



Coupling innovative solutions with stakeholder involvement

The future to Climate Neutral Cities

Abstract

Energy systems lie at the heart of Positive and Clean Energy Districts (PCEDs). These forward-looking neighbourhoods are characterized by their energy efficiency and flexibility, as well as the use of locally produced renewable energies, and the integration of electric mobility in it. Energy system design can encompass a wide variety of energy technologies and combine with diverse energy services. Exploring different strategies and solutions to design efficient PCED and their replication is key for the creation of climate neutral cities.

Key points

- Integration of cooling into district heating system by Dresden
- Citizen engagement for the district decarbonisation of Ghent
- The use of geothermal energy to district decarbonisation the city of Munich

The decarbonization of the heating and cooling sector is central to achieving the energy transition. District heating has a great potential for efficient, cost-effective and flexible of low-emission energy sources in the energy mix. However, the decarbonisation potential of district heating is largely blocked, as fossil fuels still dominate district network supplies globally.

The importance of district heating decarbonization has been also highlighted in the 'Fit for 55' package, with a series of updates for the EU legislation to ensure that the European policies facilitate our climate goals.

In this sense, the acceleration of renewable energy is key, and with the review in 2023 of the Renewable Energy Directive (EU/2023/2413) new targets have been set to strengthen the development of renewables for the district heating and cooling.

In 2022, The share of renewables provided only 24.8% of the final energy consumption in the heating and cooling sector according to Eurostat.

But In Europe, District Heating and Cooling networks are especially well established especially in the northern countries, Finland, Sweden, Denmark, and Baltic countries, due to the low temperatures reached in winter, have the highest rates.

And so, collaboration and knowledge transfer are essential to boost replication and address also the challenges that are holding back the decarbonization of heating in Europe.

Three cities that are working towards the full decarbonisation of such technology are Dresden, Munich, and Ghent. These three municipalities, involved in NEUTRALPATH and ASCEND, two Horizon Europe projects for the development of Positive and Clean Energy Districts (PCEDs), are working toward developing solutions to transform their district heating systems into climate neutral energy solutions.

DRESDEN: ADDING COOLING TECHNOLOGIES TO DISTRICT HEATING

Like many cities in Central and Northern Europe, Dresden is experiencing rising summer temperatures due to climate change. This increase in heat makes imperative the introduction of new cooling methods for buildings while maintaining high energy efficiency of these. A solution the city has been experimenting with is the integration of cooling mechanisms into the district heating system.

The main challenge Dresden is facing in implementing such technologies within the district heating system is the unpredictability of the secondary network's response to lower temperatures. The city's system consists of two grids: the primary grid (from gas-fired generator to heat transfer station) and the secondary grid (from heat transfer station to house station). While the primary grid can handle temperatures as low as 15°K, the secondary grid is still in the trial phase.

To address this unpredictability, Dresden has developed a plan to upgrade the heat stations and improve the house stations, which have been in operation for 30 years providing high temperatures. The plan includes the use of smart solutions in the house stations and the installation of solar panels (PV) on their roofs. This approach will enable Dresden to meet the energy demands of its residents with the renewable energy generated by the PVs.

REDUCING ENERGY POVERTY THROUGH THE CREATION OF NEW BUSINESS MODELS

While developing an integrated district cooling and heating system is essential for the city's overall decarbonization, the Technical University of Dresden is exploring various methods to make building renovations affordable for low-income residents. The renovation plan designed by this educational and research institution ensures that citizens can remain in their homes during the refurbishment process. This plan involves installing insulation on the external walls of buildings using existing pipes, which helps store heat and reduces the electricity needed from heat pumps due to lower flow temperatures.

Another refurbishment option considered by the university pairs a grid-friendly, sustainable energy supply with buildings suitable for renewable energy. As part of this strategy, buildings must be connected to the soil to ensure efficient heat storage. This approach reduces energy costs and provides affordable solutions for the population.

MUNICH: EXPANDING ENERGY RENOVATIONS THROUGHOUT GERMANY

In its journey towards climate neutrality, Munich is taking significant steps to reduce its dependency on fossil fuels. One of the main initiatives is the redevelopment of the Harthof district as a Positive Energy District (PED). This residential area, consisting of rental apartments owned by Münchner Wohnen and built between the 1940s and 1970s, is characterized by low energy efficiency and is largely heated

by oil and gas. Additionally, the district lacks any functioning shared mobility solutions.

To address these issues, Munich has adopted a citizen engagement strategy to develop sustainable mobility solutions, create local renewable energy sources, enhance energy efficiency, and utilize digital tools to support these efforts.

In collaboration with multiple partners, the city is installing solar panels on building façades to increase local renewable energy production. This is being done through the serial refurbishment of these buildings using prefabricated elements. Simultaneously, these buildings are being connected to a smart heat grid, which optimizes energy flows and increases energy efficiency. The smart heat grid also provides thermal short-term buffer storage, which can be used for local self-consumption by tenants or to power e-mobility charging points.

Another measure Munich is implementing is linking all buildings to the district heating grid, which is currently being decarbonized using geothermal energy combined with large-scale heat pumps and heat storage systems. Munich plans to transition its district heating to renewable energy by 2040.

To achieve a complete understanding and acceptance of such changes in the city, Munich is adopting citizen engagement practices that have contributed to the development of a prosumer business model. The actions that have been taken from a local level to enhance this mentality are the organisation of awareness-raising events for tenants/owners, the provision of energy consultants for citizens, and the creation of a Participatory District Energy Council.

GHENT: ENGAGING CITIZENS FOR A SUCCESSFUL DECARBONISATION

The Belgian city of Ghent has extensive experience collaborating with citizens to ensure the energy transition becomes a reality. The Muide-Meulestede district, situated between the harbour and the city centre, is a young, lively, and low-income neighbourhood. Although the number of

renovations in the area is rising, only higher-income households can afford the EUR 100,000 needed to refurbish their homes.

To make home renovations more inclusive, Ghent is adopting a collective approach by actively involving various local stakeholders. These stakeholders include energy companies, the district energy coalition, neighbourhood hubs, and the consortium of partners from the Living Lab of Muide-Meulestede district.

Three pilot projects with potential for replication are being developed using this collective approach: Standaard Muide, Voorhavenlaan 25, and Loods 26. The first two projects focus on creating a mini district heating system fueled by a local geothermal field to provide heating for surrounding homes. Loods 26 aims to provide sustainable electricity to vulnerable residents.

Standaard Muide, a football field, is undergoing renovations to harness geothermal energy from beneath the field

to heat the nearby 43 private houses and the 23 refurbished social housing apartments. To achieve so, the football field requires a collective groundwater heat pump with a capacity of 150 to 250 kW.

Based on a cost-effectiveness analysis, addressing costs of interventions by groups shows a relevant reduction of costs. Around EUR 19,000 are saved when choosing to act collectively.

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All the solutions that were presented by these cities are still in the process of testing and implementation.

Geothermal energy seems to be taking up more ground as a preferred option for those municipalities that wish to rapidly decarbonise their energy systems. However, European cities must not forget about the necessity to bring citizens and all relevant stakeholders to the table when implementing such changes. An affordable, acknowledged, and embraced transition will not take place without coupling technology and society.

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