Digital intelligent and scalable control for renewables in heating networks

Deliverable D3.1

# Description of the test site chosen to implement and test the new technology and of the equipment that have to be installed in order to allow the monitoring of the system

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# Document sensitivity

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# Table of Contents

# Executive summary

The deliverable D3.1 summarizes the selection process of the test site for the application of the model predictive control algorithm on a small scale district heating network alongside with all the activities carried out to set up the control and measurement equipment on the test site chosen. The test site of the Sant'Anna Hospital of Cona is described in the following pages, with focus on its characteristics, composition and energy systems. Compared to other possible test sites, the Hospital of Cona turned out to be the most suitable option in terms of technical feasibility and mathematical modeling. Nevertheless, additional measurement and control equipment have been installed not only to monitor the plant performance, but also to set up the building management system for the integration with an external supervisor.

# 1. Introduction

This report is the Deliverable D3.1 of Work Package WP3 of the DISTRHEAT project, led by Siram Veolia. The work package "WP3 - Prototyping and demonstration for small DHC" aims to implement and demonstrate the novel control algorithm developed in WP2 in a real test site. The deliverable summarizes the results of tasks "T3.1 - Selection of the test site" and "T3.2 - Design, provision, installation and testing of measurement equipment".

# 2. Test site

The selection of the test site has been crucial to the success of the project. Indeed, different aspects have been considered to identify the most suitable site. In particular, the characteristics that have been considered are:

- complexity of the power plant;
- multiplicity of energy services;
- technological level of the measuring equipment;
- integrability of the building management system.

After evaluating different locations, the test site was finally selected as described in T3.1 of WP3. It is Sant'Anna Hospital of Cona (Figure 1), located close to the city of Ferrara, in the north-east of Italy (Emilia-Romagna region).

Figure 1. View of the Sant'Anna Hospital of Cona (Ferrara, Italy).

Indeed, the site was chosen considering that:

- the complexity of the power plants sufficiently satisfies the requirements for building the mathematical model, in particular after the engineering and construction of a new trigeneration plant to support the "older" heating plant;
- multiple energy services are present, including heating and cooling demands for space heating and cooling, electrical demand for the hospital appliances as well as a steam demand for other hospital special utilities such as the laundry, the sterilization department and the kitchen;
- new measuring equipment could have been installed to monitor the energy consumptions and productions of the plant, as part of renewal works alongside with the construction of the new trigeneration plant;
- the possibility of installing a brand-new building management system on the trigeneration plant could consistently increase the integrability of the control system with an external supervisor.

From a technical perspective, the site comprises:

- the thermal power station, where heating, cooling and electrical power, as well as thermal power for steam, are produced
- a small-scale district heating and cooling network that distributes heating and cooling energy to the Hospital buildings.

In detail, the thermal power station is composed of the following machines:
- a natural gas-powered internal combustion engine, working in cogenerative mode for combined heat and electricity production;
- an absorption chiller, for cooling production from cogenerated heat recovery;
- four natural gas-fired boilers for hot water production, in series to the cogenerator;
- three electric chillers for cold water production, in series to the absorption chiller;
- three gas-fired steam boilers for the production of high-pressure vapor.

# 3. Measuring equipment

The measuring equipment is functional to collect all the necessary information on the power plant functioning, on the hospital energy needs and on the current status of all the technical equipment. From an energy modeling perspective, by measuring the majority of the energy flows from the power plant it is possible to identify the power plant baseline and evaluate energy efficiency interventions. Considering the power plant schema (Figure 2), the following energy flows are monitored:

- natural gas consumption
- boilers heat production
- cogenerator heat production
- cogenerator heat dissipation
- cogenerator electricity production
- absorption chiller heat consumption
- absorption chiller cooling production
- chillers cooling production
- hospital heat demand
- hospital cooling demand
- electricity withdrawn from the grid
- electricity injected into the grid

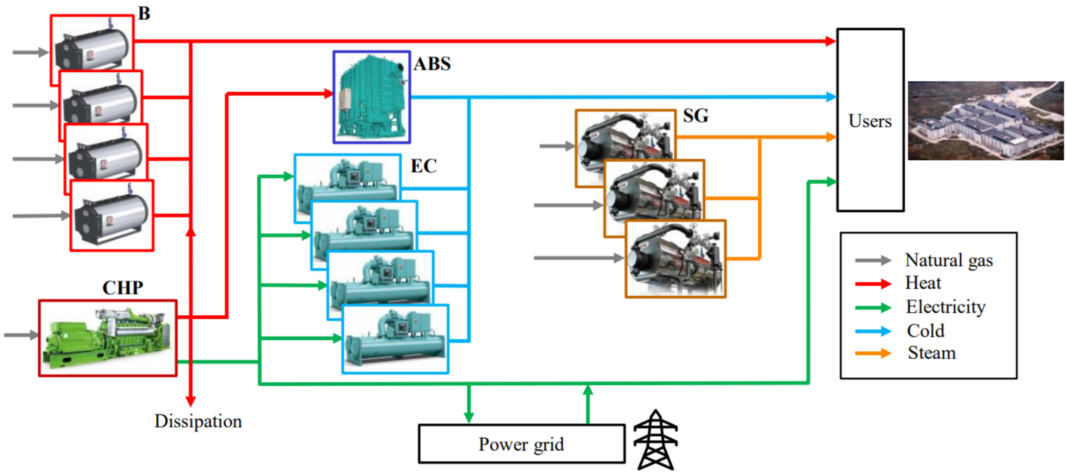


Figure 2. Schematic representation of the thermal power station of the Cona Hospital, including the cogenerator (CHP), the hot water boilers (B), the absorption chiller (ABS), the electric chillers (EC), and the steam generators (SG).

In addition, concerning the heating and cooling distribution side, two energy meters were installed to determine the real-time consumption of the main distribution circuits of the hospital.

# 4. Control equipment

The installed version of the building management system was incompatible with automatic data export processes, and many control units were obsolete. Overall, the control system was not suitable for real-time data analysis and integration. For this reason, a new and integrated control system has been installed and tested in order to manage energy production and dispatchment to the hospital. In particular, all the different control units were integrated into a single SCADA system in order to centralize the power plant management and data collection. From an operating perspective, the following three macro-activities were carried out:

- the upgrade of the existing software (SE TAC Vista) to the new one (SE EcoStruxure for Building Automation)
- the installation of new control units (SE EcoStruxure Building SmartX Server AS-P)
- the implementation of the control logics of the trigeneration system on the new control units

After these activities, a huge amount of data became accessible for energy analysis purposes and real-time data exchange.

# 5. Conclusions

After the identification of the test site, all the necessary activities were carried out to correctly setup the power plant for remote monitoring and control, including the installation of new measuring equipment, control units, and SCADA software. Overall, these activities were successfully completed.