WELCOME TO THE WORKSHOP

SEP. 29, 10:30-12:30 CET, online

DHC Networks
in EU Innovation Projects

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801.
AGENDA

10:30 – Welcome statement and Workshop overview [ACCIONA] – María Victoria Cambronero

10:35 – General overview WEDISTRICT project [ACCIONA] – María Victoria Cambronero

10:40 – 12:30 - DHCs real demonstrators and experiences

   10:40 – Alcalá demosite – WEDISTRICT Project [DHECO] – Jon Martínez
   10:55 – Bucharest demosite – WEDISTRICT Project [UPB] – Constantin Ionescu
   11:25 – Rewardheat Project [RINA] – Federica Fuligni
   11:40 – Related Project [TECNALIA] – Antonio Garrido
   12:10 DHC inefficiencies and lessons learnt [RAMBOLL] – Frederik Palshøj Bigum

12:20 AB Feedback, other questions from audience, open discussion

12:30 – Wrap-up and close of the workshop [ACCIONA] – María Victoria Cambronero

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Smart and local renewable Energy
DISTRICT heating and cooling solutions for sustainable living

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°857801.
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WEDISTRICT technologies

3 Different Solar Technologies

Low emissions Biomass technology

Hybridation PV-Geothermal Energy

2 different Cooling from renewable energy sources

Data centre heat waste recovery

Molten salts Energy storage

Advanced ICT system

Other conventional technologies

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801.
WEDISTRICT technologies will be implemented in 4 real-scale projects in Spain, Romania, Poland and Sweden.
A set of virtual demos selected from the identification of potential demo-followers will be simulated by the WEDISTRICT Simulation Working Group and different scenarios with technologies developed within the project will be integrated in order to evaluate the most cost-effective system for each particular demo follower.

The main objective of the activity is to improve the current system by integrating renewable energy solutions and demonstrate WEDISTRICT replicability from 3rd to 5th GDHC.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801.
WEDISTRICT expected main results

- 100% renewable district heating and cooling systems
- A portfolio of replicable solutions for DHC systems
- Higher public acceptance of DHC systems

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 857801.
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Thank you for your attention!

María Victoria Cambronero Vázquez
mvcambronero@acciona.com
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Alcalá DemoSite

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Where is Alcalá?

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Where is Alcalá demosite?
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°857801

In 1975 CEPSA founded the CEPSA’s Research Center. Cepsa Research activities are mainly focused in the optimization of chemical processes, the development of improved and novel products and identifying novel technological trends.

Thermal and cooling consumption of the building is shown in the following table:

<table>
<thead>
<tr>
<th>Building</th>
<th>CEPSA RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating (kWh&lt;sub&gt;y&lt;/sub&gt;)</td>
<td>1.317.220</td>
</tr>
<tr>
<td>Cooling (kWh&lt;sub&gt;y&lt;/sub&gt;)</td>
<td>730.960</td>
</tr>
</tbody>
</table>

Current Heating installation
3 Gas boilers
Brand: ADISA / Duplex EVO 400
Heating Power: 378 kW (1137 kW)

Current Cooling installation
2 Air-condensing water coolers
Brand: LENNOX / LCH 702 VKLN
Cooling Power: 646 kW (1292 kW)
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New building and Solar field

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New building for the Power Plant
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Hydraulic scheme

1. TC-FTC
2. Parabolic trough collector
3. Fresnel collector
4. Biomass boiler
5. Advanced absorption chiller
6. Commercial absorption chiller

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Description of the Power Plant (1/3)

*Concentration Solar Collectors (3 different technologies):*

- **PTC (186 kW th)**
- **Fresnel (249 kW th)**
- **Tracking Concentrator for Fixed Tilt Collector (242 kW th).**
Description of the Power Plant (2/3)

*High efficiency low emissions biomass boiler:*

- Biomass boiler (~ 1 MW)
- Advanced air filters for reducing air pollutants.
Description of the Power Plant (3/3)

**Solar cooling:**

- **Desiccant Indirect Evaporative Renewable Cooling Unit (R-ACU) (10 kW)**
- **High efficiency absorption Chiller (100 kW)**
- **Conventional absorption chiller (730 kW)**
Control system: Advanced digitalization platform

The Command-and-control suite is the central module in charge of the automatic control and optimization.

- **General Control System**
- **System Optimization**
- **C&C Dashboard**
- **Smartphone app**
Lessons learnt

1. High-temperature solar installation (250°C) and molten salt thermocline tank:
   - Budget limitation
   - Technical problems
   - Alcalá DHC is a small installation

2. Difficulties to obtain municipal licenses
   - City council was not included in the consortium
   - Support letter is not enough
Thank you!
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Location of Bucharest demo-site – UPB Campus

Target Building – RES Laboratory

CHP Plant

Bucharest demo-site

Rectorat

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Location of Bucharest demo-site – UPB Campus

CHP – Cogeneration Heat & Power Plant;
TB – Target Building;
TS – Thermal Station;
DP – Distribution Point

Primary network
Secondary network

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Objectives of UPB Demo

- generate three forms of energy (electricity, heat and cold) based on a hybrid renewable energy source (geothermal and solar);
- the electricity produced to cover at least the consumption of the thermal energy generation unit (on a yearly basis);
- fully cover the heating and cooling demand for the Target Building using thermal energy produced from 100% renewable energy sources;
- reintegration of the Target Building into the UPB heat distribution network to inject the overproduction of heat;
- develop a modular concept that will ease the process of replication and scaling.
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**Demo-site block diagram**

- **Hybridization:** geothermal – PV
- **2 interconnected subsystems:** thermal & electrical
- **Electrical energy production** to cover the consumption of the thermal subsystem, on a yearly basis
- **Overproduction of heat** produced from RES injected into DH
- **Zero CO₂ emissions** at demo-site level
Thermal subsystem layout *(heating regime)*

- Master/slave ground-to-water HPs: 63 kW heating/ 50 kW cooling
- 12 BHE (100m depth)
- TES tank (HW/CW) of 2000 l
- DHW tank of 750 l (instant DHW production capability)
- PVT panels (3 m²)
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Control system strategy

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Equipment deployment areas

- **2nd PV array** (39.3 kWp)
- **Target Building**
  - 1st PV array (26.7 kWp)
- **BHE emplacement**
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Borehole Heat Exchanger installation
BHE (concept)
# Barriers, risks & issues (actual)

<table>
<thead>
<tr>
<th>Type</th>
<th>Risk Description</th>
<th>Probability</th>
<th>Impact on timing</th>
<th>Impact on resources</th>
<th>Contingency Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>Incompatibilities between new and existing equipment</td>
<td>Unlikely</td>
<td>1-2 weeks delay</td>
<td>Possible costs for extra needed materials</td>
<td>Find alternative founding source to sustain possible expenditure. Reconfiguration and redesign of the affected part of demo-site.</td>
</tr>
<tr>
<td></td>
<td>Communication issues between automation &amp; control components</td>
<td>Unlikely</td>
<td>1 week</td>
<td>Minor</td>
<td>Automation &amp; control system design and components were chosen to be fully compatible.</td>
</tr>
<tr>
<td></td>
<td>Reconfiguration of connection pipe with thermal substation for heat injection</td>
<td>Possible</td>
<td>Low</td>
<td>Minor</td>
<td>Prior consideration of two alternative layout for piping circuit.</td>
</tr>
<tr>
<td>Contractual</td>
<td>Delays in purchases</td>
<td>Unlikely</td>
<td>1-2 weeks</td>
<td>None</td>
<td>Permanent contact with suppliers. Alternative suppliers considered.</td>
</tr>
<tr>
<td></td>
<td>Delays in installation schedule</td>
<td>Possible</td>
<td>1-2 weeks</td>
<td>Minor</td>
<td>Signed contracts have clauses that cover unexpected situations.</td>
</tr>
<tr>
<td>External factors</td>
<td>COVID-19</td>
<td>Nearly certain</td>
<td>Depends on the particular situation.</td>
<td>Minor</td>
<td>Depending on local/national Covid imposed regulations, measures to continue onsite works will be taken.</td>
</tr>
<tr>
<td></td>
<td>Unfavorable weather conditions for PV system installation</td>
<td>Possible</td>
<td>Depends on weather conditions</td>
<td>Medium</td>
<td>Constant tracking of weather forecast. Concentration of installation team efforts on outside works during good weather periods.</td>
</tr>
<tr>
<td></td>
<td>Unfavorable weather conditions could lead to UPB DH start before the connection of demo to the local network</td>
<td>Possible</td>
<td>2-3 weeks</td>
<td>None</td>
<td>The demo connection to the network will be made with highest priority.</td>
</tr>
<tr>
<td>Other</td>
<td>Measurement, operation and accidental errors</td>
<td>Unlikely</td>
<td>Few days delay</td>
<td>Minor</td>
<td>Constant communication and reporting Constant review of the measurements, data acquisition, etc</td>
</tr>
</tbody>
</table>
## Operation plan of Bucharest demo

<table>
<thead>
<tr>
<th>Operation activities</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jan (M28)</td>
<td>Feb (M29)</td>
</tr>
<tr>
<td>Heating regime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive cooling regime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active cooling regime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring and data collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation of heating regimes KPIs</td>
<td></td>
<td>Partial results</td>
</tr>
<tr>
<td>Evaluation of cooling regimes KPIs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Lessons learned

**Technical**
- Close collaboration with experts in the field (from industry)
- Validation through numerical simulation
- Double check using multiple methodologies

**Financial**
- Higher budget margin to avoid price fluctuations
- Exchange rates should be considered (for non EUR countries)
- Signed contracts should be clear and detailed

**Project resources**
- Allocate more time for permits and licenses
- Public tender procedures are high time and human resource consumers
- Form research team with multidisciplinary abilities
- Constant communication and weekly status meetings
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Thank you!

Follow us on:  

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement N°857801
Data centre
waste heat recovery

• The WEDISTRICT Luleå demo-site

• Recovery of waste heat with fuel cells

The fuel cells will generate electricity, which will be used to power the data center.

The excess heat from the data centre and fuel cells will be supplied to the local district heating grid.

Dr Jon Summers, Demo-site lead

Scientific Lead in Data Centers, RISE
Data centre waste heat recovery

Why?

Today 0.03% of input power is in the data stream.

Today 99.97% of input power is in the thermal stream.

Based on:

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Waste heat recovery

Where?

WHR from Data Centres is not new

Many initiatives in Europe for Waste Heat Recovery from Data Centres:

- Yandex / Nivos Energia Oy, Mäntsälä, Finland
- Facebook / Fjernvarme Fyn, Odense, Denmark
- GleSYS/Falkenberg Energi, Sweden
- Dalkia, Val d’Europe, France
- NorthC data center/Aalsmeer Energy Hub, Aalsmeer, the Netherlands
- Open District Heating, Stockholm, Sweden
- Telia/Fortum, Helsinki, Finland

AND MANY MORE.
Data centre waste heat recovery

How?

Heat pumps are used to increase temperature of the data centre heat for supply to the district heating network.

Who manages the heat pumps? Data Centres have invested effort to remove the compressor from their estate.

Source: https://sustainability.fb.com/
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Data centres and fuel cells

Less Infrastructure + Less Complexity = Reduced Cost & Risk

50% decrease in physical infrastructure on-site
5-10% decrease in total DC COGS rate
24-40% efficiency improvement
22-50% CO2 reduction (more w/ RNG)

SIMPLECTY
Streamlined Design
Reduces Risk
Minimal customization
Reduced failure zone

LOWER COST
Elimination of electrical distribution
Less site equipment to maintain
Waste heat reuse
Simple energy supply chain

IMPROVED EFFICIENCY
Dramatic improvement in efficiency
Lower PUE, Reduced losses
Reduced TTM-construction time down 6 months

SUSTAINABILITY
Lower Emissions
Reuse of waste heat

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801
Data centres and fuel cells

MICROSOFT-CUMMINS ADVANCED ENERGY LAB

The lab’s initial focus will be on powering datacenters with natural gas powered fuel cells. The 20 rack environment in the lab simulates datacenter conditions to evaluate whether the fuel cells have the potential to improve efficiency, reduce emissions and cut costs.

Equinix installs fuel cells in 12 US data centers

Apple installs 10MW fuel cell

CenturyLink installs hydrogen fuel cells at California data center

Uptime Institute recognizes Fuel Cells as a reliable source of onsite power

Data centres and fuel cells for reliable prime power, low noise for urban areas. Data centres are investing in FC technology.

Our message is not to replace heat pumps in data centre applications, but to leverage the prime power FC enhanced thermal arrangement to provide thermal energy to the DH.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801.
Demonstration site

**LULEÅ** (Sweden)

Climate zone: Northern European Weather

**Excess heat integration in existing district heating**

**TECHNOLOGIES PLANNED:**

- The **excess heat from the data centres** will be recovered by **liquid cooling technology**
- The excess heat will be boosted to temperatures suitable for supplying the Luleå’s district heating by **fuel cell technology**.
- Challenge to construct demonstrator in Northern Sweden is two-fold:
  - No piped gas, so the gas will need to be stored.
  - High temperature of 3rd generation district heating networks.
Demonstration site

LULEÅ (Sweden)

Orientation, location and setup of demo-site

Two stacked ISO containers

Biogas storage
Demonstration site

**LULEÅ** (Sweden)

Thermal arrangement of fuel cells and data centre

- **Top module/container** – 20-foot ISO for Fuel Cells
- **Bottom module/container** – 20-foot ISO for Data Centre

**LULEÅ**

Demonstration site

Thermal arrangement of fuel cells and data centre

Top module/container – 20-foot ISO for Fuel Cells
Bottom module/container – 20-foot ISO for Data Centre

Dry cooler

Fuel Cell Module (TOP) – Exhaust gas

Bio gas

Main building

Water

District heating

Power grid

L1

L2

L3

Immersion cooled Data center

UPS

Air pre-heater

LULEÅ (Sweden)

Thermal arrangement of fuel cells and data centre

Top module/container – 20-foot ISO for Fuel Cells
Bottom module/container – 20-foot ISO for Data Centre

Dry cooler

Fuel Cell Module (TOP) – Exhaust gas

Bio gas

Main building

Water

District heating

Power grid

L1

L2

L3

Immersion cooled Data center

UPS

Air pre-heater
Demonstration site
LULEÅ (Sweden)
Fuel cell electrical arrangements

Single phase Solid Oxide Fuel Cells.
Phases to be synchronised by the utility.
Demonstration site
LULEÅ (Sweden)

Fuel cell BlueGen BG-15 thermal efficiency
DH supply temperature 2020

Fuel cell thermal efficiency drops from around 30% to 10% as the temperature of the water circuit increases from 30°C to 80°C, with an expected maximum of 95°C.

87% WHR
50% WHR

% of year meeting DH supply temp.
WEDISSTRICT
LULEÅ (Sweden) demonstrator lessons so far!

The demonstrator in Luleå plans to go live in late 2021 and will operate for over a year and the data collected will be available via the EU’s Open Research Data Pilot initiative.

Operating the data centre between 10 and 60% utilisation, the demonstrator will run on the biogas and the heat is anticipated to be recovered and consumed in the local district heating network for more than 7000 hours per year (DH temperature challenges - 3rd GEN)

The demonstrator should prove to be able to run with WHR all year around on a 4th generation district heating network. Challenges with access to gas – piped gas better.

Data centre applications require a greater density of Solid Oxide fuel cells. SolidPower has on their roadmap raising the 2.7kW/sq.m to nearer 10kW/sq.m. Could become a way to build out Edge infrastructure in urban areas – close to end users, need for heat, access to piped gas, quite operation

Using natural gas will be the initial way forward in Europe, but that will quickly become a discussion point (price point today!). SOFC can operate with up to 35% hydrogen in the gas and if it is green hydrogen – carbon intensity will drop.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N°857801
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Overview on the REWARDHeat project

Federica Fuligni, RINA Consulting
federica.fuligni@rina.org
**Background**

- 72% of the European population (EU28) lives in cities and towns
- A huge amount of low-grade waste heat is diffused within the urban texture, the largest amount being rejected by air-conditioners, cooling systems in industrial processes and tertiary buildings, chillers of refrigeration systems and service facilities, e.g. sewer pipes
- For historic reasons, cities and towns have born along rivers, lakes and seashores. All these sources make low-temperature renewable energy available, which utilisation is highly replicable because it is accessible right where it is needed
- ...not to mention the solar source, available for thermal and electric energy production

*Source: Ricardo Gomez Angel on Unsplash*
The Vision

• The overall objective of REWARDHeat is to demonstrate district heating and cooling (DHC) networks, which are able to recover renewable and waste heat available at low temperature, i.e. lower than 40°C

• To do this, we need to lower the supply temperature compared to conventional networks. Focus on supply temperature lower than 60 °C and down to 10-20°C.

• Focus is on the exploitation of the energy sources available within the urban context, allowing to maximize the upscale potential of the decentralized solutions developed
Specific Objectives

TO INTEGRATE MULTIPLE URBAN RENEWABLE AND WASTE ENERGY SOURCES

REWARDHeat will explore alternative configurations of a DHC network, where multiple heating and cooling sources are available, with the aim to providing recommendations for the replication of the systems depending on their boundary conditions.

- Planning schemes database
- Pre-design tool
- Informational material for publication in wiki-tools
- Guidebook for planners
- Serious gaming

Source: Kelly Sikkema on Unsplash
Specific Objectives

**TO DEVELOP INNOVATIVE TECHNOLOGIES FOR FLEXIBLE USE OF HEAT IN DHC NETWORKS.**

Substations - Two approaches are pursued: prefabrication for building solutions and standardisation for large-scale district heating plants:

- Small-size (up to 50 kW) prefabricated substations including booster heat pump specialised to specific demonstration cases.
- Large scale industrialised energy Centre at sub-network level
Specific Objectives

TO DEVELOP INNOVATIVE TECHNOLOGIES FOR FLEXIBLE USE OF HEAT IN DHC NETWORKS.

Pipes adapted to low temperature networks

Source: Vattenfall
Specific Objectives

TO DEVELOP INNOVATIVE TECHNOLOGIES FOR FLEXIBLE USE OF HEAT IN DHC NETWORKS.

Thermal storages

• Local, intra-day storages at customer substations
• Central, intra-day storages to balance the network and store energy during off-peak periods
• Central, seasonal storage: borehole storage
Specific Objectives

TO DEMONSTRATE DIGITALISATION SOLUTIONS ALLOWING TO OPTIMISE THE MANAGEMENT OF THE DHC NETWORK

In REWARDHeat, storage capacity and control will be used synergically to manage the system.

- Smart metering communicating real-time
- Data-mining platform will permit to manage communication with smart meters and to handle controls
- Fault detection and expert control strategies elaboration for optimisation and electricity grid coupling
**Specific Objectives**

**TO DEVELOP BUSINESS MODELS AND FINANCIAL SCHEMES TO ENABLE LARGE PUBLIC AND PRIVATE INVESTMENTS TO BE MOBILIZED**

Options will be studies to sell heat as a service in contrast to a commodity, and **business models** will be built for each of the demonstrator networks.

The overall the idea is to change paradigm from “Heat as a Commodity” to “Heat as a service”

**Financial support approaches** will be elaborated based on reliable and transparent information, allowing for a clear risk assessment.

*Source: Nikita Kachanovsky on Unsplash*
REWARDHeat demo cases

**Demo description**

1. **MILAN (IT)** - Newly built neutral-temperature networks
2. **SZCZECIN (PL)** - Newly built low-temperature network
3. **ALBERTSLUND (DK)** - Retrofitted network to low-temperature
4. **HELSINGBORG & MöLNDAL (SW)** - Newly built low-temperature networks
5. **TOPUSKO (HR)** - Heat cascading in low-temperature network
6. **TOULON (FR)** - Upscaled neutral-temperature network
7. **HEERLEN (NL)** - Intra-day storage in neutral-temperature network
# REWARDHeat demo cases

<table>
<thead>
<tr>
<th>DEMOSITE</th>
<th>RENOVATION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Helsingborg &amp; Mölndal</td>
<td>Newly built low-temperature networks</td>
<td>REPARATORY WORKS, ANALYSIS ON ENERGY USAGE</td>
</tr>
<tr>
<td>2. Milan (Balilla)</td>
<td>Newly built neutral-temperature networks</td>
<td>RETROFIT/CONSTRUCTION</td>
</tr>
<tr>
<td>3. Milan (Gadio)</td>
<td>Intra-day storage in neutral-temperature network</td>
<td>MONITORING AND CONTROL OPTIMIZATION</td>
</tr>
<tr>
<td>4. Heerlen</td>
<td>Heat cascading in low-temperature network</td>
<td></td>
</tr>
<tr>
<td>5. Topusko</td>
<td>Upscaled neutral-temperature network</td>
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<td></td>
<td>Demix</td>
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<td></td>
<td>EPC</td>
<td></td>
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<tr>
<td>6. Toulon</td>
<td>Retrofitted network to low-temperature</td>
<td></td>
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<tr>
<td></td>
<td>Shunt valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>waste heat</td>
<td></td>
</tr>
<tr>
<td>7. Albertslund</td>
<td>Newly built low-temperature network</td>
<td></td>
</tr>
</tbody>
</table>

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**NB.** The construction/retrofit of the demonstrator networks needs to take place between M18 and M30.
DEMONSITES Commissioning phase: Helsingborg & Mölndal

Helsingborg: Novel low-temperature network that exploits a borehole seasonal thermal energy storage system with a centralised heat pump, and reload of heat from industrial surplus heat.

Mölndal: Novel low-temperature sub-network that exploits a borehole seasonal thermal energy storage system with a centralised heat pump for domestic heat and local heat pumps for hot water.
Thank you

www.rewardheat.eu
RELATED PROJECT: LESSONS LEARNT FROM SUBSTATION INSPECTION ON LOW TEMPERATURE DH NETWORKS.

29/09/2021
RELaTED – demo of Tartu

• LTDH conversion of an existing DH network in Tartu, Estonia.

• Characteristics:
  • Demo area’s length: 5.34 km.
  • Peak heat load: 4.3 MW.
  • Over 50 consumers: residential, commercial, educational and offices.

• 10-15°C reduction after the installation of a mixing chamber.
RELaTED – demo of Tartu

- > 50 substations.
- 5 data points.
- Hourly collection.
- >24 months of monitoring.
Data analytics of DHN

- Large set of collected data.
- Traditionally, inspection of the data is a resource-intensive task.
- In BAU, only the most important substations are carefully analyzed:
  - bigger ones;
  - those at the end of the line.
- To ease the process, automatization is set up using python.
Data analytics of DHN

Primary side temperatures (T1 and T2)
Data analytics of DHN

Secondary side temperatures (T3 and T4)
Data analytics of DHN

Domestic Hot Water (T5)
Conclusions

• Data monitoring as essential tool for DH optimization.

• Time-consuming to analyze in a traditional way.

• Automatization to improve DH operation, identifying issues in real time.

• Automatic data analysis at low computational cost.
Conclusions

• One year of hourly data from 54 substations analysed in less than 10 minutes with a laptop.

• Large DH operators often lack this kind of service.

• A proactive approach to further optimize the DH operation is yet to be exploited.
RELaTED, A FLEXIBLE APPROACH TO THE DEPLOYMENT AND CONVERSION OF DH NETWORKS TO LOW TEMPERATURE, WITH INCREASED USE OF LOCAL SOLAR SYSTEMS

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http://www.relatedproject.eu/

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The „District Future House“
Smart City solutions for tenants & housing companies

Sustainable Places Online Conference, 29/09/2021

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Outline of our H2020-project

Dresden team

Funding

- 17,5 Mio. € entire consortium
- 48 Actions - 4,5 Mio. € Dresden

10/2017 – 06/2023
Steps to facilitate the integration of fluctuating RES into the DH-grid

1. Measuring system for dynamic operating behaviour @ expanded the heat storage

2. Feasibility study for DH line for solar thermal plants

3. LowEx: Investigation on reduction of DH inlet temperatures
   - reduction of losses
   - improved feed-in options for RES

\[
\dot{Q} = \dot{m} \cdot c_p \cdot (\theta_{\text{Inlet}} - \theta_{\text{Outlet}})
\]
What's smart about the “District Future House”?

**Project sketch**
- Lighthouse project of the housing cooperative WGJ
- 14 residential units
- Cutting edge communicative building equipment
- Completion in 11/2018

**Services**
- Digital submetering and billing of operating costs
- Consumption data visualization / Smart Home
- Tenant electricity model and upgrade to tenant electricity smart
The building manager – the central unit

- data for the digital billing of operating costs
- Electricity consumption and weather data to the housing managers
- controls and optimises the heat supply
- Malfunction messages

DH transfer station
PV power inverter

Smart electric meter  water meter  heat meter

Control functions

weather station

District Future House | Alexander Haidan | Sustainable Places | 29/09/2021
Apartment manager

- Energy consumption (heating, [warm] water, electricity) with historical benchmarks
- Solar power generation
- Room temperatures
- Weather and outside temperatures
- Information of housing cooperative
- Open windows

**Display**

- Roomwise temperatures & heat curves
- Solar protection (blinds)
- Light (Central off switch when leaving)
- Smoke alarm

**Control function**
Tenant electricity tariffs become smart

**Example of load and simulated generation profile**

- **Step 1** – fixed time slot
- **Step 2** – time and weather dependent (locally gathered weather data)
- **Step 3** – time, weather and energy data dependent (energy data of pv system and weather forecast)

**Price discount in different steps (at least 2 ct./kWh)**

Discount slot on apartment manager
The Future District House generates...

More active tenants
- “Own green & flexible tariffs” highly appreciated
- apartment manager used daily or several times a week
- $\frac{2}{3}$ of tenants acts during discount slots of flexible tariffs

Increased sustainability
- Primary energy demand - 9% 6,8 MWh_{PE}/p.a.
- Emissions - 30% - 5,5 t CO²/p.a.
- self-consumption $\emptyset$ 90%
- autarky $\emptyset$ 26% (summertime ~40%)

New business models
- Green & flexible tariffs
- automated billing process
Thanks for your attention

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@matchupEU #matchupEU

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Our tenant electricity model

- Tenants
  - Benefit for participating tenants

- Building owner
  - Roof usage contract

- Apartment building
  - Tenant electricity
  - Non-participants

- Public grid
  - Power from public grid
  - Residual electricity
  - Surplus solar feed-in

- Tennant electricity contract
  (voluntary for participating tenants)
DHC inefficiencies and lessons learnt

Sustainable Places 2021
29/09 2021

Smart and local renewable Energy DISTRICT heating and cooling solutions for sustainable living

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°857801
About me

Frederik Palshøj Bigum

Education
• Aalborg University in Copenhagen, M.Sc. Sustainable Cities 2019

Professional carrier
• Energy consultant / Project manager at Rambøll District Energy Planning and Infrastructure 2019-Today

Typical projects
• National and international district heating and cooling
• Conversion of fossil-based systems to renewable solutions
Introduction

The Horizon 2020 project Renewable District Heating and Cooling (DHC), in short W.E.DISTRICT investigates technologies in four demonstration sites in Europe. Thereby the WEDISTRICIT project aims to showcase DHC systems that help improve efficiency, enable fluctuating renewable energy sources (RES), and provide cost-effective security of supply.

Through the WEDISTRICT project an overview of the current stock of DHC and the future development trends for the district energy markets in Europe has been assessed. By identifying inefficiencies, barriers, and improvement potentials in the current DHC systems in Europe, the ‘lessons learned’ are taken into account in the WEDISTRICT designs for new and retrofitting of existing DHC.

Disclaimer

Any dissemination of results must indicate that it reflects only the author's view and that the Agency and the European Commission are not responsible for any use that may be made of the information it contains.
Background for WEDISTRICT

Today, heating and cooling of buildings in EU accounts for 50% of the total energy consumption. 70% of this energy is still generated from fossil fuels. To identify improvement possibilities, it is necessary to understand the current stock of DHC and energy market of the European Union member countries.

Great potential for district energy solutions

Heating and cooling of buildings in EU accounts for

- 50% of total energy consumption in EU
- 70% of this energy is generated from fossil fuels
Smart and local renewable Energy DISTRICT heating and cooling solutions for sustainable living

Lessons learnt – Share of heat demand by DH

Small share (<10 %)
Lack of culture → No masterplan, regulatory framework
High use of individual heating and fossil fuels
Associated to warmer climates

Medium share (10 - 50 %)
Mainly fossil fuels or biofuels. Predominance individual boilers.
Heat price and CO2 emissions still favour individual solutions.
Refurbishment of infrastructure.

Large share (>50 %)
Increased focus on biofuels.
Saturated markets focused on improving efficiency and introduction of RES
In countries with limited or no DH or DC, there is no culture or historical background for district energy. This makes it difficult for investors to have stable conditions for long-term investments.

The EEDs are not implemented to the same degree in every European country and it is interpreted differently. Often national building codes favour individual solutions over district energy solutions. This can lead to sub-optimizations and not necessarily the most cost-effective solutions for communities.
Suggested improvements

- The huge variety of DHC systems and climate zones in the EU calls for improvements with very different starting points.
- Create a stable methodology and guideline for carrying out cost-benefit analyses of heat supply options in line with the provisions in the EU’s Energy Efficiency Directive (EED).
- Creation of long-term financing schemes in line with other infrastructure projects and buildings at low competitive interest rate. While making sure of a transparent market for electricity related services considering time dependent energy prices, capacity, and regulation.
- Access to laying pipes on public and, if necessary, private land.
- Ensure fair competition between DHC and building level solutions. Implement the EU directives with regards to the building codes to improve the performance of the buildings, as DCH often is the most cost-effective way to integrate renewable energies.
- Existing DHC can be retrofitted to provide higher technical and institutional performance. E.g. by establishing combined heating and cooling and installing pressure and temperature control of all end-user substations.
Suggested improvements

- The stage of the DH system has an influence of the development of DC, and large-scale HPs will play an important role in integrating possibilities to develop combined heating and cooling.

- Create regulations with the purpose of protecting the consumer, including price and/or profit structures, consumer influence and transparency for utilities. In close collaboration with the industry.

- Energy planning by dividing the cities and regional into zones best suited for gas, DH, or individual heat supply. Zoning ensures that the networks do not compete within same areas of parallel infrastructures.

- Consider energy planning as a natural part of the urban planning of infrastructure, if possible, with interaction between buildings, DHC and thermal generation.

- DH has a significant market share in countries in which the cities have establish a public utility. These public utilities are responsible for both heating, gas, electricity, and waste, and can therefore optimize the zoning of the networks and ensure integrating of the sectors.

- Attaining reliable and long-term energy solutions call for the right structural balance between private sector knowledge and public sector framework. Which enables DH infrastructure for the long term by having a relatively clear view of future market changes and low risks.
Thank you for listening

Please see our article on this topic in latest HOT COOL paper (link)

If any questions please contact me at FPB@RAMBOLL.COM

If you are interested in the WEDISTRICT project please follow us here:

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