International Energy Agency Implementing Agreement on

**District Heating and Cooling including Combined Heat and Power**

# Annex XI final report summary

# "Smart use as the missing link in district energy development: a user-centered approach to system operation and management"

Project short title: Smart use – District energy XI-03

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# Executive Summary

Smart energy networks, generation and use of electricity, district heating and remote cooling can be combined and coordinated, thus providing new opportunities for utilizing our shared resources more efficiently. In order to achieve that, the energy network is not enough, the energy must also be used in a smart way, and we have to become smart users of energy. In many previous attempts at efficiency, automations have certainly facilitated the user, but at the same time they have contributed to the user not understanding the technical systems around them and therefore using them inefficiently.

In this project, we have tried to do the opposite, and tried to approach the challenge from a different direction. We wanted to explore how to design an interface that invites the user to understand the smart energy network and thus enable the user to contribute to efficient resource utilization. In order to do this, the user must be given an overview and the possibility to control, but also receive feedback and strategies to adjust energy consuming activities. We have developed a platform for a home in a near future scenario, that is connected to a smart energy network and where some home appliances are also powered by district heating or cooling. Its user interface enables all members of a household to participate to use energy consuming products in an informed and smart way.

# Abbreviations

(in alphabetic order / only those present in the summary report)

| | |
|---|---|
| CHP | Combined Heat and Power |
| DHC | District Heating and Cooling |
| HEMS | Home Energy Management System |
| IEA | International Energy Agency |

# 1 Project Objectives

In this project, Boid, together with the Samsø Energy Academy, Göteborg Energi, Chalmers University of Technology, the Chalmers Industrial Engineering Foundation and CIT Energy Management, have established a platform for overview and control of energy use in a home that is connected to a smart energy network. The purpose of the project was to see how a customized user interface can help people in their daily lives satisfy their needs while reducing their environmental impact by exploiting the opportunities for efficiency improvements in smart energy networks.

# 2 Project Outcome

The projects main objective was to develop a concept for a user interface of a home energy management system that enables and encourages people to use energy from a smart energy system in an efficient way. The suggested user interface for a home energy management system consists of two major parts presented below.

## 2.1 Physical & Digital Prototype

### 2.1.1 Activity Organizer

The Activity Organizer is an energy platform focused on future energy-reliant activities in the home and their relation to energy use in relation to peaks demand and in production - something that can be described as availability of energy. The Activity Organizer presents energy information with enough detailing so that the information becomes actionable for individuals.

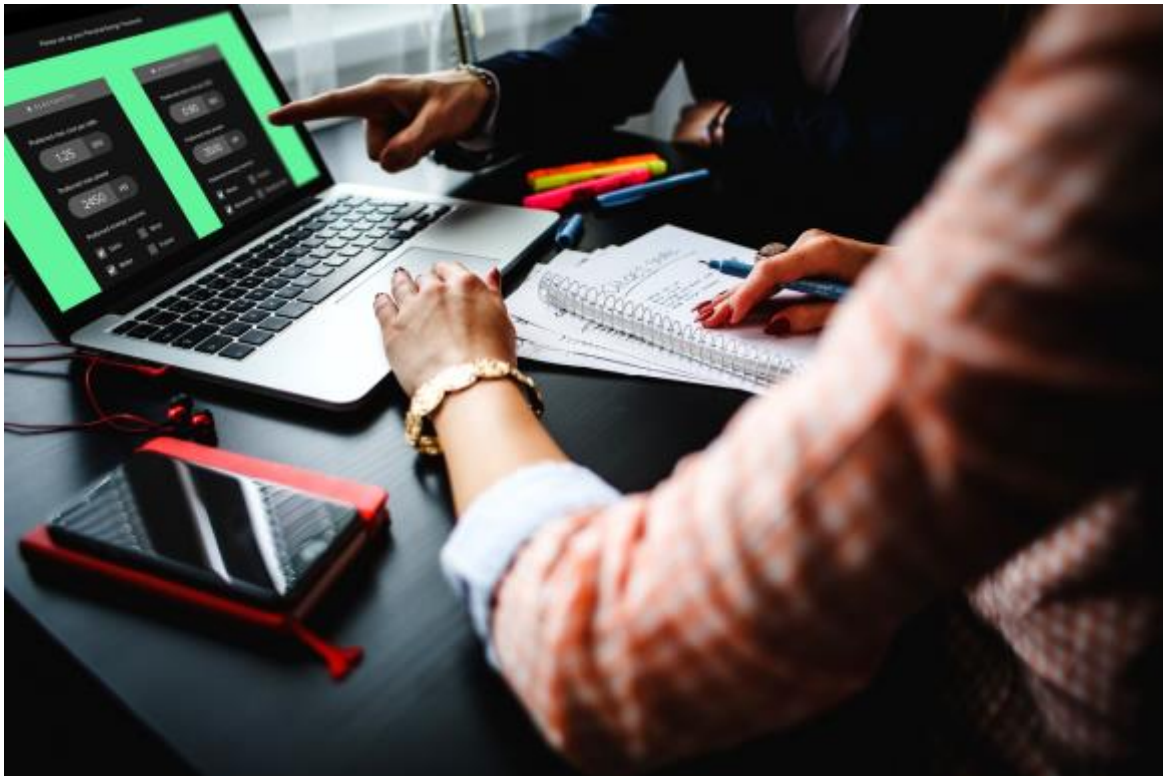

*Figure 1: Activity Organizer*

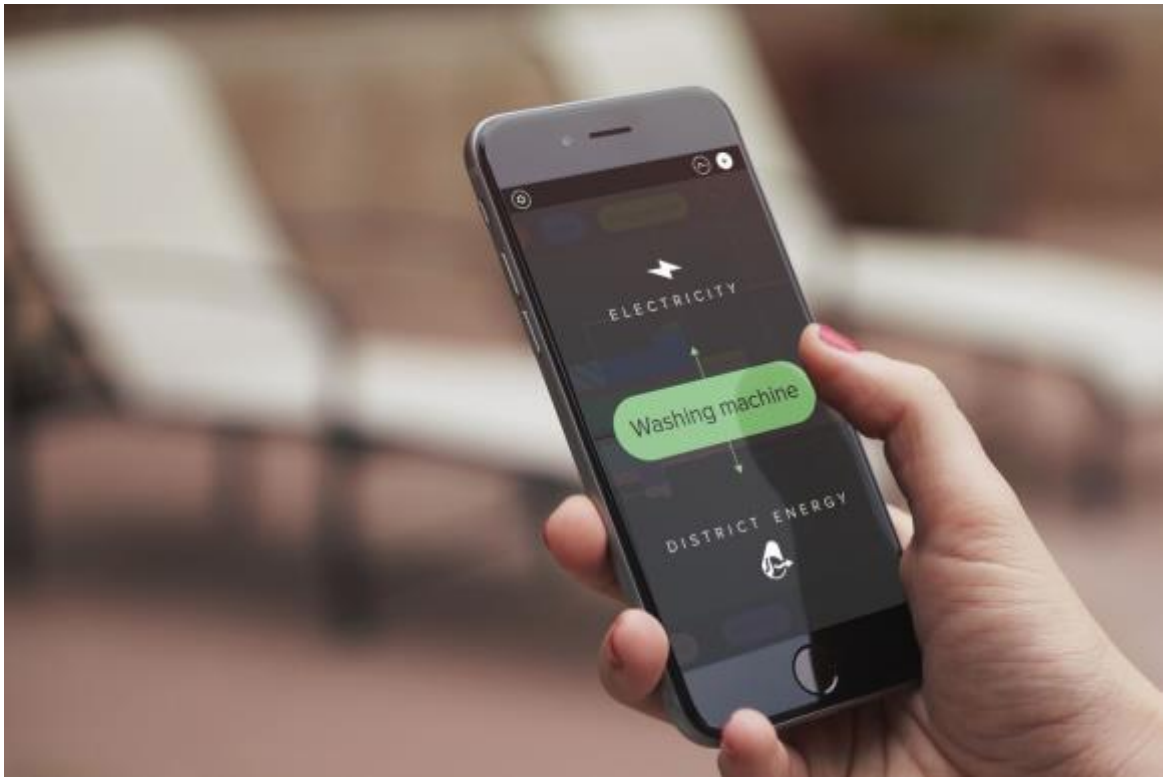


*Figure 2: Activity Organizer Iphone*

### 2.1.2 Status Unit

The Status Unit focus on the current energy situation in relation to energy availability for both electricity and district energy. Here the focus is on simplicity, raising awareness, and curiosity. The Status Unit could, like a clock, take on various forms and styles. Therefore we have created two different examples. A sketch of a minimal digital version to use on wearable such as smart wristwatches with easy access to the extended functionalities of the Home Energy Management System (HEMS), as well as a physical demonstrator in form of two light objects hanging from which each that can move up and down in relation to a fixed line mounted on the wall. Their light functionality, if turned on, indicates more energy availability the brighter the subtle indicator shines.

Both major parts, the Activity Organizer as well as the Status Unit, rely on a unique use feature, the Personal Energy Threshold (PET). The PET is a personal momentary energy use level based on personal preferences as well as on energy availability. The PET varies with time, but is forecasted in the Activity Organizer and function as a threshold indicating to users that the energy they are using does not match their energy preferences.

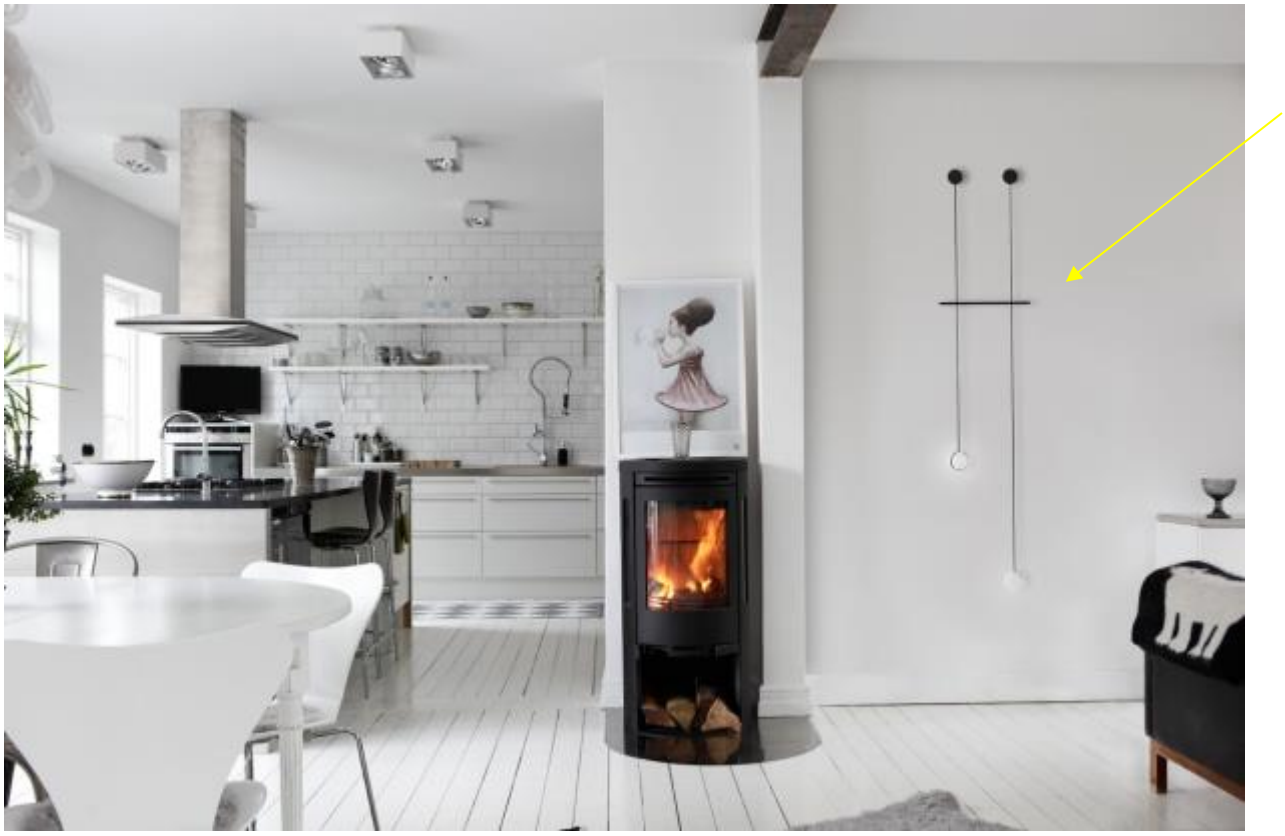

*Figure 3: Status Unit in an interior*

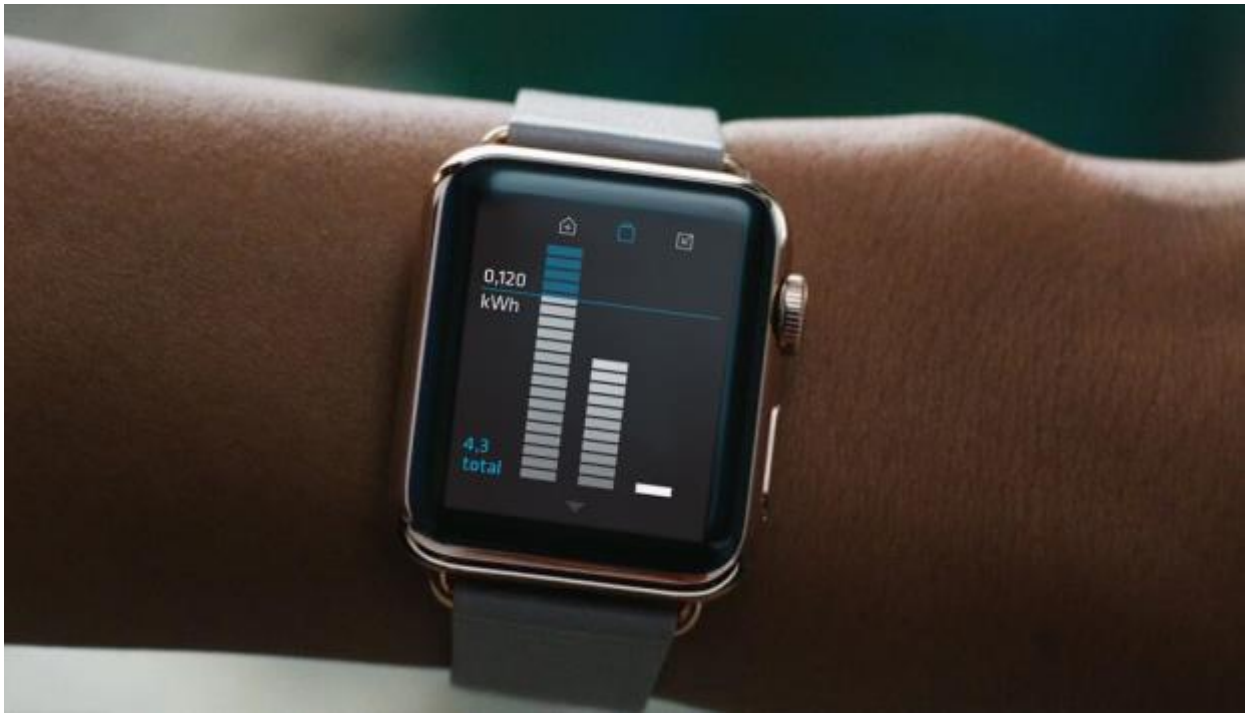


*Figure 4: Digital Status Unit*

# 3 Results & Benefits

Through this new home energy system, the end users of district energy will become more aware of the benefits with district energy, i.e. its environmental benefits, its resource and cost efficiency, and its convenience. They will also be able to manage their energy consumption in a user-friendly way, something that could result in energy savings up to 20 % (Nest Labs, 2014). The home energy management system will also enable efficient integration of district heating operated appliances. In this way, the users can benefit from a resource and cost-efficient way fulfilment of everyday needs, such as doing laundry, as well as enjoying resource efficient leisure activities such as swimming in a pool heated with district energy. The home energy management system will together with the new district heating-operated appliances contribute to the attractiveness of district energy among residents, something the district energy sector will benefit from. Further, through the home energy management system the residents will contribute to a shift in demand to off-peak hours thus creating a more even load, contributing to efficiency in the generation of district energy.

The approach, to design a system interface that is highly intuitive, minimizes possible differences in user behavior between different countries. The aim is that the resulting product and service can be transferable to any country with an existing infrastructure for district energy. The result of energy savings will have immediate impact. The impact of the possibility to integrate district heating operated appliances will increase during a short term as the industry become aware of this new possibility and start producing such appliances. The attractiveness of district heating will also start to grow as these appliances become available. The effects of demand-side-management will continue to increase as more and more residents starts using the proposed home energy management systems but the impact will be seen also on a short term (Caird & Roy 2008).

# Bibliography

Caird, S., & Roy, R. (2008). User-centred improvements to energy e ciency products and renewable energy systems: research on household adoption and use. International Journal of Innovation Management, 12(3), 327-355.

Nest Labs, N. (2014). Nest. Retrieved 2014-01-28, Available at: https:// nest.com/thermostat/life-with-nest-thermostat/

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