EMB3Rs

EMB3Rs
Heat and Cold matching platform

EMB3Rs - heat and cold matching platform: An overview of the EMB3Rs tool - with a Swedish case study

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1st Plenary Meeting of the Concerted Action for the Energy Efficiency Directive

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847121

SPIRE PROJECT

CONTENTS

- Thoughts on excess heat
- EMB3Rs Summary
- Landskrona Case Study
- CoolDH Project

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District Heating/cooling

District heating / cooling is a network of underground pipes which connects heat/cold sources and heat/cold sinks

- The size can be from only covering a few houses to very large network in bit cities

- Different types systems: The temperature of heat sources and the temperature of the water is very determining for the overall technical setup of the systems

- Efficient: Typically based systems where heat is a biproduct (CHP)
- Flexible: The heat delivered to the network can be from any heat source

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Excess Heat

DH systems allows excess heat sources to be utilized. These sources may otherwise be wasted.

EH potential in Sweden: The excess heat form industrial and commercial activities contributes to 8% of DH supply in Sweden – with potentials

- Excess heat is - also known as waste heat/surplus heat. It is heat produced as a by-product – or extracted from an industrial/commercial process. Heat from CHP plants is not regarded as EH.

- Cooling water from a hot process
- Cooling from exhaust systems
- Thermal cooling/heating systems – refrigeration
- EH will be available from H2-production

- Cooling water from a hot process – 80-120C
- Cooling from exhaust systems 80-120C
- From refrigeration - 40C

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Excess Heat

Barriers and how to overcome them – for policy-makers:

1. Map potential sources and sinks (WHAT potential)
2. Raise awareness (WHO needs to know)
3. Facilitate processes by helping actors (HOW to utilize heat)
4. Easy and transparent regulation (WHERE is WHAT allowed)

- Forms of collaboration
- Cultural differences
- Business models
- Contract negotiations

- Access to a market (district heating network),
- Lack of a comprehensive regulatory framework
- Lack of standardised contracts,
- Lacking sinks (end users)
- Absent financial incentives to make excess heat a viable option for the potentially involved stakeholders

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Excess Heat

Contracts: Mutual dependence is critical for source and sink. Contracts reduce (but doesn't eliminate) risk.

- Tariffs
- Is it fair to put tariffs or taxes on EH?

- Price-setting
- Structure
- Duration and
- Risk-mitigation.

1. The DH company invests and owns the system
2. The company which produces EH invests and owns the system
3. The DH Company and EH producer invest together and own together
4. A third party invests and owns.

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PROJECT SUMMARY

Follow our journey!

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- EMB3Rs

Project partners

- H2020 Grant No. 847121
- Starting date: 2nd September 2019 (36+9 months)
- 16 partners, 7 EU countries
- Mix of industries, SMEs, research centres and public institutions
- EU contribution: 3,984,671.32 €

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CHALLENGES

- Improve energy efficiency industry
- Mapping availability excess thermal energy (heat & cold - HC)
  - Low recovery & use of excess industrial heat
- Ability to perform analysis of possible routes of utilization of excess HC
- Valorisation of excess heat
- Integration of renewables
- Explore innovative Business Models

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CHALLENGES

- There are many hurdles from the industrial side
  - Each plant is unique – no such thing as a custom solution
  - Fear of affecting the process – focus is on selling products, not energy
  - Communication between different stakeholders
- Also from the networks transporting heat/cold
  - Excess heat, no demand
  - Price of alternative (e.g. NG) comparatively low
  - Switching the current infrastructure that uses NG to using waste heat not trivial

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EMB3Rs – MAIN OBJECTIVES

Develop an open-sourced energy modelling platform to identify feasible solutions for the recovery and use of industrial excess HC

Simulate alternative technological and/or business scenarios

To be independently used by a wide variety of industries and other stakeholders at EU geographies

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EMB3Rs – SPECIFIC OBJECTIVES

Identifying **users with geographic relevancy** for HC supply and demand, and enabling their interlinking

Matching quality and temporal profiles of the excess HC available for local supply/demand

Exploring cost **efficient internal and external technology routes** for the recovery, conversion and distribution of the available excess thermal energy

Assessing **effective business models** and **policy instruments** to overcome barriers to the implementation of the most promising scenarios.

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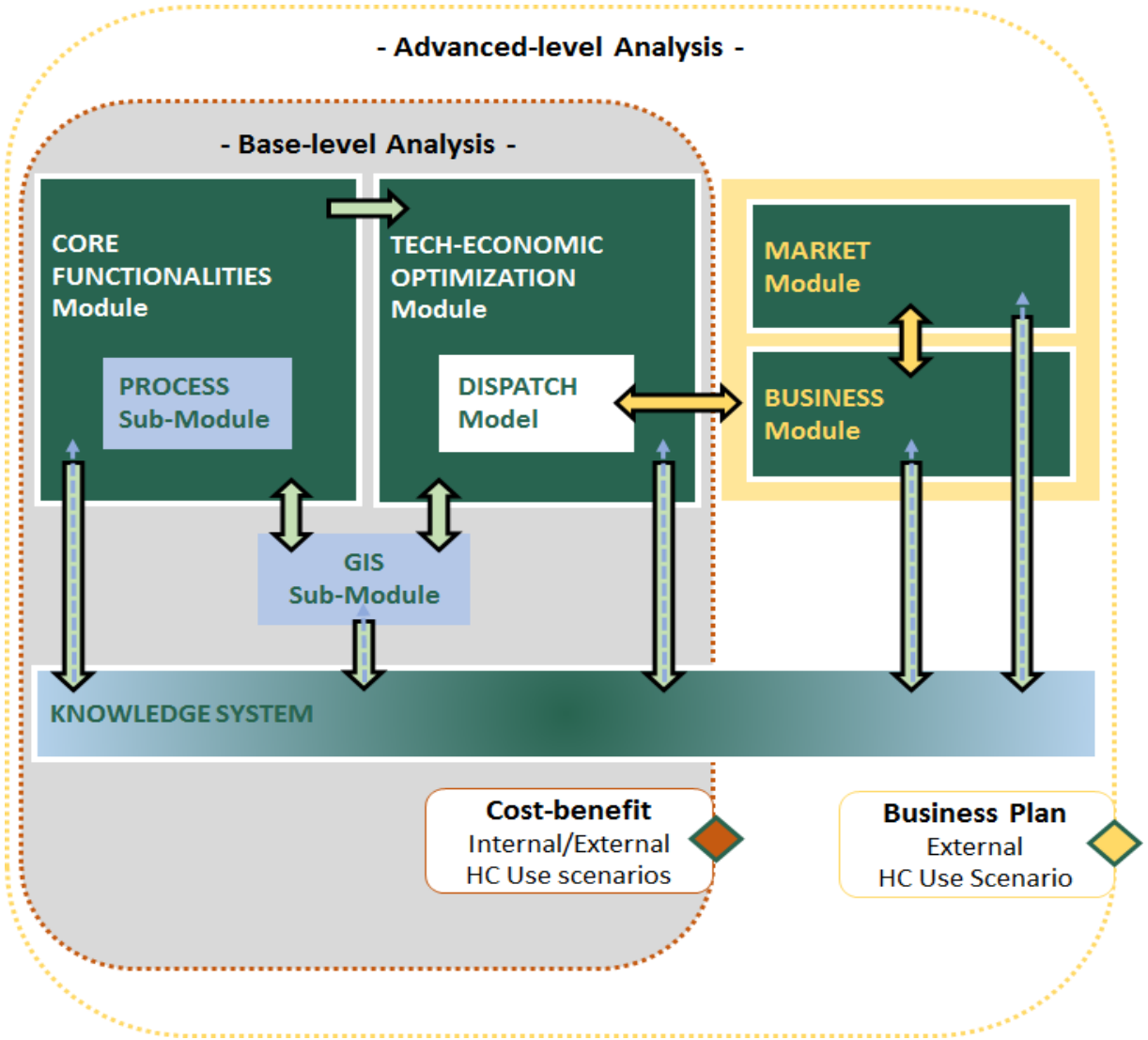
EMB3Rs PLATFORM

Main goal: contribute to increased use of excess thermal energy from industry via intra- and inter-sectorial H/C networks or other uses (e.g., electricity generation)

- Open source
- Modular platform
- Modules can be replaced
- Planning tool
- Single user/collaborative modes



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MODULAR OPEN-SOURCED PLATFORM

Core Functionalities module & Knowledge System (cross-cutting)

- Interface between modules & users
- Maps & characterizes supply & demand nodes (profiles)
- Allows internal optimization of excess H/C (industries)
- Information on quantity and quality of excess heat
- Databases: technologies, simulations, defaults, market & regulations, user data

GIS module

- Least cost pathway to linking demand & supply nodes

Techno-economic module

- Scope out different technical options of recovering, distributing and (re)using H/C

Business models & Market modules

- Valorisation of excess heat

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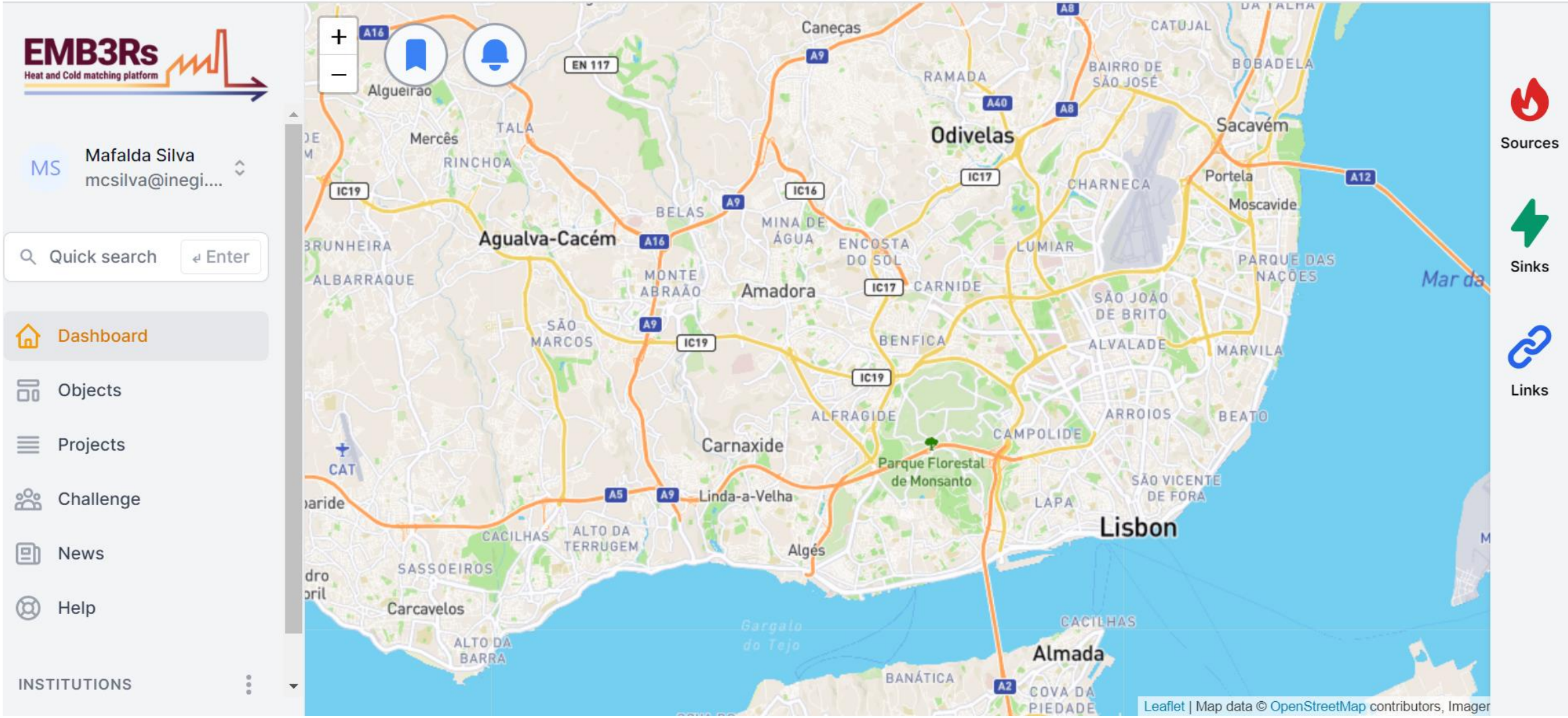
A SNEAK PEEK OF THE PLATFORM



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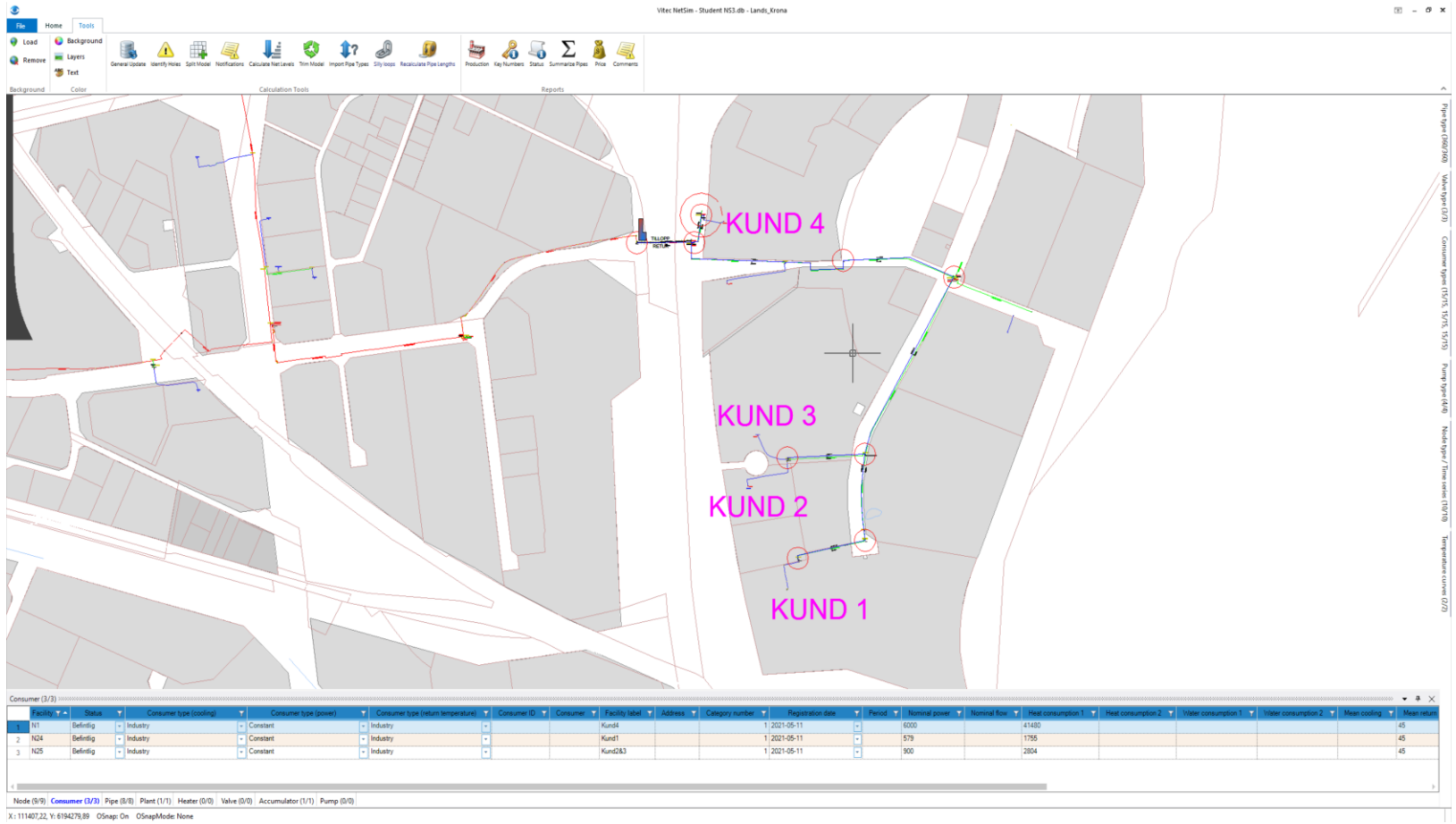
Landskrona case study – Kronan area



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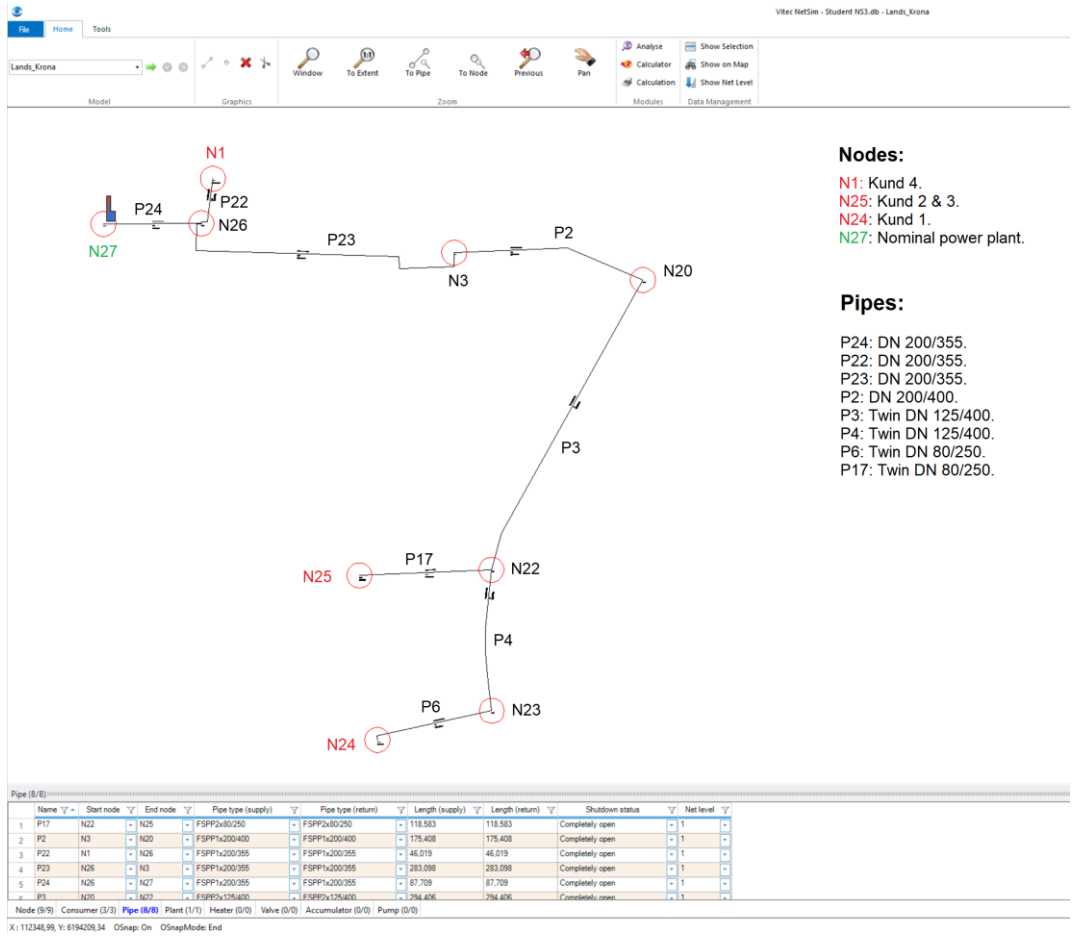
Landskrona case study – Kronan area

Simulations using NetSim commercial platform



Nodes:

N1: Kund 4.
N25: Kund 2 & 3.
N24: Kund 1.
N27: Nominal power plant.

Pipes:

P24: DN 200/355.
P22: DN 200/355.
P23: DN 200/355.
P2: DN 200/400.
P3: Twin DN 125/400.
P4: Twin DN 125/400.
P6: Twin DN 80/250.
P17: Twin DN 80/250.

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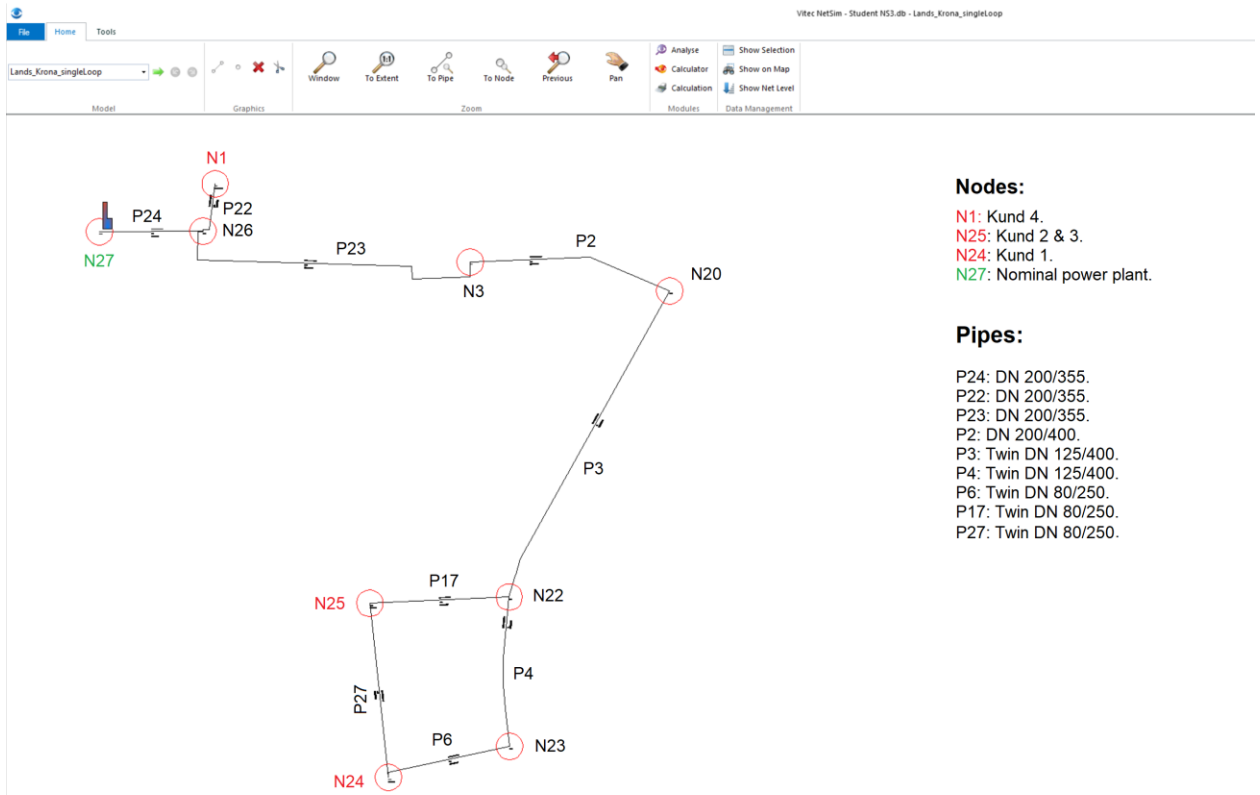

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Simulations using NetSim commercial platform

Total flow from producers:
40.4 kg/s

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Landskrona case study – Kronan area

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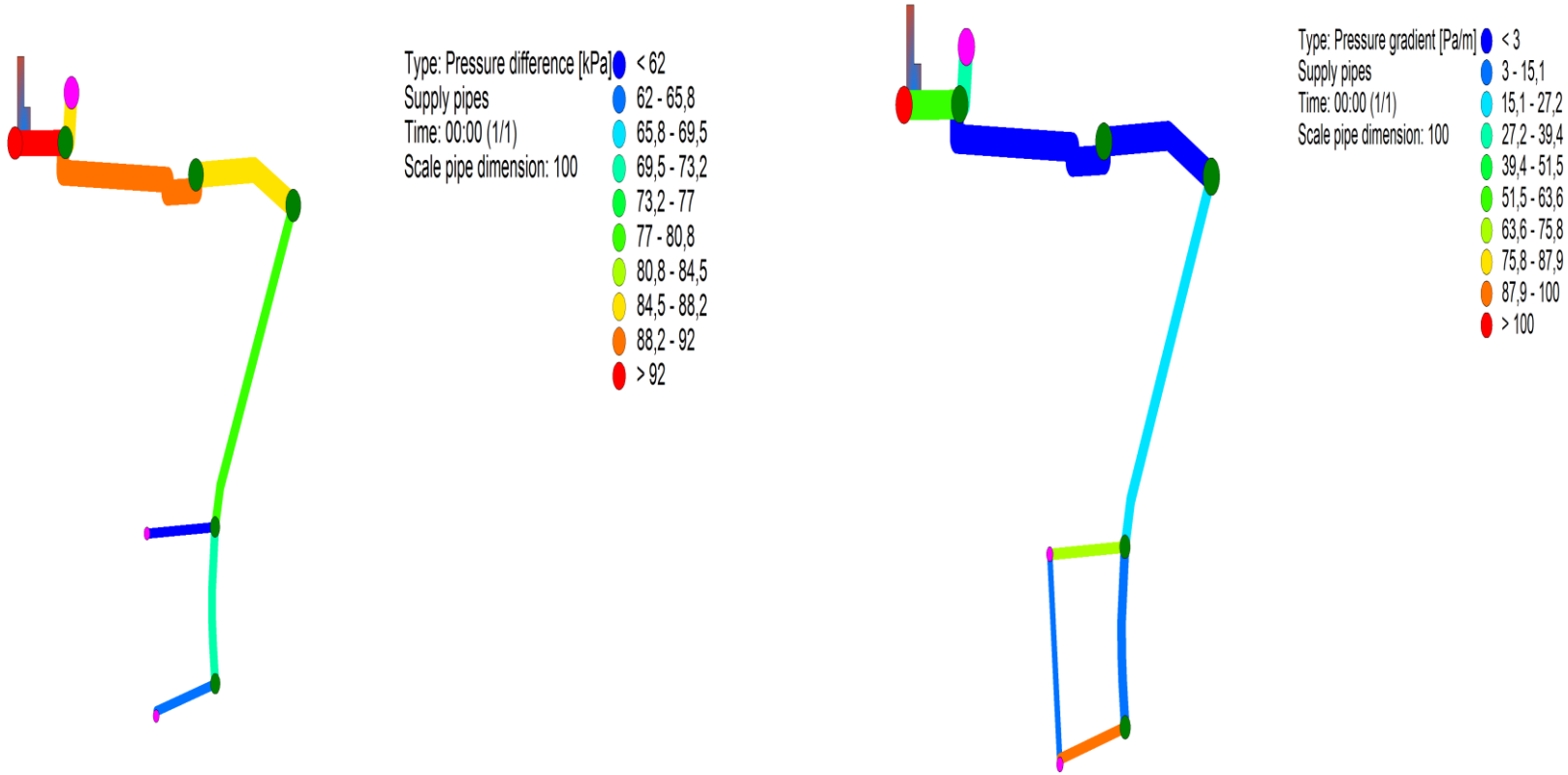

Pressure gradient (Pa/m)

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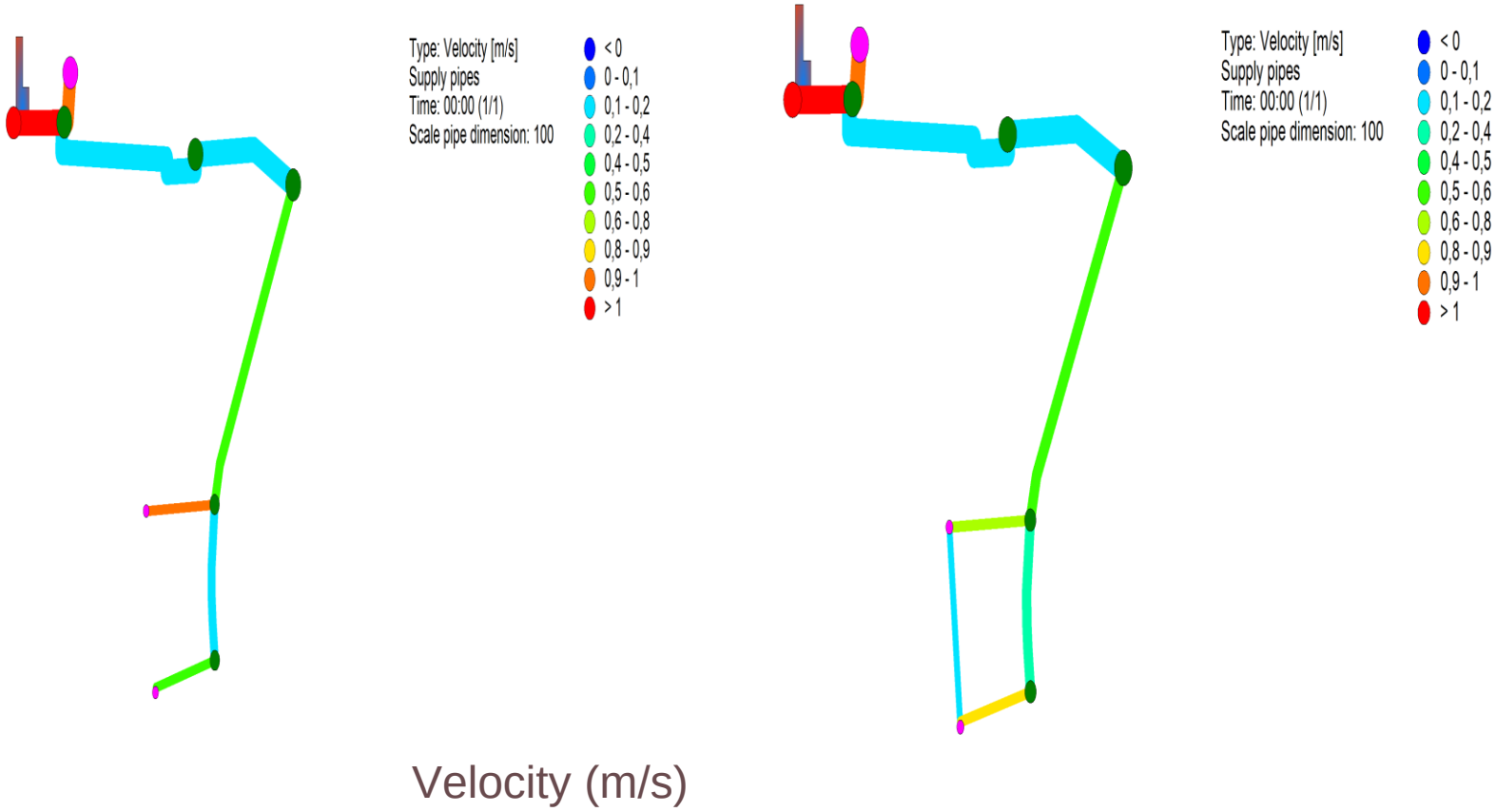
Landskrona case study – Kronan area

Simulations using NetSim commercial platform



Velocity (m/s)

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Testing on the platform developed in EMB3Rs (ongoing)

- Core functionalities module
- GIS module
- TEO module
- Market module
- Business module

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EMB3Rs

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Slides about the EU Horizon 2020-project COOL DH

Kerstin Sernhed & Ali Moallemi, Lund University

"The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 767799-COOL DH- H2020-EE-2016-2017/H2020-EE-2017-RIA-IA"

COOL DH
COOL DISTRICT HEATING

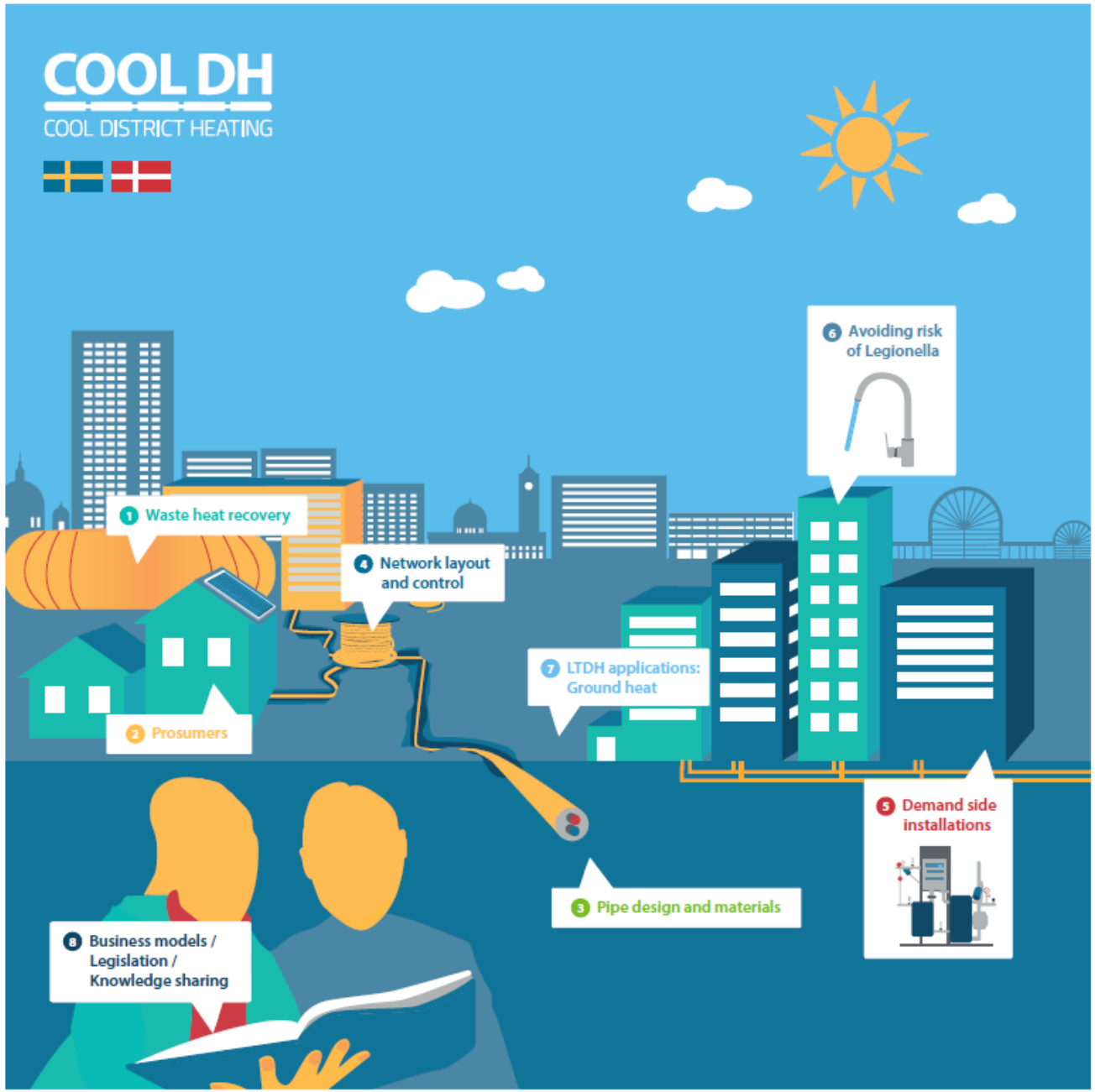
COOL DH – An EU Horizon 2020 project about low tperature district heating that demonstrates solutions in parallel at two **demo sites**

District heating in Denmark and Sweden - Similar but still different

Lund - Brunnshög (Sweden) => 40.000 people
New district under development

Høje-Taastrup - Østerby (Denmark)
Existing area composed by slightly renovated buildings

COOL DH
COOL DISTRICT HEATING



Low Temperature District Heating (LTDH)

1 Waste heat recovery

LTDH networks enable efficient recovery of energy from surplus heat and cooling, for example from the science facility MAX IV in Lund and a shopping mall with solar powered heat pumps as well as several other buildings in Høje Taastrup.

2 Prosumers

LTDH is well adapted to low-energy houses and enables local integration of customer's renewable heat sources. COOL DH investigates control technology for integration of several types of heat sources.

3 Pipe design and materials

LTDH enables the use of non-conventional pipe materials and design, lowering the investment cost, allowing easier and safer transportation and installation and facilitating coordination with other infrastructure. COOL DH evaluates different types of plastic pipes and pipe components.

4 Network layout and control

Due to lower temperature losses, LTDH enables more efficient heat distribution. To optimize the distribution and minimize heat losses, COOL DH evaluates network layout, connections and control of heat pumps and chillers in the LTDH system.

5 Demand side installations

COOL DH verifies and compares different technical solutions of demand side installations that affect the heat load and return temperature in the LTDH system. For example, heat driven appliances as well as substation components are investigated.

6 Avoiding risk of Legionella

COOL DH investigates different techniques to reduce the risk of growth of Legionella bacteria in LTDH systems.

7 LTDH applications: Ground heat

COOL DH investigates LTDH applications that can optimize the use of low-temperature heat while benefiting the public, for example through ground heat that removes snow.

8 Business models / Legislation / Knowledge sharing

COOL DH investigates possible LTDH business models, legislative frameworks related to district heating and shares the knowledge at European level.

COOL DH
COOL DISTRICT HEATING

Distribution (PE-RT)

COOL DH
COOL DISTRICT HEATING

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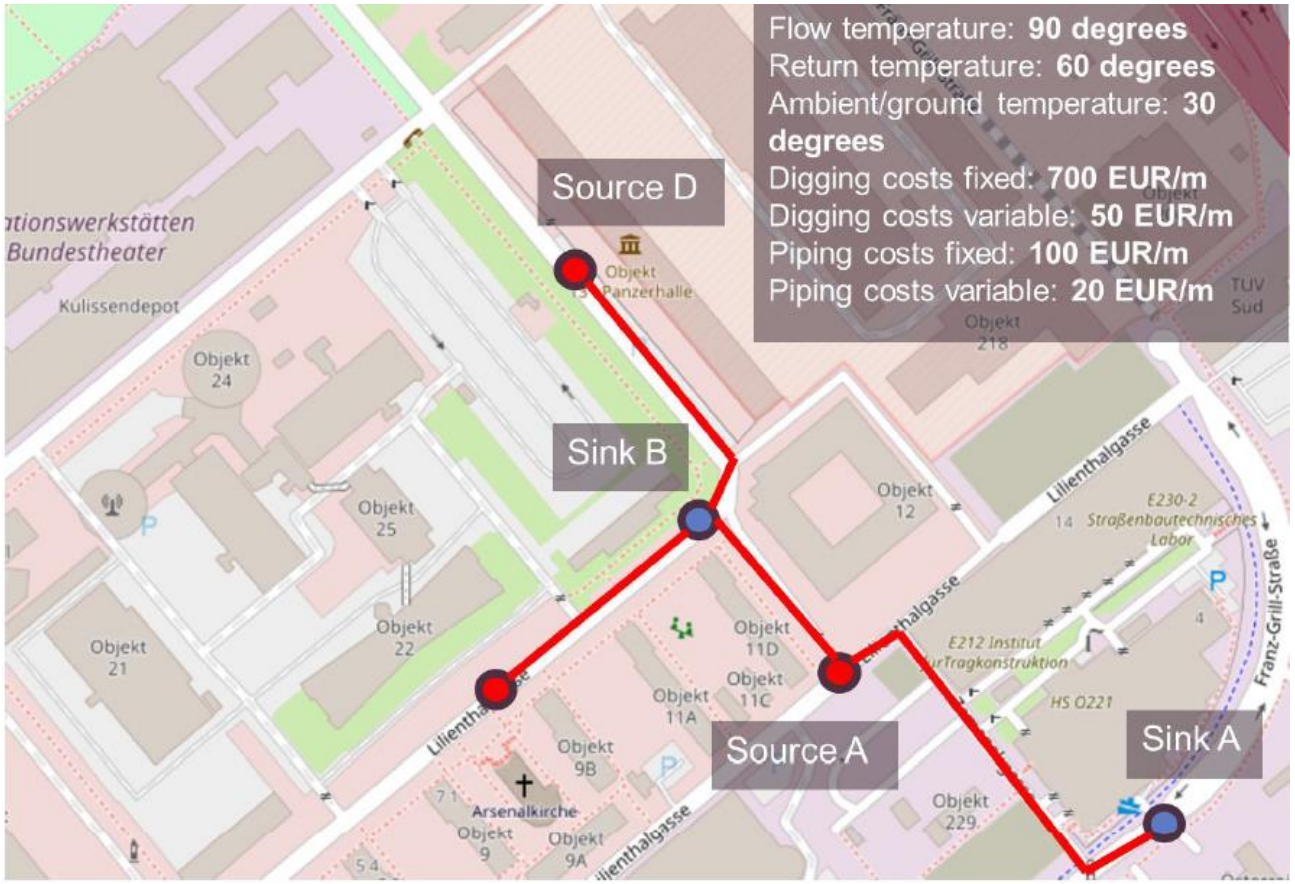
GIS MODULE



- Calculates a network solution between chosen set of sources and sinks – lowest cost path based on the Open Street Map road network
- Inputs: flow/return & ambient/ground temperature, digging & piping costs
- Provides network graph, thermal energy losses & total costs for network

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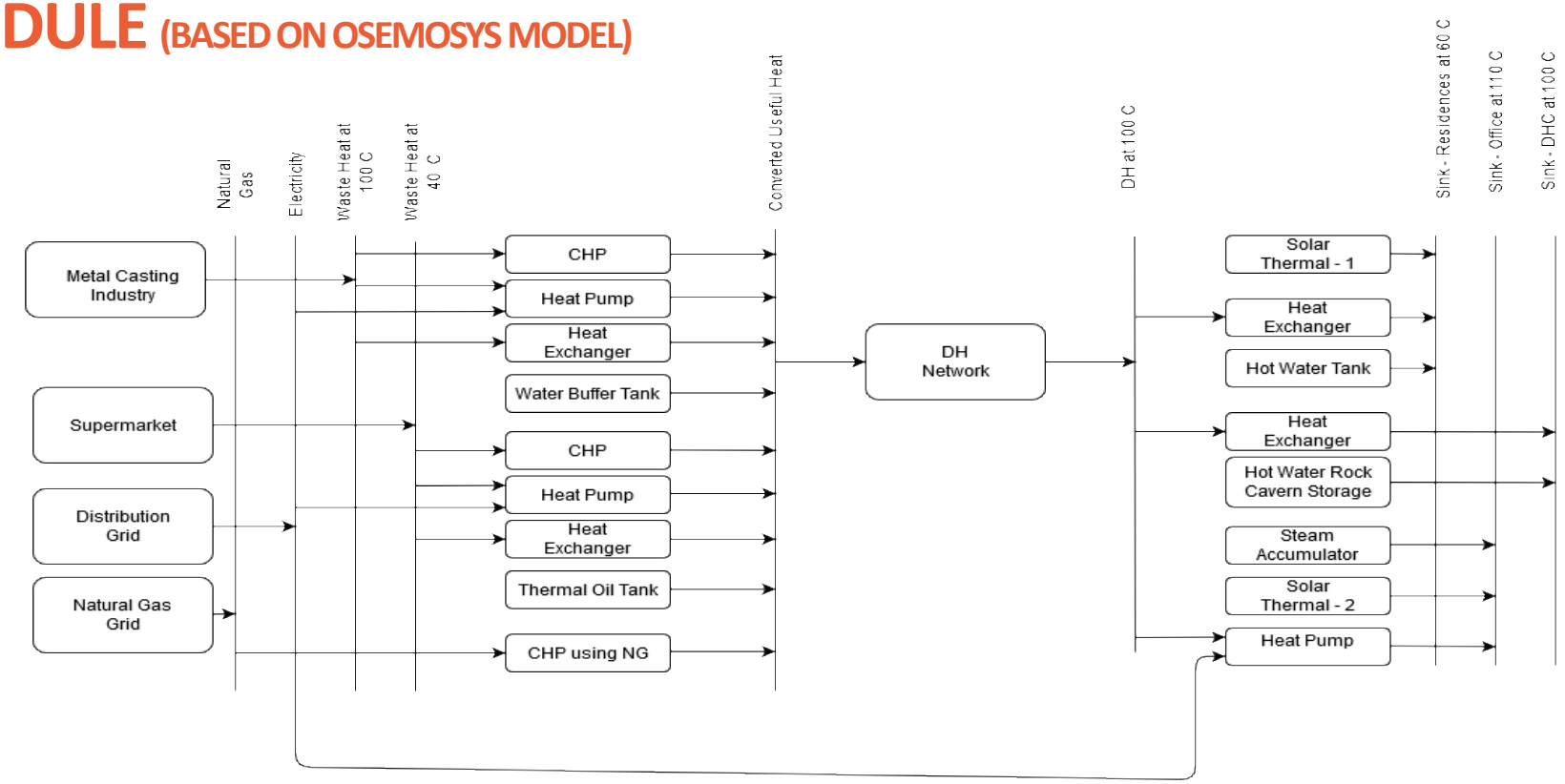
TEO MODULE (BASED ON OSEMOSYS MODEL)



- Least cost optimization of the whole energy supply chain considering a set of sources, sinks & network
- Inputs: temperature outflows/inflows, demand & supply profiles, technical & economic details nodes
- Matches source and sink supply-demand based on quality of thermal energy (T)
- Planning and capacity investment optimization for the period of analysis (e.g. until 2030)

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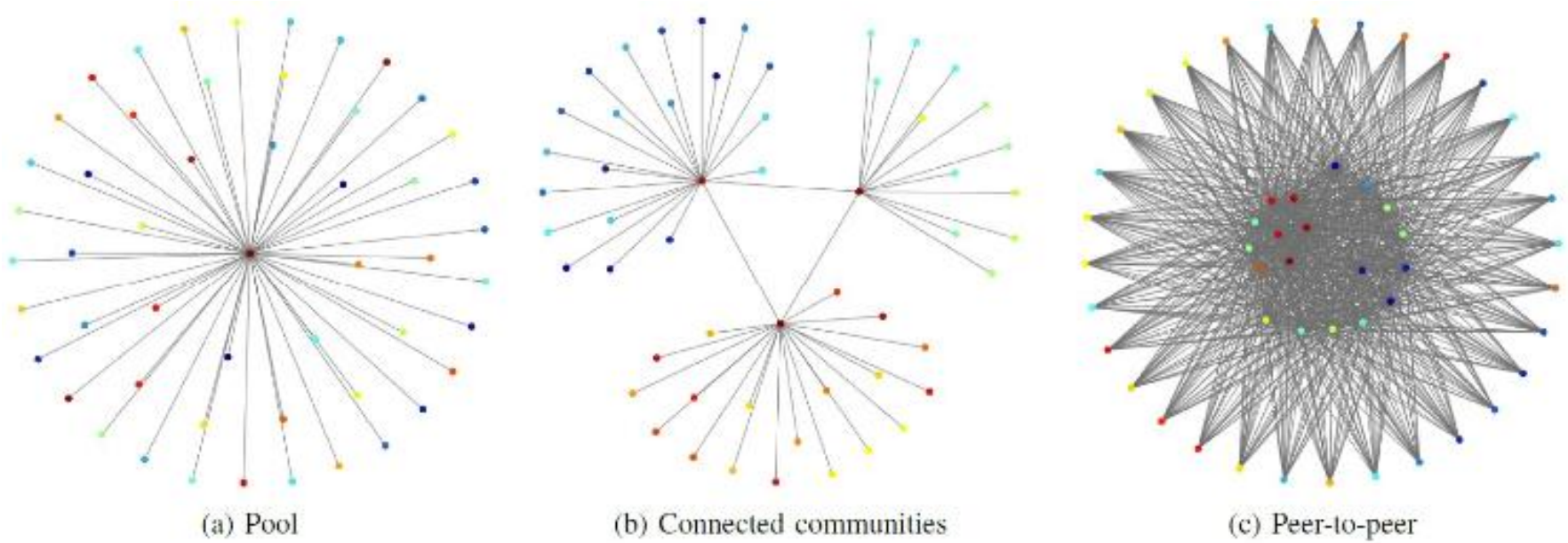
MARKET MODULE



(a) Pool (b) Connected communities (c) Peer-to-peer

- Calculates the overall economic benefit of a market type – pool, communities, P2P
- Inputs: tariffs, type of market (user), regulatory framework
- Provides revenue (sources) and cost (sinks) for each agent
- Optimizes match of heat production and consumption under market conditions

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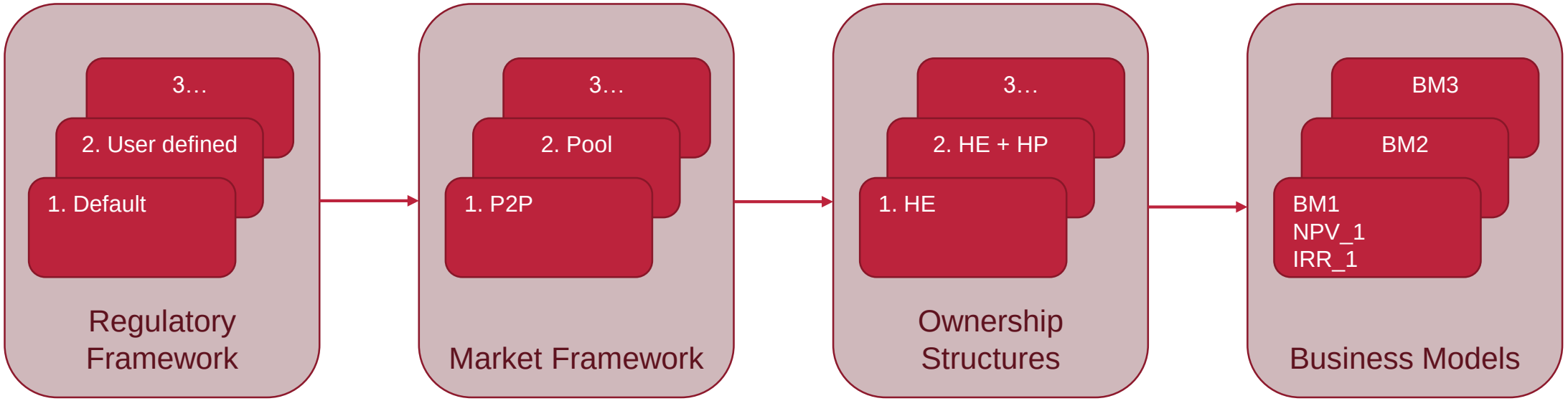
BUSINESS MODEL MODULE



- Factors and conditions influencing feasibility of excess H/C recovery and use projects: financial, environmental and risk analysis
- Inputs: applicable regulatory framework, market structure, techno-economic outputs
- Analyses will be divided into user groups through the value chain: excess heat supplier, the heating grid operator, and the end-users (e.g. sinks)

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INDUSTRY CENTRIC CASE STUDIES

Goal: validate full suite of analysis features of the EMB3Rs tool, especially those linked to detailed implementation of H/C recovery & use of industrial sources

Cement plant – PT
- Thermal optimization
- Heat-to-power
- Heat-to-network

Foundries & Metal Casting SMEs – UK
- Thermal optimization
- Heat-to-power
- Heat-to-network

Industrial Park – Greece
- Thermal optimization
- Industrial symbiosis
- Matching H/C between industries
- Heat-to-network

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NETWORK CENTRIC CASE STUDIES

Goal: validate features linked to incorporation of excess H/C into existing networks & DHC network requirements in general (different ownership DHs)

DHC Network – PT

- Incorporation of **excess heat** from **local sources** into **existing H/C network**
- Replacement of NG
- Private Company

P2P Heat Markets with excess heat – DK

- **Expansion of capacity of existing DH network** with local excess H/C
- Exploring market configurations
- Incorporation of non-industrial excess heat sources

DH Network – SWE

- **Expansion of capacity of existing network** with locally available industrial H/C
- Links to regional network
- Network owned by municipality

Heating Campus UoW – UK

- Explore options for **DH network for UoW campus** using excess (industrial) heat from nearby sources

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