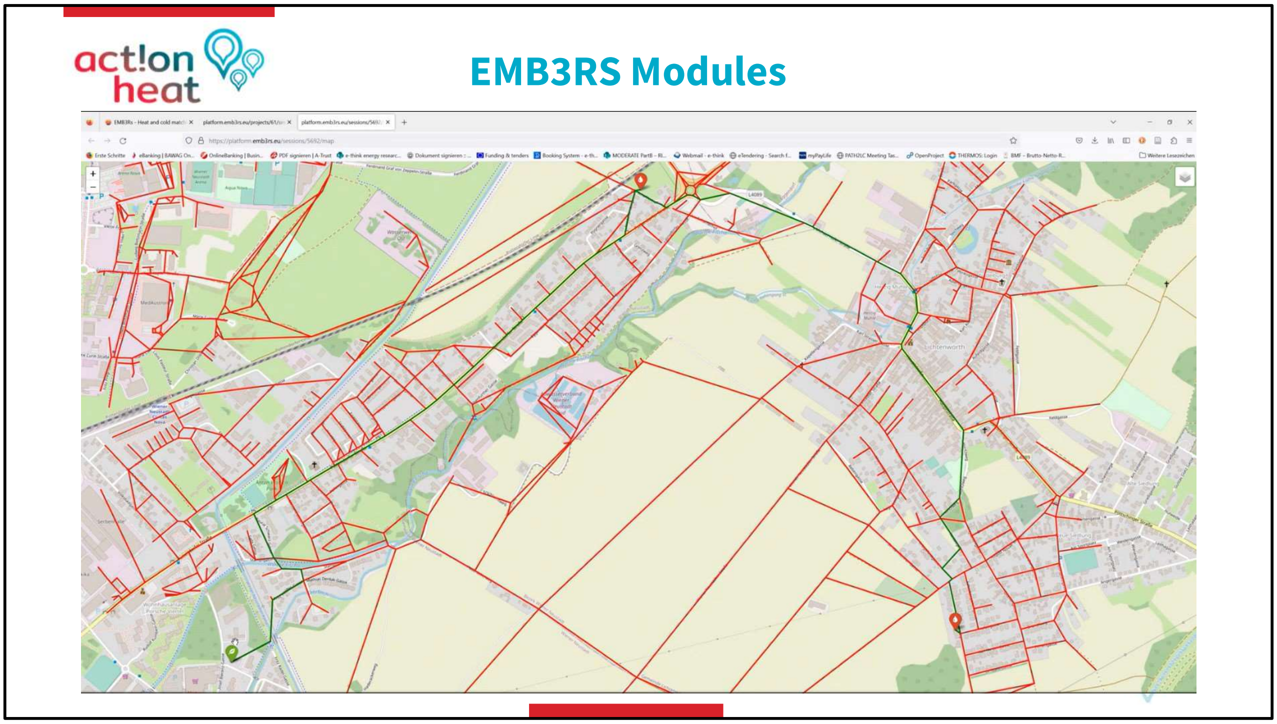
You need to define your project, territory, and the sources and sinks.

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.



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.

act!on heat

Discussion – Q&A

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

act!on heat

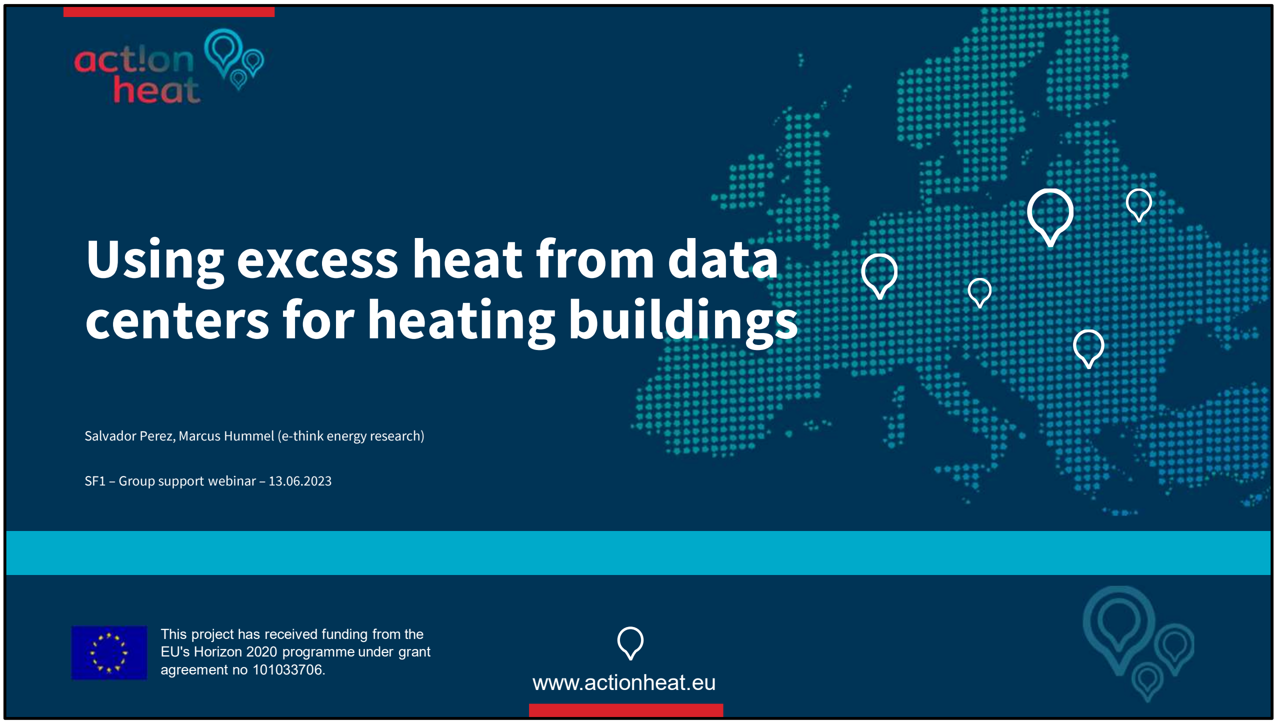
Thank you for your attention!

conforto@e-think.ac.at, hummel@e-think.ac.at, perez@e-think.ac.at
aadit.malla@tuwien.ac.at

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

www.actionheat.eu

Fraunhofer ISI
TU WIEN TECHNISCHE UNIVERSITÄT WIEN
ICLEI
centre for sustainable energy
e-think
creara
eclareon



Webinar 5:
Using excess heat from data centers for heating bulidings

Act!onHeat SF1 Time: 1 h 11 min

- Serial 2:
    - Webinar 5
        - Strategical Heating & Cooling planning
        - Group support for municipalities and stakeholders
- Presented by:
    - e-think / Austria
    - TU-Wien / Austria

Contents

Part I: Datacenter Excess Heat: Introduction

- Theoretical physical background (15‘)
- Political landscape (15‘)
- Discussion, Q&A (5‘)

Part II: How to reuse Datacenter Excess Heat

- Overview of technologies and concepts that can be used (20‘)
- Best practice examples (Technical and economic data) (15‘)
- Discussion, Q&A (10‘)

www.actionheat.eu

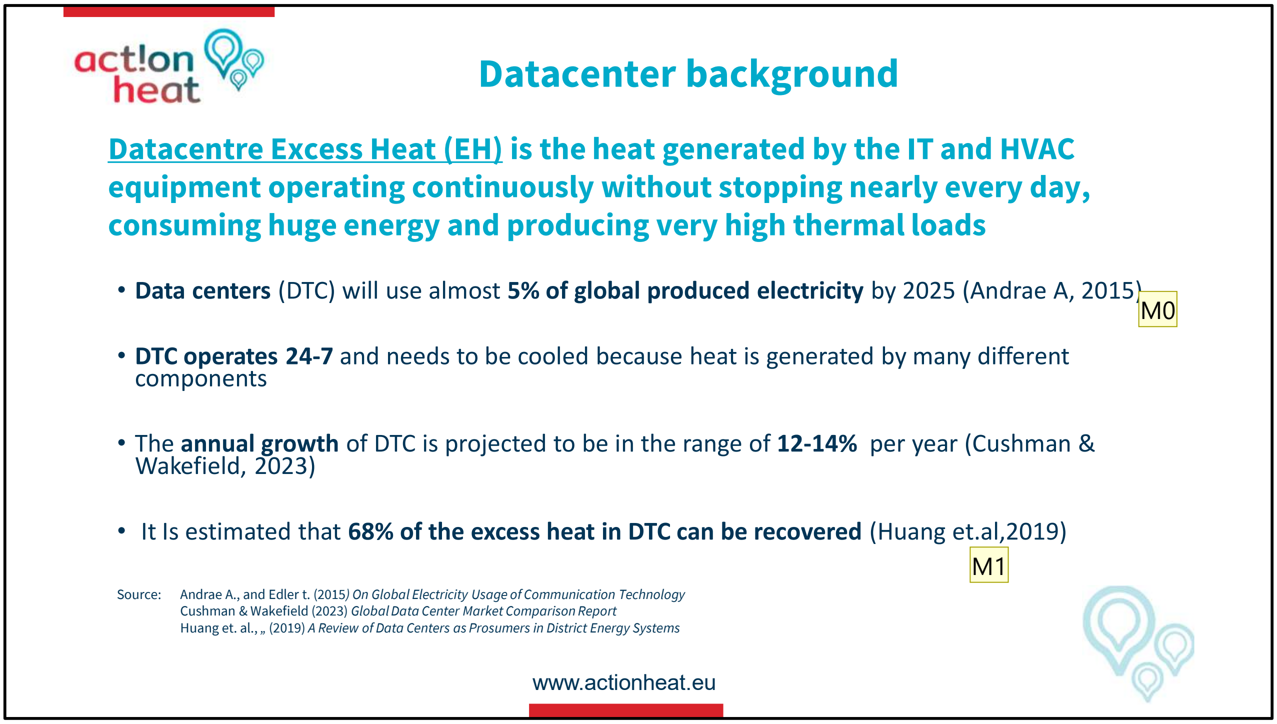
act!on heat

Theoretical physical background

Part I - Datacenter Excess Heat: Introduction

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

www.actionheat.eu



Why reuse the Excess Heat from Data Centers?

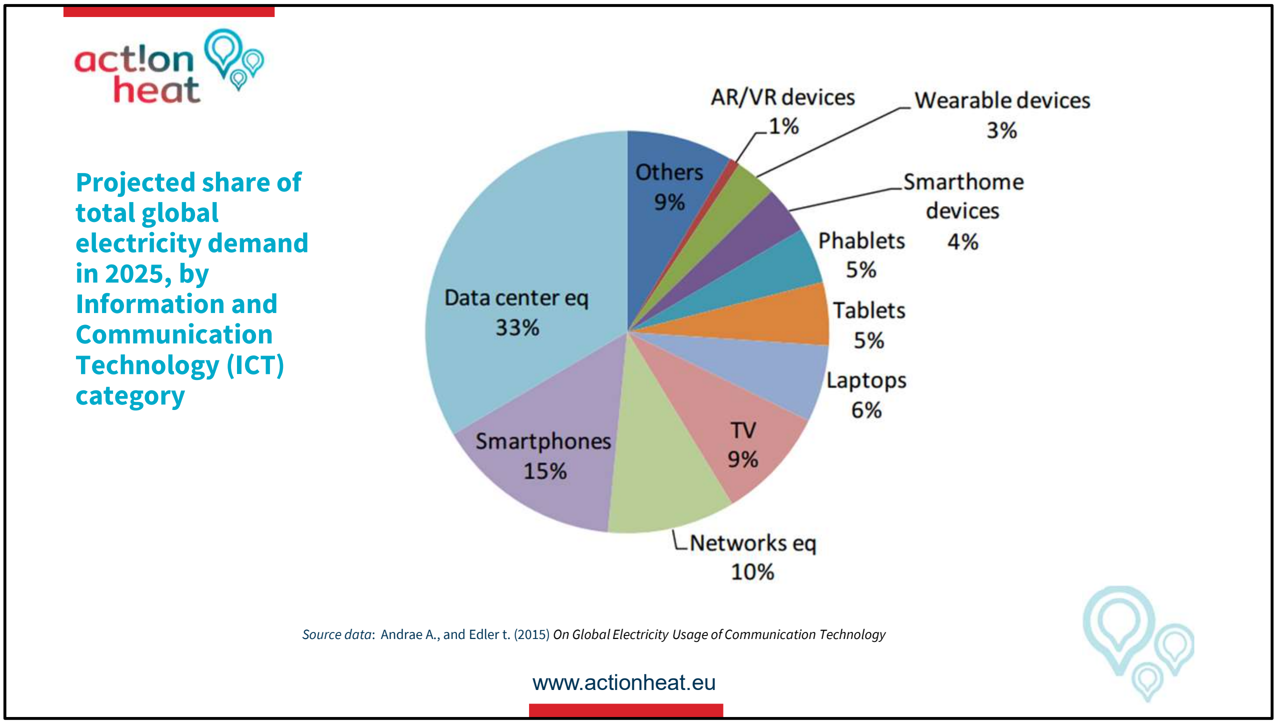
- Data centers will continue growing exponentially.
- The Data centers produce Excess Heat day and Night
- The Heat can be increased and reused for District Heating

Folie 4

M0 Source needed
Autor; 2023-06-09T12:40:32.908

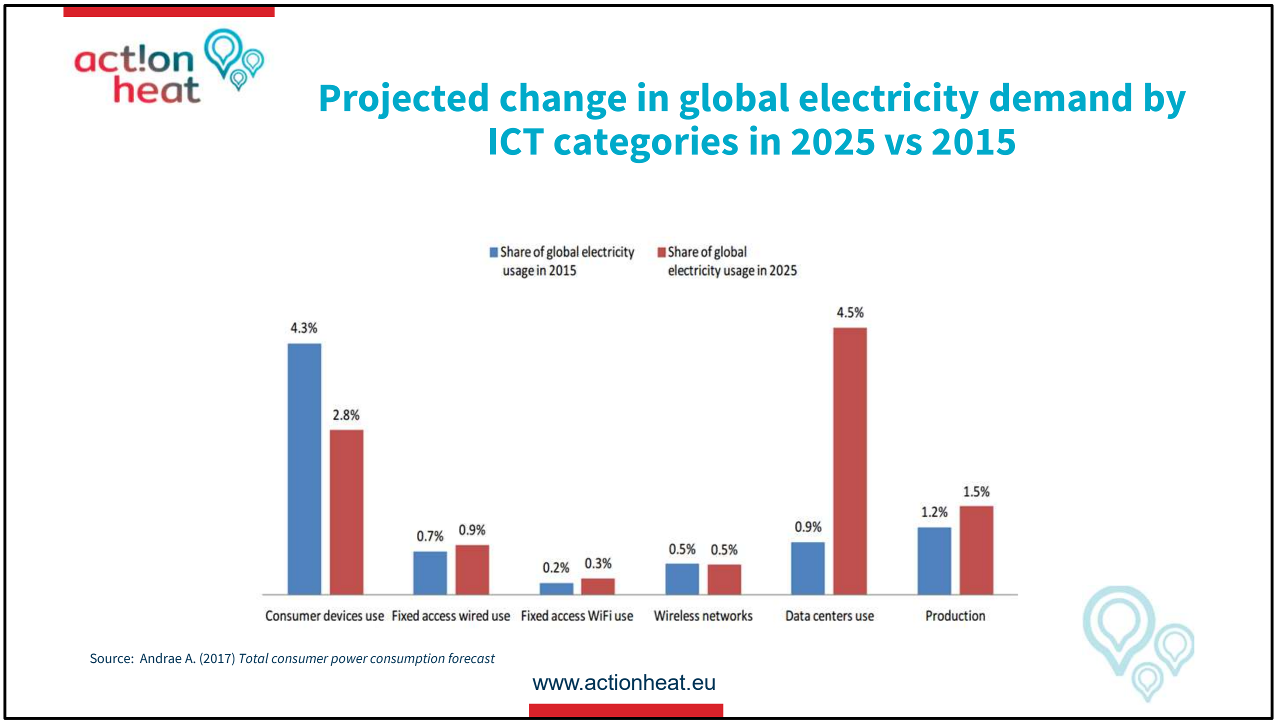
M1 What do other sources state?
Autor; 2023-06-09T12:51:22.471

M1 0 And: what are the restrictions that are taken into account in this estimation?
Autor; 2023-06-09T12:51:43.839



Datacenter DTC energetical demand by 2025

- Data centers are projected to consume 1/3 of all Information and Communication (ICT) global electricity demand by 2025
- ICT Information and Communications technology
- AR (Augmented reality) real-world and VR (Virtual reality) is entirely virtual.



Comparative projection of energetical demand in ICT

Information and Communications technology ICT comparative electricity demand by sectors

Global electricity demand by data centers is projected to increase +400% by 2025 (vs 2015)

- The blue lines represented the consumption by sector in 2015

- The red lines represent what the consumption will be by each sector in 2025

act!on heat

Data Center heat production: Standard vs High-performance Servers

Component	Temperature	Proportion of total heat
Microprocessors	85 °C	30%
DC/DC conversion	50 °C	10%
I/O processor	40 °C	3%
AC/DC conversion	55 °C	25%
Memory chips	70 °C	11%
Fans	30 °C	9%

Component	Temperature	Proportion of total heat
Disk drives	45 °C	6%
Motherboard	40 °C	3%
Microprocessors	85 °C	53%
DC/DC conversion	115 °C	13%
I/O processor	100 °C	10%
Memory chips	40 °C	14%

Source: ASHRAE whitepaper (2011). *Gaseous and particulate contamination guidelines for data centers*

www.actionheat.eu

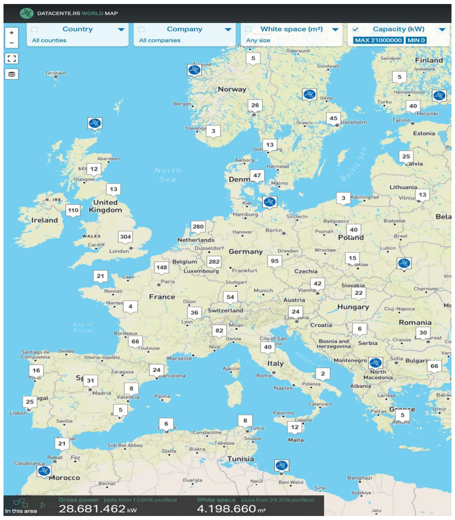
Heat demand temperature for different DTC components

- The IT server racks have dif. temperature. Between Elect. Comp. (Dsk, MB, Mic)
- Consequently, the heat dissipation rates btw those Elec. Divs are different.
- The table summarizes the heat and temp. distribution of different components in standard and high-performance servers.
- Different types of servers dissipate dif. proportions of temp. and H densities
- Conventional DCs have Heat Dissipation Rates (HDR) in the range of 400 and 900 W/m^2, cubic meter
- With the development of compact and high-power modules in new DC the HDR has increased 10 times in ranges from 6,000 to 11,000 W/m^2
- The heat dissipated inside the DC should be removed by Cool. Sist.
- Therefore for dif. dissipation rates. Different Cool Sist and Tec. had been developed to reuse the EH from DTC

Folie 7

M0 Total of heat shares sums up to more than 100% --> why is this the case?
What exactly does the proportion of heat mean
Autor; 2023-06-09T12:35:00.452

Datacenters World Map



Country	Company	White space (m²)	Capacity (kW)
Cable & Wireless Munich	Cable&Wireless Worldwide	-	-
Carrierswitchraum Jena	Thüringer Netkom	-	-
CE Colo	CE Colo	3400 m²	20200 kW
Cham	DATAWIRE AG	-	-
City Hall	City of Ingolstadt	-	-
ColoCenter Frankfurt	ColoCenter Frankfurt am Main GmbH	-	-
ColoCenter Frankfurt am Main GmbH	ColoCenter Frankfurt am Main GmbH	-	-
colozueri.ch Zurich	Colozueri.ch AG	-	-
Colozug.ch	Colozug.ch	-	-
Colozug.ch	NTS Workspace	-	-
Cornaredo	SoftLayer Technologies (IBM Cloud)	-	-
Czech Republic	Aruba.it	1500 m²	1000 kW
Darmstadt	Facility for Antiproton and Ion Research in Europe Gmbh (FAIR)	-	-
DARZ	DARZ	2400 m²	-
Data Centre 1	Altus Information Technology ltd.	150 m²	180 kW
Data Centre 2	Altus Information Technology ltd.	250 m²	520 kW
Data centre Markoja	Markoja d.o.o.	-	-
DataCamp.cz	SuperNetwork s.r.o.	-	-
DataCamp.cz	Datacamp.cz (SuperNetwork Ltd.)	-	-
DataCenter LuzernZentralschweiz	CKW	-	-
DataCenter Winterthur	Clinch	30 m²	-
Datacenterpark Falkenstein	Hetzner Online GmbH	-	-
Datacenterpark Nuremberg	Hetzner Online GmbH	-	-
DataCentre Casablanca	Casablanca INT	-	-
Datacentrum Moravia	Merit Group a.s.	-	-
Datacube	Datacube	2800 m²	20000 kW
DataHub Winterthur	DataHub (data:hub)	1100 m²	-
DC Jarosova	Slovak Telekom, a.s.	-	-
DC Primario	Insiel	-	-

Source: www.datacente.rs

www.actionheat.eu

Some DTC localization and information

The World Map of Datacenters internet site shows some Information about the company like:

- Name of the Datacenter
- Size of different data centers
- Capacity of different DTC around the EU

For the participants of the Webinar, it will be possible to find one in their regions.

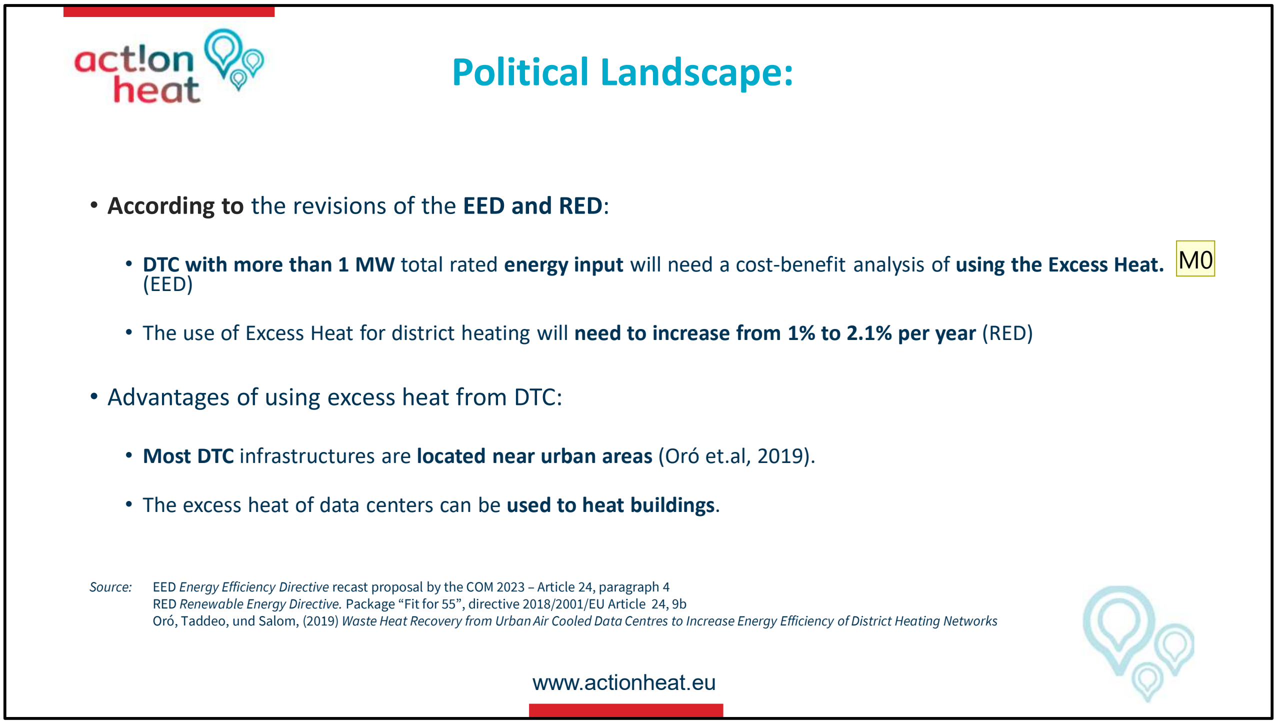
act!on heat

Political Landscape

Part I - Datacenter Excess Heat: Introduction

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

www.actionheat.eu



According to the revision of the Energy Efficiency Directive EED and the Renewable Energy Directive a RED for the 'Fit for 55' package, two legislative policies will affect data centers and their excess heat recovery and may indirectly promote heat recovery for DC.

One of the revisions requires that DTC with more than 1 MW total rated energy input need to do a cost-benefit analysis of using the Excess Heat,

Unless they can prove that it is not technically or economically possible, this proposal will be mandatory for the future construction of data centers.

Additionally, the proportion of excess heat in district heating and cooling should increase from 1% to 2.1% per year, pushing district heating companies to look for additional excess heat sources.

In September 2022, the European Parliament adopted the two revisions, and the European Council is still considering both. It is expected that adoption by the EC will happen by the end of this year. Once the EU has adopted them, a deadline will be set by which each member state must have incorporated the directives into national law.

Folie 10

M0 Would be interesting to see the exact formulation of the paragraph in the EED recast --> also cite article

Autor; 2023-06-09T13:09:09.422

	Denmark	Norway	Netherlands	Germany
Regulatory initiatives and proposals	Removal of tax on excess heat New price regulation on excess heat	Requirement for planned data centres above 2 MW to assess the potential to utilize excess heat	Data centres must explore the use of excess heat for heating nearby homes	Draft of the Energy Efficiency Act: Mandatory reuse of 30% and (later) 40%
Political focus on excess heat	✓	✓	✓	✓
Proposed DC heat recovery regulation	✗	✓	(✓)	✓
Example of excess heat recovery	Meta's data centre in Odense is suppling excess heat to 7,000 households	Excess heat recovery in Hima Seafood's trout farm (world's largest trout farm)	NorthC data centre south of Amsterdam	Pilot project on excess heat recovery in Frankfurt to supply 1,300 apartments

European political initiatives by country

Denmark removed taxes on EH from electrical processes to promote the recovery of EH from DTC and other electrical-based industries. Furthermore, a new price regulation on EH removes taxes to supply it to DH networks. Nevertheless, there are not yet any requirements in Danish law to recover the EH from DTC.

Norway is processing a low-to-require DTC with more than 2 MW capacity to reuse its EH for DH unless they prove it is not technically or economically possible. Additionally, the government has created a map of distribution stations to assist DTC in finding a spot to connect its EH to the DH network.

Netherlands developed new policy measures that required DT to explore using EH for heating nearby homes. At the beginning of 2022, the government announced it is working on new rules to control the construction by area of new hyper-scale DC.

German government drafted a legal framework in 2023 for DC, which, in addition to strict demands on energy consumption, includes mandatory reuse of EH. It is specified that 30% of the EH from DC that starts operations in January 2025 and 40% that starts operations in January 2027 must be reused.

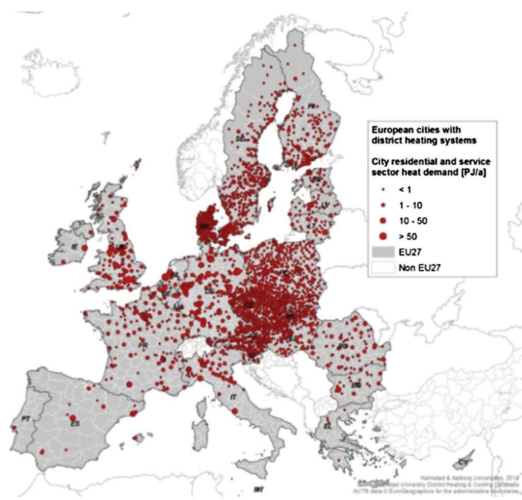
act!on heat

District heating networks

Country	Supply Temperature [°C]	Return Temperature [°C]
Denmark	70	40
Finland	70	40
Germany	80	60
Spain	90	70

Examples from the International Energy Agency of standard operational temperatures in European district heating networks (Skagestad & Mildenstein, 2018)

M0



Source: Oró, Taddeo, und Salom, (2019) *Waste Heat Recovery from Urban Air Cooled Data Centres to Increase Energy Efficiency of District Heating Networks*

www.actionheat.eu

Existing H&C networks to connect data centers

Actually, it is a trend to develop low-temperature DH networks. Nevertheless, the most common DH networks are "high-temperature".

- On the left side, the table shows the standard temperature operation of some DH networks in Europe. Explain

- On the right side, the map shows that DH systems are widely spread around Europe.

Folie 12

M0 Link does not work

Autor; 2023-06-09T13:12:11.403

DTC in Act!on

Examples of **locations using excess heat** from data centers to **heat buildings** and homes, through district heating networks

Company	Year	Location	Excess heat reuse?
Tieto	2011	Espoo, Finland	1 500 detached houses
Telecity Group	2013	Helsinki, Finland	4 500 apartments
Yandex	2015	Mämtsälä, Finland	1 000 private houses
Ericsson	2016	Kirkkonummi, Finland	1 000 single homes
Facebook	2019	Odense, Denmark	7 000 homes
Veolia	2019	Braunschweig, Germany	600 households
Telia Company	2022	Helsinki, Finland	20 000 single homes
Bahnhof	2030	Stockholm, Sweden	30 000 households

Sources: Huang u. a., „ (2019) *A Review of Data Centers as Prosumers in District Energy Systems*
Wahlroos u. a., (2018) *Future Views on Waste Heat Utilization – Case of Data Centers in Northern Europe*

www.actionheat.eu

Datacenters supplying buildings

The table shows successful examples of data centers supplying buildings and households with their Excess Heat around Europe.

Over the last ten years, data centers have increased in capacity and size. Therefore, the potential to distribute excess heat for district heating has increased by more than 100 per year, as can be seen in the table.

act!on heat

Discussion, Q&A

Part I - Datacenter Excess Heat: Introduction

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

www.actionheat.eu

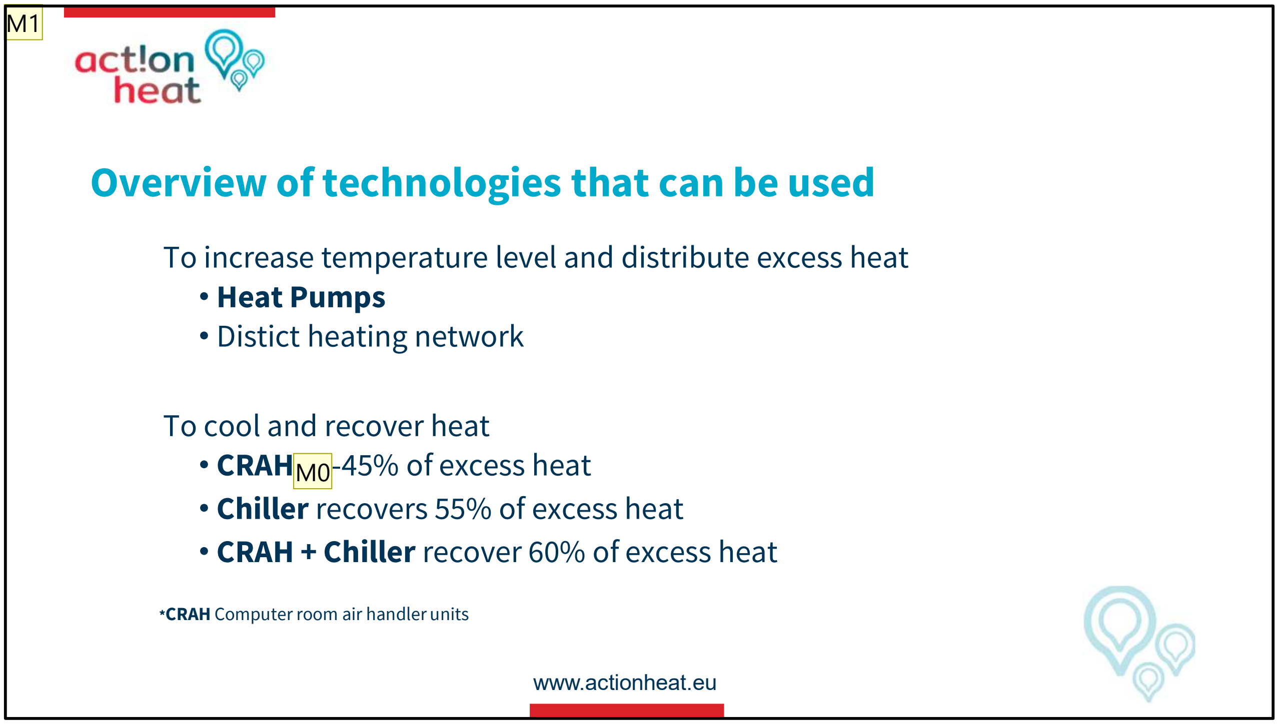
act!on heat

Overview of technologies

Part II - How to reuse Datacenters Excess Heat

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

www.actionheat.eu



The EH from data centers requires a heat pump.

Heat pumps are the best solution to reuse the low temperature of EH for district heating, increasing the low water temperature to be distributed in the DH network.

Now speaking about heat recovery, the best place to recover EH in DTC is after or before the cooling system. CRAH and Chiller are the most common cooling systems.

For example (CRAH) or Computer room air handler units are primarily used in medium-big size data centers (>100 kW).

Nevertheless, the absorption chiller is the most promising passive cooling technique for recovering heat.

Folie 16

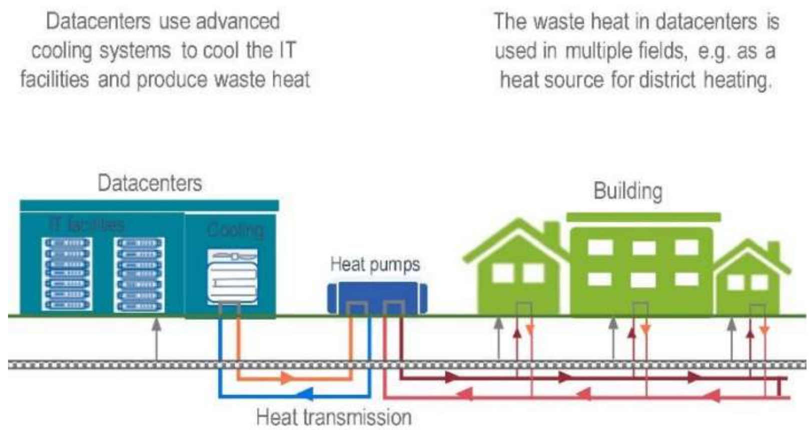
M0 Abbreviation needs to be written / introduced somewhere
Autor; 2023-06-09T13:18:19.231

M1 Re fre
Ger ator
Autor; 2023-06-10T18:51:16.329

M1 0 Cooling system
Autor; 2023-06-10T18:59:16.162

Heat Pumps

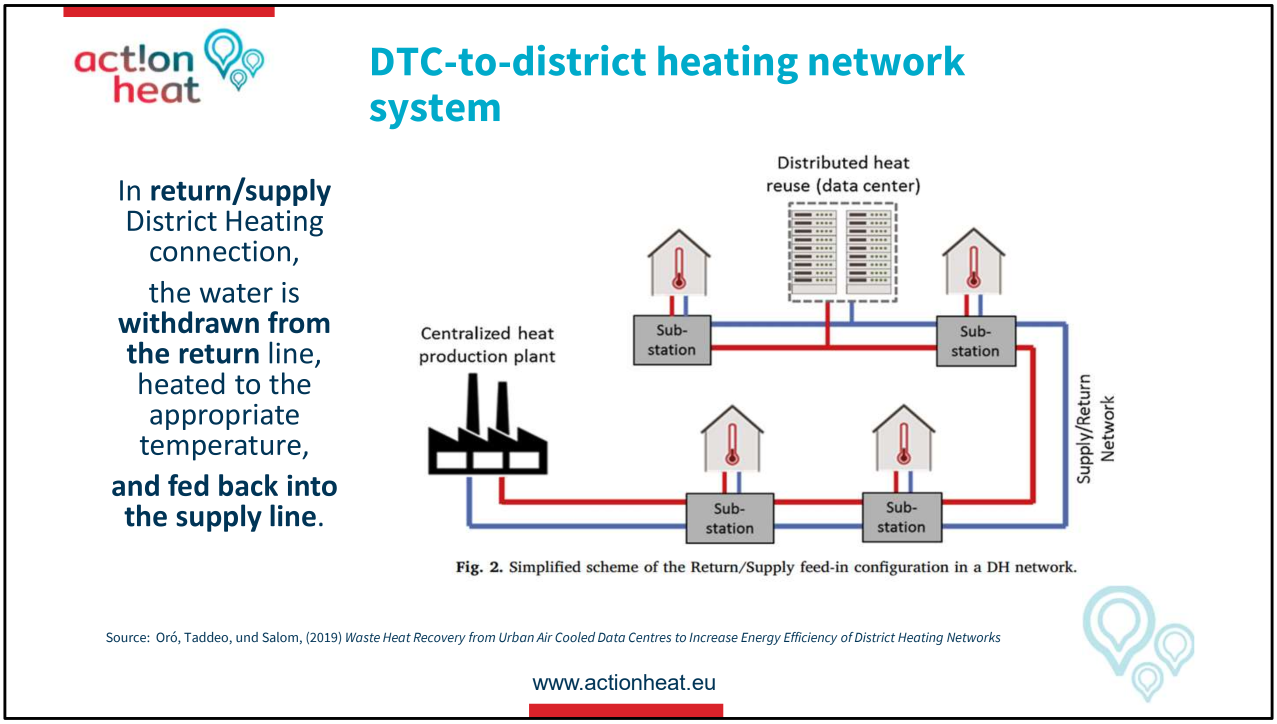
The **low-grade Excess Heat** recovery in the DTC is fed **into the heat pump,** heated to the supply temperature, and then delivered directly **to district heating** end-users.



Source: Huang u. a., „ (2019) *A Review of Data Centers as Prosumers in District Energy Systems*

www.actionheat.eu

Heat pumps are the best solution to reuse the Excess Heat for district heating because heat pumps are made to work with low- temperatures rates. Therefore, we do not recommend another technic to reuse the Heat for building use.



Different connections to district heating

Exist four different ways to connect and distribute heat reuse from data centers to a DH network (i) return/supply, (ii) return/return, (iii) supply/return, and (iv) supply/supply.

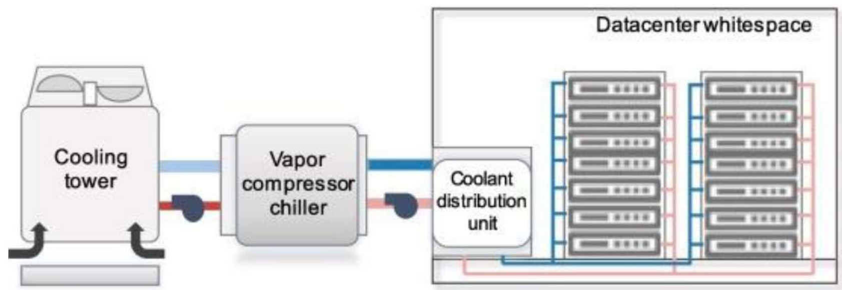
The most beneficial system for DTC is the return/supply solution.

In this configuration, the water is withdrawn from the return line, heated to the set temperature, and fed back into the supply line. This feed-in configuration does not affect the return line temperature.

In addition, supplying the DTC excess heat close to the consumers reduces the heat loss in both lines due to the lower mass flow rate circulating in the entire loop. This is reflected in reducing the heat power requirement from the heat pump and, therefore, the distribution prices in the hold network.

Excess Heat recovery from water

In **water-cooled systems**, the temperature of water is at the highest when exiting server racks (**75–80 °C** maximum). Thus, the optimal location to recover excess heat is **where the water exits the server racks**. This can be done by adding a water-to-water heat exchanger.



Source: Huang u. a., „ (2019) *A Review of Data Centers as Prosumers in District Energy Systems*

www.actionheat.eu

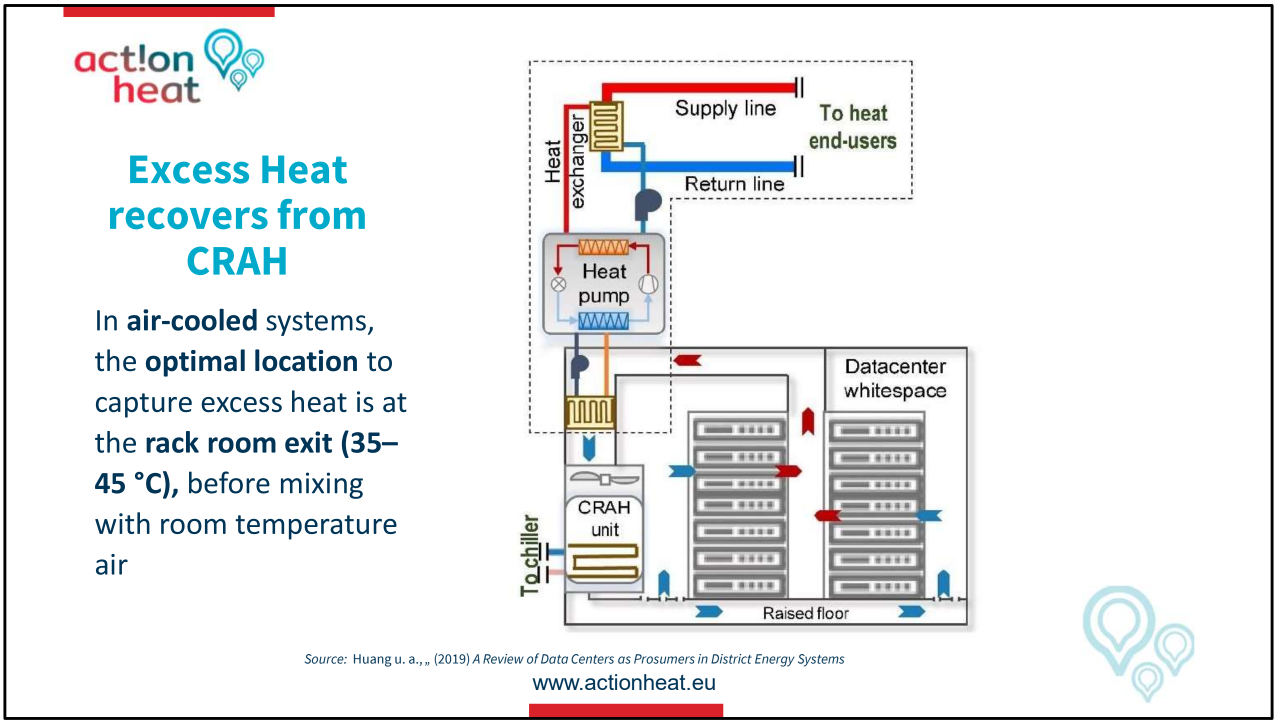
Water cooler system for DTC

In water-cooled systems, the water temperature is at the highest on the exit for the server rack (75–80 °C maximum). So, there is the optimal location to recover excess heat. This can be done by adding a water-to-water heat exchanger.

It is essential to mention that most of the existing DTCs have air cooling systems because of installation costs.

The water cooling systems are costly because the water needs to flow close to the electronic components.

This system is best for small DCs.



Air cooler system

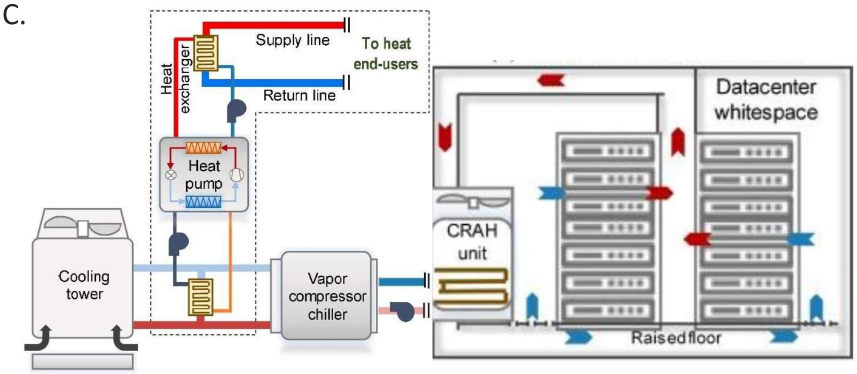
The optimal location to capture EH in air-cooled systems is at the exit point of the rack room (35–45 °C). In the diagram, this is at the top-left point. Here is where to connect the HP before mixing with room air temperature to prevent energy loss.

At this point, a water-to-air heat exchanger must be installed.

In the heat exchanger, the low-grade water is fed into a heat pump, where the water temperature is upgraded to the required level for use by the DH network.

Excess Heat recovery from Chiller

In air-cooled systems, it is also possible for heat recovery following the **chiller condenser** systems, using a water-to-refrigerant heat exchange installed in parallel with the condenser (or dry cooler) of the chiller. The temperature can reach up to 50 °C.



Source: Huang u. a., „ (2019) *A Review of Data Centers as Prosumers in District Energy Systems*

www.actionheat.eu

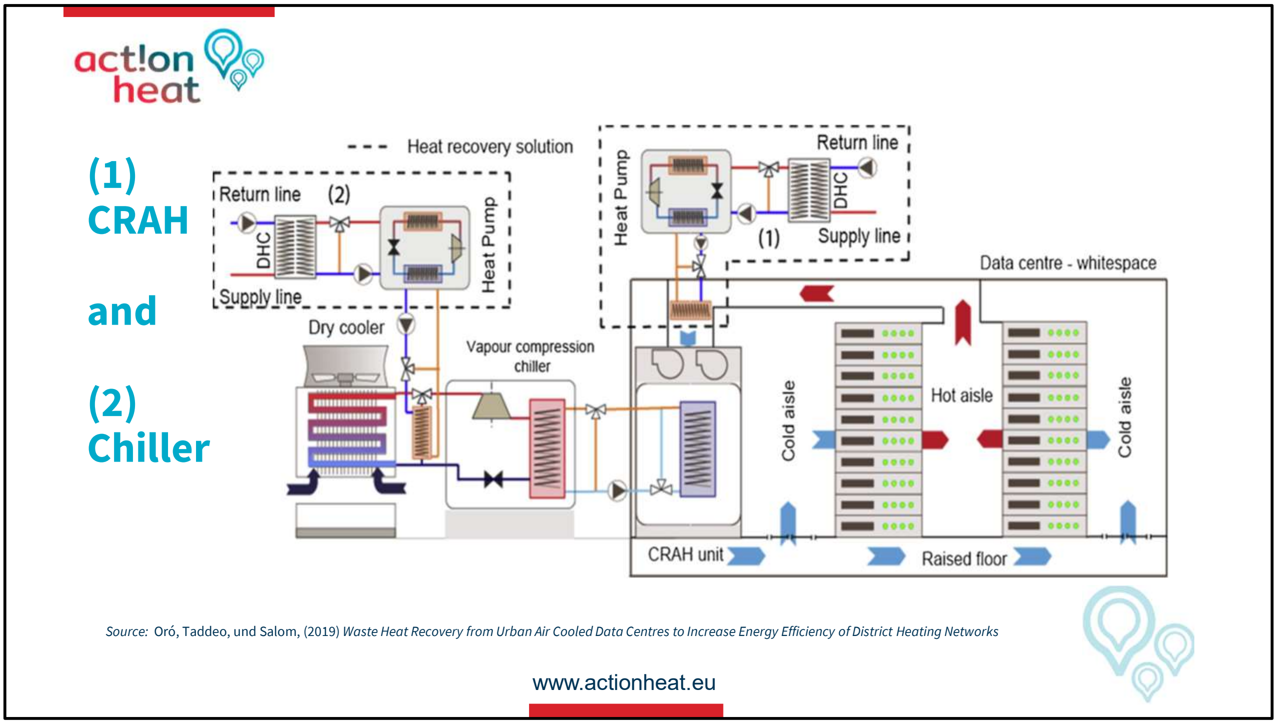
Air cooler to water

Another option to recover excess heat is the chiller condenser, which applies to air and water-cooled systems.

For heat recovery from the chiller, a water-to-refrigerant heat exchange is installed in parallel with the chiller’s condenser (or dry cooler).

Part of the heat produced by the chiller passes into the surrounding environment, and the remaining heat is captured by a secondary water circuit. The temperature can reach up to 50 °C.

Here, the low-grade water from the chiller is fed into a heat pump, where the water temperature is upgraded to the required level for use by the DH network.

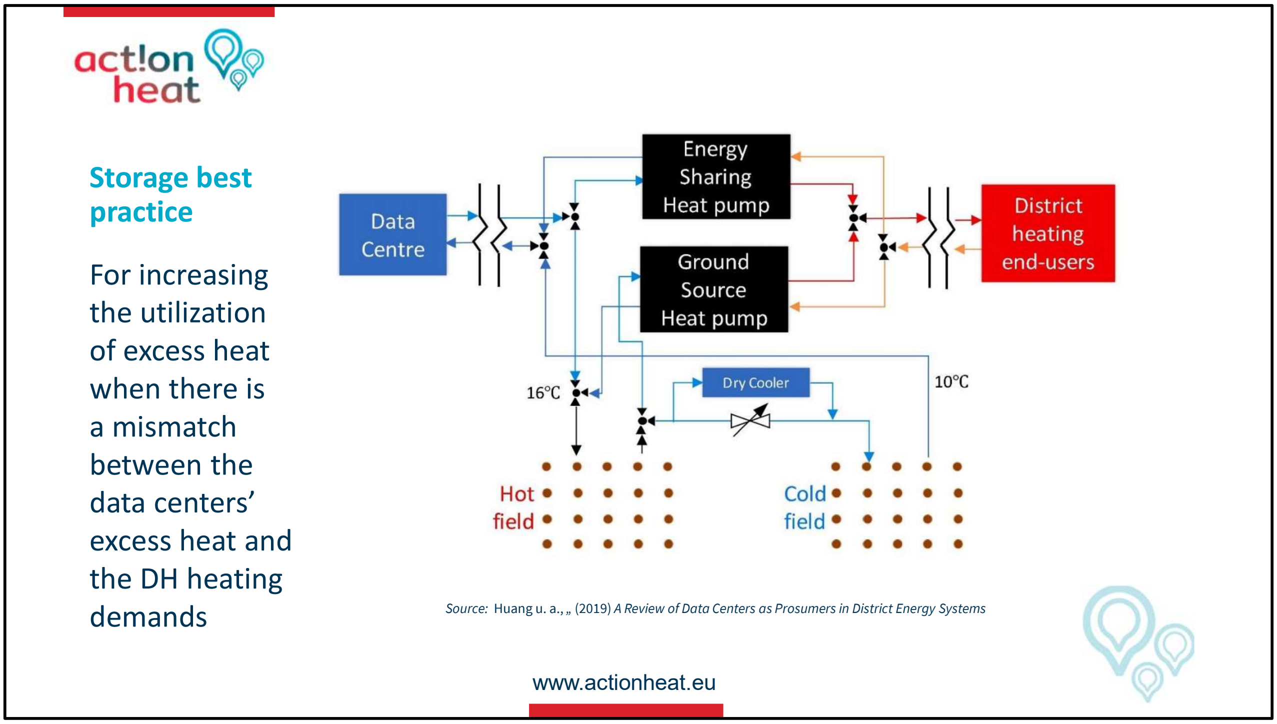


Combination of cooling systems

Air-cooled systems are the most common cooling systems in existing data centers.

They typically arrange server racks into cold areas and hot areas. The cooled areas carry cool air to each server, while the hot air exits the servers in the hot aisled area.

In general, the best option to optimize the use of excess heat in this system is to use two Heat pumps, one at the rack room exit point and the other after the condenser of the vapor-compression chiller.



Possible extra adaptations to the cooling system

To increase excess heat utilization when there is a mismatch between the DC excess and the DH demands, a ground source heat pump and a bore field can be integrated into the system.

In this case, the ground source heat pump will operate in cooling/heating mode to control the temperature. The bore field acts as a large thermal energy storage to alleviate the mismatch. Typically, more than one heat pump is required to manage temperatures between all system parts. Therefore, it is recommended to install two heat pumps.

Finally, to improve the ground source heat pump heating efficiency and provide free cooling for the DTC, an additional bore field can be added. In that case, one bore field acts as a 'hot' thermal storage, and the other as a cold thermal storage.

Best practice examples

Part II - How to reuse Datacenters Excess Heat

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

www.actionheat.eu

Excess heat recovery in DTC in Act!on

Company	Location	IT load capacity	Cooling technology	Excess heat reuse	Estimated excess heat reused / recovered	Nr. Of buildings supplied by the excess heat
Telecity Group (5 locations)	Helsinki, Finland	7 MW (2 MW with excess heat reuse)	District cooling	District heating	unknown	4 500 apartments 500 detached houses
Telia Company	Helsinki, Finland	24 MW	Unknown	District heating	200 GWh/a	Unknown
Bahnhof (3 locations in operation, 1 under construction)	Stockholm, Sweden	3 MW (21 MW under construction)	Heat pumps	District heating	600 kW (Pionen) 500 kW (St Erick) 1 500 kW (Thule)	Unknown
Tieto	Espoo, Finland	2 MW	Heat pumps	District heating	30 GWh/a	1500 detached houses
Yandex	Mäntsälä Finland	10 MW	Free cooling	District heating	20 GWh/a	1 000 detached houses
Meta	Odense Denmark	Unknown	Heat pumps free cooling	District heating	25 MW, 100 GWh/a	6 900 homes

Sources: Huang u. a., „ (2019) *A Review of Data Centers as Prosumers in District Energy Systems.*
Wahlroos u. a., (2018) *Future Views on Waste Heat Utilization – Case of Data Centers in Northern Europe.*

www.actionheat.eu

When analyzing the table, it is important to consider several factors:

IT capacity refers not only to the computing power of the systems and the support staff but also to the capacity designed in the plan, which may not always be fully utilized.

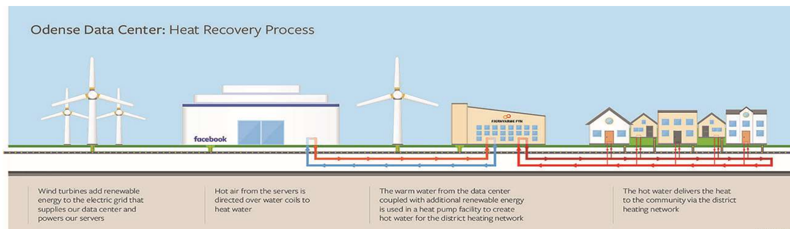
If excess heat from a Data Center (DTC) is used for district heating, the temperature needs to be increased using a heat pump. The efficiency of this process is determined by the Coefficient of Performance (COP) of the heat pump.

In the table, the 20 MW supplied to the network does not indicate that the entire amount is solely from excess heat. Due to the heat pump, the actual amount of usable heat will be lower, as the heat pump efficiency reduces the output.

Additionally, when evaluating examples of heat pumps used in district heating systems, it’s important to recognize that the COP can vary, especially if the heat pump is also used for cooling the network.

Facebook – Odense, Denmark

- Organisations involved:
  - Data center operator: Meta (Facebook) – supply of excess heat for free
  - DH operator: Fjernvaerme Fyn – took all investment
- Heat recovery:
  - 176 cooling units on the roof of the data center
  - Water is heated from hot air in the coils
- Reused heat:
  - Up to 25 MW
  - 100 GWh/a
- Start of operation: 2023



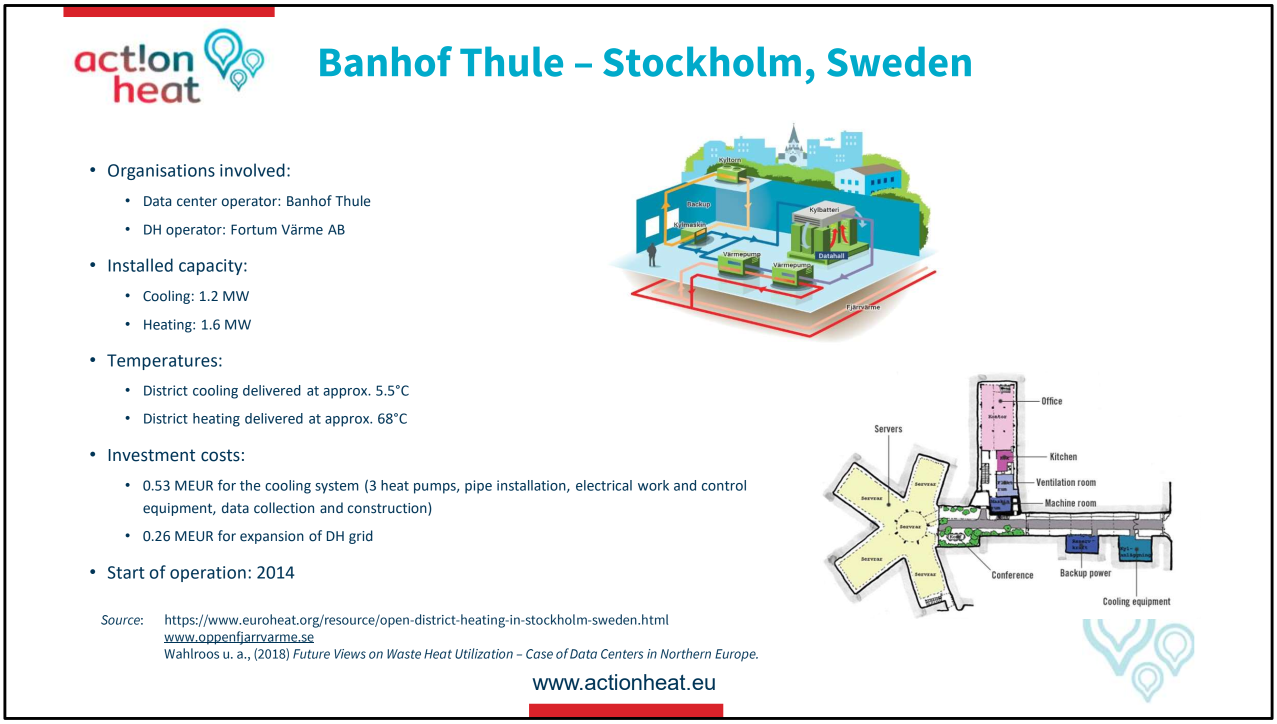
Source: https://tech.facebook.com/engineering/2020/7/odense-data-center-2/
https://www.datacenterdynamics.com/en/news/metafacebook-to-expand-odense-data-center-campus-in-denmark/

www.actionheat.eu

A recent example of heating reuse

The business model there is that the operator takes all the investment, and Facebook does not receive anything from the income of the use of Excess Heat for district heating.

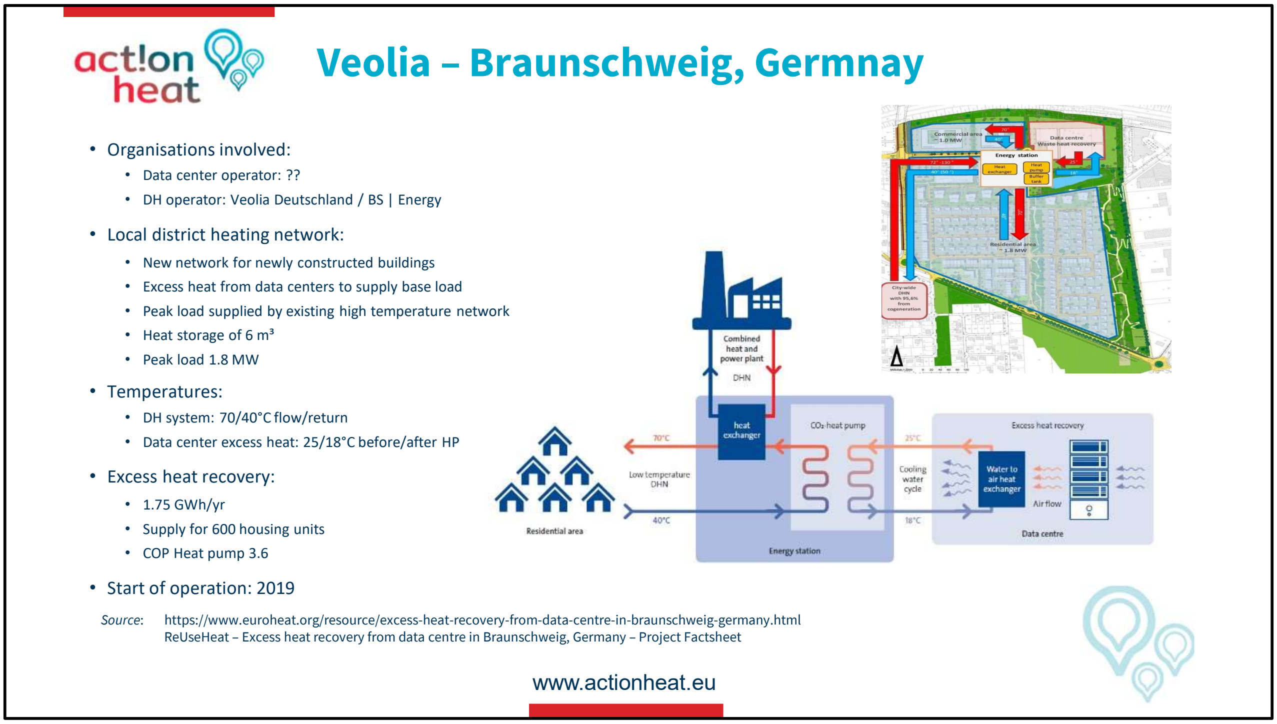
The reuse of the energy in the system works with heat exchangers on the top of the roof in the building through recovery metal pipes and sent to the Heat Pumps to be increased and sent to the district heating network.



Data center added to existing DH network

The Bahnhof Tule data center is one of several DTC the Stockol heating and cooling network has. becaues they have an open network, and it is possible to be integrated into the grid by advice and discussion with the operator.

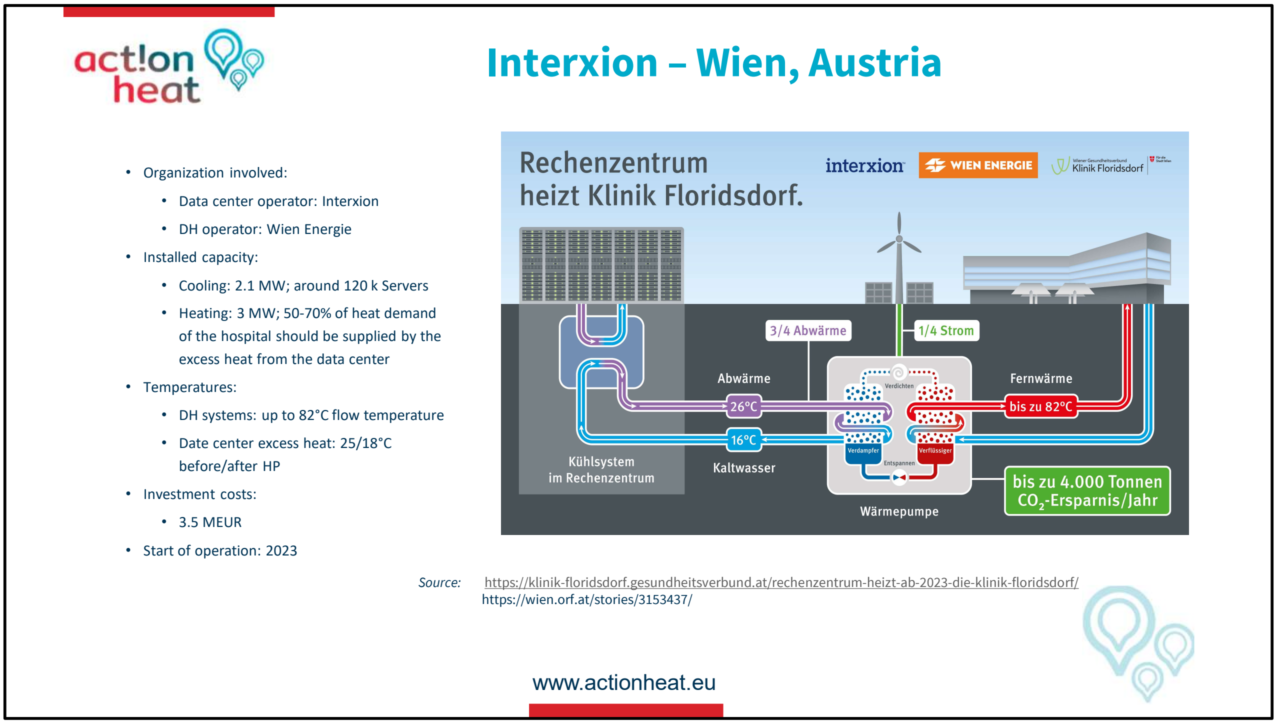
With 3 heat pumps deliver district heating with almost 70 degrees. The installation cost is also divided between heating and cooling, where the first investment cost is more becaues the pumps and then a second expansion phase to the network was added to the grid and started to work in 2014.



The data center was built, and nearby construction of houses was built.

The district heating operation operates the complete district heating in Braunschweig, with a high-temperature district heating.

Therefore they built a separate district heating network with low-temperatures to supply the house with storage capacity.



Example of Vienna

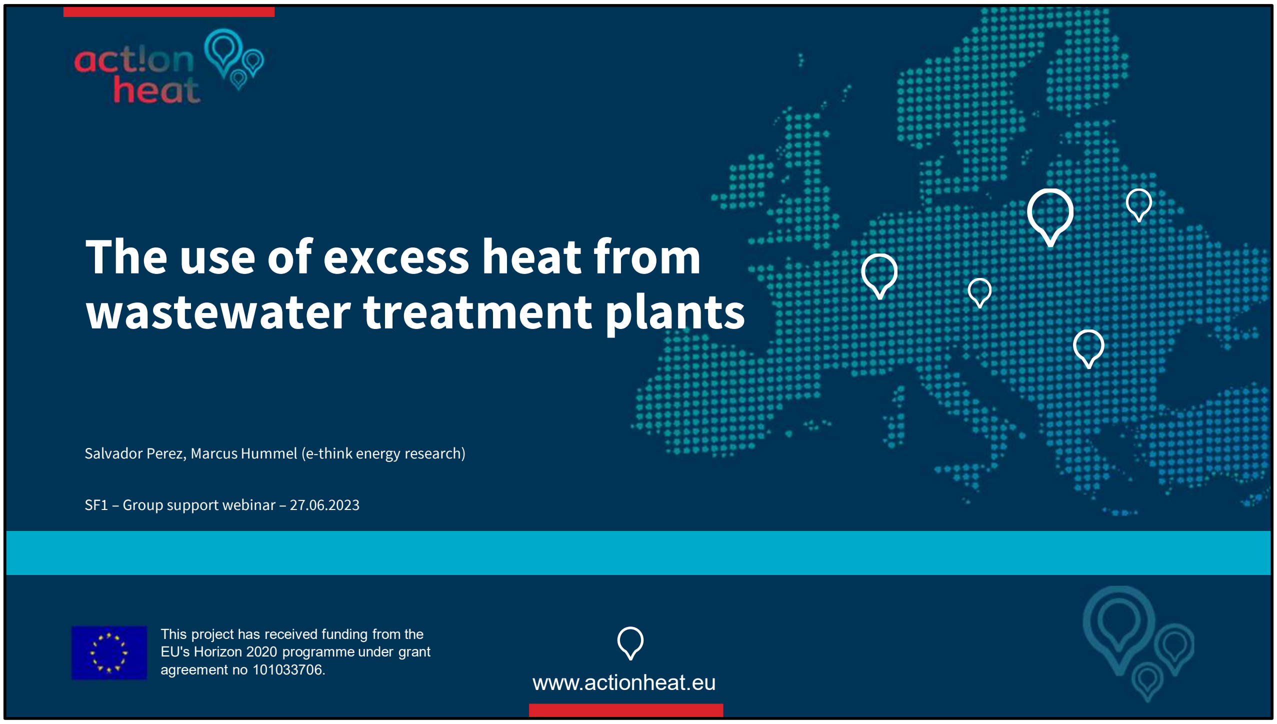
- The data center is only connected with a Hospital.
- It is a small project that supplies 70 percent of the hospital.
- The system heat and cool the hospital; therefore, the COP is high.
- Is in the final face of construction and will operate soon.

Discussion, Q&A

Part II - How to reuse Datacenters Excess Heat

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

www.actionheat.eu



Webinar 6:
The use of excess heat from wastewater treatment plants

Act!onHeat SF1 Time: 1 h 11 min

- Serial 2:
  - Webinar 6
    - Strategical Heating & Cooling planning
    - Group support for municipalities and stakeholders

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

act!on heat

Contents

Part I: Potentials and technologies

- Overview of WWTP and options for energetic use (15’)
- Characteristics of excess heat and considerations for the implementation of HPs (10’)
- The Hotmaps database on excess heat potentials from WWTPs (10’)
- Discussion, Q&A (10’)

Part II: Practice examples

- Successful use of excess heat from wastewater treatment plants (20’)
- Discussion, Q&A (10’)

www.actionheat.eu

Use of Excess Heat (EH) from WWTP

Waste Water Treatment Plants WWTP

- First part
  - What kind of energy potential does WWTP have?
  - Use the EH with Heat Pumps for District Heating
- Second part
  - Existing WWTPs and the characteristics of these plants.

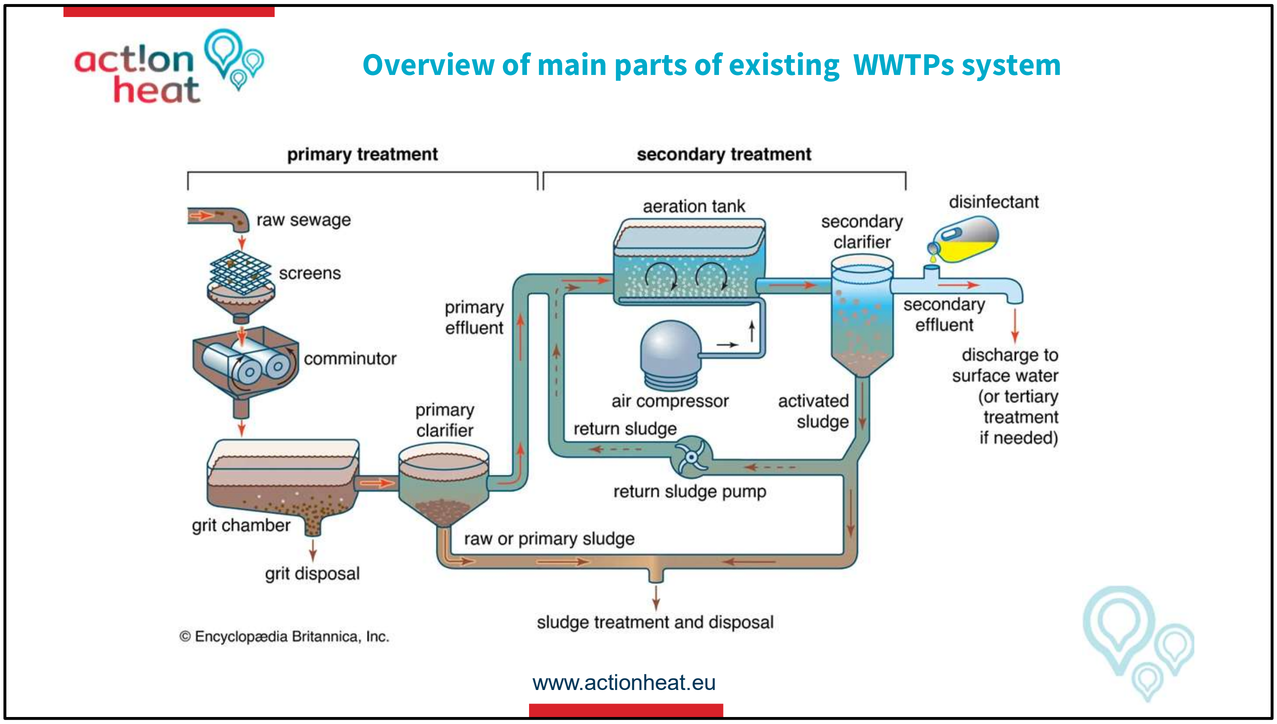
act!on heat

Overview of WWTP and options for energetic use

Part I - Introduction to Excess Heat from WWTP

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

www.actionheat.eu



Components of a WWTP

Common parts of a treatment plant for district wastewater, not for industrial sites:

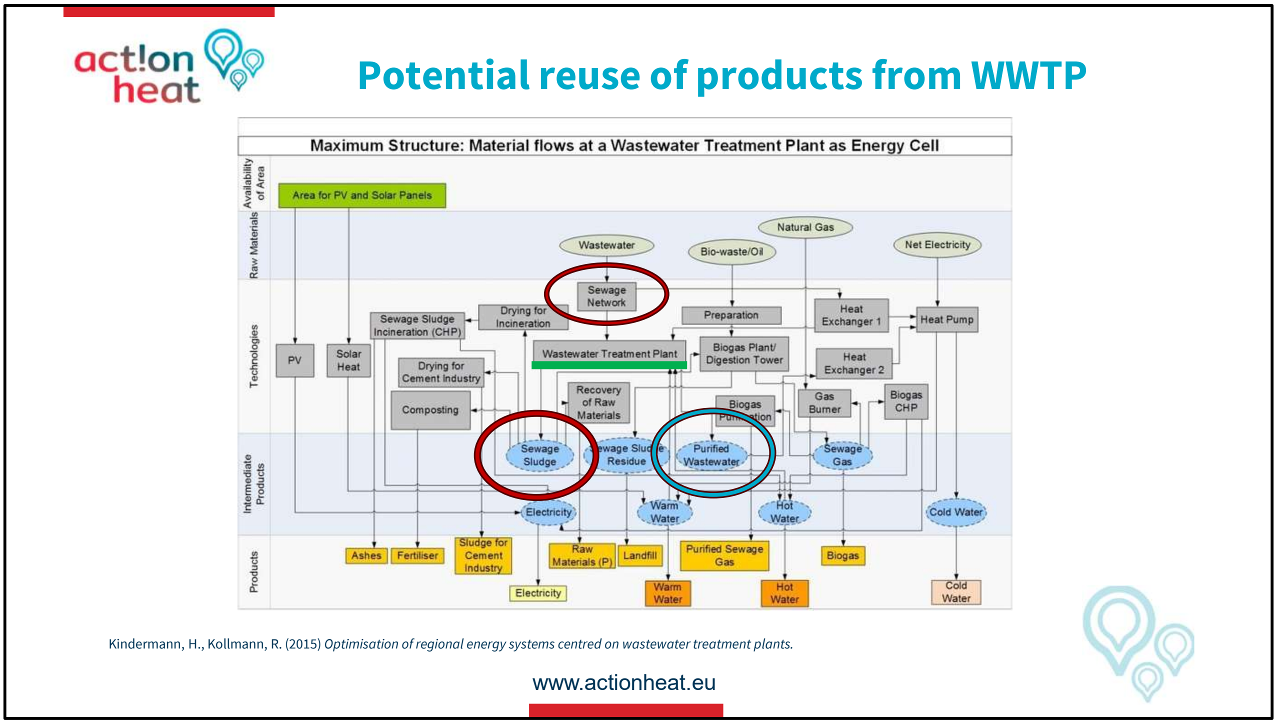
Primary Treatment:

- Raw sewage enters the plant.
- During primary treatment, solid materials are extracted and separated.

Secondary Treatment:

- This is typically a biological treatment using aerobic and anaerobic processes.
- Effluent (clean water) is discharged from the plant.

The webinar does not focus on the overall operations within the plant but rather on specific stages, such as raw sewage water, the sludge produced during the process, and the effluent from which clean water is discharged.



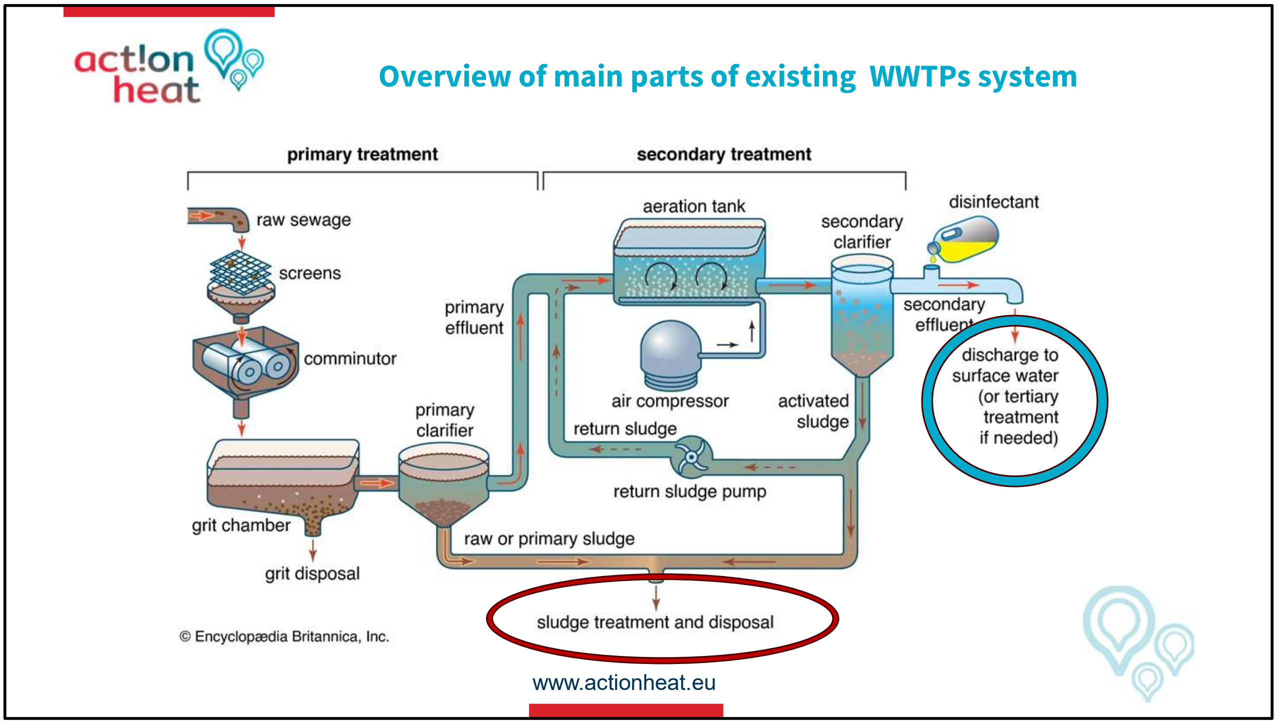
Different parts and their energy products

The table shows differet process stages from the WWTP process and the possibilities of transforming the results into energetical products.

Through a sewage network, wastewater enters the plant to be treated, resulting in:

- Sewage sludge
- Purified water

The table shows the different process stages of the WWTP and the possibilities for transforming the results into energy products.

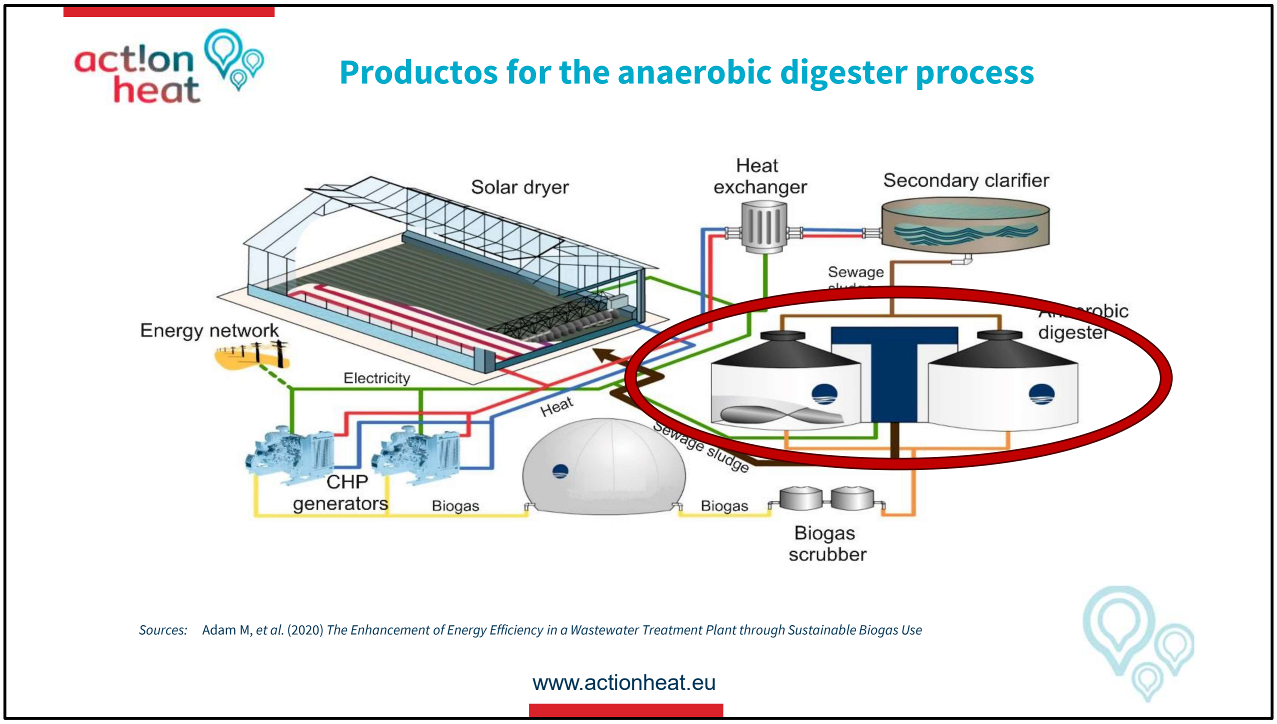


Two results and their place in the process

Sludge and clean water are some of the results of the treatment process, among others.

The graphic aims to clarify where these results occur within the process.

Identifying these two results on the graphic will help understand their energy reuse potential in the following example.

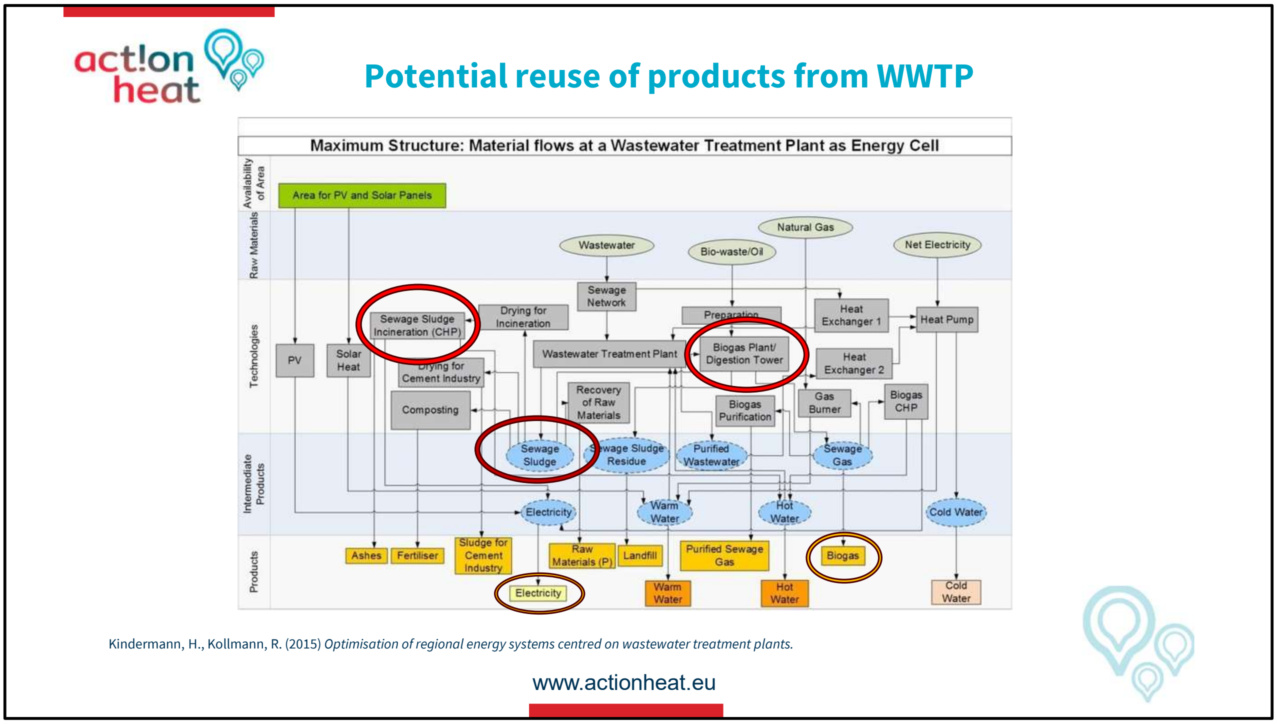


Examples of energy products from sludge

The sludge waste undergoes an anaerobic digestion process, and a scrubber is used to generate biogas.

The biogas is then used in CHP (Combined Heat and Power) generators to produce electricity.

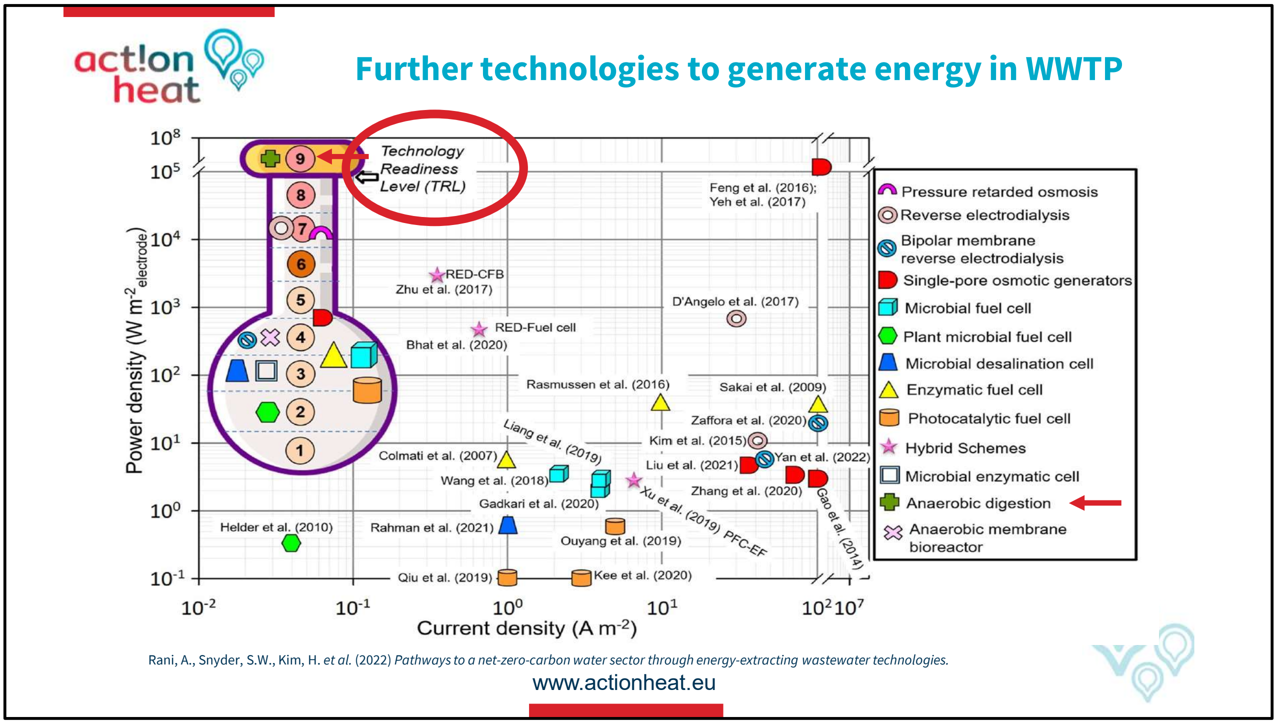
The electricity can be used internally within the plant or externally for private use.



Resulting products from sewage sludge

- Biogas from the sludge
- Electricity when you burn the biogas

These are just two examples of the energy and environmental advantages of WWTPs over others. The table presents additional energy products. However, the webinar will focus more on potential alternatives for reusing excess heat from the treatment plants in heating and cooling processes.

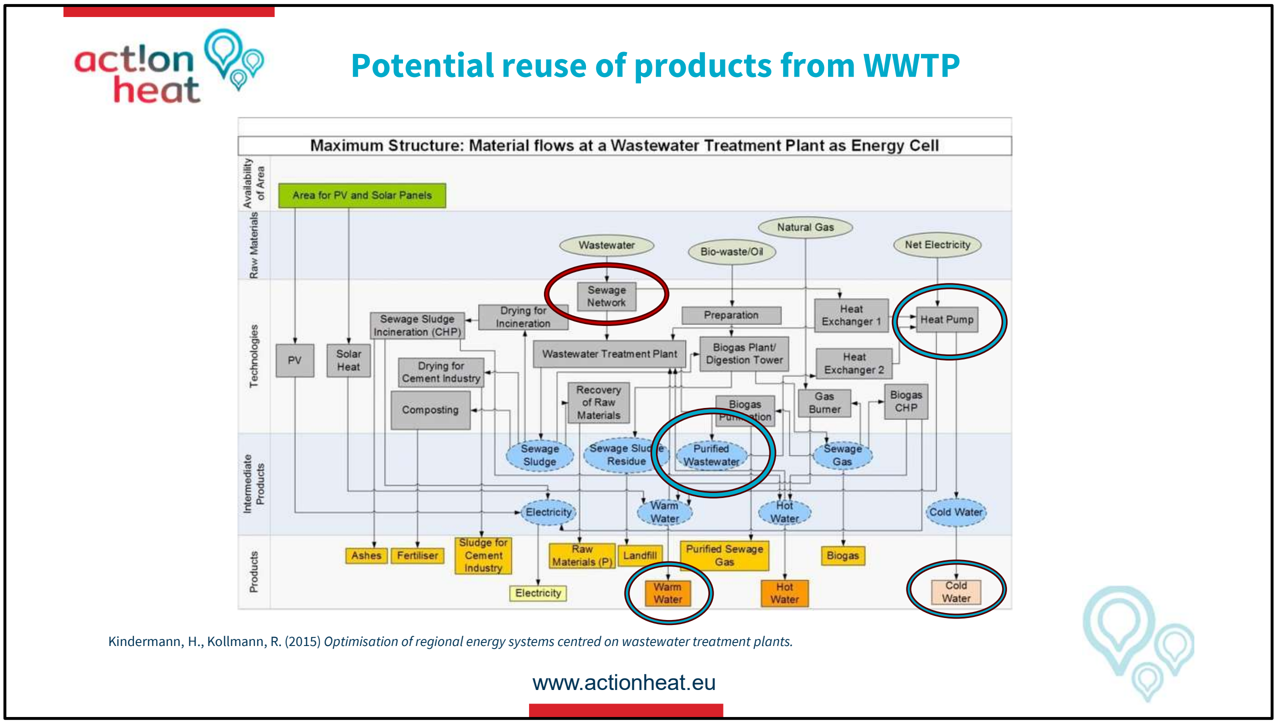


Potential electricity generation

There are a lot of other WWTP processes that produce energy out of the sludge depending on technological desition from needs.

The table shows different forms of generated electricity depending on the technology used for flouting and interaction with the particles in the process.

The anaerobic digestion that generated biogas which can be used to produce electricity, is the only technology in level 9 on this comparative graphic from 2022.

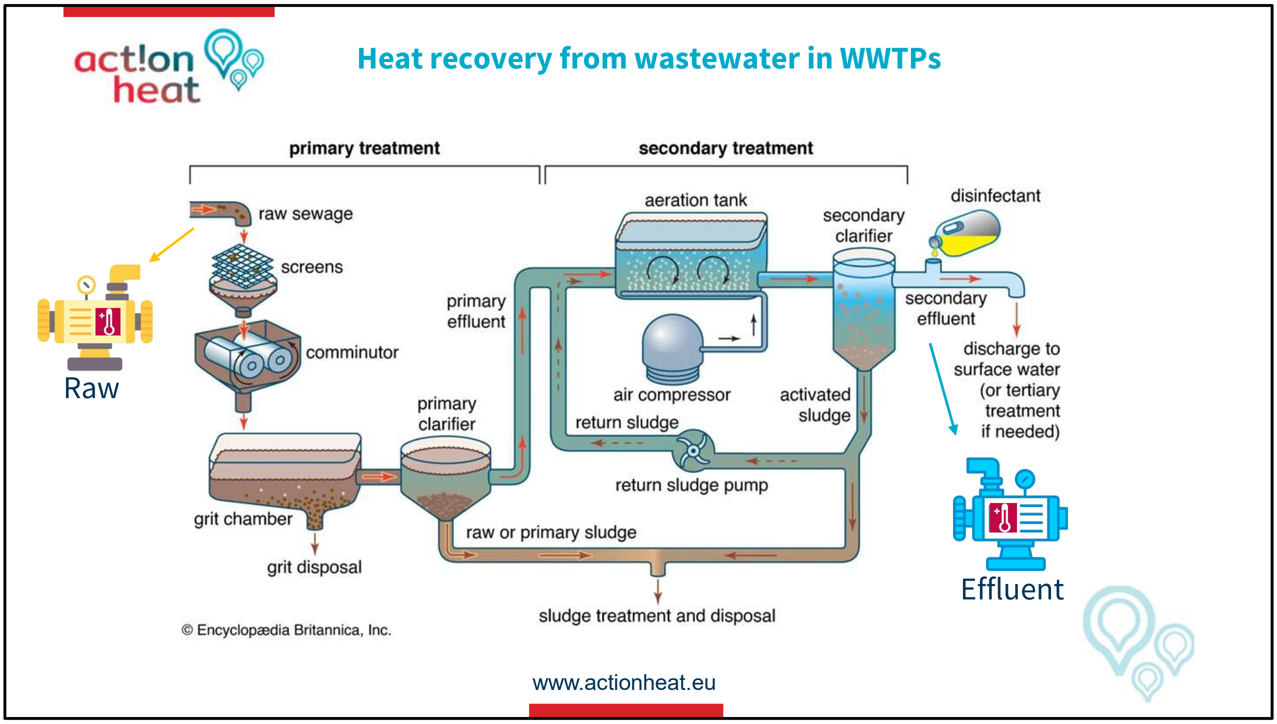


Excess Heat reuse from District Heating

There are two ways to extract low-energy heat from a WWTP, which can then be connected to a heat pump for reuse in district heating:

1. Before the treatment process, in the sewage network.
2. After the purified water process.

In both locations, when connected to a heat pump, it is possible to generate both hot and cold water.

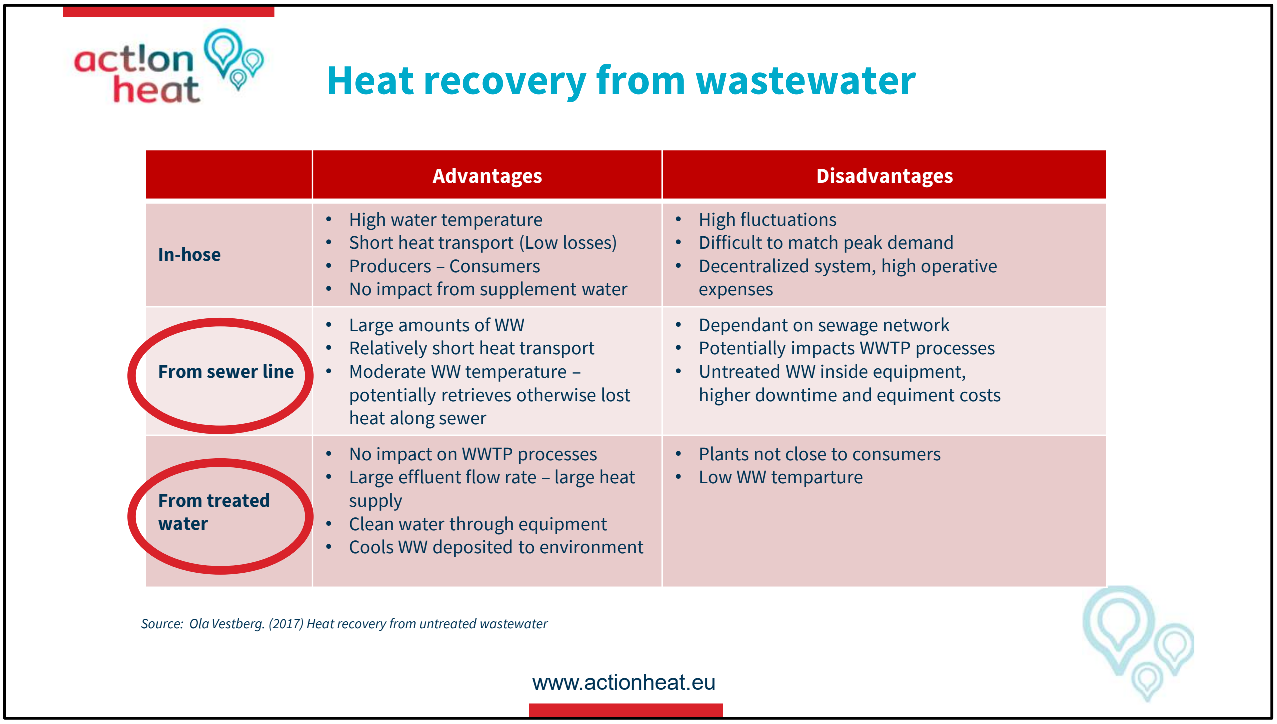


Installation of Heat Pumps on the plant

The design pretends to illustrate where it is possible to install Heat Pumps HP

- Raw wastewater (Before the process)
- Effluent purified water (After the process)

Each connection has different characteristics.



act!on heat

Heat recovery from wastewater

	Advantages	Disadvantages
In-hose	• High water temperature • Short heat transport (Low losses) • Producers – Consumers • No impact from supplement water	• High fluctuations • Difficult to match peak demand • Decentralized system, high operative expenses
From sewer line	• Large amounts of WW • Relatively short heat transport • Moderate WW temperature – potentially retrieves otherwise lost heat along sewer	• Dependant on sewage network • Potentially impacts WWTP processes • Untreated WW inside equipment, higher downtime and equiment costs
From treated water	• No impact on WWTP processes • Large effluent flow rate – large heat supply • Clean water through equipment • Cools WW deposited to environment	• Plants not close to consumers • Low WW temparture

Source: Ola Vestberg. (2017) Heat recovery from untreated wastewater

www.actionheat.eu

Advantages and disadvantages of the connections

- It is also possible to connect a heat pump (HP) outside of houses or buildings, but we will not provide examples of these connections.

- From the sewer line or raw wastewater, it is possible to obtain return heat or cooling water near the users, but filters are required to clean the water used by the heat pumps.

- From treated or purified effluent, you can take advantage of the environmental temperature of the return water, and the heat pump does not require filters. However, WWTPs are typically located far from consumers.

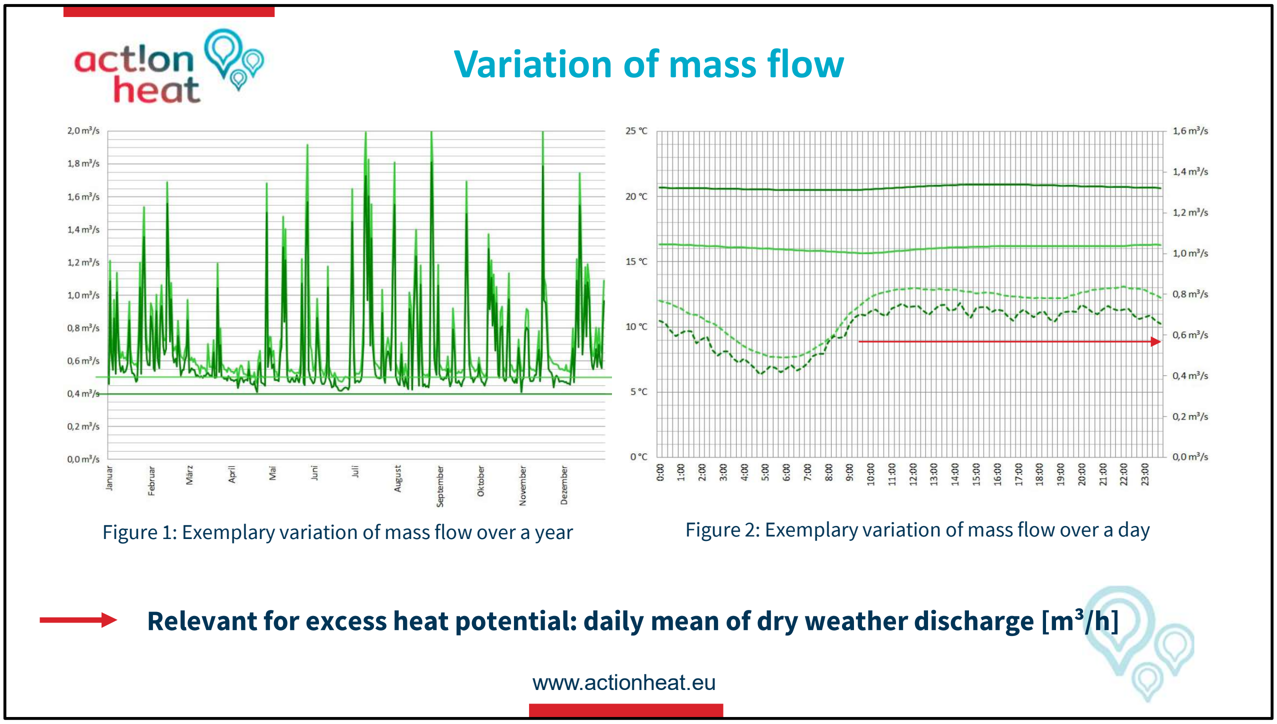

act!on heat
Characteristics of excess heat and considerations for the implementation of HPs
Part I - Introduction to Excess Heat from WWTP
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu

Contents

Overview of characteristics

- Mass flow
- Temperatures
- Legal aspects
- Economic aspects

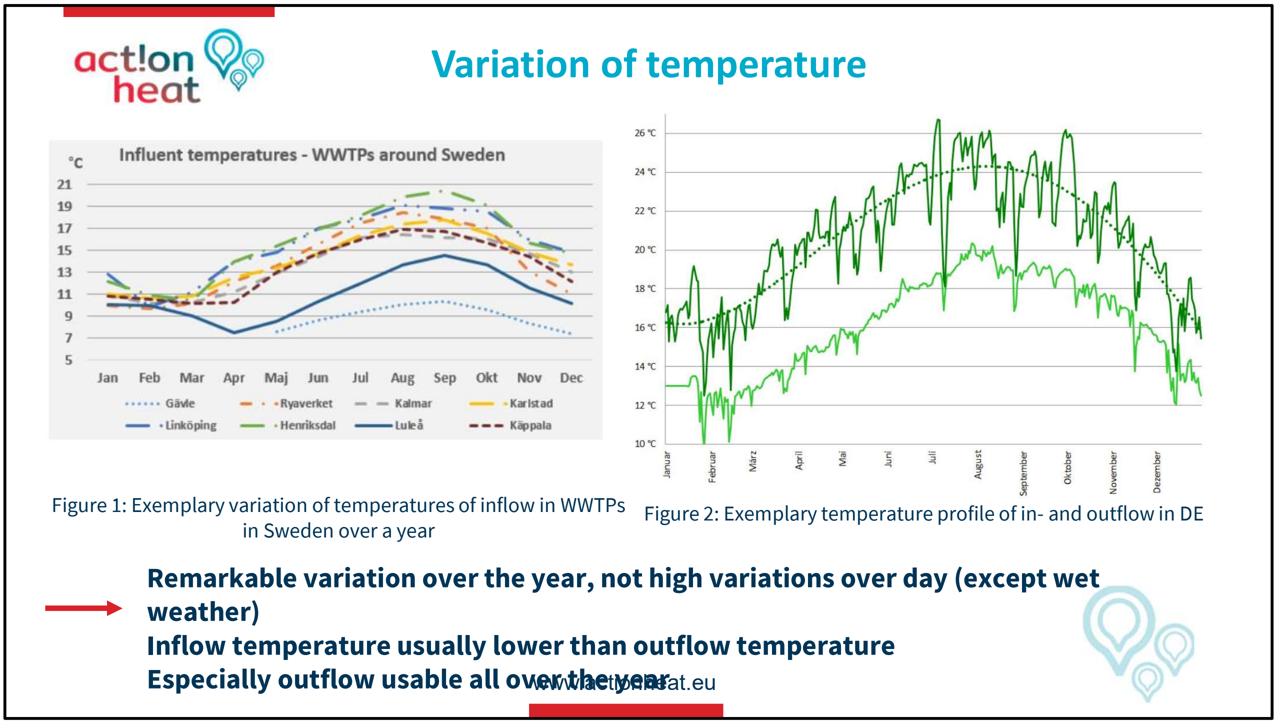
www.actionheat.eu



Graphics of mass flow in a plant in Germany

Left side: Variation over the year
Right side: Variation over the day

- The graphics display temperatures and mass flows, showing variations in inlet and outlet flows.
- What is shown is the variation over the year, with high and low flows due to the rainy season, where rainy days experience higher fluctuations.
- The temperature flow remains constant during the day and is lower and irregular at night. Therefore, the day flow is used to dimension the potential needed for the heat pump.

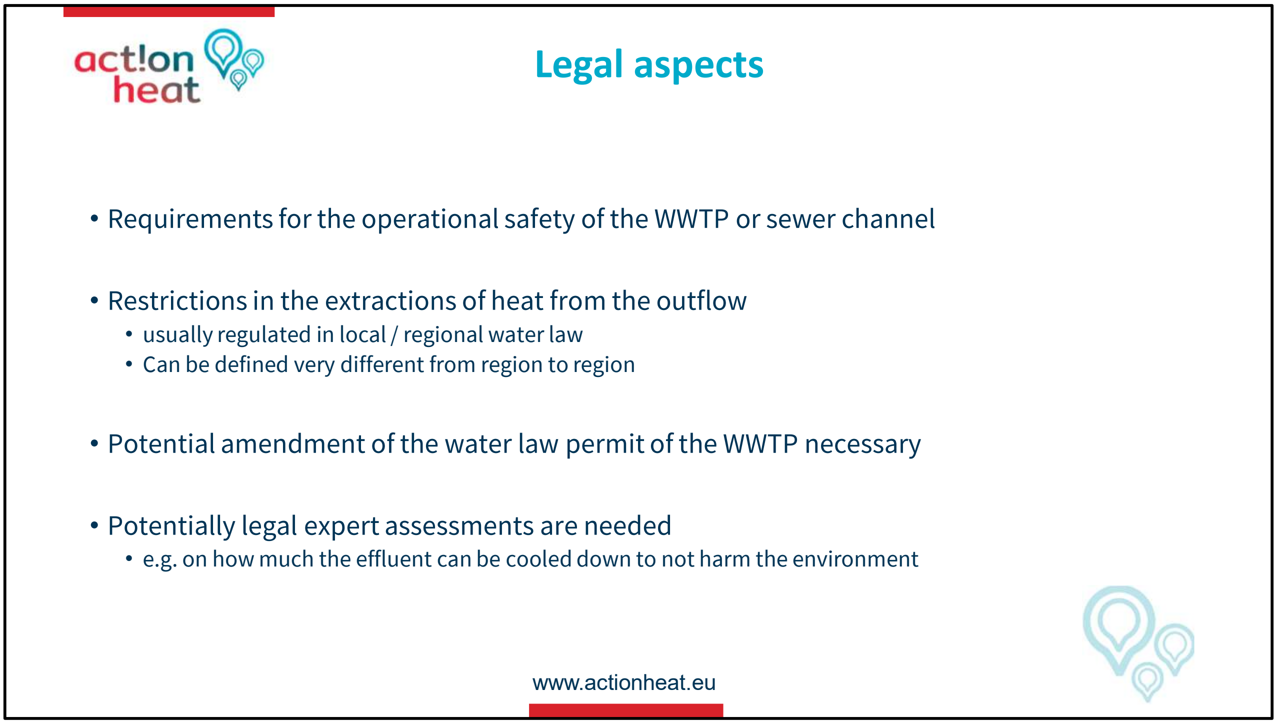


WWTP temperatures over the year

- On the left side is the raw water temperature before it enters the treatment plant in different cities in Sweden.

- On the right side, the inflow and outflow temperatures of a plant in Germany, showing variations over the year.

The effluent temperature variation between summer and winter is lower, usually due to biological processes. Therefore, excess heat can also be used during the winter.

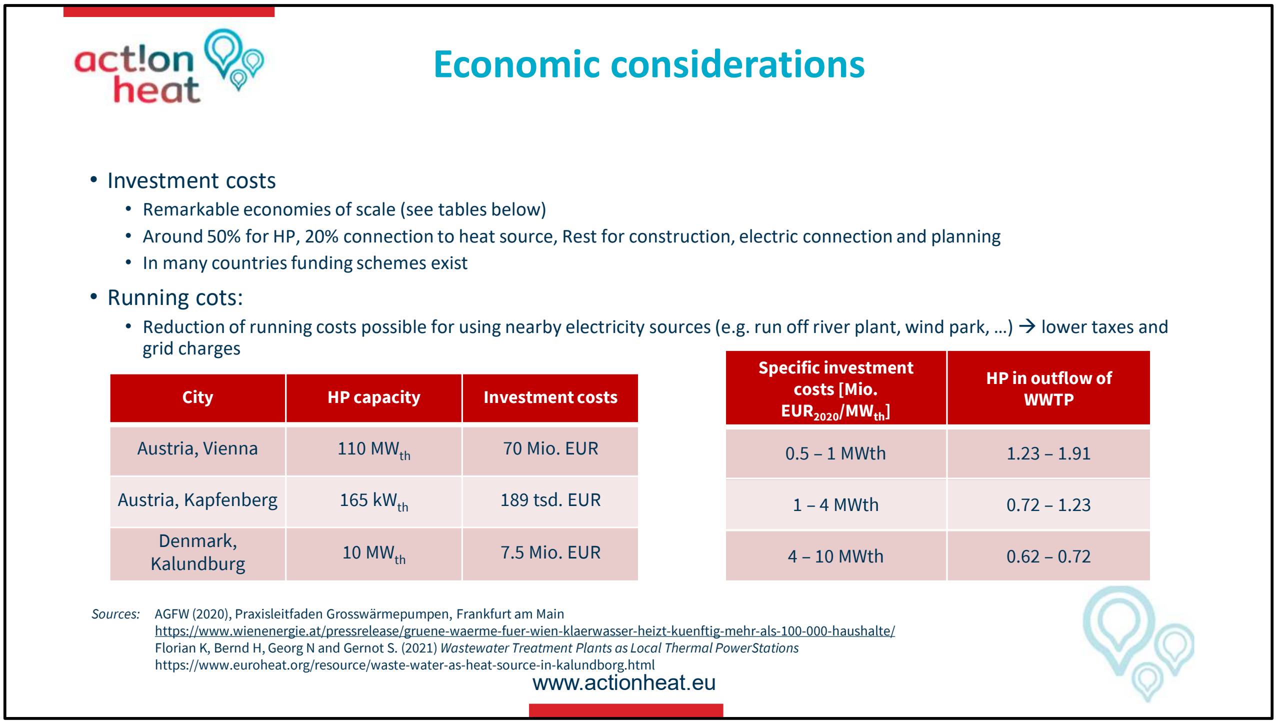


Local political regualtion

- From the sewer channel, there are specific operational requirements becaues it stays below the surfaces.

- From the Outflow, extraction restrictions exist because of the temperature introduced into the river.

The WWTP also needs to enter into negotiations in the outflow case becaues they usually have a legal regulation on this aspect.

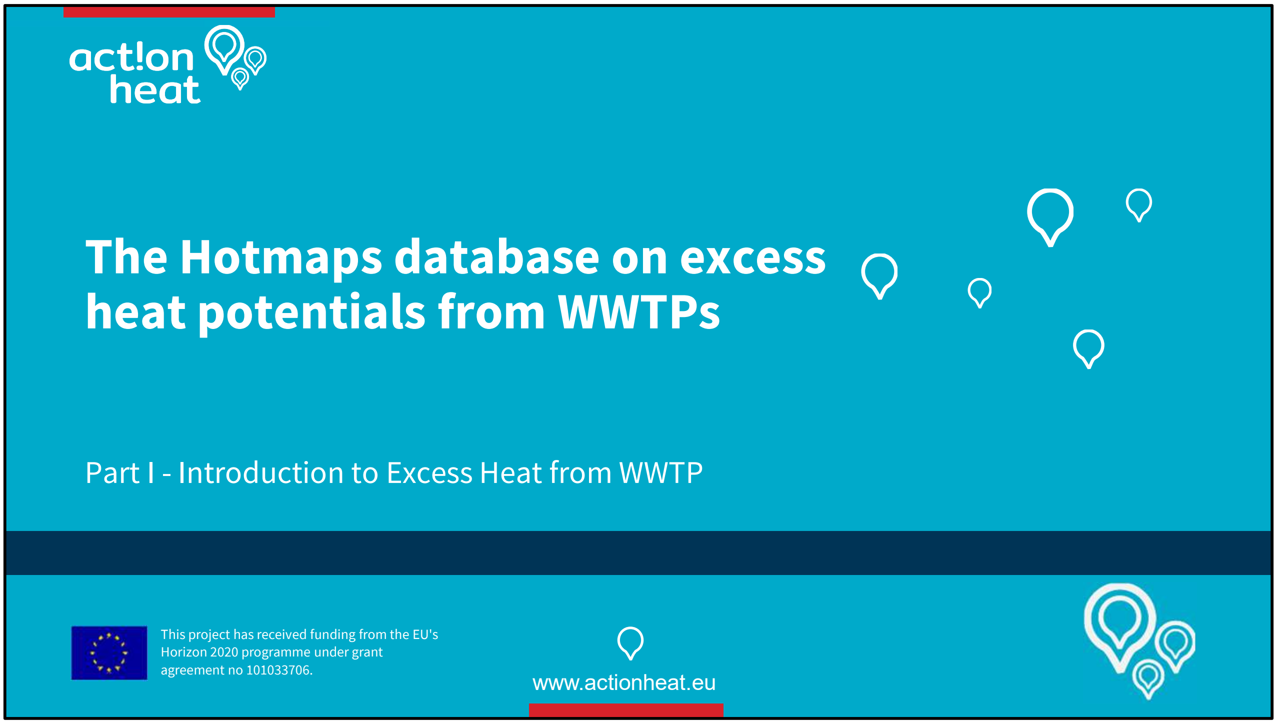


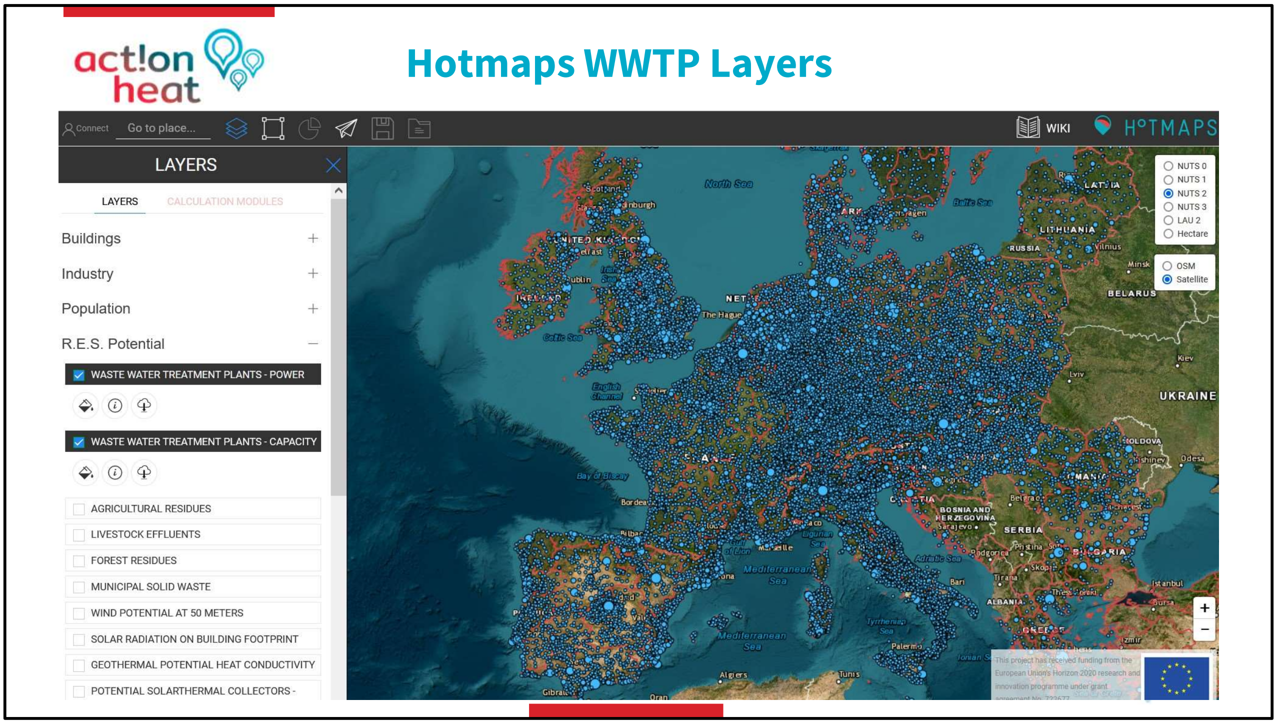
Guidelines for the Use of Heat Pumps in Germany

Using heat pumps to extract heat from the effluent or outflow of the WWTP is cost-effective if the supply distances are short.

In Norway, where plants are located far from the users, heat pumps are connected to the wastewater network.

There is also a reduction in costs if electricity is generated locally, avoiding grid charges.


act!on heat
The Hotmaps database on excess heat potentials from WWTPs
Part I - Introduction to Excess Heat from WWTP
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu

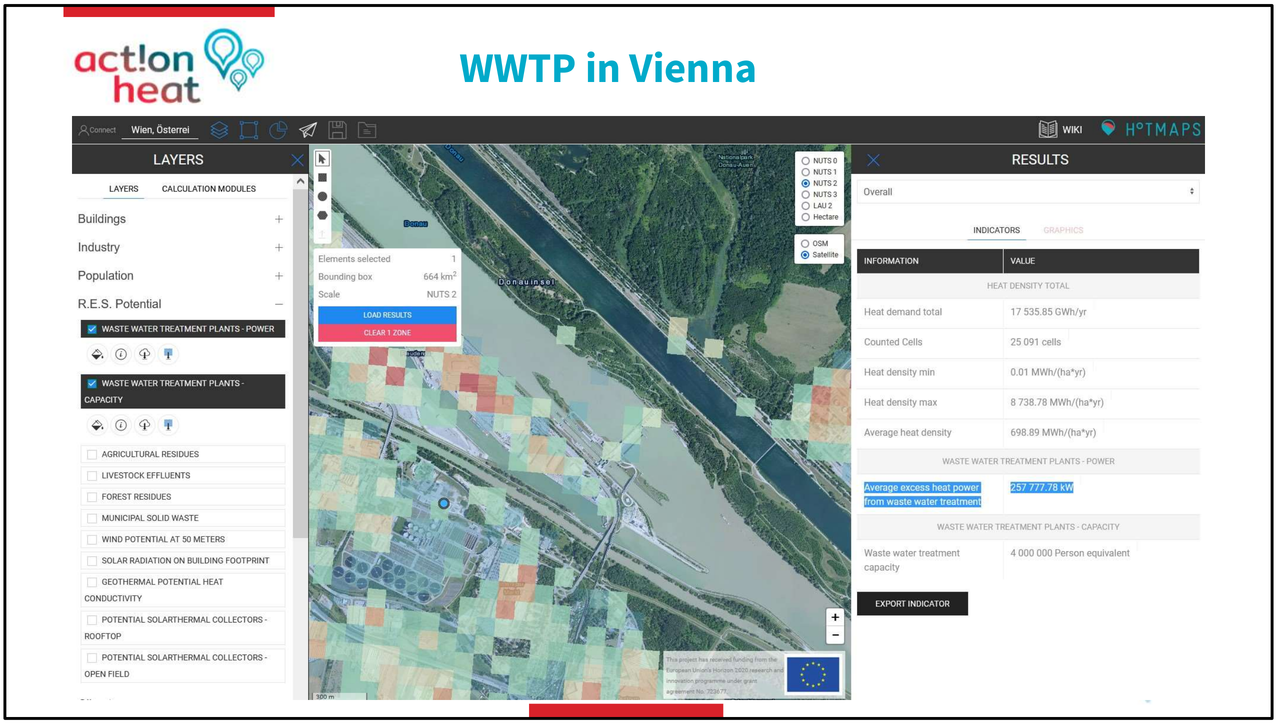


WWTP Layers option on Hotmaps.

Two layers exist for wastewater treatment plants WWTP:

- WASTE WATER TREATMENT PLANT - POWER
- WASTE WATER TREATMENT PLANT - CAPACITY

Which has an extensive data base for Europe.

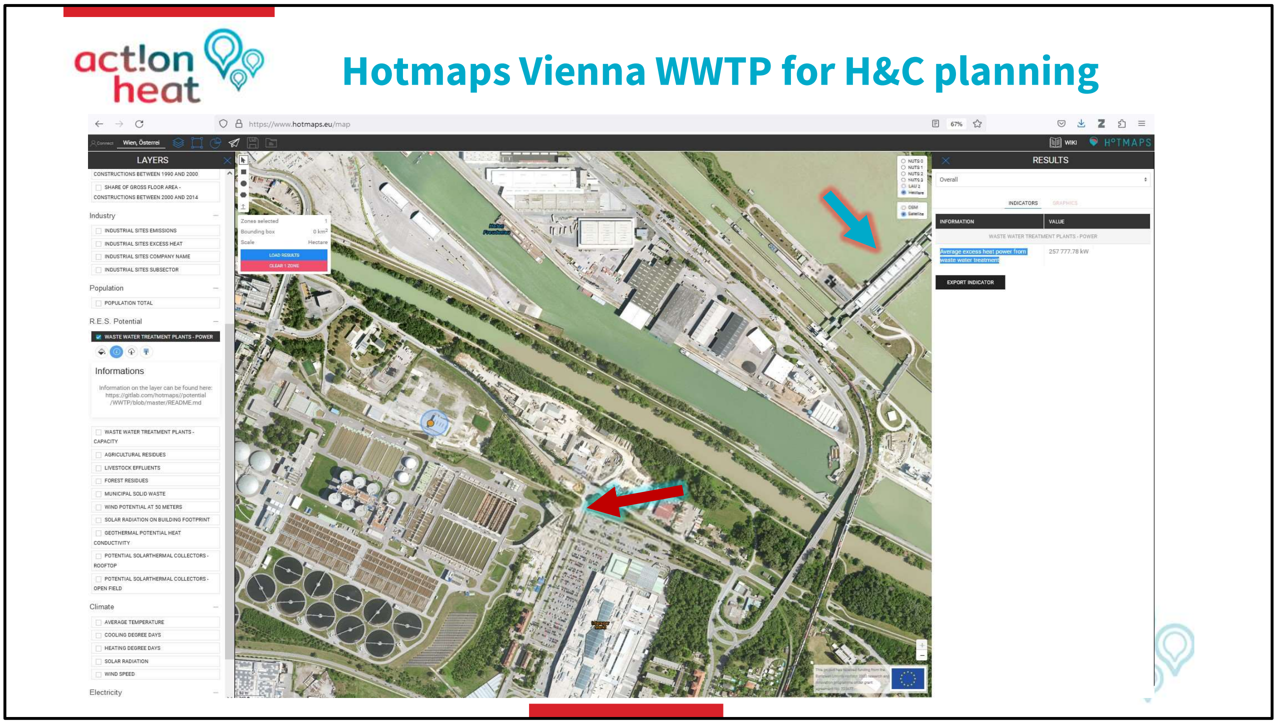


The WWTP for the city of Vienna

Capacity is given in person equivalents, which is typically the dimension of the plant.

The average excess heat power from the WWTP is determined by the amount of clean water flowing through the plant per person capacity and the temperature difference that can be utilized.

Note: The parameters are estimations. For more information, click on the pictograms of the layers to view the parameters assumed for the calculations.



Reuse for WWTP Excess heat for DH in Vienna

In red, the heat pumps will be connected near the outflow or effluent areas, not far from the Danube.

In blue is the hydroelectric power plant upstream of the Danube River, which will supply the electricity needed for the heat pumps to increase the water temperature for district heating (DH).

act!on heat

Discussion, Q&A

Part I - Introduction to Excess Heat from WWTP

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

www.actionheat.eu

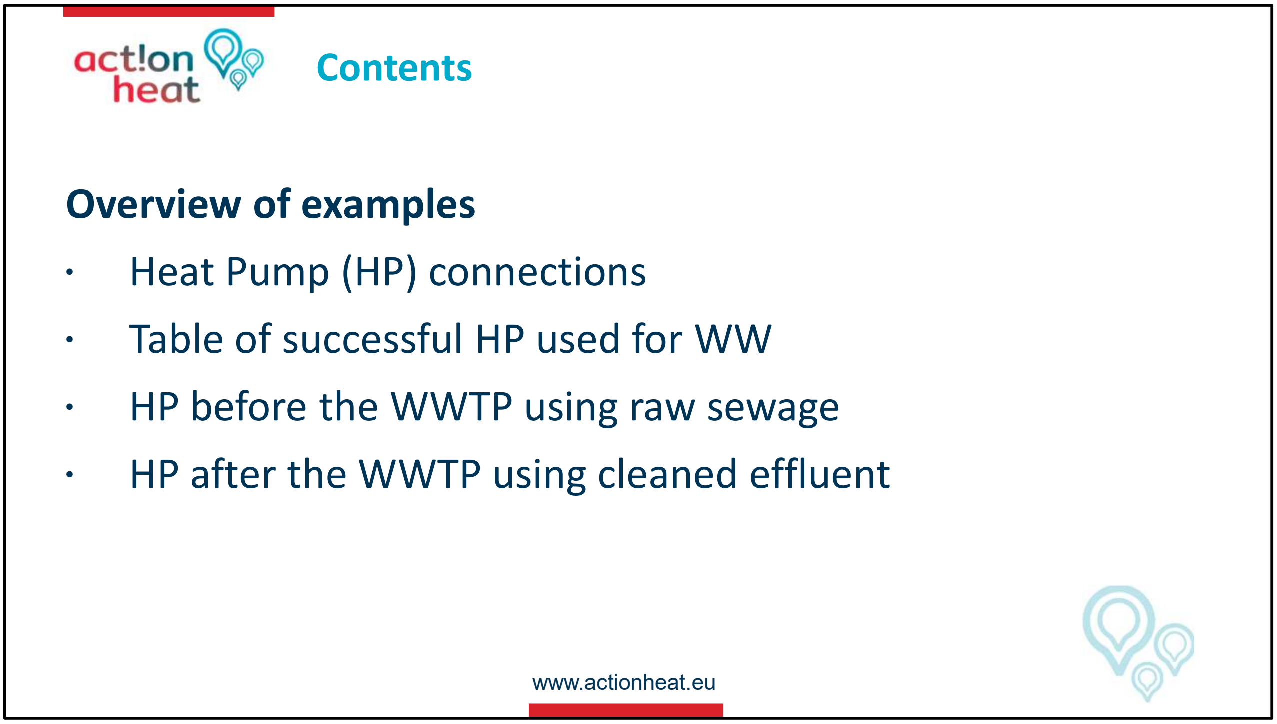
act!on heat

Successful use of excess heat from WWTP

Part II: Practice examples

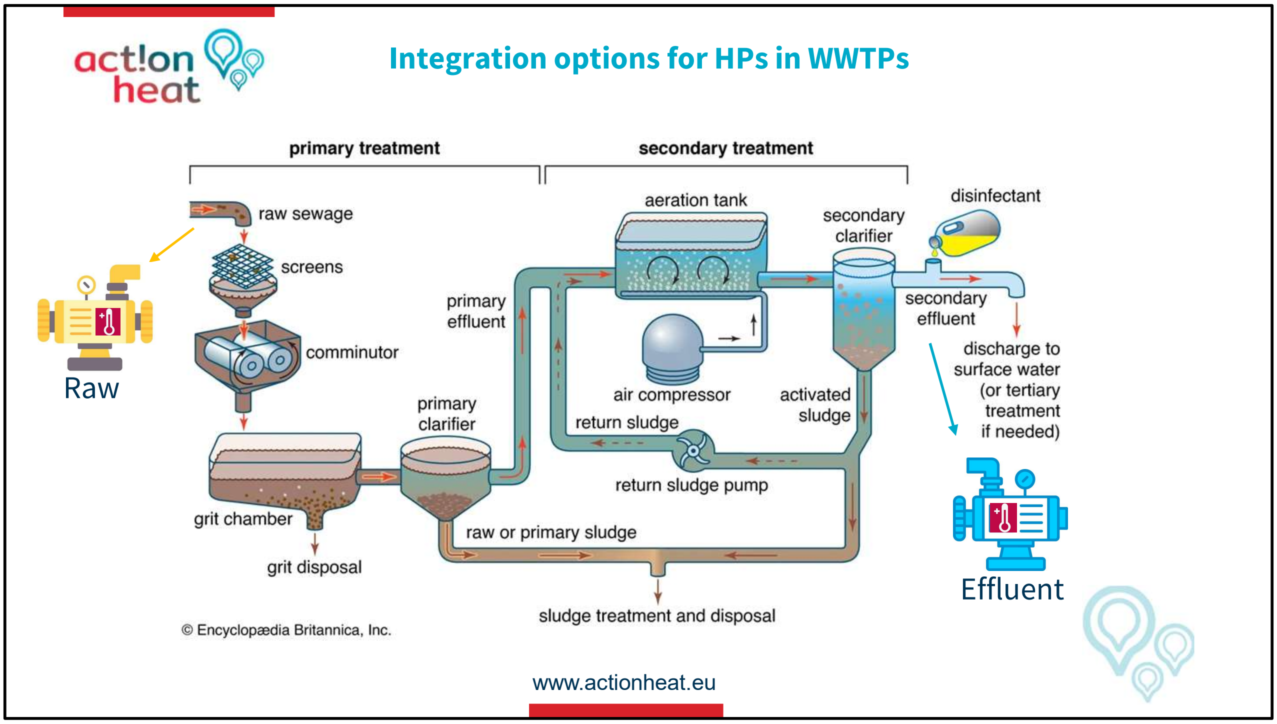
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.

www.actionheat.eu



The second part of the Webinar

During this part of the presentation, it was possible to see different European examples for the use of Excess Heat coming from WWTP connections in Row or Outflow.



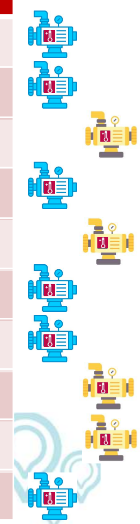
Connection places of Heat Pumps

The infographic shows the locations where heat pumps are typically connected to reuse excess heat from wastewater treatment plants.

Examples of the use of excess heat from WW

Sources: Lokietek T., *et al.* (2022) *Heat Recovery from a Wastewater Treatment Process—Case Study*

Year	Country / City	System Supplier	HP Capacity COP	HOTMAPS		Purpose	Arragement
				WWTP /PE Capacity	EH Power WWTP /MW		
1984 (2003)	Sweden, Lund	Lund Energi	1 x 13 MW + 2 x 40 MW, COP 3.3	97 006	6.25	Heating/HW 80 to 90 °C + Cooling, R-134a	8 to 16 °C Effluent
1986– 1991– 1997	Sweden Hammarby, Stockholm	Fortum Energi	5 HP total 131 MW, COP 3.0	1 197 006	77.14	Heating + Hot water (HW)	Effluent
1998 (2008)	Norwey Sandvika, Oslo	Friotherm AG	2 x 6.5 MW + 2 x 4.5 MW, COP 3.10	700 000	45.11	Heating 68 °C + Cooling, R 134a	10 °C Raw wastewater
2002	Poland Grudziadz	Unknow	2 HP Total 82.6 kW, COP 4.0	198 000	12.76	Heating + Hot water	Treated sewage
2005 (2008)	Norwey Sköyen Vest, Oslo	Hafslund Fjernvarme AS	28 MW, COP 2.8	300 000	19.33	Heating 90 °C R 134a	10 °C Raw wastewater
2006	Finland Katri Vala, Helsinki	Friotherm AG	3 x 30 MW + 2 x 30 MW, COP 3.5	--------	--------	Heating/HW 88 °C + Cooling, R 134a,	10 °C Effluent
2006	Finland Kakola, Turku	Friotherm AG	2 x 10 MW + 2 x 30 MW, COP 3.3	--------	--------	Heating/HW 78 °C + Cooling, R 134a	10 °C Effluent
2014	Hungry, Budapest Military Hospital,	Thermowatt Ltd.	3.8 + 3.9 MW COP 6-7	3 553 266	17.84	Heating/Cooling	Raw wastewater,
2018	Switzerland Dietikon (Zürich),	Huber, Tec. ThermWin	4.0 MW COP 5,5	3 664 933	236.18	Heating + HW 40 °C NH3	Raw wastewater,
2023 2027	Austria Wien	Johnson	3 x 20 MW 4 x 15 MW, COP 3.5	4 000 000	257.78	Heating/HW 90 °C + Cooling	13 to 17 °C Effluent



Heat pumps use for District Heating.

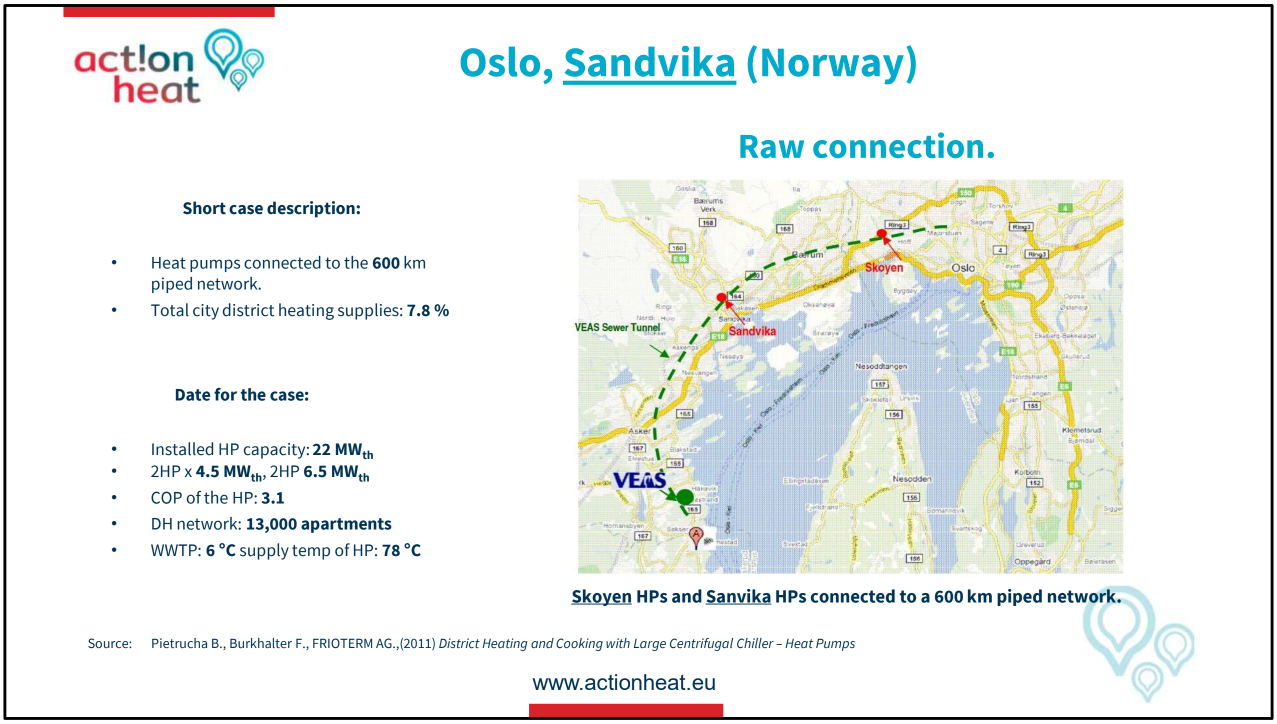
The table shows the year of installation for different heat pumps used to reuse excess heat from WWTPs.

The blue heat pumps represent connections to the effluent or outflow from the treatment plant.

The yellow heat pumps are connected to the wastewater after the treatment plant.

The first cases of heat pump installations for district heating using wastewater began in northern European countries. In recent years, central European countries have started to reuse this type of low-temperature excess heat.

The data from Hotmaps help with the heat pump comparison in the table, as they provide an estimation of the system size, which can be applied to the outgoing treated water cases.



Two different HP connections in Oslo

Two complexes of heat pumps are installed on the wastewater return line to reuse excess heat and supply heating and cooling water to different parts of Oslo.

Oslo, Skoyen (Norway)

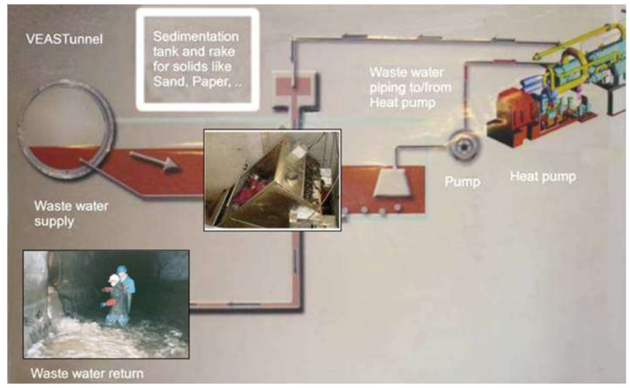
Short case description:

- **300m** inside the rockface under the residential area
- Pump force of **3,800 m3** of sewage per hour.

Data for the case:

- Installed HP capacity: **28 MW_{th}**
- 1HP **18 MW_{th}**, 1HP **10 MW_{th}**
- COP of the HP : **2.8**
- DH network: **13,000 apartments**
- WWTP: **6 °C** supply temp of HP: **90 °C**

Raw connection.



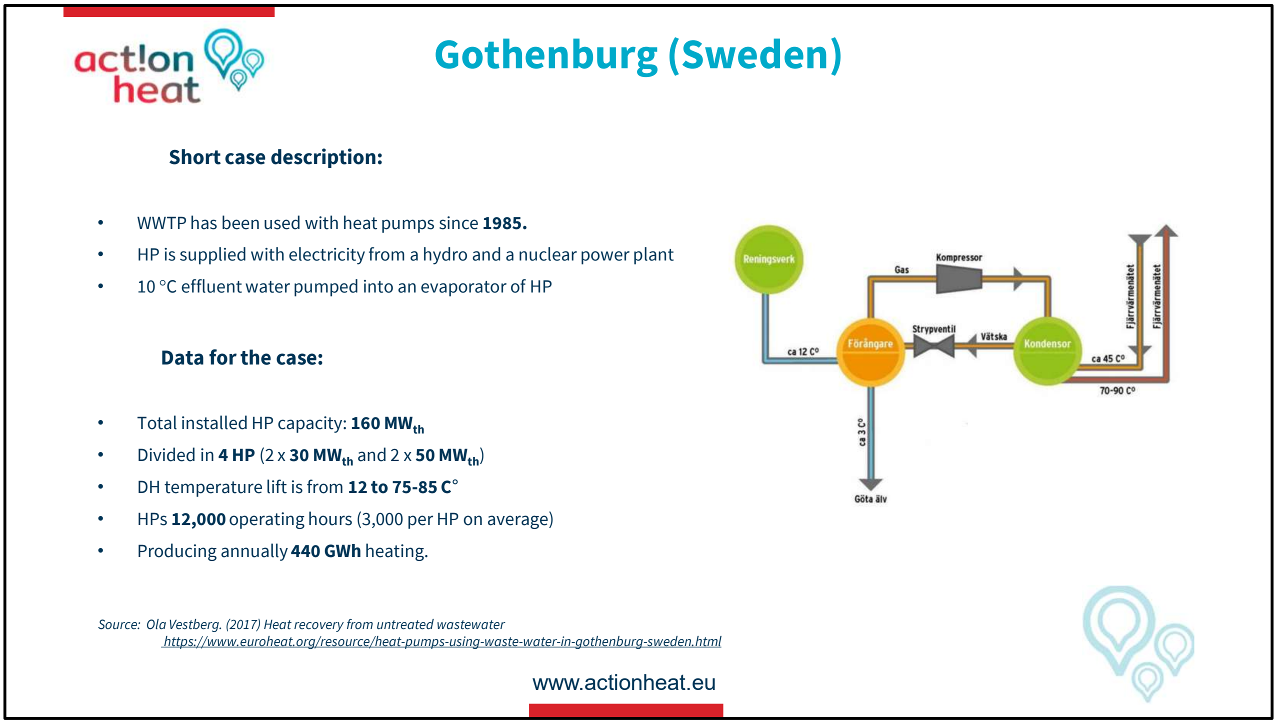
Raw wastewater pumping into the HP

Source: https://www.klimaoslo.no/2019/10/16/district-heating-from-sewage/
https://www.lsta.lt/files/events/21_bailer.pdf

www.actionheat.eu

The second connection to the return line

The connection from where it took the low temperature is almost 300 meters under the city, and from there are connected the pumps used to feed the surrounding area of Skoyen with cool and hot water.



Example of the Effluent connection

Gothenburg, Sweden, is home to one of the oldest and largest connections from a wastewater treatment plant to a district heating system in Europe.

It is the oldest in terms of construction time and the largest in terms of heat pump capacity.

act!on heat

Hammarvyverket (Sweden)

Short case description:

- Hammarbyverket is the world's largest heat pump plant that extracts district heating and cooling from purified wastewater.

Data for the case:

- WWTP: Treated from Henriksdals
- Total installed **7HP** capacity: **225 MW_{th}**
- HP: R234a and R22 as regrigerant
- DH temperature lift from **10-19 to 60-90 C°**
- DH temp. season decrease **0.5 to 11 °C**
- Producing annually **900 GWh** heating.

Source: Ola Vestberg. (2017) *Heat recovery from untreated wastewater*
https://heatpumpingtechnologies.org/annex47/wp-content/uploads/sites/54/2018/12/annex-47hammarbyverket.pdf

www.actionheat.eu

Biggest connection from WWTP

Hammarbyverket in Sweden has the largest system connection from a WWTP in Europe.

Seven heat pumps are fed by the treated water.

The treated water is stored in two large cylinders.

A system of pipes inside the cylinders extracts the low temperature from the water.

The low-temperature water is then fed into the heat pumps.

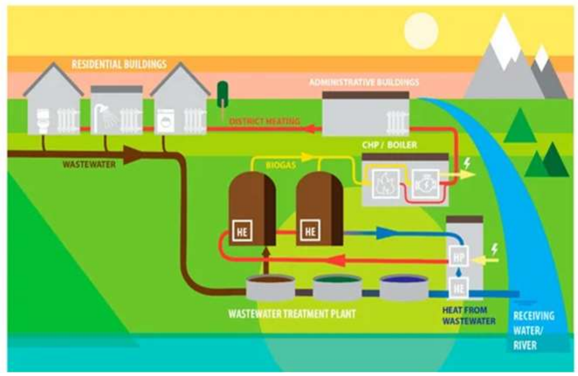
The pumps increase the temperature of the water.

Hot or cold water is then pumped into the district heating network.

Kapfenberg (Austria)

Short case description:

- Anaerobic digestion using the sewage sludge to produce biogas
- Biogas is converted into electricity and heat and provided to the DH network
- A HP uses the excess heat of the WWTP outflow to supply heat for the anaerobic digestion as well as for the office buildings at the WWTP site



Data for the case:

- Installed **CHP** power of **124 kW$_{el}$** and **165 kW$_{th}$**
- Thermal output of the **HP 200 kW$_{th}$**
- WWTP treatment capacity of **49,000** population equivalents
- Investment costs: **189 tsd. EUR**

Source: Florian K, Bernd H, Georg N and Gernot S. (2021) *Wastewater Treatment Plants as Local Thermal PowerStations*

www.actionheat.eu

Not connected to district heating

The biogas from the sludge is used to produce electricity and preheat the water through gas boilers.

In contrast to other cases, the heat is reused for heating office buildings but is not introduced into the district heating network.

Kalundborg (Demark)

Short case description:

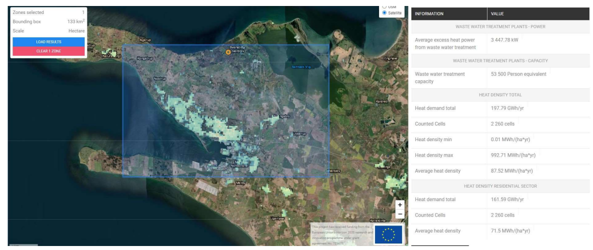
- Organic content used for biogas production
- Higher temperatures to accelerate biological processes
- Heat pump (HP) to supply district heating (DH)

Data for the case:

- Installed HP capacity: **10 MWth**
- DH network: **5010 consumers**
- WWTP temperature between **20-25 °C**
- **COP** of the HP is between **3.6 and 4**
- HP worked **8000 hours** in the first 2 years
- Investment costs: **7.5 Mio EUR**

General data from Hotmaps:

- Heat demand in the city: around **190 GWh/yr**
- Average excess heat power from WWTP: **3.5 MW**



Source: https://www.euroheat.org/resource/waste-water-as-heat-source-in-kalundborg.html

www.actionheat.eu

Comparative data from Hotmaps

On the left side are data coming from Hotmaps showing the heat demand in the city and the estimation of the excess heat power generated from the wastewater treatment plant.

Note: The data for Hotmaps represent the energy for the water that can be used for the Outflow or Effluent

Hamburg, Köhlbrand (Germany)

Short case description:

- Heat pump to be installed at the outflow of the WWTP
- Replacement of the coal-fired thermal power plant

Data for the case:

- Installed storages: **60 MW_{th} in 2025**
- Four Heat Pumps: **15 MW_{th}**
- **450,000 m^3**/day of wastewater treated in the plant
- HP expected to supply **39,000** residential units with heat

Visualisation: Hamburg plans to build a 60-MW heat pump at the Dradenau wastewater treatment plant. Image by Hamburg Wasser.

Source: https://renewablesnow.com/news/hamburg-to-power-district-heating-with-60-mw-wastewater-heat-pump-799005/
https://www.aquapublica.eu/article/members-activities/hamburg-wasser-launches-concept-recover-energy-waste-water

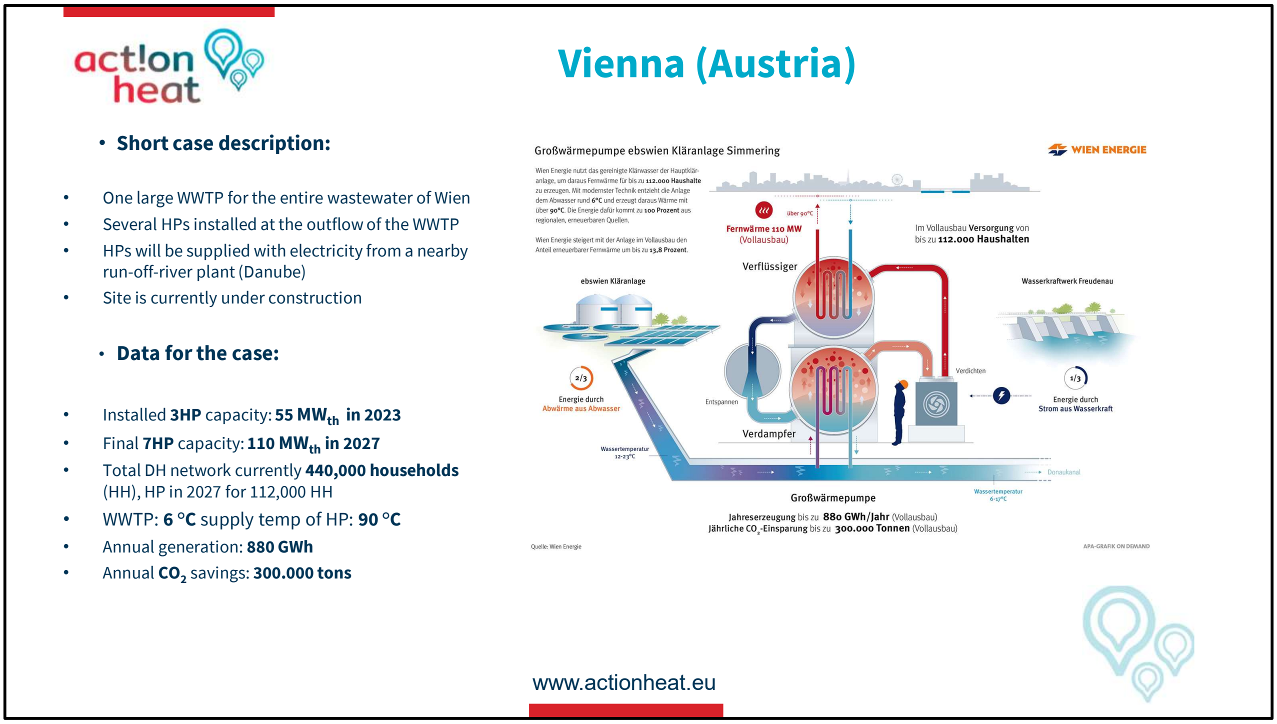
www.actionheat.eu

Decision According to Planning

Hamburg, Germany, planned to construct a larger system for Köhlbrand with a capacity of almost 100 MW to reuse excess heat from the WWTP for the city.

However, based on the results of case studies, it was decided to install a 60 MW heat pump system instead.

Therefore, it is essential to understand the needs and conditions of the municipality at the start of project planning. Nevertheless, sometimes it may be necessary to adapt the project to gain approval from local authorities.



Vienna has different construction phases

The final project will have a capacity of 110 MW to supply the district heating network in Vienna.

During the first phase, three heat pumps were installed, which began operating in the winter of 2023.

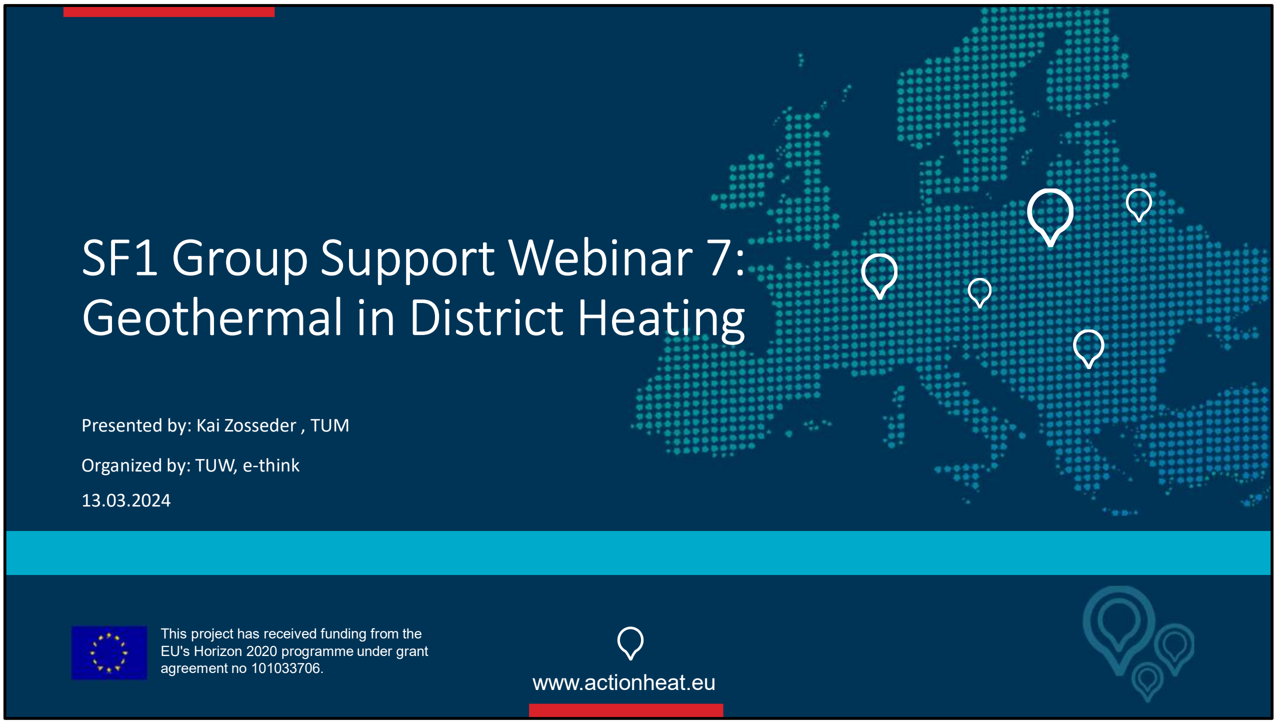
In the second phase, another four pumps will be installed, with the goal of fully feeding the network with 110 MW by the end of 2027.

Discussion, Q&A

Part II: Best practice examples

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

www.actionheat.eu

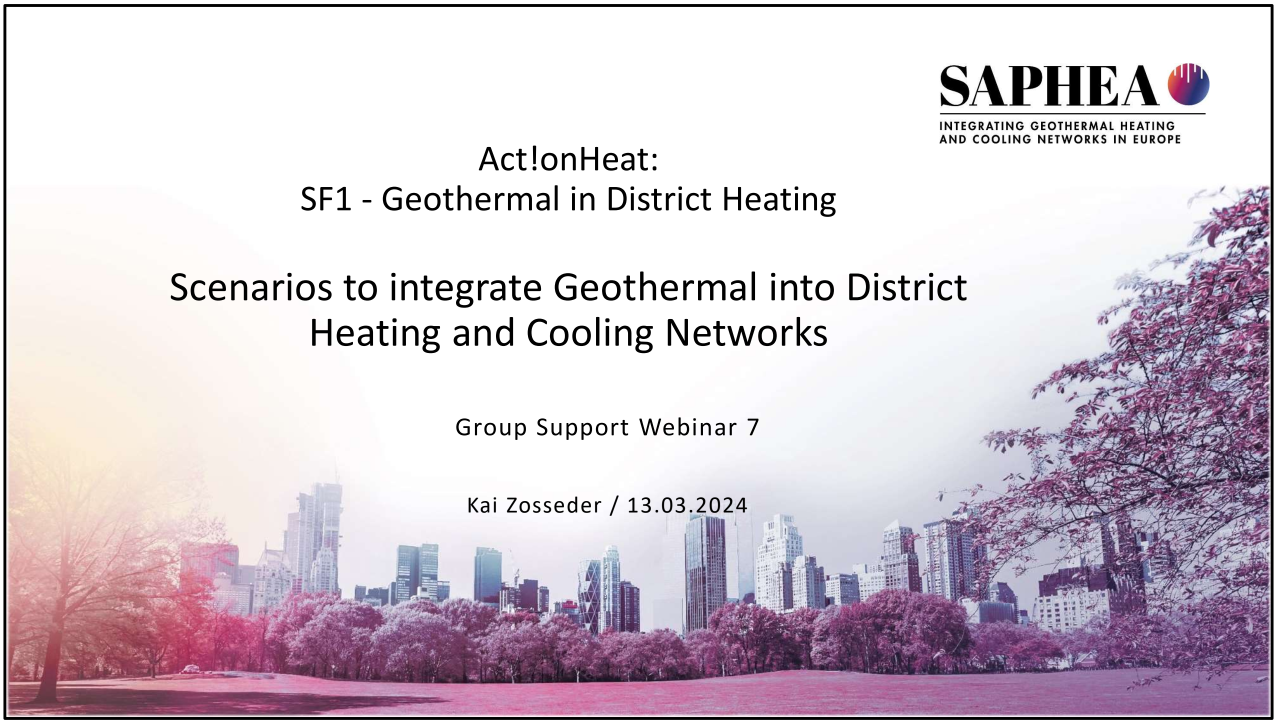


Webinar 7:
Geothermal in District Heating

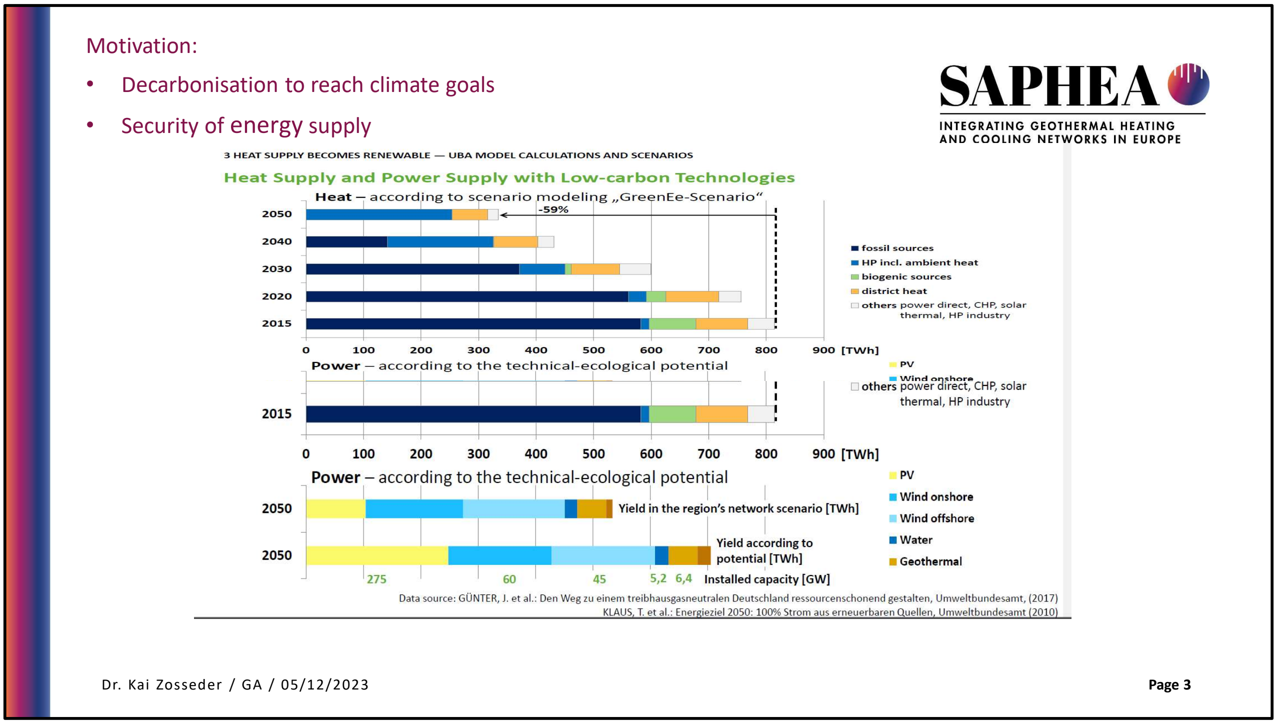
Act!onHeat SF1

- Serial 3:
    - Webinar 7
        - Strategical Heating & Cooling planning
        - Group support for municipalities and stakeholders

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

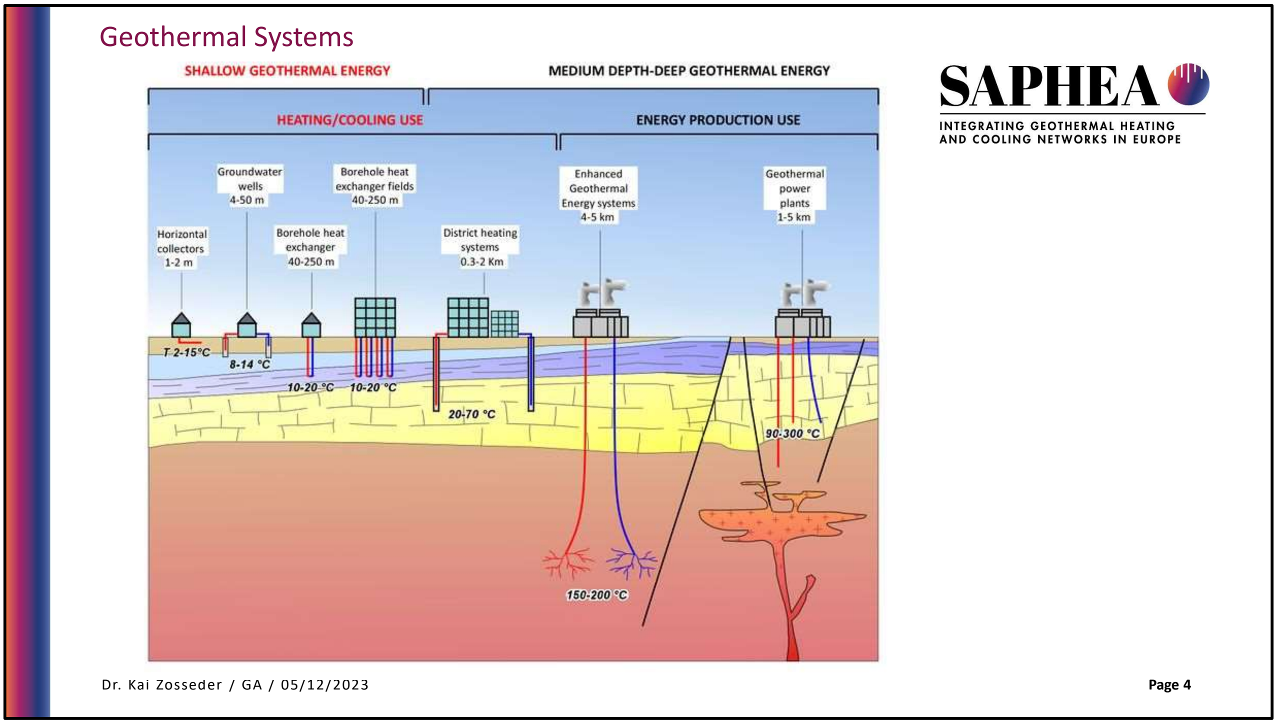


- The presentation provides an overview of the Scenarios to integrate Geothermal into District Heating and Cooling Networks.
- The work was carried out within the SAPHEA project and presented by Dr. Kai Zosseder.

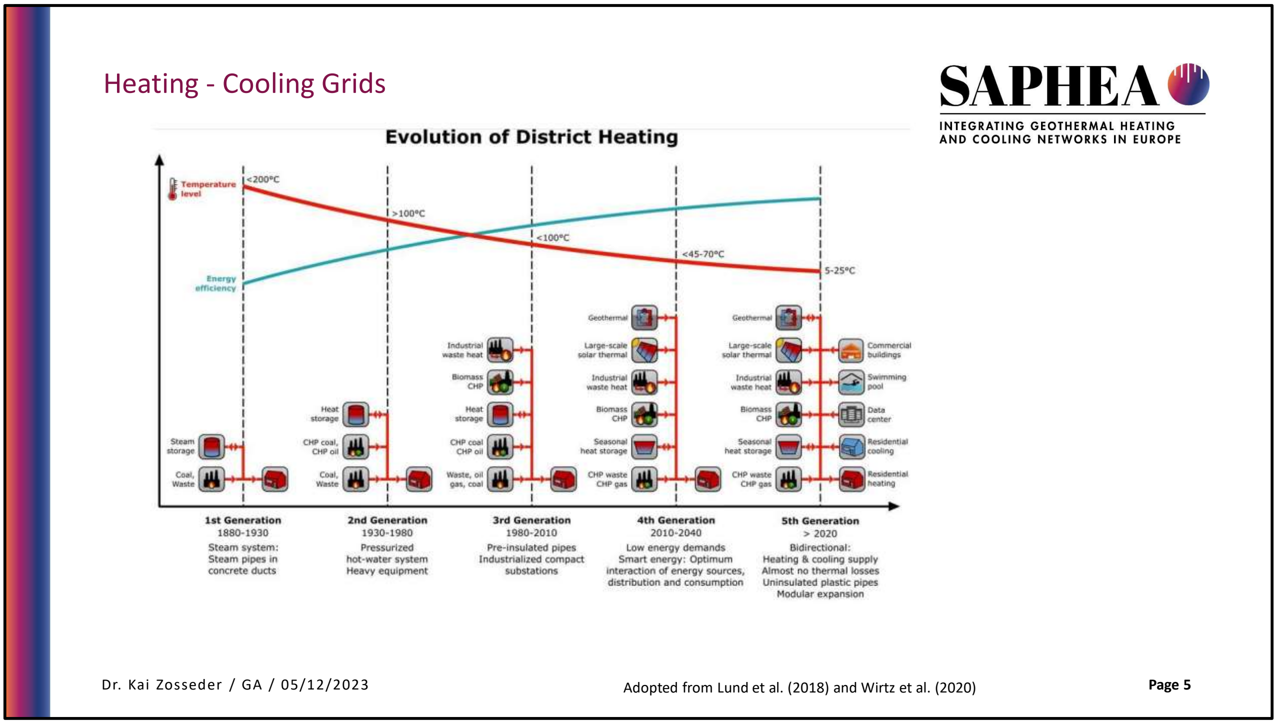


The motivations for using geothermal in district heating are:

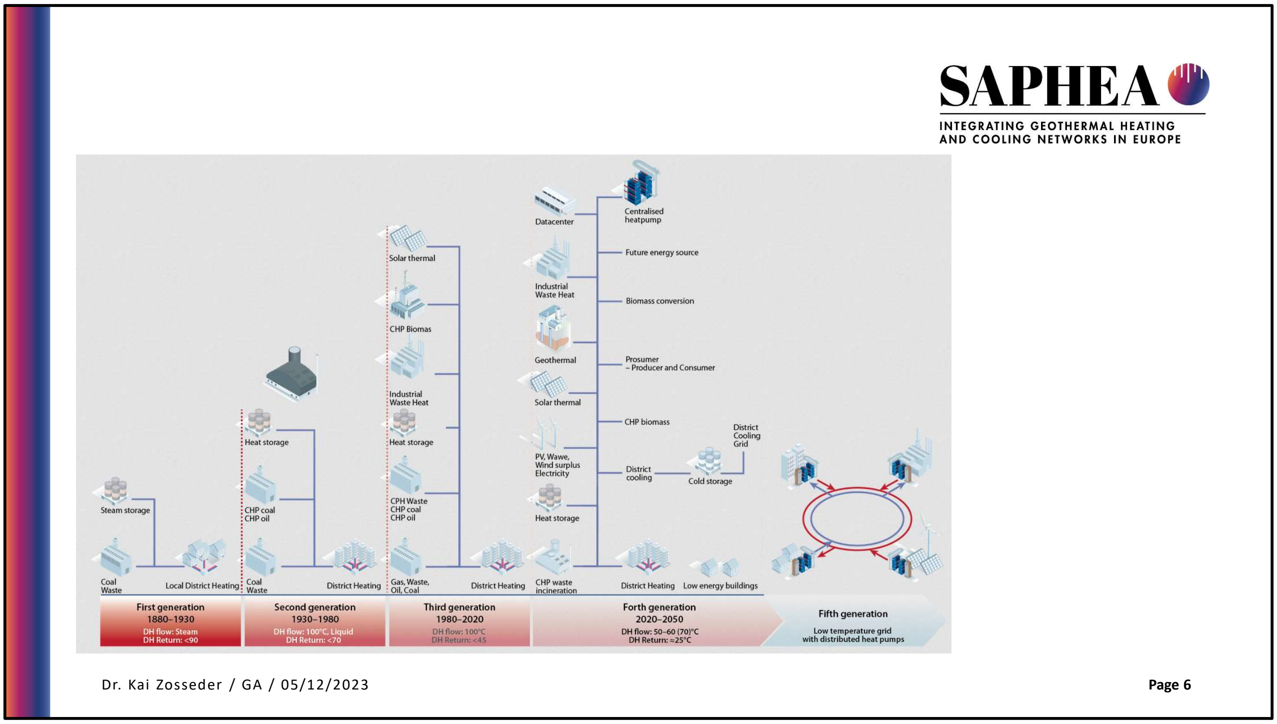
- Achieving decarbonization targets
- Security of supply
- Ambient heat could contribute to a major portion of the supply shares in the future



- Overview of geothermal systems, including shallow and deep geothermal sources.
- Emphasis on geothermal energy as a stable, low-emission heat source.
- Details on technical aspects such as:
  - Depth of wells.
  - Heat extraction methods.
  - Suitable temperature ranges for different applications in district heating and cooling.



- Focus on heating and cooling grids and their integration with geothermal systems.
- Highlights the role of geothermal energy in creating efficient and flexible heating and cooling grids, facilitating energy transfer between sources and users.
- Emphasizes how newer generations, including 4th and 5th, enhance energy efficiency and integrate renewable sources like geothermal energy more effectively.



- This slide contains visual content without specific text or detailed information.
- Likely serves as a transition or visual representation of geothermal systems or district heating concepts.
- Could be used to emphasize the shift towards geothermal energy in heating and cooling networks.

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

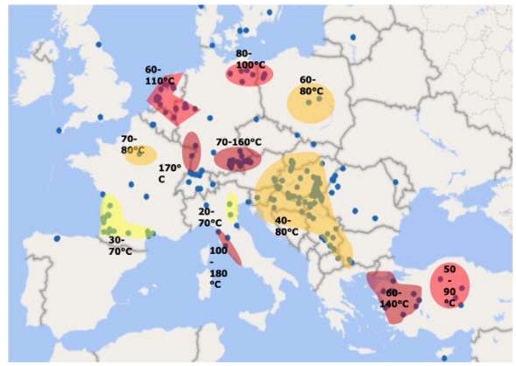
„Geothermal“ Networks distributed in Europe

Table 1: Statistical KPIs of direct geothermal energy used in heating networks in Europe as for 2019 based on the EGEC Geothermal Market report 2020 (data source: European Geothermal Energy Council).

KPI	Sample Size	P50	P75
Installed capacity (MW)	341	7	14
Temperature of production well (°C)	179	72	80
Capacity factor (gross heat / installed capacity (kh/yr)	234	2,59	3,98

Source: Goetzl et al., 2022

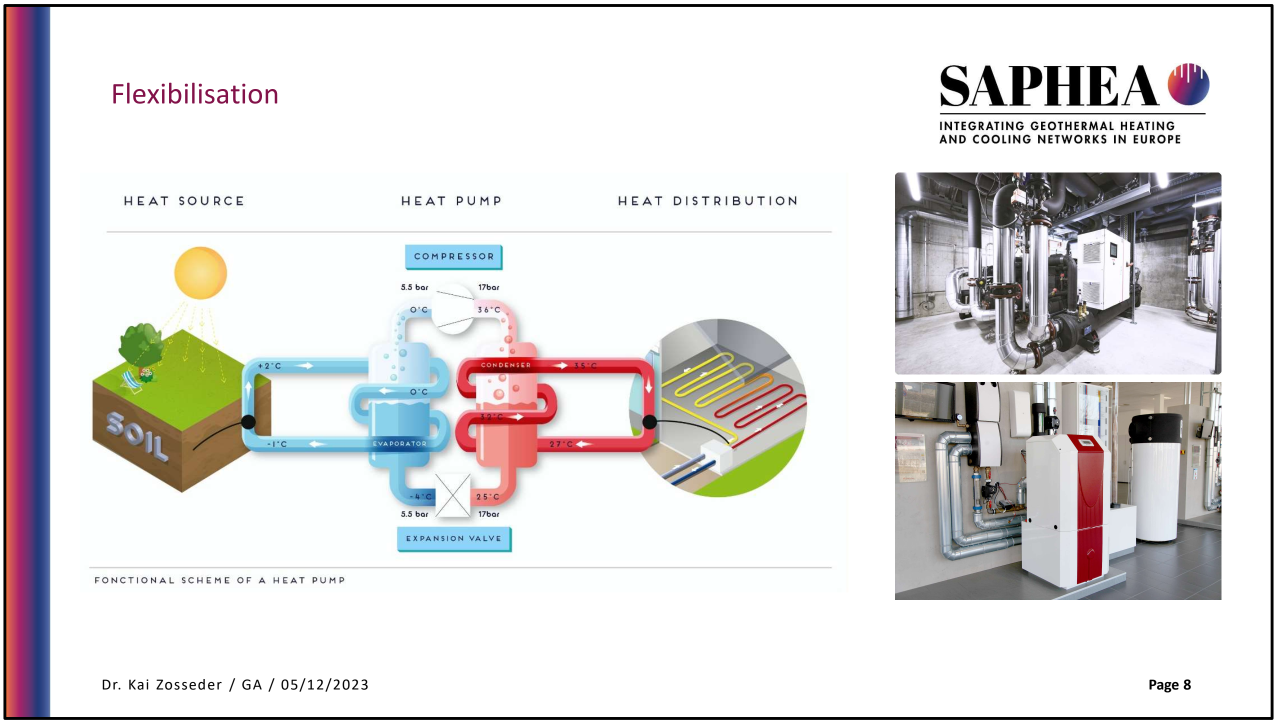
- **364 direct use geothermal DH networks** in Europe ~ **5.6 GW capacity**
- **Approx. >100 5G networks** in Europe linked to geothermal technologies



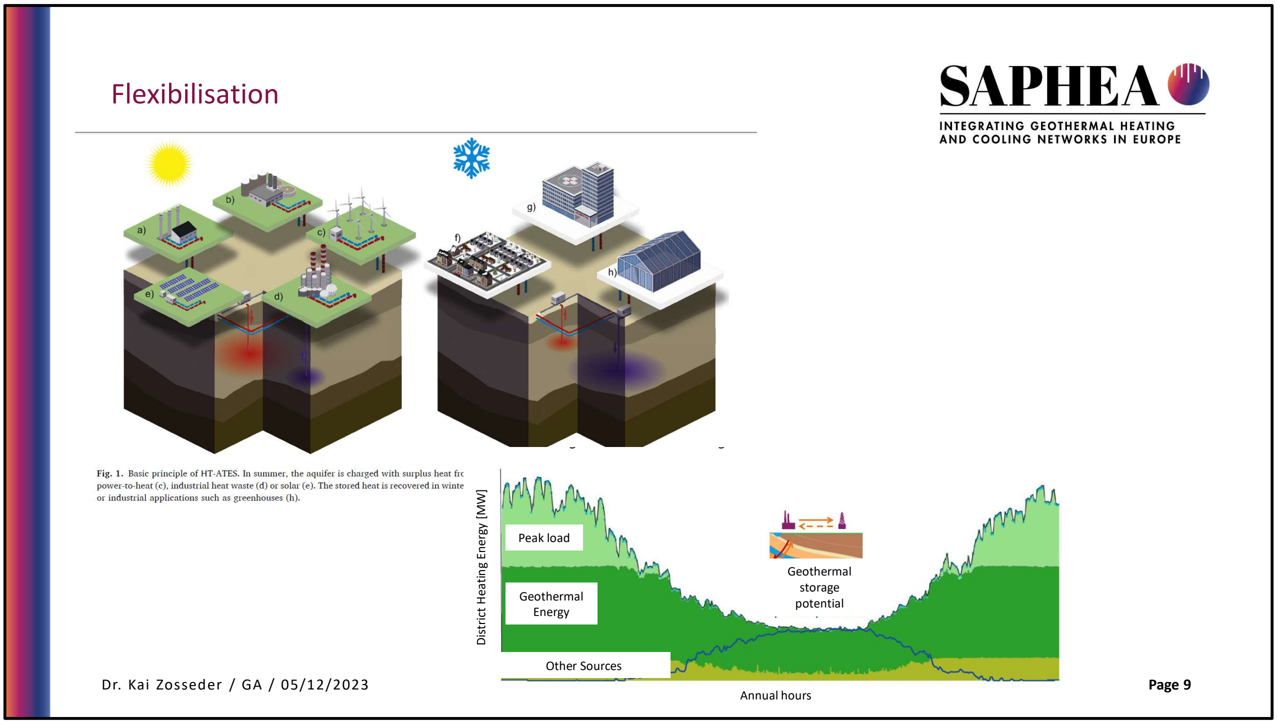
Source: EGEC Geothermal Market Report 2021

Dr. Kai Zosseder / GA / 05/12/2023 Page 7

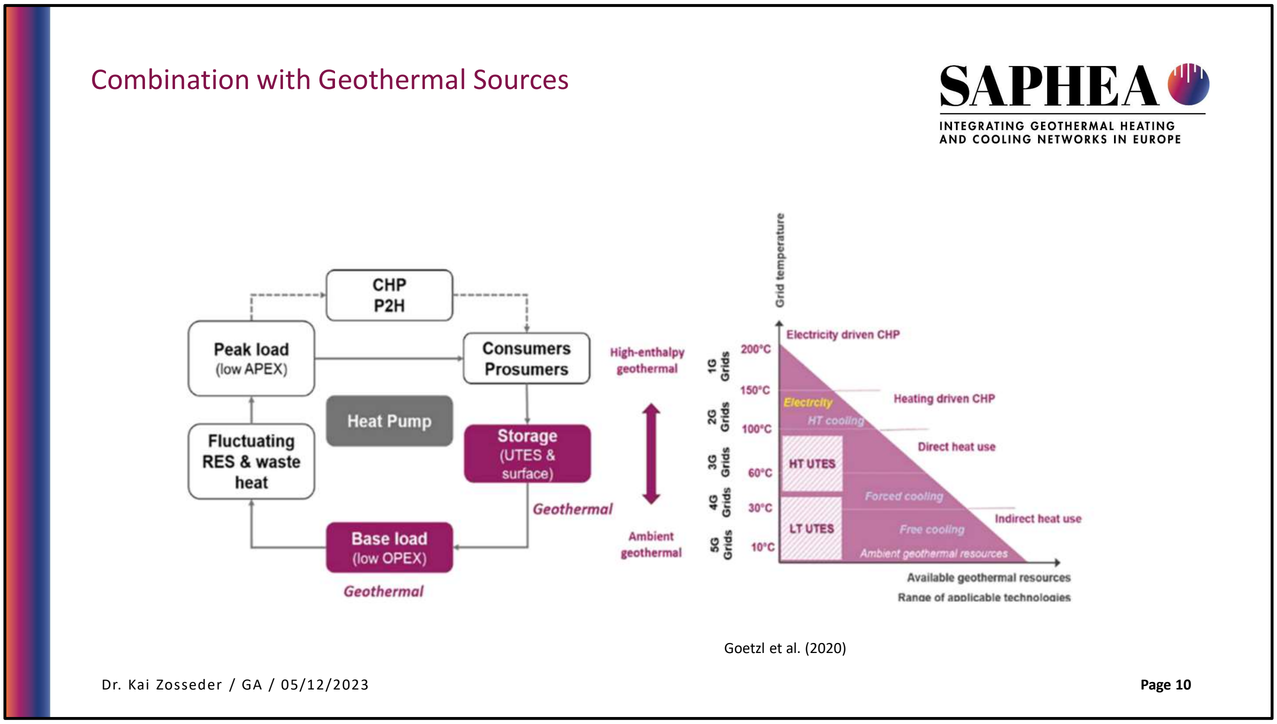
- Overview of 364 geothermal district heating networks in Europe, providing around 5.6 GW capacity, with over 100 emerging 5th generation (5G) networks.
- 5G networks support flexible energy systems and better integration with renewables like solar and wind.
- Expanding geothermal can reduce fossil fuel dependency, support EU climate goals, and improve energy resilience year-round.



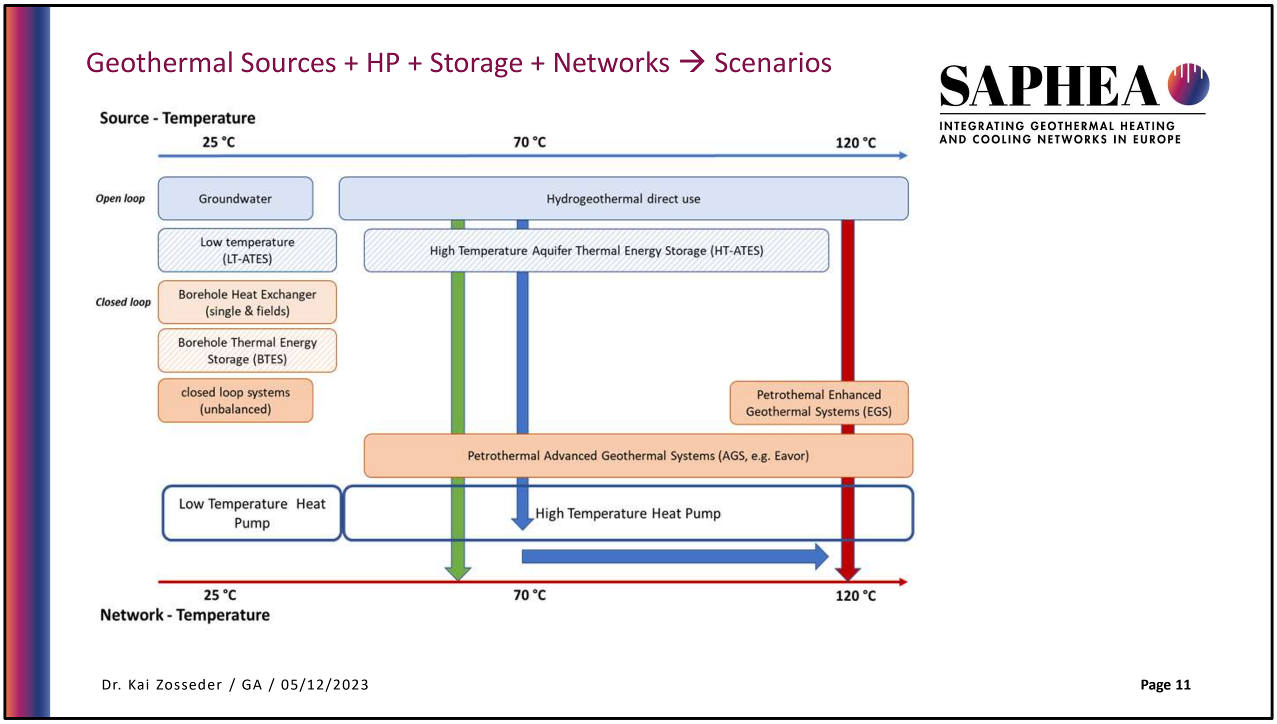
- Focus on the concept of “flexibilization" in district heating, emphasizing the role of geothermal energy in balancing supply and demand.
- Highlights how geothermal can be used alongside other energy sources to manage peak loads and optimize system efficiency.
- Flexibilization is crucial for adapting to varying energy demands and integrating renewable sources, ensuring a stable energy supply throughout the year.



- Discusses the potential of geothermal energy storage to enhance system flexibility in district heating.
- Illustrates how geothermal can handle peak loads by storing excess heat and using it when demand is high.
- Emphasizes the integration of geothermal with other renewable sources to maintain a consistent energy supply, optimizing district heating efficiency throughout different seasons.



- Explores the combination of geothermal energy with other heat sources to enhance district heating systems.
- Highlights the potential benefits of hybrid systems that integrate geothermal with technologies like heat pumps and thermal storage.
- Such combinations allow for greater adaptability and improved efficiency in meeting varying heating demands.



- Presents scenarios combining geothermal energy with heat pumps, storage solutions, and district heating networks.
- Emphasizes the need for strategic planning to optimize the mix of technologies for different regional contexts.
- Highlights the potential of these combinations to enhance the flexibility and sustainability of district heating systems.

Scenarios for Integrating Geothermal into DHC-Networks

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

- **Basic Scenarios:** Basic scenarios are simpler in design and are already commonly used throughout Europe or in single countries.
- **Complex Scenarios:** Complex scenarios consist of a combination of different technologies such as storage scenarios or scenarios using a HTHP, and are already installed in some places.
- **Future Developments:** Future scenarios are based on technology that is not yet market-ready. These are especially scenarios using enhanced or advanced geothermal systems (EGS, AGS) or uncommon combinations.

Dr. Kai Zosseder / GA / 05/12/2023 Page 12

- **Basic Scenarios**: These are simpler, commonly used configurations across Europe, involving standard geothermal integration.
- **Complex Scenarios**: These involve a combination of technologies such as heat pumps, storage systems, and high-temperature heat pumps (HTHP), already in use in some areas.
- **Future Scenarios**: Based on advanced geothermal systems (EGS/AGS) and emerging technologies that are not yet market-ready but hold potential for broader adoption in the future.

Basic Scenarios

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

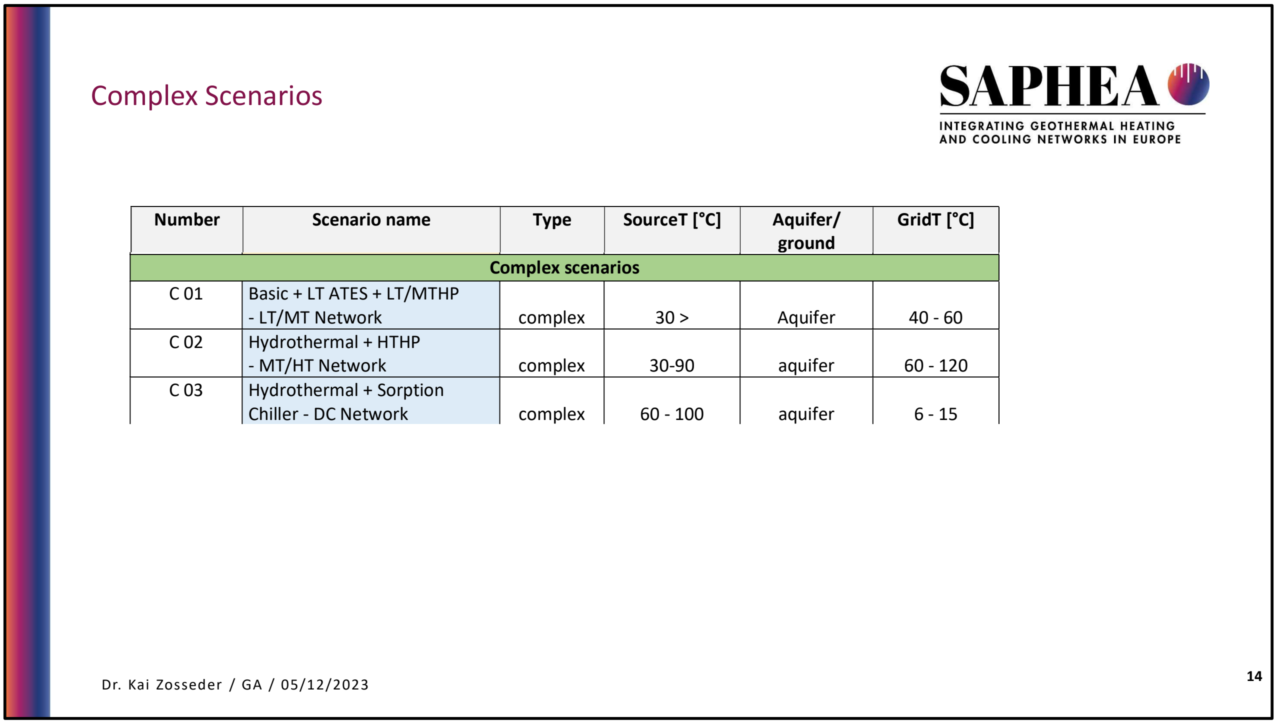
Number	Scenario name	Type	SourceT [°C]	Aquifer/ ground	GridT [°C]
Basic scenarios					
B 01	Shallow geothermal & Free cooling - DC Network	basic	5-25	aquifer/ground	0-15
B 02	Groundwater + decentral LTHP - LT Network	basic	10	aquifer	10-25
B 03	Hydrothermal Direct Use - HT Network	basic	90 <<	aquifer	80 - 120
B 04	Hydrothermal Direct Use - MT Network	basic	40 - 90	aquifer	40 - 60
B 05	Groundwater + central HP - MT/HT Network	basic	10 - 30	aquifer	25- 90
B 06	BHE + central HTHP/BTES - MT/HT Network	basic	-4 - 30	ground	25 - 90
B 07	BHE + decentralized LTHP - LT Network	basic	-4 - 25	ground	10

Dr. Kai Zosseder / GA / 05/12/2023

13

- **Basic Scenarios**: These are straightforward, simpler designs already implemented across Europe, focusing primarily on integrating shallow or direct-use geothermal technologies into existing district heating and cooling (DHC) networks.
- **Examples of Basic Scenarios**:
  - Shallow geothermal systems combined with district cooling networks.
  - Direct-use hydrothermal wells extracting groundwater for medium- to high-temperature district heating applications.

Basic scenarios typically involve mature technologies, such as low-temperature heat pumps or direct geothermal use, which offer more accessible entry points for integrating geothermal energy into local networks. These systems often have lower investment costs and can serve as a foundation for future expansion or hybridization with more complex technologies.



Number	Scenario name	Type	SourceT [°C]	Aquifer/ ground	GridT [°C]
Complex scenarios					
C 01	Basic + LT ATES + LT/MTHP - LT/MT Network	complex	30 >	Aquifer	40 - 60
C 02	Hydrothermal + HTHP - MT/HT Network	complex	30-90	aquifer	60 - 120
C 03	Hydrothermal + Sorption Chiller - DC Network	complex	60 - 100	aquifer	6 - 15

- **Overview**: Combines geothermal with technologies like high-temperature heat pumps (HTHPs) and storage systems.
- **Key Points**:
  - Uses geothermal alongside other energy sources for greater efficiency.
  - Already installed in some European regions, improving heat supply flexibility.

Future Scenarios

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

Number	Scenario name	Type	SourceT [°C]	Aquifer/ ground	GridT [°C]
Future scenarios					
F 01	Basic + HT-ATES – MT/HT Network	future	90 >>	aquifer	90
F 02	Advanced Geothermal Systems (AGS)	future	90 >>	ground	90
F 03	Enhanced geothermal system (EGS)	future	90 - 120	ground	90
F04	Deep BHE + HTHP – MT/HT Network	future	20 – 50	ground	90

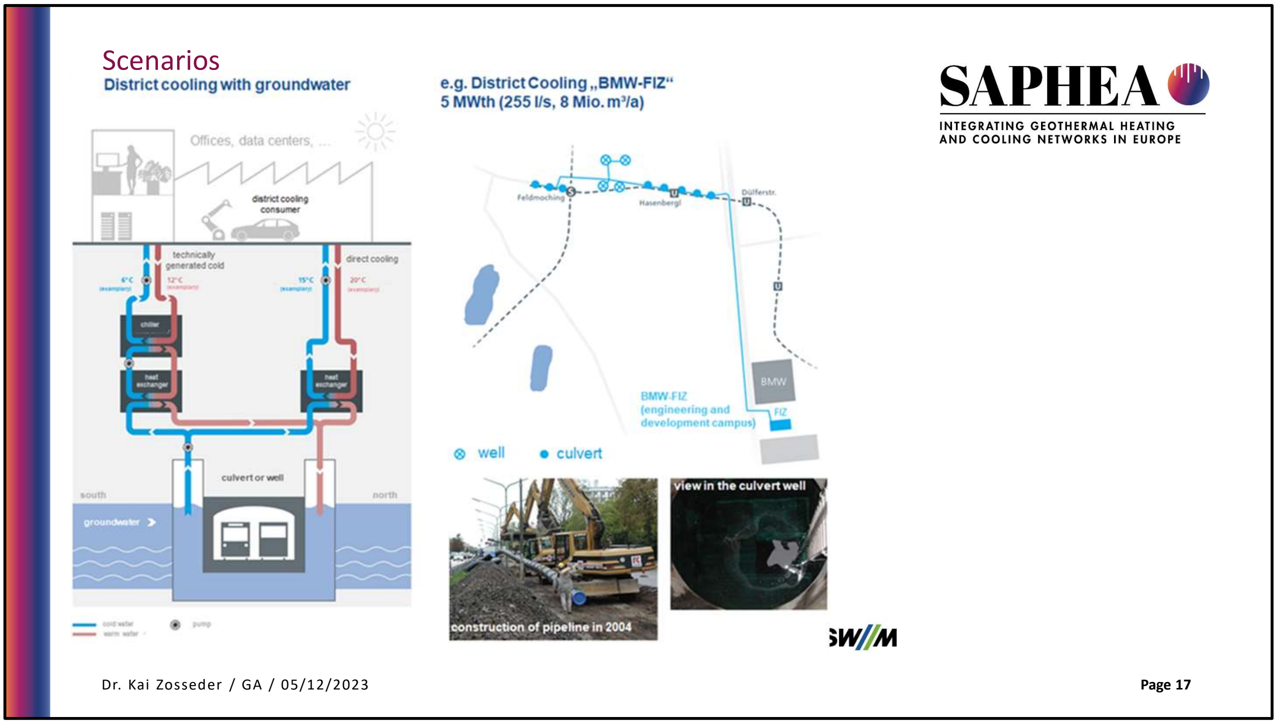
Dr. Kai Zosseder / GA / 05/12/2023

15

- Focuses on future developments in geothermal integration, especially advanced and enhanced geothermal systems (AGS and EGS).
- **AGS and EGS**: These technologies involve closed-loop systems or enhanced geothermal wells, which are still in development and not widely commercialized.
- Potential for these systems to provide more flexible and scalable geothermal energy, making them applicable in a wider range of geographic and economic contexts.

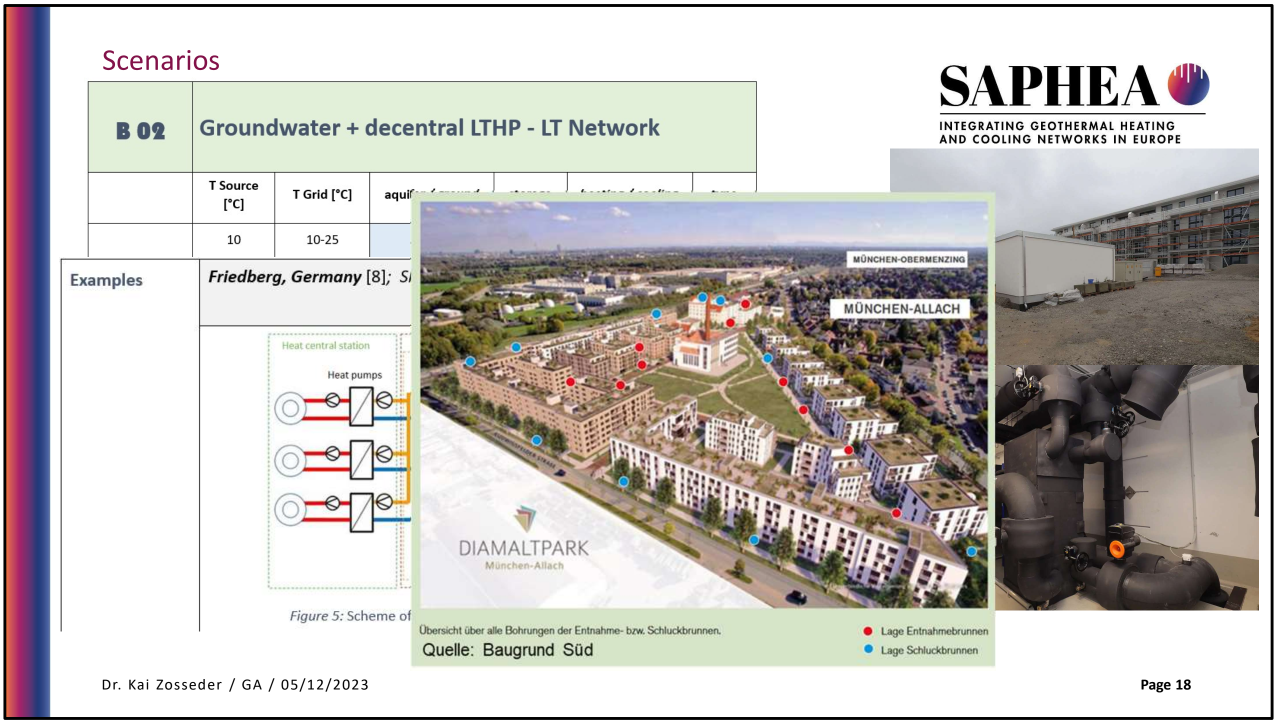
SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

Basic Scenarios

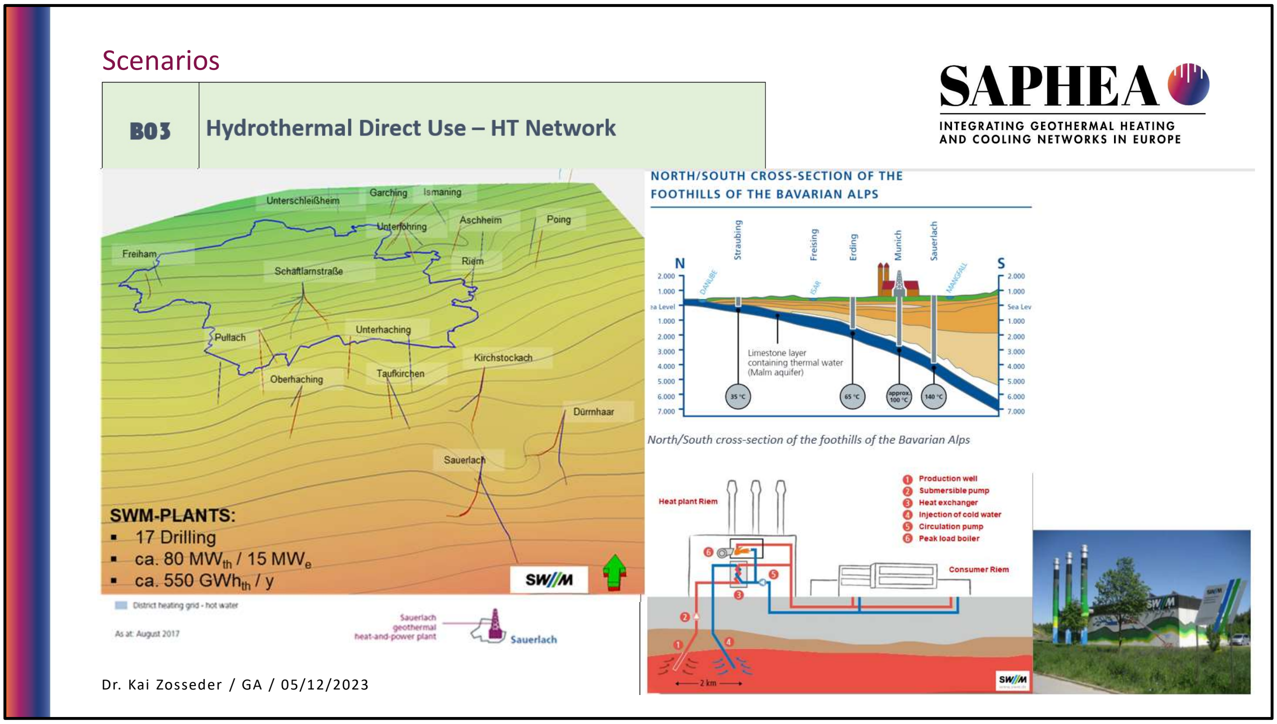


- Utilizes shallow geothermal energy with groundwater wells to supply cold water for district cooling (DC) networks.
- Cooling is delivered directly via a closed circuit, with supply temperatures typically around 4-8°C and return temperatures of 13-16°C.
- Suitable for systems where free cooling can be used, minimizing energy consumption and eliminating the need for mechanical chillers in many cases.

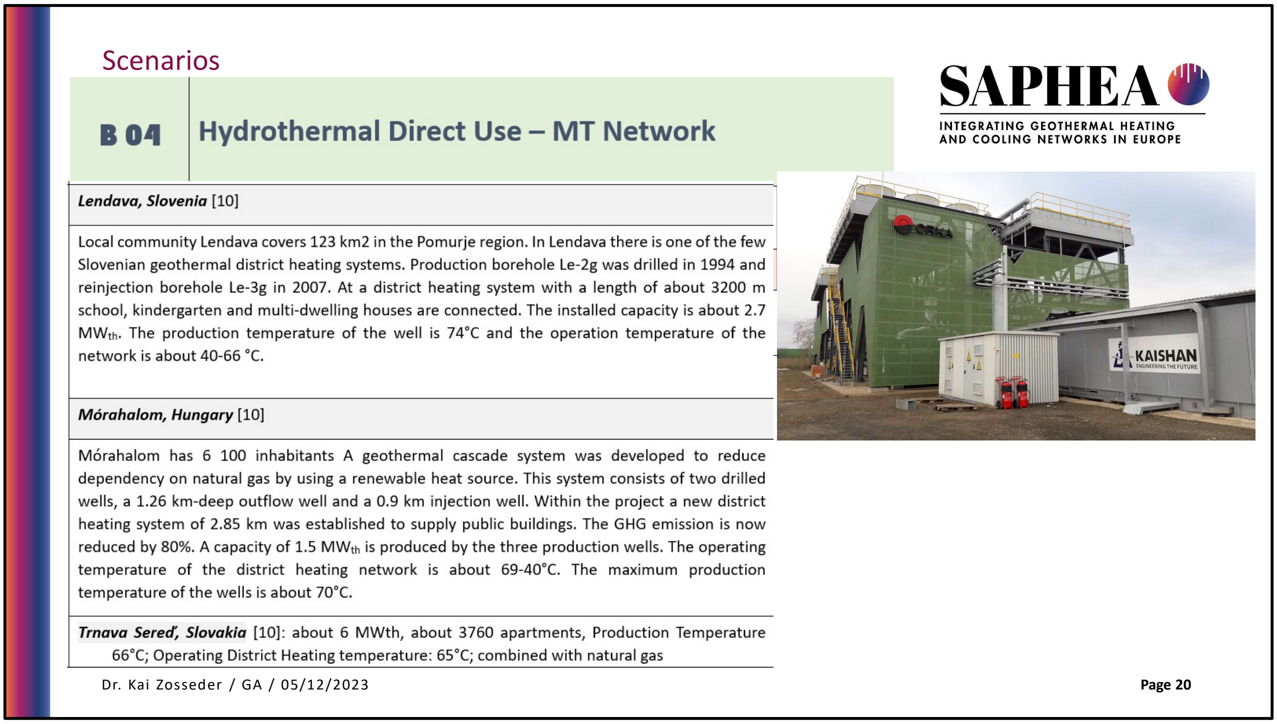
This setup is cost-effective with low maintenance and running costs, offering a highly efficient solution for district cooling



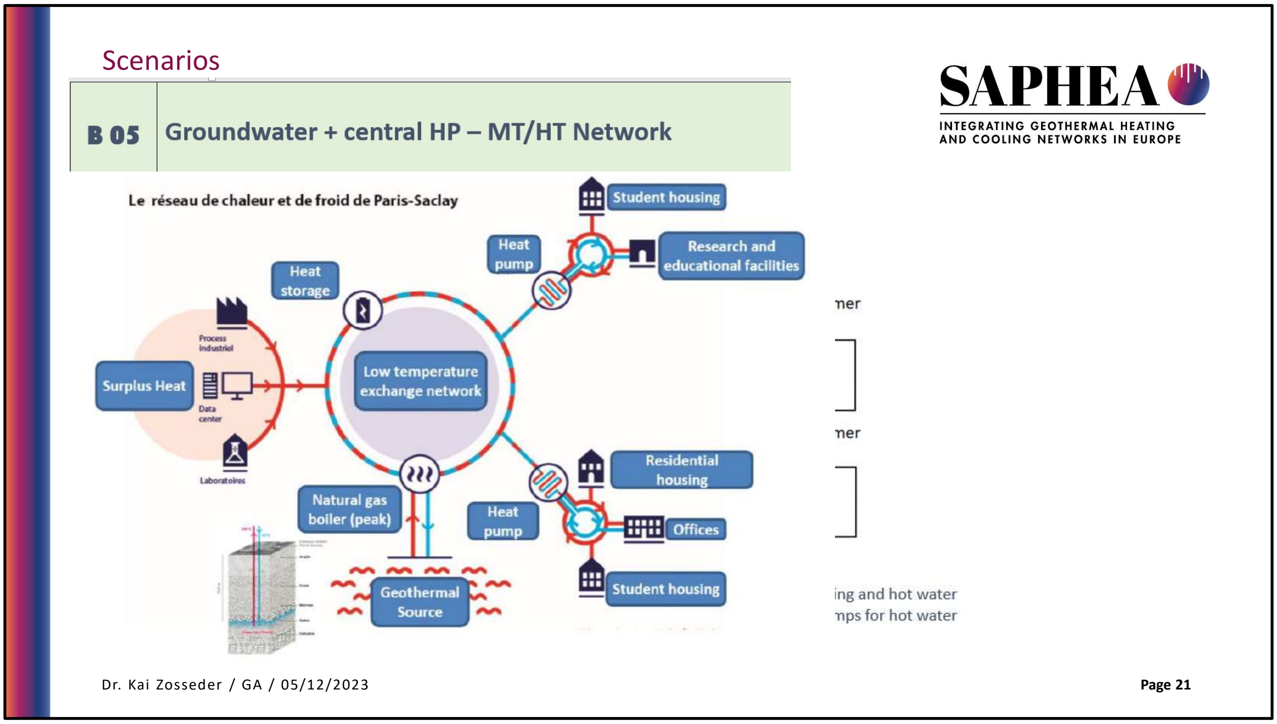
- In this scenario, groundwater wells are used to extract water at a low temperature (around 10°C) for a low-temperature district heating network (10-25°C).
- Each building has a decentralized low-temperature heat pump (LTHP) that raises the temperature to meet the required heating level for the building.
- This system, often referred to as a 5th Generation District Heating and Cooling (5GDHC) network, primarily serves as a provider of low-temperature ambient heat.
- It is particularly efficient for areas where low-temperature heating or cooling is needed, with minimal heat loss and flexible network operation.



- Involves hydro geothermal well doublets extracting groundwater at 90-120°C from deep geothermal reservoirs.
- Heat is transferred directly to high-temperature district heating networks (90-120°C).
- Suitable for high-temperature district heating systems (2nd and 3rd generation).
- Example of implementation: Munich, Germany, where this system is used to supply district heating.

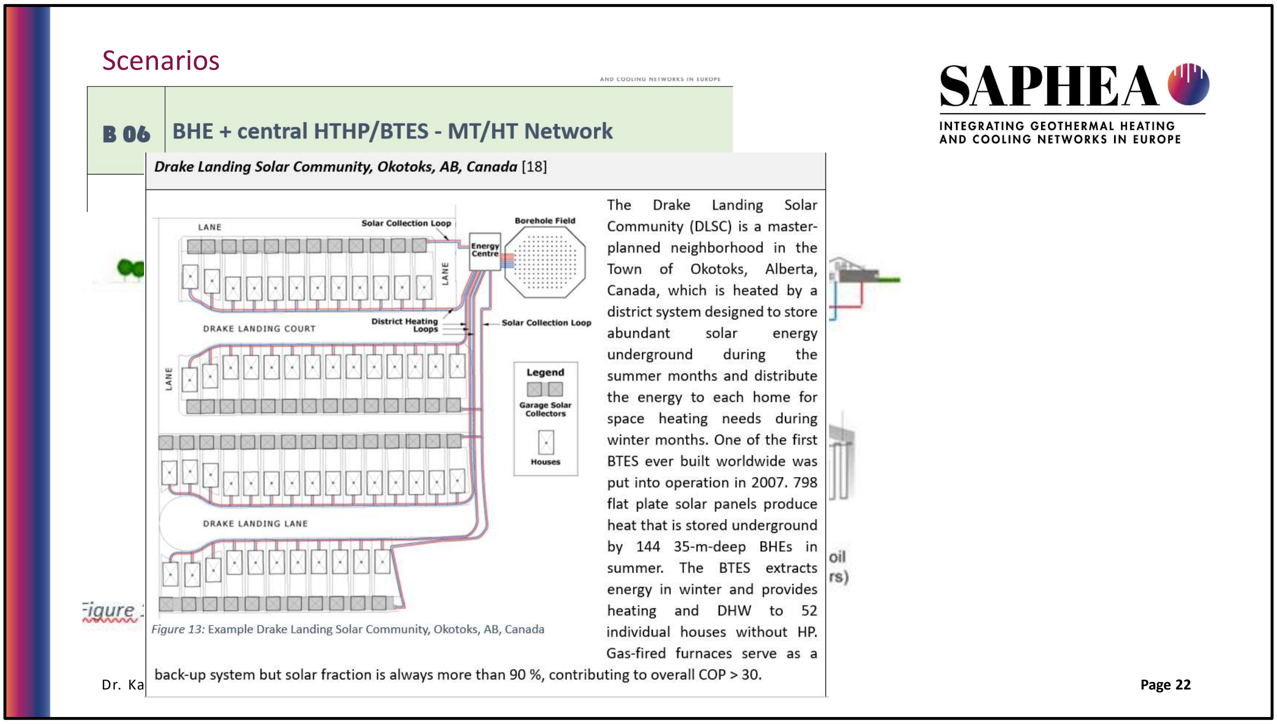


- Hydrothermal well doublets extract groundwater at 40-90°C from geothermal reservoirs at depths of approximately 1,500 meters and below.
- Heat is transferred via heat exchangers to district heating networks, supplying hot water at 40-60°C to end users.
- This scenario is suitable for medium-temperature networks (2nd and 3rd generation DHC systems).
- Examples include the Lendava system in Slovenia and Mórahalom in Hungary, where geothermal heating systems operate with moderate temperatures to meet local demand.

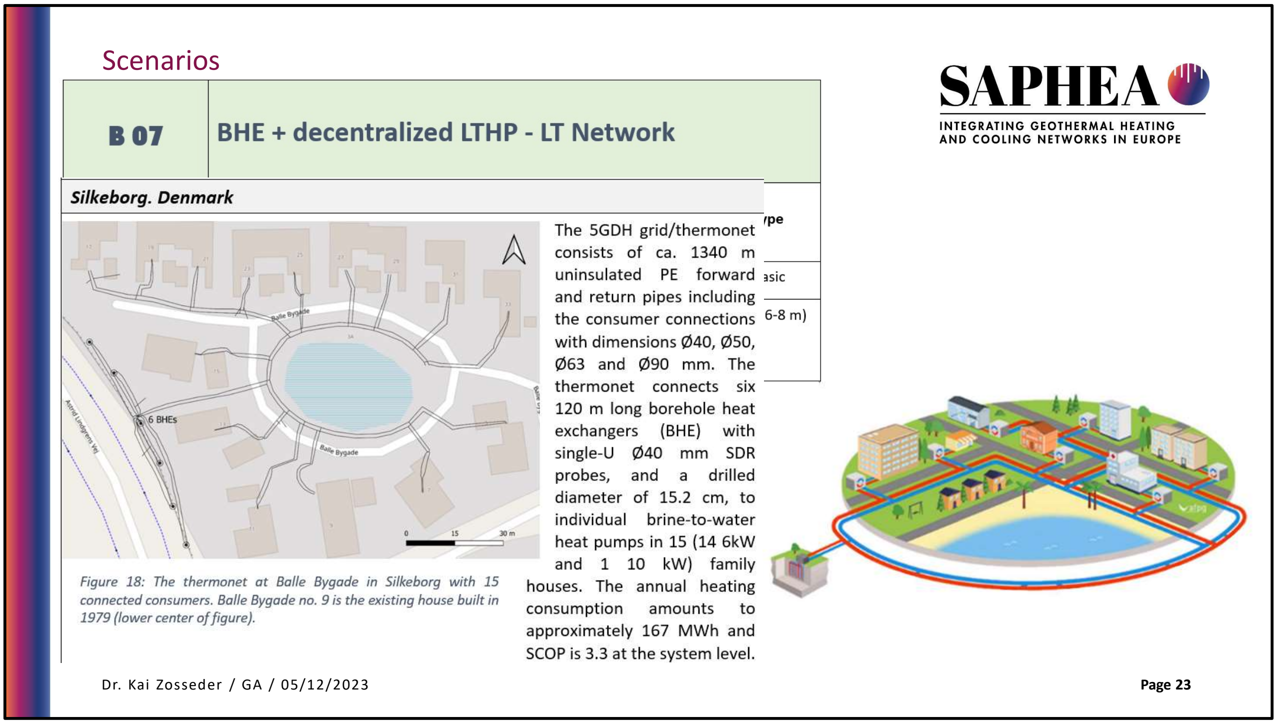


- Groundwater wells at shallow depths (10-30°C) combined with central large heat pumps to increase the temperature for district heating.
- The scenario typically serves medium- and high-temperature networks (25-90°C), covering the base load of the heat demand.
- Often integrated with other sources like combined heat and power (CHP) for added flexibility and efficiency in district heating networks.

This scenario is suitable for 4th generation district heating (4G DH) systems, offering flexibility in temperature adjustment to meet diverse energy demands across different regions.



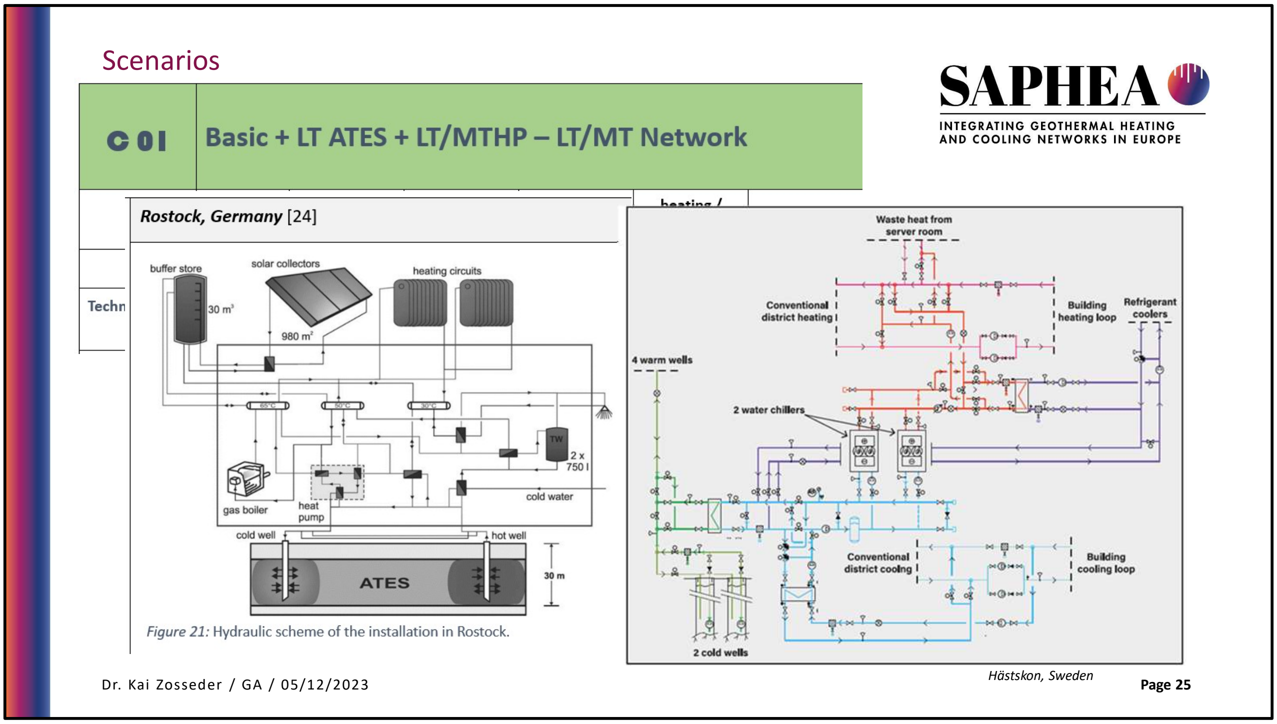
- Borehole heat exchangers (BHE) are used in combination with high-temperature heat pumps (HTHP) and borehole thermal energy storage (BTES) systems.
- BHEs are installed at depths of 50-200 meters to deliver energy year-round, providing either heating or cooling depending on the season.
- During summer, heat is collected via solar panels or waste heat and stored in shallow BHEs (<50 m), while in winter, heat is extracted from deeper BHEs and delivered to the grid for heating.
- Short-term storage tanks (50-100 m³) improve system efficiency by acting as an intermediary between the BTES and the heating grid.



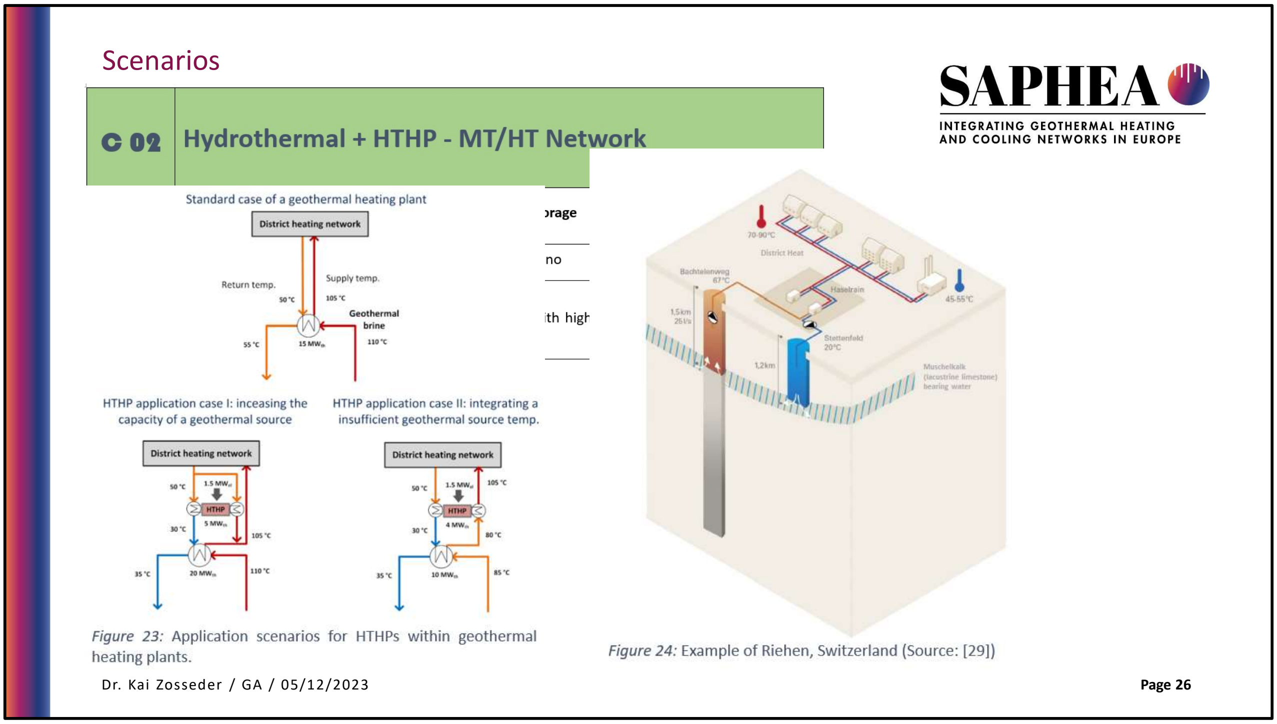
- Borehole heat exchangers (BHEs) are used to exchange thermal energy with a low-temperature district heating network.
- Each user is equipped with a decentralized low-temperature heat pump (LTHP) that adjusts the temperature of the heat from the BHE for space heating or cooling.
- The system can operate in both heating and cooling modes, depending on seasonal demand, with energy being extracted or injected into the ground.
- Suitable for 5th generation district heating and cooling (5GDHC) networks, this setup optimizes energy efficiency with minimal heat losses.

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

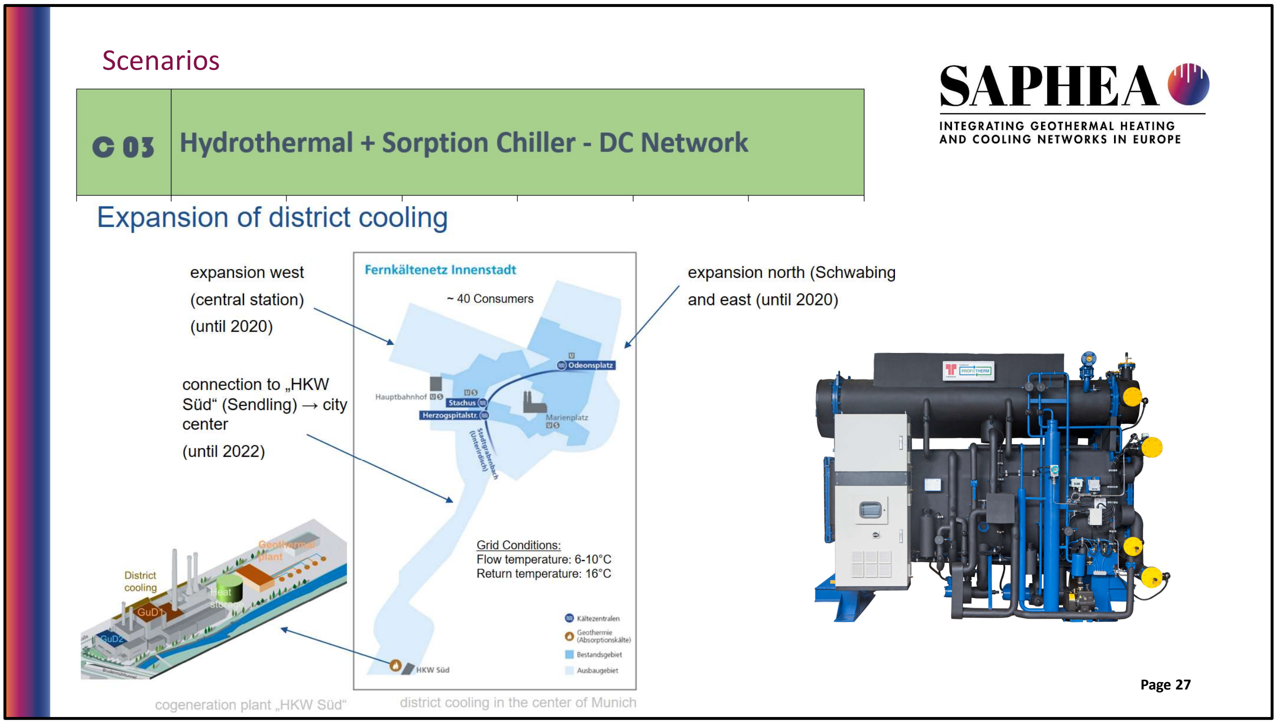
Complex Scenarios



- The scenario uses Aquifer Thermal Energy Storage (ATES) systems to provide low-temperature (LT) and medium-temperature (MT) heating for district heating networks.
- Groundwater is extracted from aquifers and stored for later use, supporting efficient heating in buildings, with temperatures ranging from 30°C in the aquifer to 40-60°C in the grid.
- The system enables cooling during summer by utilizing cold groundwater stored in the previous winter season and reinjecting excess heat from cooling processes into the warm well for winter heating.



- Demonstrates the use of hydrothermal well doublets combined with high-temperature heat pumps (HTHP) to supply medium- to high-temperature district heating networks.
- The scenario shows how lower-temperature geothermal sources (30-90°C) are lifted by HTHPs to match the heating grid requirements of 60-120°C.
- This setup increases the efficiency and flexibility of district heating systems, enabling better use of lower temperature geothermal resources in regions that require higher network temperatures.

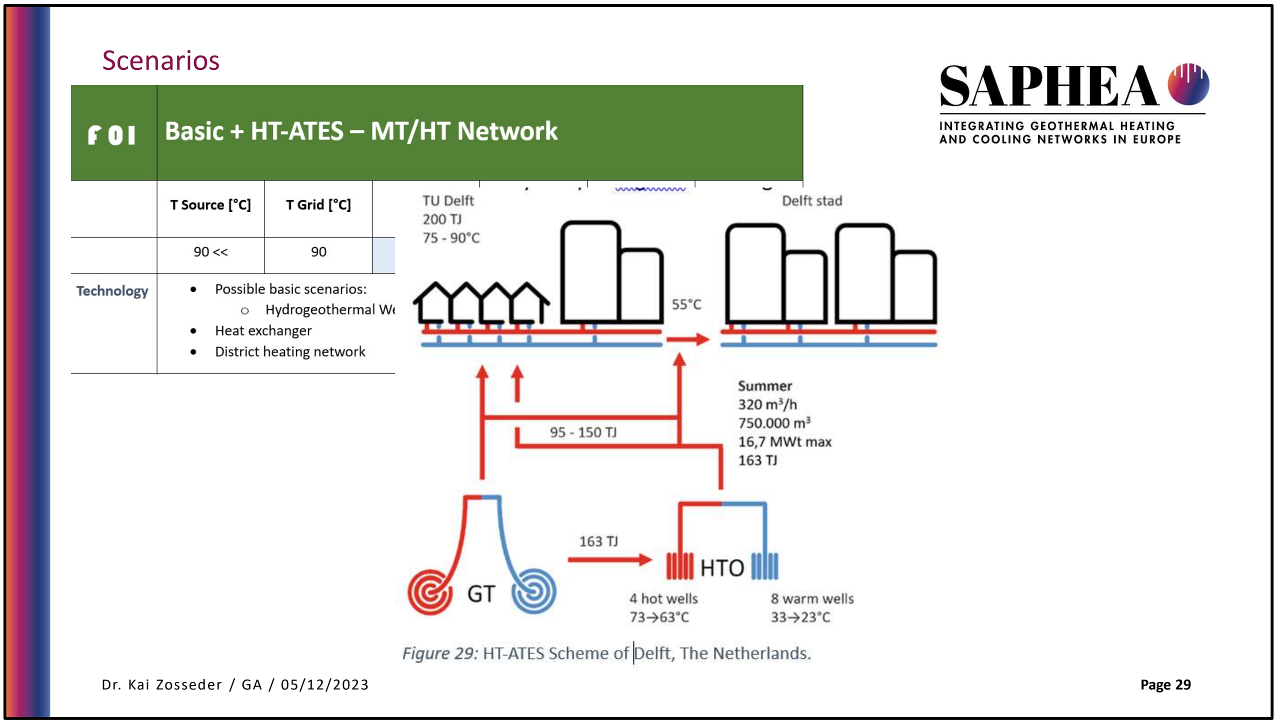


- Hydrothermal well doublets extract geothermal heat (60-100°C), which is used to drive sorption chillers for district cooling networks.
- The cooling network operates with supply temperatures around 6-10°C and return temperatures of 15-17°C.
- This scenario is suitable for larger commercial and industrial buildings, where sorption chillers offer a lower electricity demand compared to traditional vapor compression cycles.

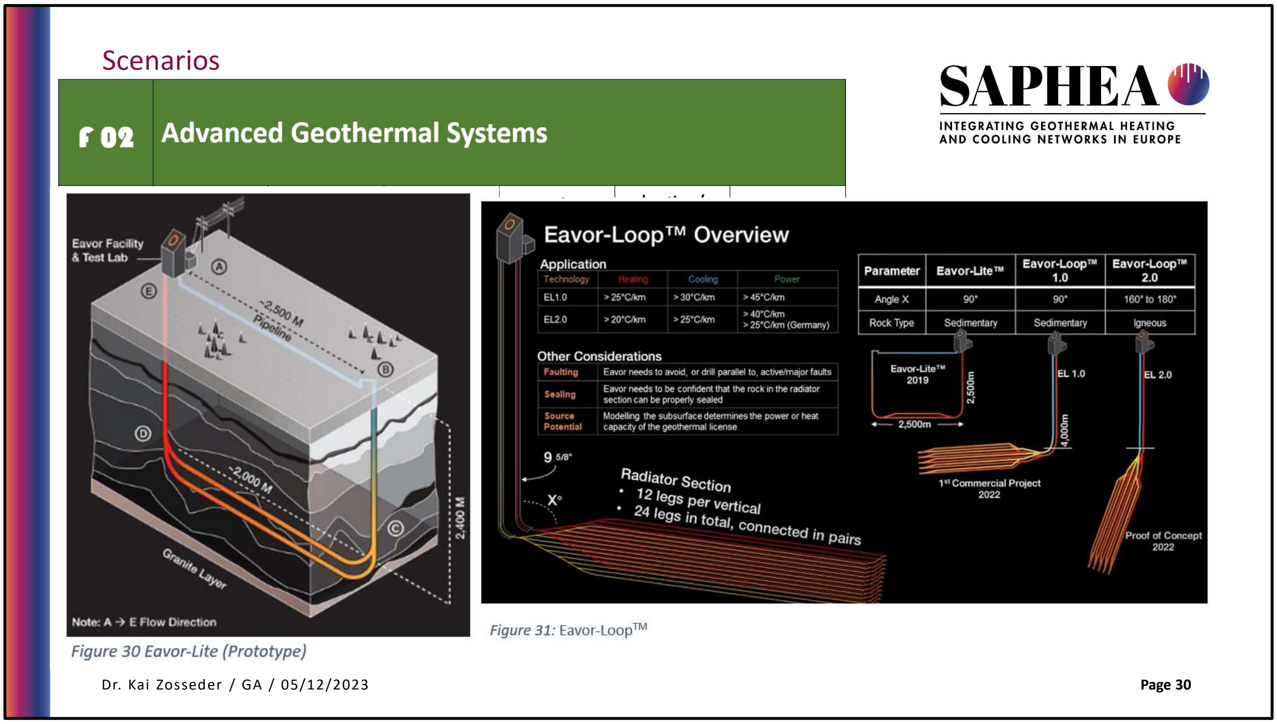
SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

Future Scenarios

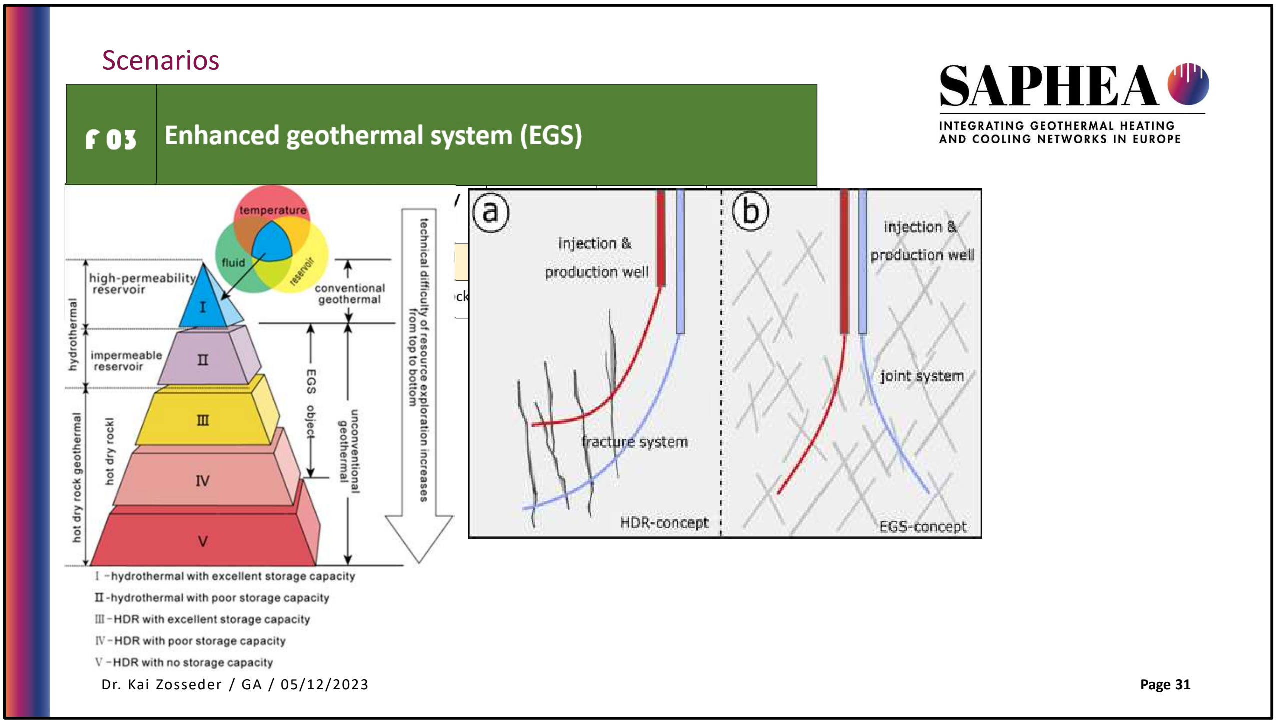
Dr. Kai Zosseder / GA / 05/12/2023



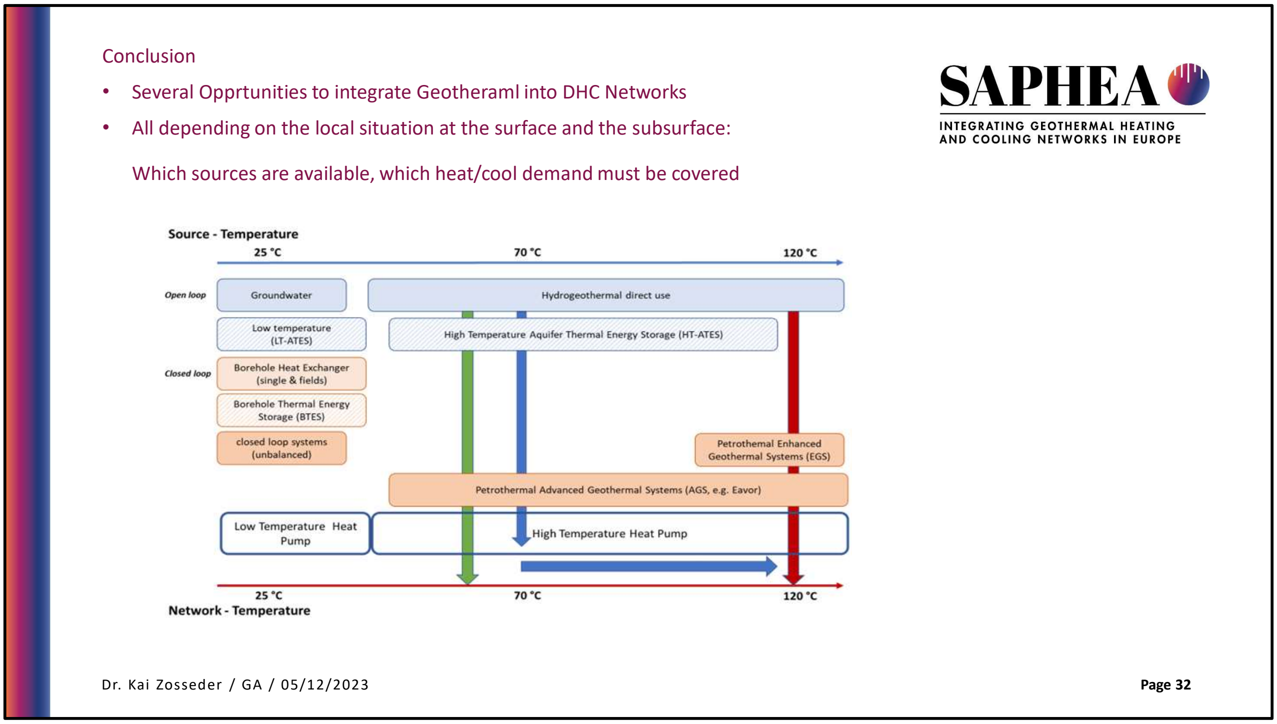
- The scenario demonstrates the use of high-temperature Aquifer Thermal Energy Storage (HT-ATES) systems to provide heat to medium- and high-temperature district heating networks.
- Aquifers serve as storage mediums, with stored temperatures reaching up to 90°C at depths between 300 and 3,000 meters.
- Heat is extracted from the aquifer using well doublets and transferred via heat exchangers to district heating networks, ensuring consistent heat supply.



- This scenario focuses on **closed-loop geothermal systems** like **Eavor-Loop™** and **GreenLoop**, where no fluids are extracted from the Earth.
- Fluids circulate in sealed pipes deep underground, picking up heat by conduction, and carry it to the surface for heating or electricity generation.
- These systems reduce risks such as seismic activity and water consumption and can be implemented in a variety of locations due to their scalability.
- Suitable for future developments in both heating and power generation applications.



- The Enhanced Geothermal System (EGS) harnesses geothermal heat from deep underground (3-6 km), utilizing low-permeability rocks.
- EGS involves creating a large subterranean heat exchanger by injecting pressurized water into the rock to widen existing cracks, enhancing the flow of heat.
- EGS systems can provide heat for district heating networks and are capable of operating at temperatures between 90-120°C, offering potential for high-efficiency, high-temperature heating solutions in the future.



- Several opportunities exist to integrate geothermal energy into district heating and cooling (DHC) networks, contingent upon local surface and subsurface conditions.
- The availability of geothermal sources and the specific heating and cooling demands that need to be met will dictate the most effective integration approach.
- Strategic planning and assessments are essential for optimizing the mix of technologies tailored to local circumstances.

Thank you!

Get in contact with us:
www.saphea.eu

#SAPHEA_EU

SAPHEA
INTEGRATING GEOTHERMAL HEATING AND COOLING NETWORKS IN EUROPE

Dr. Kai Zosseder

Technical University of Munich
kai.zosseder@tum.de

GeoSphere Austria · Università di Torino · ethink Energy Research · GEL Geothermal Engineering Ltd · Technical University of Munich TUM · VIA University College · AGH · TU Wien Technische Universität Wien Vienna | Austria · EGEC Geothermal · ENGIE Solutions

Funded by the European Union

This article/publication is based upon work from the project SAPHEA, funded by the European Union's HORIZON EUROPE research and innovation programme under the Grant Agreement number 101075510

Page 33

Webinar 8:
Space Cooling

Act!onHeat SF1

- Serial 3:
    - Webinar 8
        - Strategical Heating & Cooling planning
        - Group support for municipalities and stakeholders

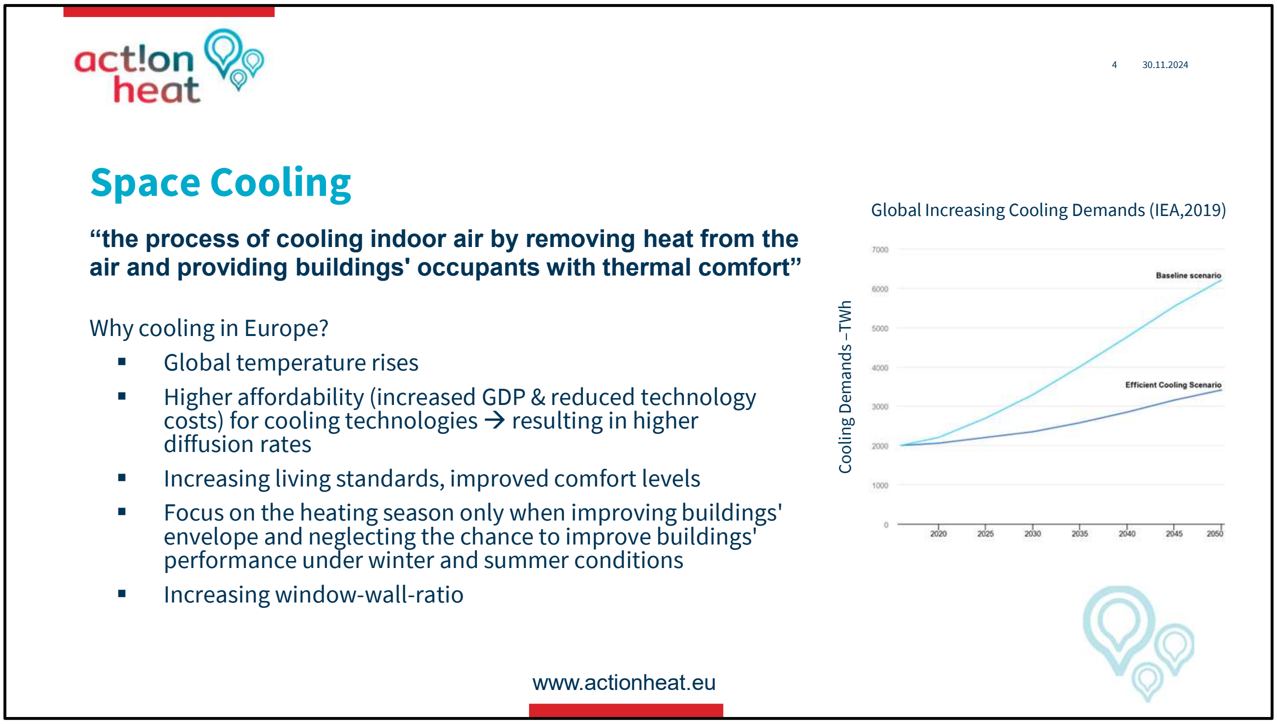
- Presented by:
    - e-think / Austria
    - TU-Wien / Austria

This webinar focuses on space cooling, covering increasing demand, reduction potential, and sustainable supply opportunities. The presentation is delivered by Aadit Malla from TU Wien, highlighting strategies to address cooling challenges in the context of rising demand and EU policy frameworks.

Contents

Part 1: Existing and projected demands and EU policy landscape

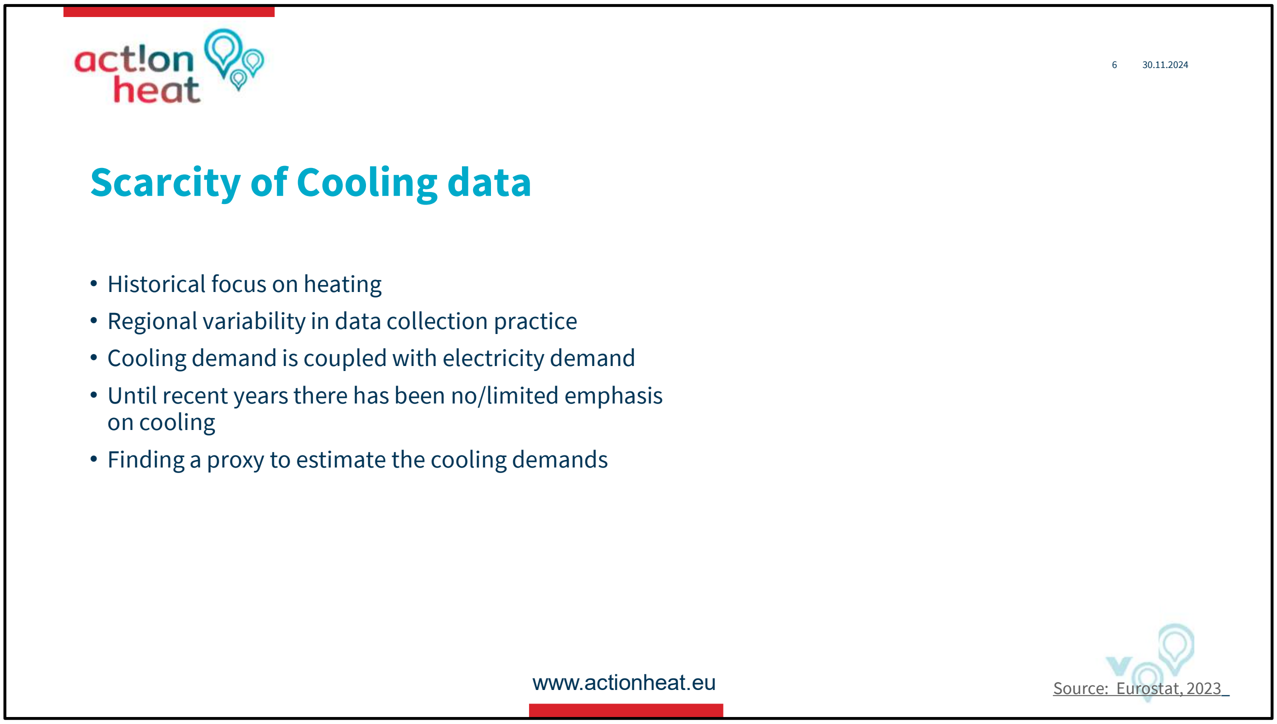
- ❑Space cooling in Europe
- ❑Cooling demand: Data scarcity and Modelling
- ❑EU cooling policy and framework



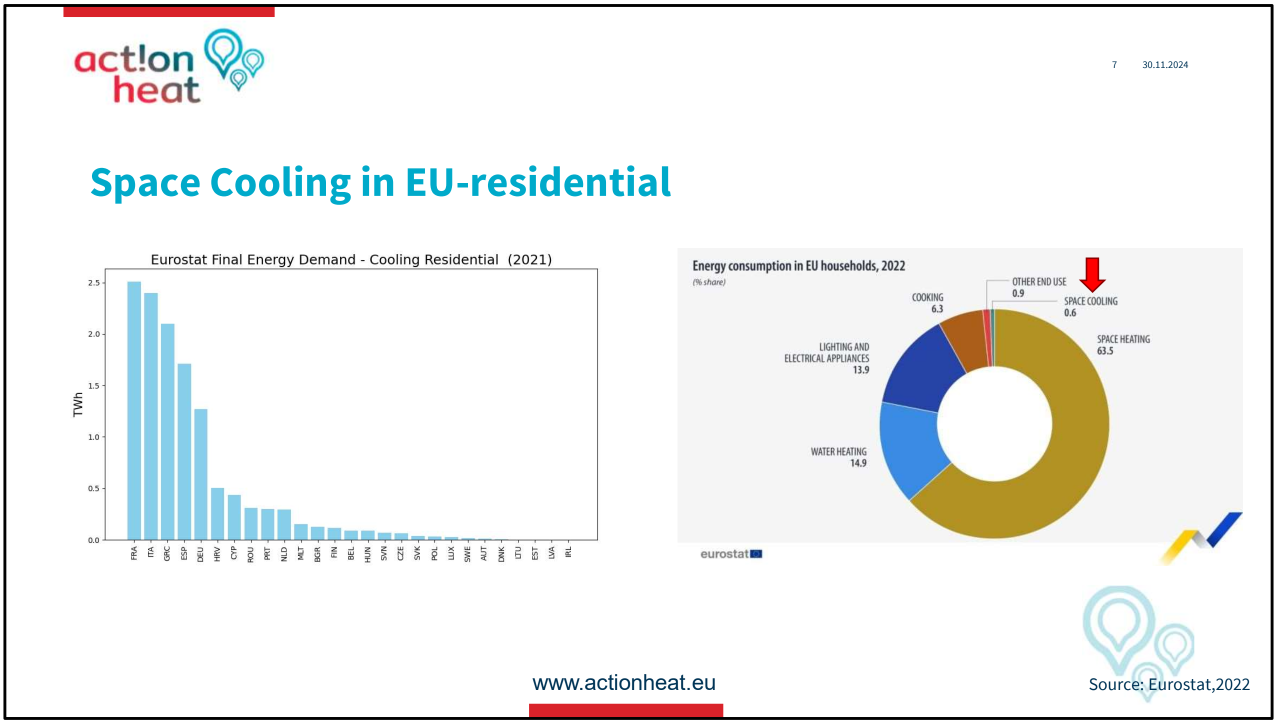
- The presentation focuses solely on space cooling, which refers to cooling aimed at maintaining indoor comfort for occupants. Process cooling is excluded from the scope.
- Global cooling demand is rising due to factors such as higher affordability, improved living standards, and increased comfort expectations.
- Innovative approaches offer opportunities to control demand growth and transition towards sustainable cooling supply solutions.
- A shift in building improvement strategies is needed to address performance during both summer and winter, emphasizing holistic climate-responsive designs.

Part 1: Existing and projected demands and EU policy landscape

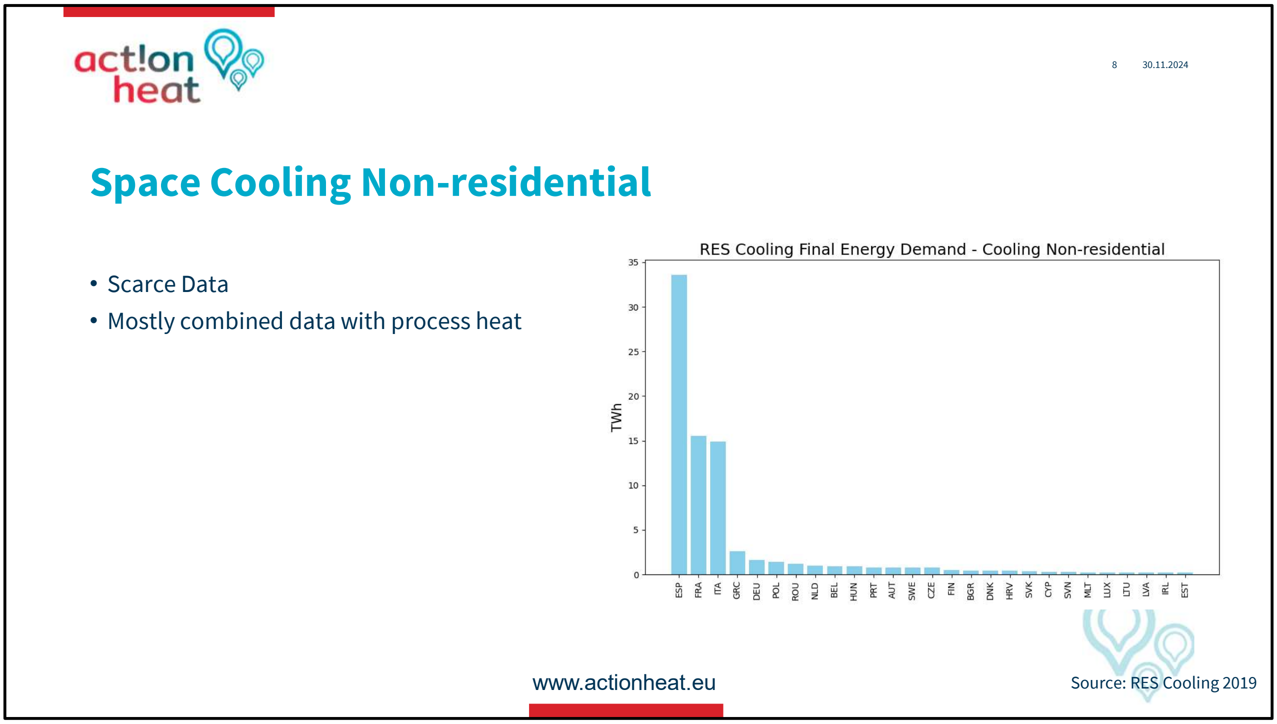
- ❑Space cooling in Europe
- ❑Cooling demand: Data scarcity and Modelling
- ❑EU Cooling policy and framework



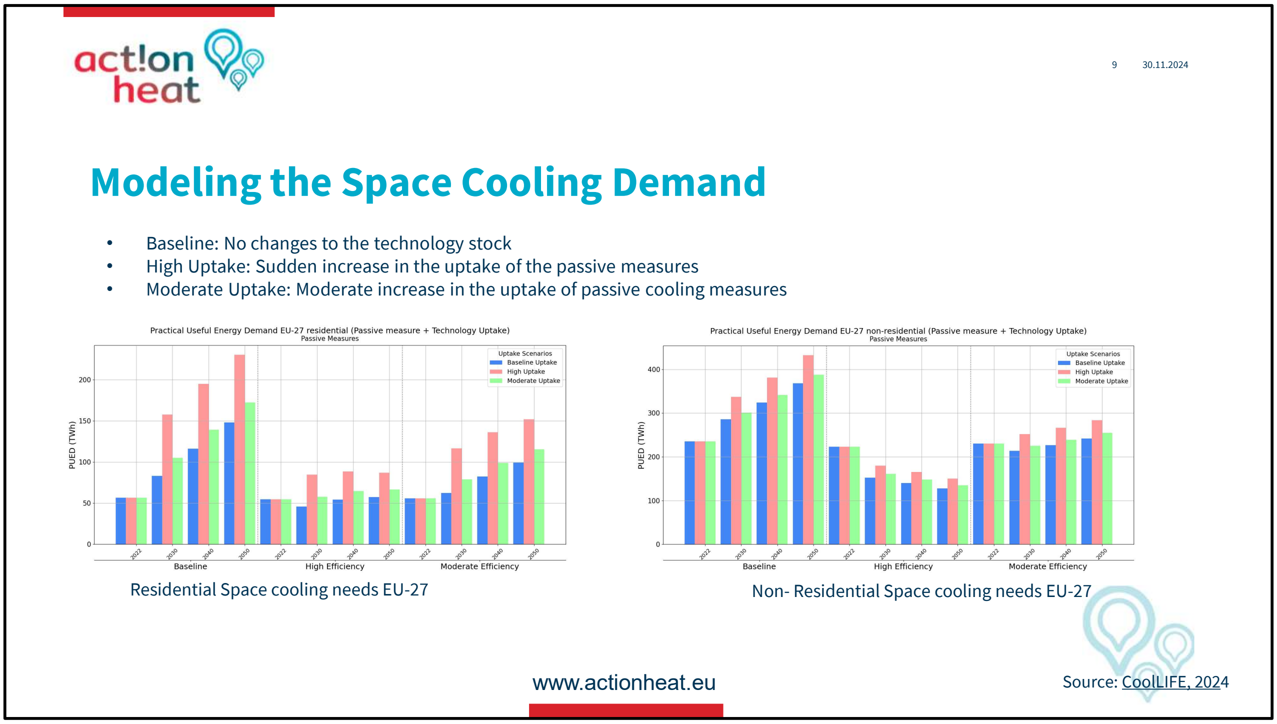
- The scarcity of reliable data complicates the prediction and modeling of cooling demand across Europe.
- Cooling demand has traditionally been overlooked, with more focus placed on heating data collection and analysis.
- Cooling Degree Days (CDD) provide a straightforward yet simplistic method for estimating cooling demand.
- Improved data collection practices and proxies are necessary for more accurate demand assessments, especially given regional variability.



- Space cooling represents a minimal portion of the total energy demand in the EU residential sector.
- The demand is primarily influenced by external temperatures, building insulation quality, and occupant behavior.
- Increased affordability and diffusion of cooling technologies are gradually driving demand growth in residential buildings.
- Accurate demand modeling for this sector remains challenging due to limited data availability and historical focus on heating needs.



- In the non-residential sector, cooling demand data is often combined with process heat data, making it challenging to isolate specific cooling needs.
- The lack of granular data hampers accurate assessments and planning for space cooling in non-residential buildings.
- Non-residential cooling demand is influenced by operational schedules, internal heat loads, and building design
- Improved data segregation and collection methodologies are essential to understand and address the unique cooling requirements of this sector.



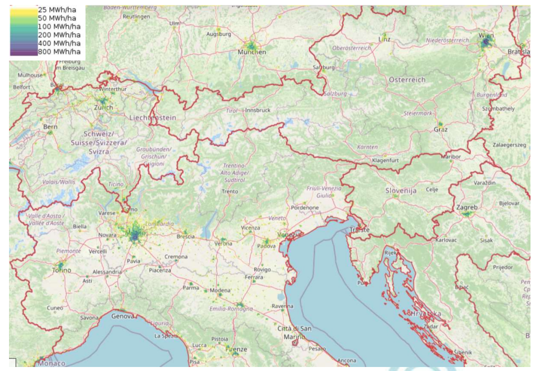
- The space cooling demand was modeled under three scenarios, each varying by the rate of uptake of passive cooling measures.
- The adoption rate and efficiency of passive measures significantly influence the potential for demand reduction.
- Large uncertainties exist regarding the future adoption rates of these measures and their real-world effectiveness.
- Passive measures include strategies like shading, advanced window glazing, night ventilation, and adjusting indoor temperature setpoints to reduce cooling needs.
- These scenarios aim to provide insights into how passive measures can contribute to sustainable cooling strategies.

act!on heat

10 30.11.2024

Spatial distribution of the cooling demand density

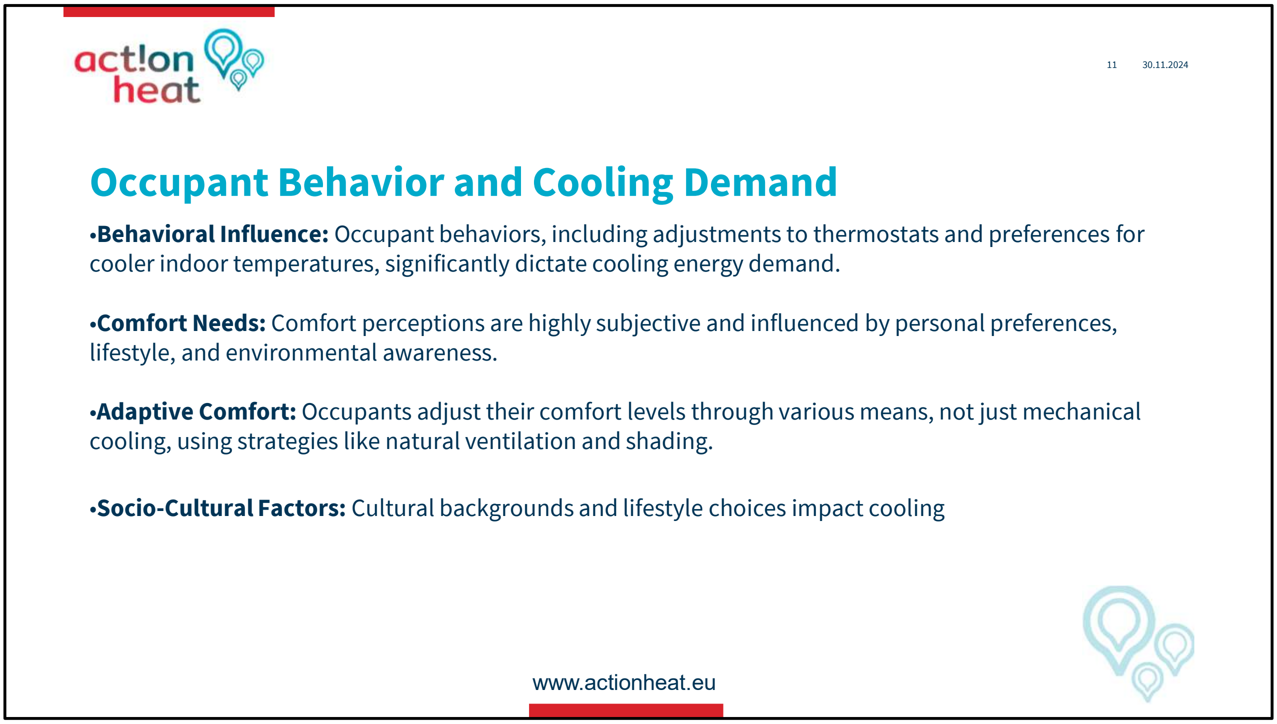
- Numerical data to spatial distribution helps policymakers, urban planners, and energy providers visualize and address the demand more effectively.
- Available hotmaps layers
- Overview of the demand in major cities across Europe



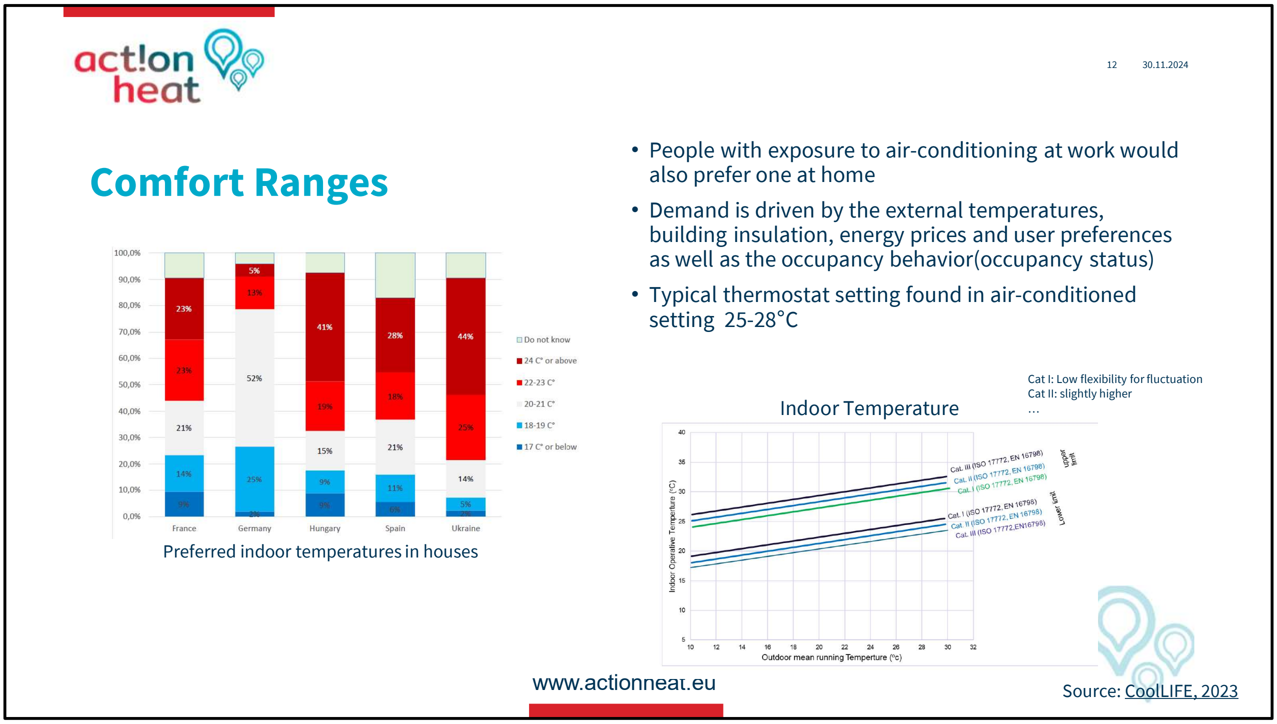
www.actionheat.eu

Source: Hotmaps

- Spatial data on cooling demand density adds an important dimension to planning and policy-making.
- It helps visualize demand patterns across regions, enabling targeted interventions for cooling infrastructure and energy supply.
- Policymakers, urban planners, and energy providers can use this data to address demand more effectively and equitably.
- Tools like Hotmaps layers can provide an overview of cooling demand in major cities, facilitating region-specific strategies for sustainable cooling.



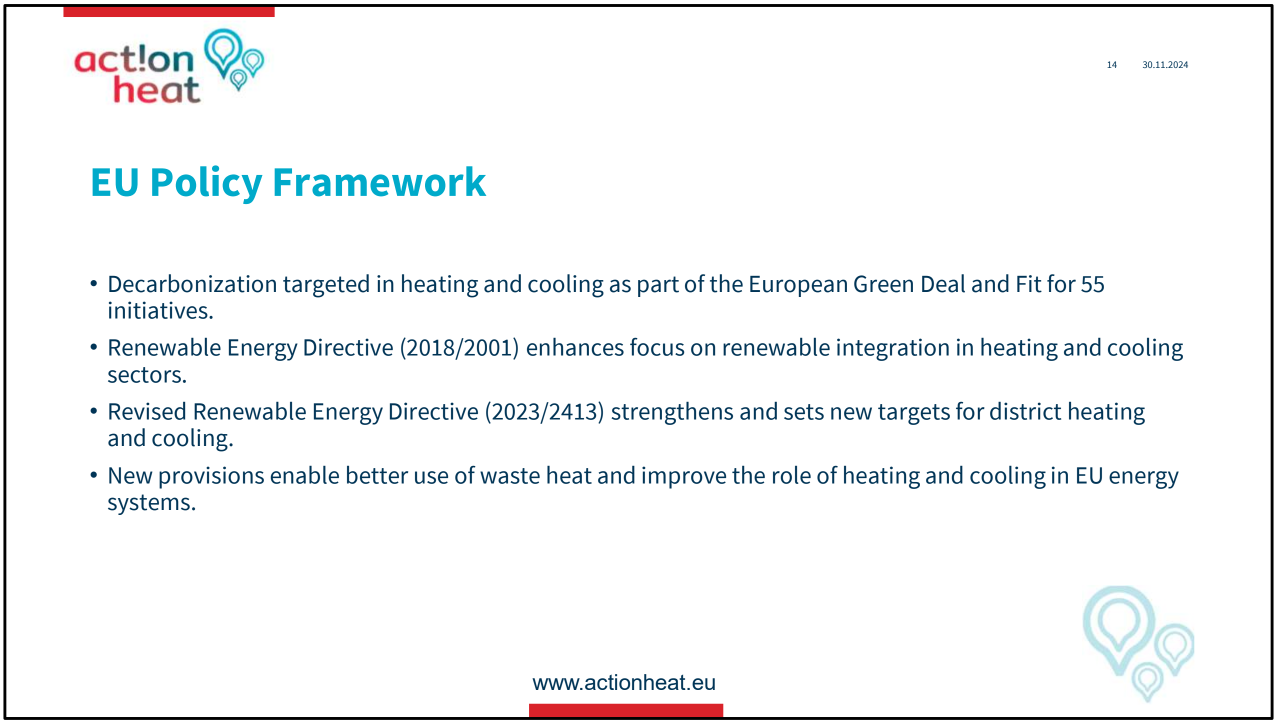
- Occupant behavior significantly influences cooling demand, adding complexity to demand modeling efforts.
- Behavioral aspects, such as thermostat adjustments, preferences for cooler temperatures, and lifestyle habits, must be considered alongside building physics modeling.
- Comfort needs are subjective, influenced by socio-cultural factors, personal preferences, and environmental awareness.
- Incorporating these dynamic and human-centered factors is crucial for developing accurate and comprehensive space cooling demand models.



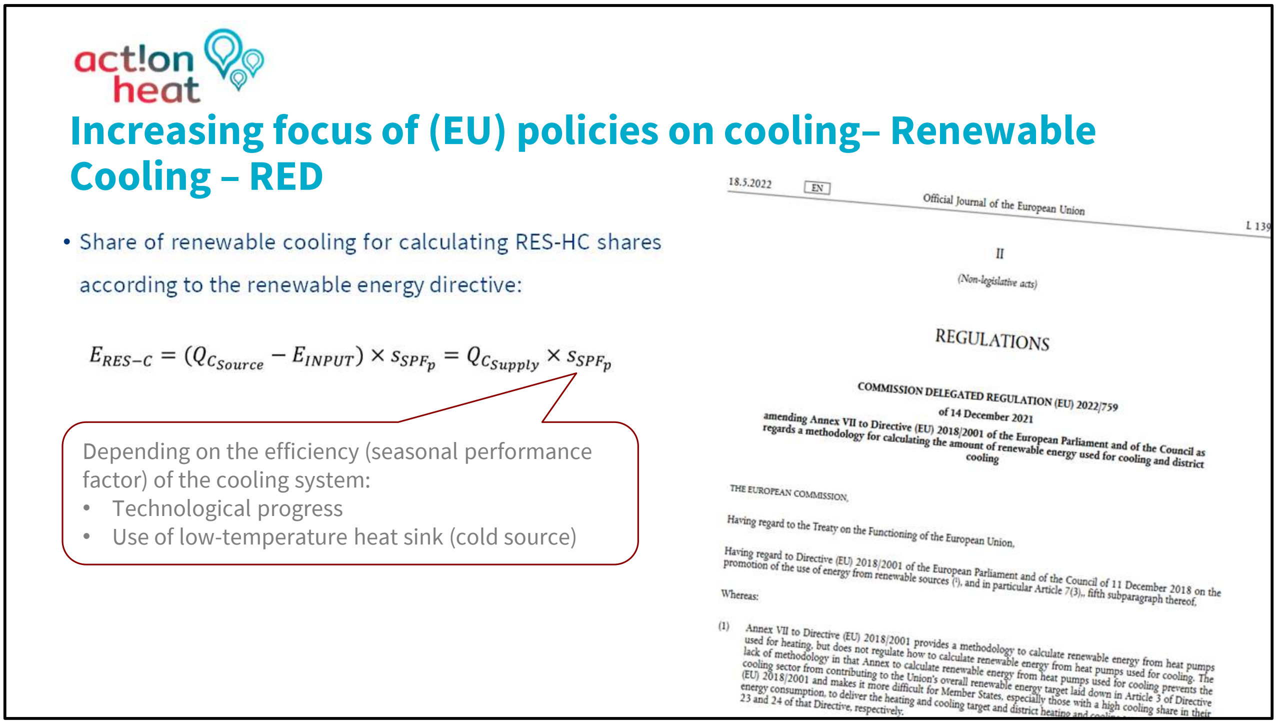
- The figure on the left illustrates preferred indoor temperatures across various countries, reflecting cultural and climatic differences.
- The bottom figure highlights the relationship between indoor temperatures and outdoor conditions, providing a framework for estimating comfort levels.
- These calculations are essential for architects, urban planners, and energy engineers to design energy-efficient HVAC systems tailored to local climatic variations.
- Properly designed systems can maintain thermal comfort while minimizing energy use, particularly in areas with significant fluctuations in outdoor temperatures.

Part 1

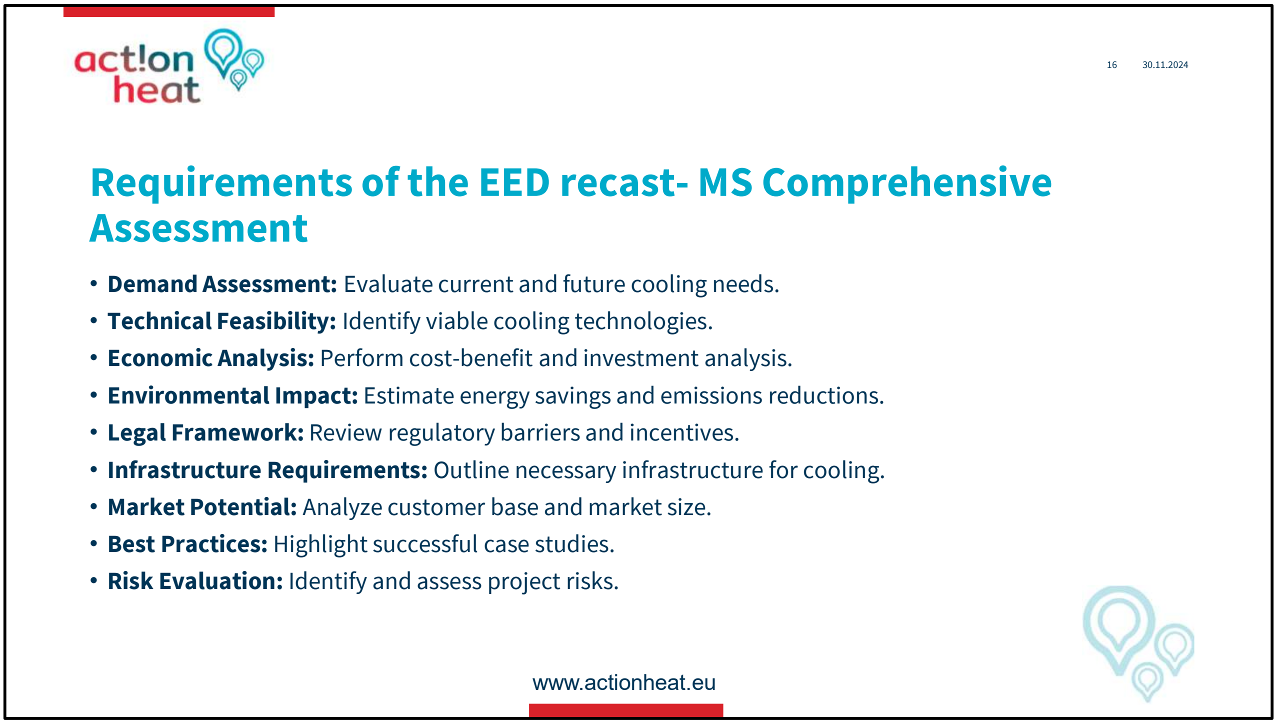
- ❑Space cooling in Europe
- ❑Cooling demand: Data scarcity and Modelling
- ❑EU cooling policy and framework



- The European Green Deal and the Fit for 55 package emphasize decarbonizing heating and cooling sectors to achieve climate neutrality by 2050.
- The Renewable Energy Directive (2018/2001) sets a binding overall Union target to reach a share of at least 32% of energy from renewable sources in the Union’s gross final consumption of energy by 2030.
- The revised Renewable Energy Directive (2023/2413) strengthens the heating and cooling target (Article 23) and the district heating and cooling target (Article 24). It also extends measures EU countries can take to achieve these targets and includes specific provisions on integrating waste heat and cold.
- These directives aim to enhance the role of heating and cooling in the EU's energy system integration, promoting the use of renewable energy sources and improving energy efficiency.



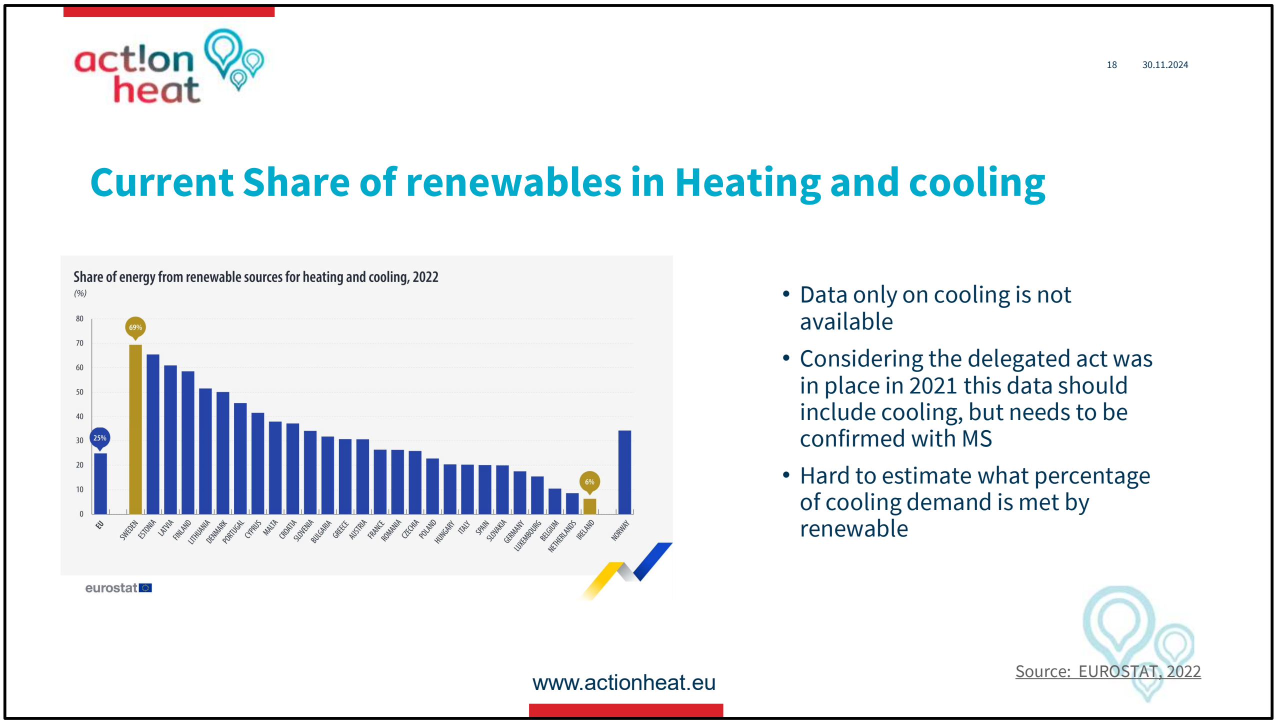
- EU policies are increasingly prioritizing the integration of renewable cooling within the broader energy transition agenda.
- The Renewable Energy Directive (RED) emphasizes renewable cooling as a key component for achieving energy efficiency and decarbonization targets.
- Renewable cooling is defined based on efficiency thresholds, promoting technologies like heat pumps, free cooling, and waste heat recovery.
- The RED encourages Member States to develop frameworks to support renewable cooling adoption and monitor its contribution to renewable energy targets.
- This focus aligns with the EU's Green Deal and Fit for 55 objectives to transition the heating and cooling sectors to sustainable and energy-efficient solutions.



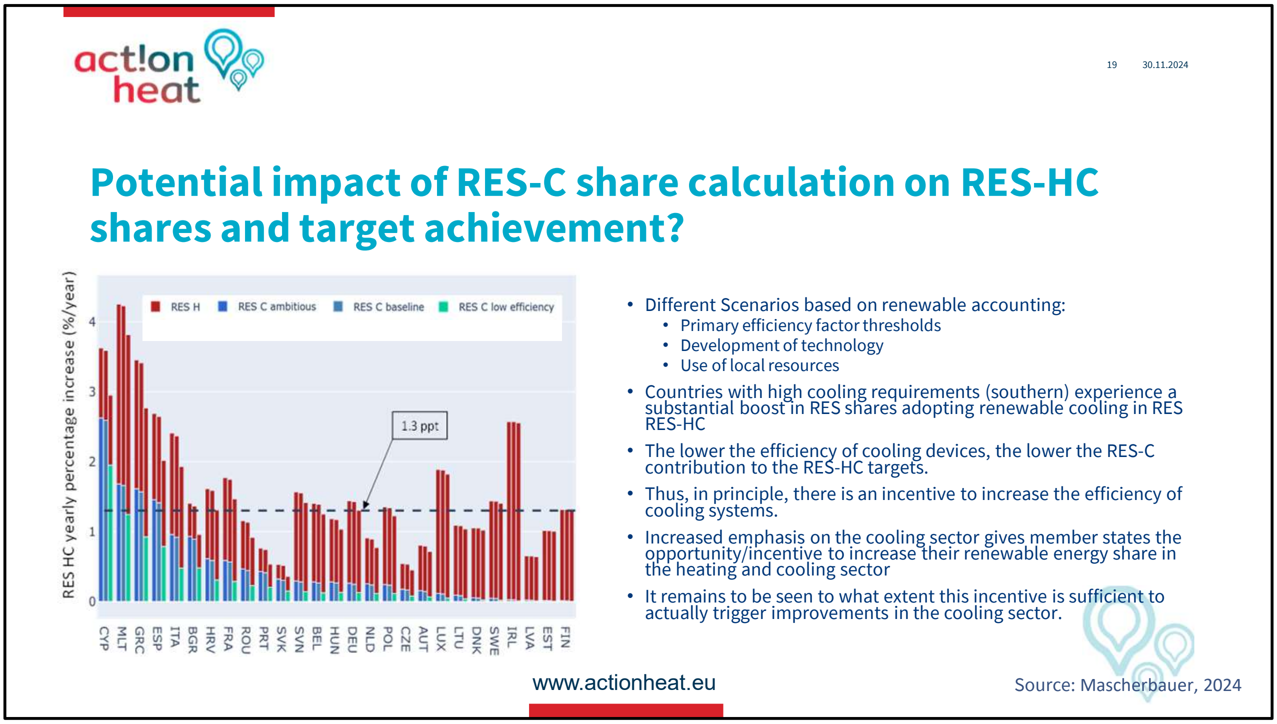
- The EED recast requires member states to assess cooling demand, identify viable technologies, and evaluate economic and environmental impacts.
- It emphasizes addressing regulatory barriers, market potential, and infrastructure needs.
- Risk assessment and best practices are key to advancing sustainable cooling strategies.

Part 2: Opportunities for reduction and sustainable supply

- ❑Impact of Cooling on Achieving Renewable Energy Targets
- ❑Overview of Active and Passive Cooling Measures
- ❑Reduction potential from passive measures
- ❑ Evaluating Central and Decentralized Cooling Technologies



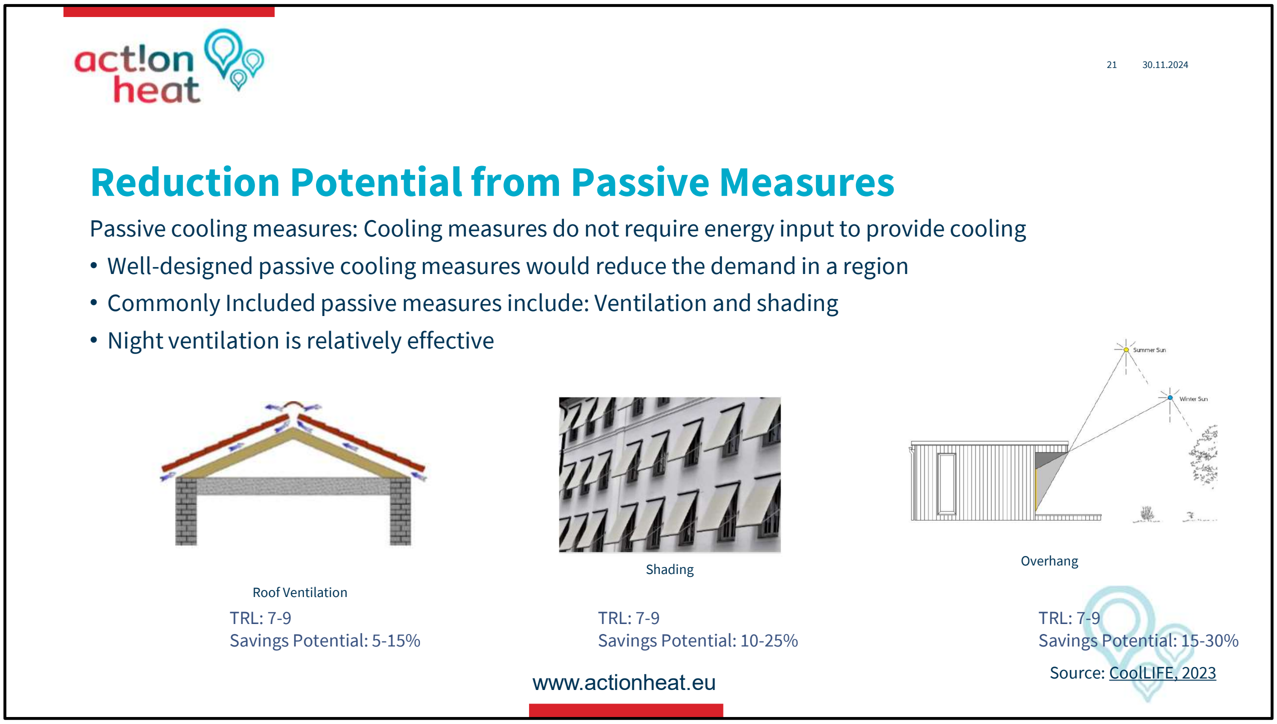
- Data on the share of renewables specifically for cooling is limited, as current statistics often combine cooling with heating data.
- The Renewable Energy Directive (RED) aims to integrate cooling into renewable energy targets, emphasizing the need for accurate and updated data.
- Member states are encouraged to evaluate and report renewable cooling contributions to better align with EU energy goals.



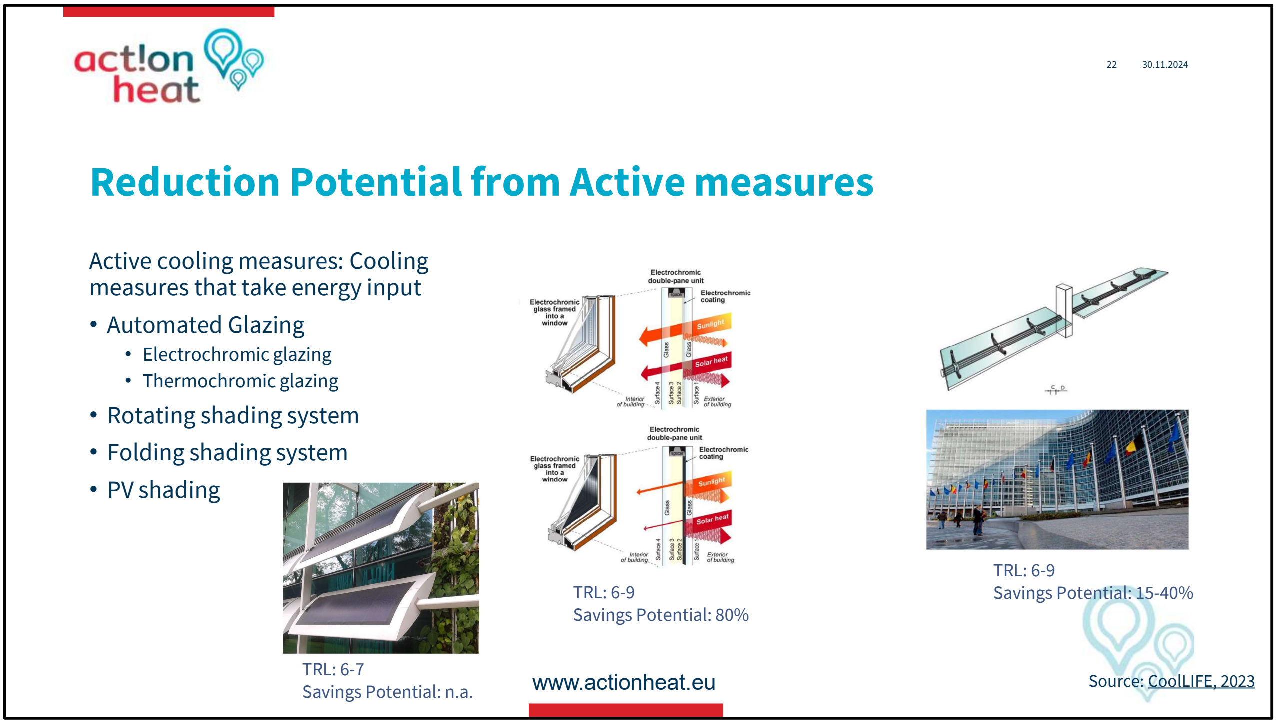
- The efficiency of cooling systems significantly influences renewable cooling (RES-C) contributions to renewable heating and cooling (RES-HC) targets.
- High cooling demands in southern regions can substantially boost renewable shares with effective RES-C integration.
- Policies encourage improving system efficiency and adopting renewable technologies to meet EU decarbonization goals.

Part 2: Opportunities for reduction and sustainable supply

- ❑Impact of Cooling on Achieving Renewable Energy Targets
- ❑Overview of Active and Passive Cooling Measures
- ❑Reduction potential from passive measures
- ❑ Evaluating Central and Decentralized Cooling Technologies



- Passive cooling measures, such as shading, ventilation, and roof insulation, significantly reduce cooling energy demands, with savings potential ranging from 5% to 30%.
- The **Technology Readiness Level (TRL)** largely defines the cost and savings potential of these measures, impacting their adoption feasibility.
- Some measures are easy to integrate, while others require substantial building design alterations, which can increase costs.
- Prioritizing scalable and cost-effective measures is key to achieving sustainable cooling strategies.



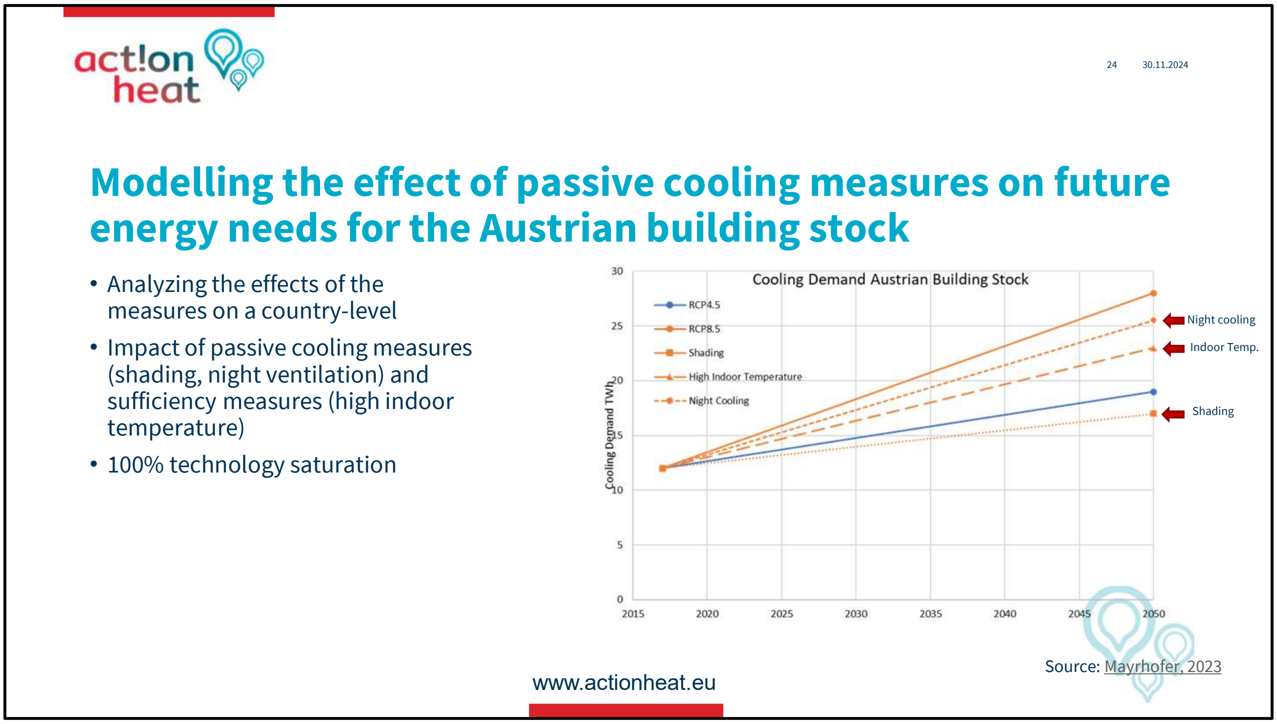
- Active cooling measures, such as electrochromic glazing, thermochromic glazing, and PV shading, require energy input but offer significant savings potential, ranging from 15% to 80%.
- Advanced technologies provide better energy-saving potential but come at higher costs, requiring a balance between upfront investment and long-term efficiency gains.
- The **Technology Readiness Level (TRL)** for these measures varies, impacting their integration feasibility and market adoption.
- These systems are ideal for projects where high savings justify the cost, but careful evaluation of costs and integration challenges is necessary.

23 30.11.2024

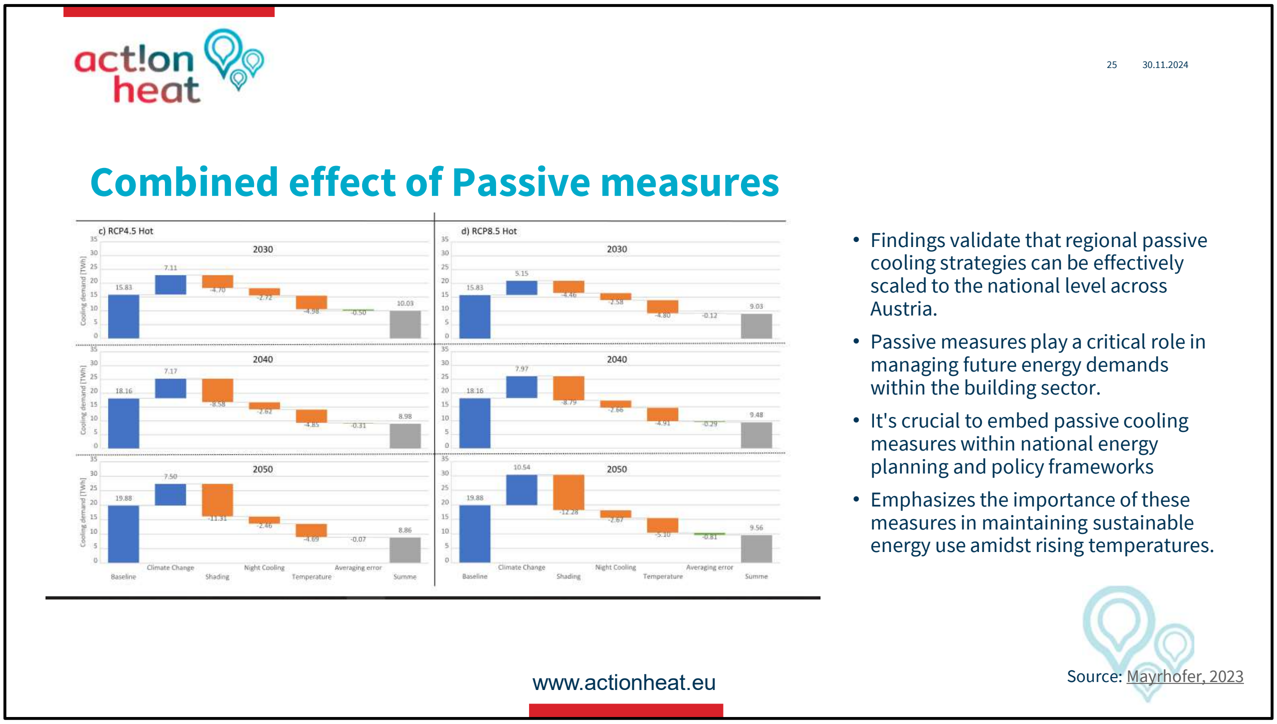
Part 2: Opportunities for reduction and sustainable supply

- ❑Impact of Cooling on Achieving Renewable Energy Targets
- ❑Overview of Active and Passive Cooling Measures
- ❑Reduction potential from passive measures
- ❑ Evaluating Central and Decentralized Cooling Technologies

www.actionheat.eu



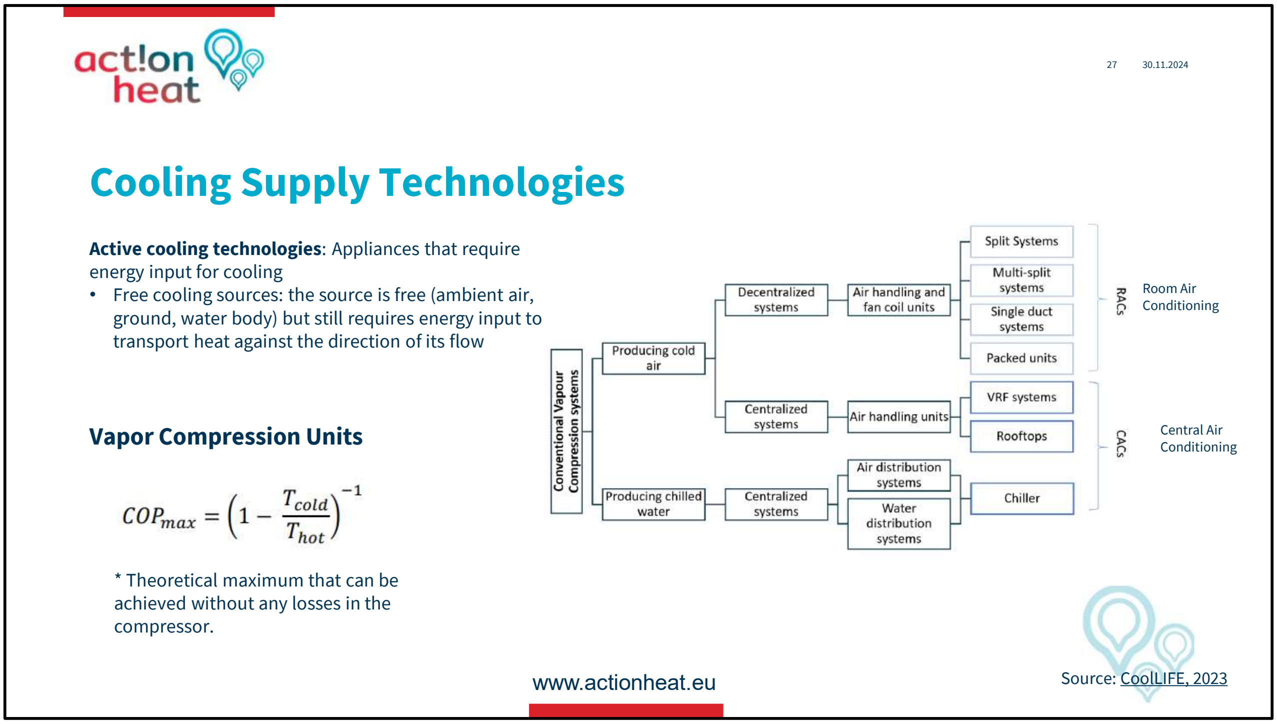
- The modeling assesses the impact of passive cooling measures, such as shading and night ventilation, on future energy demands for the Austrian building stock under **Representative Concentration Pathways (RCPs)**.
- Under RCP 4.5 (stabilization by 2040) and RCP 8.5 (high GHG emission scenario), cooling demand is projected to increase significantly by 2050.
- Despite these increases, passive measures and sufficiency strategies (e.g., higher indoor temperatures) offer a substantial reduction potential of 68–73% in energy demand.
- The results underscore the importance of incorporating regionally optimized passive cooling strategies into Austria's energy policies to mitigate climate-induced demand increases.



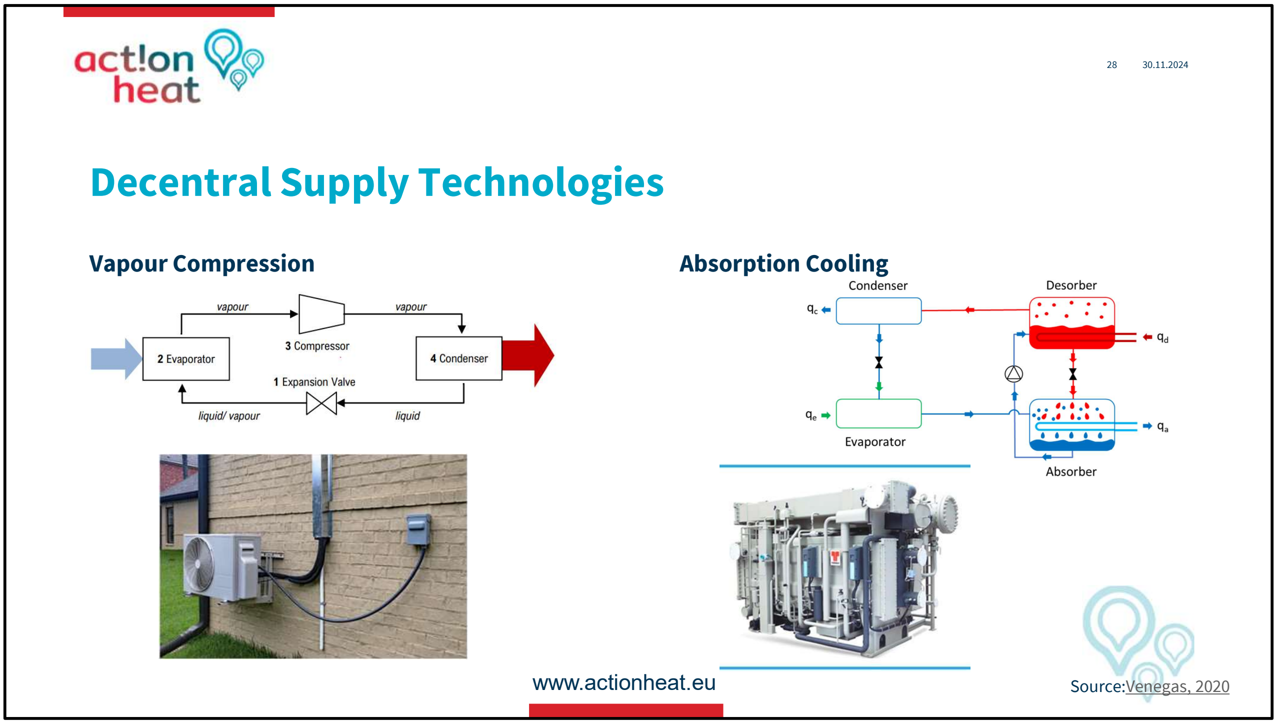
- Passive cooling measures, such as shading, night ventilation, and maintaining higher indoor temperatures, have a combined potential to significantly reduce energy demand.
- Modeling for Austria shows these measures can mitigate the impacts of rising temperatures under RCP 4.5 and RCP 8.5 scenarios.
- Scaling passive strategies to the national level is essential for sustainable energy planning and achieving climate resilience.
- These findings highlight the critical role of passive measures in reducing future energy needs while addressing increasing cooling demands driven by climate change.

Part 2: Opportunities for reduction and sustainable supply

- ❑ Impact of Cooling on Achieving Renewable Energy Targets
- ❑ Overview of Active and Passive Cooling Measures
- ❑ Reduction potential from passive measures
- ❑ Evaluating Central and Decentralized Cooling Technologies



- Cooling supply technologies include active systems like vapor compression units, central air conditioning, and room air conditioning.
- **Free cooling sources**, such as ambient air, ground, or water bodies, offer sustainable options but require energy input to transport heat.
- Advanced cooling technologies are essential for achieving higher efficiency and reducing emissions in line with EU climate goals.
- Selection of supply technologies should balance efficiency, cost, and sustainability to address both current and future cooling demands.



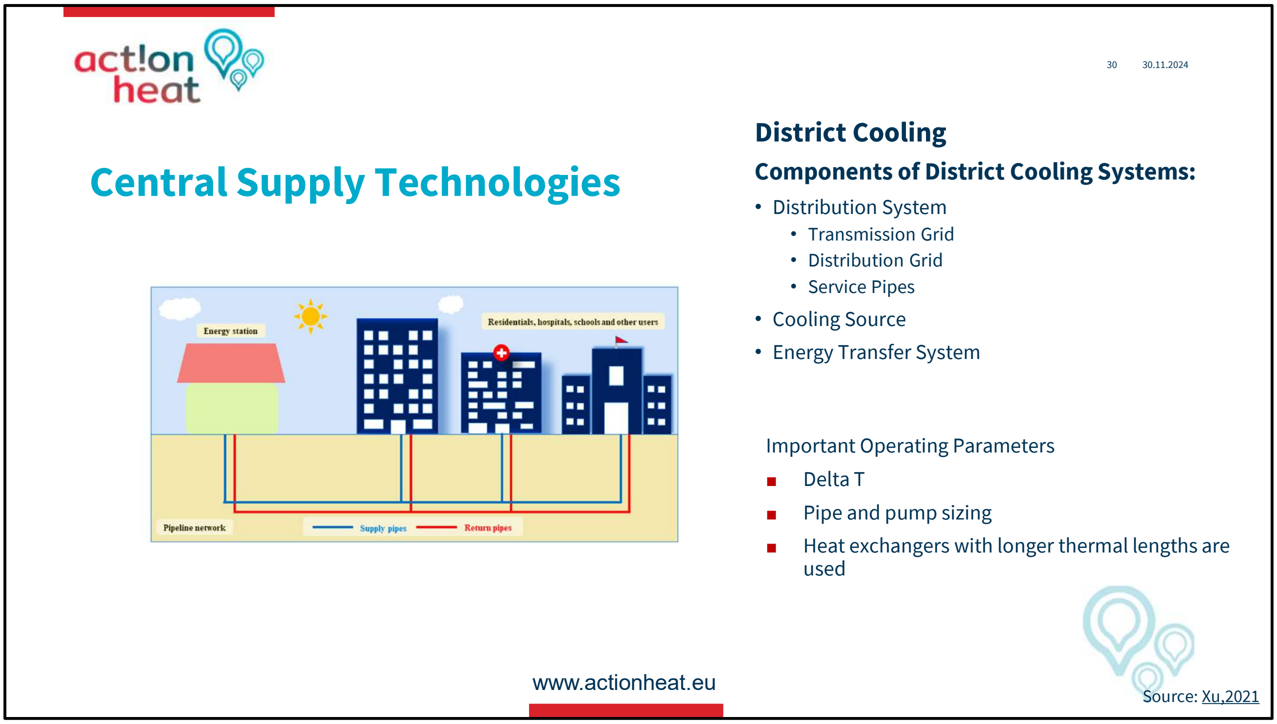
- Decentralized cooling technologies, such as vapor compression and absorption systems, offer flexible and localized solutions for cooling needs.
- These technologies are particularly suitable for areas without centralized infrastructure or where retrofitting existing buildings is required.
- While decentralized systems provide adaptability, centralized systems often achieve **higher efficiencies through economies of scale**, making them more energy and cost-effective in dense urban areas.
- Decentralized technologies remain a critical component of a diversified and sustainable cooling strategy.

Commonly Used Cooling Technologies

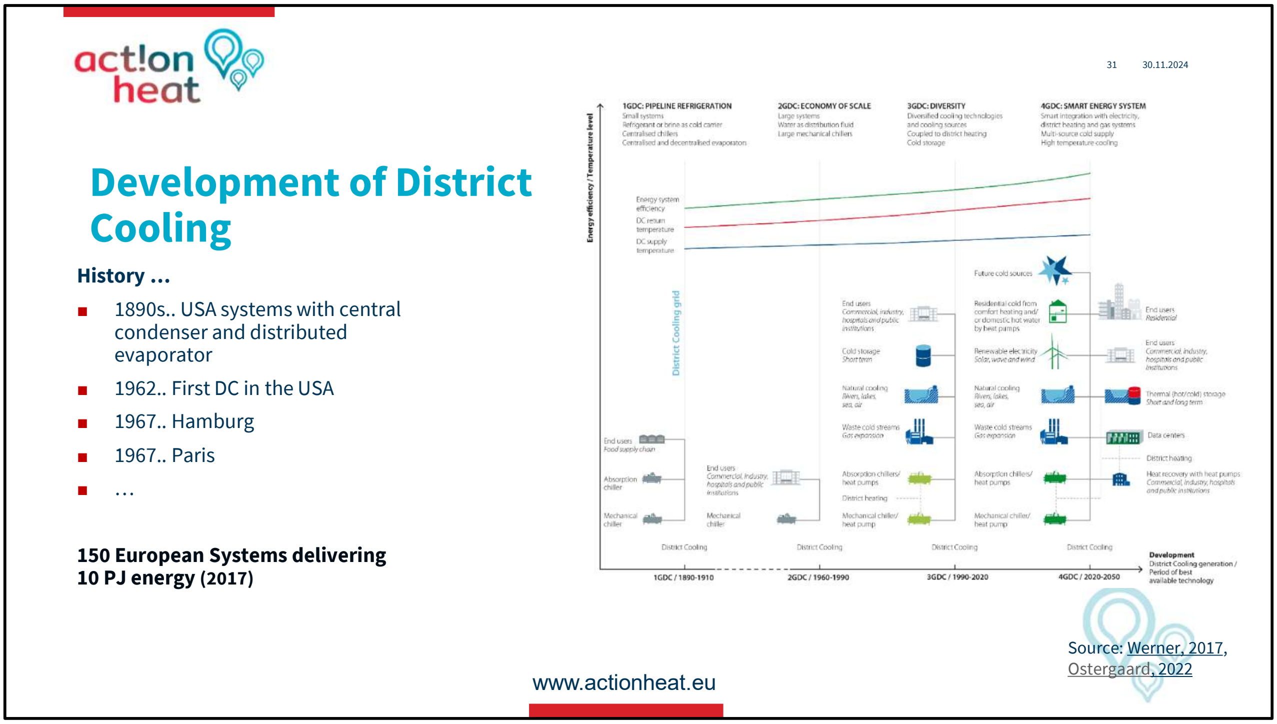
System Types	Costs (€/Units)	(Typical) SEER
Movables	409	2.49
Small Split (<5 kW)	1,051	4.4
Big Split (>5 kW, inclusive ducted)	1,692	4.17
Variable refrigerant flow systems	19,720	3.96
Rooftop + Packaged	18,135	3.88
Chillers (air-to-water) < 400 kW	20,768	3.51
Chillers (air-to-water) > 400 kW	111,370	3.52
Chillers (water-to-water) < 400 kW	1,676	4.8
Chillers (water-to-water) > 400 kW	88,033	5.8

Source: EURAC, 2021

- Centralized cooling technologies, such as district cooling, achieve **higher efficiencies through economies of scale** and are ideal for dense urban areas.
- Key components include distribution networks, service pipes, and energy transfer systems, ensuring reliable and efficient cooling delivery.
- Seasonal Energy Efficiency Ratios (**SEER**) represent average efficiency values but depend heavily on usage patterns and operational conditions.
- Centralized systems offer environmental and economic advantages, supporting sustainable urban cooling strategies.



- District cooling has evolved since its inception in the late 19th century, with the first systems developed in the USA and Europe.
- Modern systems are highly efficient, leveraging centralized cooling sources and advanced distribution networks.
- The technology has expanded globally, with over 150 systems in Europe as of 2017, delivering approximately 10 PJ of energy annually.
- Continued development is driven by urbanization, rising cooling demands, and the need for sustainable, large-scale cooling solutions.



- Low-temperature district cooling networks utilize ambient or waste cooling sources to improve energy efficiency and sustainability.
- These systems reduce energy losses during distribution and enable the integration of renewable and free cooling sources, such as groundwater or ambient air.
- Low-temperature networks are a key innovation for modernizing district cooling systems and aligning with decarbonization goals.
- Their implementation supports reduced operational costs and emissions, making them ideal for future-proof urban cooling strategies.

act!on heat

32 30.11.2024

Low-Temperature Networks

B 02	Groundwater + decentral LTHP - LT Network						
	T Source [°C]	T Grid [°C]	aquifer / ground	storage	heating / cooling		type
	10	10-25	Aquifer	no	Heating	Cooling	Basic
Technology	• Groundwater wells • Grid to transport water • LTHP to lift temperature at end users (decentralized) • 5G DHC						

Examples	***Friedberg, Germany*** [8]; *Shallow aquifer well doublets, 5GDH; only Heating*

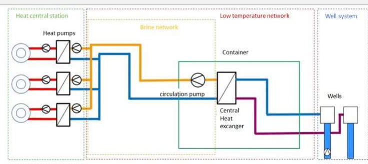


Figure 5: Scheme of the low temperature network operating with groundwater in Friedberg.

B 07	BHE + decentralized LTHP - LT Network						
	T Source [°C]	T Grid [°C]	aquifer / ground	storage	heating / cooling		type
	-4 – 25	10	Ground	yes	Heating	Cooling	Basic
Technology	• Borehole heat exchangers (type: 1-U, 2-U, coaxial; depth: 50-200 m; spacing; 6-8 m) • One or several heat pumps for each user • 5GDHC distribution grid						

www.actionheat.eu

Source: SAPHEA, 2023

- Low-temperature networks enhance energy efficiency by reducing distribution losses and utilizing renewable or free cooling sources like groundwater or ambient air.
- These systems support the integration of decentralized and centralized cooling technologies, enabling greater flexibility and sustainability.
- They align with decarbonization objectives, offering reduced emissions and operational costs compared to traditional high-temperature networks.
- Low-temperature networks are pivotal for modernizing district cooling systems and future-proofing urban cooling solutions.

action heat

33 30.11.2024

Identifying District Cooling Feasibility

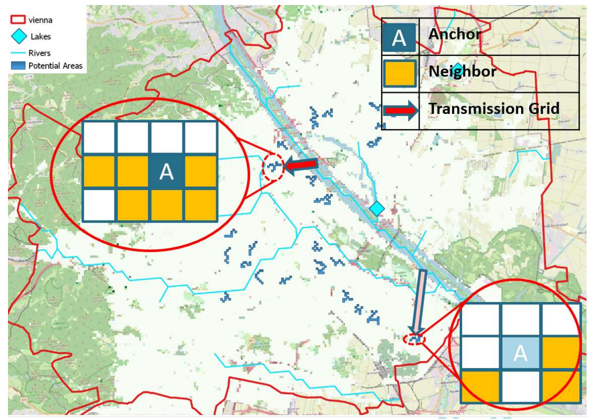
In a city/region,

- Which locations show feasibility for investment in DC networks?
- How much demand for cooling can be covered?
- What are the tentative investments?

$$\frac{1}{n}\sum_{n=1}^{n} L_{G_{a_n}} \leq LCOC_{ind_{a_n}}$$

$$LCOC_{DC_c} = L_{G_c} + \frac{crf \cdot (I_{pump} + I_{trans} + I_{supply}) + O_f + ElecP \cdot (O_{v_{pump}} + O_{v_{supply}})}{\sum UED_{act_i}}$$

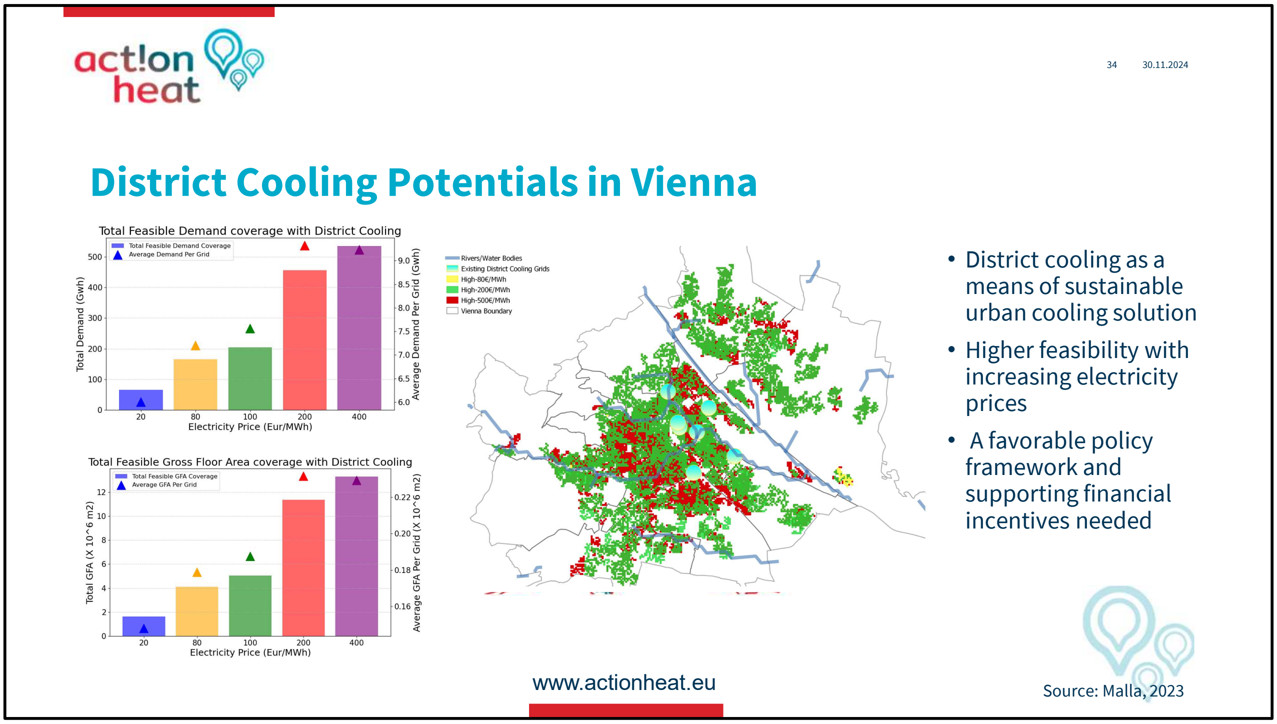
$$LCOC_{DC_c} \leq LCOC_{ind}$$



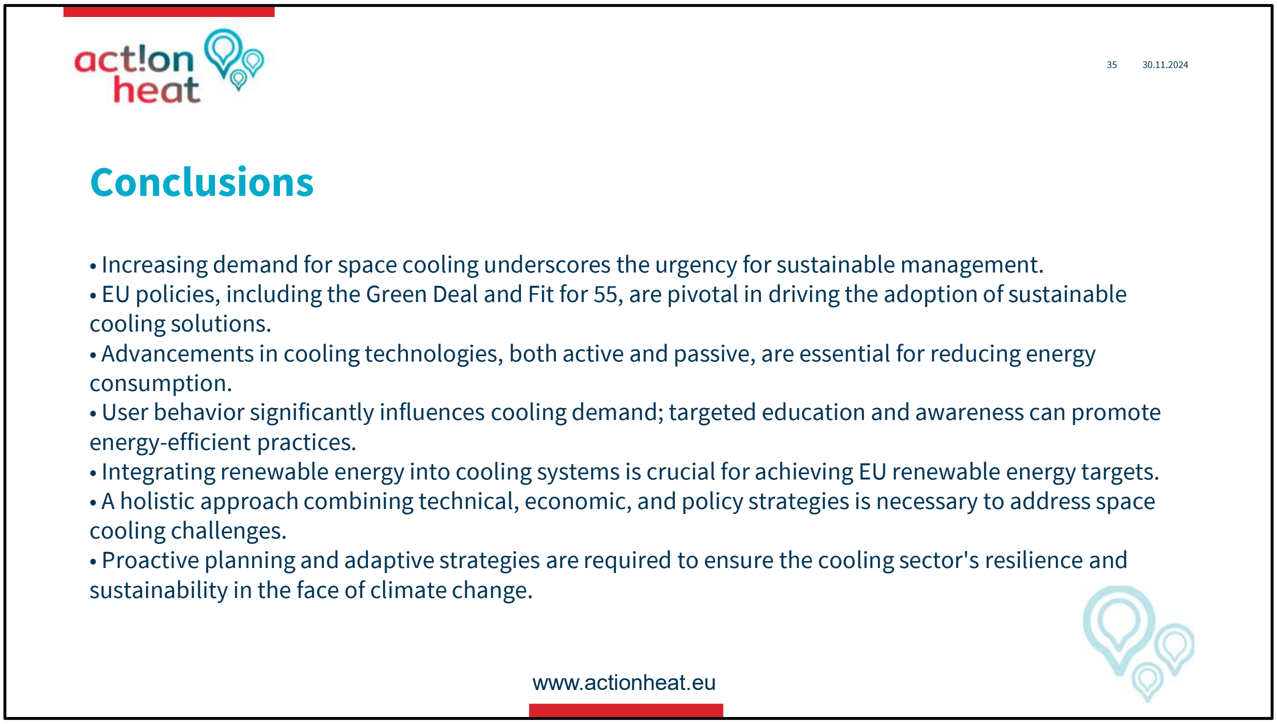
www.actionheat.eu

Source: Malla, 2023

- Feasibility assessments for district cooling focus on identifying locations with sufficient demand density to justify investment in infrastructure.
- Key considerations include the percentage of cooling demand that can be met, initial investment requirements, and operational efficiencies.
- These evaluations guide policymakers, urban planners, and investors in determining where district cooling networks are most viable and impactful.
- Accurate feasibility studies are critical for optimizing resource allocation and maximizing the sustainability benefits of district cooling systems.



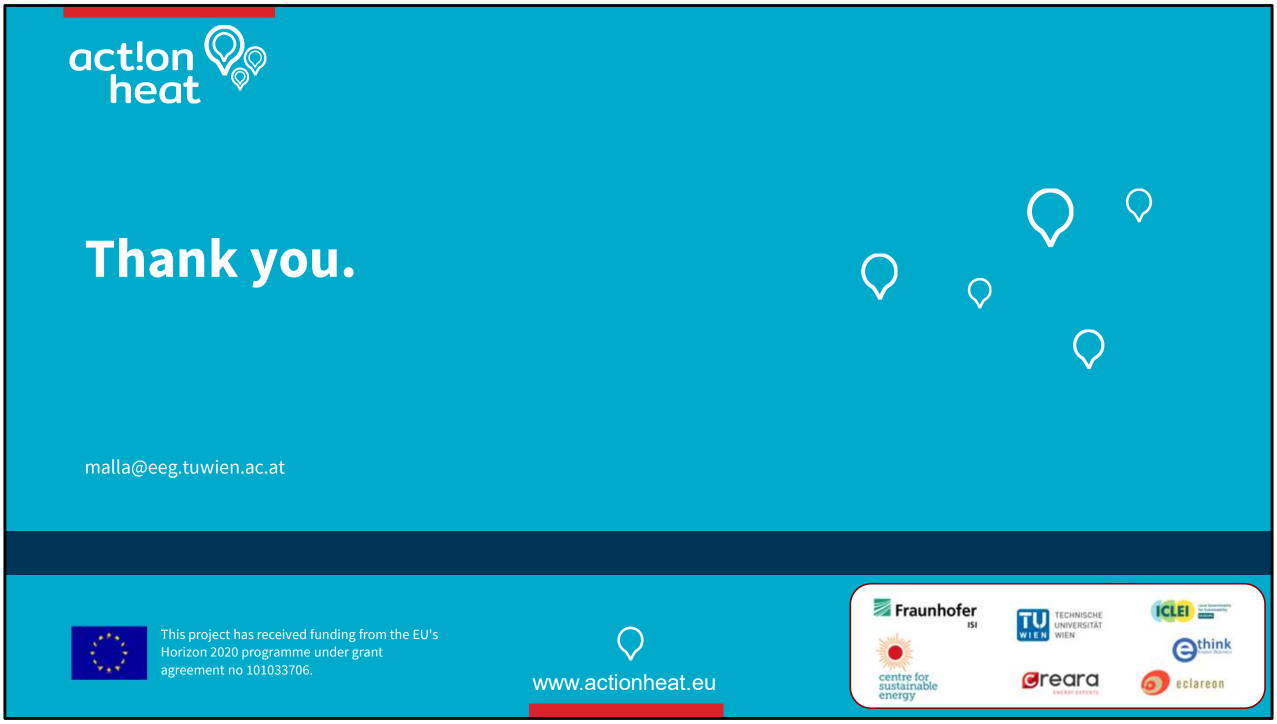
- District cooling offers a sustainable solution for Vienna, improving energy efficiency and reducing emissions.
- High upfront costs necessitate **supporting incentives** and policy frameworks to ensure financial viability and encourage adoption.
- Rising electricity prices enhance the economic appeal of district cooling systems, making them a competitive option.
- Scaling district cooling aligns with Vienna's climate and sustainability goals, contributing to long-term urban development plans.



- Rising cooling demand necessitates urgent action for sustainable management through energy-efficient and renewable solutions.EU policies like the Green Deal and Fit for 55 are key drivers in adopting sustainable cooling technologies and achieving decarbonization targets.
- Advancements in both active and passive cooling measures are critical to reducing energy consumption and emissions.
- User behavior significantly influences cooling demand, highlighting the need for education and awareness to promote energy-efficient practices.
- A holistic, integrated approach combining technical, economic, and policy strategies is essential to address the challenges of space cooling.

Contents

- Part 1: Existing and projected demands and EU policy landscape
  - Space cooling demands in Europe, reasons for increasing space cooling demands
  - EU regulations related to space cooling, requirements within the Comprehensive Assessment in the EED Art. 25
- Part 2: Opportunities for reduction and sustainable supply
  - Reduction potential from passive measures
  - Identifying Sustainable Supply technologies - Central and Decentral
  - Impact of occupant behavior on cooling demand


act!on heat
Thank you.
malla@eeg.tuwien.ac.at
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu
Fraunhofer ISI
TU WIEN TECHNISCHE UNIVERSITÄT WIEN
ICLEI
ethink
centre for sustainable energy
creara
eclareon

Webinar 9:
Existing heat planning policies in Europe

Act!onHeat SF1

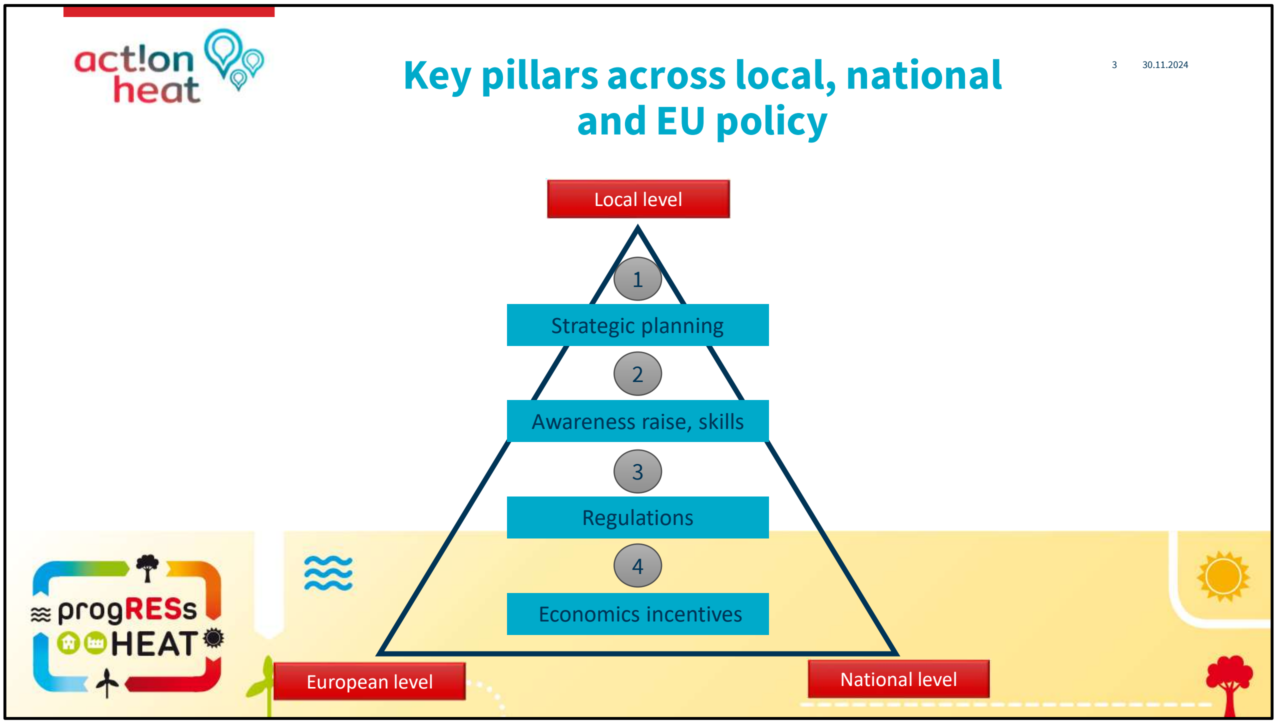
- Serial 3:
    - Webinar 9
        - Strategical Heating & Cooling planning
        - Group support for municipalities and stakeholders

- Presented by:
    - e-think / Austria

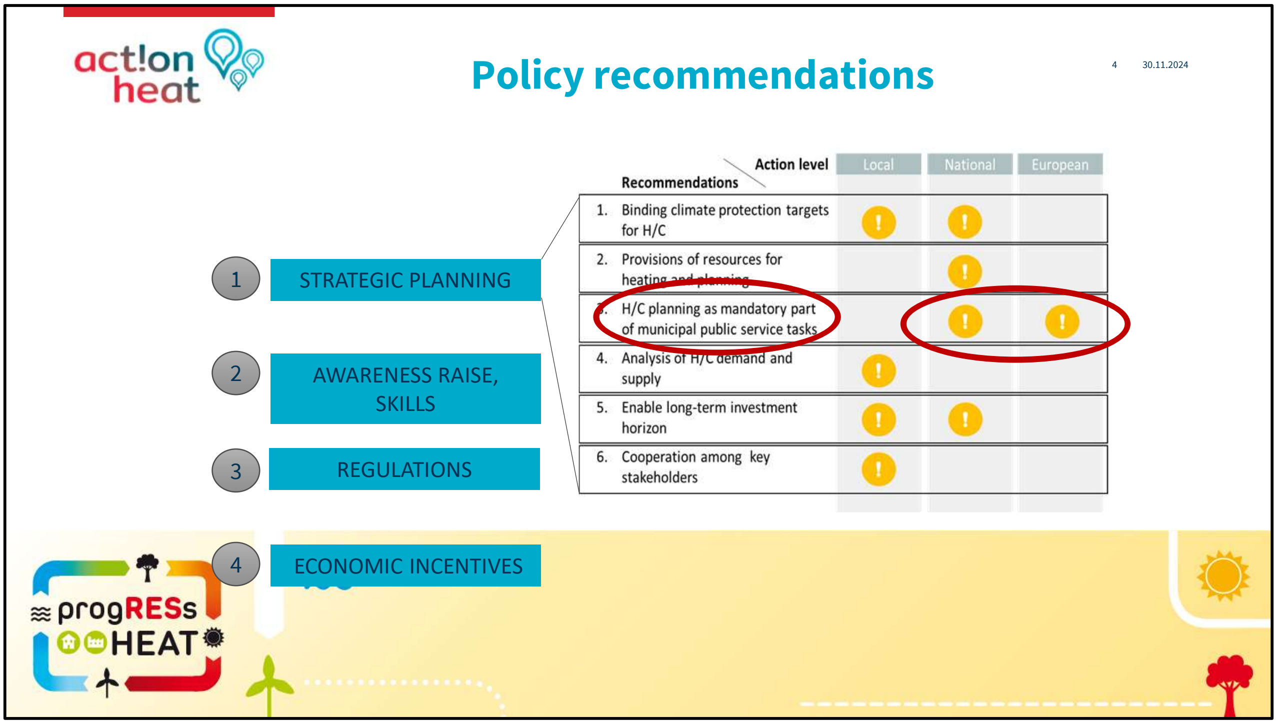
The discussion explored current heat planning policies in Europe, with a focus on zoning policies and best practices across various countries. It examined how these practices align with the Energy Efficiency Directive (EED) to support sustainable heating and cooling systems. The webinar was led by Marcus Hummel.

Content

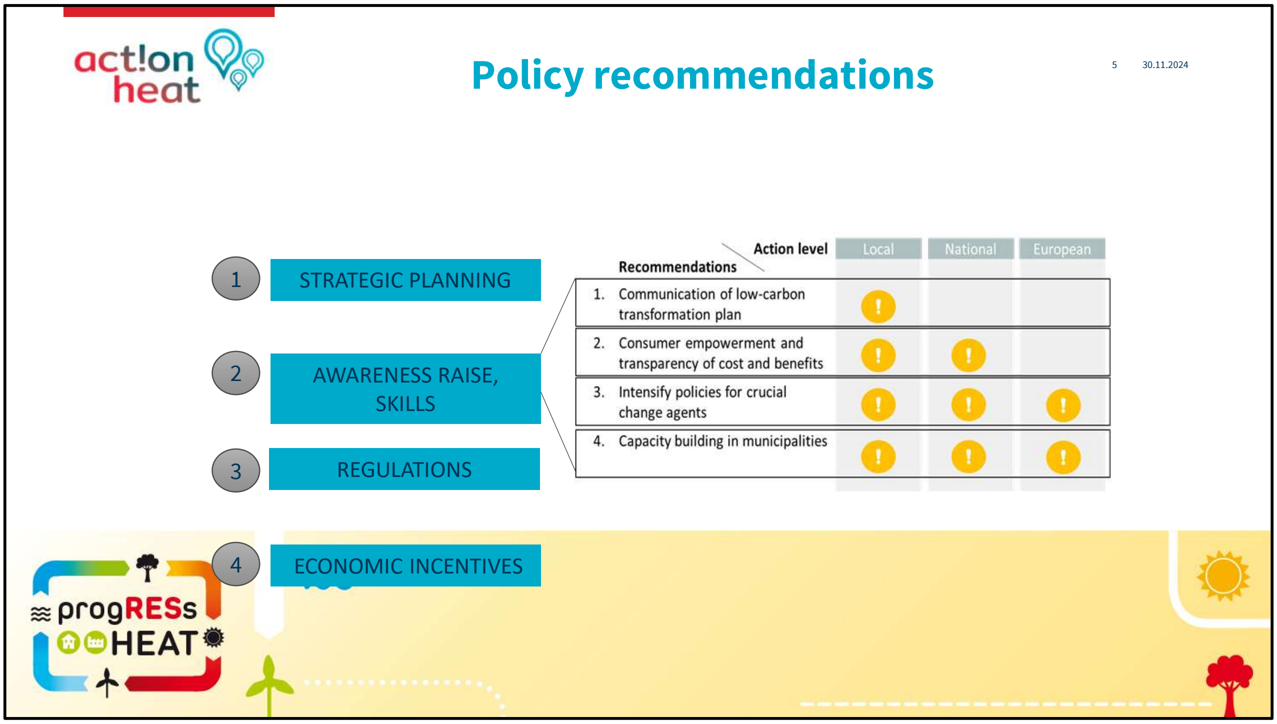
1. Recommended policies for H&C planning
2. Overview of current situation in Europe
3. Mandatory heat planning in the EED2023
4. Special focus on zoning for district heating
5. Discussion



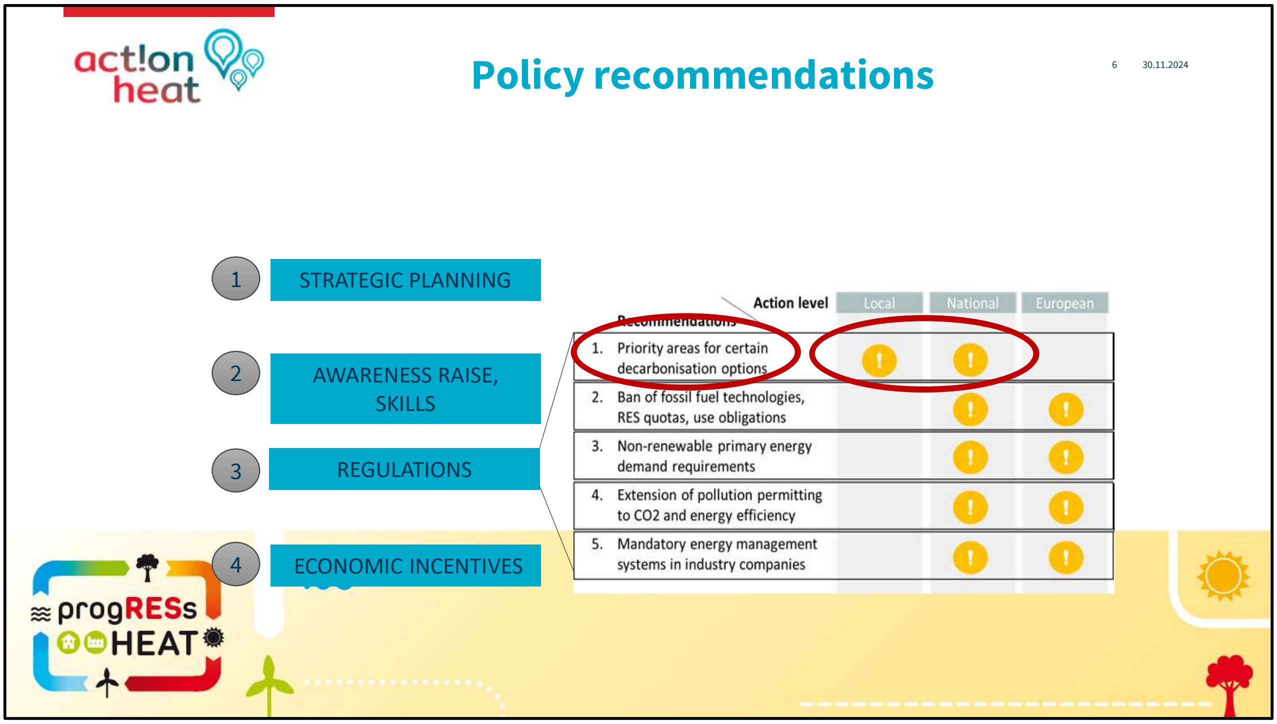
- Emphasis on strategic planning, regulations, awareness-raising, and economic incentives to drive effective heat planning.
- Collaboration is essential across local, national, and EU levels to align policies and maximize impact.
- Zoning policies, combined with mandatory connection requirements, can significantly improve district heating networks.



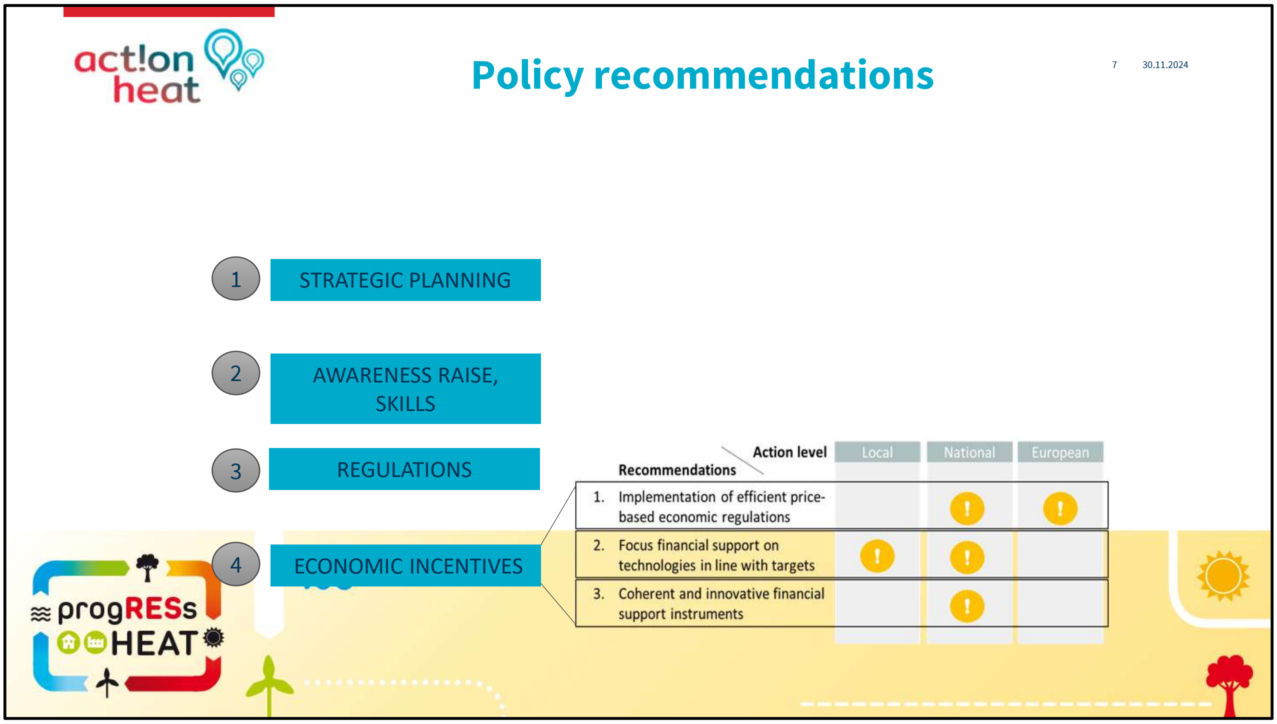
- Heating and cooling (H&C) planning should be a mandatory responsibility for municipalities.
- Establishes a structured approach to meet local energy needs efficiently and sustainably.
- Ensures alignment with national and EU-level policies for cohesive action.
- Helps municipalities prioritize energy efficiency and integrate renewable sources in H&C supply.



- Raising awareness is crucial to gain public support for sustainable heating and cooling (H&C) initiatives.
- Skill development programs are needed for local authorities to implement effective H&C planning.
- Educating stakeholders helps promote energy-efficient technologies and practices.
- Strong awareness and skills create a foundation for successful and long-lasting H&C solutions.



- Regulations are essential to align heating and cooling (H&C) planning with environmental and energy objectives.
- National-level designation of priority areas for district heating should be implemented locally.
- A strong regulatory framework ensures consistent standards and compliance across all regions.
- Clear regulations support the long-term sustainability and effectiveness of H&C systems.



- Economic incentives are crucial to encourage investments in sustainable heating and cooling (H&C) systems.
- Financial support can make it easier for municipalities and consumers to transition to district heating and cooling.
- Incentives help accelerate the adoption of energy-efficient and renewable technologies.
- Well-designed incentives drive progress towards decarbonized and resilient H&C systems.

Selected overall conclusions to make DH renewable and efficient

- ***Policy packages needed** taking into account all 4 pillars of action and 3 levels of regional scope*
- ***Long-term targets** and long-term **analysis / planning** is crucial at national and local level taking into account all possible options (efficiency, RES-H/C, RES-E for heating)*
- ***DH** is the **only way to decarbonise densely populated areas** with limited efficiency potentials & DH **facilitates the integration of RES**, excess heat and power-to-heat in the system*
- ***Zoning** (definition of DH priority areas) **is a promising approach to reach low costs of DH** even with decreasing heat demand (through high connection rates)*
- *Clear indication that **DH as public service cheaper than profit-oriented DH***
- ***Integration / information of consumers / end-users is very important** for successful conversion to efficient and renewable DH*

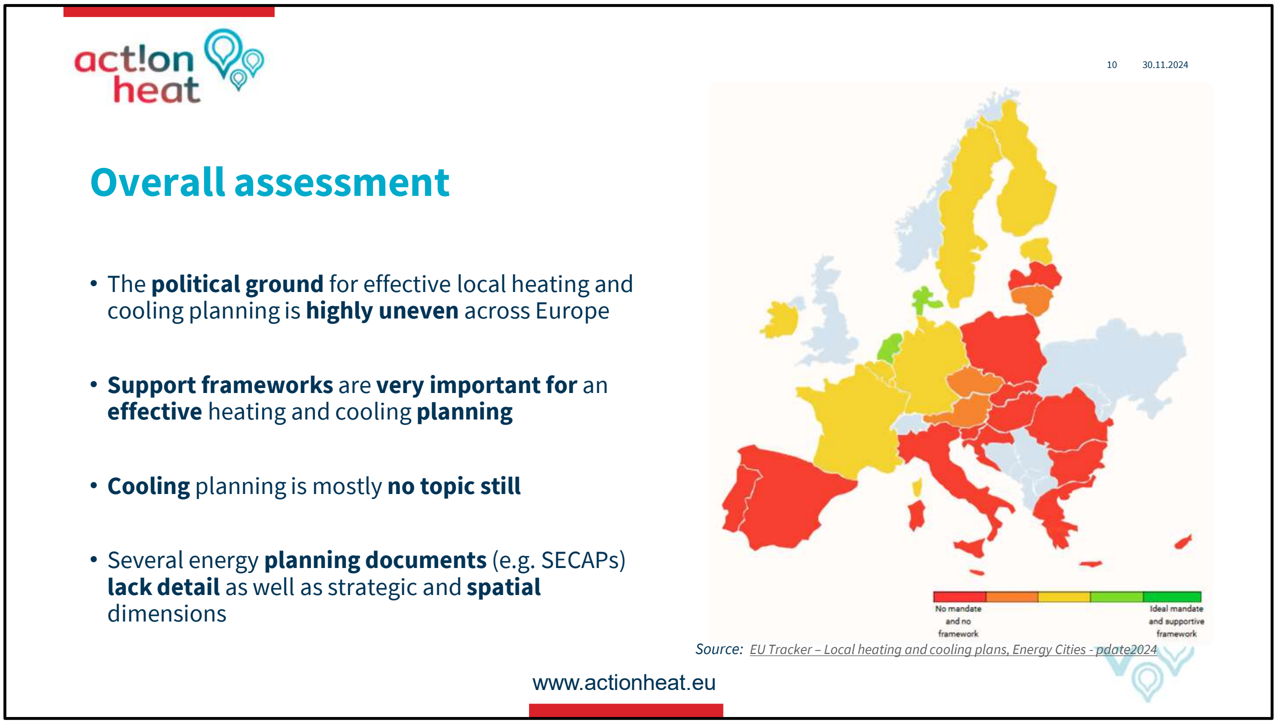
act!on heat

9 30.11.2024

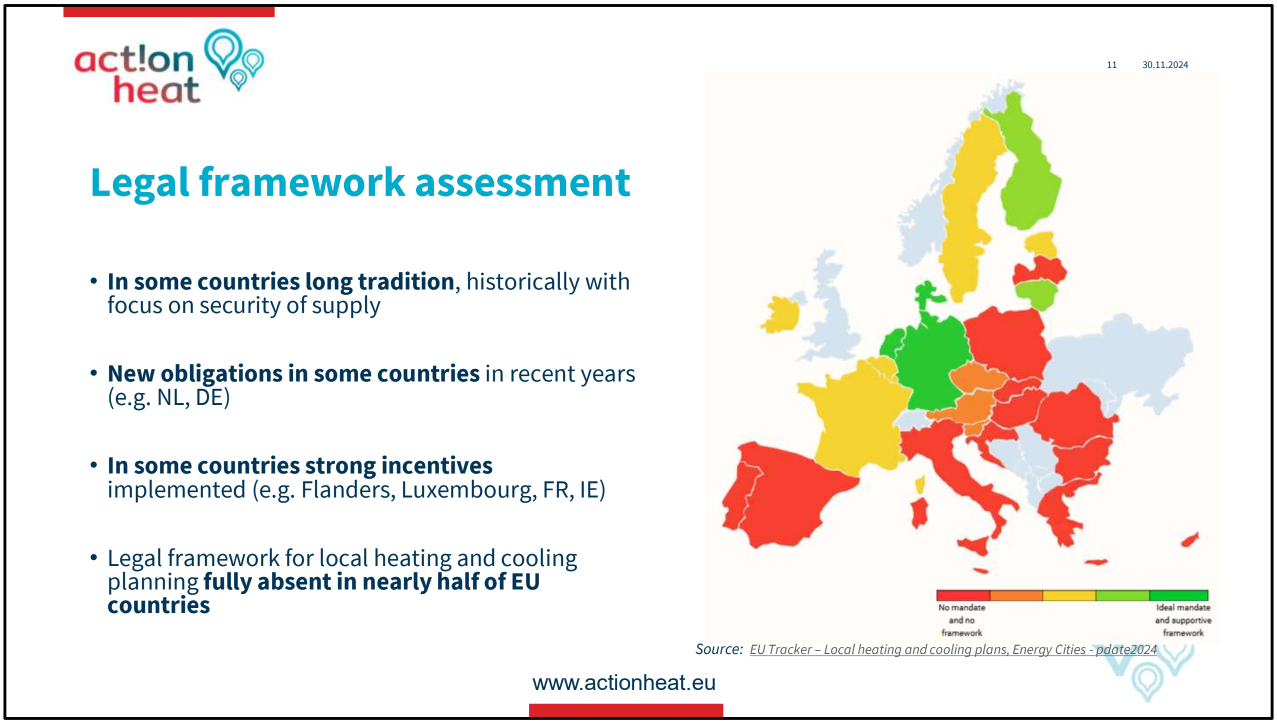
Content

1. **Recommended policies for H&C planning**
2. **Overview of current situation in Europe**
3. **Mandatory heat planning in the EED2023**
4. **Special focus on zoning for district heating**
5. **Discussion**

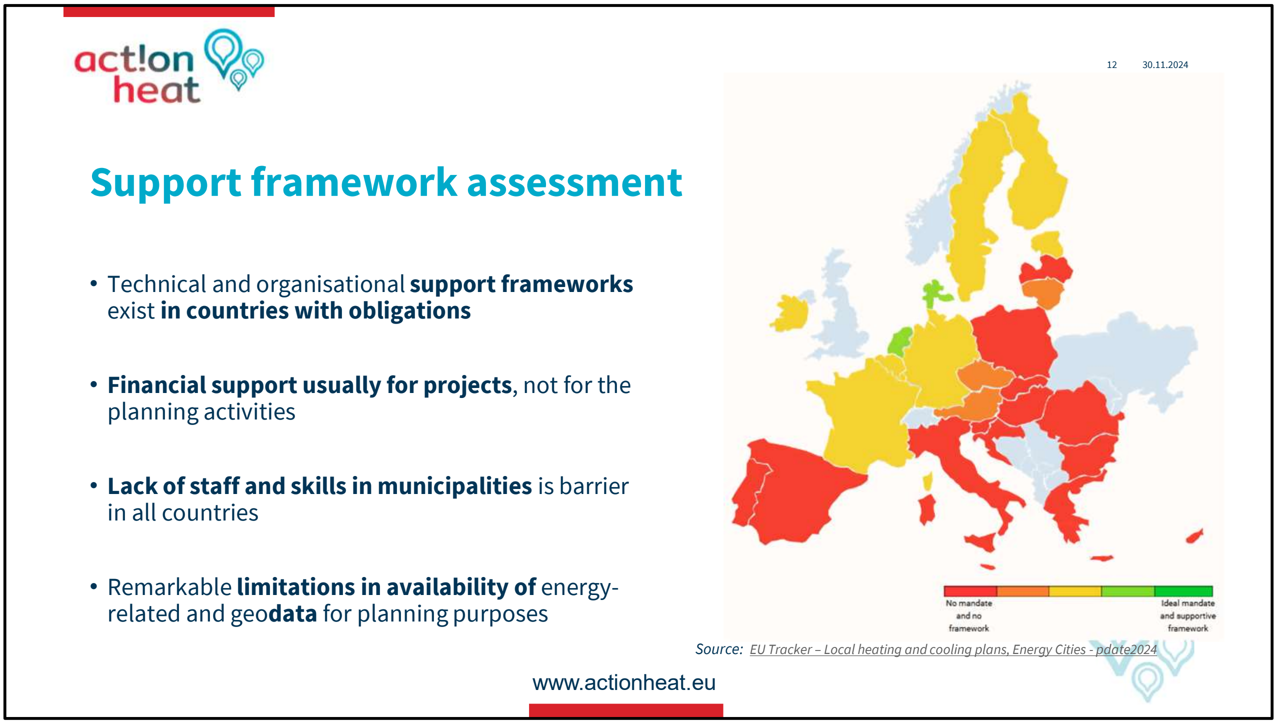
www.actionheat.eu



- H&C planning across Europe shows significant disparity; some countries lack clear policies and support frameworks.
- Technical and financial assistance are essential, as legislation alone is insufficient for effective implementation.
- Cooling planning remains a gap in many countries, with limited integration into broader H&C strategies.
- Spatial dimensions, such as zoning for district heating, are critical but often missing, reducing plan effectiveness.



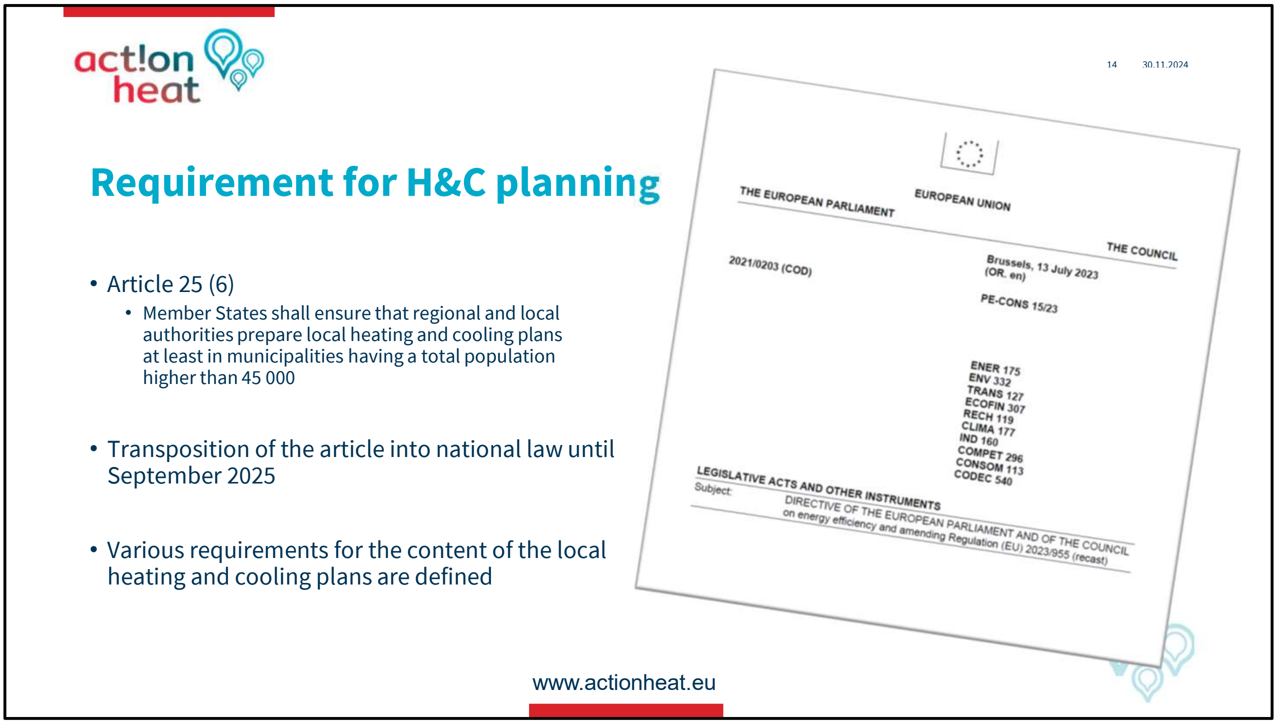
- Some countries have a long tradition of H&C planning, often driven by energy security rather than climate protection.
- Recent years have seen new obligations introduced in countries like the Netherlands and Germany.
- Strong incentives exist in regions like Flanders, Luxembourg, and France, but nearly half of EU countries lack a legal framework.
- Comprehensive legal frameworks are essential to establish consistent and effective H&C planning.



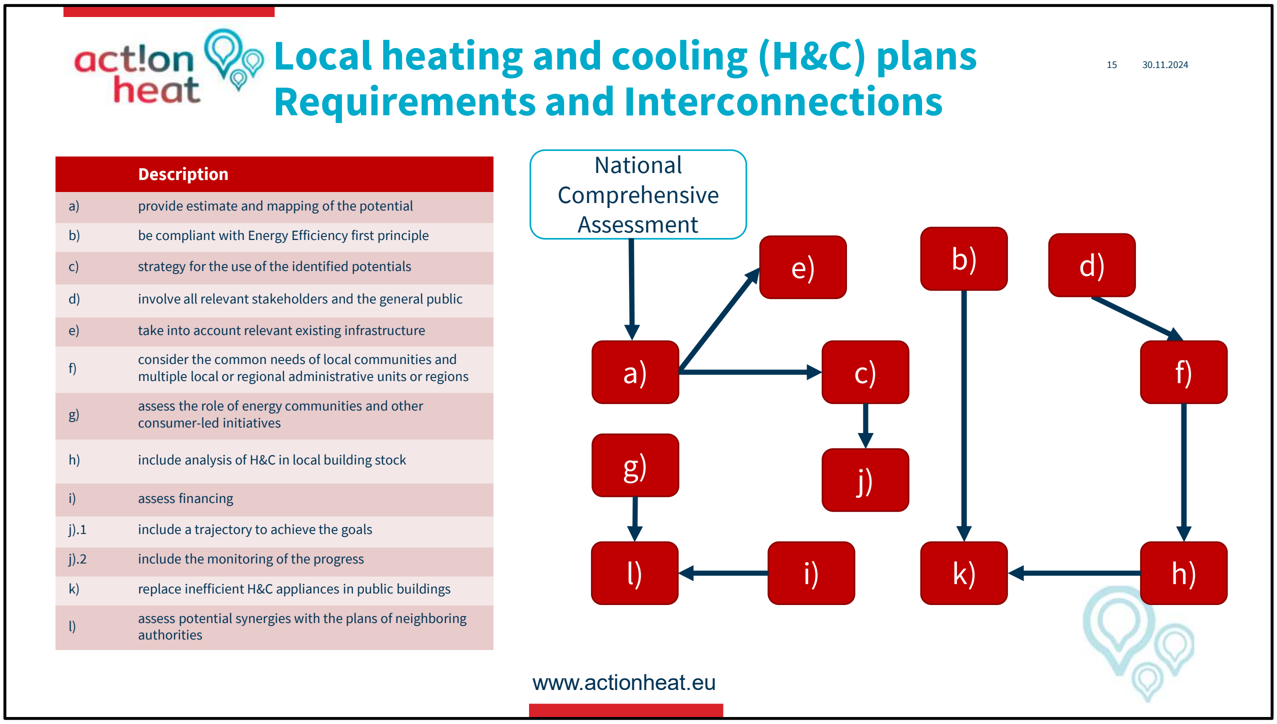
- Countries with H&C planning obligations often provide technical and organizational support frameworks.
- Financial support is typically project-focused, with limited funding for planning activities.
- A lack of staff and expertise in municipalities remains a significant barrier across Europe.
- Access to reliable energy-related and geospatial data is crucial for effective planning but is often insufficient.

Content

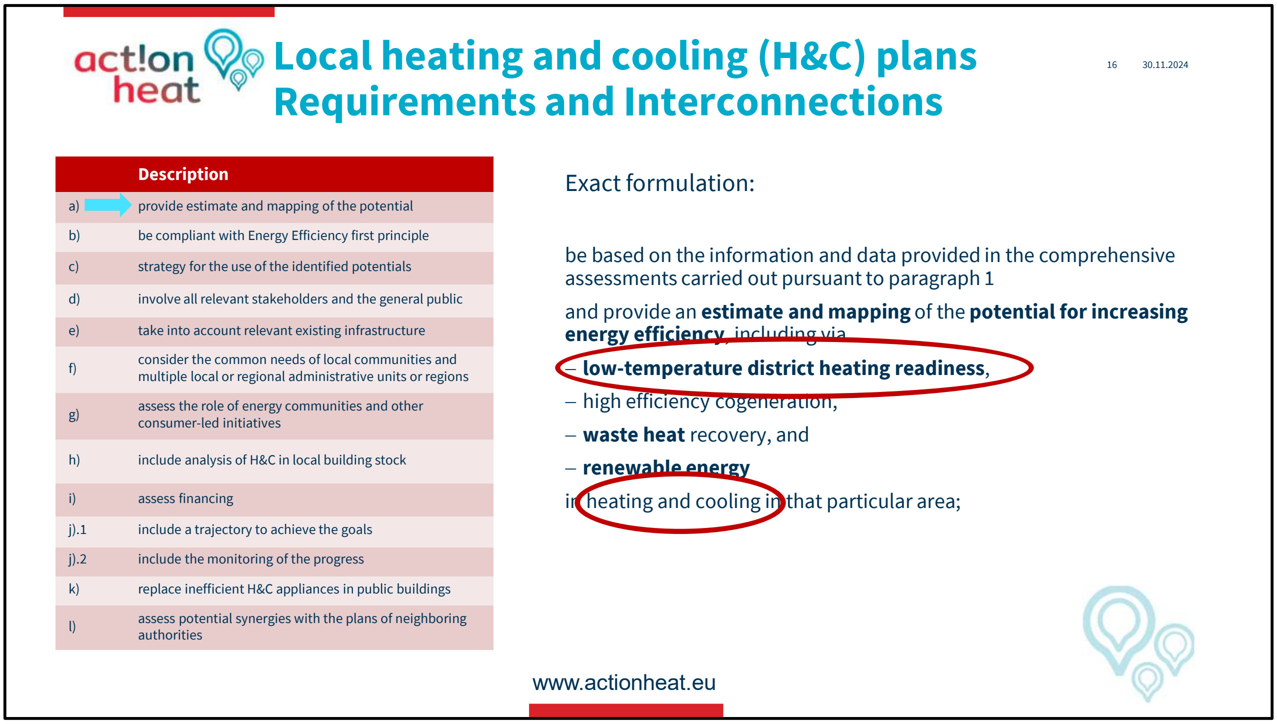
1. Recommended policies for H&C planning
2. Overview of current situation in Europe
3. Mandatory heat planning in the EED2023
4. Special focus on zoning for district heating
5. Discussion



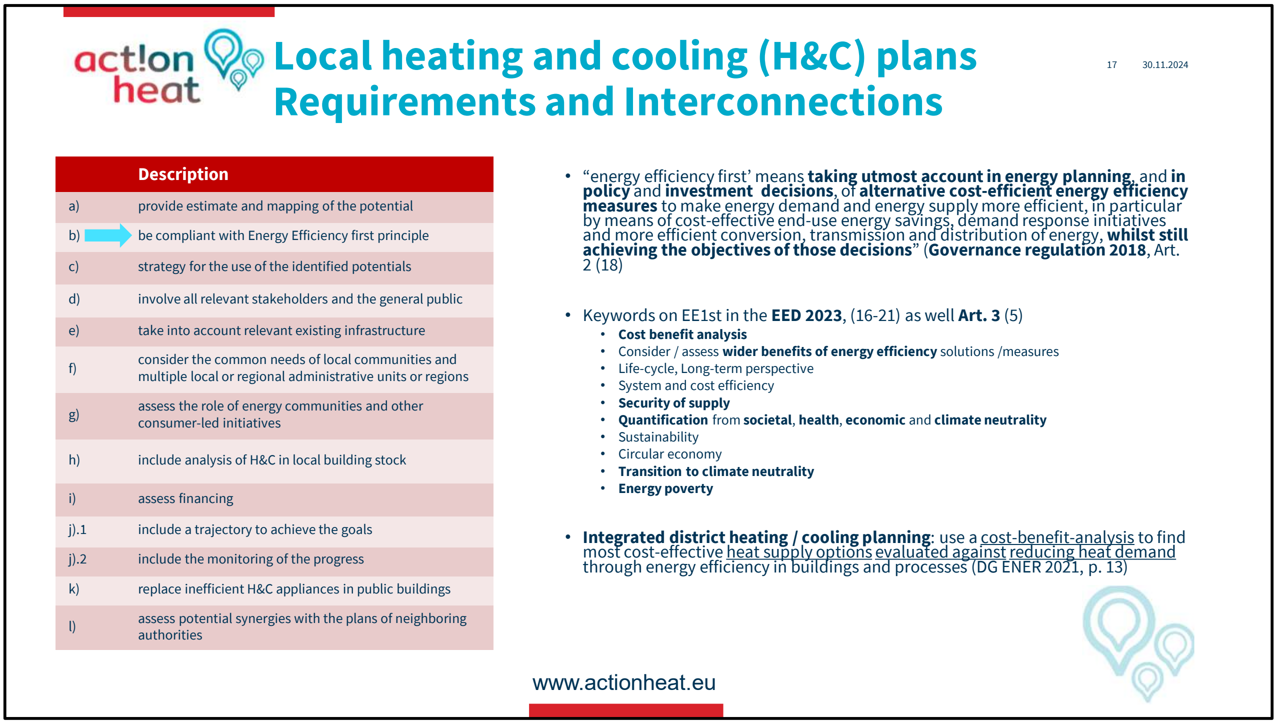
- Article 25(6) of the EED mandates local H&C plans for municipalities with populations over 45,000.
- These plans must estimate and map potential for energy efficiency, waste heat recovery, and renewable energy integration.
- Transposition into national law is required by September 2025 to align with EU regulations.
- Clear guidelines are needed to ensure consistency and compliance across regions.



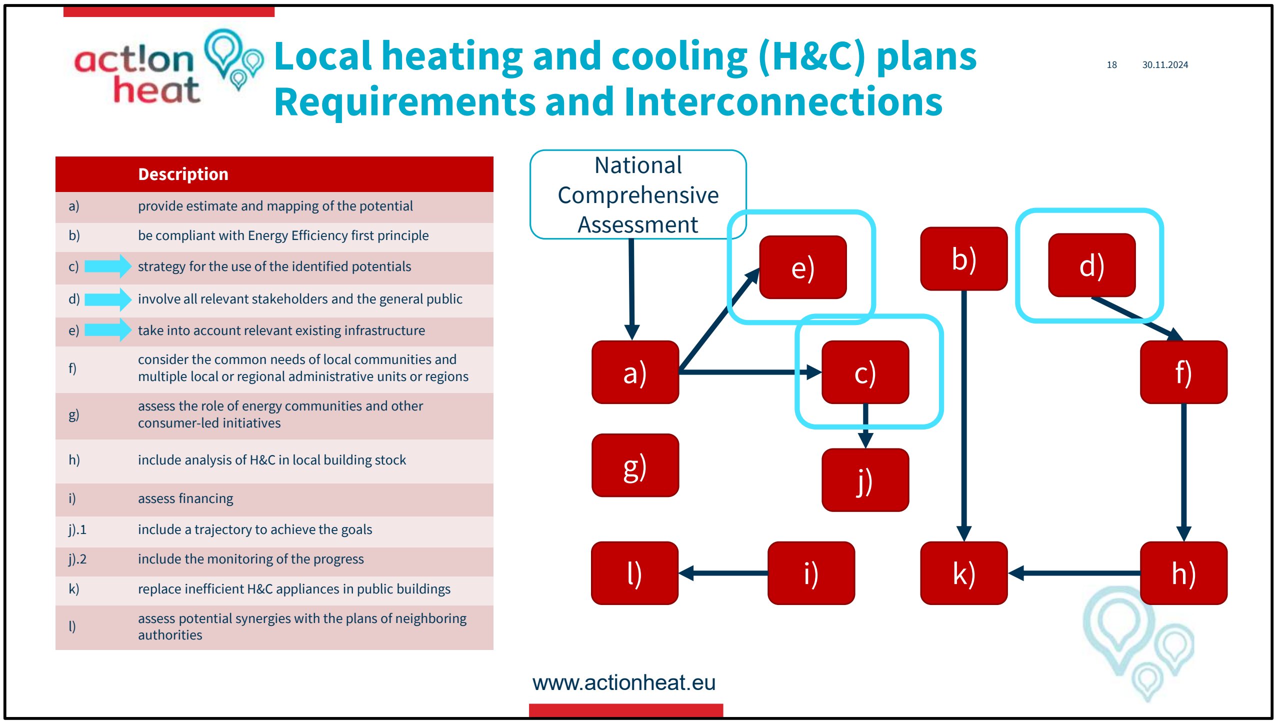
- Plans must address energy efficiency improvements, renewable energy integration, and district heating readiness.
- Regular comprehensive assessments should be conducted to ensure compliance with EED Article 25.
- Plans should include top-down calculations and identify energy efficiency as a top priority.
- Cooling requirements, often overlooked, must be explicitly included in H&C plans.



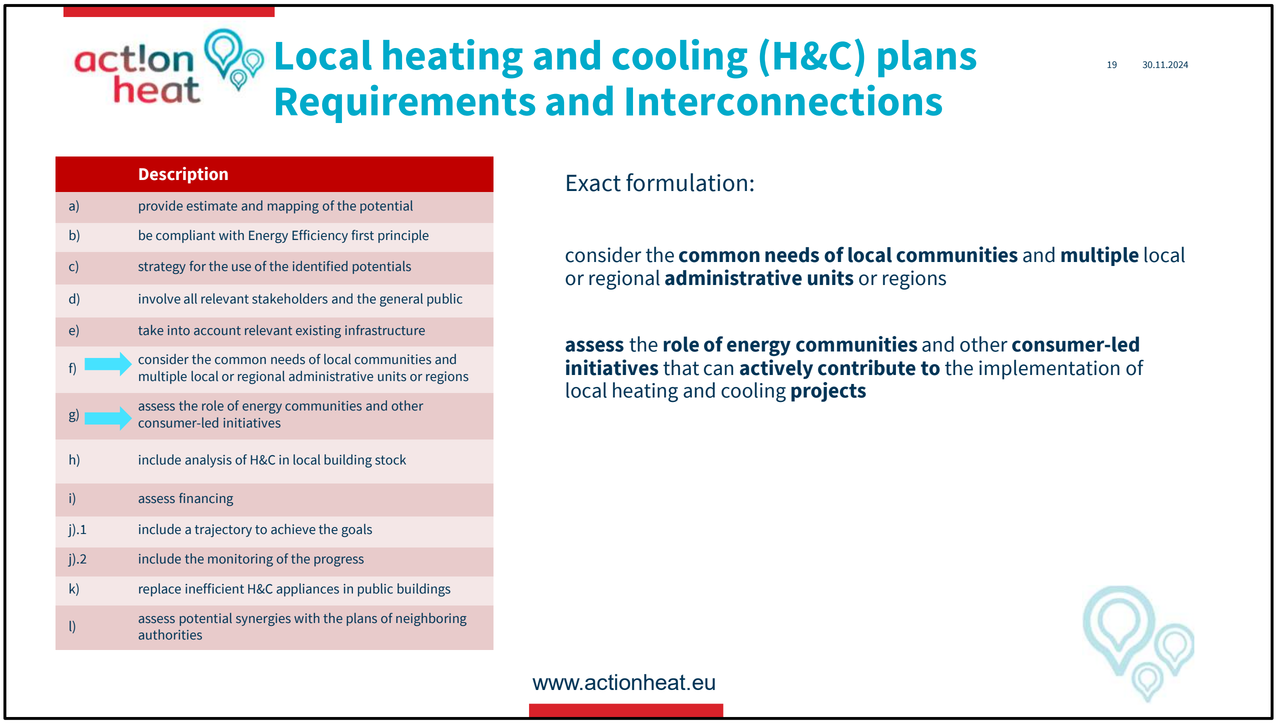
- Prioritize energy efficiency in H&C planning before exploring new energy supply options.
- Implement cost-effective measures to reduce energy demand and improve system efficiency.
- Use cost-benefit analyses to evaluate societal, economic, and environmental benefits of efficiency measures.
- Ensure energy efficiency is central to achieving climate neutrality and reducing energy poverty.



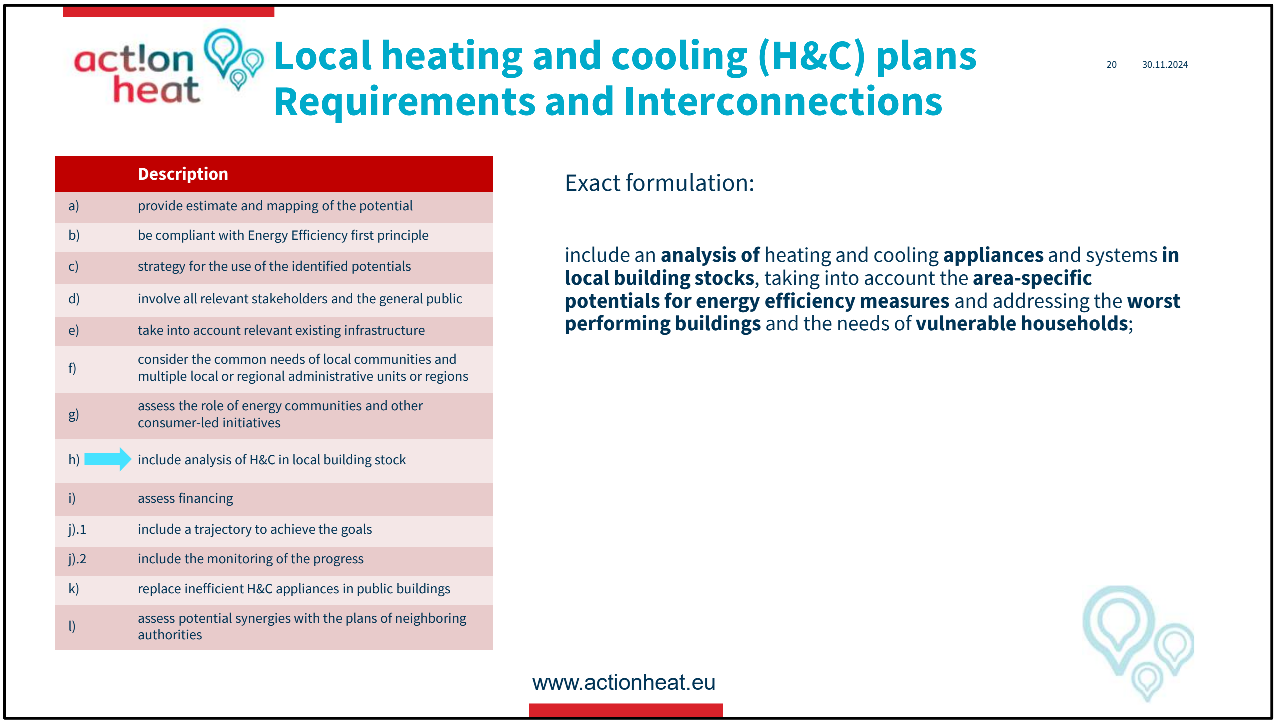
- Effective H&C plans require active involvement of all stakeholders, including local energy communities.
- Strategies should move beyond city-led initiatives, incorporating consumer-driven contributions.
- Engage stakeholders early to align expectations and ensure practical implementation of plans.
- Combine technical assessments with participatory planning to enhance acceptance and success.



- Identifying energy potential must be complemented by strategic planning to ensure effective implementation.
- Infrastructure development should align with actionable strategies, prioritizing efficiency and sustainability.
- Stakeholder engagement is critical to designing infrastructure that meets community and policy needs.
- Incorporating diverse inputs ensures robust infrastructure planning for heating and cooling systems.



- Local energy communities are often overlooked in H&C planning but have great potential to contribute
- Empower consumer-led initiatives to support the transition to sustainable heating and cooling systems.
- Encourage collaboration between local authorities and energy communities to create robust plans.
- Integrate community-driven solutions to enhance inclusivity and effectiveness in H&C planning.



- Reliable data, particularly geospatial and energy-related, is crucial for effective H&C planning.
- Addressing data gaps helps align planning efforts with energy efficiency and sustainability goals.
- Accurate data enables targeted interventions for vulnerable households and worst-performing buildings.
- Enhanced data collection supports better decision-making and energy poverty alleviation.

act!on heat

Local heating and cooling (H&C) plans Requirements and Interconnections

21 30.11.2024

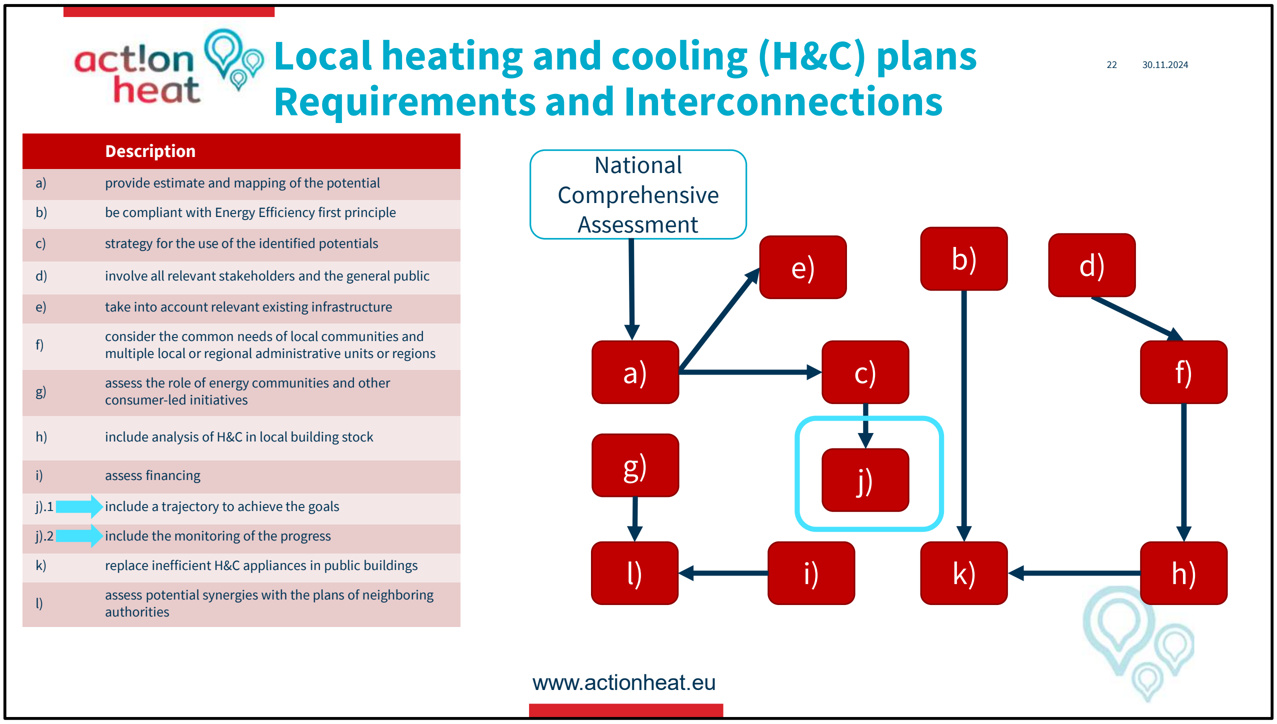
	Description
a)	provide estimate and mapping of the potential
b)	be compliant with Energy Efficiency first principle
c)	strategy for the use of the identified potentials
d)	involve all relevant stakeholders and the general public
e)	take into account relevant existing infrastructure
f)	consider the common needs of local communities and multiple local or regional administrative units or regions
g)	assess the role of energy communities and other consumer-led initiatives
h)	include analysis of H&C in local building stock
i) →	assess financing
j).1	include a trajectory to achieve the goals
j).2	include the monitoring of the progress
k)	replace inefficient H&C appliances in public buildings
l)	assess potential synergies with the plans of neighboring authorities

Exact formulation:

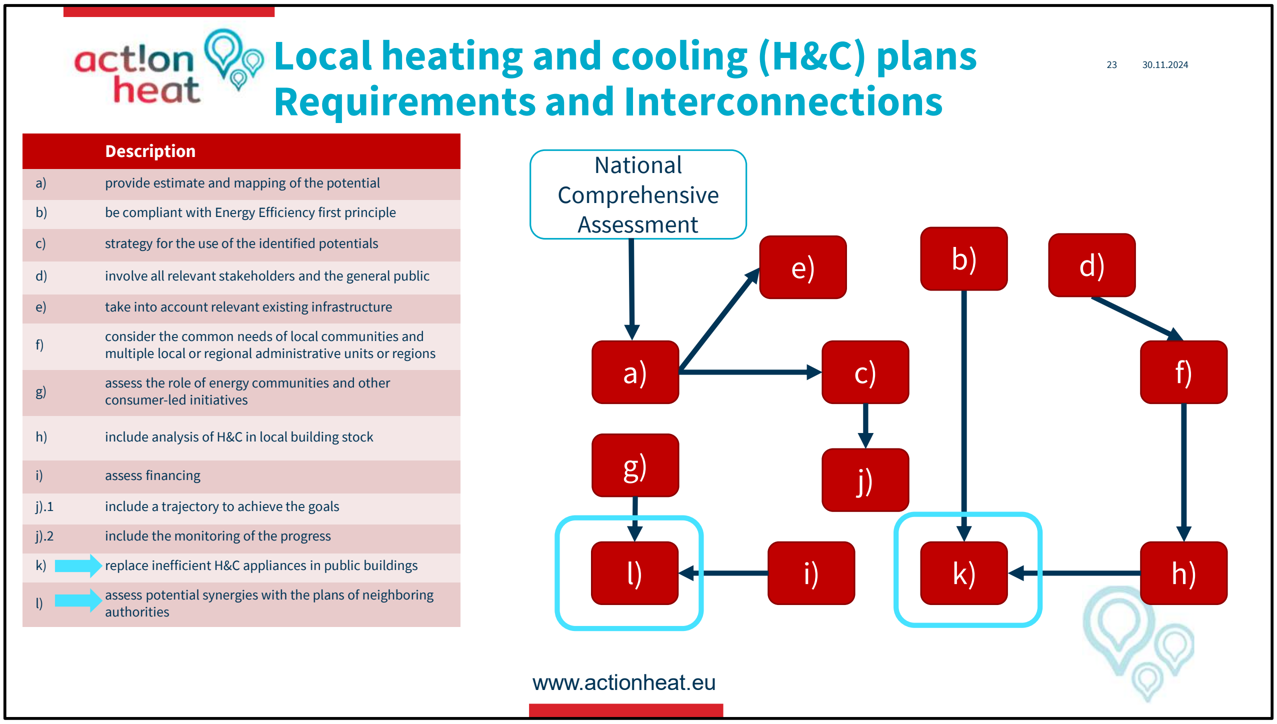
assess how to **finance** the **implementation of policies and measures** and **identify financial mechanisms** allowing **consumers** to shift to renewable heating and cooling;

www.actionheat.eu

- Identify funding mechanisms to support the shift to renewable heating and cooling systems.
- Develop strategies to make financing accessible for consumers and municipalities.
- Prioritize financial support for vulnerable households to ensure an equitable transition.
- Link financing solutions to long-term H&C plans to sustain momentum in decarbonization efforts.



- Develop clear roadmaps with milestones to track progress towards decarbonization goals.
- Transition from target setting to actionable trajectories with defined steps and timelines.
- Monitoring and evaluation mechanisms are crucial to ensure compliance and adapt plans as needed.
- Incorporate feedback loops to improve planning based on real-world outcomes.



- Public buildings offer an accessible starting point for municipalities to implement H&C plans.
- Targeting public buildings can demonstrate the feasibility of energy efficiency measures.
- These projects set an example for broader community adoption of sustainable practices.
- Prioritize retrofitting and renewable energy integration in public infrastructure to drive decarbonization.

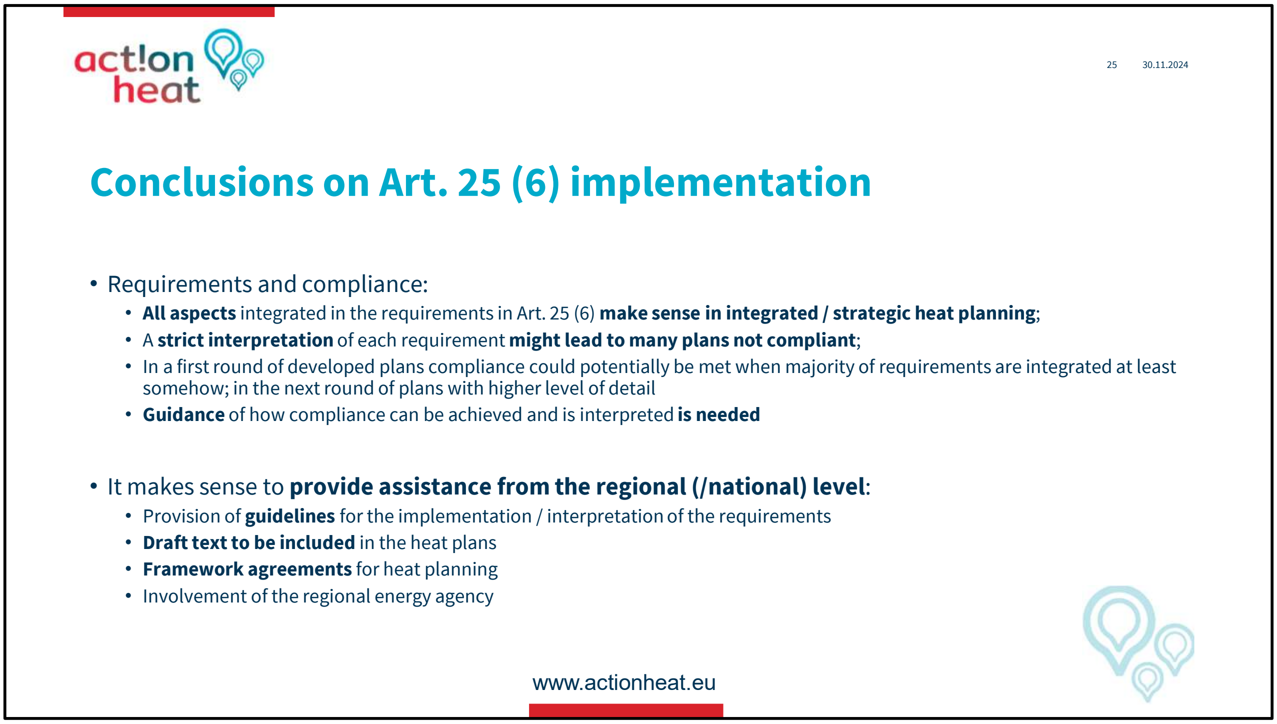
Local heating and cooling (H&C) plans

24 30.11.2024

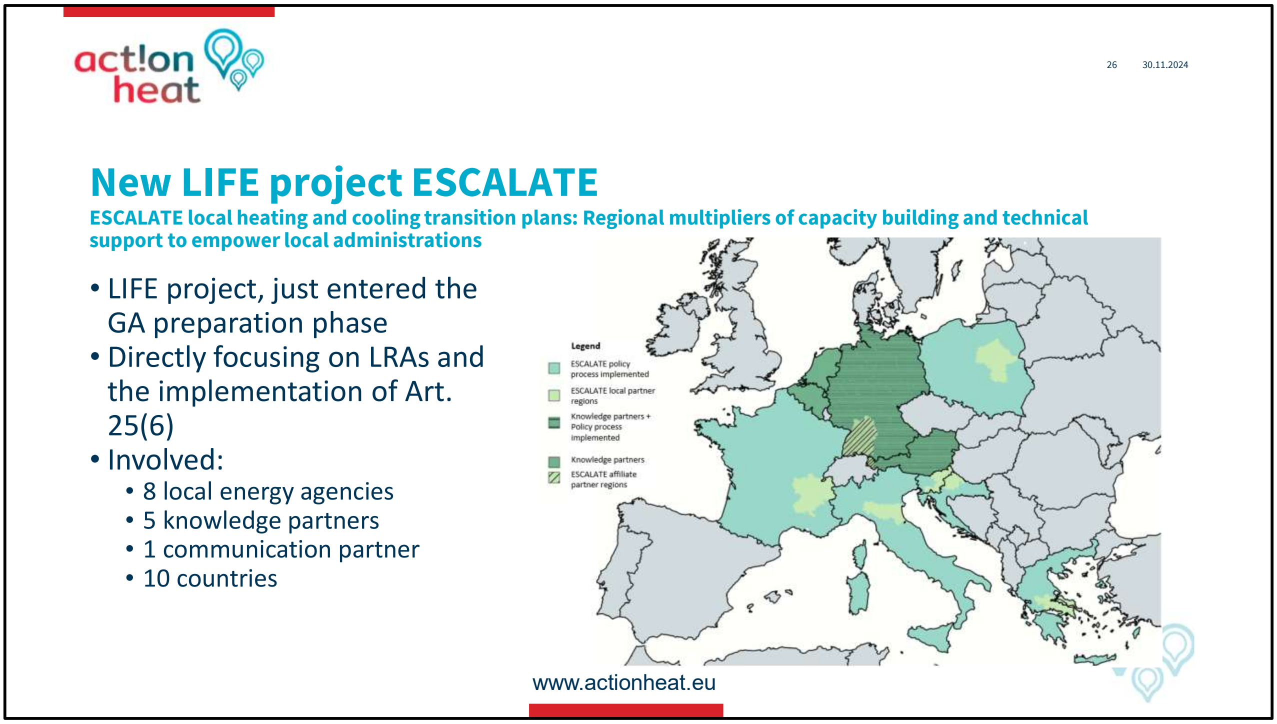
Directive Breakdown		Key Words Collection for checking the relevant passages in the H/C plan documents	Checklist for compliance
Potential for increasing energy efficiency	estimate	Renovation, efficiency, renovation scenario, demand forecast, maps, building archetype, building renovation status, maps	# Building renovation scenarios are presented # A description of the method and the assumptions of the renovation scenarios is provided # Heat zoning (current state of demand) based on building renovation/demand/building type is presented # A map with savings over the territory is provided
	mapping		
Potential for low-temperature district heating readiness (readiness of buildings)	estimate	Low temperature district heating (LTDH) (readiness), renovation level, low temperature supply systems, radiators	# The temperature level of the existing heat supply systems in the buildings are mentioned / analysed # Buildings potentially supplied by LTDH are identified # Zones potentially suitable for low-temperature district heating are identified
	mapping		
Potential for high efficiency cogeneration	estimate	High efficiency cogeneration, CHP, highly efficient	# High-efficiency cogeneration is mentioned in the plan # Existing (cogeneration) plants are presented on a map # Relevant parameters for cogeneration plants to be highly efficient is presented # Presented potentials of cogeneration plants distinguish between highly efficient and not highly efficient
	mapping		
Potential for waste heat recovery	estimate	Waste water treatment, waste heat, industrial waste heat, data centers	# Locations of waste heat sources are identified # Estimates of the temperature level and the available waste heat are presented
	mapping		
Potential for Renewable Energy	estimate	Shallow geothermal, deep geothermal, Solar PV, Solar thermal, Biomass	# The available potential of renewable energy for heat and cold supply is presented (in terms of energy and/or power) # The potential is shown on a map (maybe not covering all potentials)
	mapping		
Potential for cooling	estimate	cooling demand, commercial buildings	# An estimation of the energy demand for cooling of buildings is presented # A map showing the (theoretical) energy demand for cooling in the territory is presented (# The increasing cooling demand due to climate change is addressed)
	mapping		

www.actionheat.eu

- A checklist was developed to ensure compliance with regulatory requirements.
- Include mapping and estimation of energy efficiency potential and renewable integration.
- Address energy poverty and prioritize measures for vulnerable households.
- Standardized checklists simplify evaluations and improve plan consistency across regions.



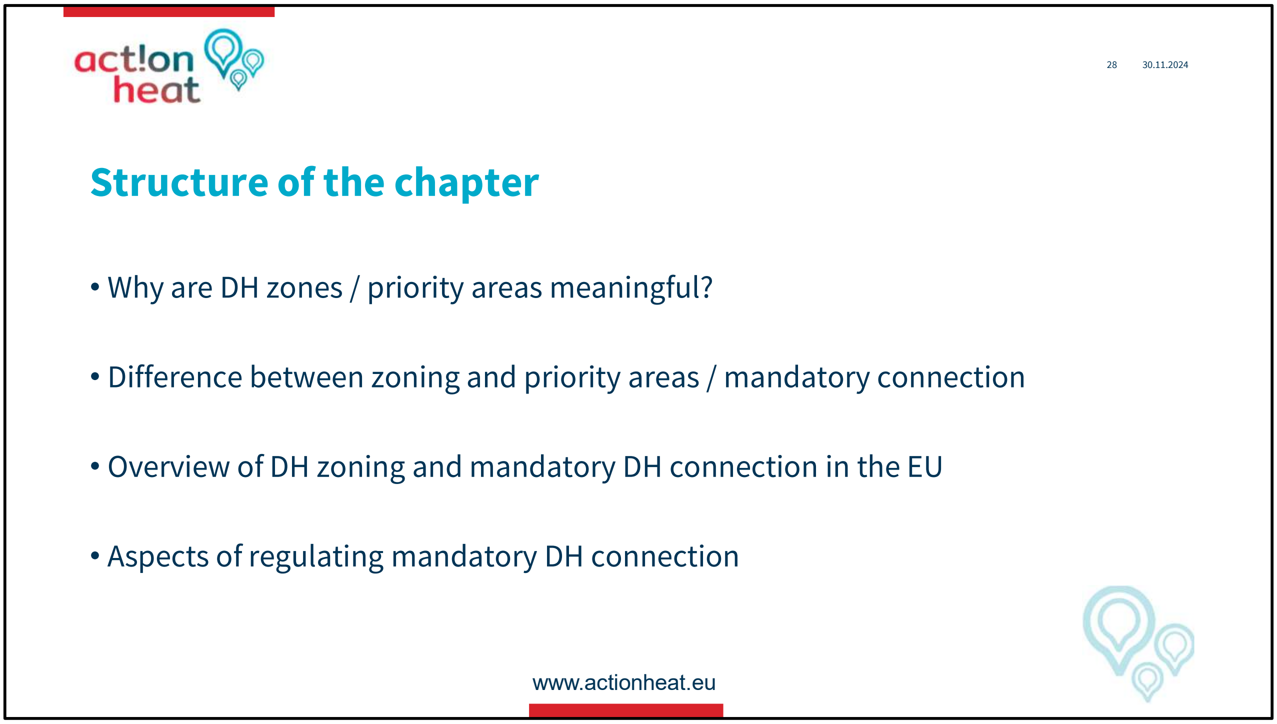
- Strong guidance is essential to ensure municipalities meet regulatory requirements.
- Provide frameworks at national and regional levels to support effective H&C planning.
- Include clear guidelines on interpreting and implementing compliance criteria.
- Assistance from energy agencies can help municipalities align plans with policy goals



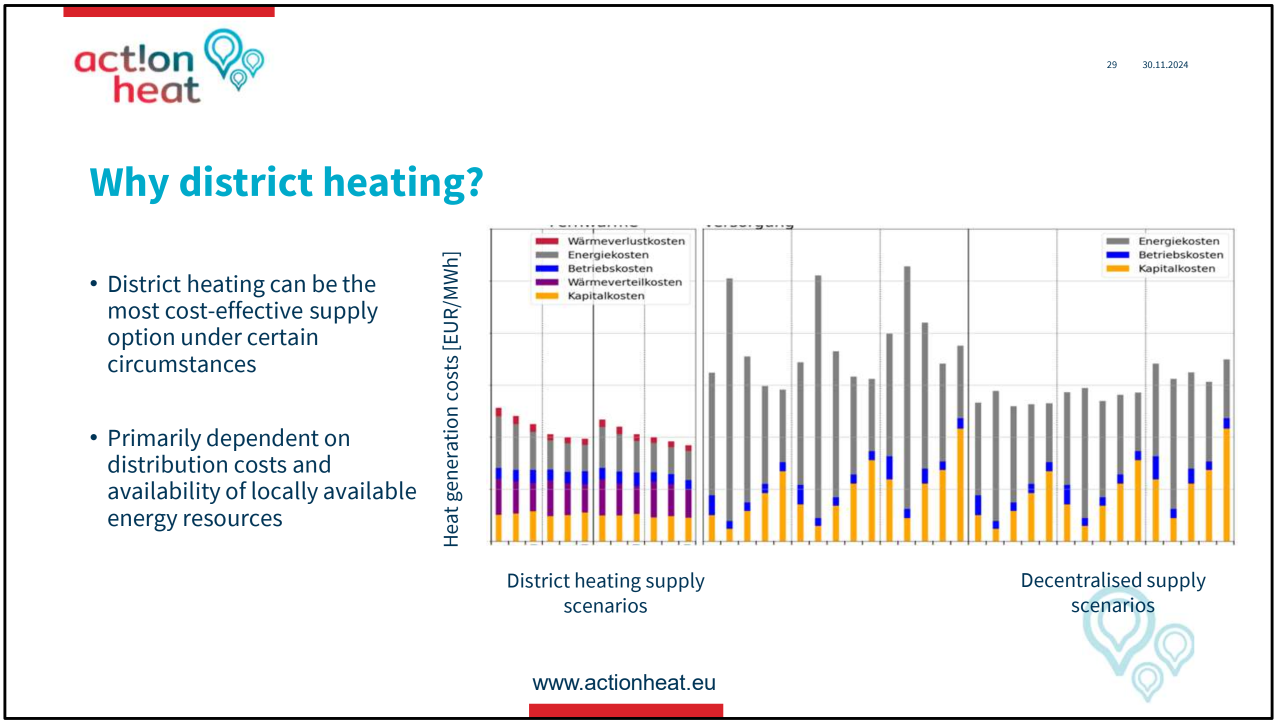
- Update heating and cooling (H&C) plans to reflect the latest regulations and priorities.
- Ensure plans are comprehensive, addressing energy efficiency, renewable integration, and zoning.
- Emphasize the role of municipalities in implementing detailed, actionable strategies.
- Align planning processes with evolving technological and policy landscapes.

Content

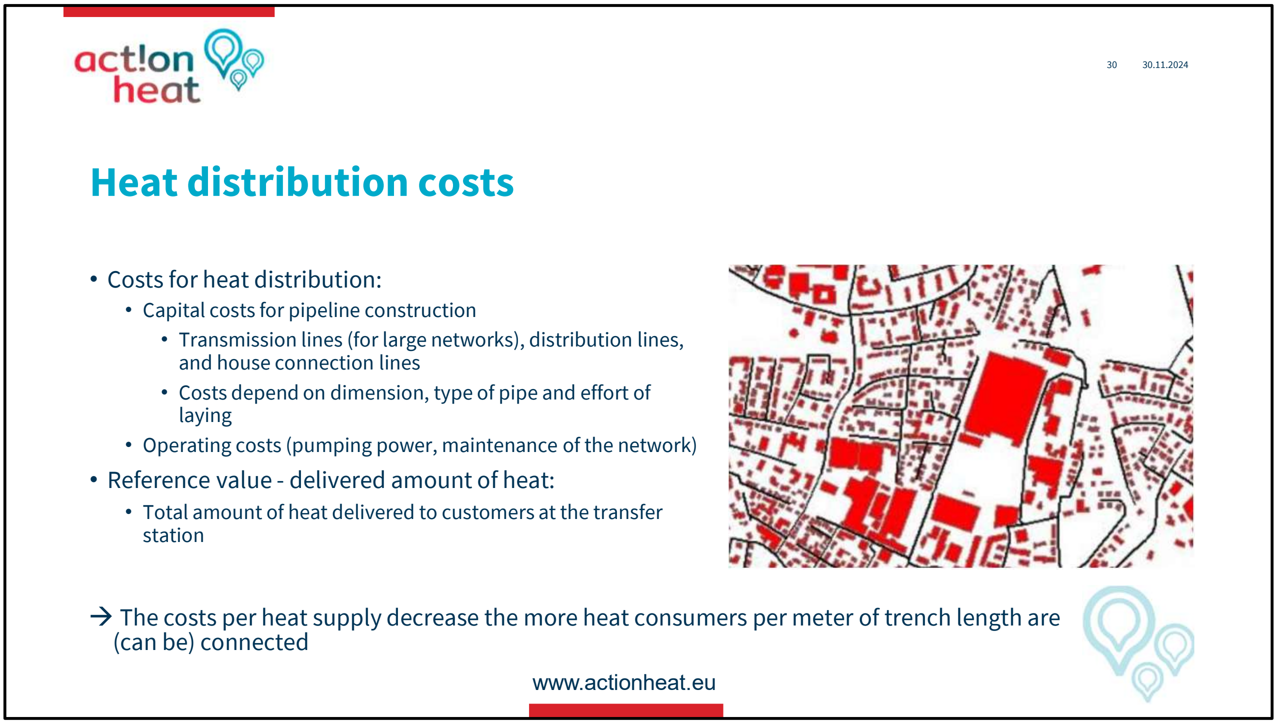
1. Recommended policies for H&C planning
2. Overview of current situation in Europe
3. Mandatory heat planning in the EED2023
4. Special focus on zoning for district heating
5. Discussion



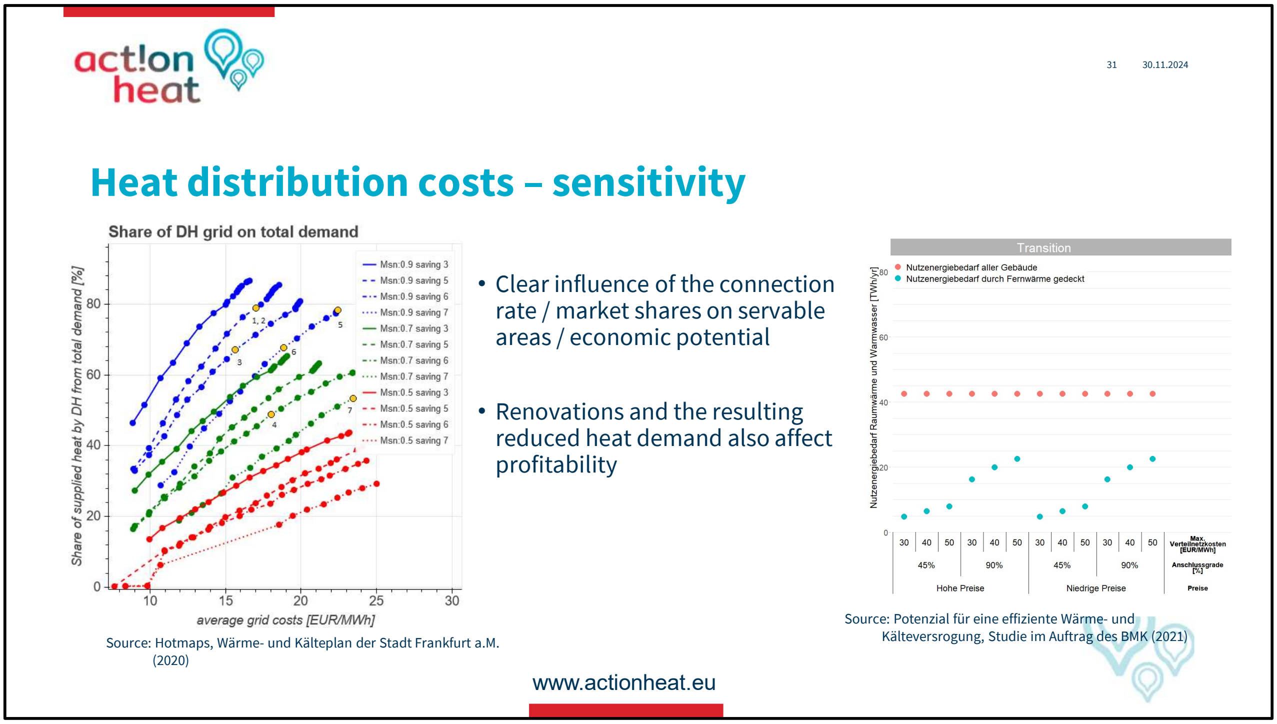
- Need to understand the difference between zoning and priority zones



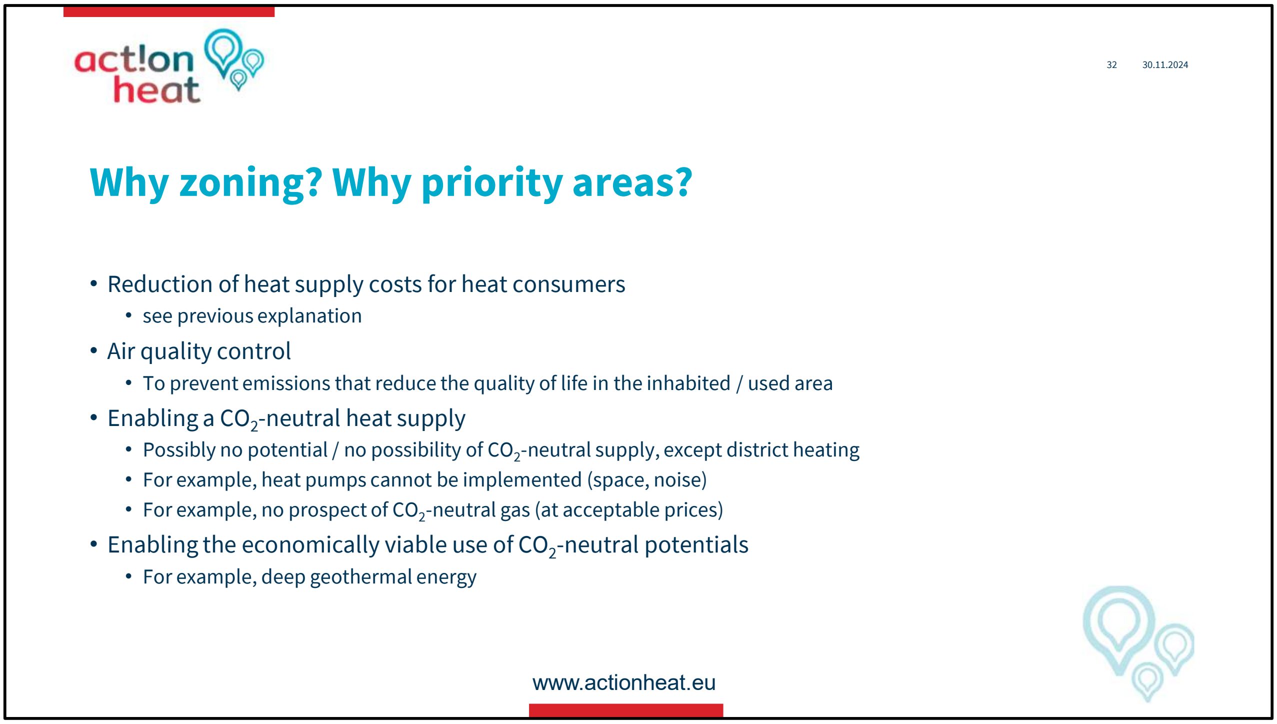
- District heating (DH) is often the most cost-effective option in densely populated areas.
- Reduces distribution costs and integrates renewable energy sources effectively.
- Enables CO_2-neutral heat supply where alternative options are limited.
- Provides a scalable solution for decarbonizing heating in urban regions.



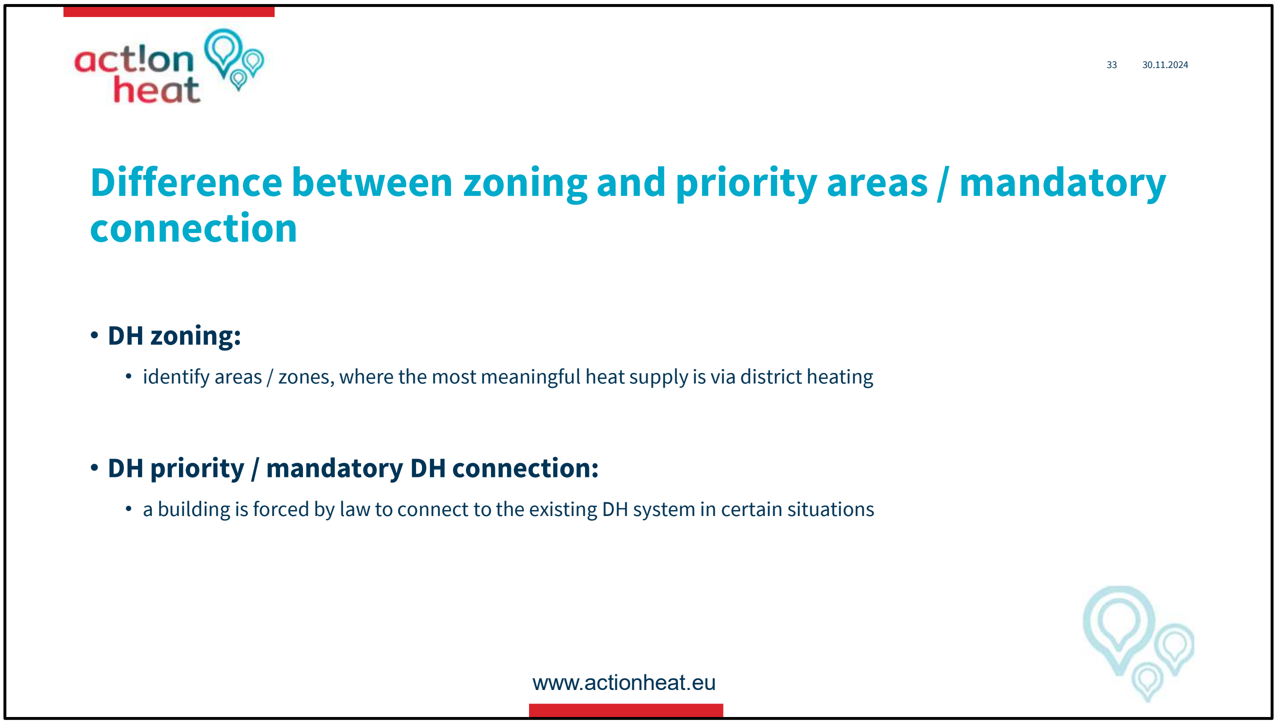
- Heat supply costs decrease with higher connection rates and shorter trench lengths.
- Increasing connections improves economic viability and reduces per-unit costs.
- Renovations that lower heat demand impact the profitability of DH systems.
- Achieving high connection rates is key to making DH systems cost-effective.



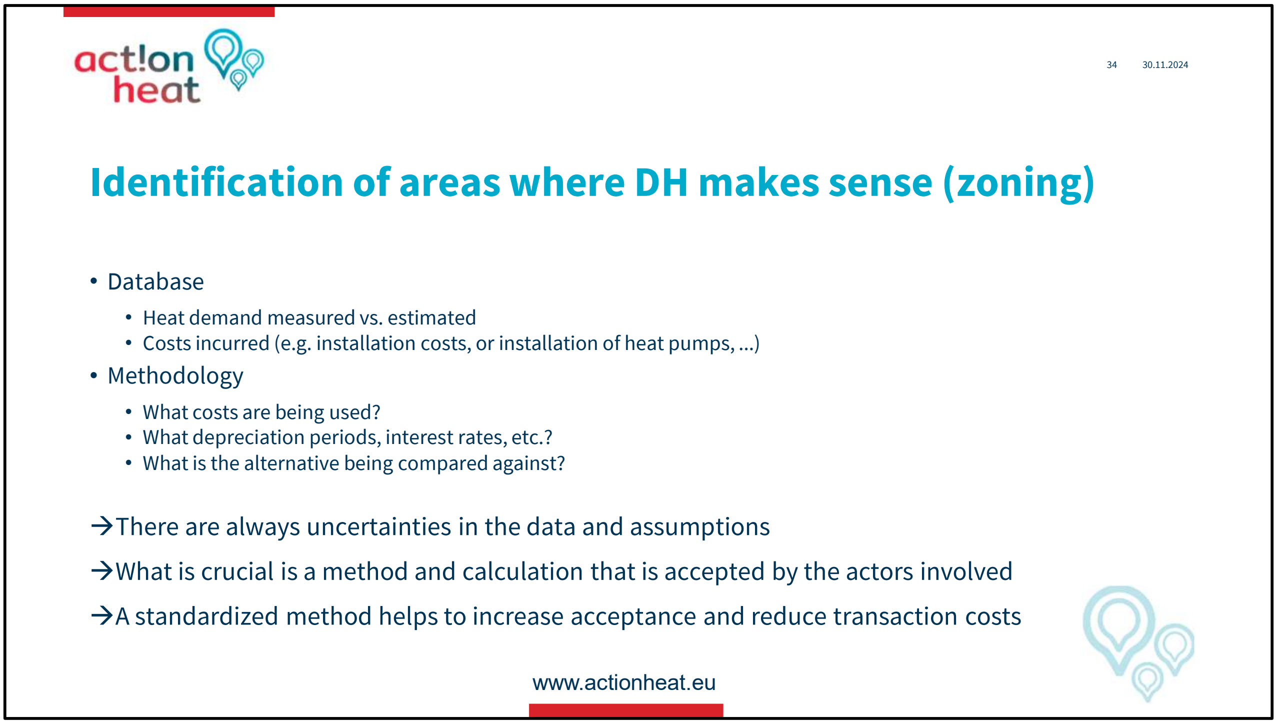
- Higher connection rates significantly lower heat supply costs for consumers.
- Increased connections enable the use of advanced and cost-efficient technologies.
- High-density connections improve network efficiency and reduce operational costs.
- Connection rates directly influence the economic potential of district heating systems.



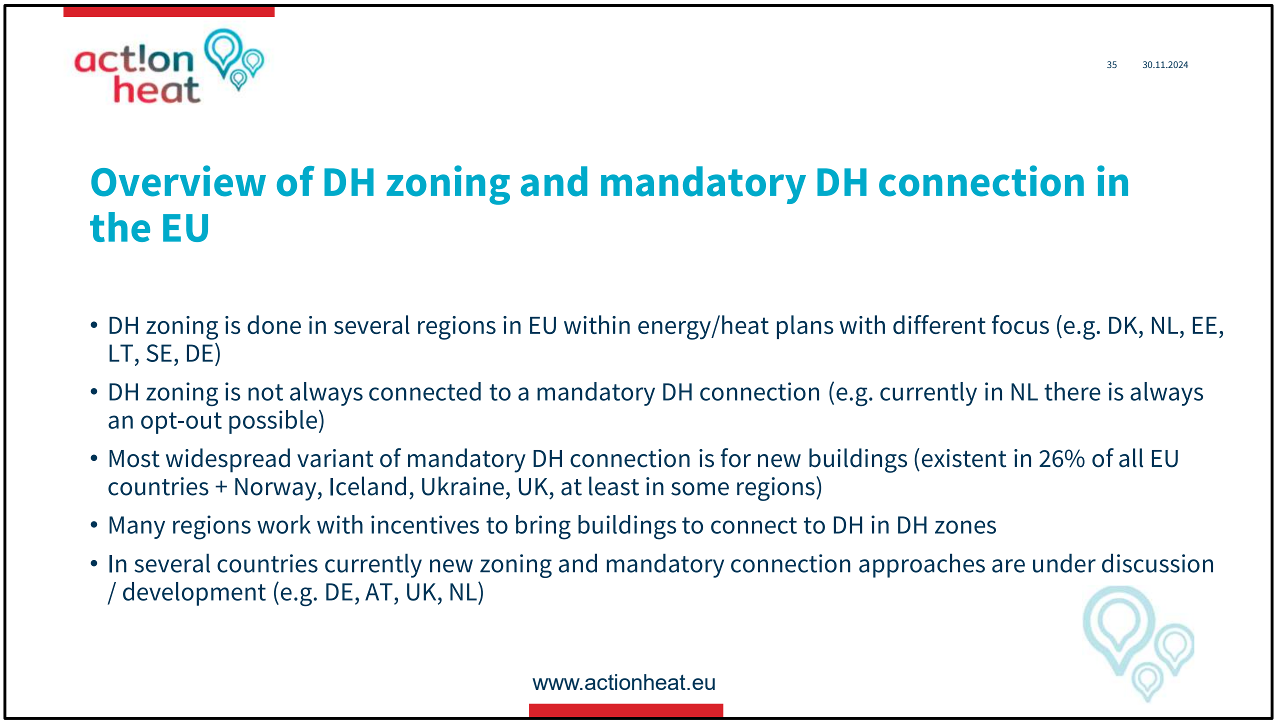
- Zoning identifies areas where district heating (DH) is most feasible and cost-efficient.
- Priority areas ensure high connection rates, making expensive technologies more viable.
- Proper zoning reduces costs for consumers while enabling CO_2-neutral heat supply.
- Supports efficient infrastructure planning by focusing on economically viable regions.



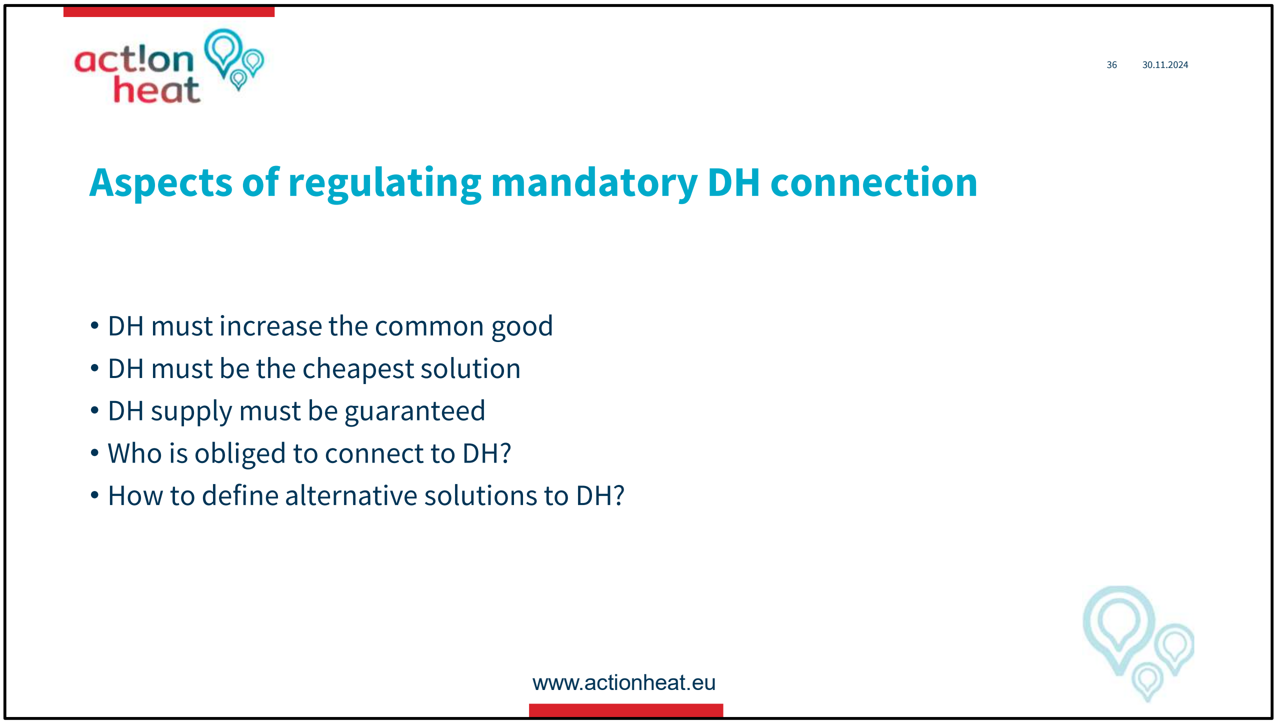
- Zoning defines areas where district heating (DH) is the most efficient heat supply option.
- Mandatory connections legally require buildings to join DH networks in designated zones.
- Zoning supports strategic infrastructure planning, while mandatory connections ensure utilization.
- Both approaches aim to increase connection rates and reduce system costs.



- Reliable data, including heat demand and installation costs, is critical for zoning assessments.
- Methodologies should consider depreciation periods, interest rates, and alternative options.
- Standardized methods increase transparency and acceptance among stakeholders.
- Address uncertainties with robust assumptions and clear communication.



- District heating (DH) zoning is integrated into heat plans in several EU regions, such as Denmark and Germany.
- Mandatory connections are not always required but exist for new buildings in some countries.
- Incentives are widely used to encourage connections in designated DH zones.
- New zoning and mandatory connection policies are under discussion in many EU countries.



- Mandatory connections ensure district heating (DH) supports public benefits, including climate protection and energy security.
- DH must provide the most cost-efficient and sustainable solution for society.
- Regulatory frameworks define when mandatory connections are required, balancing feasibility and public interest.
- Clear provisions ensure DH systems align with environmental and economic goals.

- Countries link mandatory district heating (DH) connections to broader societal benefits.
- These include environmental protection, public health improvements, and economic efficiency.
- DH enhances energy security by leveraging renewable energy and reducing dependency on imports.
- Policies must balance public interest with cost-effectiveness for mandatory connections.

38 30.11.2024

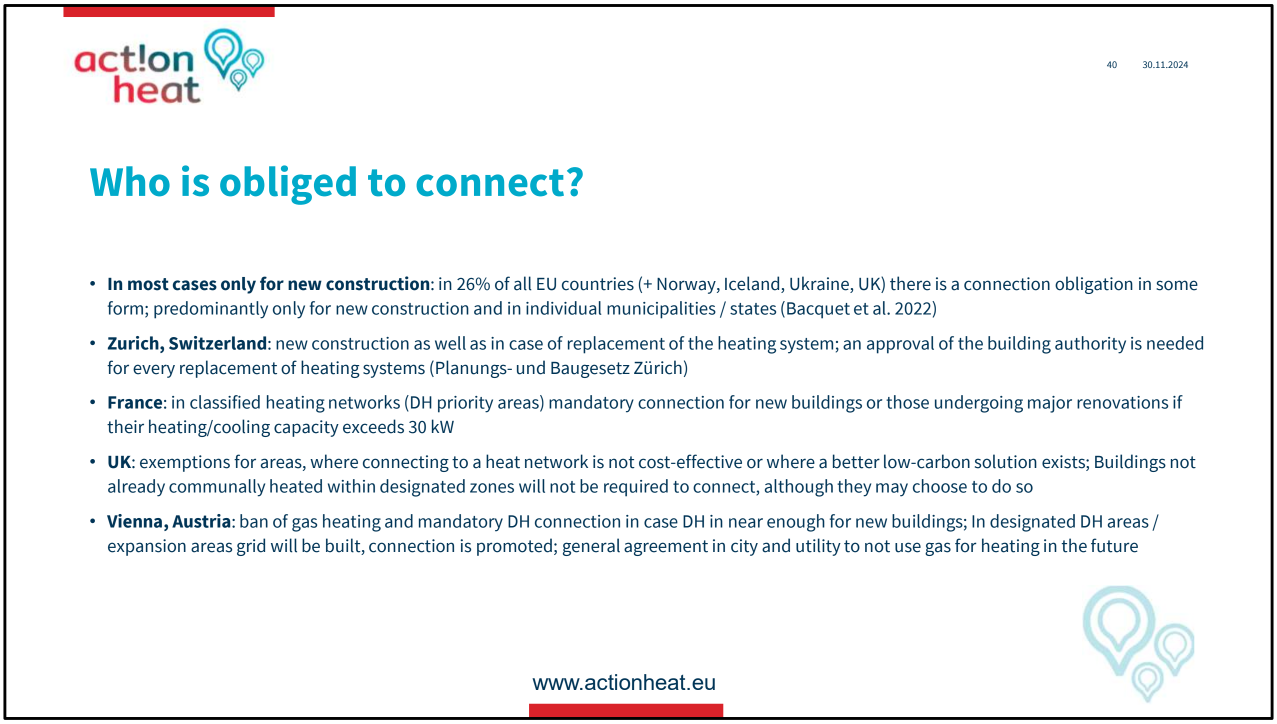
District heating must be the cheapest solution

- A mandatory connection should generally not result in additional costs for consumers compared to an alternative solution.
- **Denmark / UK**: a standardized method derives regions, where DH is the cheapest heat supply option (Danish Heating Supply Act, UK Energy Act 2023)
- **France:** a DH connection obligation is only possible if a study demonstrates that DH is the most cost-effective supply option (Bacquet et al. 2022)
- **Switzerland**: depends on Canton; In Zürich an xls sheet is used to calculate levelized costs of heat for DH compared to an oil heating for single buildings (Planungs- und Baugesetz Zürich)
- **Estonia**: DH regions are determined via a feasibility analysis developed by the municipality (often outsourced) in collaboration with the local operator and participation of the public; DH price is regulated and needs to be approved by the Competition Authority (EE District Heating Act)

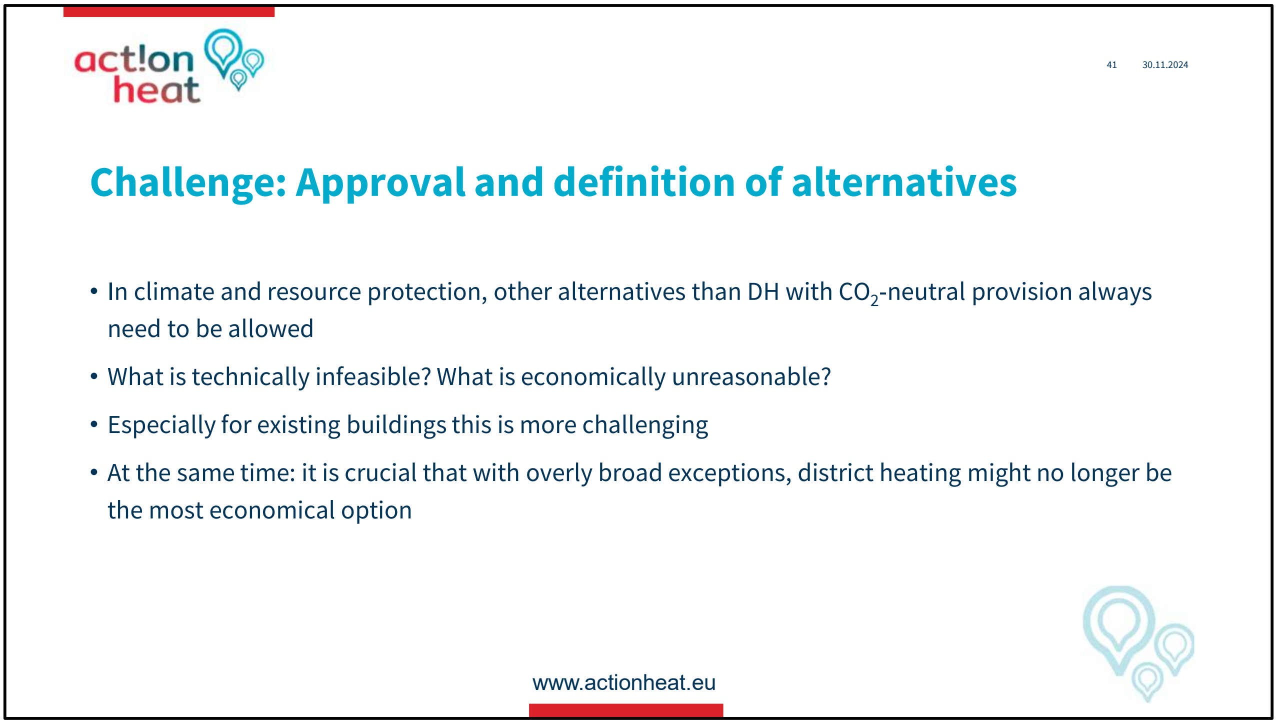
www.actionheat.eu

- Countries differ in their approach to mandatory district heating (DH) connections.
- Some focus on environmental and health benefits, while others prioritize energy security and cost-efficiency.
- Regulatory frameworks must align with national priorities while ensuring fairness and sustainability.
- A tailored approach considers local contexts and common good principles.

- Authorities and DH operators must ensure reliable and affordable heat supply in mandatory connection zones.
- Municipal DH providers, like those in Denmark, often operate under non-profit obligations.
- Transparent commitments from DH operators build trust and ensure compliance with regulations.
- Clear pricing and service conditions are essential for consumer confidence.



- Mandatory district heating (DH) connections primarily apply to new buildings in most EU countries.
- Some countries, like Switzerland, extend obligations to heating system replacements in existing buildings.
- Policies often require cost-effectiveness studies to justify mandatory connections.
- Clear exemptions are defined for areas where DH is not feasible or cost-effective.



- Mandatory DH connections must account for technical feasibility and economic viability.
- Alternatives to DH must be clearly defined, balancing climate and resource protection goals.
- Existing buildings pose challenges due to diverse heating systems and retrofit costs.
- Policies should avoid overly broad exceptions to maintain the economic viability of DH systems.

Content

1. **Recommended policies for H&C planning**
2. **Overview of current situation in Europe**
3. **Mandatory heat planning in the EED2023**
4. **Special focus on zoning for district heating**
5. **Discussion**

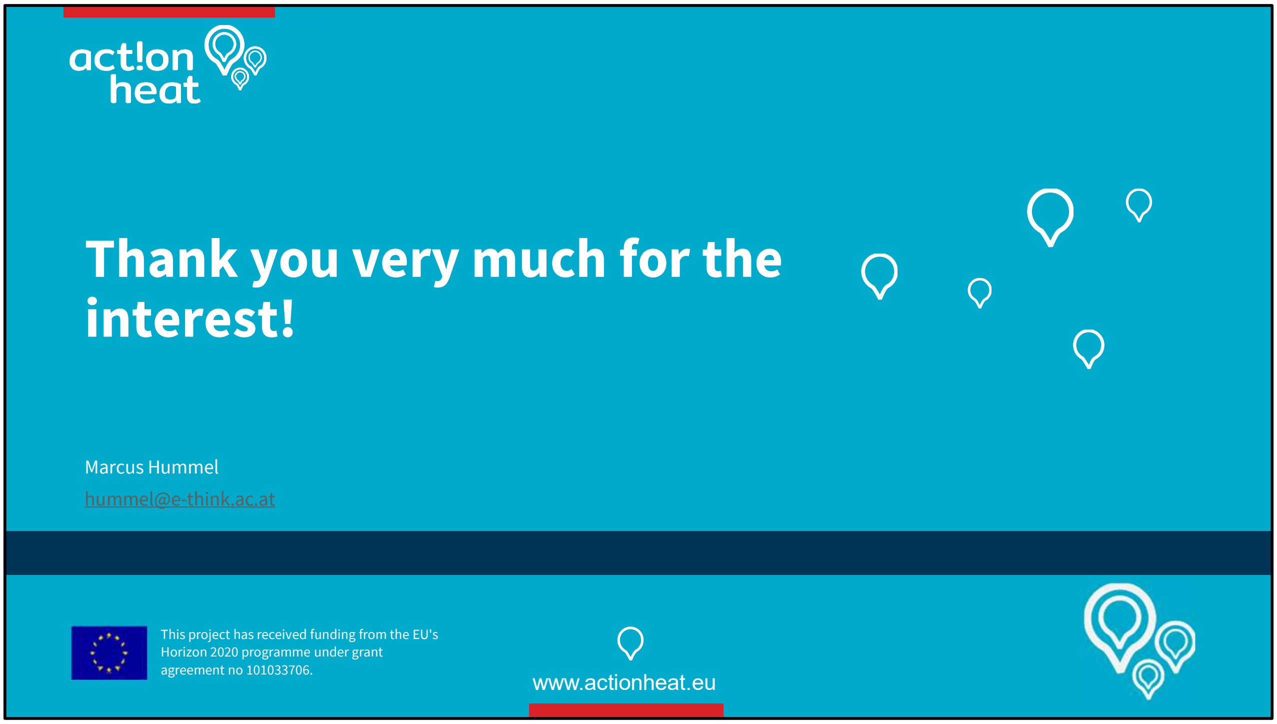
Summary

- Many activities ongoing in different countries
- Some countries have strong policies in place
- Many countries still do not have relevant heat planning policies in place
- Open questions in all places
- No one solution fits all

act!on heat

Room for your questions

www.actionheat.eu


act!on heat
Thank you very much for the interest!
Marcus Hummel
hummel@e-think.ac.at
This project has received funding from the EU's Horizon 2020 programme under grant agreement no 101033706.
www.actionheat.eu

3 Summary and Conclusions

The webinars highlighted key challenges and opportunities in the decarbonization of heating and cooling (H&C) systems across Europe. One major issue was the accessibility of H&C data. While better data availability is needed, the influence of local political structures was recognized as essential for the success of decarbonization efforts. A supportive political environment can help address data gaps, with tools like the Hotmaps database playing a crucial role.

The importance of dynamic, geospatial data for heat planning was emphasized, though inconsistencies in data quality across regions complicate the process. Collaborative knowledge sharing and open-source tools, such as energy atlas projects, were seen as helpful, but localized adjustments are needed to ensure effectiveness.

The potential of industrial excess heat for district heating was also discussed. While industries often use excess heat internally for cost benefits, supplying heat externally is a valuable option, provided there are necessary infrastructure investments. Planning for backup suppliers and managing heat losses are essential for a consistent supply.

Excess heat from data centers, especially outside the Nordic countries, was another important topic. While Nordic nations reuse heat from large data centers, smaller centers in other parts of Europe are beginning to adopt similar strategies. However, the political and technical conditions for heat reuse vary by country, requiring tailored solutions.

The use of low-temperature wastewater for district heating, particularly in smaller municipalities, was presented as a cost-effective and eco-friendly solution. Successful cases in Northern Europe were highlighted, with hopes for expansion through stakeholder and policymaker engagement.

Geothermal energy emerged as a promising option for decarbonizing district H&C systems. Its potential depends on local conditions, and advanced technologies like Enhanced Geothermal Systems (EGS) could broaden its applicability. Effective geothermal integration requires strategic planning and stakeholder engagement.

As space cooling demand grows in Europe, sustainable solutions like district cooling and passive cooling strategies are gaining attention. While renewable energy integration and energy-efficient technologies are key to meeting decarbonization targets, addressing data gaps remains a priority for effective policy implementation.

Finally, heat planning challenges, particularly long timelines and evolving market conditions, were discussed. Rapid advancements in technologies like heat pumps present both opportunities and difficulties. Ensuring CO_2-efficient systems and maintaining transparency and community involvement are critical for achieving long-term, sustainable outcomes. The webinars emphasized the need for flexible, data-driven approaches, with strong political, technical, and community engagement for successful decarbonization