HYPERGRYD

Live-in Labs use cases description

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LIVE-IN LAB USE CASE DEFINITION

HYPERGRYD will perform a wide demonstration campaign relying on 4 demonstration actions to reproduce the multi-faceted context of DHC, in terms of operating conditions, technological aspects, and use cases.

What is a Live-in Lab use case?

It is how the Live-In-Lab is used within the project. Various use cases have been defined for each Live-in Lab to best fit its peculiarities resulting from the audit. Moreover, the definition of the use cases takes into account the expected results of the HYPERGRYD project.

Normally, the different HYPERGRYD solutions relate to the use cases mainly for two reasons:

- The HYPERGRYD solutions are tested in the Live-in Lab;
- The HYPERGRYD solutions use the use case as data source.

Why is it important to define the use cases?

The definition of the use case is the base to define more in detail the demonstration activities and clarify the role of the different partners involved.

TECHNOLOGIES & TOOLS

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TECHNOLOGIES

A. Modular reversible Heat Pump (MHP) with short-term PCM storage

B. Sorption storage

C. Reversible micro-CHP with steam engine

TOOLS

1. BIM-GIS toolkit for DHC network piping and configuration planning
2. Exergoeconomic optimization tool for 4th and 5th generation of DHC
3. SAInt - Scenario Analysis Interface for Energy Systems
4. Grid Singularity Exchange (local energy marketplace tool)
5. Data-driven models for DH load prediction using various machine learning techniques
6. Optimization-based demand side management of electric and thermal-coupled networks in buildings
7. Implementation guidelines of an edge IoT solution for the optimization of heat pump operation

ENVIPARK

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ENVIPARK (TURIN, ITALY)

TYPE: Office district (grid utilities)
PECULIARITIES:

- Urban mini-hydroelectric plant
- PV totem of 16 kWp installed, and planning to install PV on the roof
- Heat is provided by the DH network to the internal heating grid through a HEX.
- Heat Pumps for Domestic Hot Water production
- On-site production of hydrogen with an electrolyzer

ENVIPARK

HYPERGRYD

TECHS/TOOLS:

3. SAInt - Scenario Analysis Interface for Energy Systems

USE CASE APPLICATIONS

Islanded mode for electric and heat demand

4th generation DHC high-RES share

DHC with other energy

EXPECTED RESULTS

- Technical and economic feasibility of retrofitting to a 4th generation DHC
- Combined management and operation of electric and thermal grids
- Reduction of external energy sources

Provide historical data on energy consumption and production within the park (thermal and electrical). The simulation tool can model/simulate how to achieve the islanded mode and the 4th generation DHC high-RES share within ENVIPARK both by increasing electricity production (new PV, storage capacity – with Monte Carlo or other loop simulation) and implementing more electric-based heat/cooling production units.

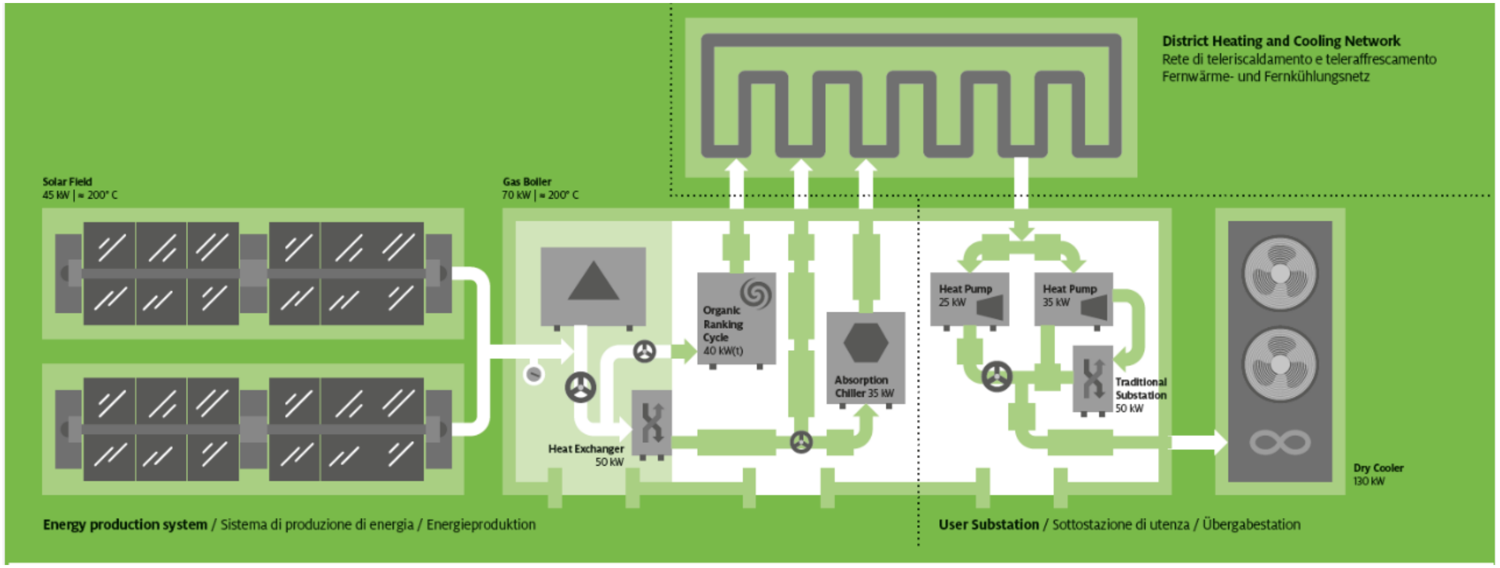
The simulation tool can **model/simulate** how to introduce other energy carriers in the ENVIPARK DHC network. The use of hydrogen for the storage of electricity and its use in fuel cells for power generation will be investigated.

EURAC RESEARCH

EURAC RESEARCH –ENERGY EXCHANGE LAB (BOZEN, ITALY)

TYPE: Research Lab
PECULIARITIES:

- Equipment for heat and cold generation: concentrated solar thermal field, gas boiler, absorption unit and heat pumps
- Small-scale DHN for testing purposes
- System flexibility to run with multiple RES and variable thermal/electric loads simulating different grid typologies and climatic conditions



EURAC RESEARCH

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TECHS/TOOLS:

C. Reversible micro-CHP with steam engine
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USE CASE APPLICATIONS

DHC with coordinated operation of heat pumps, storages, and PV production

RES-based CHP for electricity and heat generation and heat pump mode for grid services.

EXPECTED RESULTS

- Proven energy security of the DHC thanks to the integration of steam engine for CHP and of the steam buffer.
- Smart management of 5th GDHCN through optimal management of user substations integrating Heat Pumps

Laboratory test on 5th GDHCN coordinating the operation of user substations integrating heat pumps and storages with the thermal energy distribution along the network.

Laboratory test on the reversible micro-CHP + steam buffer in its different operating modes. The outcomes of this test campaign will be used as input for the tools connected with the EURAC Live-in Lab for validation and optimization purposes.

KEZO RESEARCH CENTER

KEZO RESEARCH CENTER (JABLONNA, POLAND)

TYPE: Lab and office buildings
PECULIARITIES:

- Three buildings linked in one system.
- The cooling and heating system consists of four main lines connecting all buildings.
- Possibility of testing different thermal levels of the users (20/35ºC or 40/60ºC).
- Transcritical CO_2 heat pump, adsorption chiller and PV plant in place, will be integrated with HYPERGRYD technologies.
- Control and management software will be interfaced with HYPERGRYD ICT tools.

KEZO RESEARCH CENTER

HYPERGRYD

TECHS/TOOLS:

A. Modular reversible Heat Pump (MHP) with short-term PCM storage
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USE CASE APPLICATIONS

Simulation of building, hotel and tertiary loads in small districts

DHC with coordinated operation of heat pumps, sorption cooling, storages and PV

Real data-driven simulation of multi-carrier DHC

EXPECTED RESULTS

- Effectiveness of the optimal operation of various sources with heat Storage
- Optimization of coordinated operation using both hardware and software innovations
- Reduced computing time in real-time management

Provide real-time data and/or historical data of the electrical and thermal loads installed in the KEZO LiL to validate simulation models for investigating the effectiveness of the integration of different resources and technologies into the "emulated" DHC system and the computing time in real-time management.

Test the management algorithms driven by the ICT software tool developed within the project. KEZO heating and cooling system will be treated as a small district with heat pumps (CO_2 and MHP with PCM storage), sorption cooling, and PV as production sources, with water tanks as heat/cool storages and sorption storage.

SONNENPLATZ

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SONNENPLATZ (GROßSCHÖNAU, AUSTRIA)

TYPE: Biomass-based distant heating system

PECULIARITIES:

- Distant heating system of the Municipality of Großschönau based on biomass as heat source.
- As utility, providing throughout the whole year heat for 700 kW installed end-user heat exchanger, representing about 50% of the total heat used within the municipality.
- Customers are residential houses, and commercial and public buildings.
- The heat generation system includes, besides the boiler, a back-up heater, a heat pump and a solar heater.
- Historical data and IoT devices and sensors are available.

SONNENPLATZ

HYPERGRYD

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USE CASE APPLICATIONS

Local energy market for heat and power

DHC network planning including spatial constraints

EXPECTED RESULTS

- Integration of flexible heating systems in electrical grid
- Dynamic pricing effect on flexible assets
- Exergy reduction of DHC

Provide historical data of energy consumption and generation profiles for each building, energy prices, grid topography and others to the Grid Singularity Exchange tool to simulate a local energy marketplace (LEM). The simulations will focus on investigating how flexible assets (heat pumps) can be incentivized by grid operators by implementing dynamic tariffs to raise LEM self-sufficiency and reduce grid congestion.

Provide historical data on the electrical and thermal loads and cadastral information of the buildings installed in SONNENPLATZ LiL. The data will be used by the tools connected to this LiL to analyze different scenarios and aspects of the DHC network planning including spatial constraints and to optimize the operation of the DHC network, from an exergoeconomic point of view, by shifting to 4GDHC.

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Thank you for your attention

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