

# Energy Flexible Buildings

## IEA EBC Annex 67

Bart Bleys

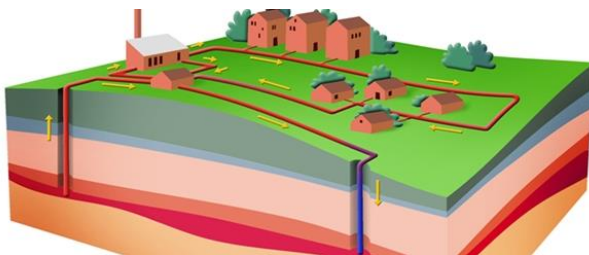
Belgian Building Research Institute

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Rehva Brussels Summit

Brussels, November 13, 2018

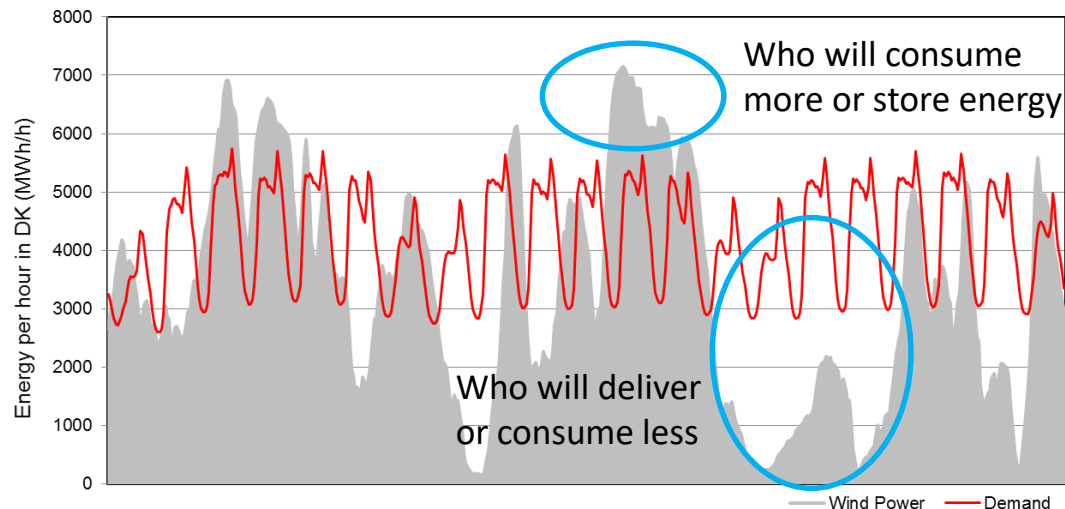
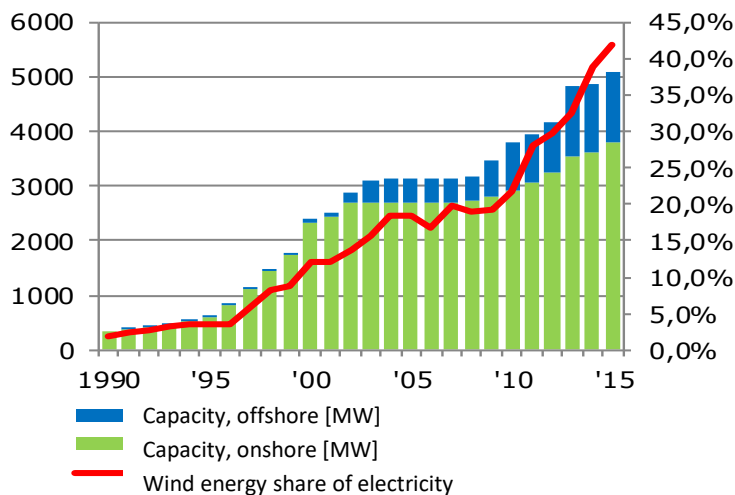
# Common understanding that we need to replace fossil fuels with renewable energy



## Example: Denmark

Goal: 50 % wind in power grid by 2020 and  
only RES in the total energy system by 2050

MW



## Solutions to large share of RES in the energy systems

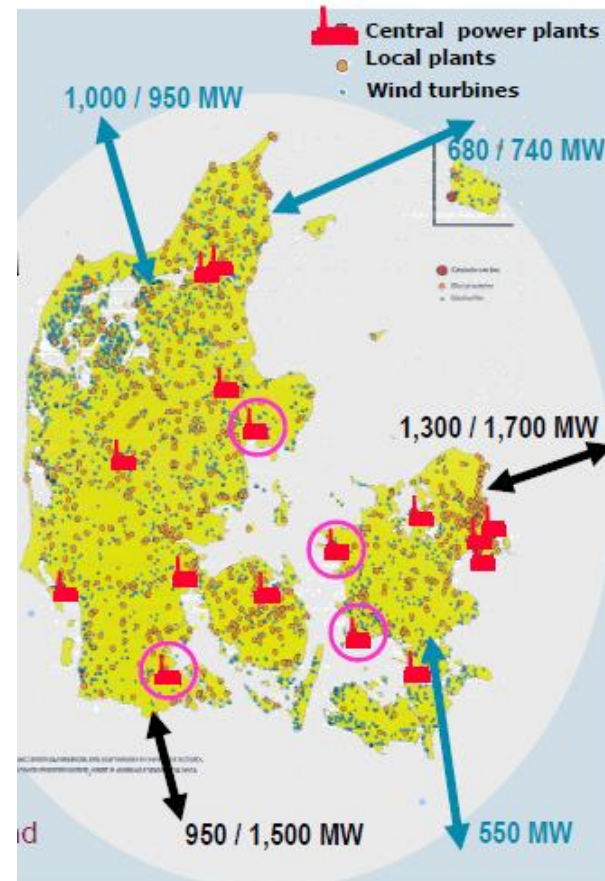
Large interconnectors - export/import

Heat pumps in district heating

Generation of hydrogen and  
upgrading of biogas

RES based fuel factories

Demand response – industry and  
buildings





ventilation systems



cooling systems

supermarkets

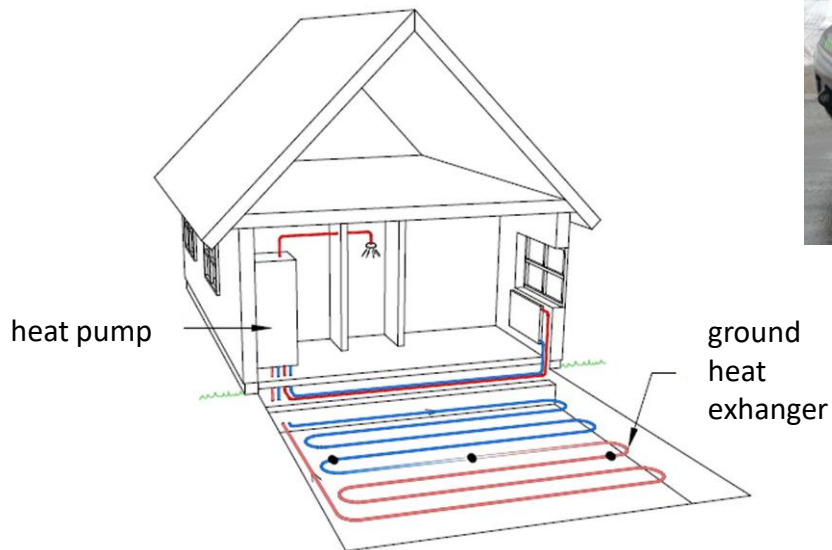


pumps



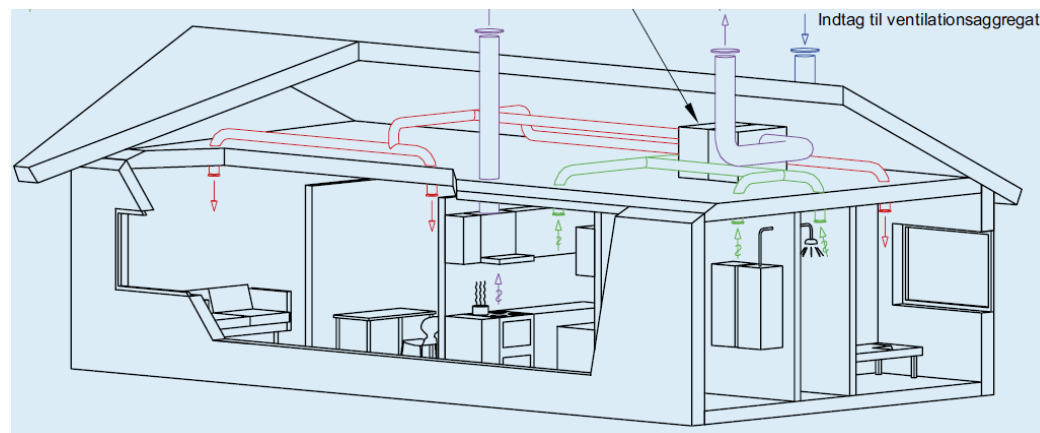
# Electricity demand in households

## heat pumps (aircondition)



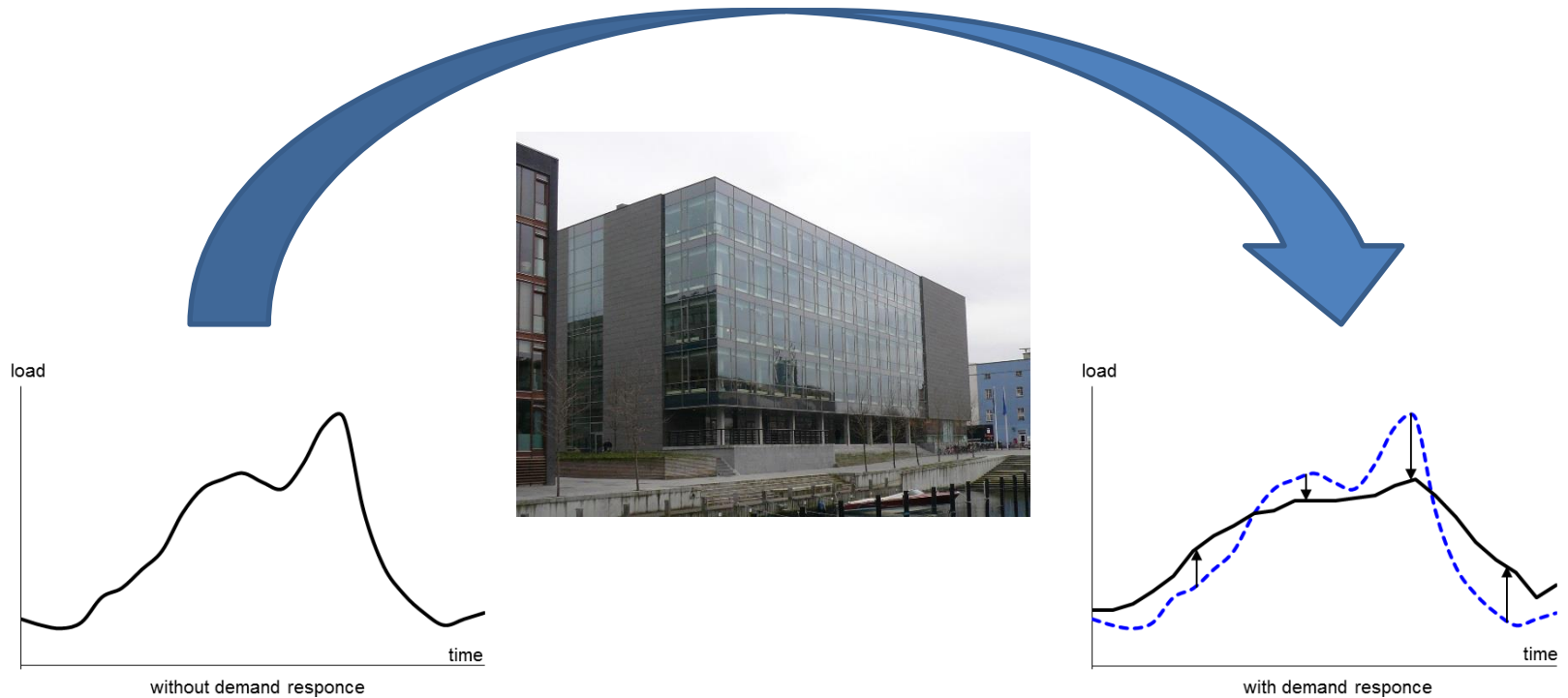
## EVs

## ventilation systems



## white goods

# Most buildings have the ability to become energy flexible



# IEA EBC Annex 67

## Energy Flexible Buildings

June 2014 – June 2015: Preparation phase: done

June 2015 – June 2018: Working phase: ongoing

June 2018 – June 2019: Reporting phase: ongoing

Seventh working meeting:

Montreal, October 10-12, 2018

Eight working meeting:

Aalborg, April, 2019



# Annex 67 work plan

## Subtask A: Definitions and Context

- Common terminology and definition of Energy Flexibility in buildings
- Methodology for characterization of Energy Flexibility in buildings
- User needs, motivation and barriers for application of EF in building
- Market analysis

## Subtask B: Analysis, Development and Testing

- Simulation of Energy Flexibility in single buildings and clusters of buildings
- Control strategies and algorithms
- Laboratory tests of components, systems and control strategies
- Example cases and design examples

## Subtask C: Demonstration and User Perspectives

- Measurements in existing buildings
- Demonstration of Energy Flexibility in real buildings and clusters
- User motivation and acceptance

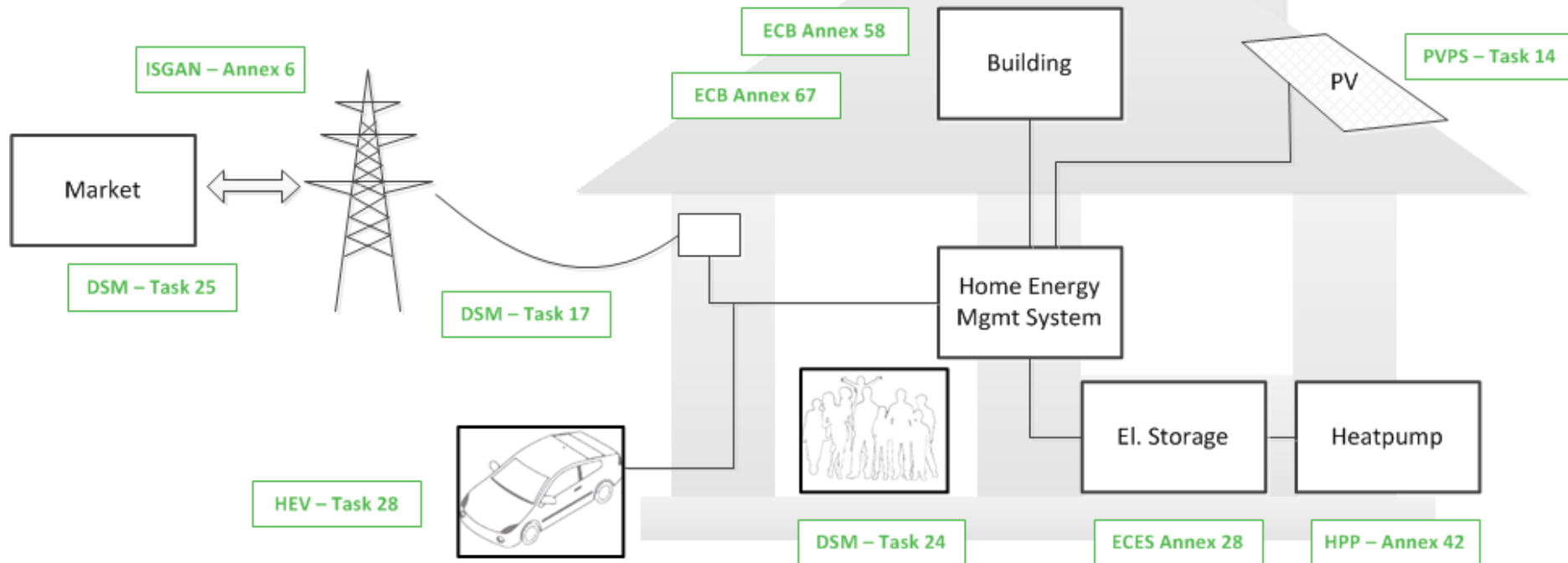
# Participating countries (16)

- Austria
- Belgium
- Canada
- China
- Denmark
- Finland
- France
- Germany
- Ireland
- Italy
- Norway
- Portugal
- Spain
- Switzerland
- The Netherlands
- UK

# Other related IEA activities



## *Demand Flexibility and RES Integration*

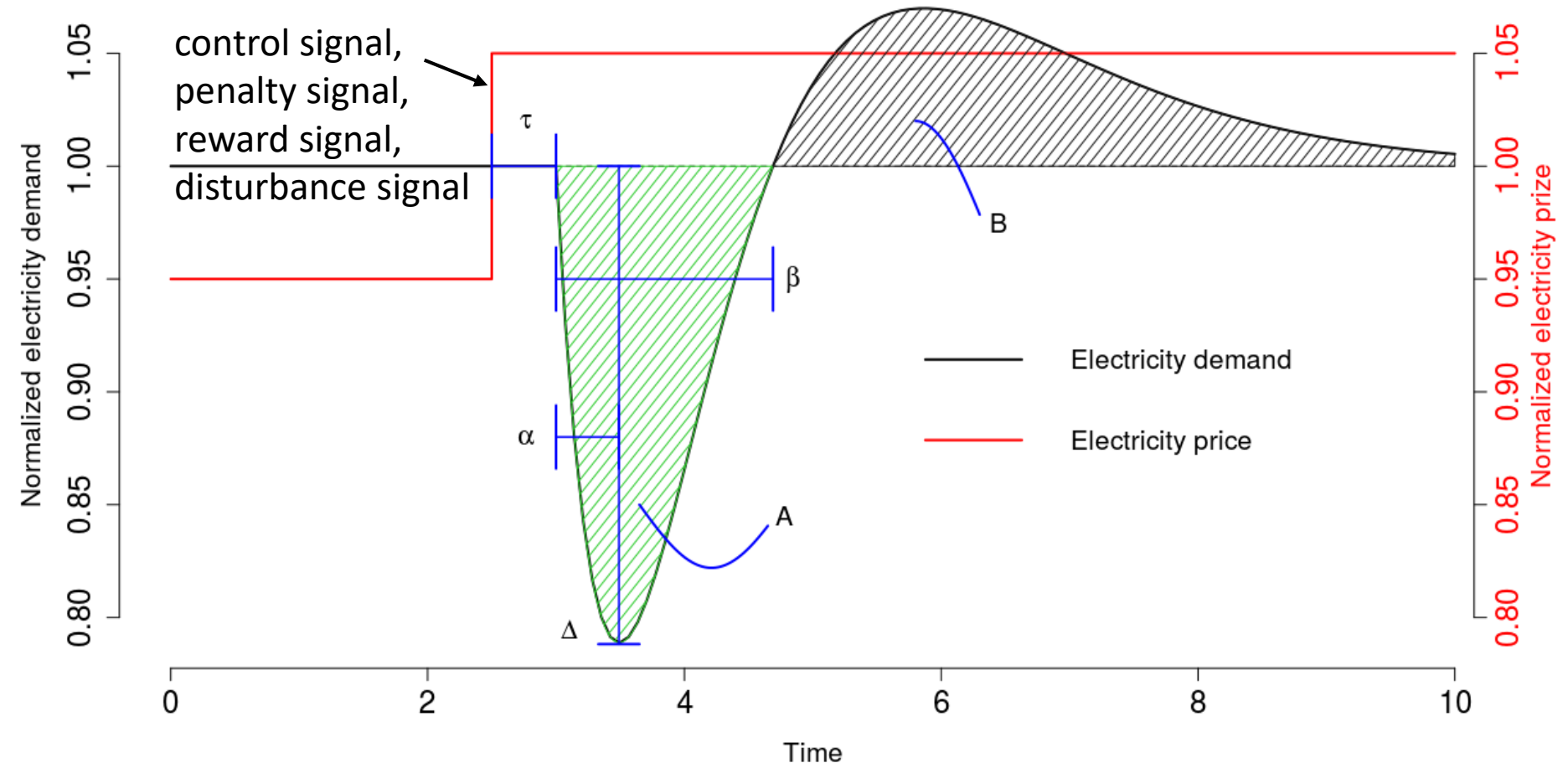


# Definition of Energy Flexibility in buildings

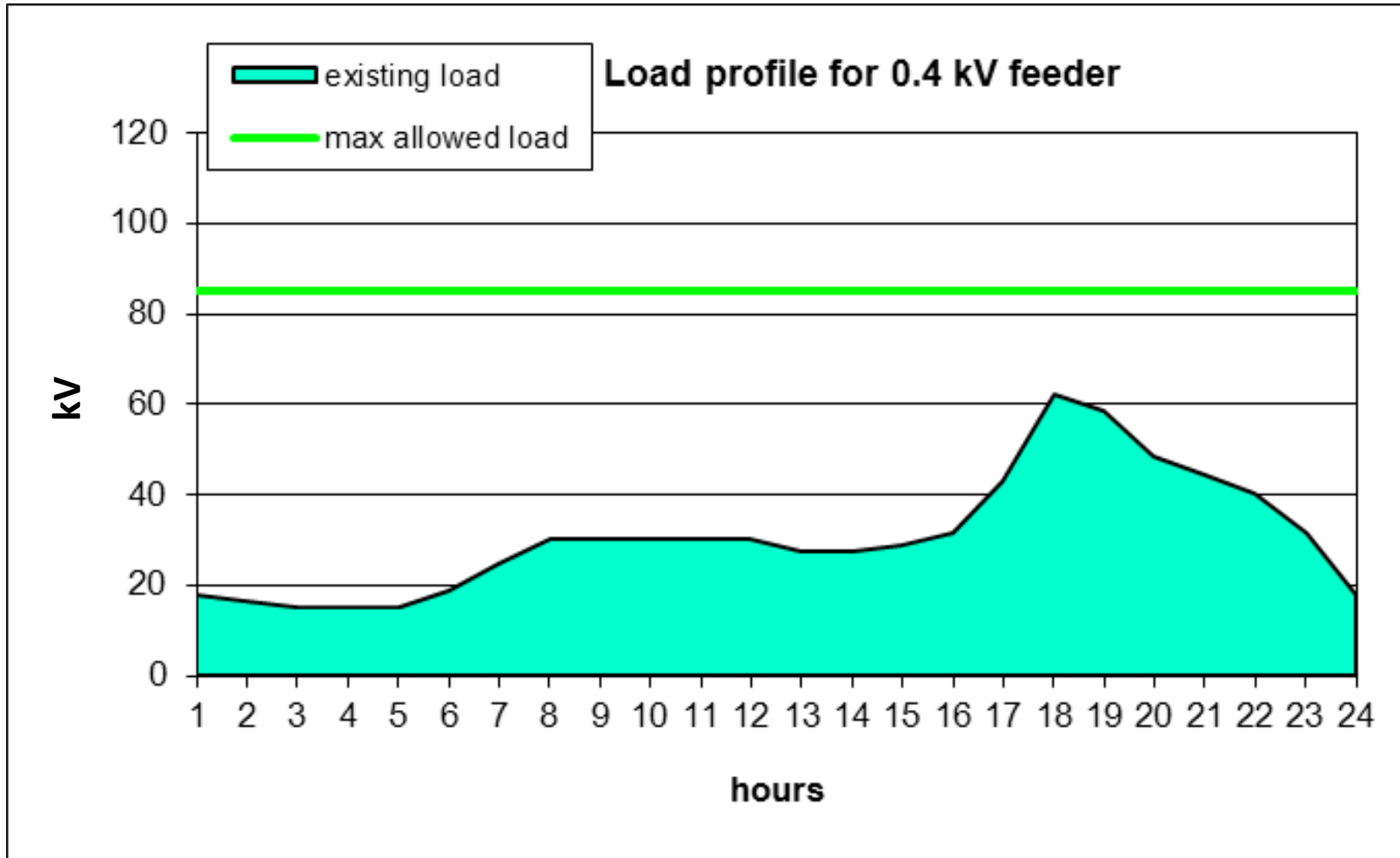
- The Energy Flexibility of a building is the ability to manage its demand and generation according to local climate conditions, user needs and grid requirements.
- Energy Flexibility of buildings will thus allow for demand side management/load control and thereby demand response based on the requirements of the surrounding grids.



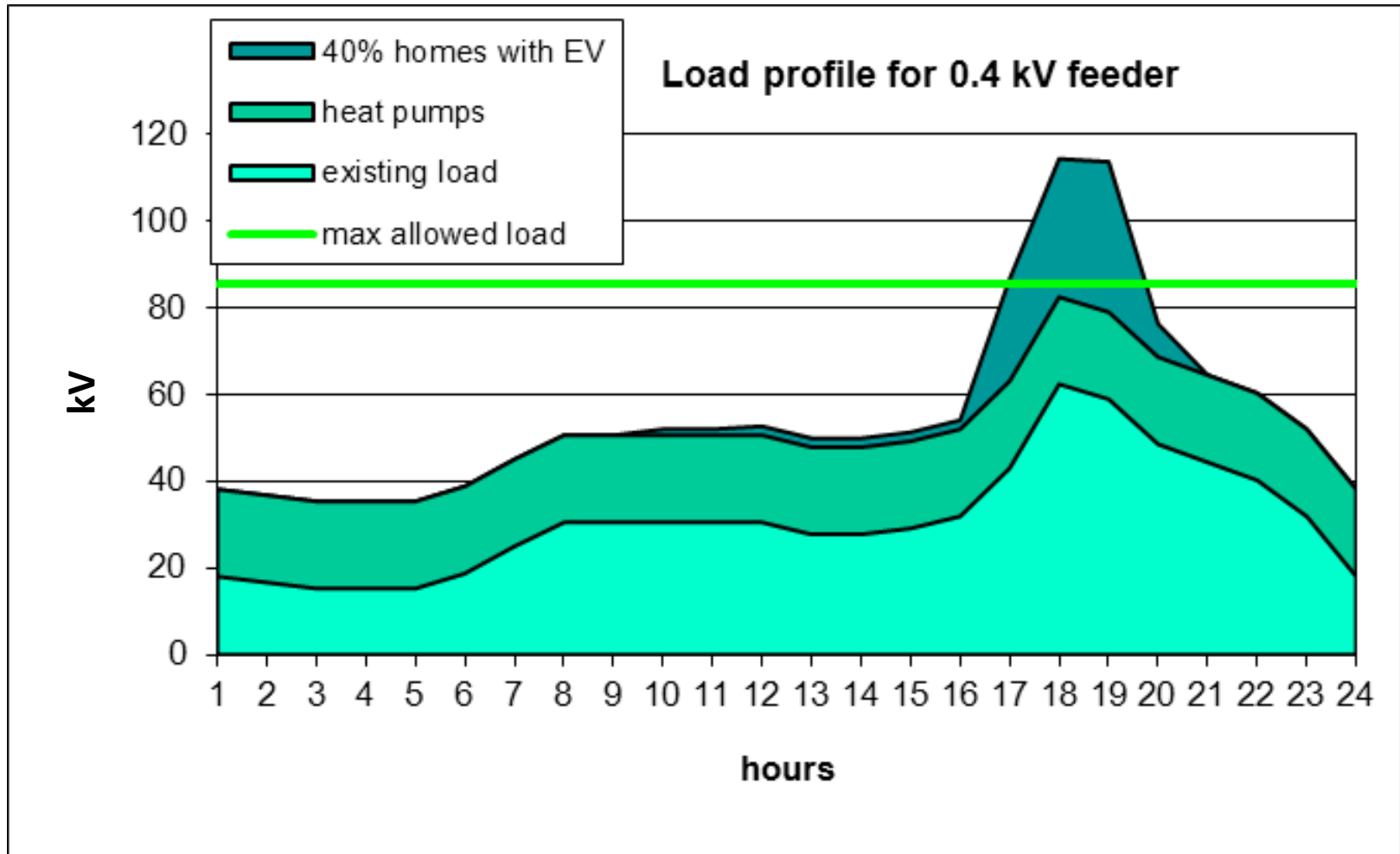
# Characterization and labelling of Energy Flexibility in buildings



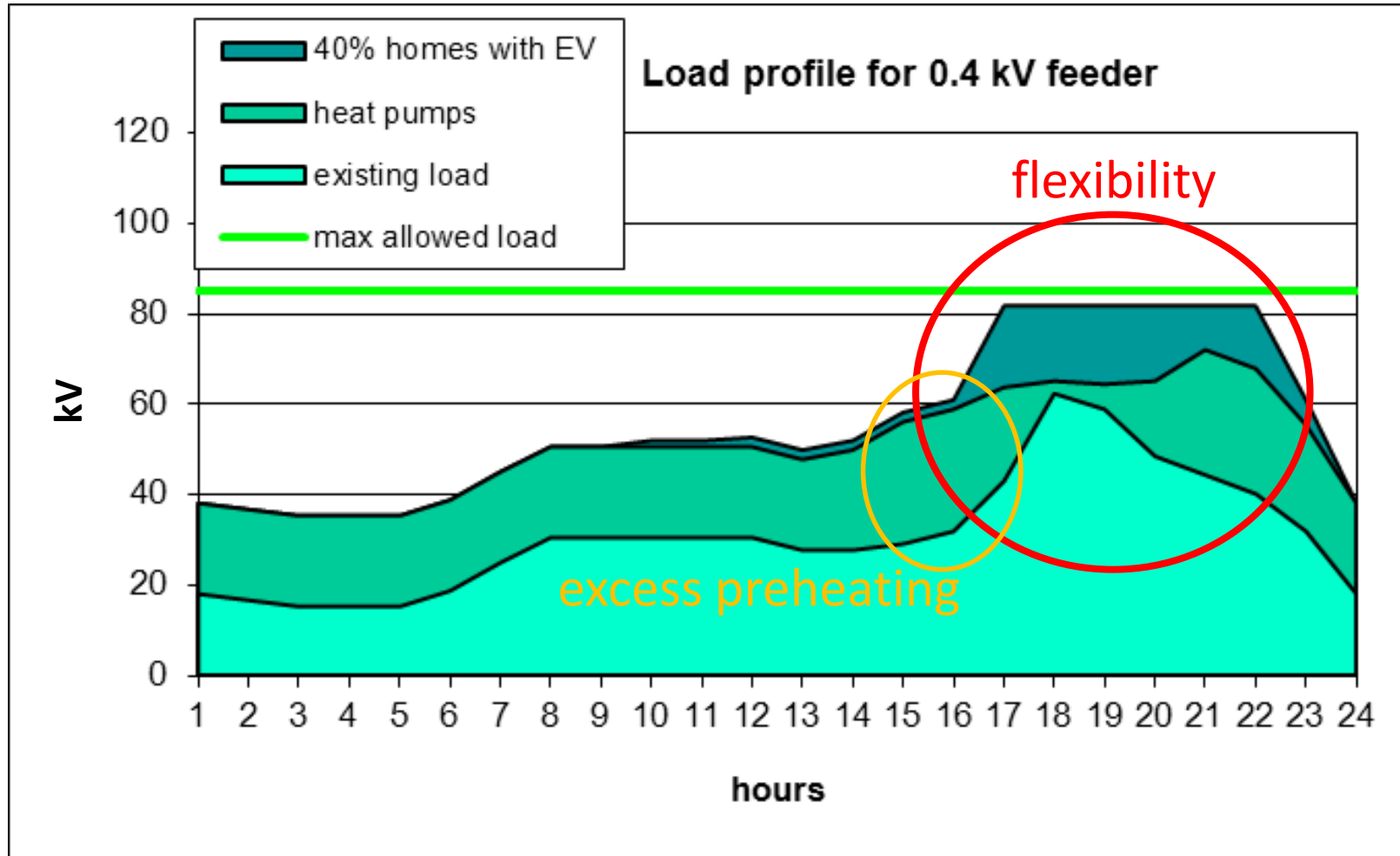
# Example 1



# Example 1

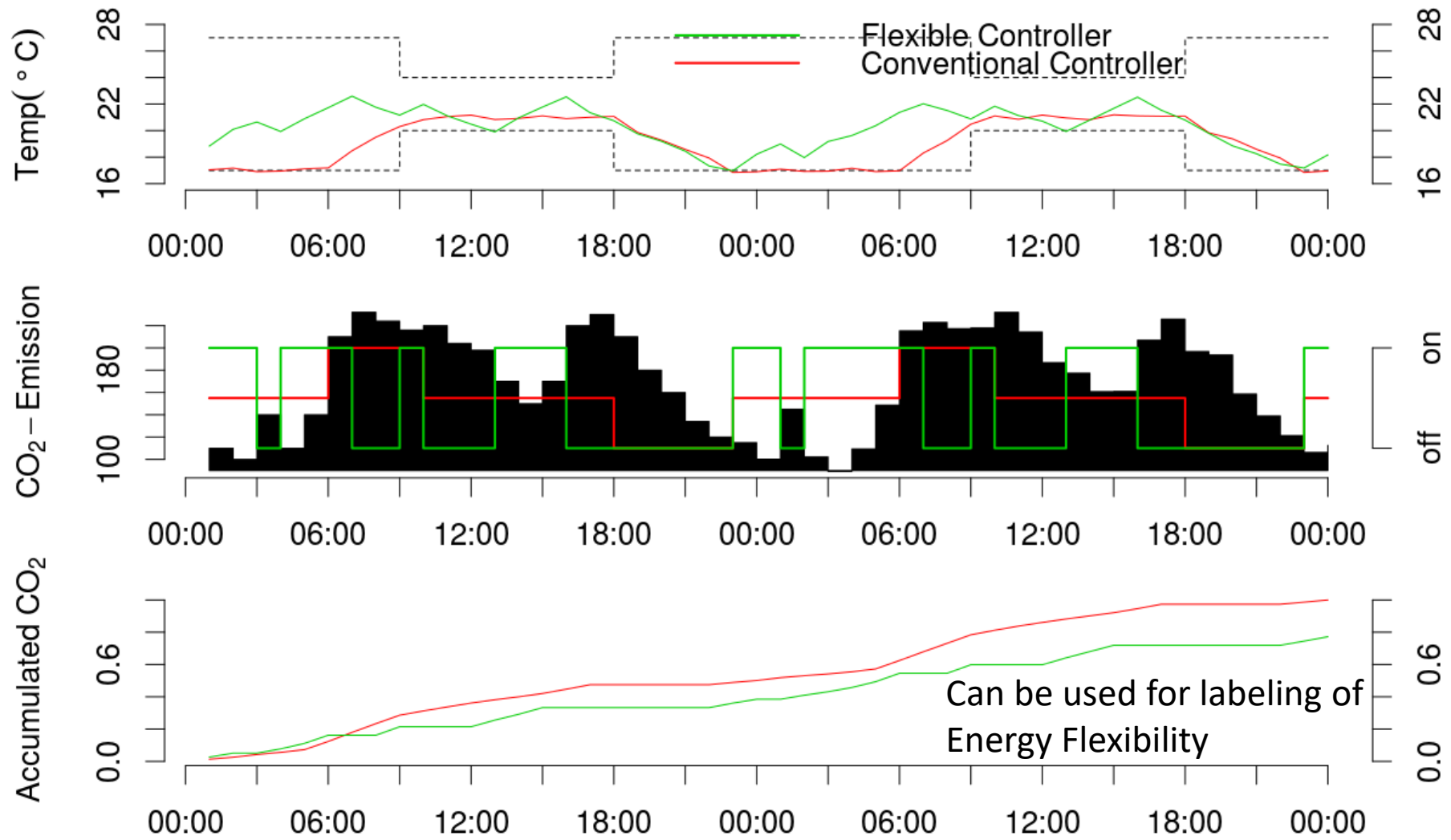


# Example 1





## Example 2



Characterizing the Energy Flexibility of Buildings and Districts.

<https://www.sciencedirect.com/science/article/pii/S030626191830730X>

# European Union

## Smartness Indicator in EBPD (Energy Performance in Buildings Directive)

- The introduction of a smartness indicator rating the readiness of the building to adapt its operation to the needs of the occupant and the grid, and to improve its performance
- The smartness indicator should be used to measure buildings' capacity to use ICT and electronic systems to optimise operation and interact with the grid

# Smart readiness indicator in EPBD

Annex 67 has written a Position paper

There is a need for an approach that takes in to account the **dynamic behavior** of buildings rather than a static counting and rating of control devices. It is further important to minimize the CO<sub>2</sub> emission in the overall **energy networks** rather than optimize the energy efficiency of the single energy components in a building.

## Energy Flexibility as a key asset in a smart building future

Contribution of Annex 67 to the European Smart Building Initiatives

Position Paper of the IEA Energy in Buildings and Communities Programme (EBC) Annex 67 "Energy Flexible Buildings"

October 2017

<http://annex67.org/media/1470/position-paper-energy-flexibility-as-a-key-asset-i-a-smart-building-future.pdf>

## ■ Energy context:

- As the energy-use for space heating continues to diminish, *energy-use for domestic hot water* (DHW) becomes *increasingly relevant*
- *Efficient design* of DHW installations becomes ever more important
- Pressure to *reduce DHW production temperatures*



## ■ Hygienic context:

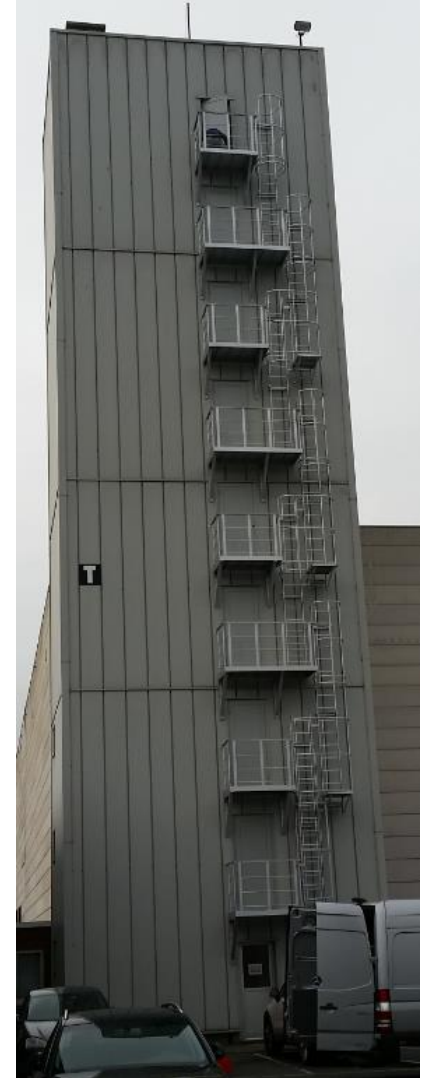
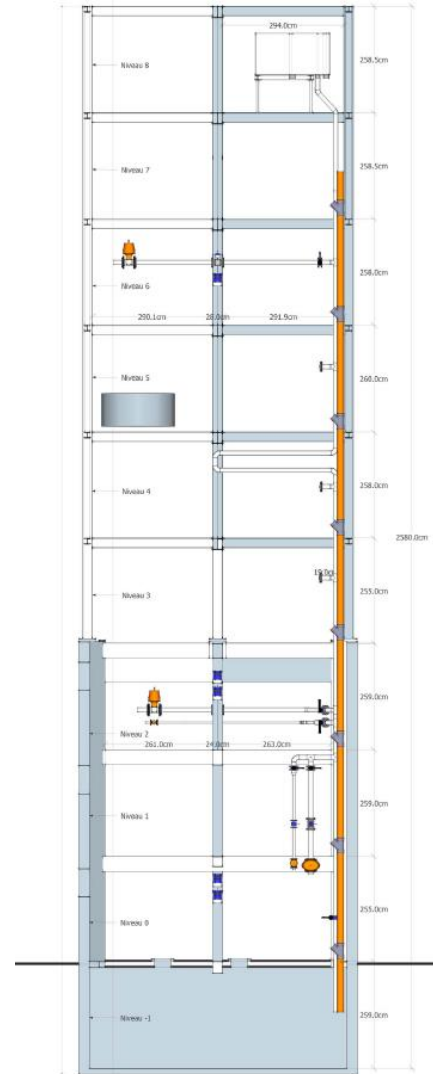
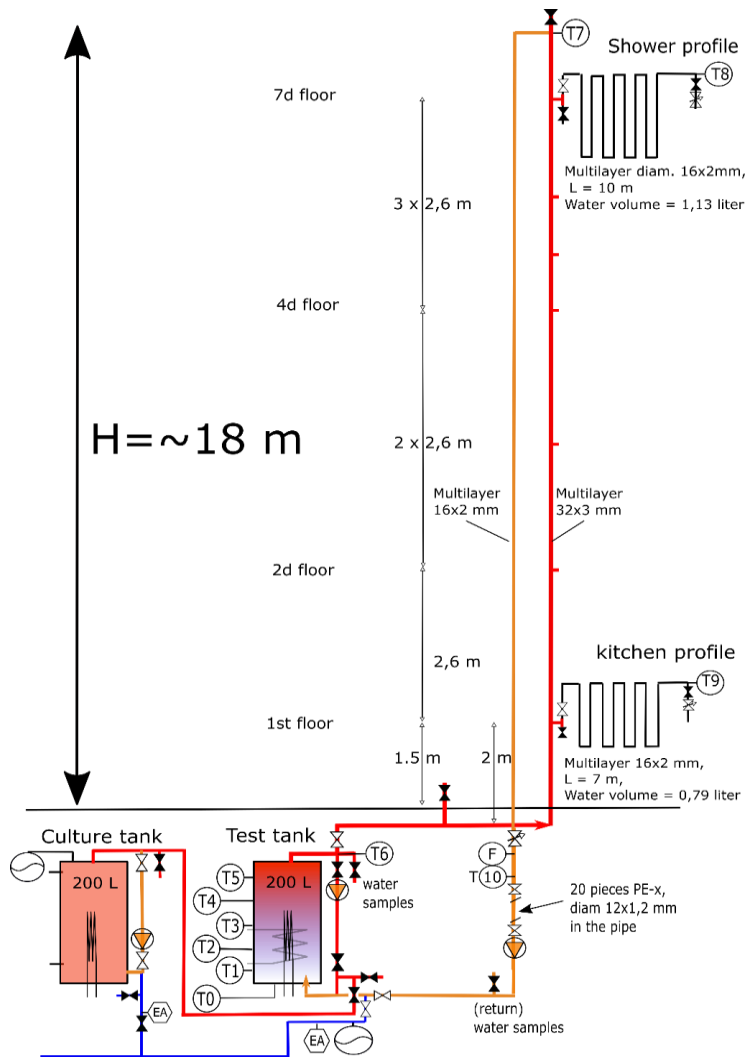
- Having a *good water quality at the faucet is essential*, and certainly more important than energy related aspects



- Evaluation -on a full scale test facility- of the possibility to reduce the DHW production temperature without increasing risk of Legionella development



# Flexibility potential in DHW systems

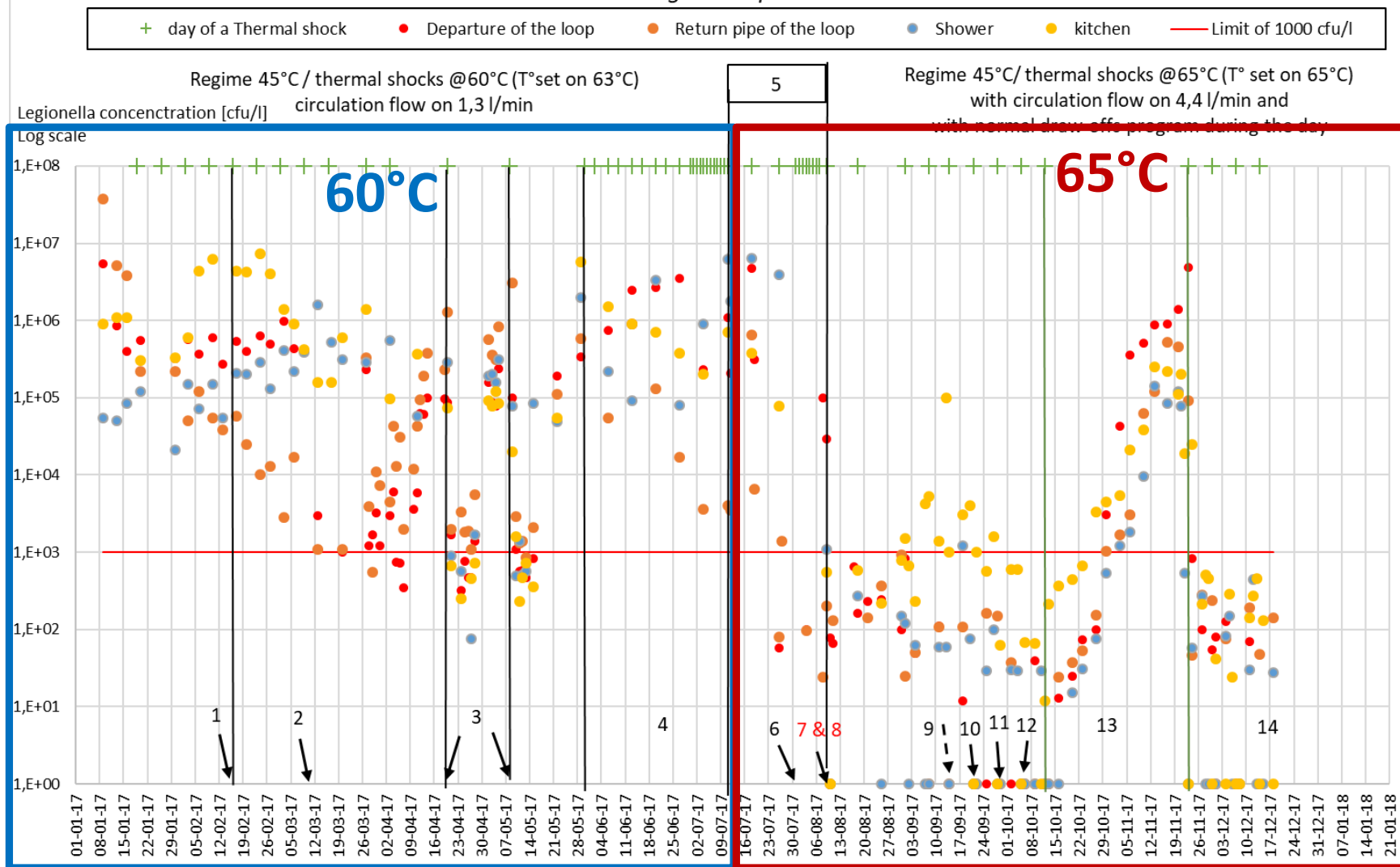


# Flexibility potential in DHW systems

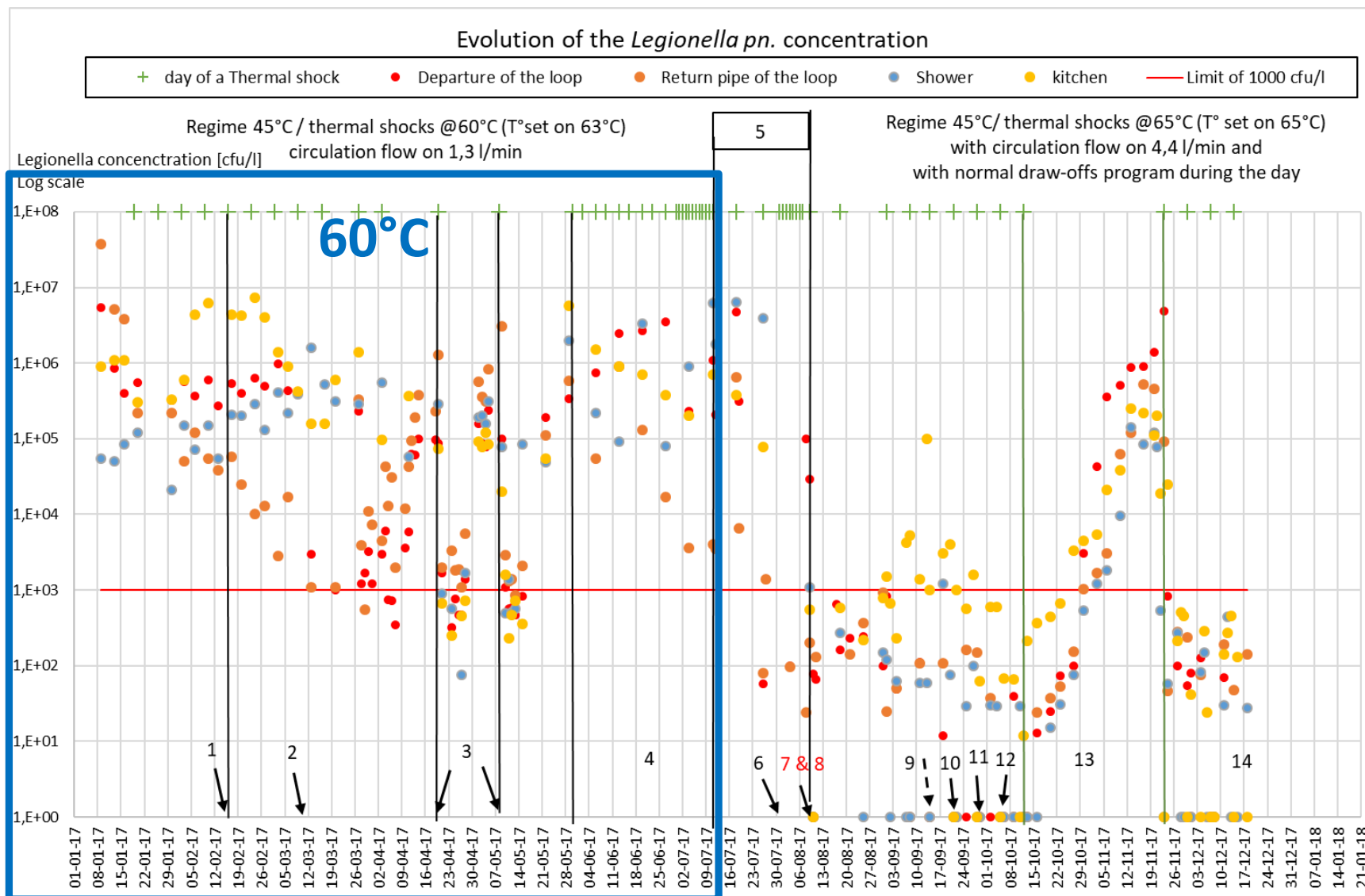
$T_{\text{prod}}$	$T_{\text{heating}}$	Heating duration	Frequency
45 °C	60 °C	30 min	1x/week
45 °C	60 °C	1h	1x/week
45 °C	60 °C	1 h	1x/week, with extra circulation on tank
45 °C	60 °C	1 h	1x/week, with extra circulation on tank and disinfection tapping pipes
45 °C	60 °C	1h	7x/week
45 °C	65 °C	30 min	1x/week
45 °C	65 °C	1h	1x/week
45 °C	65 °C	1 h	1x/week, with extra circulation on tank
45 °C	65 °C	1 h	1x/week, with extra circulation on tank and disinfection tapping pipes
45 °C	65 °C	24h	1x/week, with extra circulation on tank + increasing tap duration in kitchen
45 °C	65 °C		1x/week, with extra circulation on tank + tap duration 150s

# Flexibility potential in DHW systems

Evolution of the *Legionella pn.* concentration

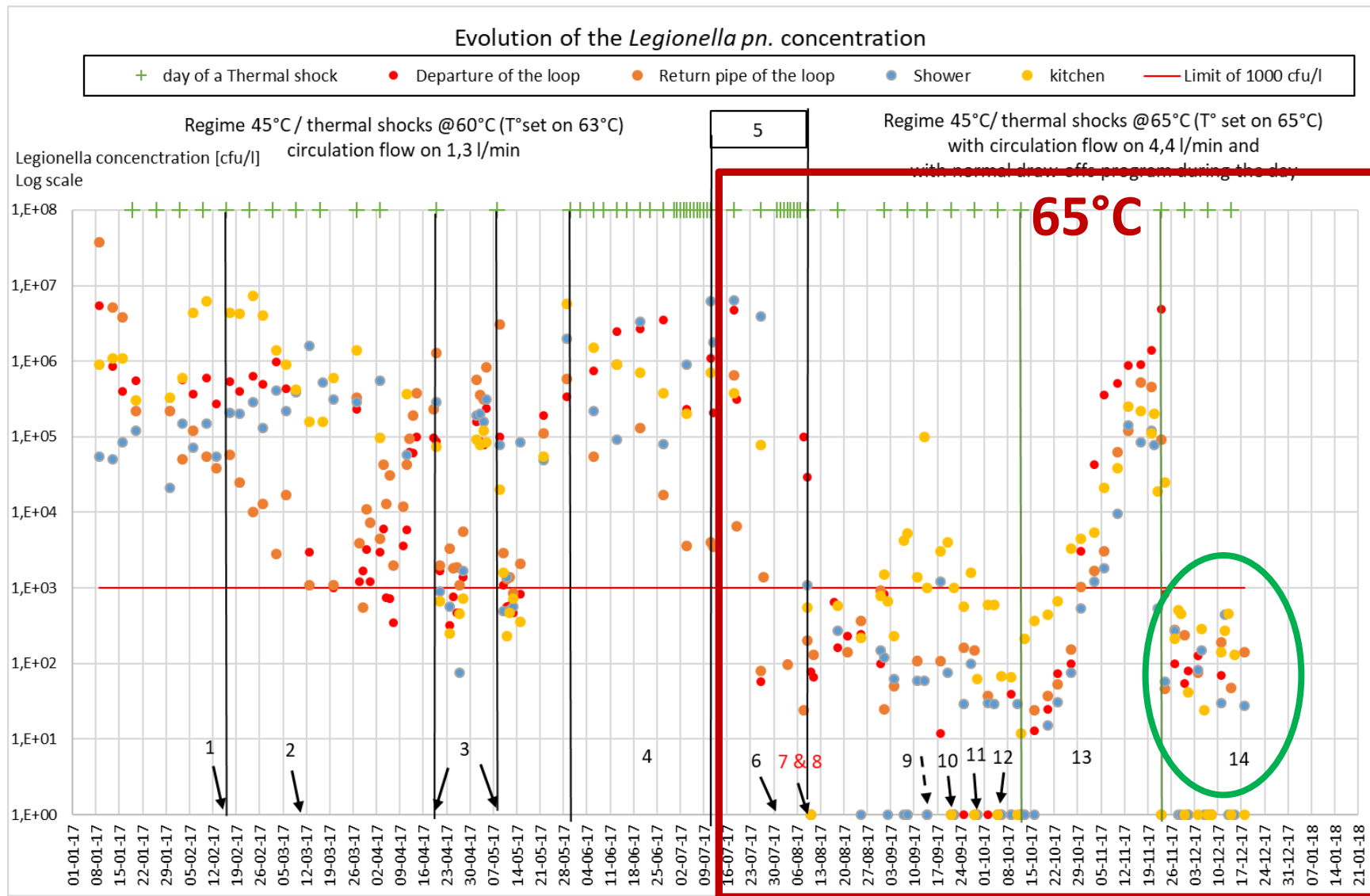


# Flexibility potential in DHW systems





# Flexibility potential in DHW systems



# Flexibility potential in DHW systems

In a contaminated installation, with ***DHW production temperature*** of ***45°C***:

- ***regular thermal shocks at 60°C were insufficient***
- ***weekly thermal shocks during 24h at 65°C***, in combination with ***regular draw-off*** during this shock on both draw-off pipes (of minimum ***150 s*** in this test facility), ***were sufficient*** to stabilise the Legionella concentration **below 1000 cfu/l**

[https://www.wtcb.be/homepage/download.cfm?lang=en&dtype=projects&doc=Evaluation of the risk of Legionella spp development in sanitary install.pdf](https://www.wtcb.be/homepage/download.cfm?lang=en&dtype=projects&doc=Evaluation%20of%20the%20risk%20of%20Legionella%20spp%20development%20in%20sanitary%20install.pdf)

# Website

## [annex67.org](http://annex67.org)



The screenshot shows a web browser window displaying the homepage of [annex67.org](http://annex67.org). The browser's address bar shows the URL. The website header includes the EBC logo, the text "ANNEX 67", and a search bar. A navigation menu is located below the header, containing links to Home, About Annex 67, Subtasks, Publications, Newsletters, Next meeting, Participants, Contact, and Member login. The main content area features a paragraph about the project's aim to increase knowledge on Energy Flexibility, followed by a diagram illustrating the hierarchy of energy systems from Smart Grid & other energy infrastructures down to the User. Below the diagram, there is a link to "Read more about Annex 67, [click here](#)". At the bottom of the page, there are two images: one showing a person working on a laptop and another showing a dog lying down. The footer contains the text "Objectives" and "Project beneficiaries". The Windows taskbar at the bottom shows various application icons and the system clock indicating 10:08 on 13/03/2017.

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Currently there is no overview or insight into how much Energy Flexibility different building types and their usage may be able to offer to future energy systems. The aim of the Annex is thus to increase knowledge on and demonstrate the Energy Flexibility buildings can provide for the energy grids, and to identify critical aspects and possible solutions to manage this Energy Flexibility.

In-depth knowledge of the Energy Flexibility that buildings may provide is important for the design of future Smart Energy systems and buildings. The knowledge is, however, not only important for the utilities it is also necessary for companies when developing business cases for products and services supporting the roll out of Smart Energy networks. Furthermore, it is important information for policy makers and government entities involved in the shaping of future energy systems.

Read more about Annex 67, [click here](#)

Smart Grid & other energy infrastructures

Built environment

Building

Floor

Room

Workingplace

User

Objectives

Project beneficiaries

10:08  
13/03/2017

**Thank you for your attention**