SUSTAINABLE PLACES 2021

W.E. DISTRICT
Heating & cooling solutions

MATCHUP

RELaTED

REWARDHeat

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

DHC Networks
in EU Innovation Projects

WELCOME TO THE WORKSHOP

W.E. DISTRICT

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**
- 11:10 – Lulea demosite – WEDISTRICT Project **[RISE] – Jon Summers**
- 11:25 – Rewardheat Project **[RINA] – Federica Fuligni**
- 11:40 – Related Project **[TECNALIA] – Antonio Garrido**
- 11:55 – "Future District House" – Match UP Project **[SACHSENENERGIE] – Alexander Haidan**
- 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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W.E. DISTRICT

Smart and local reneWable Energy **DISTRICT heating and cooling solutions for sustainable living**

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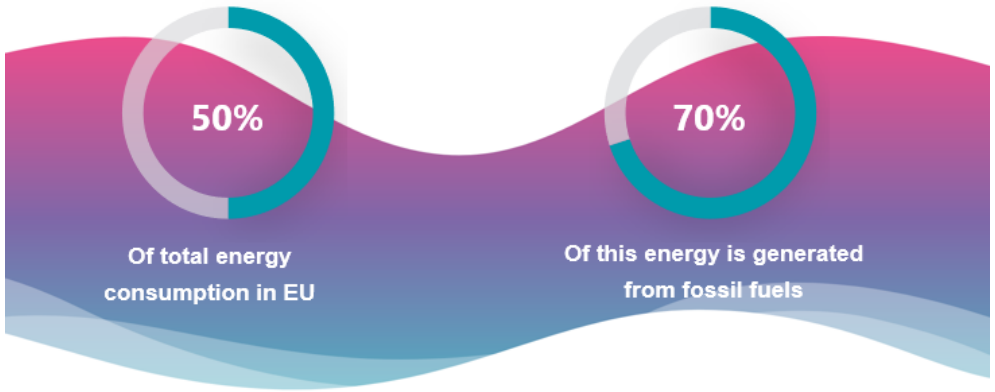
WEDISTRICT goal is

Heating and cooling buildings and industry in EU accounts for



To demonstrate innovative 100% fossil free heating and cooling solutions for new and existing district heating & cooling systems

- Multiple sources of renewable energy and excess heat from data centres
- Advanced thermal storage to redistribute heat to buildings as needed,
- Smart technologies to increase the operational efficiency of the systems.

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WEDISTRICT **technologies**

3 Different Solar Technologies

Data centre heat waste recovery

Low emissions Biomass technology

Molten salts Energy **storage**

Hybridation PV-Geothermal Energy

Advanced ICT system

2 different Cooling from renewable energy sources

Other **conventional technologies**

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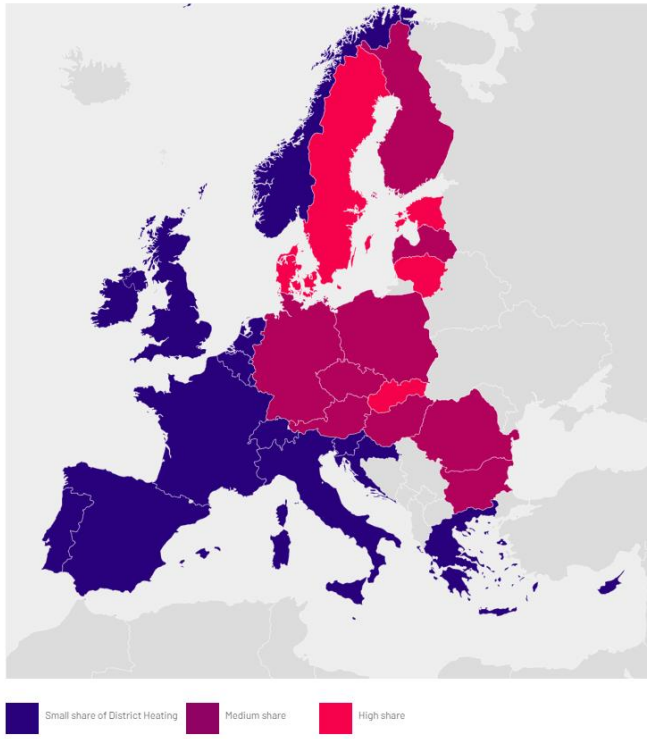
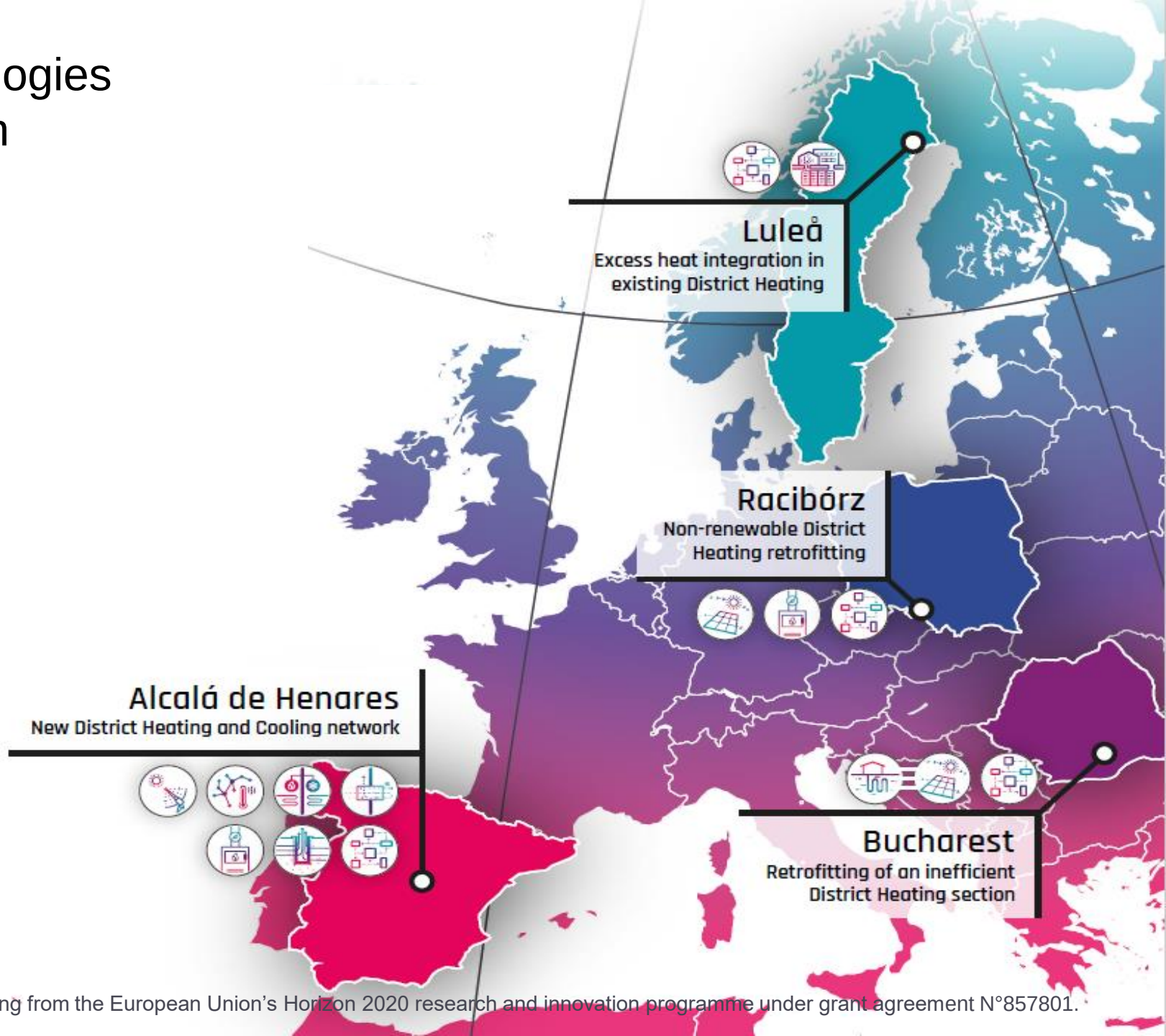
WEDISTRICT technologies will be implemented in **4 real-scale projects**

in Spain, Romania, Poland and Sweden.





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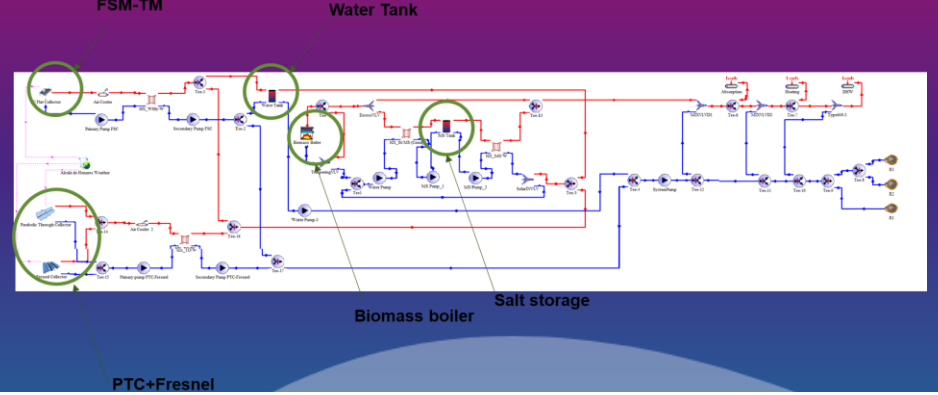
WEDISTRICT Replication Simulation Activity



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**.

NEW DH/C SYSTEMS		
Demo-follower	**Location**	**Description**
SeiMilano	Milan (Italy)	New modern urban and landscape re-development project that transforms the area by generating a new landscape.
Montegancedo Campus	Madrid (Spain)	School of software engineering and research pole with multiple research institutions currently supplied by individual gas boilers and compression chillers.
Playa del Inglés	Gran Canaria (Spain)	New DHC network in potential Canary Islands area.
Tecnoalcalá	Alcalá de Henares (Spain)	Scientific and Technological Park with individual heating and cooling supply in more than 40 companies located in the Park.
Independencia	Santiago de Chile (Chile)	10 clients (4 health clients, 2 residential apartments, 1 university, 1 mall and 2 offices and public clients), with 18 buildings for a new DHC proposal.
RETROFITTING OF EXISTING DH/C SYSTEMS		
Demo-follower	**Location**	**Description**
Parc de l'Alba	Barcelona (Spain)	New urban development with a high efficiency energy system and DHC partially implemented. 2 new production plants are planned.
Cyprus University	Nicosia (Cyprus)	DHC initially developed in 1999, expanded twice (in 2007 and 2010) and new expansion planned for year 2022. Currently operating with oil boilers and air-cooled chillers.
Żyrardów	Żyrardów (Poland)	Existing DH with around 500 heat centres coal-fired based (35-year old)
Valladolid	Valladolid (Spain)	6 buildings covered by a recent (2018) DH installation biomass-based with extension perspective.
Focsani	Focsani (Romania)	Old DH network retrofitted in 2018 with new CHP and gas boiler facilities.
Mrągowo	Mrągowo (Poland)	Old DH network (247 buildings connected) which has started a retrofitting action replacing coal by biomass.

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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

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WEDISTRICT
Main data

EU Funding:

14.972.852,64 €

Start:

Oct. 2019

End:

March 2023

22
Partners

9
Countries

4
Demosites

10
Technologies developed

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Our Partners

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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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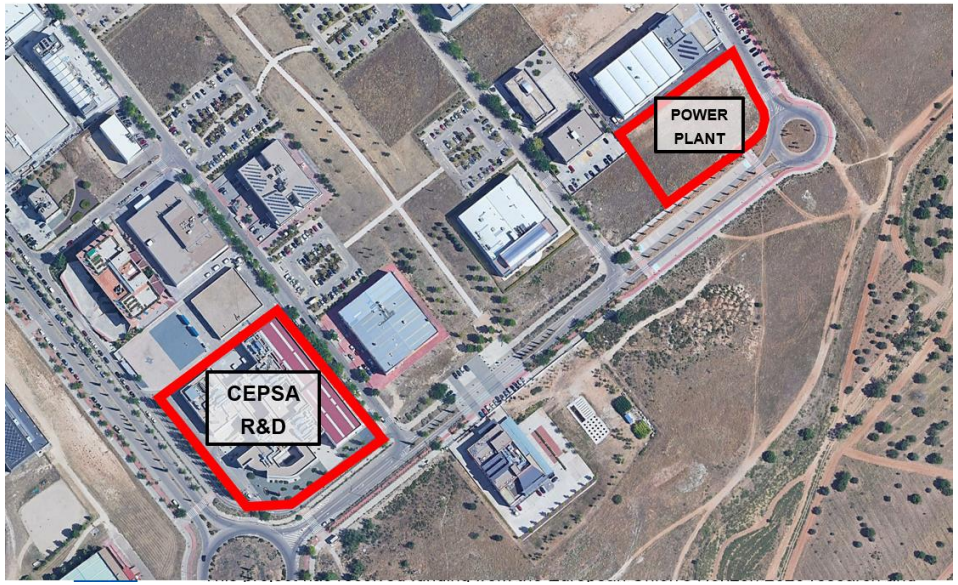
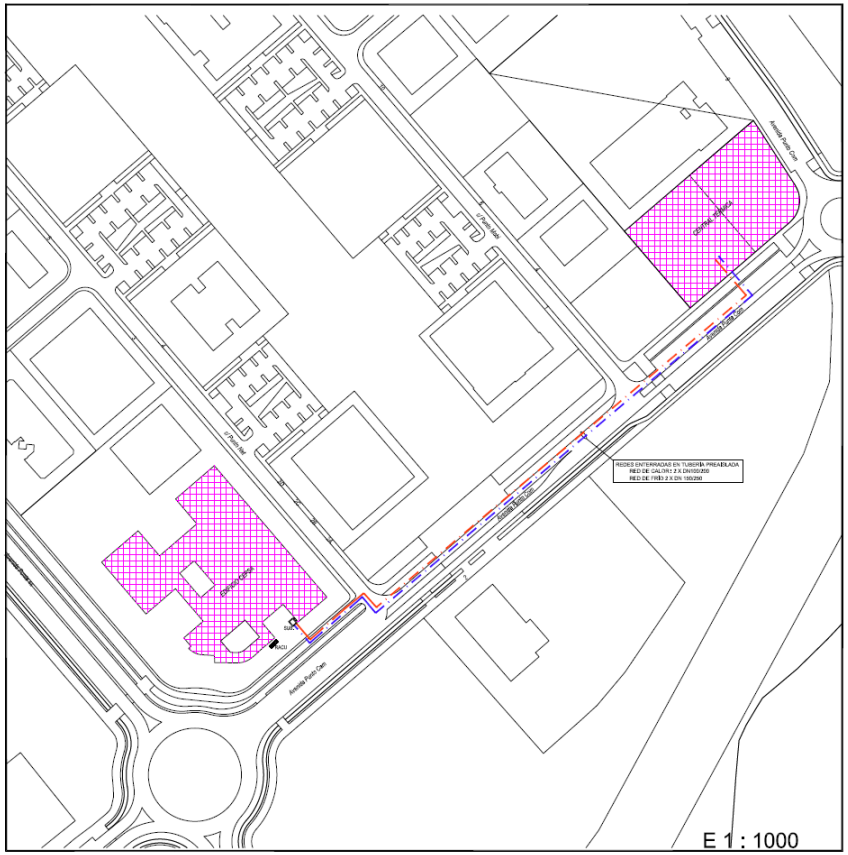
Where is Alcalá demosite?





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Building connected to Alcalá DHC

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:

Building	CEPSA RC
Heating (kWh_y)	1.317.220
Cooling (kWh_y)	730.960

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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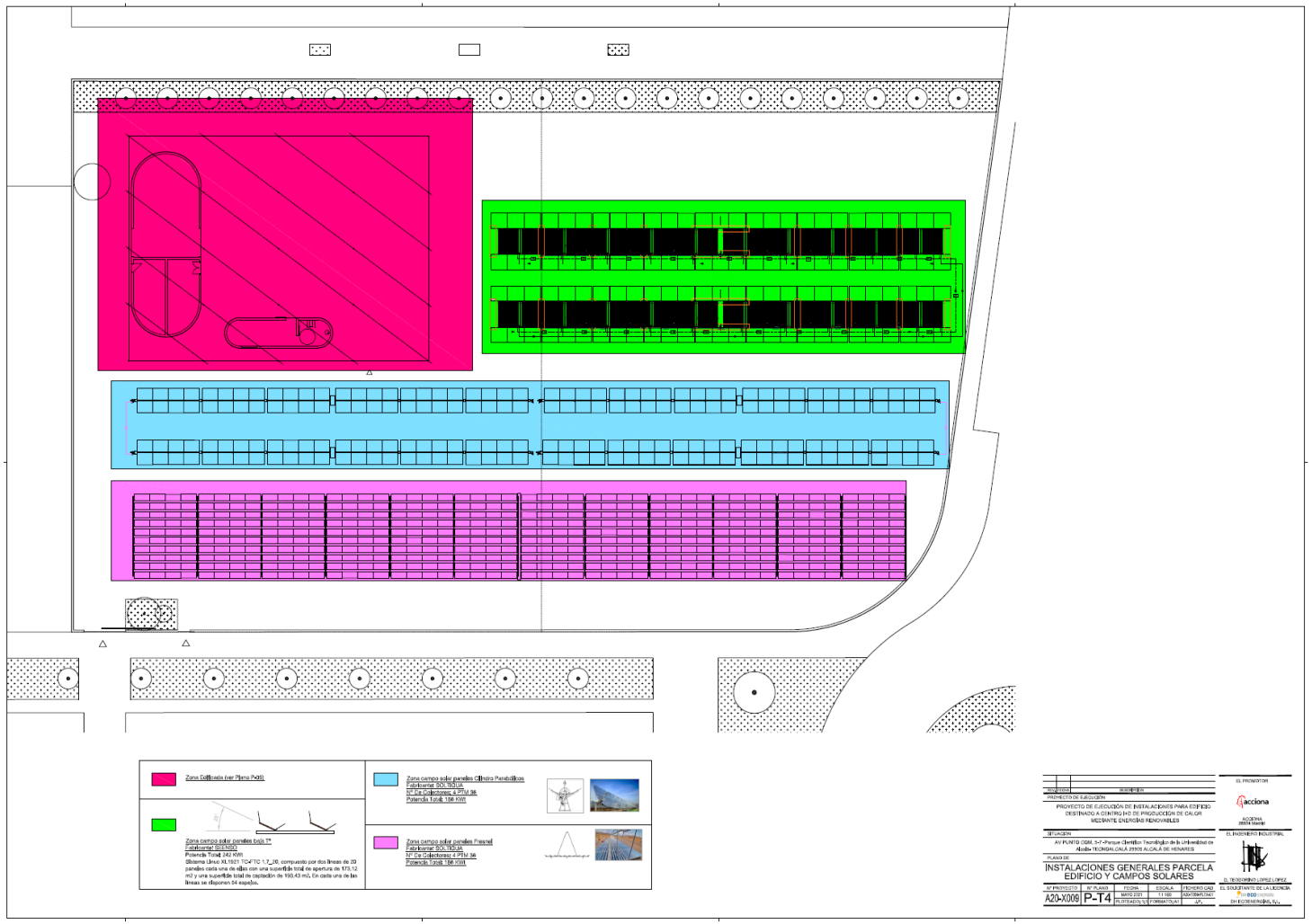
New building and Solar field



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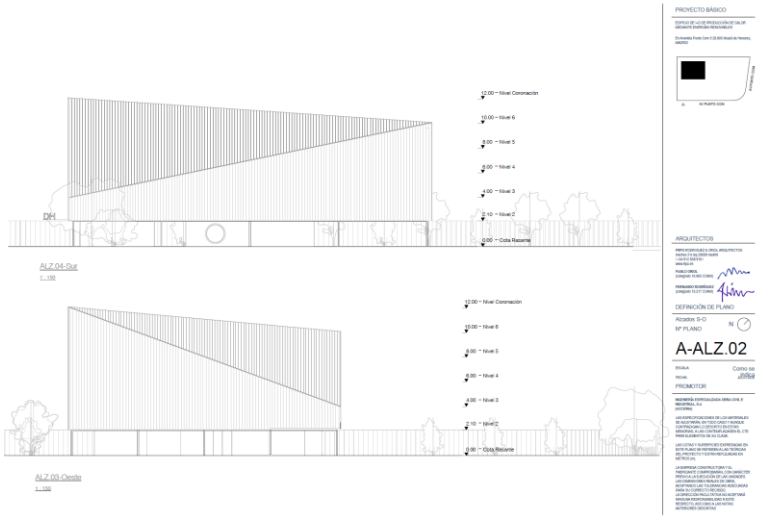
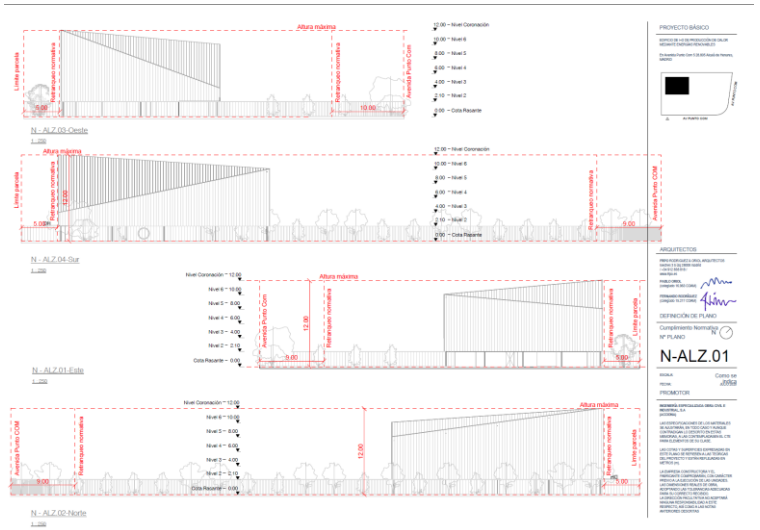
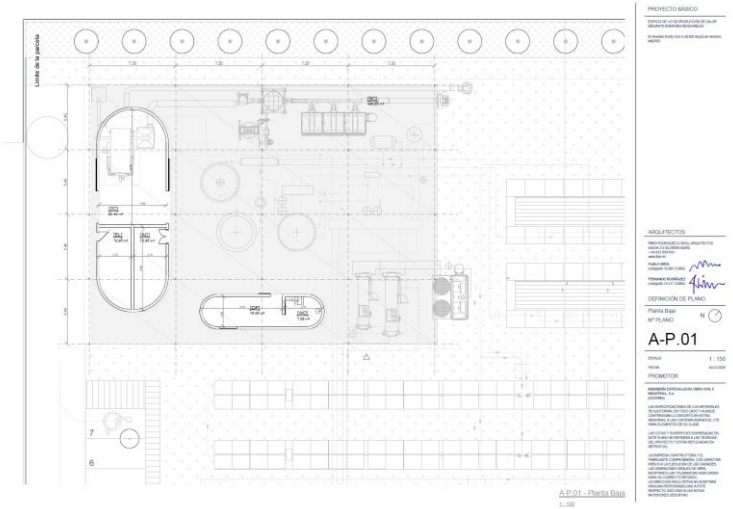
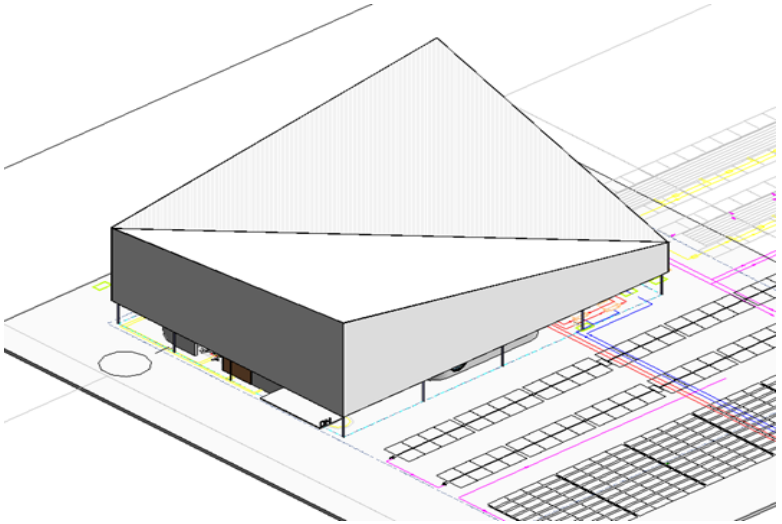
New building for the Power Plant



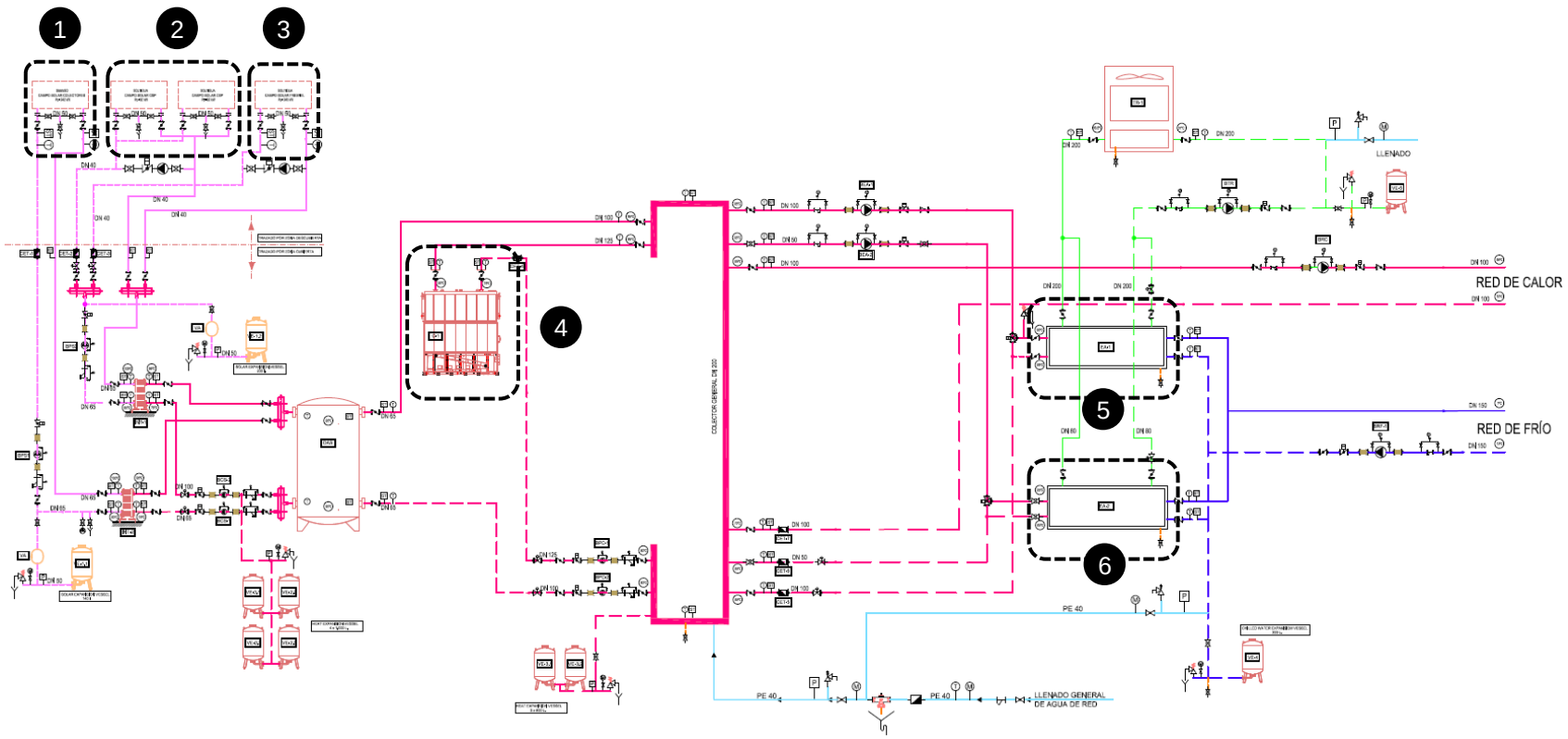






Hydraulic scheme

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



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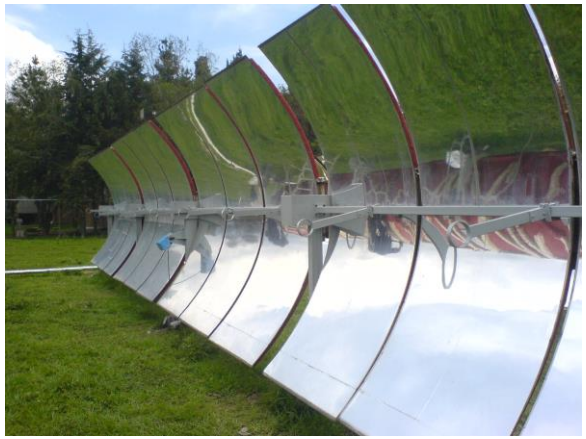
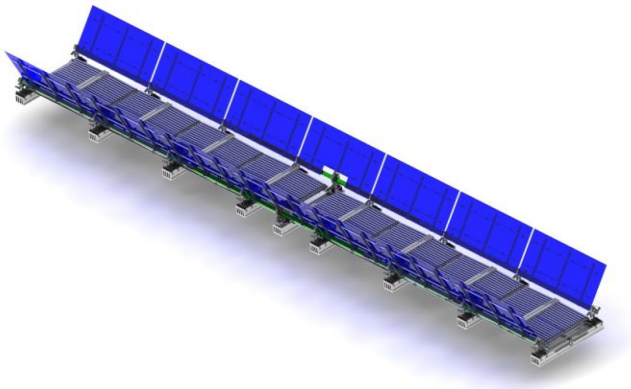
Description of the Power Plant (1/3)

Concentration Solar Collectors (3 different technologies):

- ***PTC (186 kW th)***
- ***Fresnel (249 kW th)***
- ***Tracking Concentrator for Fixed Tilt Collector (242 kW th).***





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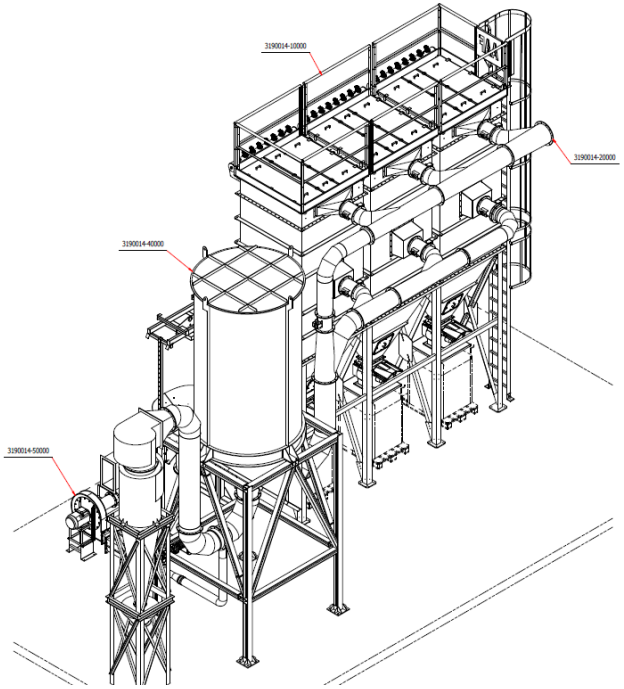
Description of the Power Plant (2/3)

High efficiency low emissions biomass boiler :

- ***Biomass boiler (~ 1 MW)***
- ***Advanced air filters for reducing air pollutants.***



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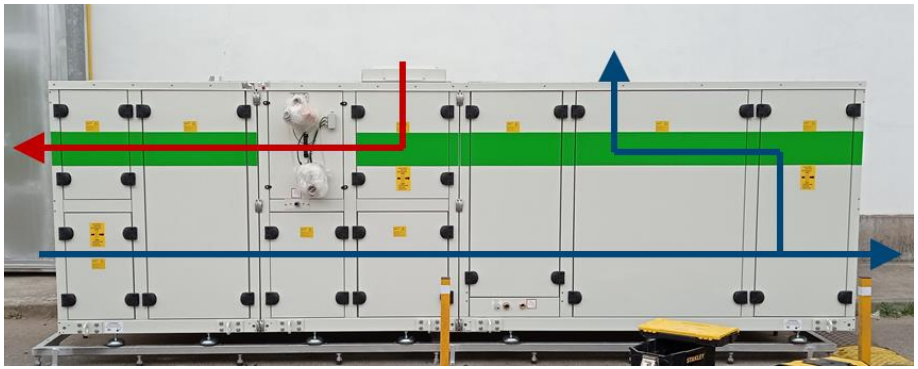
Description of the Power Plant (3/3)

Solar cooling:

- ***Desiccant Indirect Evaporative Renewable Cooling Unit (R-ACU) (10 kW)***
- ***High efficiency absorption Chiller (100 kW)***
- ***Conventional absorption chiller (730 kW)***



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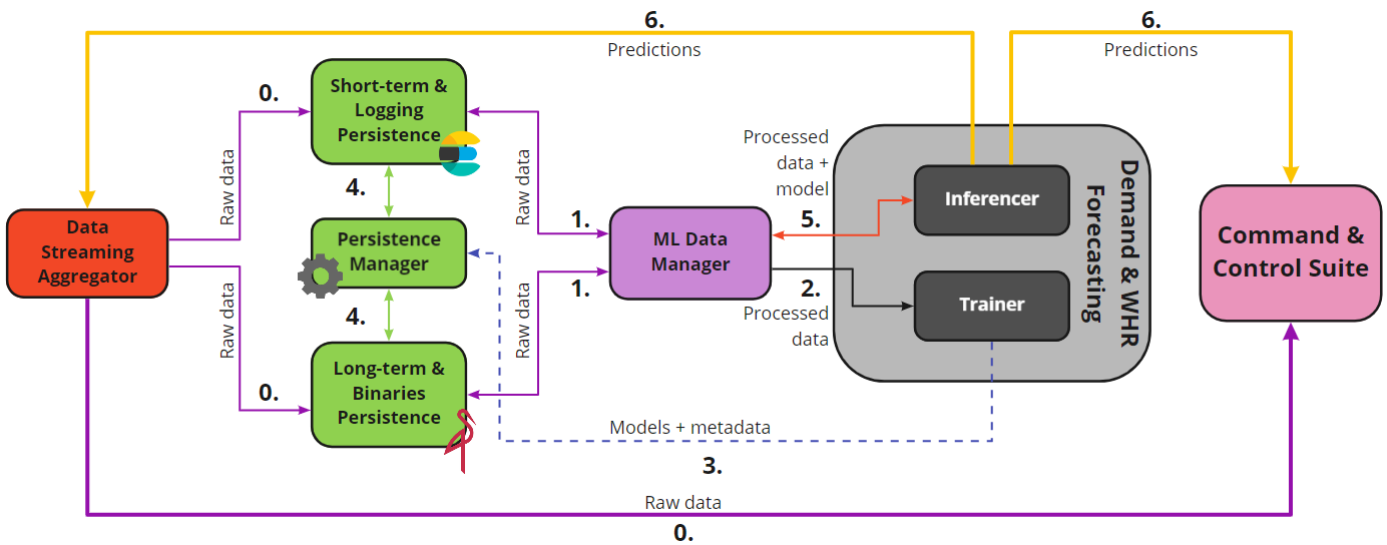
Control system: Advanced digitalization platform

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***



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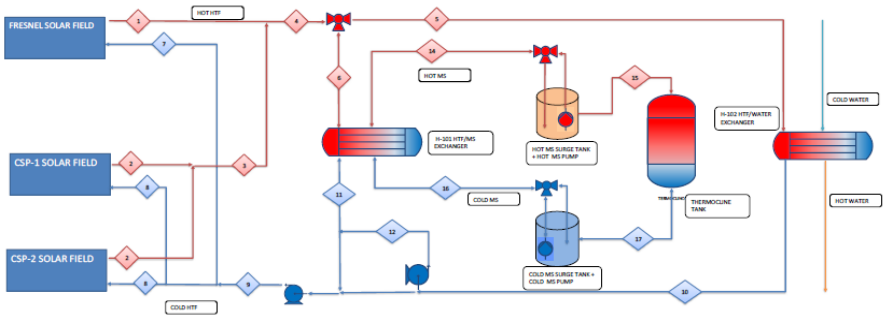
Lessons learnt

1. High-temperature solar installation (250ºC) 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

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Bucharest demo-site

Sustainable Places 2021, 29th September 2021

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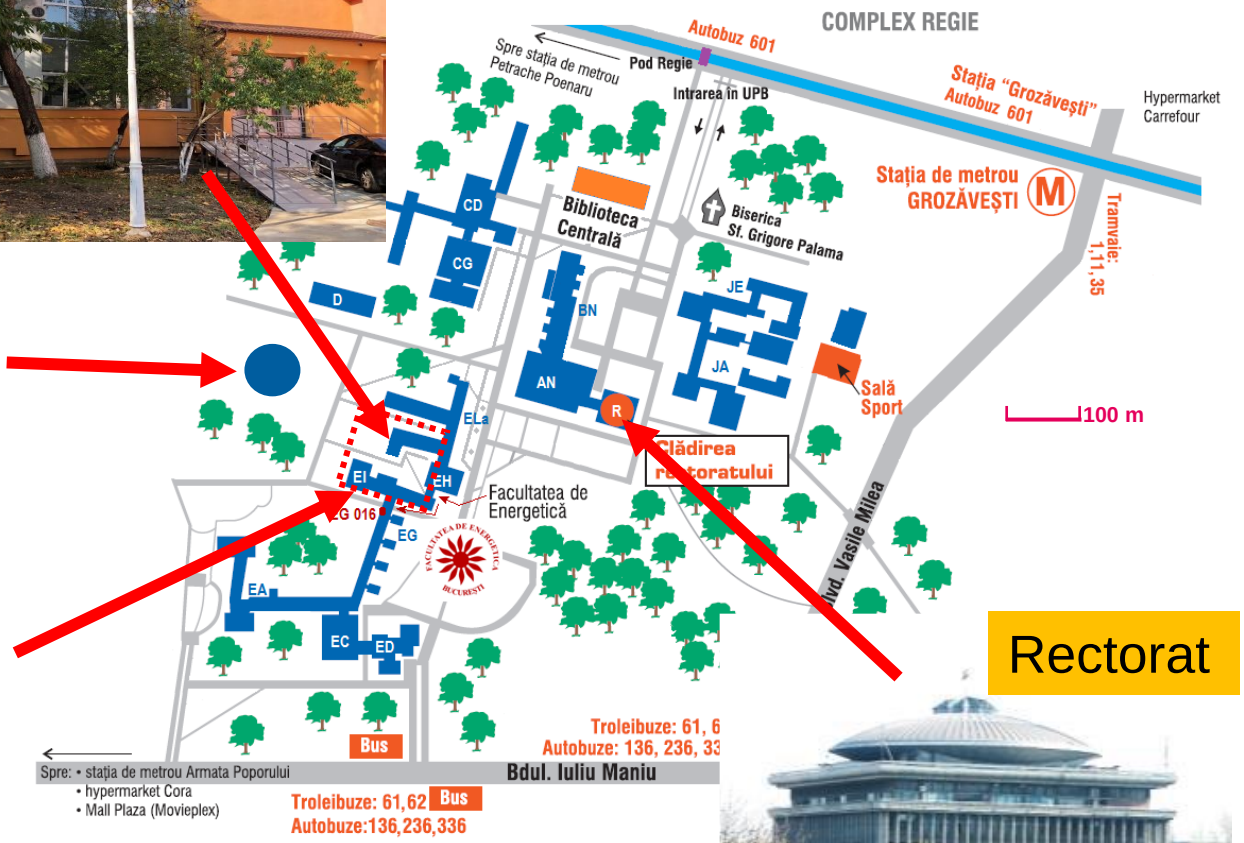
Location of Bucharest demo-site – UPB Campus

Target Building – RES Laboratory

CHP Plant



Bucharest demo-site

Rectorat

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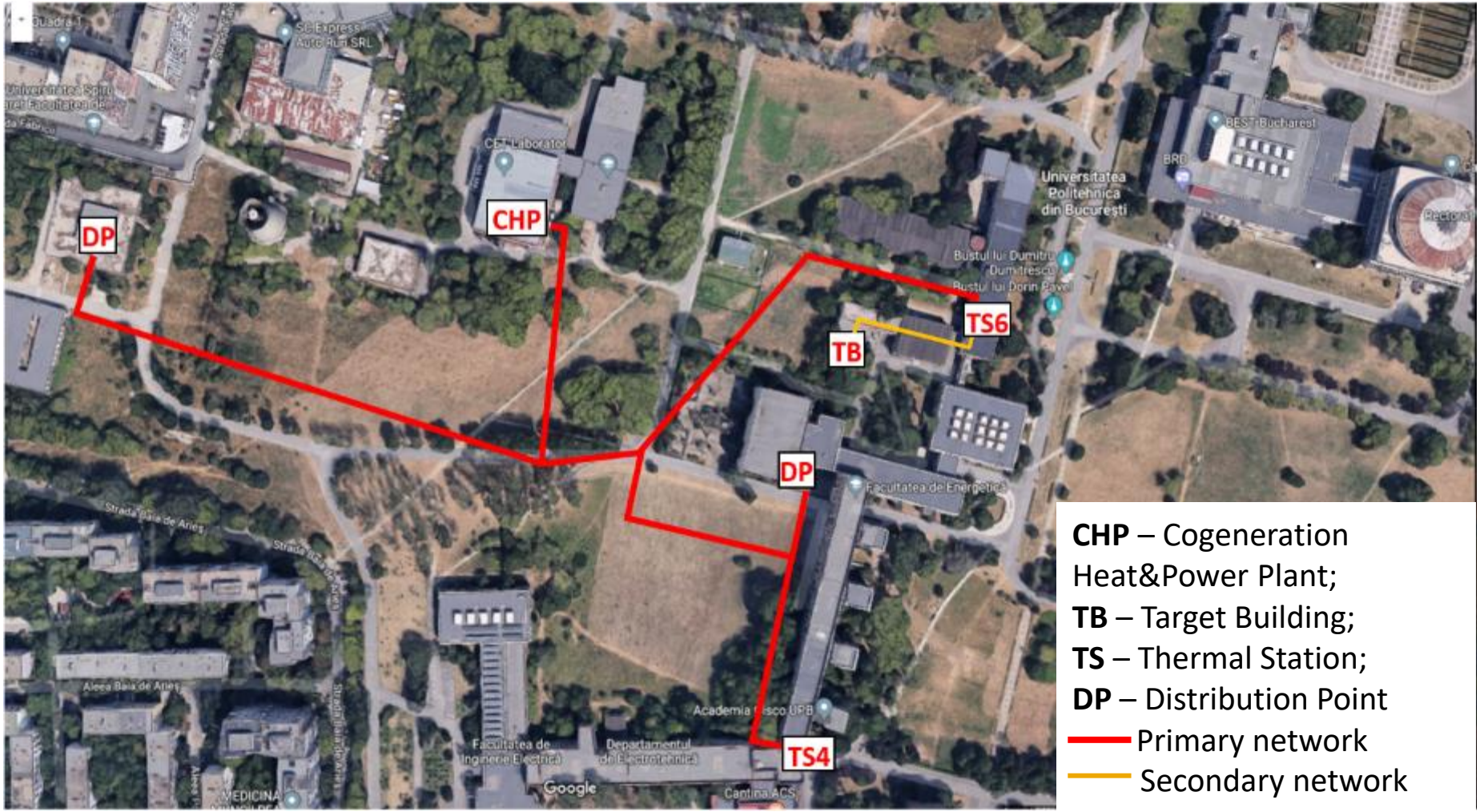
Location of Bucharest demo-site – UPB Campus



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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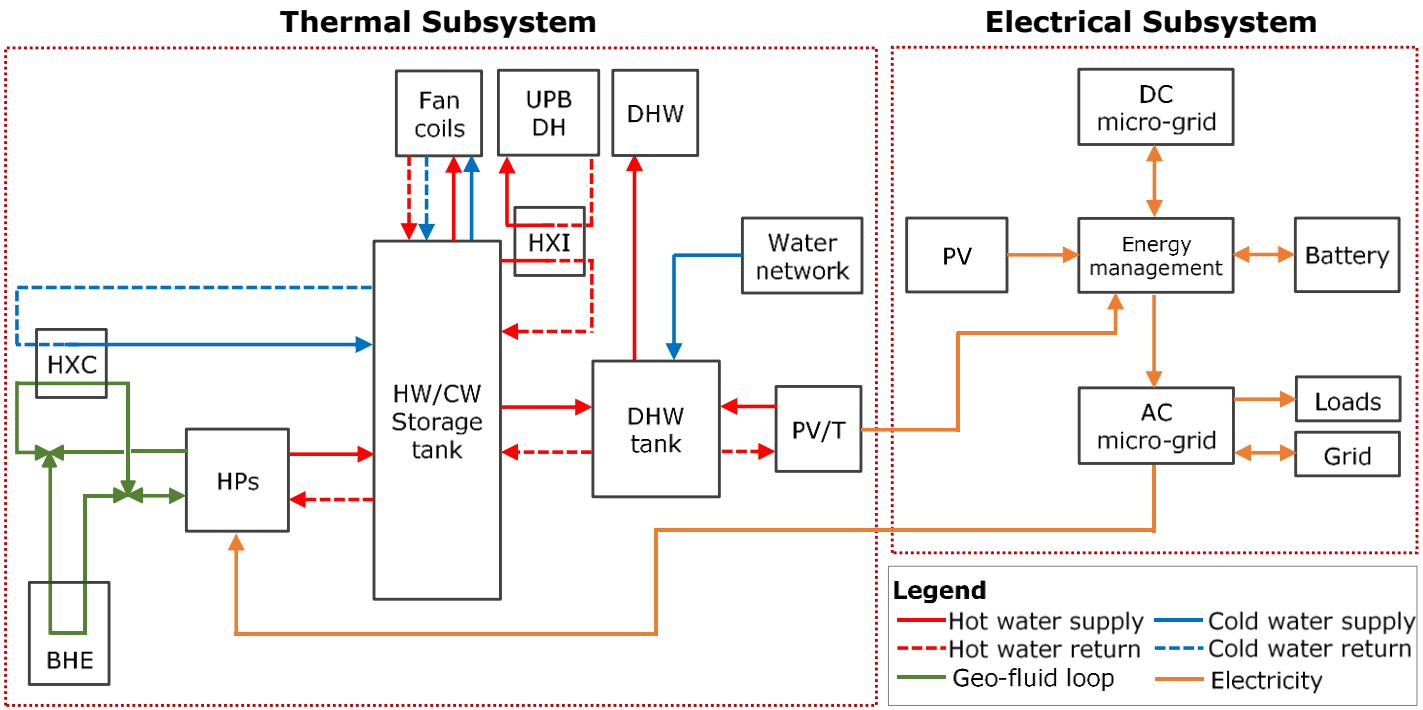
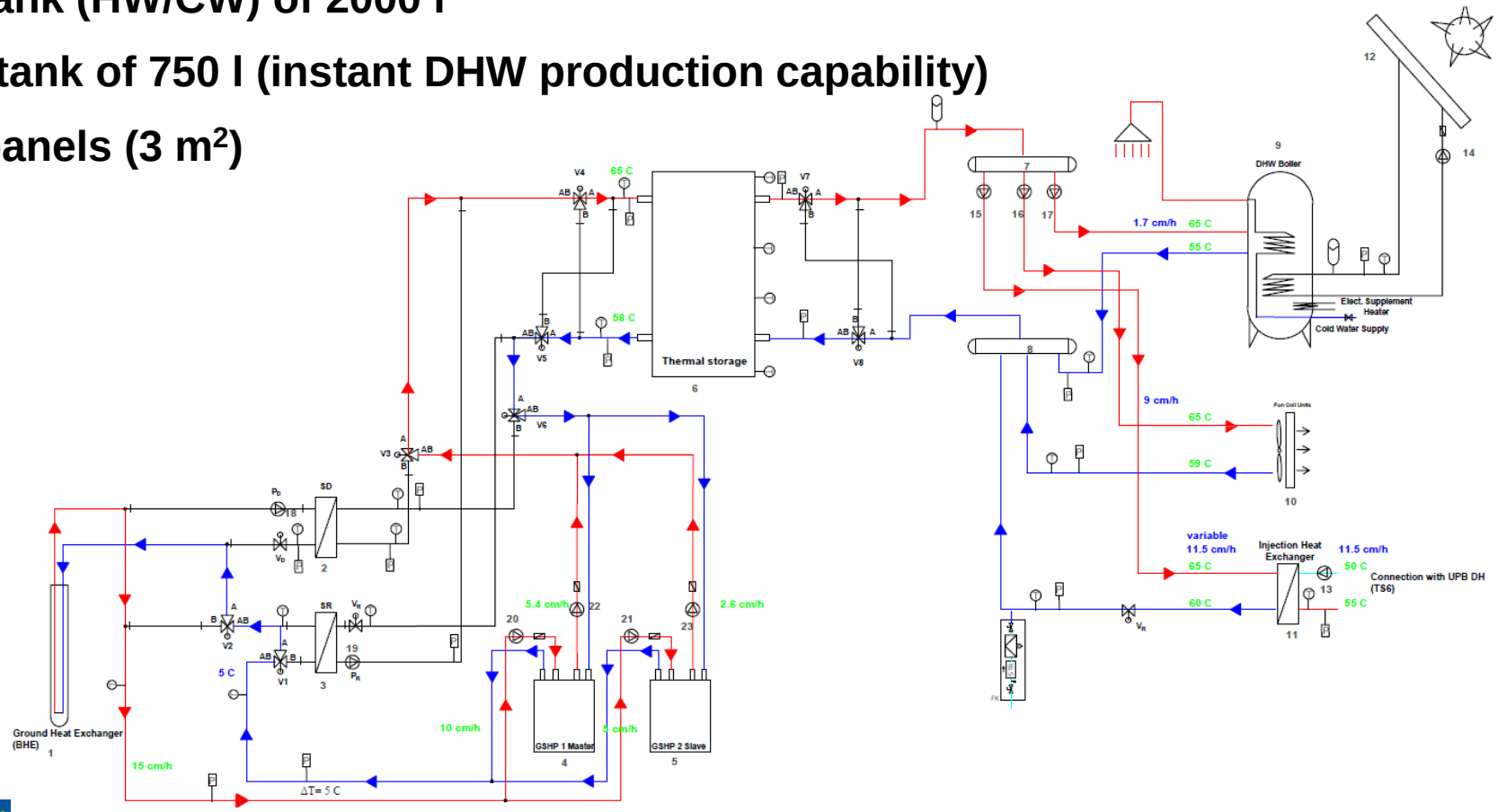
Demo-site block diagram



- **Hybridization: geothermal – PV**
- **2 interconected 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 CO_2 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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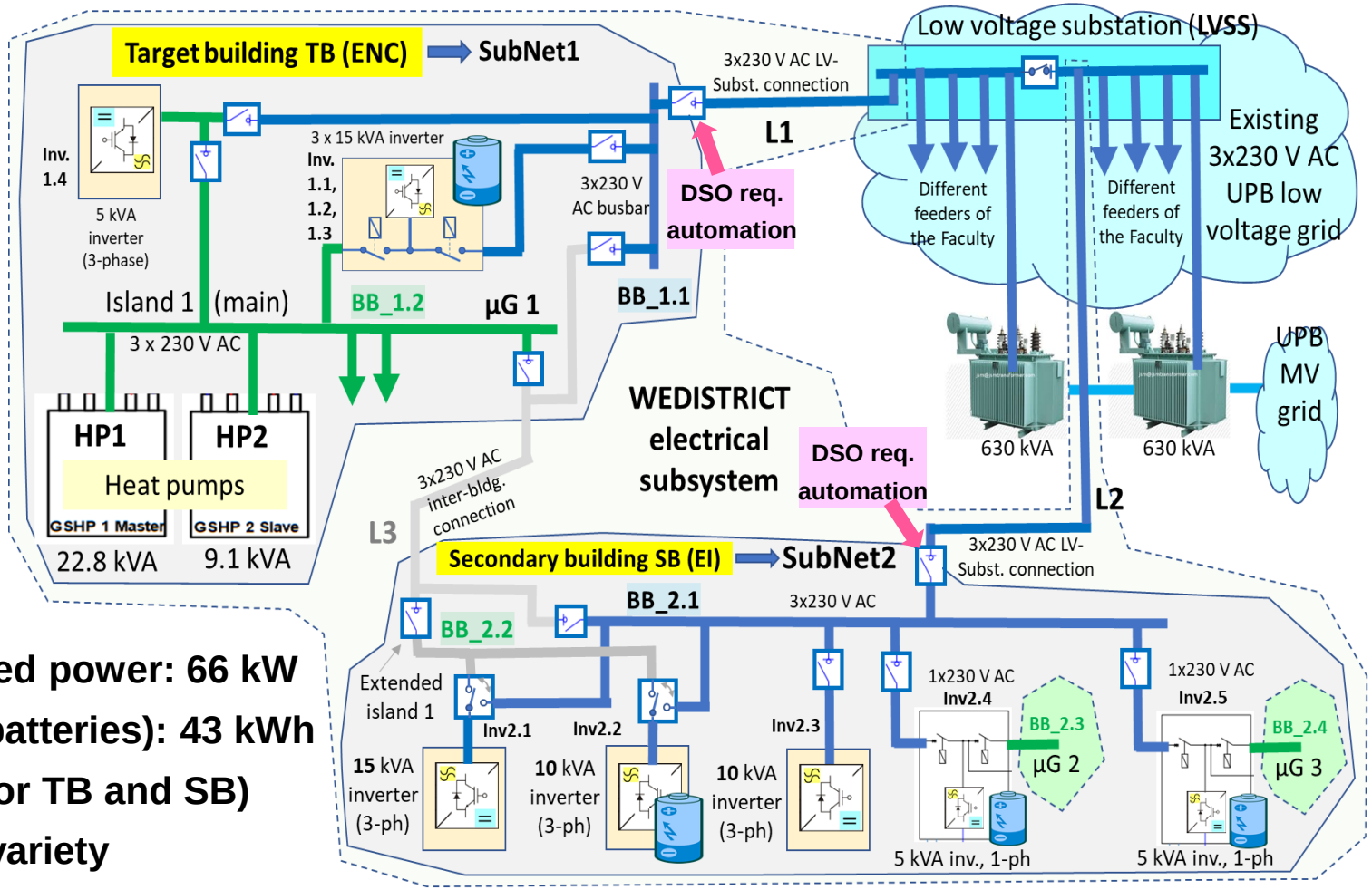
Electrical subsystem layout



- **Total PV installed power: 66 kW**
- **Total storage (batteries): 43 kWh**
- **Two Subnets (for TB and SB)**
- **Technological variety**

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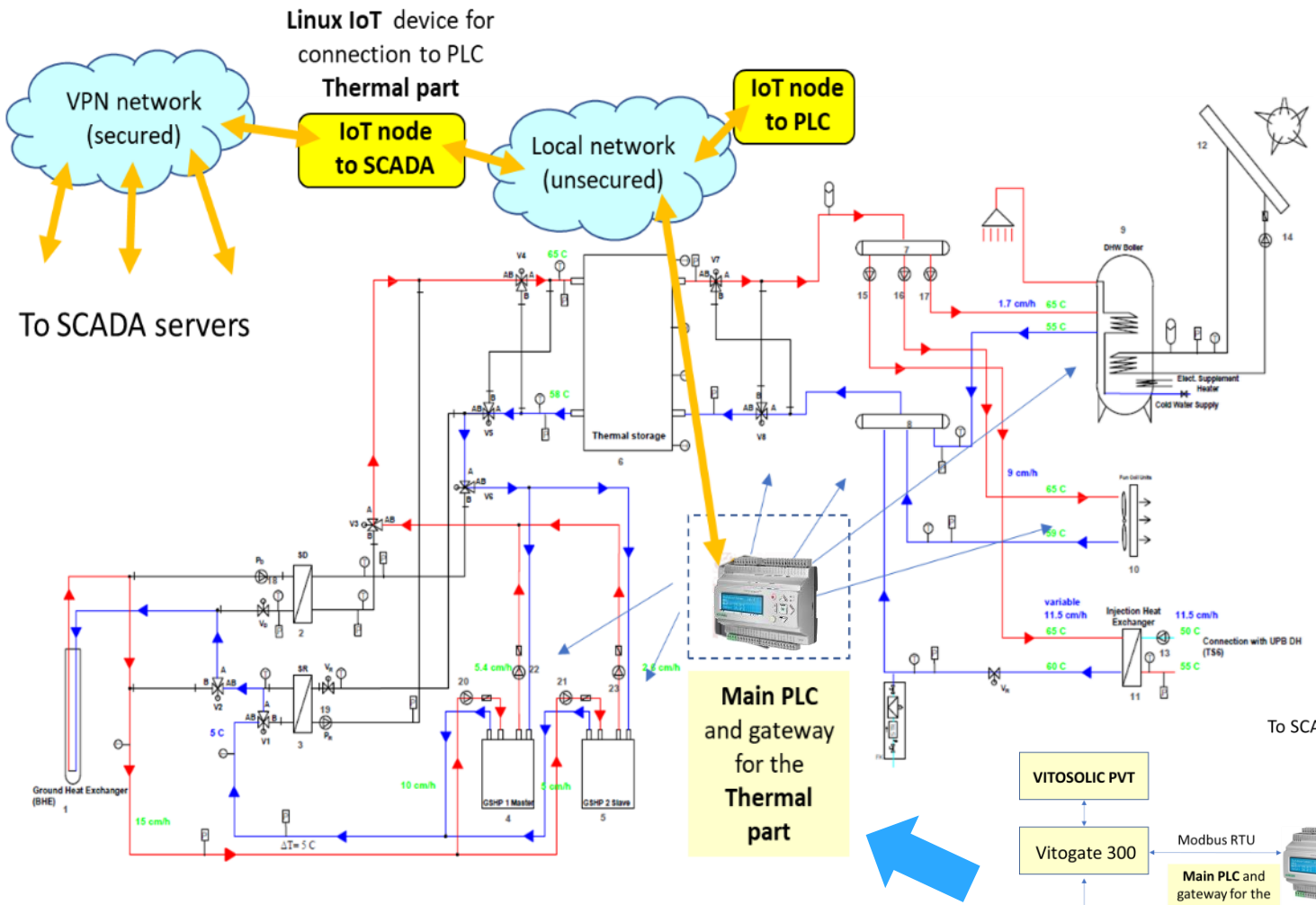
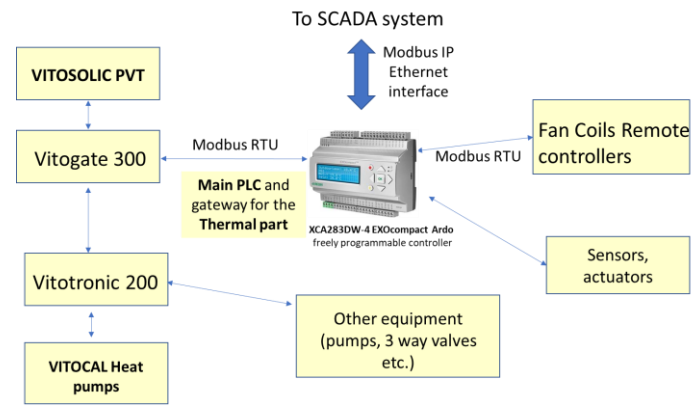


SCADA system with rich data collection from the thermal and electrical processes



Control system strategy

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Equipment deployment areas

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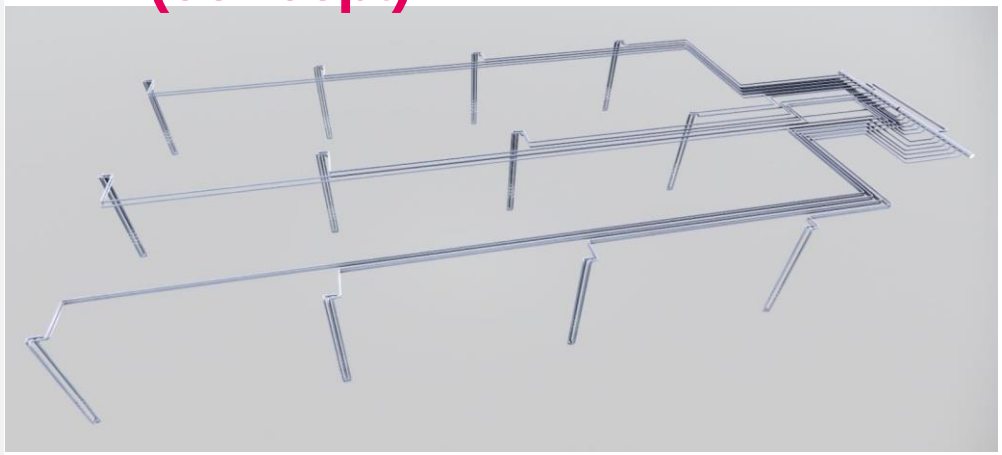
Borehole Heat Exchanger installation

BHE (concept)



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Barriers, risks & issues (actual)

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

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Operation plan of Bucharest demo

Bucharet demo operation plan														
	2022												2023	
	Jan (M28)	Feb (M29)	Mar (M30)	Apr (M31)	May (M32)	June (M33)	July (M34)	Aug (M35)	Sept (M36)	Oct (M37)	Nov (M38)	Dec (M39)	Jan (M40)	Feb (M42)
Operation activities														
Heating regime														
Passive cooling regime														
Active cooling regime														
Monitoring and data collection														
Evaluation of heating regimes KPIs				Partial results										
Evaluation of cooling regimes KPIs														

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Lessons learned

Tehnical

- 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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Assoc. Prof. Constantin IONESCU, PhD

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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

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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:
Rolf Landauer, “Irreversibility and Heat Generation in the Computing Process,” IBM J Res. Dev. 5, 183 (1961).
http://dx.doi.org/10.1147/rd.53.0183

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Data centre
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.

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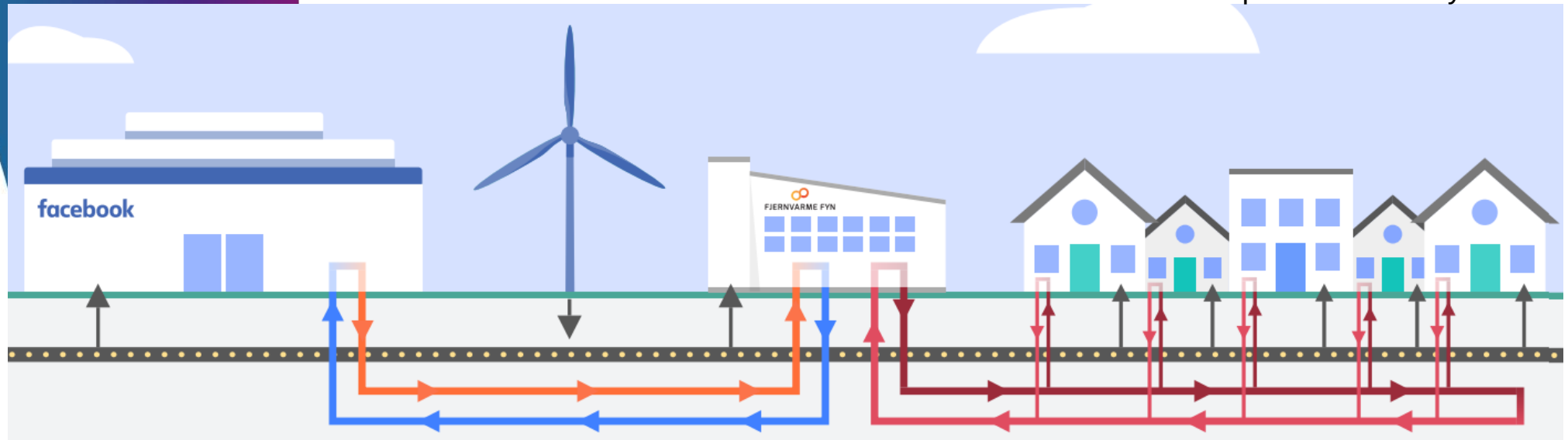
Data centre
waste heat recovery
How?

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/



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

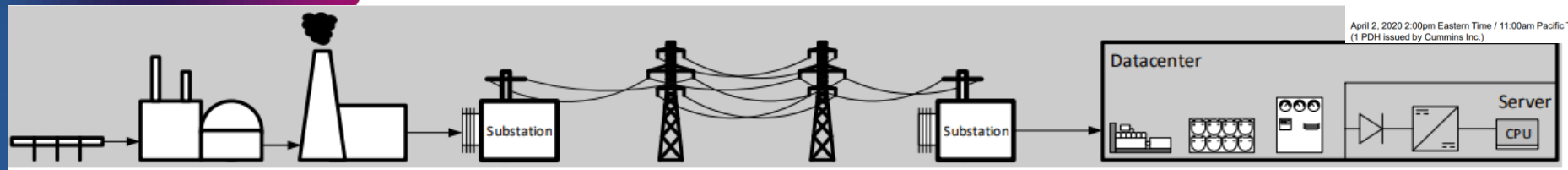
Data centres and fuel cells

Source

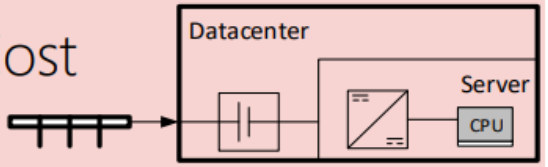
Using Fuel Cells to Address Energy Growth and Sustainability Challenges in Data Centers

PowerHour webinar series for consulting engineers
Experts you trust. Excellence you count on.

April 2, 2020 2:00pm Eastern Time / 11:00am Pacific Time
(1 PDH issued by Cummins Inc.)



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)

SIMPLICITY

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

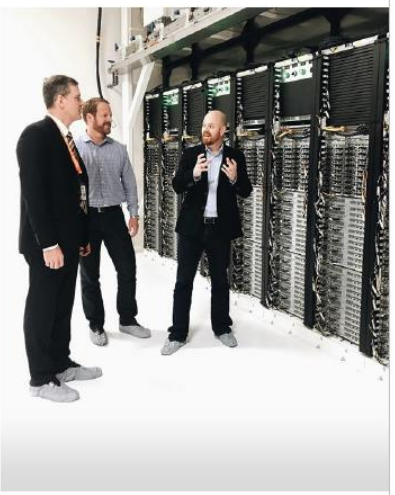
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°857801

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.

Microsoft



- 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

FC 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:

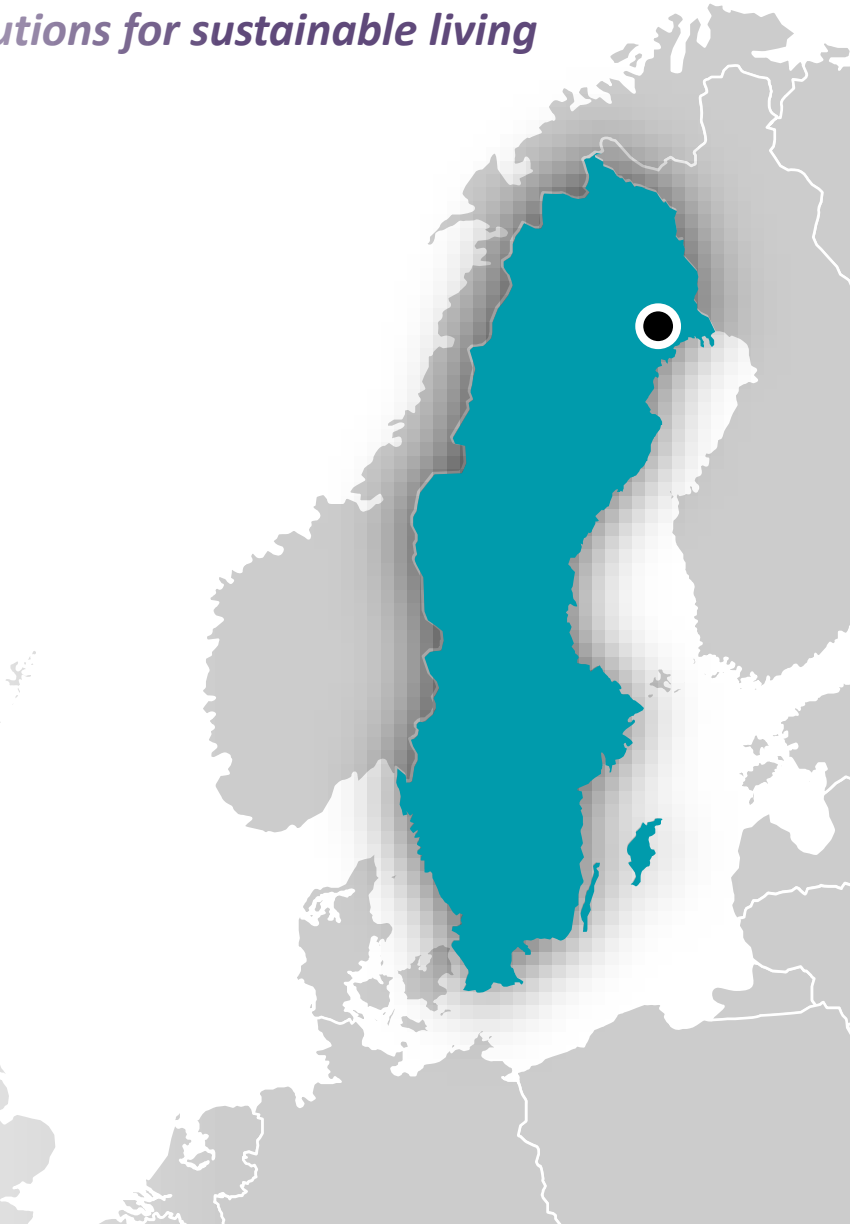
- The **excess heat from the data centres** will be recovered by **liquid cooling technology**
- The excess heat will be boosted to temperatures suitable for supplying the Luleå's district heating by **fuel cell technology**.
- Challenge to construct demonstrator in Northern Sweden is two-fold:
  - No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

ct has received funding from the European Union's Horizon 2020
h and innovation programme under grant agreement N°857801

Demonstration site

LULEÅ (Sweden)

Orientation, location and setup of demo-site



from the European Union's Horizon 2020
and innovation programme under grant agreement N°857801

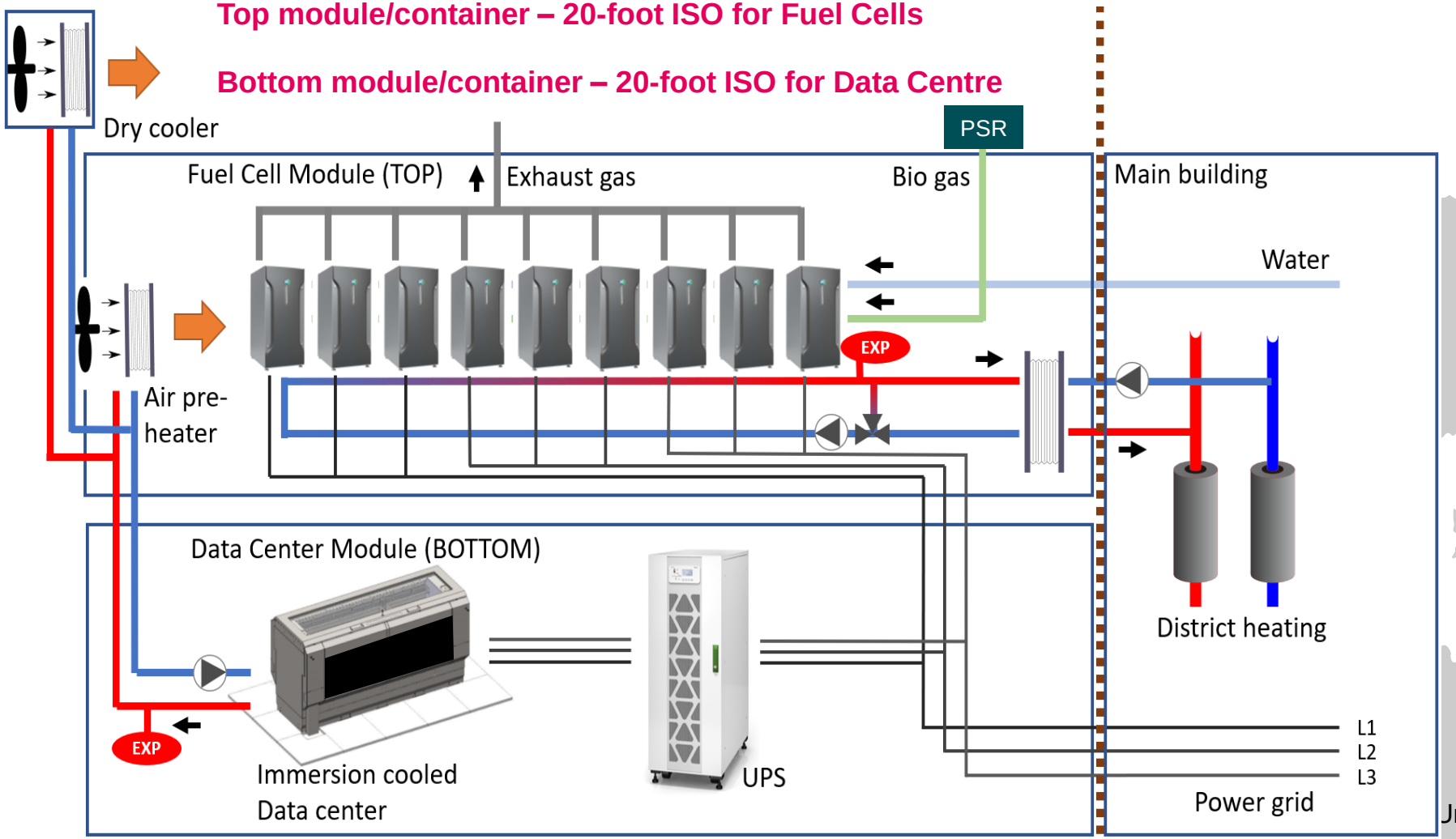
Demonstration site

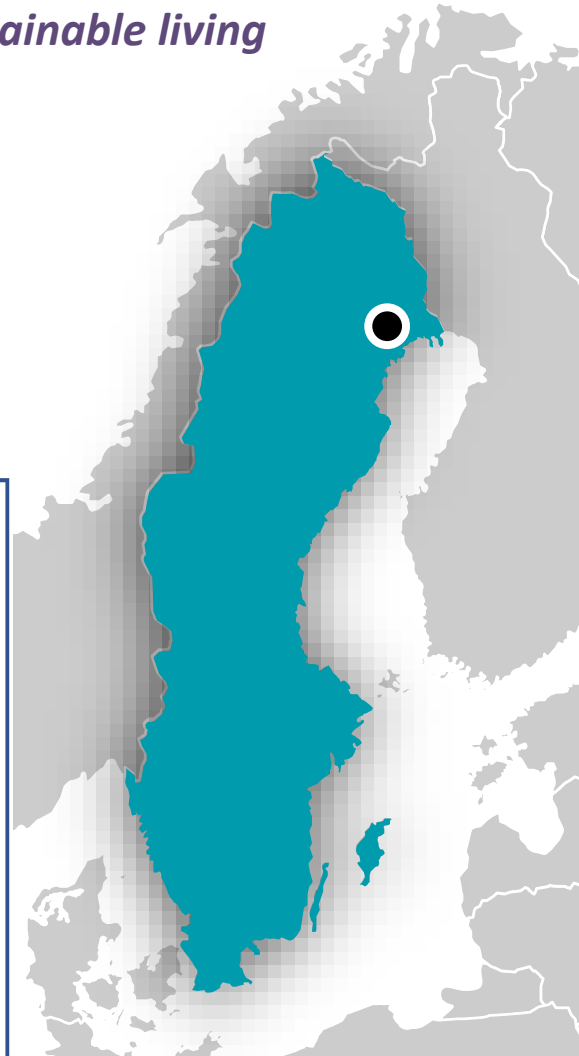
LULEÅ (Sweden)

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



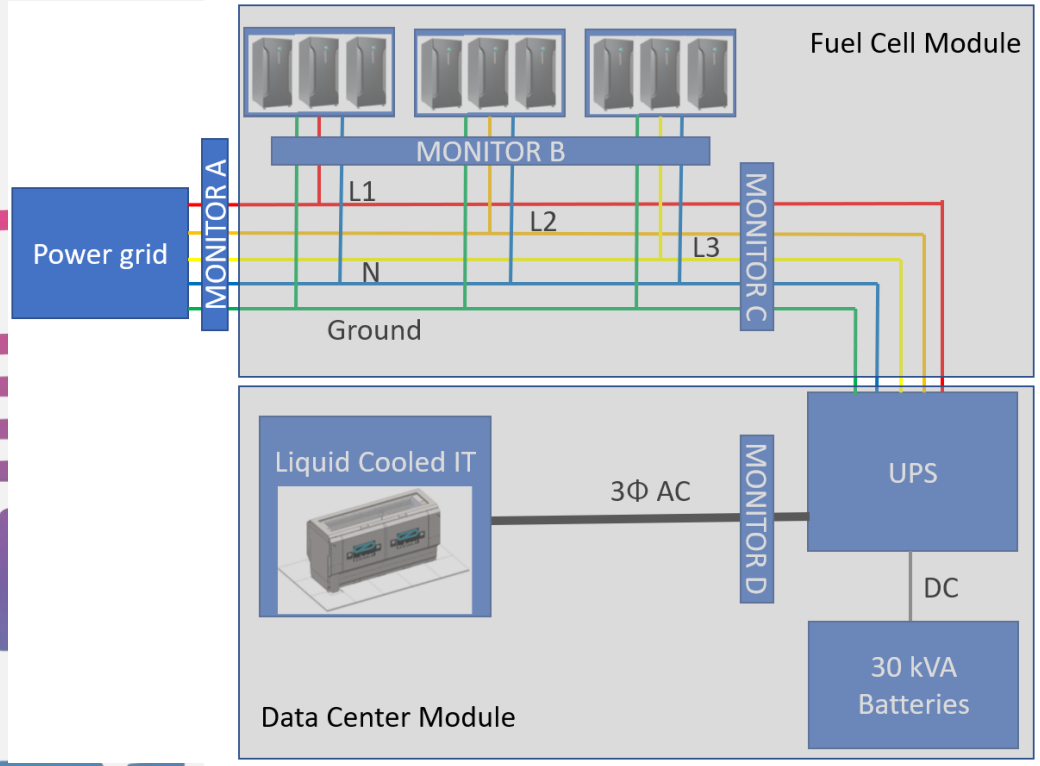


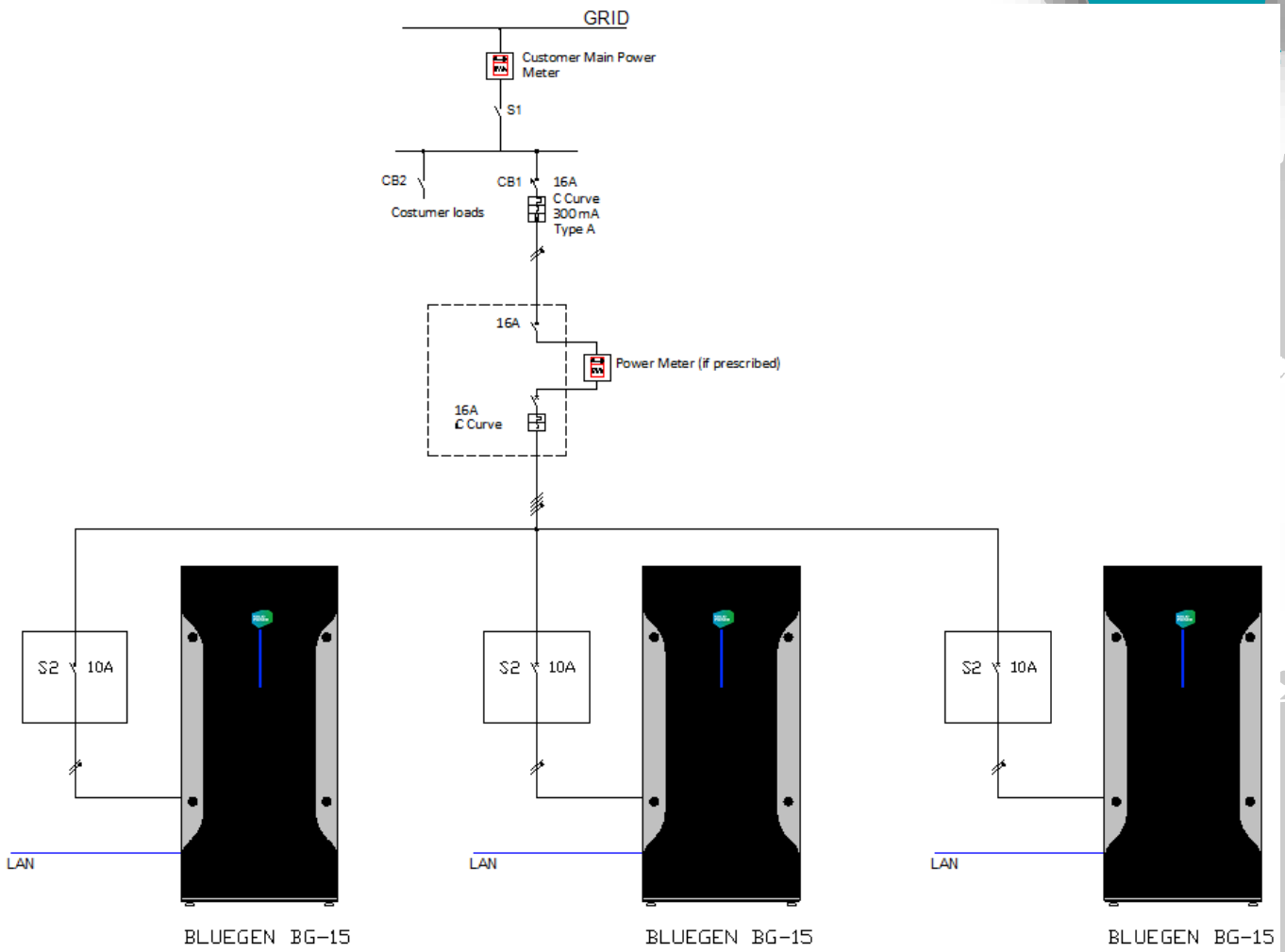
Union's Horizon 2020
n and innovation programme under grant agreement N°857801

Demonstration site

LULEÅ (Sweden)

Fuel cell electrical arrangements





Single phase Solid Oxide Fuel Cells.

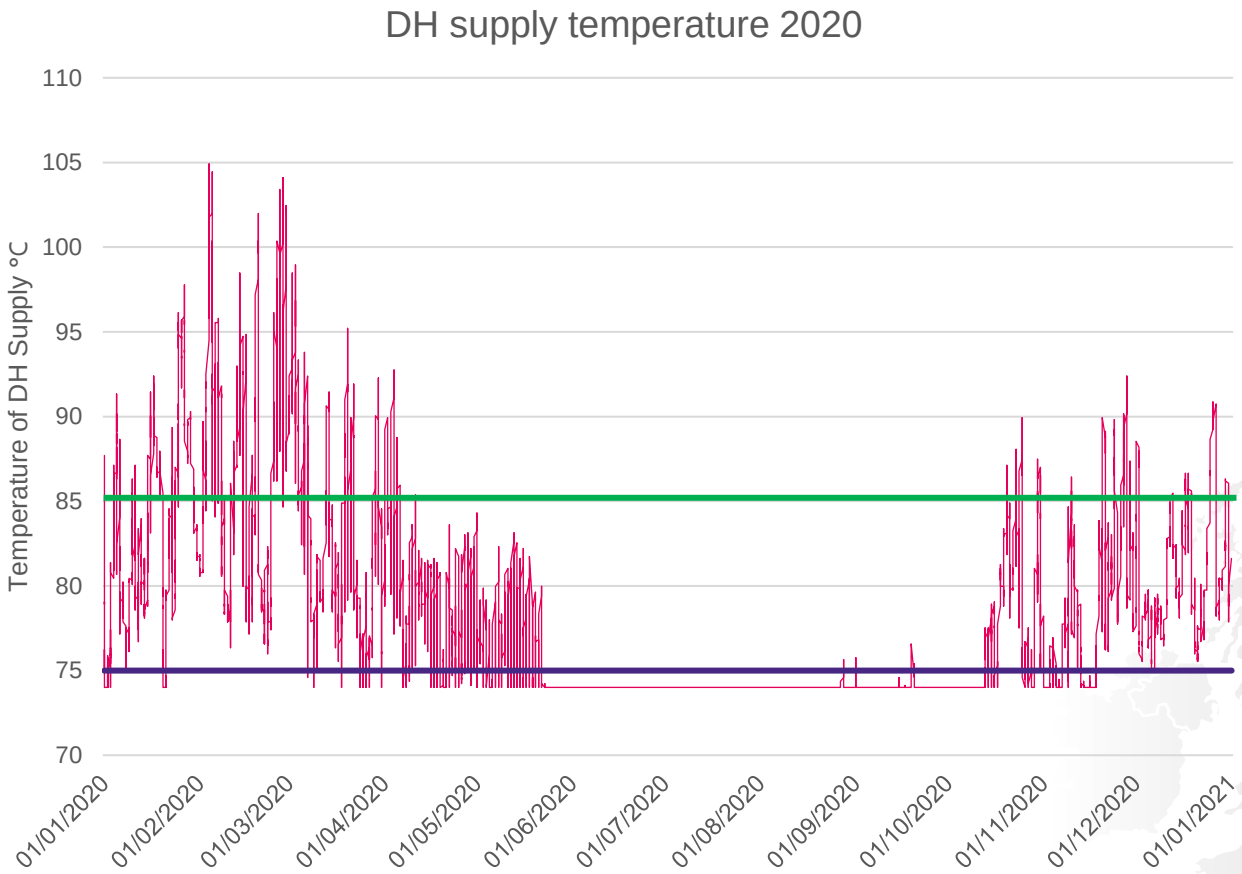
Phases to be synchronised by the utility.

ect has received funding from the European Union's Horizon 2020
h and innovation programme under grant agreement N°857801

Demonstration site

LULEÅ (Sweden)

Fuel cell BlueGen BG-15 thermal efficiency



87% WHR

50% WHR

% of year meeting DH supply temp.

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.

t has received funding from the European Union's Horizon 2020
h and innovation programme under grant agreement N°857801

WEDISTRICT
LULEÅ (Sweden) demonstrator lessons so far!

The demonstrator in Lulea 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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REWARDHeat

Overview on the REWARDHeat project

Federica Fuligni, RINA Consulting
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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

Source: Milind Kaduskar on Unsplash

Specific Objectives

REWARDHeat

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

REWARDHeat

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:

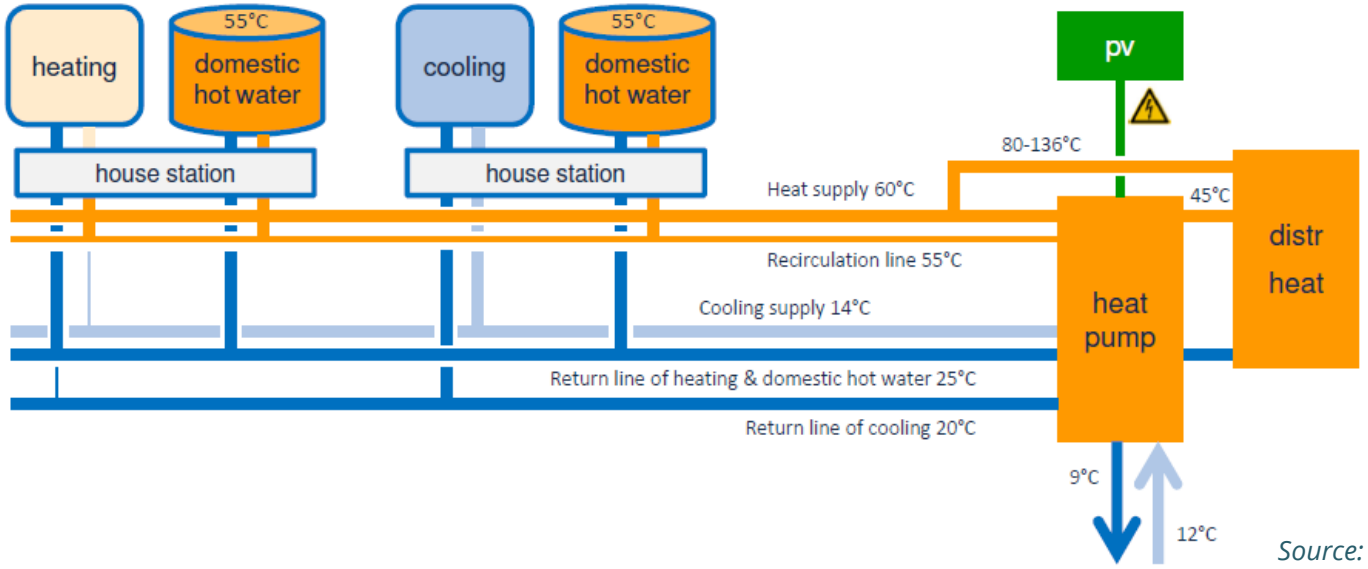
- Small-size (up to 50 kW) prefabricated substations including booster heat pump specialised to specific demonstration cases.
- Large scale industrialised energy Centre at sub-network level

Specific Objectives

REWARDHeat

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

Pipes adapted to low temperature networks



Source: Vattenfall

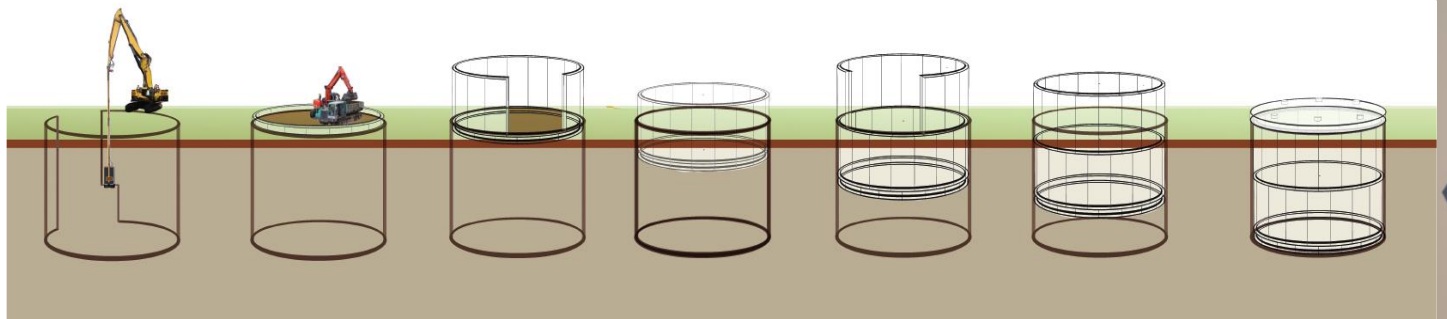
Specific Objectives

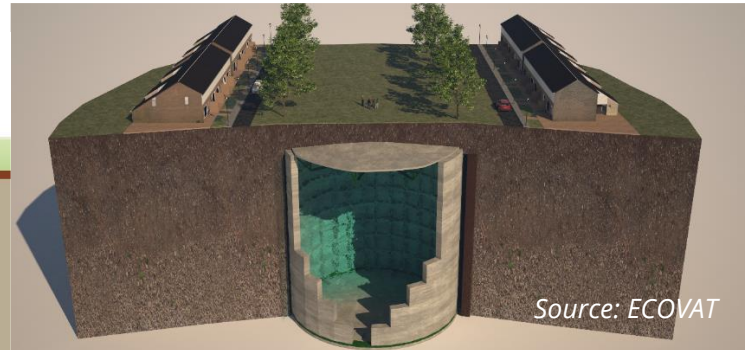
REWARDHeat

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

Source: Iya Pavlov on Unsplash

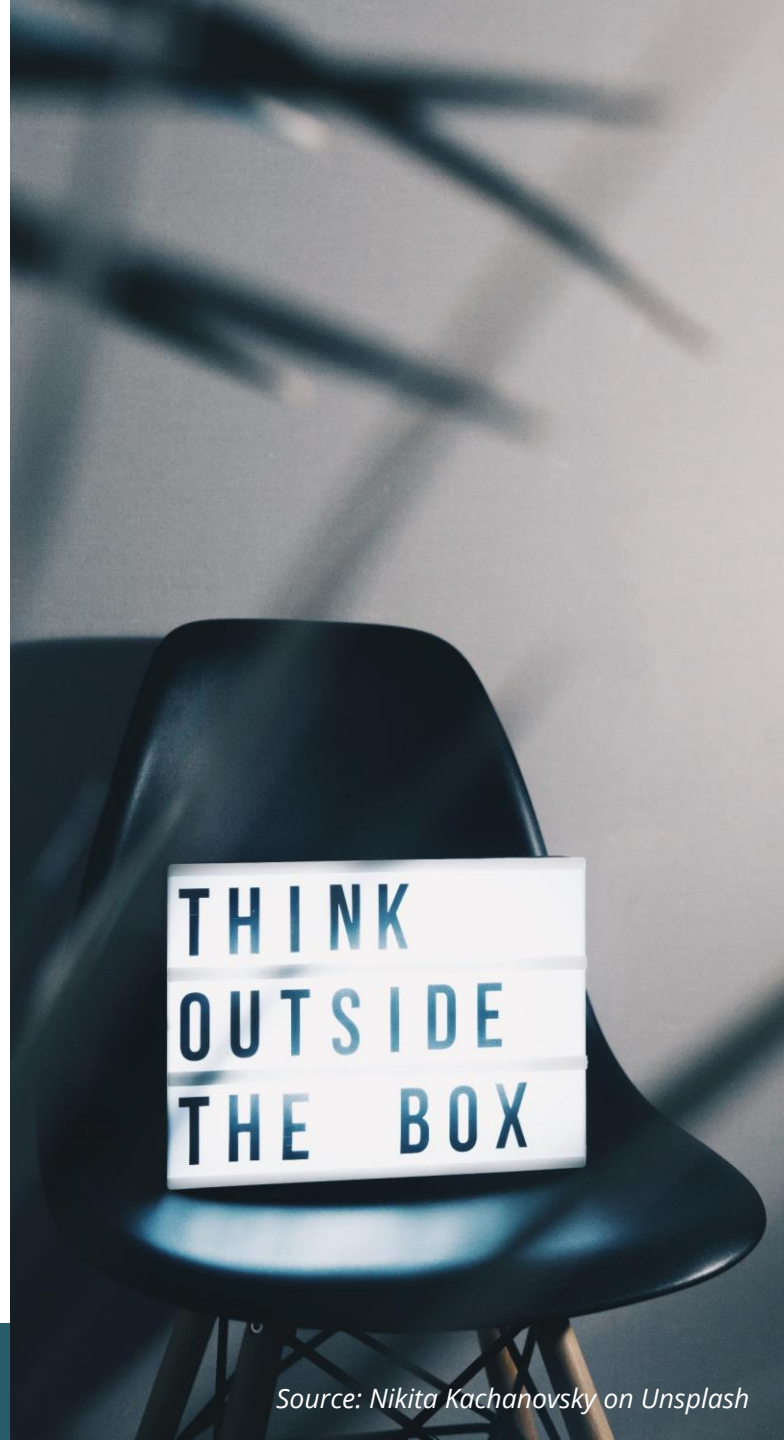
Specific Objectives

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

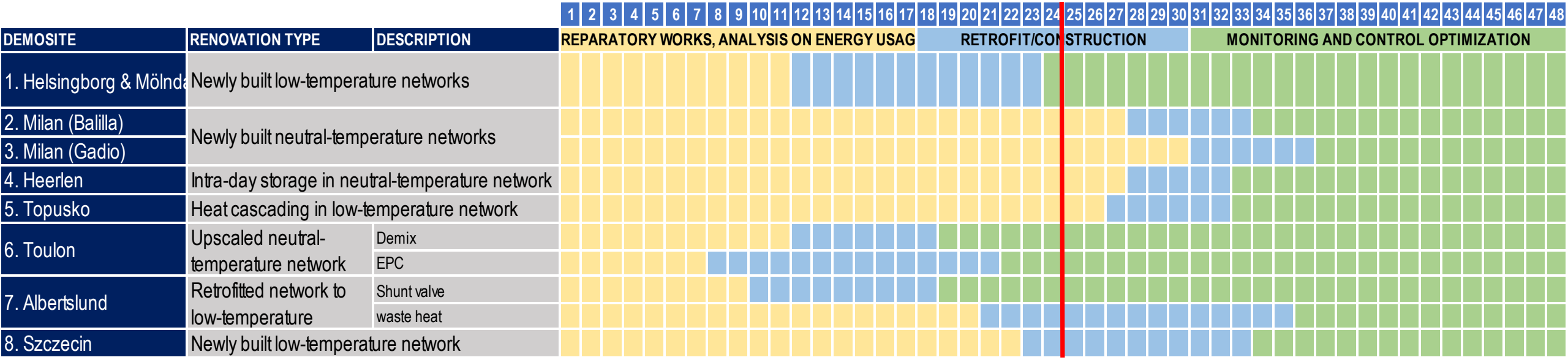
4 **HELSINGBORG & MöLNDAL (SW)** - Newly built low-temperature networks

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

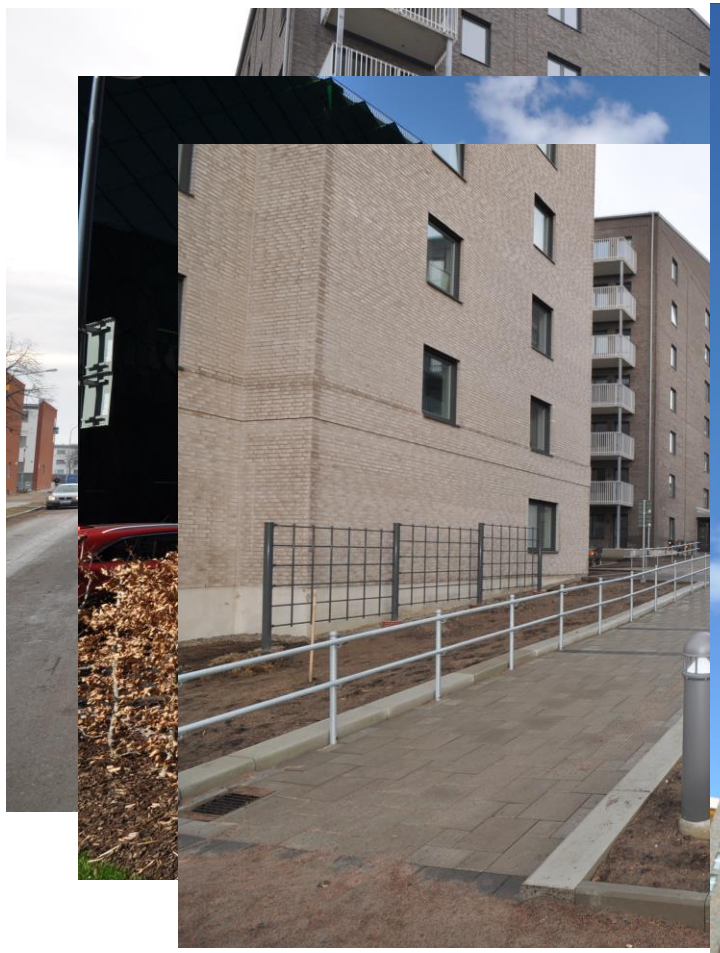
REWARDHeat demo cases



NB. The construction/retrofit of the demonstrator networks needs to take place between M18 and M30

DEMOSITES Commissioning phase: Helsingborg & Mölndal

REWARDHeat



***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.

REWARDHeat

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Thank you

www.rewardheat.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857811.
The document reflects the author's view. The European Commission has no liability for any use that may be made of the information it contains.

SUSTAINABLE PLACES

RELaTED

Antonio Garrido Marijuan
Tecnalia, Basque Research and Technology Alliance (BRTA)

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

29/09/2021

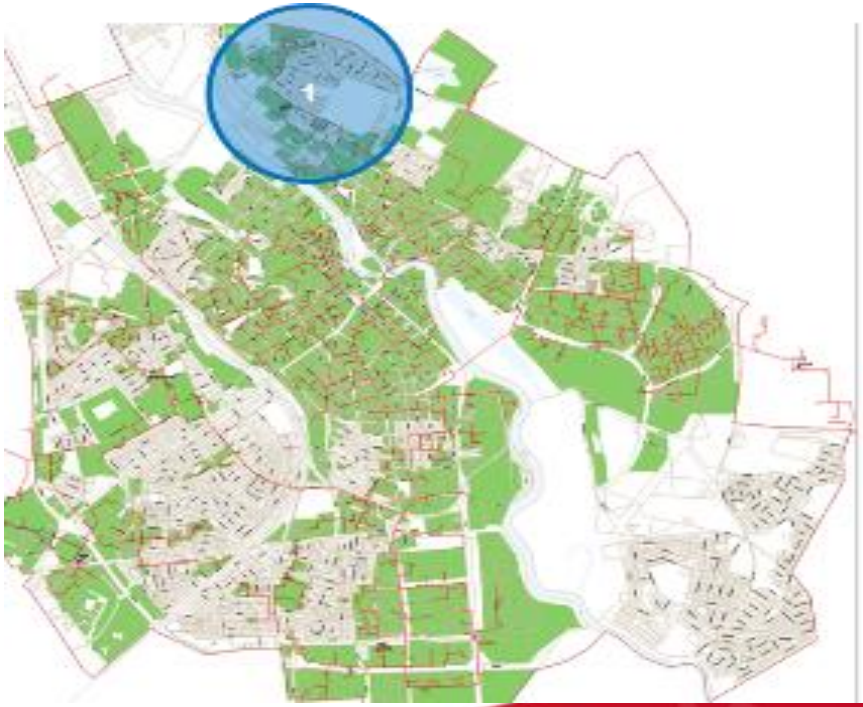
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768567

RELaTED – demo of Tartu

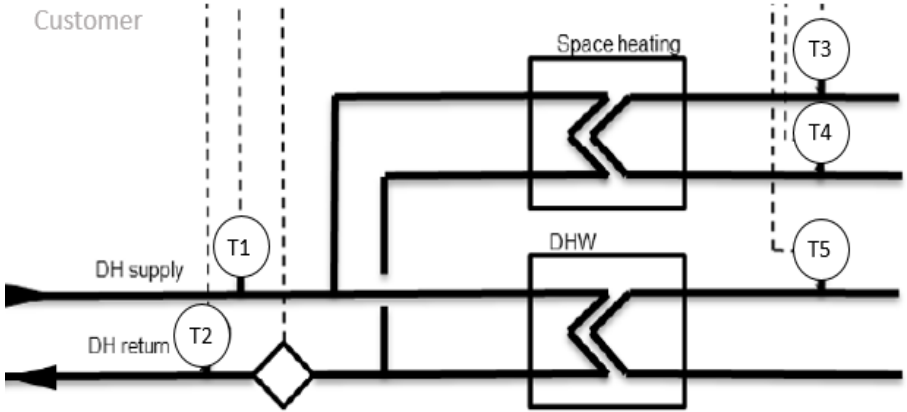
- LTDH conversion of an existing DH network in Tartu, Estonia.

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

- 10-15ºC reduction after the installation of a mixing chamber.



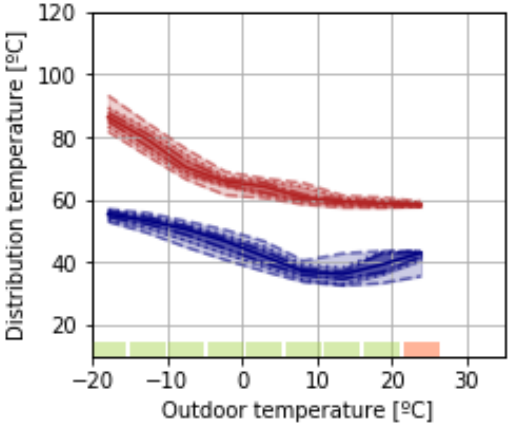
RELaTED – demo of Tartu

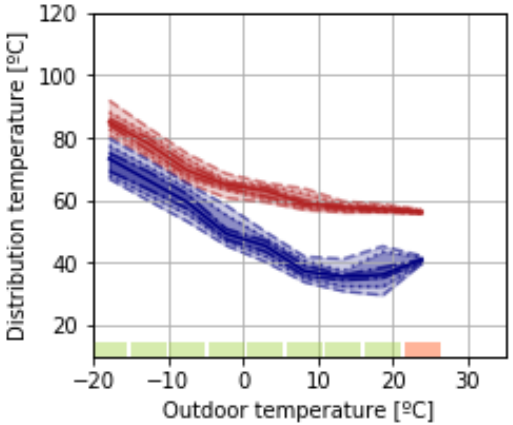


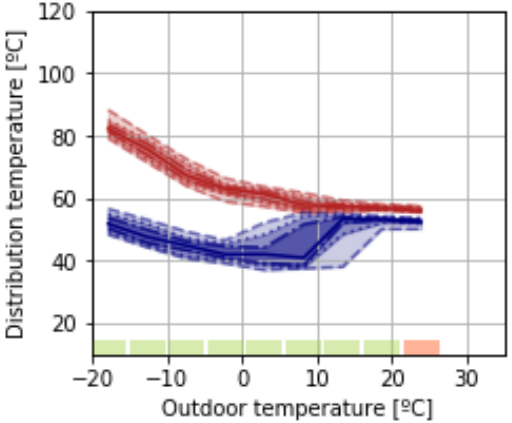
- > 50 substations.
- 5 data points.
- Hourly collection.
- >24 months of monitoring.

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

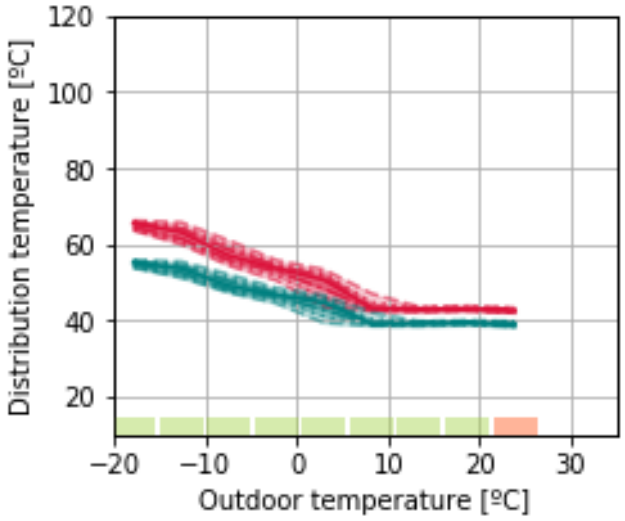
SUSTAINABLE PLACES

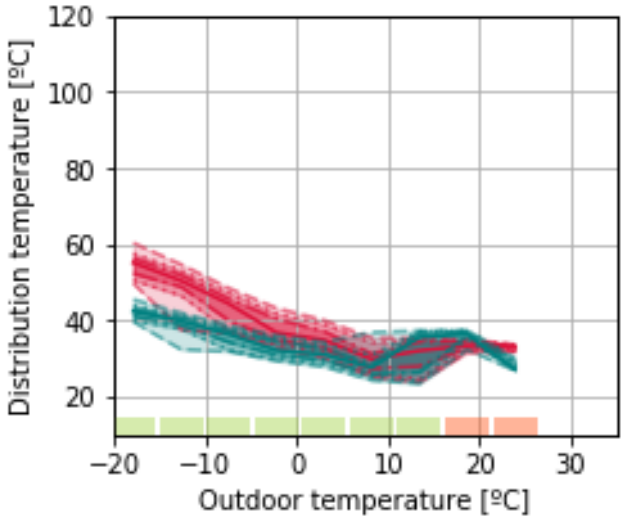
RELaTED

Primary side temperatures (T1 and T2)

Data analytics of DHN

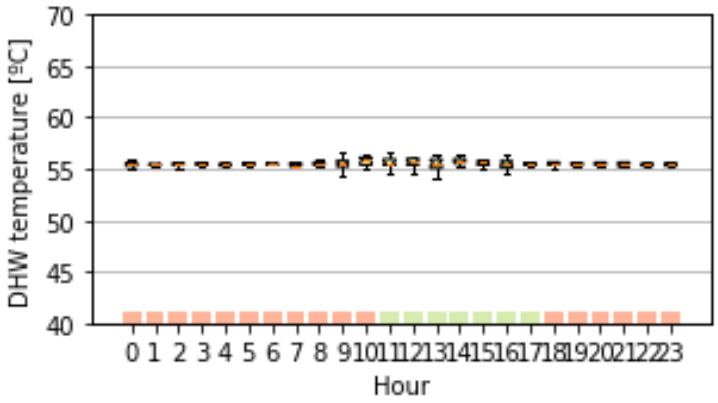
Secondary side temperatures (T3 and T4)

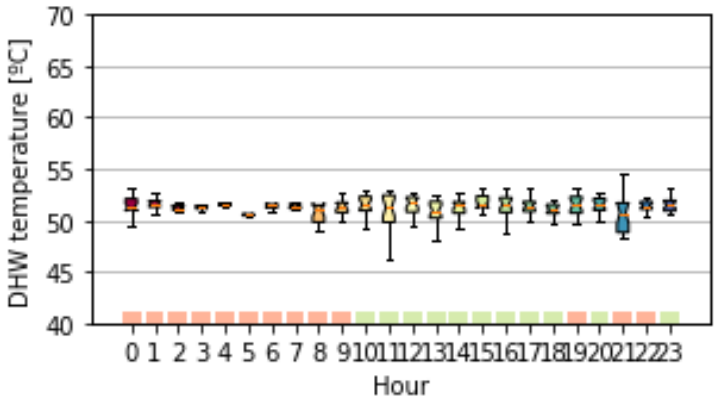




Data analytics of DHN

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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Project partners: TECNALIA, Danish Technical Institute, Fortum Tartu, Beogradske Elektrane, Basque Government, Metro Therm, Nibe, Aventa, Industrias IMAR, Basque Energy Agency, Mazovia Energy Agency, Institute of Baltic Studies, FEDARENE, El Taller De Comunicación y CIA.

http://www.relatedproject.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768567.

The „District Future House“

Smart City solutions for tenants & housing companies

Sustainable Places Online Conference, 29/09/2021

Alexander Haidan
Business Development
SachsenEnergie AG

www.SachsenEnergie.de

Outline of our H2020-project

Dresden team

Funding

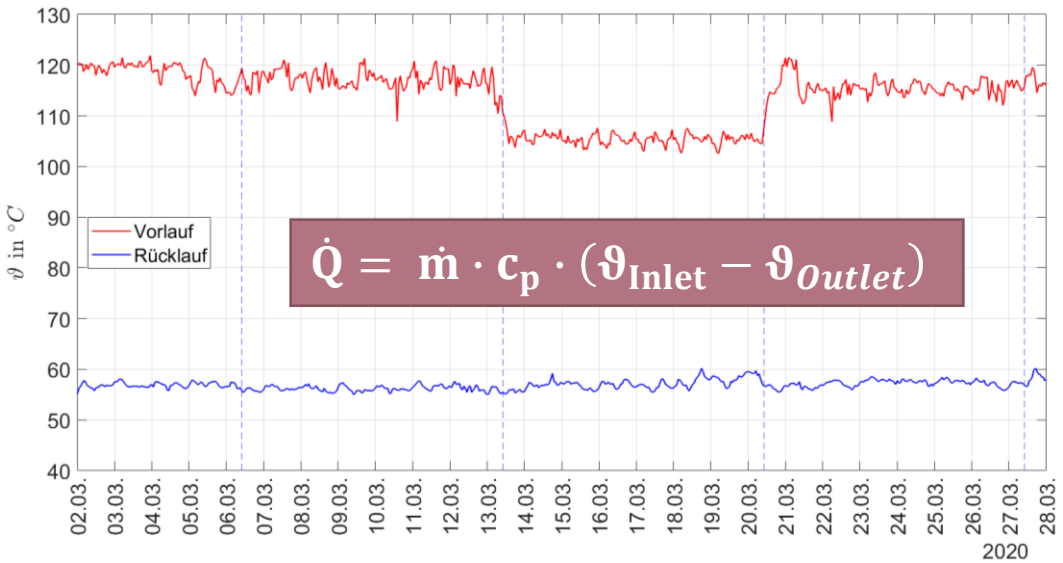
- 17,5 Mio. € entire consortium
- 48 Actions - 4,5 Mio. € Dresden

10/2017 – 06/2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

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



$$\dot{Q} = \dot{m} \cdot c_p \cdot (\vartheta_{Inlet} - \vartheta_{Outlet})$$

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

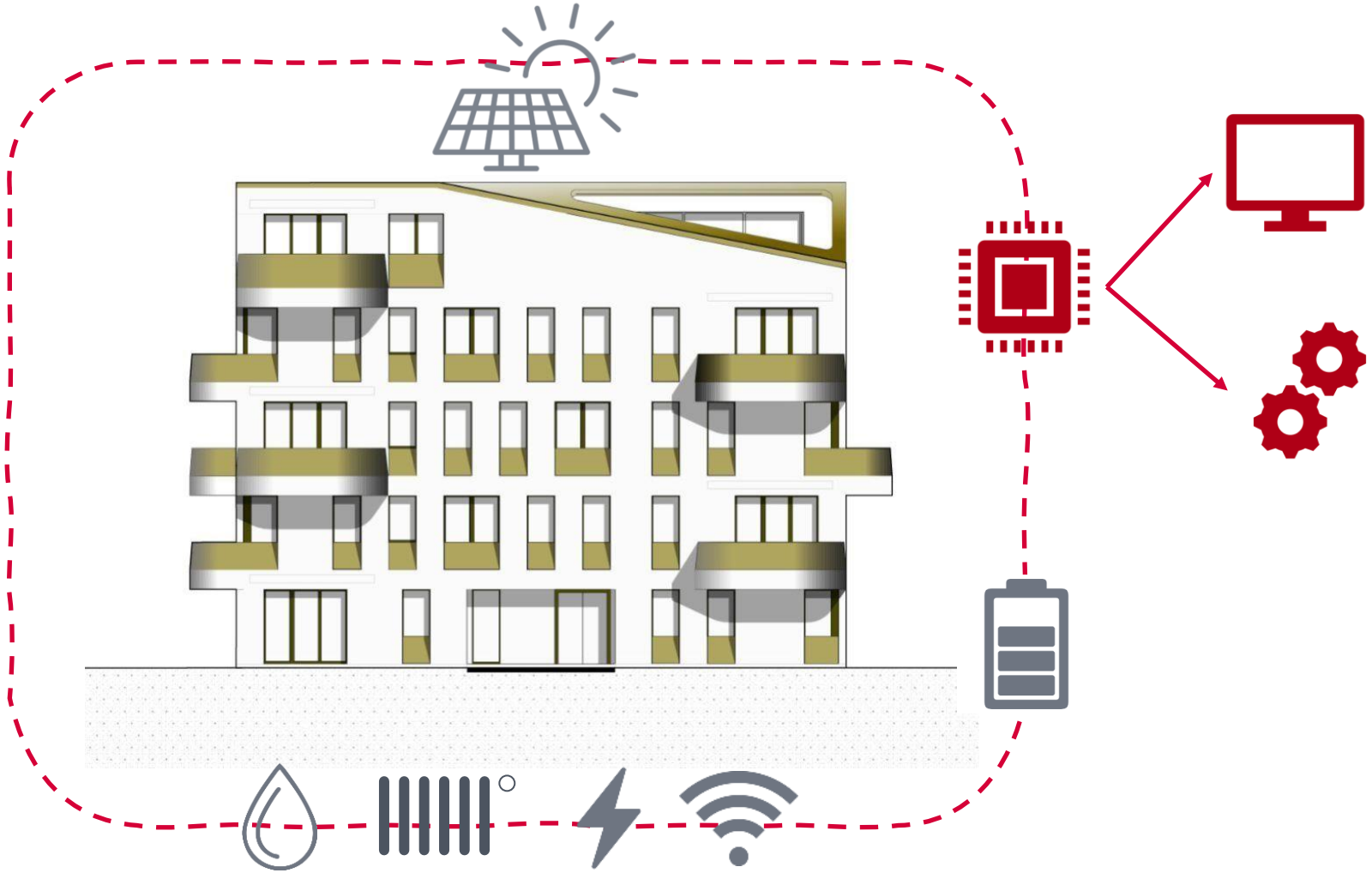
What's smart about the “District Future House”?

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



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

The building manager – the central unit

DH transfer station

weather station

PV power inverter

Smart electric meter

water meter

heat meter

Control functions

- 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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

Apartment manager

Display

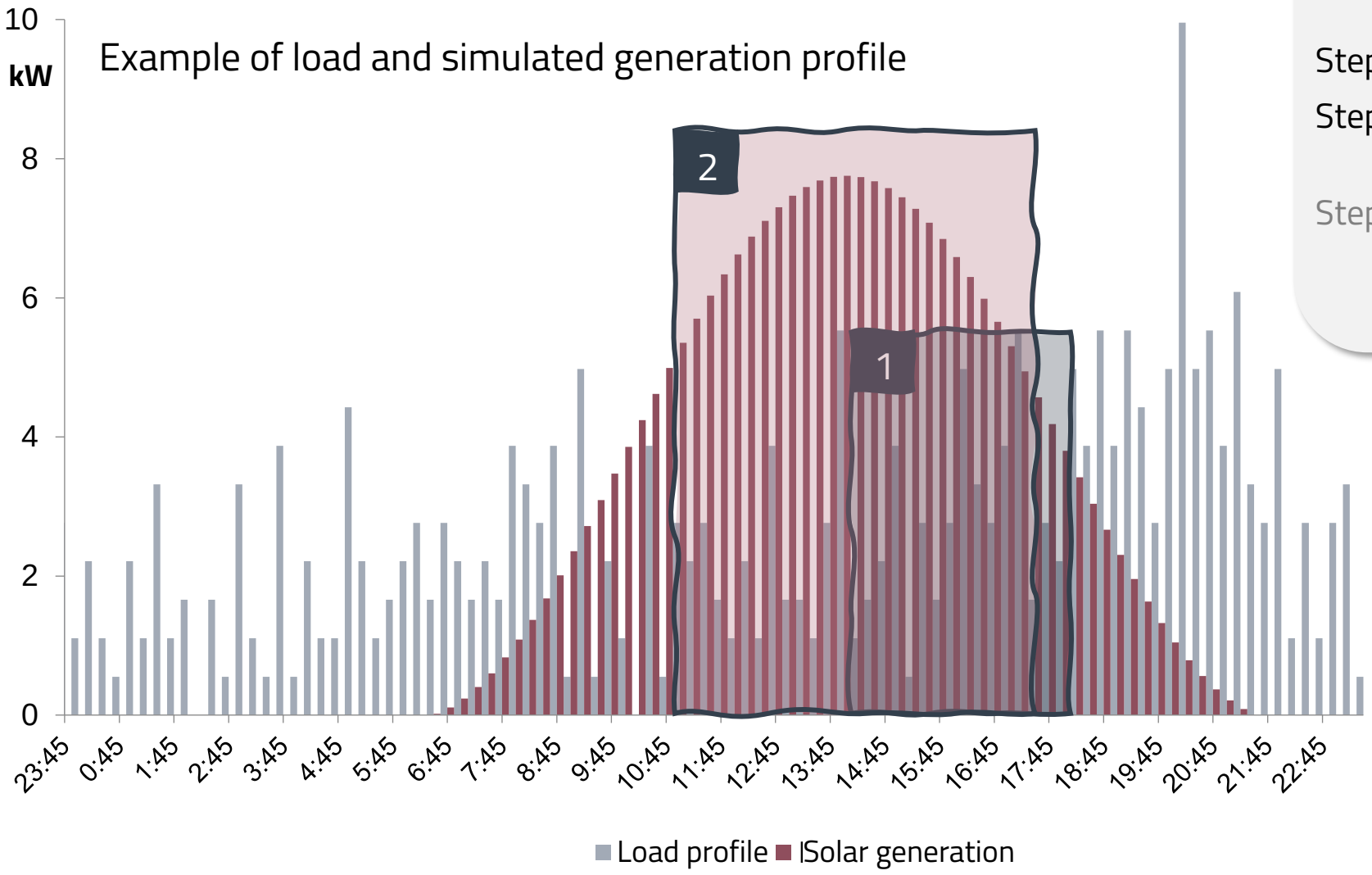
- Energy consumption (heating, [warm] water, electricity) with historical benchmarks
- Solar power generation
- Room temperatures
- Weather and outside temperatures
- Information of housing cooperative
- Open windows

Control function

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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Tenant electricity tariffs become smart



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

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)

Discount slot on apartment manager

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

The Future District House generates…

More active tenants

- "Own green & flexible tariffs" highly appreciated
- apartment manager used daily or several times a week
- $^{2}/_{3}$ 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 CO^2/p.a.
• self-consumption	**∅ 90%**	
• autarky	**∅ 26%**	(summertime ~40 %)

New business models

- Green & flexible tariffs
- automated billing process

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

Thanks for your attention

Alexander Haidan

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MATCHUP

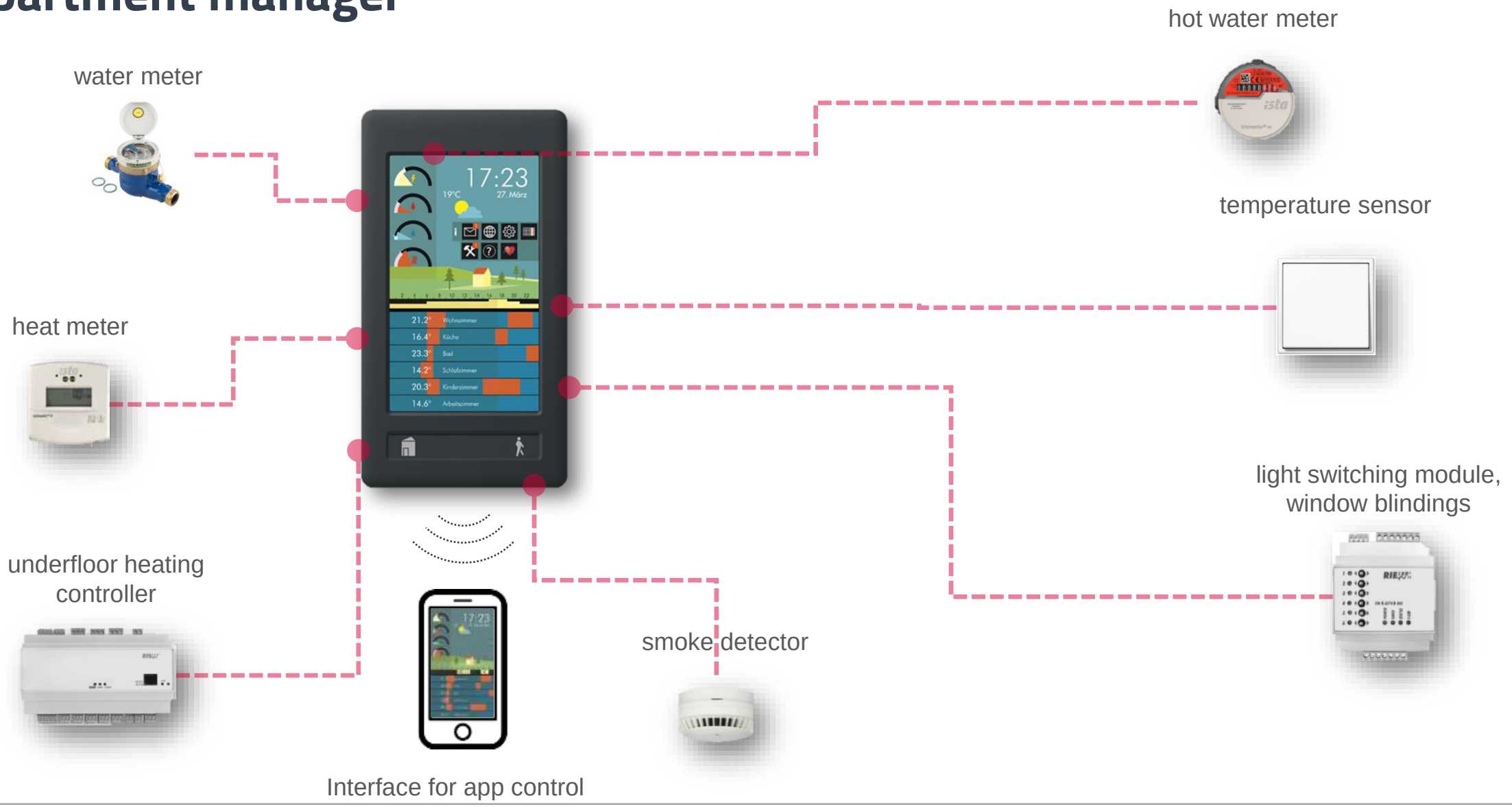
www.matchup-project.eu

@matchupEU #matchupEU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774477

Sachsen Energie

Apartment manager



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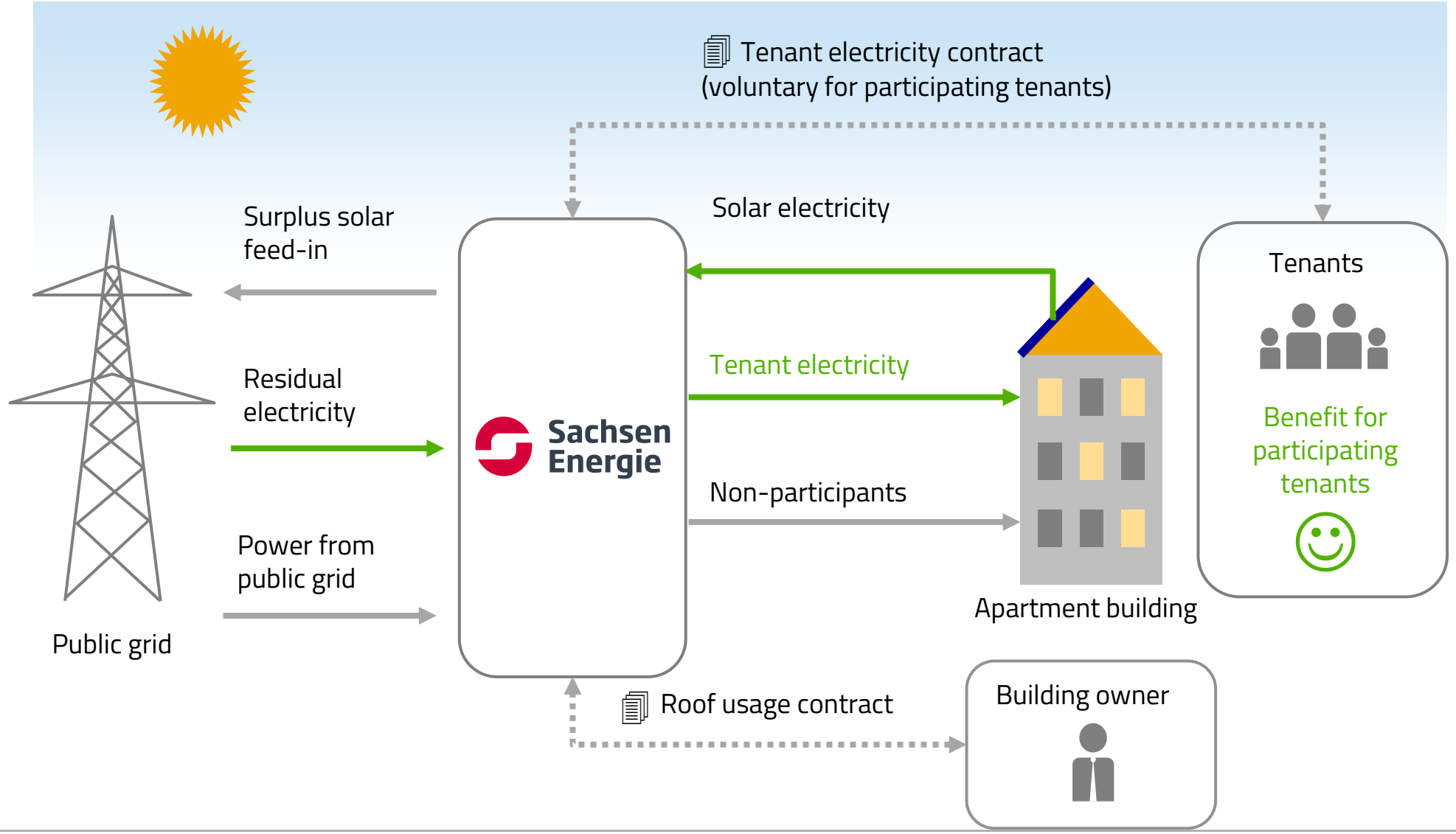
Sachsen Energie

Our tenant electricity model



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

W.E. DISTRICT
Heating & cooling solutions

SUSTAINABLE PLACES

Sustainable Places 2021

29/09 2021

DHC inefficiencies and lessons learnt

RAMBOLL
Bright ideas.
Sustainable change.

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

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

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 WEDISTRCIT 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.

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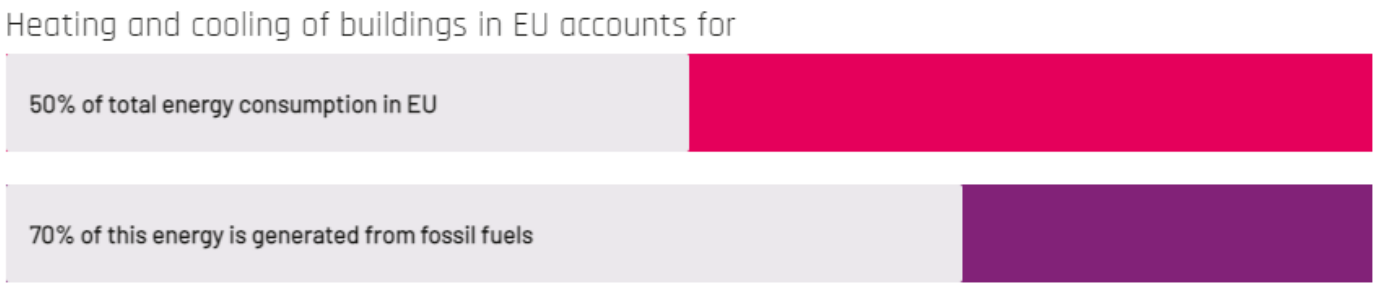
Background for WEDISTRICT

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



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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.

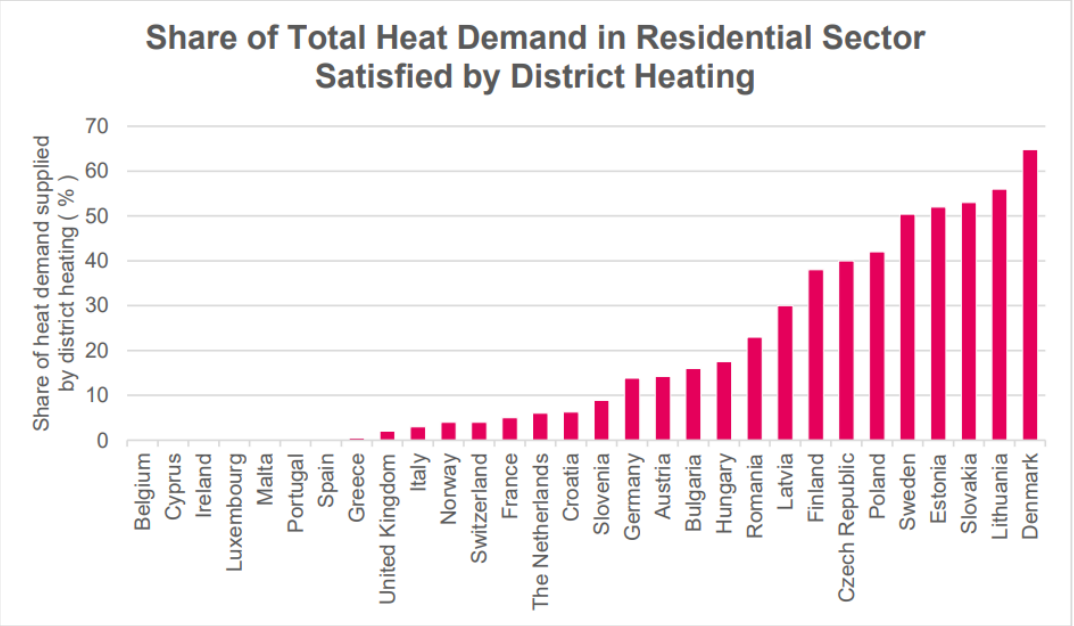
Heat price and CO2 emissions still favour individual solutions.

Refurbishment of infrastructure.

Large share (>50 %)

Increased focus on biofuels.

Saturated markets focused on improving efficiency and introduction of RES



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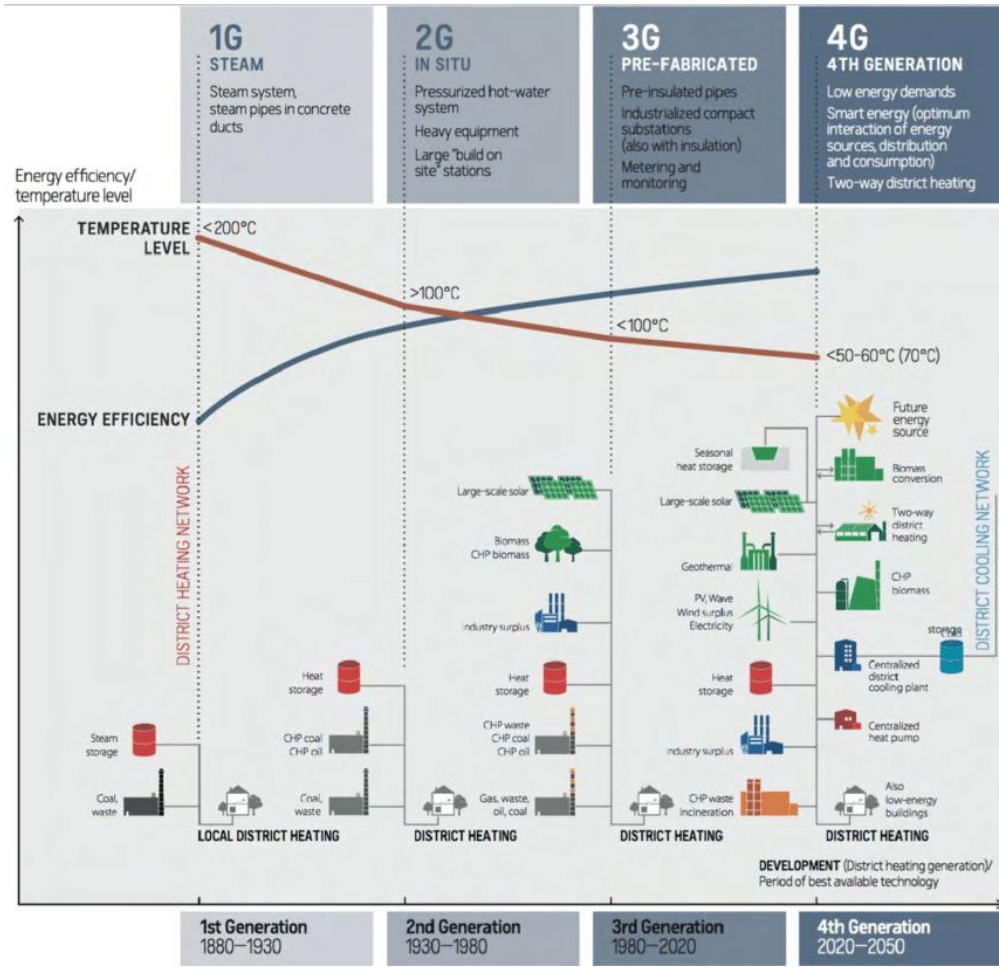
Inefficiencies and improvements identified

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.



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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.

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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.

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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:

www.wedistrict.eu

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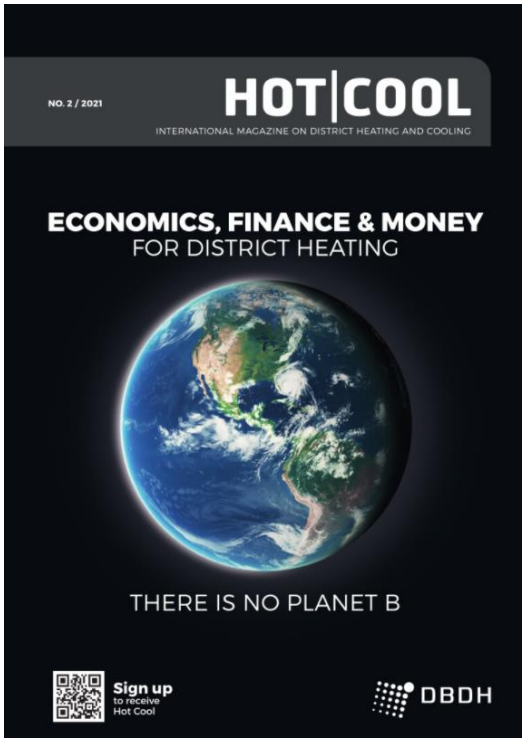

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