

# Shifts and optimisation of energy use through end-user involvement

Against the background presented above, this chapter tackles specifically the improvements enabled by the actions of the user. Here the user is not only the occupant of the building but it is also the individual that manages the HVAC system within the building. You will read about the optimisation procedure that has been developed in the [Gothenburg demonstrator called Climate agreement \(GO2\)](#) by the local energy company, Göteborg Energi. Furthermore related to this demonstrator, research within the Celsius project included interviewing owners of buildings located in Gothenburg. Hence you can read about the actual opinion of the user on their experience with a Climate Agreement (CA).

## Case study : Climate Agreement in Gothenburg, an energy efficiency service for end-users

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### Context of the DHN related services in Gothenburg

Here we provide some background and contextualization of our research, and describe what the Climate Agreement demonstrator actually is. Gothenburg is the second largest city in Sweden, situated on the west coast. 550.000 inhabitants live in the city and in bigger Gothenburg around 1 million people <sup>[4]</sup>. It has a coastal climate with mild winters that can be both windy and rainy with temperatures ranging between +5 to -5 degrees Celsius.

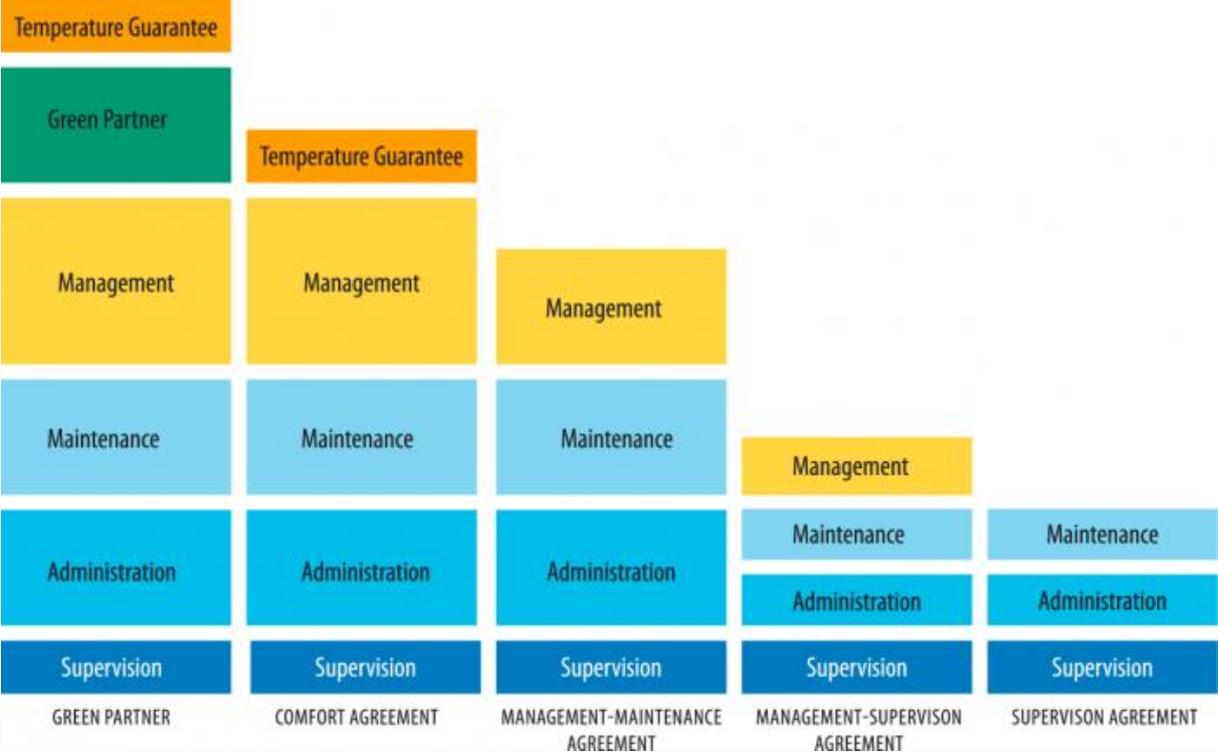


Figure 1. The five energy service agreements that are marketed by Göteborg Energi. The only agreements that offer a fixed/flat monthly price are Green Partner and Comfort Agreement ([Climate Agreement/ GO2](#)) To get the Green Partner Agreement a plan for how to reduce energy consumption by 25% is required. Apart from these five energy service agreements that include delivery of energy/DH, GE offers a plain

delivery agreement. Delivery agreement is common for large companies that manage their own service needs.

Göteborg Energi (GE) is the biggest energy supplier in the Gothenburg area. Göteborg Energi <sup>[5]</sup> delivers, as the only supplier, energy like heating, electricity, gas, energy services, cooling, renewable energy and telecommunication services to the region. It has a history dating back around 150 years. The company is 100% owned by the Gothenburg municipality. The company's vision of a sustainable Gothenburg permeates the entire business: "To manage resources sustainably and create a sustainable energy systems in the region are important cornerstones of our activities". This is also one of the reasons for the CA offer <sup>[6]</sup>.

The Gothenburg district heating system comprises around 1300 km's of piping. It is the second largest system after Stockholm area. There are five energy service agreements offered by Göteborg Energi, and Climate Agreement, also called Comfort Agreement, is only one of the service packages marketed to customers (see Figure 1 aside). The CA are described on the homepage <sup>[7]</sup>. However this information does not completely describe in detail what they are (marketing strategies, customer segments etc) therefore some inquiry was conducted to get a fuller picture, and in particular of the CA.

## Insights into the Climate Agreement marketed by Göteborg Energi

At the start some meetings mainly dedicated to the demonstrators of GE were conducted with Patrik Arvsell (February 2014), and then also with a few people from the Customer service department of Göteborg Energi (May 7, 2014). During summer 2014 an additional interview was conducted (July 10th) with Patrik Arvsell, project manager for Göteborg Energi in the CELSIUS project. This gave us insights into Göteborg Energi's strategy for approaching customers with the different types of agreements, when and why the CA was offered etc. Hereafter is a description of the data collected.

### **The service**

A Climate Agreement (CA) is a special type of district heating contract that is made with particular types of customers (see below). It has been available since 1995. The CA provides energy to customers with security of a standard indoor temperature (21C , at this temperature, a temperature rise of 1 degree increases energy costs by another 5-7 % <sup>[8]</sup>) throughout the year. This contract also includes the following:

- personal service,
- various levels of technological investigations and analyses,
- improvement suggestions and measurement installations,
- maintenance, and
- other solutions to the current complexity of optimizing the district heating systems in the customer's building(s).

It lasts between 3 and 5 years. Currently there are around 100 CA contracts, an estimated 10% of all customers in the Gothenburg area. From the other 90% of the buildings 50% could gain from getting a CA. The 90% could for example consist of larger building companies with their own personnel and technical systems to monitor and optimize energy usage. Others are large commercial buildings that have big ventilation systems with either a need of cooling instead, or where it could be difficult to keep 21 degrees Celsius. Around 40% of the 90% consists of housing cooperatives too small to gain economically from a CA <sup>[9]</sup>. Once the contract is signed, GE starts to analyze the situation and radiator system, and makes adjustments. Thereafter GE makes temporary installations of temperature sensors to learn about the building's thermal behaviour and thirdly, vaults may be installed in the DH system to optimize heat in the entire building/all apartments. These costs of adjustments and optimization are built into the contract, and thus the costs broken down to be included in the monthly fixed rate. The customer invests namely in pumps, alarms, the data system and computers. When the CA period is completed the customer owns the entire system. If the customer, for financial reasons cannot pay for the technical installations needed Göteborg Energi may give a loan, and adds a monthly instalment in the agreement. Two annual check-ups are included, as well as two personal annual

information meetings with the company/the board of the housing cooperative, where the findings are discussed based on the calculated figures. According to GE it takes around one year to adjust a building <sup>[6]</sup>.

### ***Marketing Strategy***

GE offers CA to customers based on annual billing costs, building size, energy performance and efficiency. Cost reductions and energy savings can be made for owners with district heating energy costs exceeding 300 000 SEK (around 32-33 000 EURO). The sales pitch is long; it may take 6 to 12 months for the building owner to decide on a contract. A building company has to prioritize between other (maintenance) costs and investments and compare with energy costs/savings <sup>[6]</sup>.

Before 2013 there were appointed CA sales persons that approached this customer segment with different marketing events (300 housing cooperatives could be invited to such information events where demonstration stations are displayed. Around 25% attend and around 10 will sign a contract.) <sup>[6]</sup> and with a very personalized and individualized contact<sup>[6]</sup>. Since 2013 GE has made organizational changes. Instead of the divided sales organization with appointed sales people only dealing with CA customers and another part dealing with the other four energy service agreements, there are four sales people selling all five agreements, and there are no longer any CA-focused sales events.

Göteborg Energi has started to market Climate Agreements to other Swedish cities and now cities with municipal energy companies like Helsingborg, Lund, Jönköping use the concept as well as Öresund Energi<sup>[6]</sup>. It may work for any energy company and presumptive companies marketing services for energy savings.

### ***Reasons for signing up and gains with the Climate Agreement offer***

For the energy supplier (GE) this contract is a way to extend their customer service, and connect more buildings in order to extend their market share. GE can also control and manage energy peaks of the buildings. The reason at all for GE to market the CA is that they will sell less anyway and the incentive is to be able to sell the service agreements and thereby control more. Also, if GE does not market these energy services other companies will, and also do. However, only Göteborg Energi can offer the entire Climate Agreement – both energy supply and service.

The benefit of energy savings for end-users is calculated to be between 15 and 50% depending on the type, size and age of the building. CA gives the customer a monthly flat rate and thereby possibilities to control energy costs. Another customer benefit is that GE supports the building owners in the complex process of energy saving improvements and optimizations such as (suggestions for and implementations of) technical improvements and installations of the building and the DH system <sup>[6]</sup>. In the long run, if for example a 2nd (or 3rd) CA is agreed upon, the energy costs should decrease due to the improvements made and the risen customer awareness of energy use and costs.

The CA is a shared risk taking for both parties that usually pays off for both. The common story is that CA gives a lower price, and an even temperature in all parts of the building. This can be compared with the former situation; without improvements and optimizations the temperature is commonly higher and uneven in the building, and also fluctuating depending on outdoor weather/temperature. Thus, a Climate Agreement could be viewed as an acceptance issue rather than a behaviour issue.

## **End-user efficiency strategies with Climate Agreements**

### ***A diverse sample***

Here we have collected individual and detailed stories of end-users that illustrate how they manage the heating system in the building, and in Sweden typically the building owners are responsible for this. We are focusing more on collecting stories of end-users and their experiences of district heating rather than defining general patterns or any efficiency indicators, since our aim is to understand the optimization process of district heating from an end-user perspective.

The goal of this research is to get an understanding of how different types of end-users manage and control the heating system in the buildings, and the benefits and omissions of CA for them.

Research questions: What service elements are offered in the Climate Agreement, and what are the reasons for a customer to choose the Climate Agreement from Göteborg Energi?

The research consisted of two parts, which will be reported on in the next subsections. Firstly, we analyzed the Climate Agreement and its elements which have been described in the previous section also.

Secondly, we interviewed five building owners in Gothenburg with different types of ownership. For our selection of the interview participants, we started out with defining different types of organizations in the Gothenburg area and how they manage the heating system in their building. With help from Göteborg Energi we defined three types of actors for the research into CA: 1. Private building owners. These organizations own multiple apartments or buildings and have the responsibility for managing the heating system. 2. Management organizations for private building owners. Building owners can outsource certain activities to these organizations, like management of the heating system. Typically, they have an administrative and advisory role. 3. The Swedish form of housing cooperative called 'bostadsrättsförening' which is a formal organization of several individual private (apartment) owners, that has (a collective) responsibility for managing the heating system (as well as other services for the building).

We have interviewed one large and one small private building owner (category 1), one middle-sized management company (category 2), and two housing cooperatives 'bostadsrättsföreningar' in Swedish (category 3). The respondents were selected because they had chosen a climate agreement for optimization and management of their building, apart from one large building owner, which is Stena Fastigheter. We interviewed Stena Fastigheter since they manage optimization of the heating system in their own buildings without any agreement with Göteborg Energi. However, the Stena representative is the energy and environmental department manager and has 25 years of management in building and construction, and 15 years of working experience at GE where he worked with the CA. We approached the actors with a semi-structured questionnaire, see Appendix A in Celsius deliverable 5.2 **upload file add link to the file.**

### **Strategies of building owners with CA**

From our first analysis reported in the previous section, we have defined elements within CA that are related to different types of optimization that actors referred to, eg financial- or production-related, maintenance issues, etc. Table 1 shows the optimisation options for different actors, and elements in the Climate Agreement that they relate to. Furthermore, the table highlights elements that are not addressed by CA.

**Table 1 - Overview of functionalities in Climate Agreement Göteborg Energi (29GOe)**

Type of end-user (1,2,3*)	Optimization type	Elements within CA
all	System functionality	GE optimises system
1 and 3	economic efficiency	Options for sharing risks (e.g. cold winters)
all	Maintenance of the system	GE controls the system

all	knowledge transfer efficiency / environmental aspects	Information seminars for building owners (not running currently)
1 and 3	Change in residents' behaviour	-

\*1. Private building owners, 2. Management organisations for private building owners, 3. The Swedish type of housing cooperative called 'bostadsrättförening'

This overview shows that most of the optimization types needed by building owners are offered in CA, and that only the management company does not make use of all of them, since it is the building owners that sign the contract. The management company merely advises them to choose the CA contract. The behavior change of residents, for instance to influence opening doors and windows and the use of hot water, is not addressed in CA. This is a form of optimization that the interviewed building owners address themselves in some cases. Furthermore the reasons for choosing CA are listed for the different actors that were part of the interviews, see table below. Here, we present reasons for actors to place the control of heat management at Göteborg Energi, see also Appendix B for background information of the individual participants.

**Table 2 - Overview of CA actors and reasons to take on the Climate Agreement Göteborg Energi (29GOe)**

End-user related reasons for choosing CA Göteborg (GO2)	Private building owners (multiple appts/buildings)	Management organisation for building owners	Swedish 'Bostadsrätt förening' organisation
Reduce high costs through optimization system	✓	✓	✓
Easy financial accounting	✓		✓
Even out/lower T in building	✓		✓
Energy company takes responsibility for system	✓	✓	✓
Clear T expectations residents (less complaints)	✓		

This overview shows that the reasons for choosing CA are mostly of a technical and financial character. Comfort of residents is a difficult factor, since in some cases buildings are heated (too) high up to 23 degrees Celsius before the CA is implemented. Temperature is lowered to 21 degrees after CA has been implemented, which in some cases led to more complaints from residents. However, as one private owner organization mentioned, there is great value in being able to communicate a clear policy on the height of the temperature at the beginning of a new rental contract to establish the right expectations from tenants. Also, for a housing cooperative the CA is a compelling argument for owners to reduce the temperature in order to reduce the dwelling fee.

## Acceptance of variation in indoor climate

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In this research we have identified a number of ways to increase the acceptance and effects of the

CA. This is based solely on our research findings, which should be considered as contextualized research that cannot be generalized. However, they can serve as examples to illustrate the potential of end-user related strategies for energy efficiency.

The story of Göteborg Energi shows that it is certainly possible to extrapolate the idea of providing this type of service to other customers. Göteborg Energi is now offering the CA as a concept to other cities (municipally owned energy companies) in Sweden, and possibly the offer could go to other Celsius cities in Europe, as well as to other energy related companies that offer this type of service. The results from a recent Swedish national research program Fjärrsyn [\[9\]](#), whose goal was to generate new knowledge for the Swedish district heating industries and with improved tools for competitive business models, shows the importance of and potential in improving customer dialogue and relationships. The industry has to develop to retain its strategic diligence. The conclusions of the research suggests a similar customer approach/business model to the one that Göteborg Energy offers with their CA. There are other examples illustrating how private building owners manage this type of service themselves, as the interview with Stena Fastigheter and their optimization process show. In the case of Stena Fastigheter, the owner has installed and maintained an ICT system consisting of permanent installed sensors and individual metering that allowed them to establish clear expectations from residents on the temperature level from the beginning, and to have individual billing for residents.

The story of one of the housing cooperatives showed us the importance of illustrating the financial cost reduction that is possible by reducing the heating demand, even when there is no individual billing. By negotiating new terms in their second Climate Agreement, based on the lowered heating costs, a lower dwelling fee was possible, which was evenly split over all residents of the building/cooperative. Other stories, like the two housing cooperatives have provided us insight into ongoing efforts of owners to raise awareness and change residents' behavior for environmental efficiency, such as sorting garbage, reducing opening windows/doors and using less hot water. These efforts are examples of ways to involve and engage residents towards a more socially oriented type of behavior change, rather than directly encouraging residents to reduce their individual energy consumption. Two other owners, Stena and the smaller private building owner (Kungsvik) have not yet started to address the social awareness/behavioral changes yet. The Stena representative thought the technical solutions to be simpler to address than the social awareness challenge, which they had not yet approached or found a solution to how to approach.

These are all different ways of addressing end-users energy efficiency. For the CELSIUS project it seems important to determine a varied palette of end user strategies that can be applied in different circumstances. We will continue our search into these end-user aspects in different countries, starting with UK and the Netherlands, which will be performed in connection to WP6 Acceptance.

## Evaluation of energy consumption in selected buildings with CA

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A common measure in the buildings associated with the climate agreement is to change to a more energy efficient control system. Three buildings which have climate agreements were selected to evaluate how these systems can affect the energy consumption. The buildings are listed in the table below. The time between forming an agreement and implementing energy efficient measures can differ, as can be seen in the table below. Two of the buildings received new control systems and in the third building ventilation with heat recovery was installed.

**Table 3 - Buildings with CA selected for comparison of energy consumption**

Building name	Vingen	Holmens Herr	Askungen

Climate Agreement started in	2005	2012	2007, renegotiated 2010
Number of floors	5	N.A.	6
Number of dwellings	N.A.	N.A.	100
Functional type	Offices and more	Shop	Residential
Energy efficient measure	Kabona management system (June 2011)	New mechanical supply and exhaust air with heat exchange (June 2014)	EcoCom (March 2014)

The three buildings have had different measures made to make them more energy efficient, and the diagrams below show the heat consumption by month. Figures below show the average value before and after the installation of the new control system. Since the systems in the other two buildings have been recently installed there is not yet enough data to make such a comparison for them.

[User feedback and individual metering](#) also uses end-user involvement but it is enabled by ICT and thus it is presented in the following chapter.