2050

Heat Roadmap Europe

A low-carbon heating and cooling strategy

Business cases and business strategies to encourage market uptake

Addressing barriers for the market uptake of recommended solutions

D7.11

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1. Introduction

In Europe, there is a clear, long-term objective to decarbonise the energy system. The Heat Roadmap Europe 4 (HRE4) project, co-funded by the European Union, seeks to enable new policies and prepare the ground for new investments by creating more certainty in relation to the changes that are required.

HRE4 provides new capacity and skills for lead-users in the heating and cooling (H&C) sector, including policy-makers, industry, and researchers at local, national, and EU levels. This is done by developing the data, tools, methodologies, and results necessary to quantify the impact of implementing more energy efficient measures on both the demand and supply side of the sector.

This document functions as one of these key tools, by naming and describing exemplary business cases that closely relate to the most important solutions promoted by the HRE4 project. These cases have been selected, because they highlight a range of H&C solutions, in a variety of geographical contexts, overcoming many of the most common barriers affecting the H&C sector.

Whereas this report focuses on selected business *cases*, an upcoming version (D7.16, due in 2018) will also include possible pathways for the HRE4-related technologies to increase their market shares by developing business *strategies*. These strategies will build on the scientific, and technologically-neutral, key recommendations that derive from HRE4's analysis of the fourteen EU member states with the largest heat demand in the EU28[1]. The term 'strategies' here refers to a characterisation of barriers to the uptake and deployment of the H&C solutions, and guidance on how to address them efficiently and in an economically-feasible way.

[1] Though insights from HRE4 should be quite applicable across Europe, the project especially concentrates on those fourteen countries with the highest H&C demands: Austria, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, the Netherlands, Poland, Romania, Spain, Sweden and the UK.

2. Three main pillars for decarbonising the H&C sector

The HRE4 project identifies three main "pillars" (i.e. focus areas), which are especially critical to address in order to facilitate the transition towards a future low carbon H&C system:

Heat savings	District heating	Heat pumps
Heat savings can cost-effectively reduce the total heat demand in Europe by approximately 30-50 % [1]. Decarbonising the H&C sector requires energy efficiency on both the demand and supply sides of the sector, as it is able to generate similar levels of savings in energy and CO_2. **Target:** *Improve energy efficiency both on the demand and supply sides of the H&C sector.*	District heating (DH) can capture excess heat (e.g. from industrial facilities) and integrate renewable energy (RE) sources to replace fossil fuels. Currently there is more excess heat in Europe than all of the entire building stock heat demand. Cities can be supplied with 4^{th} generation DH based on proven technologies (e.g. large heat pumps) to utilise such excess heat and/or RE sources. Additionally, heat synergy effects can be further magnified when combining DH with district cooling (DC) for improved whole-system efficiency. **Target:** *Increase the share of DH considering its ability to facilitate the integration of different sectors, as well as utilising various excess/RE heat sources.*	Heat pumps are able to effectively link relatively cheap RE electricity production (from sources such as wind and solar) with efficient RE based heat production. Individual heat pumps should supply the majority of the heat demand in lower heat-density areas, typically outside of the towns and cities. **Target:** *Deploy widespread use of heat pumps – large scale within DH networks and individual ones outside of DH areas.*

Stakeholders are faced with several barriers standing in the way of realising the above-mentioned targets. However, across Europe, various activities are ongoing to address these barriers and many of them are completely replicable. This report describes realised examples of how such barriers have already been addressed and overcome in practice, and provide hints as to how these solutions can be readily replicated in other countries.

3. Known barriers for the uptake of HRE4 recommendations

Different barriers stand in the way of the above-mentioned targets. Some of the main non-technical ones are listed below – each grouped within three overarching categories: Knowledge, Economic and Process.

It should be noted that any given barrier does not necessarily relate exclusively to the category where it is listed below – instead, the authors have sought to classify them only along their more dominant characteristics for the sake of readability. Likewise, most barriers are in one way or another applicable for multiple pillars mentioned in section 2, even if they have been worded here in a way that makes them primarily appropriate to only a single pillar. Finally, the authors wish to emphasise that the examples below constitute a non-exhaustive list of barriers [2].

Knowledge barriers

Awareness, uncertainties, general knowledge about technology/solution, etc.

- Building owners, and even contractors, are often **unaware of (innovative) best practices**.
- Though building owners are responsible for final decision-making, they are often unable to adequately evaluate different options, and instead are forced to just **rely on the contractors' suggestions**.
- Use of life-cycle costing or other long-term decision-making tools are rare in this sector and the **true costs** of measures and energy use often remain unknown.
- Uncertainties and a gap between the perceived and actual energy savings cause building owners not only to have **unrealistic expectations** about individual measures, but also to **underestimate the savings** potential for comprehensive measures.
- **Energy use is invisible**, in particular H&C, and the consequences of its use are not always so obvious or concrete for residents.
- A lack of **transparency** about energy use and its costs prevents individuals from determining how and where energy is being used/produced, along with how best to reduce their own consumption or switch H&C systems.

Economic barriers

Prices, expenses, financing sources, investment types, feasibility, etc.

- Energy prices do not adequately account for externalities (i.e. **social and environmental costs**), even when including energy taxes – therefore, decisions based on cost calculations from current energy prices do not reflect

true costs, both from an individual and societal perspective.
- Investment in many H&C measures often require **large amounts of upfront capital or financing.**
- Upfront **investment costs are given disproportionate weight** in decision-making, leading to decisions that may be more costly in the long run compared to other costs (e.g. operations, maintenance, fuel prices, etc.)
- Most markets lack clear price signals incentivising energy savings or alternative H&C systems.
- Local government **budget constraints** mean they cannot often invest in large projects, much less support citizens adequately.

Process barriers

Relationships, interactions, process-specific and/or organisational challenges, including framework conditions

- **Split incentives** abound, even within owner-occupied houses – goals and incentives are not the same for those who invest in measures and those who reap the benefits.
- Involved parties often have a variety of **motives for their behavior**, and rarely do these motives align to deliver the best energy performance.
- Most **public procurement** processes favor the lowest price, in some countries having a negative effect on the final energy efficiency or the choice to switch to alternative H&C systems.
- **Fragmented value chains suffer from** multiple professionals and/or companies often being unaligned with each other since they are involved in different stages or decision-processes.

4. Examples of how barriers have been tackled

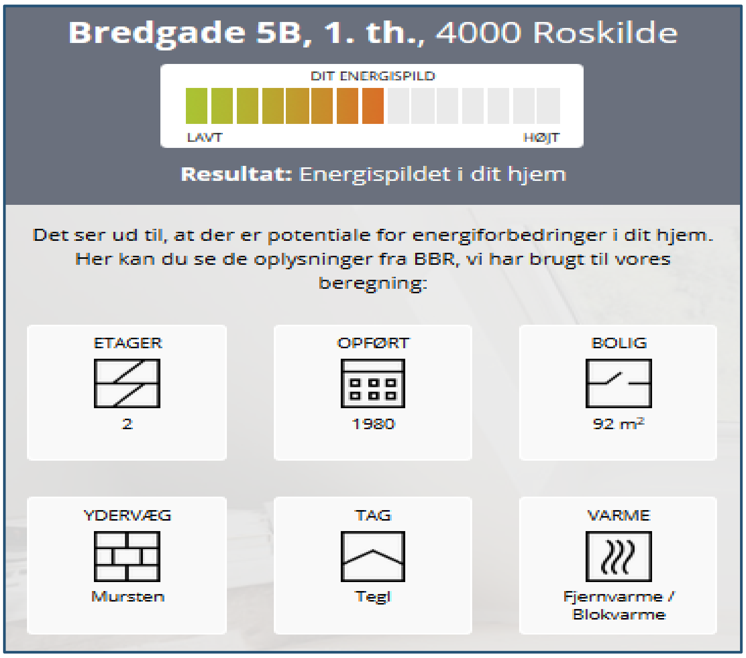
Four cases are described below, each addressing some of the challenges described above, and all having their own high replicability potential. The following points are included for all:

- Quick project facts as introduction
- General description of the case
- Business model/strategy
- Motivation for stakeholders involved
- Barriers addressed
- Replicability potential
- Links to further information

4.1. Activating a slumbering demand for deep energy renovations

One-stop-shop model supplying a deep energy renovation package

- Location: many localities nationwide across **Sweden** and **Denmark**
- Pillar(s) addressed: **heat savings**, though possibly applicable to other pillars
- Barriers addressed: **knowledge** (general information, uncertainty), unclear **processes** (fragmented value chain)
- Stakeholders involved: Industry, SMEs, financial institutions, local authorities, local professionals (e.g. installers, architects, engineers) and consumers



The boxes at the bottom indicate the number of floors, year of construction, living area, outer wall type (e.g. bricks), roof type (e.g. tile) and heating solution (e.g. DH/block heating). The information is based on a nationwide database of building properties.

Figure 1. Screenshot from the BetterHome website (here in a Danish version) for a sample address and a bar representing the preliminary estimation of its energy waste in the home, on a scale from low to high. [3]

4.1.1. General case description

BetterHome is a one-stop-shop solution coming entirely from a commercial initiative. Four major Danish building manufacturers, *Danfoss* (building technologies and appliances), *Velux* (windows), *Rockwool* (insulation) and *Grundfos* (system pumps) have initiated the model together. The four companies join forces with (local) building professionals (installers, engineers and architects), as well as with financial institutions, utilities and local governments, in order to offer a comprehensive renovation package to the customer. The model applies a holistic approach, which requires the active involvement from most stakeholders on the renovation market. *BetterHome*'s services are available to customers in both Sweden and Denmark. The consortium is expanding its market quickly and already manages around 200 renovation projects per year, mostly single-family houses in Denmark, with just a relatively recently launch in Sweden. The majority of these projects are considered to be ‘deep’ renovations resulting in energy savings of 50-70 %.

The model activates a demand for energy renovations in the residential sector by guiding the building owner through the entire renovation process. These well-known brands, and their thorough training of (local) installers, ensure a high quality of the result. By doing the renovations in such a manner, strong trust in the process is built. *BetterHome* is essentially reconstructing the renovation process, reducing fragmentation of the supply-side and mismatched expectations of the final result. The model’s success can be explained by the training of its installers and an innovative online application, guiding the installer throughout the whole process, while also ensuring a smooth experience for the building owner.

4.1.2. Business model/strategy

To boost demand for renovation, the model combines other incentives (such as comfort, aesthetics, value of the building etc.) with energy measures. Installers are trained to build a positive and trustworthy relationship with customers, as well as to increase their awareness of the multiple benefits of energy renovations. By highlighting other aspects (i.e. having a comfortable and healthy home) instead of only the potential energy savings (which is often a somewhat-abstract concept for building owners to grasp), building renovations can appeal better to residents’ more immediate concerns. Therefore, it could have a greater potential to actually compete with other types of investments (such as a family vacation or a new car) which residents often prioritise over energy measures.

The model is designed to handle two of the largest barriers to investments in energy renovation: awareness and trust in the construction sector. Though many Europeans, especially across Scandinavia, tend in general to be aware of the importance of reducing their own climate impact, few fully understand the role their building plays in this, and even less so about which measures should be implemented. The *BetterHome* model helps remove all such intermediaries and minimise the burden on building owners.

4.1.3. Motivation for stakeholders

The *BetterHome* one-stop-shop model is seen as an effective tool to increase demand for deep (energy) renovations, which increases the market share and revenues for the industry partners, as well as to the small/local businesses (engineers, architects, installers) and financial institutions involved in the process.

A boost in deep energy renovations is a win-win-win situation, for the economy, the environment and the people:

- A clear economic interest exists not only from the industry and SMEs, but also from politicians, to see an increase in energy renovations. Even though some companies cover more than one country (as in this case), the model also engages local professionals, thereby creating local jobs, often a focus point for local authorities, while contributing to speeding up the economy in general.
- A thorough decarbonisation of the building sector requires that renovations are deeper and proceed at a faster rate in order to make significant environmental impacts, which are of course instrumental to meet EU and national climate and energy targets.
- There is also a social component tied to this model. With a high share of energy poverty and health issues related to bad indoor air quality, deep renovations can both reduce energy bills and create healthier living environments for the residents.

4.1.4. Addressing the barriers

4.1.4.1. Knowledge barriers

Home owners are responsible for the decision-making regarding building performance measures. Building owners may in general receive a lot of advice and information (not all of which is accurate or suitable for their specific building), leading to difficulties in evaluating alternatives. Therefore, they often have no other choice than to rely on the suggestions from contractors and other craftsmen, which has a risk to be one-sided and/or inadequate, increasing uncertainty and lowering the overall trust in renovation works and energy efficiency.

BetterHome guides building owners through the whole renovation process, reducing the uncertainty-threshold to invest. The owner can simply insert their own building information onto the website and retrieve an estimation of energy-saving potential, possible measures and a cost estimate. This information is later confirmed and adjusted after a house visit by a *BetterHome*-trained professional. The model gathers together all relevant information and packages it nicely as an appealing package for building owners.

Building performance may be too complicated for building owners to know what to expect, which lowers their willingess to invest. The *BetterHome* model guides the customer throughout the entire proocess and provides them with easily-digestible information that enables an easier decision-making process. Furthermore, *BetterHome* is funded by four well-known building manufacturers. This lowers uncertainty about the quality of not just the products, but the whole process. In short, *BetterHome* reduces uncertainties for the building owner through tailored advice.

4.1.4.2. Process barriers

Fragmented construction value chains with multiple professionals involved at various stages, often working on different timeframes or even at cross-purposes, typically characterize most renovations. The renovation market is supply-driven, which can lead to a mismatch between the offered products and the end-users' needs. Many customers see high operating costs or a poor living environment as an acceptable alternative to a time-consuming, disruptive and risky renovation process. Too many interests and actors tend to make the process overly complex and time-consuming for building owners.

The *BetterHome* model creates a lean process by harmonising the multiple actors and activities, resulting in a better process to the customer. Building owners only have a single contact point for the whole renovation and do not have to worry about the process' effectiveness. The threshold to invest is reduced by making it simpler for customers.

The model also structures the renovation process for installers, including guidance, training, support and clear deadlines. The online application minimises extra work for installers, helping them to plan their work. What the installer is expected to do in each of the five steps (illustrated below), are clearly outlined, from the approach in the first call to the finalization of the project.

Figure 2. The five steps of BetterHome's "renovation journey"

4.1.5. Replicability

The model could be replicated in other countries if a similar group of companies are able to work together, supplying the model to the local market. Besides this, the *BetterHome* consortium may be interested in expanding their own markets to other countries as well, since they are each already represented on the international market separately. The *BetterHome* organisation may also choose to incorporate addtional local brands in order to make inroads into new markets.

Furthermore, it should definitely be noted that the core model (i.e. gathering strong market players to work together with local professionals in supplying a complete, easily-accessible/comprehensible package for customers) is hardly a model that must remain limited only to building renovation measures. A similar strategy could be applied to any of HRE4's three pillars described in section 2, or even crossing pillars for that matter.

4.1.6. Further information

- www.betterhome.se / betterhome.today
- www.danishenergyassociation.com/Theme/BetterHome.aspx
- guarantee-project.eu

4.2. Creating synergies across a large urban region

Expanding and interconnecting DH networks, and combining it with DC

- Location: **Milan** in **Italy**
- Pillar(s) addressed: **district heating**, **heat pumps**
- Barriers addressed: **knowledge** (awareness), **process**
- Stakeholders involved: Local authority, local energy utility and consumers

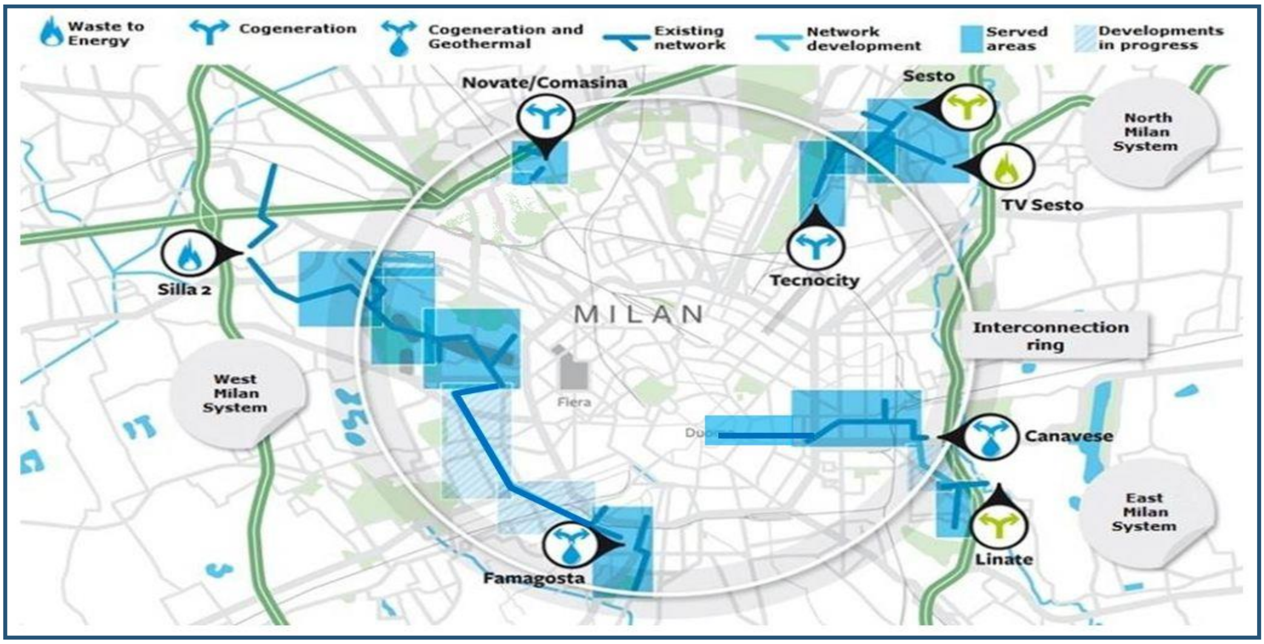


Figure 3. Interconnection status and plans for the different networks in Milan [4]

4.2.1. General description

Milan is faced with a high number of polluting diesel-fuelled boilers used for all kinds of heating purposes (residential, tertiary and industrial). To combat this, Milan and the local electricity and gas utility company *A2A* have invested in combined heat and power facilities (CHP) for DH, and partly also for cooling. Additionally, there are investments to recover the heat from an incineration plant ("Silla 2" in Figure 3) and that of an aquifer thermal energy storage (ATES) combined with a 15 MW heat pump.

After a period of great expansion, the city is now connecting its major DH networks together to increase their flexibility. Besides this, an expansion of the 11 km DC network is also planned. All these objectives are part of the city's emissions reduction plan and are integrated into their Sustainable Energy Action Plan (SEAP) as well as in its general urban planning. In 2014, the DH network consisted of 136 km of pipes providing about 714 GWh of heat, and 3.5 GWh of cooling power. The goal is to reduce emissions to 20 % below 2005 levels by 2020, when the DH network is supposed to serve even more demand (1180 GWh heat per year). The main DH networks in the city are the following (see also Figure 3):

- Gallaratese/San Siro, powered by the *Silla 2* waste-incineration plant, and the Milano Sud network, powered by the CHP and the groundwater *Famagosta* heat pump plant. These two grids were connected in December 2014, extending the outreach of the network over the whole western area of the city, and enabling a more efficient use of the heat produced by *Silla 2*.
- The Città studi/Tribunale district, powered by the *Canavese* plant, which is a combined CHP and heat pump plant, and the Santa Giulia/Mecenate area, powered by the CHP plant *Linate*. These two grids have been connected since January 2015 forming a large DH network serving the eastern part of Milan.
- The Bicocca district, powered by the *Tecnocity* plant, consists of a CCHP (trigeneration) plant that also provides heat for certain suburbs bordering the northern part of Milan.

By connecting its DH networks, the required total peak load capacity is reduced. One example from Milan, is the divestment of 6 gas engines with a total capacity of 18 MW and entry into operation of heat recovery by a heat exchanger from a glassware production facility of 5 MW.

4.2.2. Business model/strategy

With *A2A* as investor, the installation of the plants and the grid does not imply any major costs for the city – except staff time to collaborate on ad hoc activities with the utility, help citizens and facilitate the process in general. This way, the model makes the uptake of district heating and cooling (DHC) possible without significant monetary investment for the local government. The local authority grants concessions to *A2A* every year for underground use, thereby also creating a revenue stream for the city.

With the high heat-demand density and various energy sources available, the cost of DHC for customers can be kept competitive in comparison to alternative technologies, while still being profitable for *A2A*. As in most other DH systems, the customers pay a connection fee to join the DH network, in addition to rates for the energy consumed. This varies according to the location and the size of the household. A high acceptance and satisfaction among citizens are ensured through continuous quality controls, information-sharing and public consultations.

4.2.3. Motivation for stakeholders

The city achieves cleaner air for its inhabitants and complies with its environmental commitments by facilitating further development of DHC through close collaboration with the *A2A* and providing urban planning with a focus on measures to reduce GHG emissions.

The local utility has found a business model where they are able to attract customers to achieve enough income to counterbalance the large investments required (about 200 million EUR spent by *A2A* during 2008-2013 just for expanding and linking the networks).

While the offered solution cannot be much more expensive than an existing solution for the customers, significant non-economic arguments are also present, such as contributing to cleaner air/less GHG emissions, avoiding maintenance costs on their heating/cooling system (since this is now provided by *A2A*) or reduced risk of fires in the buildings (from since-removed boilers).

4.2.4. Addressing the barriers

4.2.4.1. Knowledge barriers

Citizens may be uncertain about the benefits of the different available energy solutions – or even their existence/possibilities. The city has invested in awareness-raising activities through the creation of an energy help desk (*Sportello Energia*) [5] where citizens can get free advice on different energy-saving solutions including DH. Furthermore, *A2A*'s website publishes regular updates on the DH network development to keep residents informed. Also, the website hosts a "direct line" section, which allows current and potential DH customers to ask questions about contractual terms and conditions, and receive technical support online.

4.2.4.2. Process barriers

The municipality has supported DH network development with enabling legislation and urban-planning instruments, and has guaranteed this political commitment by signing the Covenant of Mayors (2008) and Compact of Mayors (2015), giving DH a strategic importance in its broader CO_2 reduction targets. As an example of facilitating the process, the city has created a shared database to integrate the various public construction, including DH development, so that different infrastructure providers can work simultaneously and inconveniences related to traffic, noise, pollution, etc. can be kept at a minimum. Since all types of construction work disturb everyday life, especially if citizens are unprepared for the upcoming changes, *A2A* also sends out letters two weeks in advance to building administrators whose blocks will be affected, so that they and their occupants are aware of the potential inconveniences and can plan their own activities accordingly.

4.2.5. Replicability

The awareness-raising campaign carried out by the municipality and *A2A* has been very successful in making citizens understand the benefits linked to DH and has streamlined its uptake. DH through CHP or recovered excess heat is an already available, well-known and efficient technology. This means that the challenges are more linked to processes than the technology itself. A good collaboration between the utility and local government has resulted in a positive feedback loop facilitating awareness and a positive impression of the technologies in the public eye, thus making expansions much more palatable to citizens and easier to implement, thereby creating even more flexible DH solutions. For these reasons, this case likely has a high replication potential, though it should be highlighted that a sufficient building density and/or existing, exploitable heat sources should be present to attain such heat synergies, while a solid interface between urban planners and local energy providers is crucial as well.

DC can further increase whole-system efficiency, reduce electricity peaks in the summer and thereby further reduce GHG emissions. This is particularly applicable to new residential and tertiary buildings, though it is not as easy to apply in existing housing stock, because they normally do not have a centralised ventilation system.

4.2.6. Further information

- *A2A*'s activities in Milan, www.a2acaloreservizi.eu/home/cms/a2a_caloreservizi/impianti_reti/area_milano
- Heat Roadmap Europe tool to identify high-demand density areas and potential sources, Peta4[2], www.heatroadmap.eu/maps.php

[2] The Peta4 maps contain modelled heat demand at a 100 by 100 m resolution. Amongst other features, it includes a layer showing city areas where DH systems exist, and a database of modelled sources of excess heat supply.

4.3. Fast track heat pump roll-out

Heat pumps installed without high investment costs for the consumer

- Location: **Hylke** near Skanderborg in **Denmark**
- Pillar(s) addressed: **heat pumps**
- Barriers addressed: **knowledge**, **economic**
- Stakeholders involved: Local authority, energy-service provider and consumers

Figure 4. Picture from the school in Hylke [6]

4.3.1. General description

Best Green installs and maintains heat pumps for its consumer-clients, thereby selling heat as a service, instead of selling them the heat pump itself. The case of Hylke includes 11 clients ranging from public buildings, to private households and businesses. The setup is somewhat similar to a DH solution, where the customer pays a one-time connection fee (relatively small compared to the costs typical for a complete heat pump investment) and afterwards pays a mix of a fixed annual fee and for the heat actually used.

The electricity used in public and commercial buildings is certified wind power and the project has phased out approximately 30 % of the oil consumption in Hylke and in nearby areas, which have no access to DH.

All installations are Smart Grid ready. For all installations, the electricity consumption and heat production are measured and logged every 5 minutes. In the self-developed software, the data is recorded in order to monitor the performance of the heat pump (COP). This procedure enables *Best Green* to react immediately if one of the heat pumps does not perform as expected.

All installations are air-to-water heat pumps mono-block unit (*Stiebel Eltron* and *Nibe*):

- A school is equipped with a *StiebelEltronWPL23E* cascade system. The heat pump system has, after the first year in operation, covered the entire heating requirement with a measured COP of 3.2.
- A golf club and supermarket have each installed a *NibeF2300-20*. The supermarket uses the excess heat from the existing cooling installation thus reaching a COP of 3.3.
- Eight private households have installed *NibeF2040-8/12* systems reaching a COP of 3.0.

4.3.2. Business model/strategy

The business model focuses on continuous income from their customers rather than a one-time profit. In case consumers choose to disconnect, the used heat pump can be installed elsewhere, thus minimising the costs for *Best Green*.

The general and replicable business strategy is to move the focus from only one-time sales to include subscriptions, that is from selling products (including installations) to a continuous income from varied, long-term and attractive services.

Similar approaches could especially be relevant for saturated markets, such as where heat pumps could still increase their business activities by supplying the (mandatory) service check of heat pumps rather than focusing only on selling and installing the heat pumps.

4.3.3. Motivation for stakeholders

The implemented solution has enabled private and public consumers to save money on heating while reducing CO_2, without having to carry the investment cost burden of their own heat pump installation. In addition, it has helped local communities to stay "green" through the implementation of innovative and effective heating solutions in public, private, industrial and commercial buildings.

The town of Hylke has gained savings of more than 20000 EUR on its annual heating bill while reducing CO_2 emissions by 100 t yearly. The school alone saves 10000 EUR per year.

To ensure the community's involvement, an info-screen was placed in the school's common area to continuously display updates about heat consumption, indoor climate and the environmental impact of the school.

4.3.4. Addressing the barriers

4.3.4.1. Knowledge barriers

The municipality supported the roll-out of the solution with an awareness-raising campaign (e.g. the info-screen in the public area of the school), but the best communication impact has been through the private customers themselves further promoting this solution in their own neighbourhood. It has been similarly shown in many other cases that word-of-mouth among peers and neighbours is one of the most effective ways to promote a good solution, although it is also just as effective in blocking a (perceived) poor solution.

4.3.4.2. Economic barriers

The *Best Green* solution addresses the two primary barriers related to investments in new green heating installations: initial investments and operating expenses. *Best Green* sizes up, finances, owns and operates the heat pump facilities and infrastructure. The building owner owns and accounts for the part of the installation inside the building, which covers the storage tank, central heating system, thermostat, etc. Furthermore, the building owner pays a fixed price for the heat (per MWh) and a yearly fee covering maintenance and service of the heat pump.

4.3.5. Replicability

This solution is fully applicable within (and outside) other towns and cities with no DH, where the aim is to ensure the utilisation of RE electricity through flexible electricity consumption. By mid-2017, *Best Green* had, for example, applied this same solution to 13 different schools.

With the aim of reducing GHG emissions and especially phasing out oil boilers, the *Danish Energy Agency* has decided to promote this solution's roll-out. More companies providing a similar service have been invited to join this market (to increase the deployment speed) and a similar setup has been launched for larger heat pumps targeting industries. This is done by supporting a fraction of the heat pump investment for the companies' first clients in a start-up phase (maximum of approximately 2700 EUR and 13400 EUR for the "small" and "large scale scheme" respectively, gradually reduced once the number of clients increase). However, the solution has already shown to be sustainable for *Best Green*. The *Danish Energy Agency* schemes are an attempt to boost the market and speed up deployment (by introducing more players in the market[3] and initiating the separate "industry version").

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[3] The 5 companies are *Best Green*, *Greentech Advisor A/S*, *OK* a.m.b.a., *SustainSolutions* and *Verdo Go Green*.

The model is not linked to specific barriers/framework conditions in the country and should therefore also be applicable outside Denmark.

4.3.6. Further information

- www.bestgreen.dk (in Danish)
- How to implement the business model, described above (in Danish): ens.dk/sites/ens.dk/files/Energibesparelser/drejebog_til_implementering_af_forretningsmodel_til_salg_af_varme_fra_individuelle_varmepumper.pdf

4.4. Energy saving partnerships

Shared energy-performance contracting as a budget-neutral approach to improve buildings, reduce energy/water use and increase operational efficiency

- Location: **Berlin, Germany**
- Barriers addressed:, **knowledge**, **economic**
- Stakeholders involved: Financial institutions, ESCO (energy service company) and local authorities

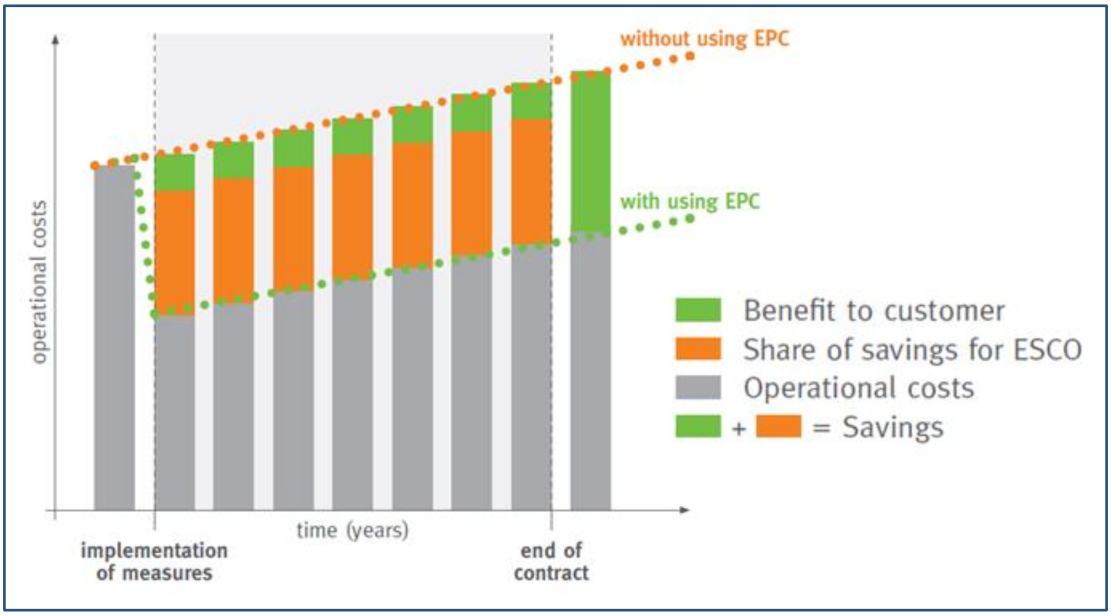

Figure 5. Indication of how the savings created can already benefit the customer as soon as the shared Energy Performance Contract (EPC) is signed [7]

4.4.1. General description

The *Energy Saving Partnerships* (ESP), developed by the *Berliner Energieagentur* and *Berlin's Senate Department for Urban Development*, is an ESCO making use of an alternative model for Energy Performance Contracting (EPC). The *ESP* in Berlin aims to renovate the city's public buildings. While typical ESCOs make the necessary investment upfront and take the full financial risk, and then are re-financed through all the savings in energy costs for a certain time period, the ESCO only takes a majority of the cost-savings, over a bit longer time period.

The cost savings are shared between both the ESCO and the building owner. This way, the building owner derives profits, and so does the ESCO. As project manager, the *Berliner Energieagentur* has successfully launched and accompanied 25 *ESPs* with 1300 public buildings and more than 500 properties in Berlin alone since 1996.

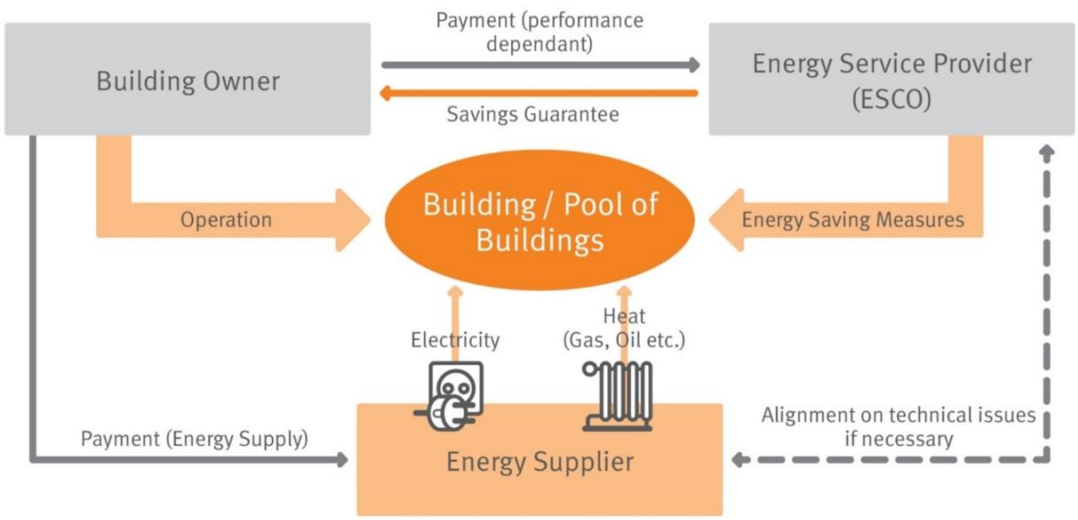

Figure 6. Principle sketch of the EPC setup [7]

4.4.2. Business model/strategy

From the ESCO's point of view, the strategy is to share part of their revenue with the clients, thereby attracting more customers – they are essentially making an "investment" in order to increase their market share. Their solution differs from many EPCs, where the owners often only reap benefits at the end since the ESCO recoups all "profits" for its own expenses first and foremost. Despite the slightly longer contracts, the *ESP's* sharing principle ought to be more appealing to owners who will be offered an immediate benefit, instead of having to wait for their reward. However, also an option of a shorter contract period is possible from the *ESP*, thus applying all savings to the ESCO, but in a shorter timeframe before the building owner can retreive all savings onwards.

4.4.3. Motivation for stakeholders

Several different stakeholders benefit from this setup:

- Authorities need to increase the renovation rate to meet energy and climate targets.
- An economic benefit can be achieved for the building owner from year one.
- Financial institutions gain additional loans/partnerships.
- Increasing investments in energy efficiency generates local jobs and possibly boosts the overall local economy.

4.4.4. Addressing the barriers

4.4.4.1. Knowledge barrier

Building performance can be a complicated field, even for the experts. In many cases, building owners have unrealistic expectations about individual measures and underestimate the potential savings from more comprehensive measures (i.e. deep renovation). Questions about best practices for a specific context or building regulations often discourage building owners from pursuing energy efficiency themselves. With this model, the building owner is provided with an overview and guarantee of the economic savings as part of the EPC, thus avoiding the uncertainty if a renovation will cut the energy bill by an expected amount.

4.4.4.2. Economic barrier

A large upfront cost for energy efficiency investments is often mentioned as one of the biggest barriers. Compared to investing in the energy-savings measures, the building owner is in this case ensured an energy reduction by the ESCO paying for the renovation and is compensated by a part of the savings in a specified period of time.

4.4.5. Replicability

The model is not limited to Berlin or Germany, and since it is not restricted to specific framework conditions, it should be replicable in other countries as well. It has already proven to be replicable due to a high number of examples, as mentioned in section 4.4.1, and has already been a success also in Leipzig (Germany) and Vienna (Austria). These cities are supporting *ESPs* from concept-planning of projects to the realisation of energy-saving guarantee contracts that have already been tested in practice.

The solution in this case differs from traditional EPCs, where a benefit for the building owner is only achieved at the end of the contract. A mix of these is also possible, as seen in the case winning the 2017 *European Energy Service Award* (EESA) in the category of *Best Energy Service Project*[4]. Here the calculated savings are fully paid to the ESCO, thus leaving the building owner with an unchanged bill for the first ten years. However, if the actual savings are larger than what was expected, the ESCO and the building owner share the profits, whereas, if they are smaller, the ESCO is not compensated at all. [8]

Several EU funds support initiatives like this, such as the *Structural Fund* (ERDF) and the *European Fund for Strategic Investment* (EFSI).

4.4.6. Further information

- *Energy Saving Partnerships*: www.berliner-e-agentur.de/en/consulting-information/energy-saving-partnerships-berlin
- *ERDF*: ec.europa.eu/regional_policy/en/funding/erdf
- *EFSI*: www.eib.org/efsi / ec.europa.eu/growth/industry/innovation/funding/efsi_en
- EPC market in Europe: www.transparense.eu/eu/home/welcome-to-transparense-project

[4] EPC project by *Siemens*, guarantee-project.eu/eesa-2017-in-pictures/winners-2017.

5. References

[1] "Low-Carbon Heating and Cooling Strategies for Europe – Final Publishable Report of the EU-funded project STRATEGO", page 14, stratego-project.eu/wp-content/uploads/2014/09/Stratego_Final_Report_download.pdf

[2] Builds on BPIE research and compilation by T. Adkins, "Overcoming barriers to energy efficiency retrofit measures in Swedish homes: An actor and policy analysis," Lund University, Lund, Sweden, 2011.

[3] BetterHome, BetterHome.today

[4] A2A, www.A2A.eu

[5] Help desk in Milan, www.comune.milano.it/wps/portal/ist/it/servizi/ambiente/energia/sportello%20energia

[6] Best Green, www.bestgreen.dk

[7] Michael Geissler, Berlin Energieagentur, Prsentation at EMA Network 22 November 2016 in Brussels. ec.europa.eu/energy/en/events/meeting-european-network-energy-and-managing-authorities-cohesion-policy-2014-2020

[8] Siemens as ESCO for Hvisovre Hospital in Denmark, www.energy-supply.dk/article/view/496967/europas_bedste_energirenoveringsprojekt_ligger_i_hvidovre?ref=newsletter&utm_medium=email&utm_source=newsletter&utm_campaign=daily

6. Abbreviations

ATES: Aquifer thermal energy storage

CHP: Combined heat and power

CCHP: Combined cooling, heating and power

COP: Coefficient of performance

DC: District cooling

DH: District heating

DHC: District heating and cooling

ESCO: Energy service company

EPC: Energy performance contract

ESP: Energy Saving Partnerships

GHG: Greenhouse gas

GWh: Gigawatt-hours

H&C: Heating and cooling

HP: Heat pump(s)

MWh: Megawatt-hours

RE: Renewable energy

SEAP: Strategic energy action plan

SME: Small and medium sized enterprise(s)