TEMPO

Temperature Optimisation For Low Temperature District Heating Across Europe

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www.tempo-dhc.eu

Table of Contents

Objective

The TEMPO – Temperature Optimisation for Low Temperature District Heating across Europe – project develops technical innovations that enables district heating networks to operate at lower temperatures. By decreasing the temperature in the systems, it reduces heat losses and allows a higher share of renewable and excess heat to be used as heat sources. The use of these heat sources will be crucial to adapt current district heating systems and create new ones suitable for a sustainable energy system.

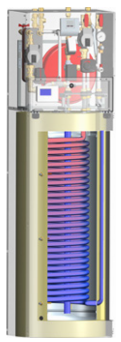
Additionally, TEMPO develops innovative approaches to consumer empowerment enabled by digital solutions. The project will also develop new business models and demonstrate their replication potential for the roll-out of sustainable and economically viable district heating networks across the EU.

Our Partners

The TEMPO project consortium gathers ten partners in six European countries. It includes complementing partners such as research institutes, industrial companies, district heating operators, a university, and an industry association.

THE SOLUTION PACKAGES / TECHNOLOGICAL INNOVATIONS

Technological Innovations



Six technological innovations that contribute to minimising the temperature in networks and enables a cost-efficient implementation of low temperature networks will undergo final development in TEMPO. Each of the innovations can bring value to most district heating networks individually. However, the main strength of this project lies in the combination of the individual technologies into solution packages for dedicated application areas. Three solution packages customised to three different application areas, will be tested in selected representative demos

The following technological innovations will be developed:

Network Optimisation - Digitalisation

A supervision ICT platform for detection and diagnosis of faults in district heating substations

75% of all district heating substations perform sub-optimally, resulting in on average 15-20°C higher return temperature than necessary. The supervision platform detects this district heating substation suboptimal behaviour automatically.

Visualisation tools for expert and non-expert users

These visualisation tools form the basis for a decision support system for expert user. This will become a powerful tool for detecting operational faults and deviations in the district heating network. The tools for non-expert users will provide knowledge on energy consumption and efficiency measures to empower them as part of the energy chain.

Smart district heating network controller, to balance supply and demand and minimise the return temperature

The controller balances the demand of heat to fluctuating renewable and residual heat sources. Furthermore, the controller can further reduce the return temperature by influencing the demand behaviour at the consumer side and coordinating this on a network level

“Smart district heating network controller, to balance supply and demand and minimise the return temperature”

Network Optimisation - Infrastructure

Innovative piping system

Substations have bypasses (for conform reasons) that cause hot supply water to be injected in the return pipes, thereby increasing the return temperatures. The innovative piping system eliminates these bypasses in substations and ensures that flow and return temperatures in the network are kept at the lowest temperature level required by the end customer..

Individual Building Optimisation

Optimisation of the building installation

The performance of district heating substations is influenced by the building installation behind the substations, which often suffers from faults. To optimise the return temperature, also faults in the building installation must be minimised.

Decentralised buffers

Decentralised buffers at the building side will cut the power peaks in the network, thereby allowing reduction of the network pipes dimensions. Especially for rural areas where the piping represents a relative high investment, this concept can enhance the economic feasibility of district heating networks.

DEMONSTRATION SITES

Demonstration Sites

Brescia: Existing High Temperature District Heating Network

The DH system in Brescia, owned and operated by A2A Calore e Servizi, is the largest DH system in Italy, with more than 1 TWh annual supply and covering about 70% of the town heat demand. The oldest part of the network started operating in 1972 and today more than 60% of the heat is produced by a waste-to-energy plant. The network delivers heat to more than 21.000 customers and the trench length is more than 670 km.

Owing to the high operating temperatures, up to 130 °C in winter, the annual heat losses are rather high. For this reason, there is a high interest in reducing the network temperatures, at least in low-density areas. The main bottlenecks to lower temperatures lie on the building side and depend typically on the heat demand, the heating system, the control function, the connection size, and the customer behavior.

The selected demo site is located on a peripheral branch in the southern part of the network. The site includes 35 customers (1 large multi-family house and 34 single-family terraced houses) with a total contract capacity of about 700 kW. This site was selected considering also the large replicability potential, since it is representative of several sites in European district heating networks.

A successful temperature reduction reached through replicable solutions is expected to pave the way to a more competitive and sustainable district heating, with higher efficiency and hosting locally available low-temperature and low- or no-carbon sources, whose integration can become economically feasible once the system temperatures are lowered.

In this demo site, the temperature reduction will be demonstrated by integrating the solution package 3 and by engaging the end costumers.

For the site preparation, old dismissed gas boilers close to the multi-family house were removed, with consequent re-qualification of the area aesthetics, and replaced with a container hosting a supply-to-return mixing station. Here, the hot water from the main network is mixed with the return (in a ratio depending on the ambient T) to get a colder supply to the demo site. Sensors to monitor the indoor temperatures were placed in some buildings, and hardware tools communicating with a cloud were installed to transmit the operating data and enable the smart control.

Nurnberg Region: New Rural District Heating Network

The municipality of Windsbach (6000 inhabitants, located 35 km south west of Nuremberg) has planned a new residential housing project, developed in rural area and heated by district heating.

For the heat supply of a development area with many single-family houses, a sustainable and affordable solution had to be found. With a view to sustainability, the administration of the town decided against making natural gas available in the residential area, and implementing a district heating network fueled by a bio gas co-generation plant instead.

A decentralized district heating network with low heat losses was to be installed in Windsbach. The newly built houses meet high thermal insulation standards, so they require relatively little heat. At the same time, there is a clear tendency towards smaller houses, with little space for a buffer tank and the rest of the domestic heating equipment.

In a decentralized heating network, each consumer installs a buffer storage tank. The domestic heat requirement is covered by the stored warm water, which in turn is being replaced with hot heating network water when it has spent its warmth. The heat network may be turned off when there's no heat demand, e.g. during summer nights. This way, heat losses of the network as well as its energy consumption for pumps may be significantly reduced. This concept works especially well in smaller and medium-sized networks with less than one hundred connected consumers.

Need for an innovation – compact buffer units with preinstalled heating equipment

As a solution, ENERPIPE develops a compact buffer tank unit with specifically small footprint, able to meet the smaller heat demand of a modern single-family home, and at the same time including the required heat exchangers, pumps and auxiliaries to provide not only heating, but also domestic hot water. Its dimensions correspond to those of a refrigerator and therefore fit into a small utility room or even a niche in more frequented rooms.

By coordinating the charging cycles of the decentralized buffers, a controller that had been previously developed in the Horizon 2020 STORM project and was specifically adapted to the Windsbach project, is able to decrease the total peak heat load in the grid. To achieve this, a 24h forecast of the total heat load is calculated together with individual heat load forecasts of all the connected buffers.

The controller will use these forecasts to calculate an optimal charging plan for the total network which is dis-aggregated and dispatched to each decentralized buffer individually. A backup controller ensures that safety and comfort boundaries are never compromised, it will force a charging cycle if the buffer temperatures are too cold and block the charging cycle when buffer temperatures are too high. To supervise the effects of the innovation and the good operation of the network, each consumer's equipment may be monitored via central computer.

With these two innovations combined, many of the advantages of a decentralized heating network may be combined with the small space demand of a centralized network's heat transfer station, providing a sustainable and affordable solution for residential neighborhoods with many single family houses.

Main Facts

DEMO SITES

Nurnberg region (DE): New Low-Temperature District Heating Network

Brescia (IT): Existing High Temperature District Heating Network

FACTS

BUDGET

€ 3.707.182,75

October 2017 / March 2022

2 Demos

10 Partners

Objective 1:

Final development of technological innovations for low-temperature (LT) district heating (DH) networks

Objective 2:

Quantify the benefits of the tempo solution packages for LTDH networks through demonstration in 2 representative demonstration sites

Objective 3:

Empowerment of end users in LTDH network

Objective 4:

Develop innovative business models and demonstrate their replication potential for the roll-out of sustainable and economically viable DH networks across the EU

Objective 5:

Guarantee EU-wide market uptake of tempo solution packages by developing a exploitation and replication plan

RESOURCES

Low Temperature District Heating

Today's district heating systems (3rd generation) are made mainly for fossil fuels that easily generates high temperatures. To create tomorrow's district heating systems (4th generation), adapted to a sustainable energy system, we need to use non-fossil heat supply such as renewable and excess heat that are generally characterised by lower temperatures. The future district heating systems also need to adapt to a decrease in energy demand from increasingly energy efficient buildings, resulting in lower operational margins for existing networks.

In the TEMPO project, we will lower the temperature levels of the networks, so that heat losses can be reduced and thereby enable the use of a higher share of sustainable sources to meet heat demand. To achieve this goal, the project relies on the demonstration of cost-effective technological innovations that will contribute to minimising the temperature level in district heating networks and enable the cost-efficient implementation of low temperature networks. Additionally, we will apply innovative approaches towards consumer empowerment and new business models for these networks to ensure a successful outcome of TEMPO.

TEMPO will therefore contribute to steering district heating networks towards a more sustainable and economically viable future.

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