DISTRHEAT

Digital intelligent and scalable control for renewables in heating networks

Deliverable 7.2

Guidelines for energy policies and feedback on different business models

28 September 2023

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Executive summary

In this deliverable, the existing policies and legislation for the heating sector are being reviewed, in connection with the new technologies suggested by DISTRHEAT. The characteristics of existing business models are discussed. A new business model is proposed, shifting towards a servitized concept where comfort and controllability are the main offering instead of heat. Finally, challenges and opportunities related to the wider adoption of this solution are presented.

1. Introduction

Introducing new technology for enhanced comfort and controllability dictates the need for a new business model in the district heating sector. Previous investigations within DISTRHEAT project suggested that there is a mismatch between the intended comfort offering by housing companies and actual perception by end users. Also, there is lack of information on heat demands to the energy utility companies. All three sides above put emphasis on comfort and controllability, therefore a paradigm shift is required in the way the business model is operated: from selling heat to selling comfort and controllability as a service.

2. Energy policies

The overarching ambition for the European Union (EU) is to reach carbon neutrality in all sectors by 2050 (European Commission, 2023). The Heating and Cooling Strategy for the EU is prioritizing the increased penetration of renewable fuels into the heating sector, whilst at the same time decarbonizing fossil-fuel-based supply (European Commission, 2023). The Energy Efficiency Directive sets binding energy efficiency targets for member states and promotes measures to increase the energy efficiency of buildings, which includes heating systems (European Union, 2023). This directive encourages the renovation of existing buildings to meet higher energy performance standards. The Renewable Energy Directive promotes the use of renewable energy sources for heating purposes (European Union, 2018). This includes incentives for the installation of renewable heating systems such as solar thermal, heat pumps, and biomass boilers. Furthermore, the EU has established the Eco-Design and Energy Labeling Regulation incorporating energy performance requirements and energy labeling for heating appliances, such as boilers, heat pumps, and water heaters. These regulations aim to phase out less efficient heating products from the market, thereby reducing energy consumption and greenhouse gas emissions. The Emissions Trading System, which puts a price on carbon emissions from certain sectors, including heating. This incentivizes industries and households to reduce their carbon footprint by choosing more energy-efficient and cleaner heating options. At national level, European countries are promoting individual policies and directives according to their corresponding energy mix and architecture of heating system.

In Sweden, energy policies focus on sustainability and security of supply, while the ambition is to eliminate CO_2 emissions by 2045. Sweden has a well-developed district heating and cooling system that is highly efficient and relies on renewable and waste heat sources. This system significantly reduces the carbon footprint of heating in urban areas. The government has encouraged the expansion of DHC networks and supports research and development in this sector. Sweden has set ambitious goals for increasing the share of renewable energy in its heating sector. This includes the use of bioenergy, heat pumps, solar thermal systems, and wind power for heating purposes. Government incentives and subsidies promote the installation of renewable heating technologies. Sweden has stringent energy efficiency standards for buildings and heating equipment. Building codes and regulations require high insulation levels and energy-efficient heating systems. These policies are aimed at reducing energy consumption and greenhouse gas emissions in the heating sector. Sweden has implemented a carbon tax, which includes heating fuels such as oil and natural gas. This tax incentivizes the use of cleaner and more energy-efficient heating sources while discouraging carbon-intensive options.

In Italy, district heating has a relatively lower degree of penetration however local district heating networks are present. Italy has implemented regulations and building codes to improve the energy efficiency of buildings, including requirements for thermal insulation, efficient heating systems, and the use of renewable energy sources for heating. This is in line with the EU's energy performance of buildings directive. Italy participates in the European Union Emissions Trading System, which puts a price on carbon emissions. This incentivizes industries and utilities to reduce carbon emissions, including those related to heating.

3. Business model

The “Business Model Canvas” framework is employed for the development of a new business model for the proposed offering. Although new control solutions have been developed and demonstrated in DISTRHEAT, the proposed offering is not a product but a service. The service comprises the supply of improved comfort to end-users and enhanced controllability to building operators. The overall structure of the proposed business model is provided in Fig. 1 below:

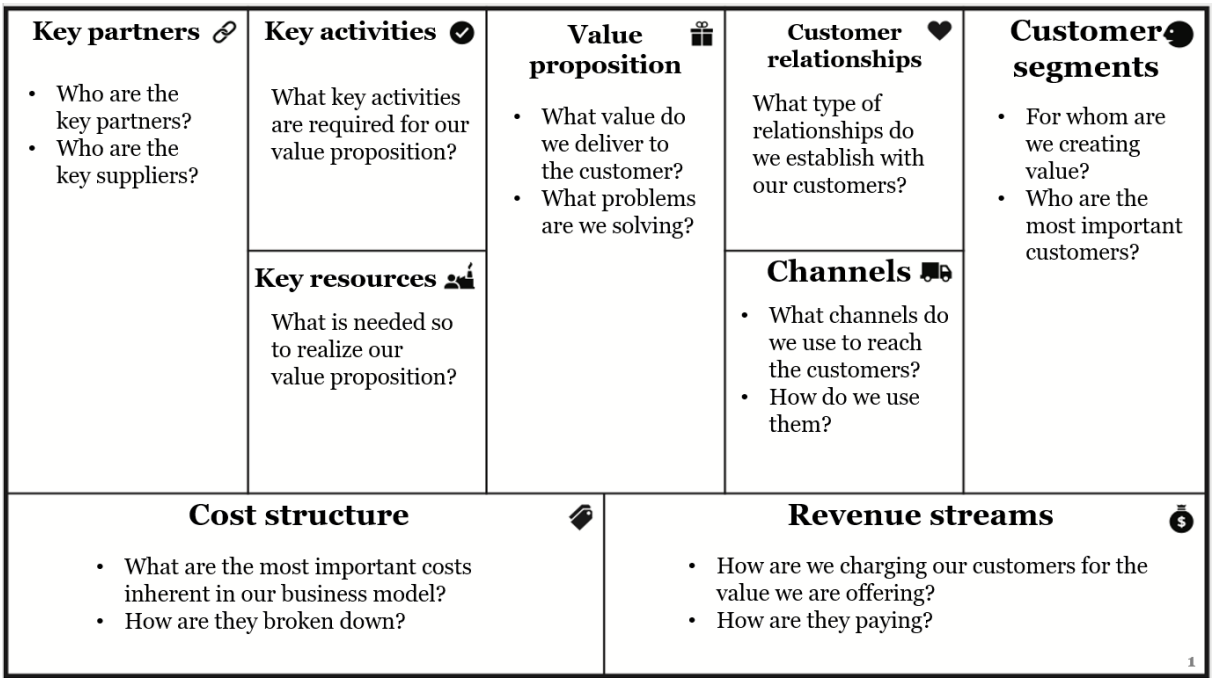

Figure 1: Overview of business model structure.

Below is the analysis of individual components of the proposed business model.

Value proposition: The present offering is provided by the energy utility company and is based on the supply of heat to the building owners. Therefore, building owners currently pay according to the amount of heat, following a pricing model based on energy consumption. The equipment and service for the heating installation is also provided by the utility company, but private actors also exist in this market. In the new business model, the utility company is selling a new service, comfort, and controllability, instead of heat. It is important to note that a split incentive exists here: housing companies buy the new service from utility providers; however, end-users inside the buildings get charged according to a contract with the building

owner. Aggregating the individual building effects at network level enables global energy/cost savings and predictability for the power plant operator. The employment of network controllers at pumping-station level will maximize the capitalization on substation control benefits and will provide a link to the main powerplant, allowing for optimal management of heat along the network.

Customer segments: The main customers for an energy utility company are the so-called “key account managers”, i.e., large building owners that manage multiple heating substations. Industrial consumers of heat or office buildings can also be key customers. In the new business model, the customers remain the same.

Key partners: Current key partners are suppliers of renewable fuels for the power plant, equipment suppliers for the network and substation components, hardware, and software suppliers. In the new business model, an extra key partner is added which provides the hardware and software for smart control. This partner acts as a major supplier for the utility company. The utility company continues as the major service provider, now offering a packaged service to the customers, now based on agreed comfort and controllability. Due to the additional needs for data management extra partners will be needed with regards to computing infrastructure and data centers.

Key activities: In the present operation, besides heat supply, activities include production planning, forecasting, monitoring, service, and maintenance. Those are usually carried out by the utility company, on a regular basis or on demand. In the new business model, added activities will include the adaptation of production planning to the forecasted demand for consumers, provision of hardware for the smart control solution including indoor temperature sensors for the apartments, and updated monitoring, maintenance, and service activities to cover the control solution.

Key resources: Current resources involve infrastructure at the central power plant (both for heat generation and process control, at the network (heat distribution and control), as well as at the consumers (substation, apartments, and control). In the new business plan, additional resources will be needed for data management and integration of the control solution into the standard equipment packaging. In terms of human resources, retraining of the operators will be needed to incorporate the controller aspects into the standard routines.

Customer relationships: Tight collaboration between utility companies and building owners is necessary at present so to capture end-user requirements and compensate for possible shortcomings. In the new model, an even tighter customer engagement will be necessary to overcome the social barriers associated with the implementation of the smart control technology. Feedback on the controllability from building operators will be needed. Similarly, feedback on comfort from end user to the utility company through the building managers will be indispensable.

Channels: The main collaboration channels between utility companies and building owners are heat supply contracts which will continue to be there in the new business model. Further communication channels include digital communication as well as questionnaires. The use of communication channels will become more frequent as customer and end-user engagement are important in the new business model.

Cost structure: In the present operation, the main cost components comprise renewable fuel costs for heat (and electricity) generation by the powerplant, costs related to the different

suppliers of equipment and services, as well as cost for maintenance and repair at plant, network, and substation level. In the new business model, the utility company will need to invest in the new control technology that is proposed. Additional maintenance and operating costs will be introduced, related to the control hardware and software together with additional sensors such as indoor temperature sensors, as well as data centers, computing infrastructure, and training of personnel. However, new capabilities related to digitalization, such as quicker detection of faults or even prediction of faults, as well as more accurate forecasting of demand which will reduce costs for unexpected failures and repairs, as well as production planning.

Revenue streams: The major revenue stream in the present operation comes from direct sale of heat to the key account managers. In the new business model, revenues will be associated to a service based on comfort and controllability instead of heat. New contracts can be formed according to the desired comfort levels and controllability margins for the building operators. Apart from the direct revenues above, indirect revenues will arise from potential peak shaving at building level which, in aggregation, can yield a bottom-up offloading for the main plant at peak conditions.

4. Challenges and opportunities for a wider adoption

Several challenges are associated with the wider adoption of smart control in the district heating sector. These can be split into three major categories:

(a) Technical challenges: Implementing smart control systems can require substantial upfront investments in sensors, meters, communication infrastructure, and control software. These costs may deter some district heating providers from adopting smart technologies. Smart control systems generate and rely on a significant amount of data. Ensuring the security and privacy of this data is crucial. Any breaches or misuse of data can have serious consequences. The installation, maintenance, and operation of smart control systems require a level of technical expertise that may not always be readily available. A shortage of skilled personnel can hinder adoption.

(b) Regulatory challenges: Regulatory and policy frameworks may not always be aligned with the adoption of smart control in district heating, especially when it comes to data sharing and communication standards. Furthermore, stronger incentives are required for adopting new technologies. This can be done through a change in pricing models, from penalizing to incentivizing, and from selling energy to selling controllability and comfort.

(c) Social challenges: End-user engagement is indispensable to a new business model for the heating sector. End-users may not be aware of the potential savings and environmental benefits, or they may not be educated in taking responsibility over their environmental footprint. Also, end-users may be resistant to changes in billing and service delivery, especially when the element of trust to housing providers and network operators is low.

However, the opportunities are still more significant and worth the investment. The heating sector is largely governed by social aspects therefore there is a prominent opportunity for explainable technical solutions to the benefit of the communities and the environment. Widely applicable solutions, like the ones referring to district heating, present the potential for wider engagement of society around a possible change.

The majority of operational data required for the implementation of the solutions proposed by DISTRHEAT is already available in standard substations, therefore capitalization on existing resources is maximized and value is created for the end-users, the housing providers, and the utility companies.

Improved controllability can yield a more stable operation for the entire heating network and consequently the central power plant. For the case of combined heat and power plants, offloading in terms of thermal demands can allow more space for generating extra electricity. Therefore, challenges related to the power grid and are emerging at the present time, can be ameliorated by sector coupling and a smarter district heating network. Finally, the generality of proposed solutions within DISTRHEAT demonstrates potential for wider adoption by the entire energy sector and the industrial sector.

5. Conclusions

The regulatory and policy framework for the heating sector in the EU is strongly promoting environmental awareness and footprint for the heating sector. A series of acts and regulations has been established towards carbon neutrality and decarbonization including district heating and cooling. A new way for conducting business is required for incorporating smart control technologies at large scale. Enhanced value will be proposed to the end users which will require the adaptations in the way the offering is provided. A paradigm shift towards servitization is eminent through selling controllability and comfort instead of heat. Wider adoption of this scheme implies technical, regulatory and societal challenges; however, the associated opportunities are considerably promising and suitable for extrapolation to other sectors.

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