DEMAND FLEXIBILITY IN DISTRICT HEATING NETWORKS

Country/region	**EU**
Type of E1st approach	A – In front / General 1 – Allowing E1st (Establishes level-playing field between supply- and demand-side resources)
Energy carrier(s) targeted	Heat
Sector(s) / energy system(s) or end-uses targeted	Energy/ heat supply, households
Implementing bodies	Local authorities
Decision makers involved	
Main objective(s)	Using ICT and utilisation of building thermal inertia for demand shifting
Implementation period	Ongoing

The aim is to improve the load factor of the households regarding heating. This has the potential to improve the attractiveness of district heating (DH) and accelerate the roll out of DH networks. Capital costs are lowered by reducing the required boiler capacity and pipework sizes. Operational costs are reduced by increasing the coverage of the primary plant and reducing heat losses and pumping energy. Shaping the heat demand and the reduction of demand peaks has the potential to improve network efficiency, integrate renewable energy sources and reduce capital costs within the network (Sweetnam et al., 2018; Mishra et al., 2019). Experimental studies on thermal peak shaving in district heating networks resulted in peak reductions between 5% and 35%, depending on the limitations of the modifications (Guelpa et al, 2019).

1. Background

Regulating demand is one way to tackle current and future challenges like volatile energy supply, decentralised generation and critical energy grid situations. This is usually referred to using the term demand side management (DSM) or demand response (DR). The terms imply that changes in demand happen as a reaction to the status of the grid or energy availability. The goal of DR is not necessarily the reduction of energy consumption, but the avoidance of high power costs, costs for grid expansion or backup power plants and conventional energies due to demand following generation (instead of vice versa).

That principle is used regarding electricity but is also applicable to homes connected to district heating networks or the control of electro-thermal devices (Sweetnam et al., 2018). The ICT is used to follow a demand-shaping signal/tariffs for homes in order to shape network level demand in a coordinated and fair manner by equalising the impact of changing outside temperatures. In this way, both demand profiles and network temperatures are optimised in a holistic approach.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 839509. The sole responsibility for the content of this website lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

2. How has the E1st principle (or similar concept) been implemented?

The Energy Efficiency First paradigm is referred to when dealing with the challenges of the energy transition and includes both energy efficiency and demand response. In the changing energy paradigm, buildings will need to be viewed as having an active role in supporting the flexibility of energy systems.

3. Effects / impacts

The impact of reducing peak heat demand or increasing the load factor allows a reduction in the size of the network or the decrease of operating costs: Pipes, pumps and the central plant can all be downsized, or existing networks can be expanded without additional primary infrastructure. Three main effects can be realised:

1) additional buildings can be connected to the network without installing new pipelines;
2) a better exploitation of renewable energy sources can be achieved; and
3) a reduction in the amount of heat produced by heat-only boilers can also be achieved (Guelpa et al., 2019).

The experimental study of district heating networks, where the heating in buildings was rescheduled, showed a peak reduction between 5% and 35%, depending on the limitations on the modifications (Guelpa et al., 2019).

Studies need to take into consideration the occupant's perceptions of comfort and indoor temperature, but results showed that the occupant perception of the indoor thermal environments did not deteriorate during the DR implementations. DR events may be triggered and executed without significantly impacting occupant satisfaction with the thermal comfort of the premises (Mishra et al., 2019).

4. Changes over time, if any

Demand-side management will play a major role in future energy systems. However, while they have been explored in some depth for electricity grids, a similar progress has not been made for district heating networks.

The European Commission's proposal of recast of EPBD (Energy Performance of Buildings Directive) on 30 November 2016 might be a necessary and logical step to integrate the readiness of buildings for DR into a regulatory framework. It introduces the "smart indicator" which rates "the readiness of the building to adapt its operation to the needs of the occupant and of the grid and to improve its performance." This regulation could facilitate and support DR in district heating.

5. Barriers and success factors

Most scientific publications mention the importance of respecting consumer requirements for comfort. Comfort, however, is difficult to define and measure, even for the consumers themselves. To facilitate this and allow adjustments, a user-friendly user-interface is necessary.

Generally, the shape of the heat-demand profile depends on the characteristics and habits and the type of heat delivery technology connected. These determinants need to be taken into account when trying to alter the load profile and maintain comfort.

6. Replicability and scalability potential

District heating might become more important in the future; it is currently ranked number 27 in Project Drawdown's 100 solutions to global warming. (Haas, 2018). Although district heating requires a long-term financial commitment that fits poorly with a focus on short-term returns on investment, it brings many advantages in comparison to individual heating systems. Usually, district heating is more energy efficient due to the simultaneous production of heat and electricity in combined heat and power generation plants. This has the added benefit of reducing carbon emissions (Dunne, 2014). Implementing DR in district heating can increase the flexibility and efficiency of the system to contribute to a sustainable use of heat.

7. Sources and references

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ABOUT ENEFIRST

ENEFIRST is a 3-year project funded under the Horizon2020 programme, which gathers a consortium of partners from across sectors and regions: IEECP, BPIE, Fraunhofer ISI, CEU, RAP, IREES, TU Wien.

From definition to implementation, ENEFIRST aims at making the “Efficiency First” (E1st) principle more concrete and operational, better understand its relevance for decision processes related to energy demand and supply, its broader impacts across sectors and markets, focusing on the building sector and related energy systems in EU Member States.

> ***E1st gives priority to demand-side resources whenever they are more cost-effective from a societal perspective than investments in energy infrastructure in meeting policy objectives. It is a decision principle that is applied systematically at any level to energy-related investment planning and enabled by an “equal opportunity” policy design.***

ENEFIRST combines policy analysis and quantitative assessments of E1st impacts to develop policy guidelines and recommendations, following a process with continuous exchanges with stakeholders.

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