

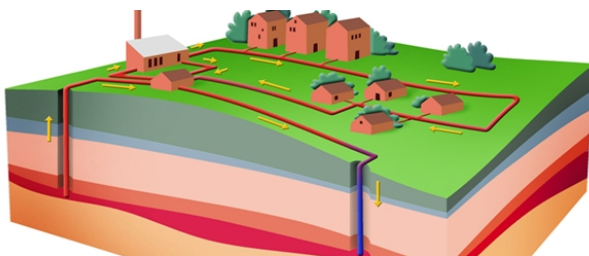
Energy Flexible Buildings

IEA EBC Annex 67

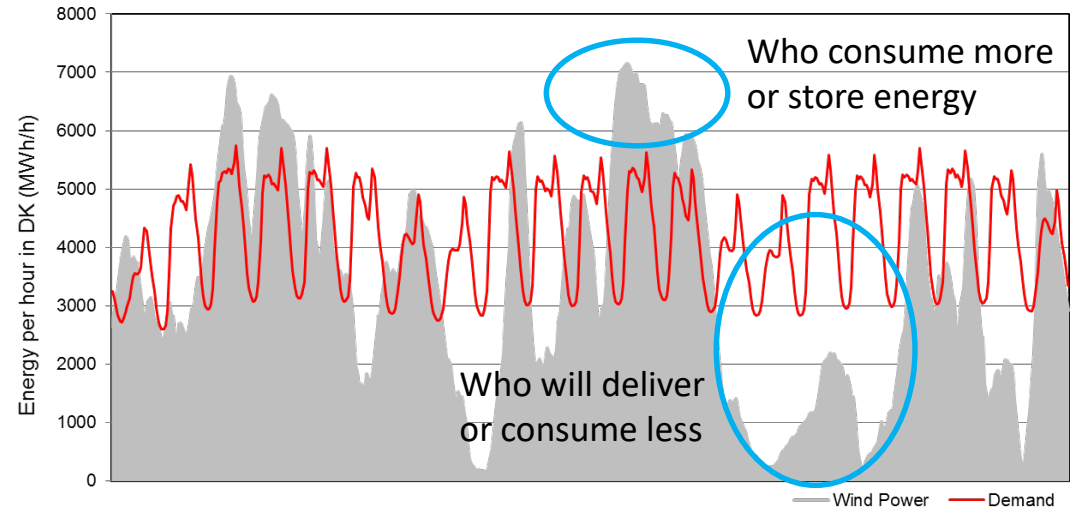
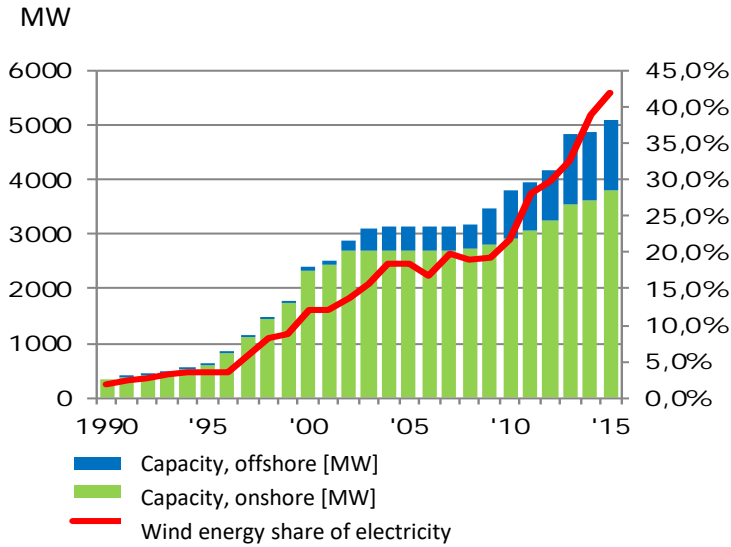
Operating Agent
Søren Østergaard Jensen
Danish Technological Institute
sdj@teknologisk.dk

Energy Flexible Buildings
Montreal, October 12, 2018

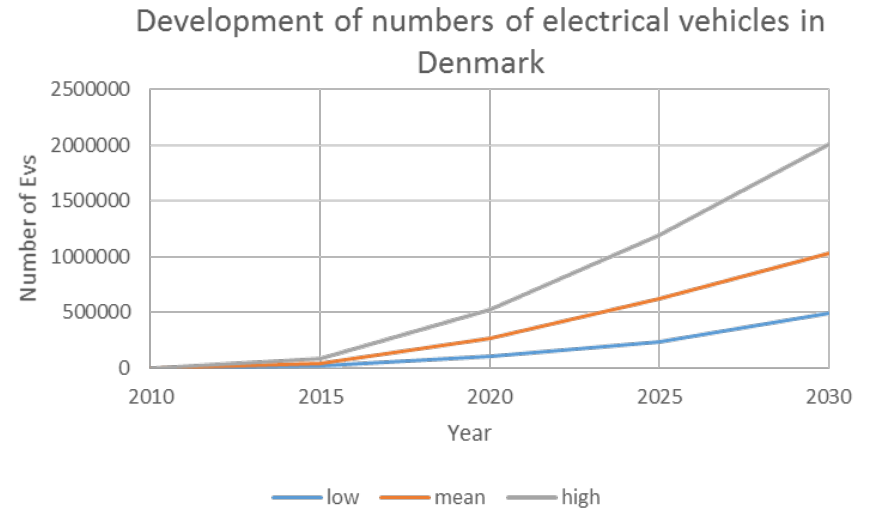
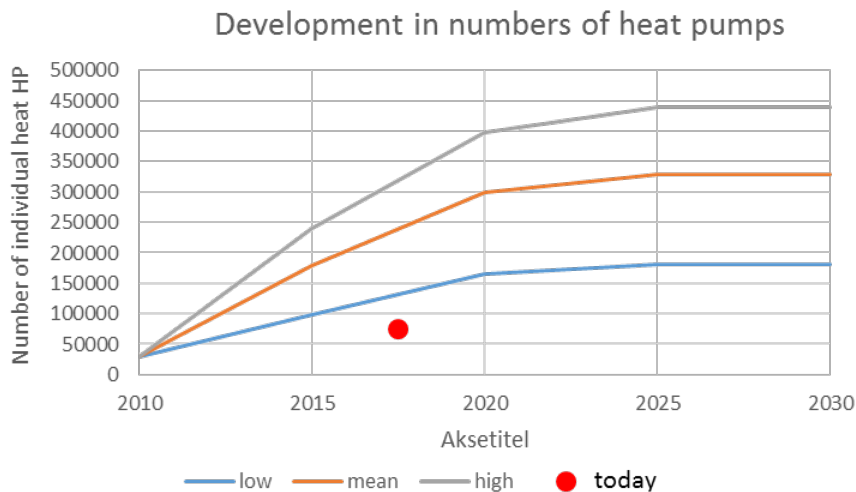
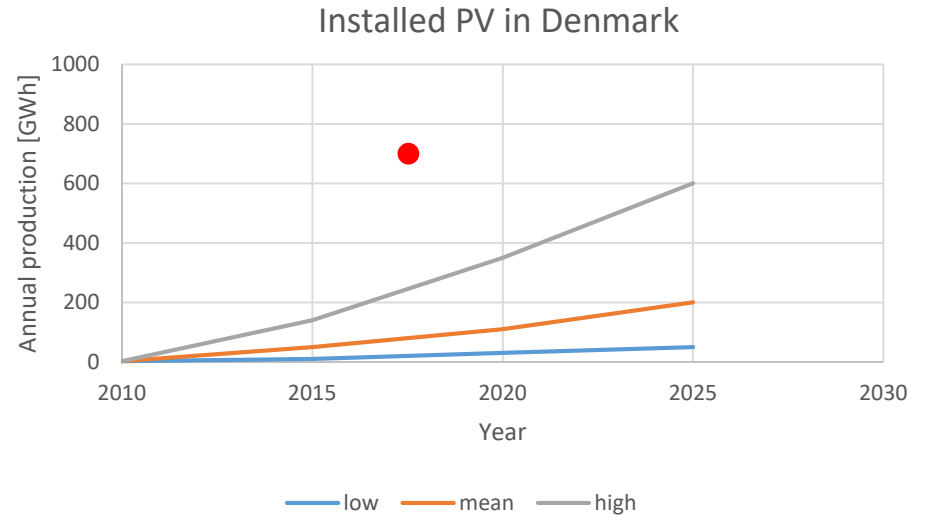
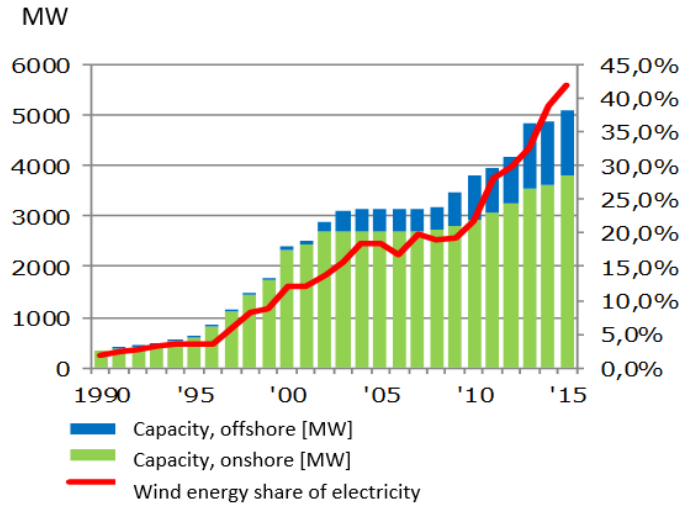
Common understanding that we need to replace fossil fuels with renewable energy



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



Production and demand are not coincident



Solutions to large share of RES in the energy systems

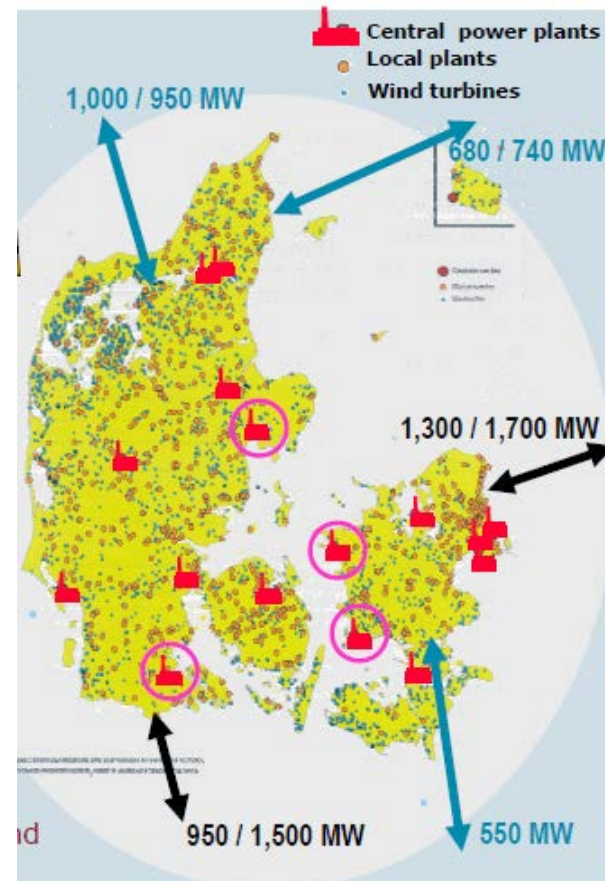
Large interconnectors - export/import

Heat pumps in district heating

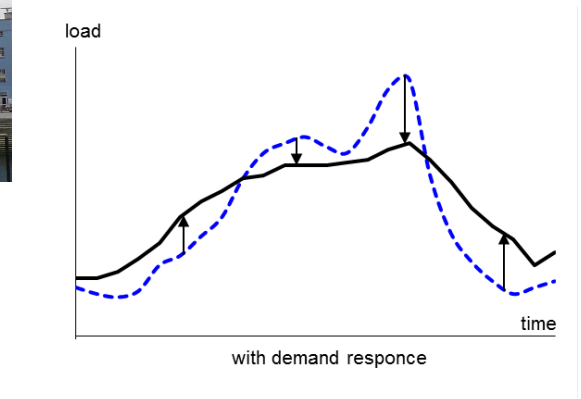
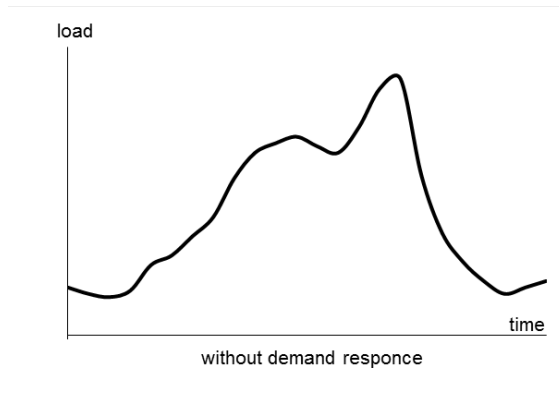
Generation of hydrogen and
upgrading of biogas

RES based fuel factories

Demand response – industry and
buildings

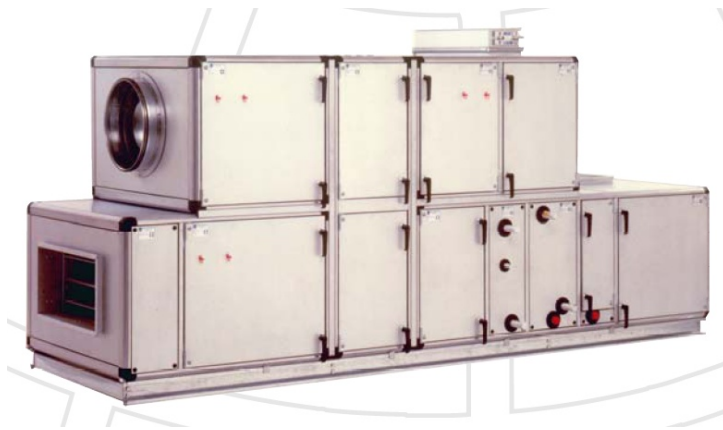


Most buildings have the ability to become energy flexible



Commercial buildings

ventilation systems



PAC 128 HF-A

cooling systems

supermarkets

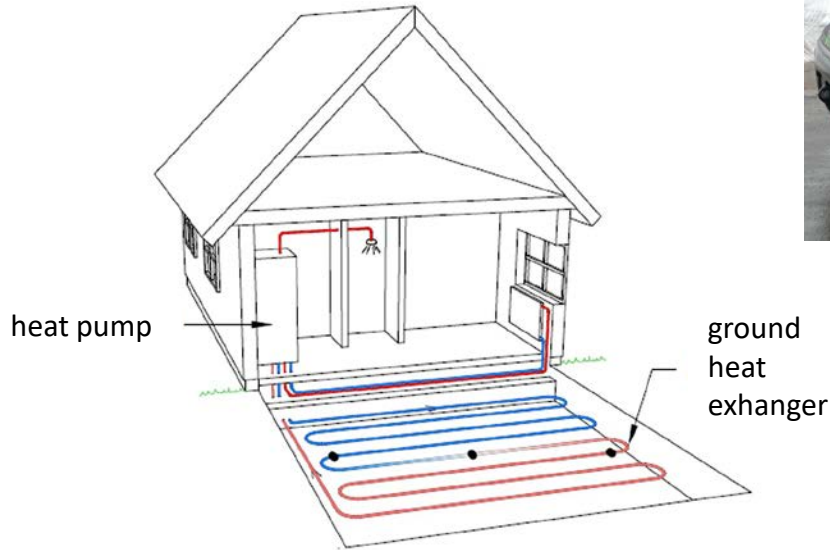


pumps



Electricity demand in households

heat pumps (aircondition)

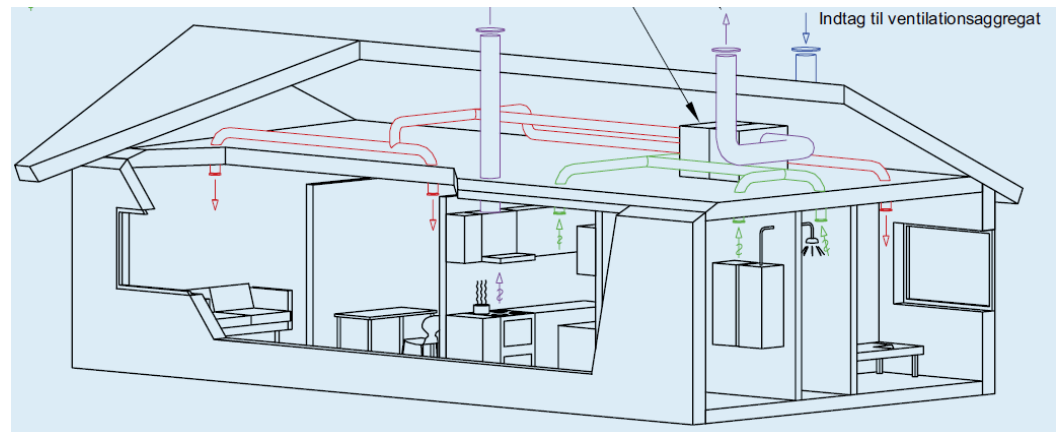


EVs

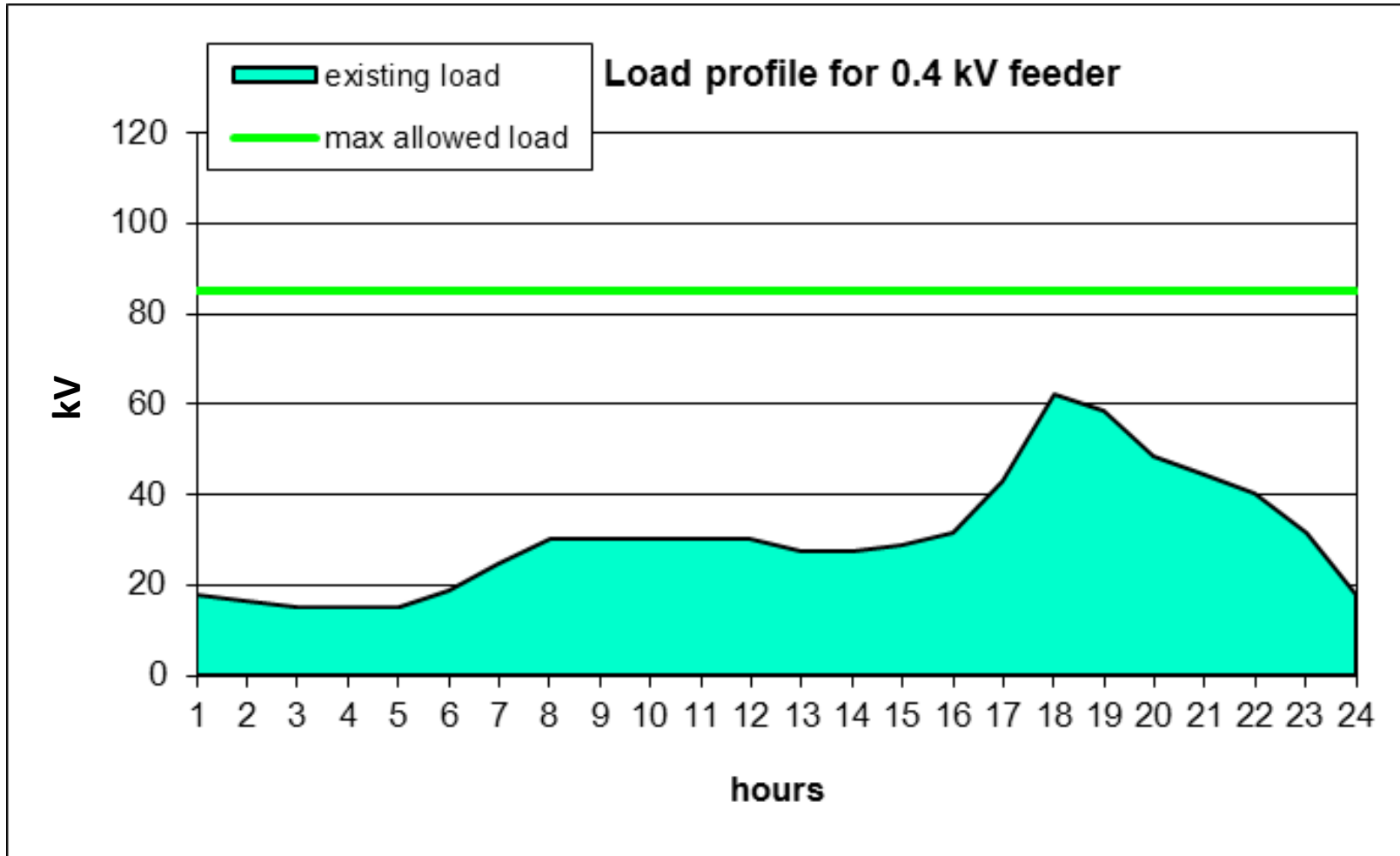
ventilation systems



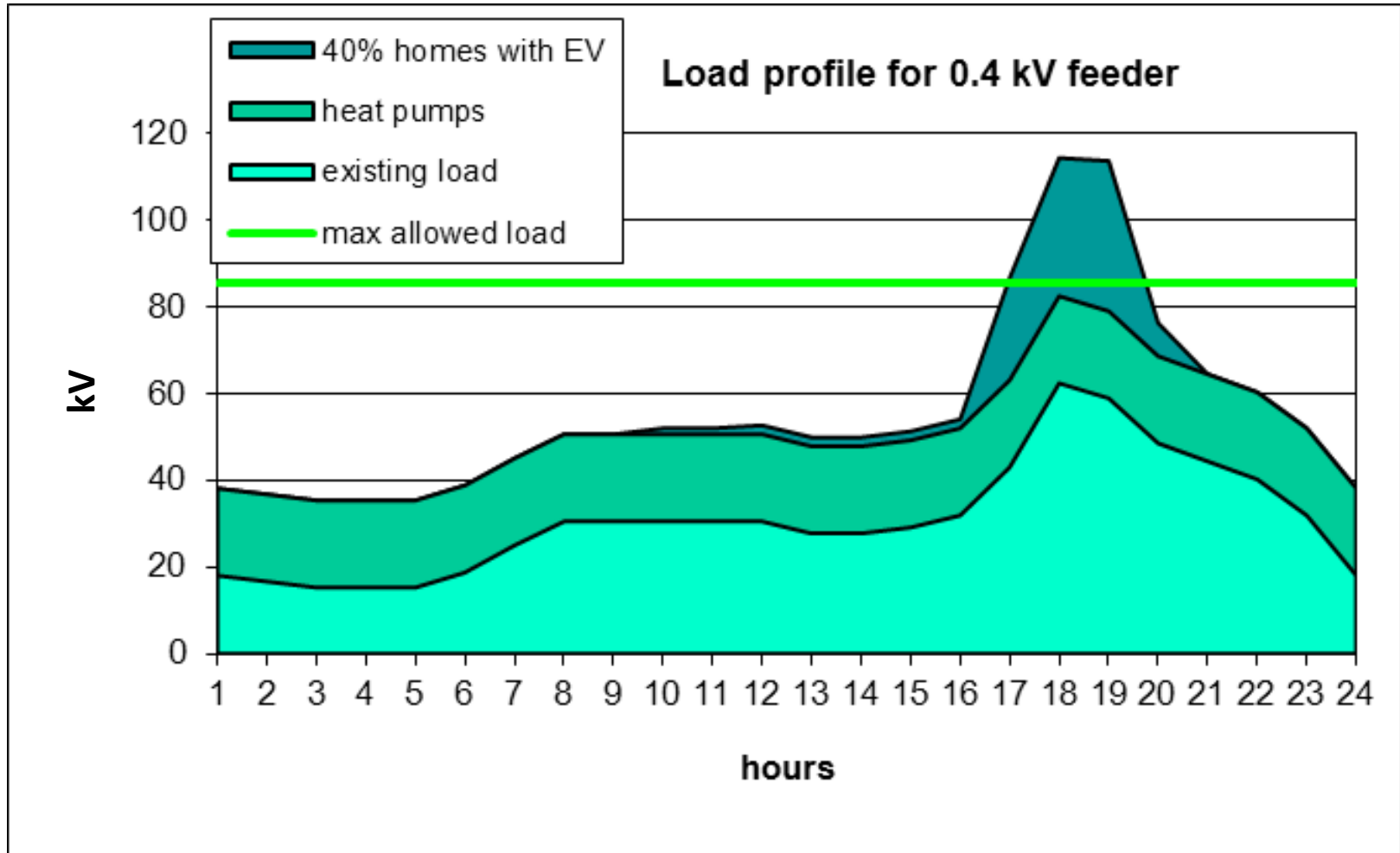
white goods



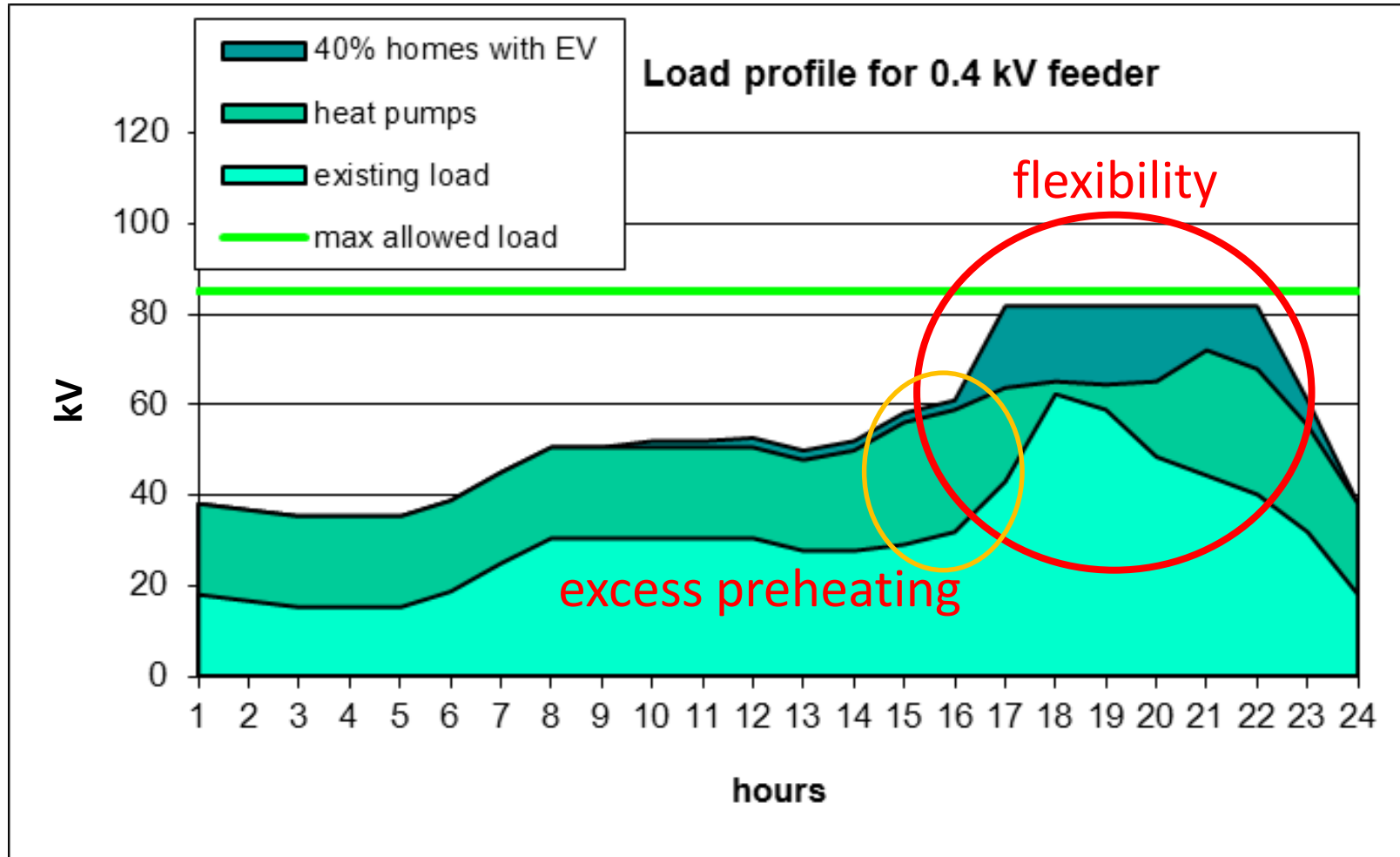
Example



Example



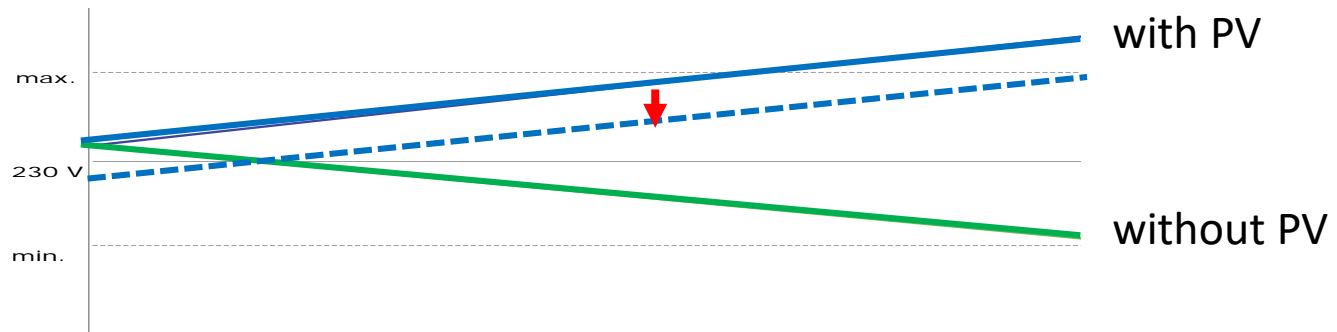
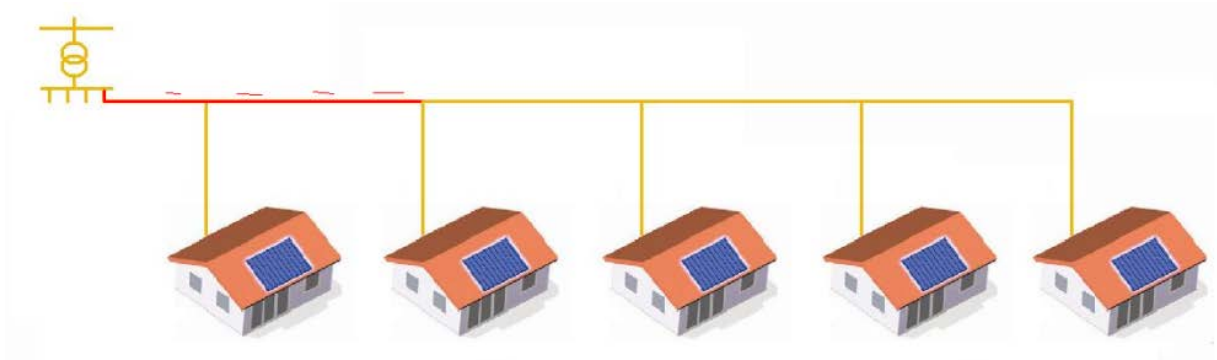
Example



Prosumers



Voltage problems



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 CO₂ 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

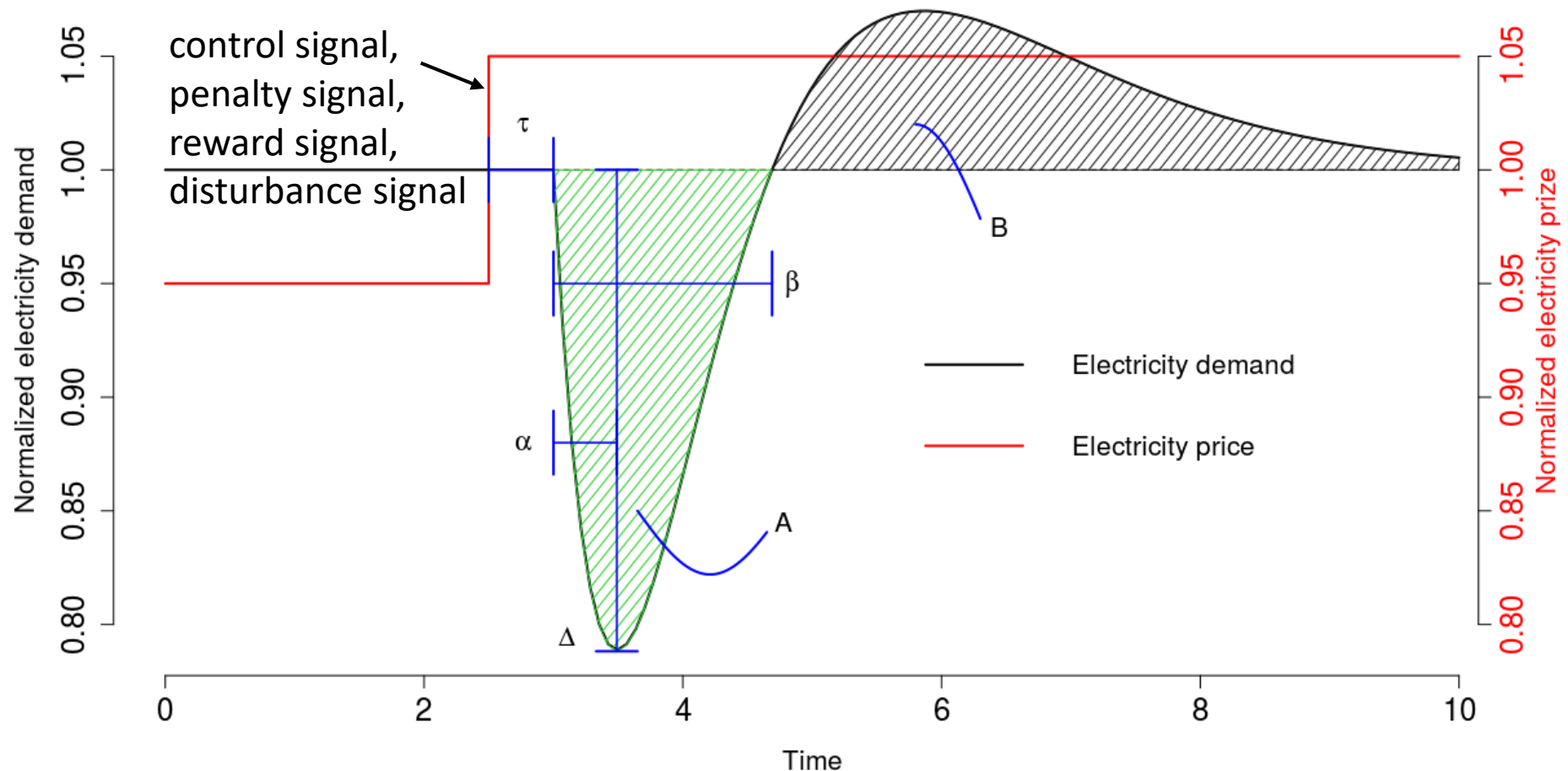
Contribution of Annex 67 to the European Smart Building Initiatives

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

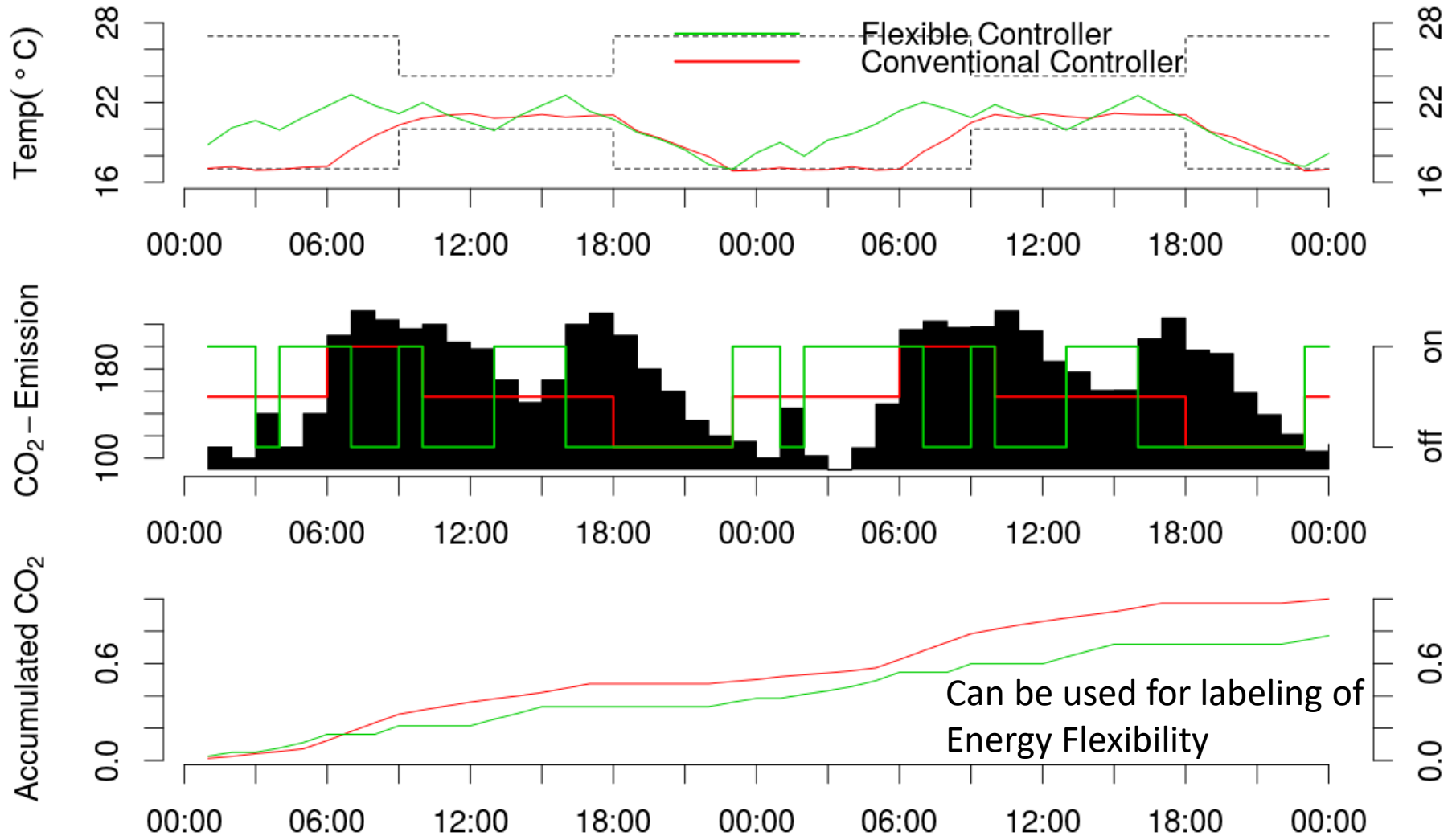
October 2017

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

Characterization and labelling of Energy Flexibility in buildings



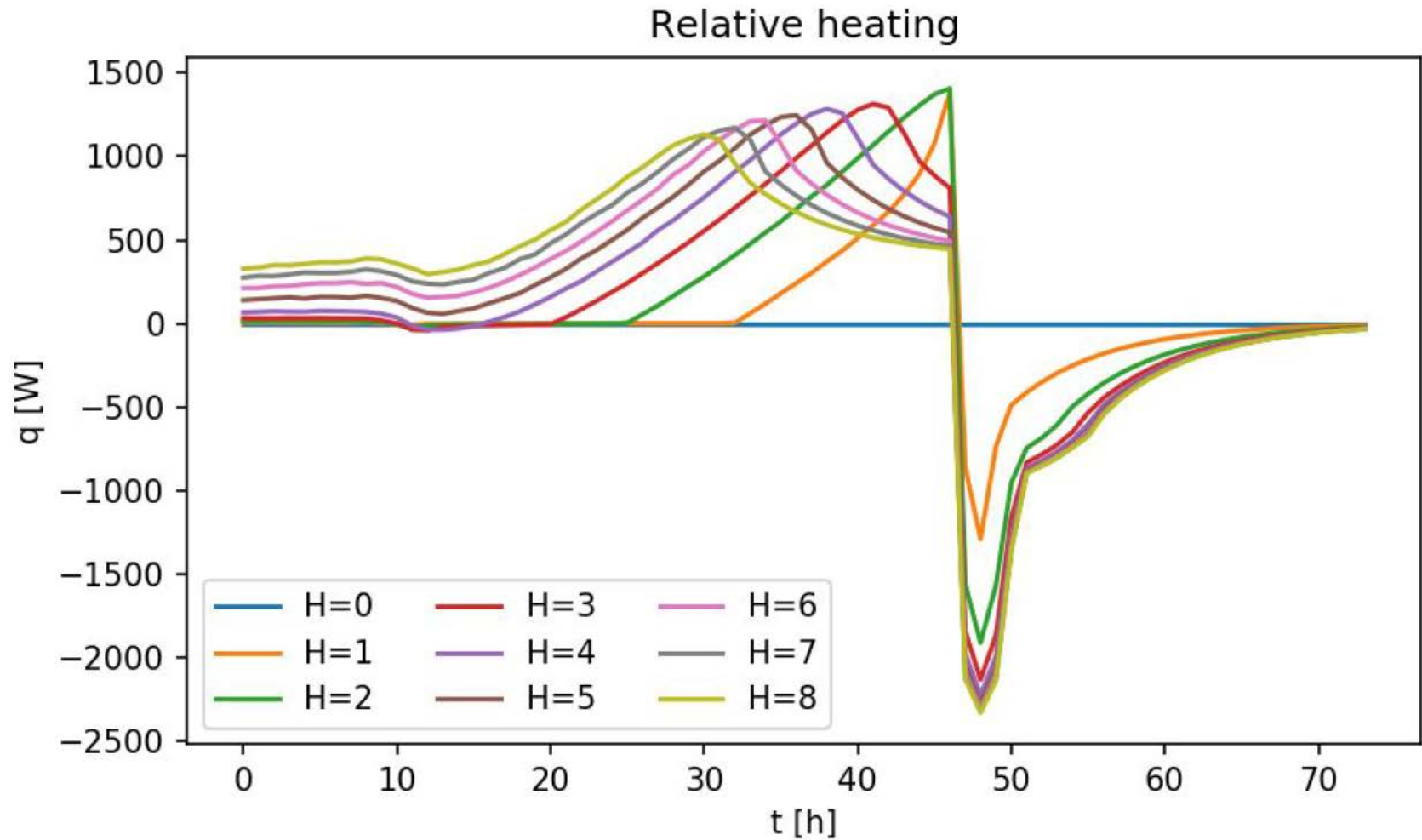
Energy Flexibility in buildings



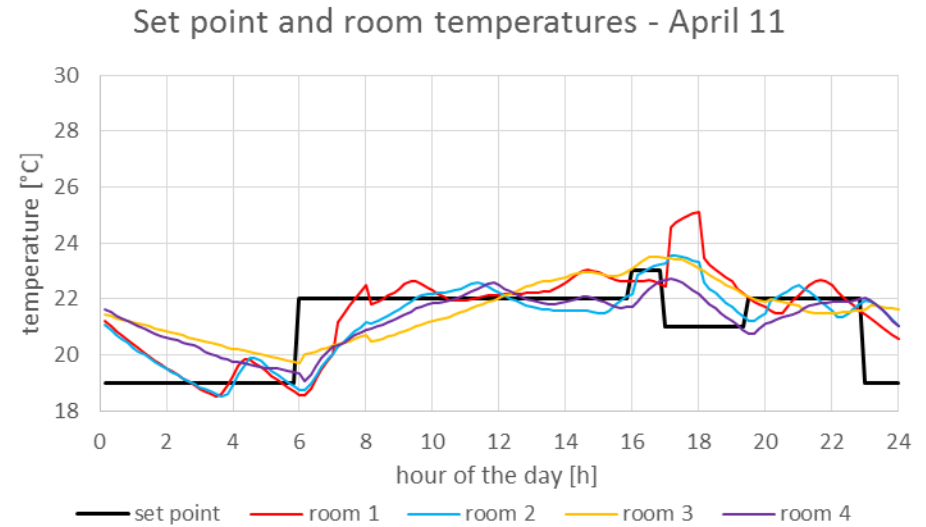
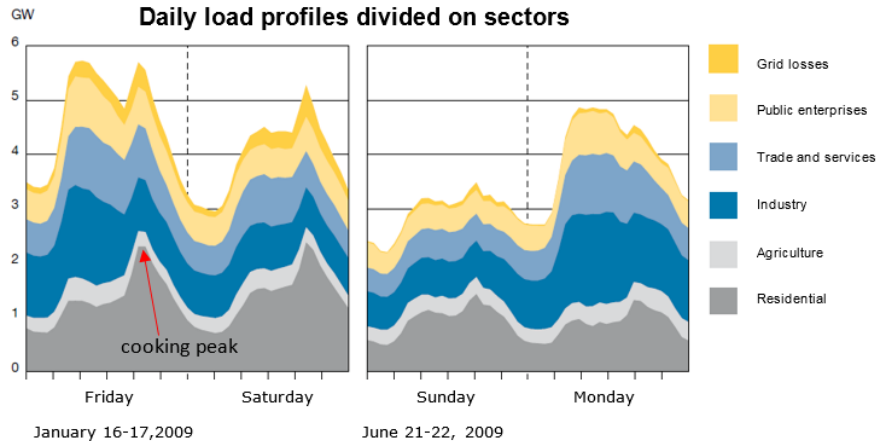
Characterizing the Energy Flexibility of Buildings and Districts.

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

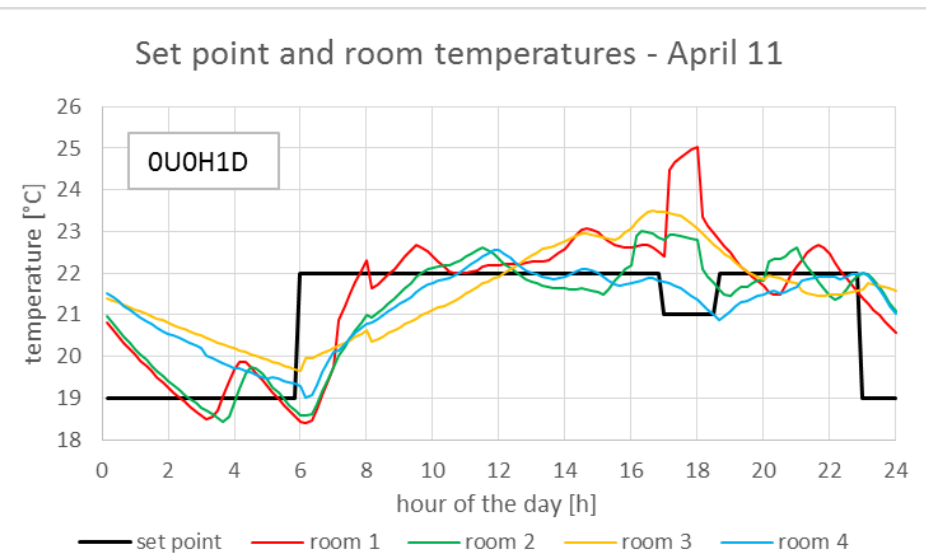
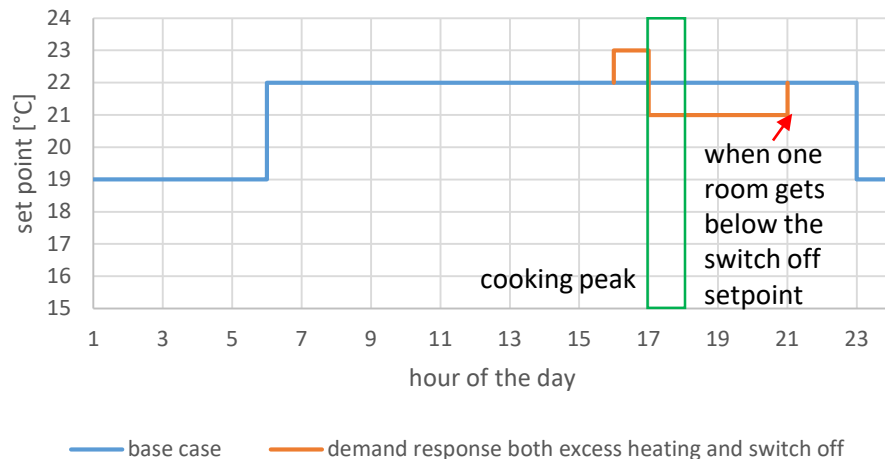
Pre-use of energy



Energy Flexibility in buildings



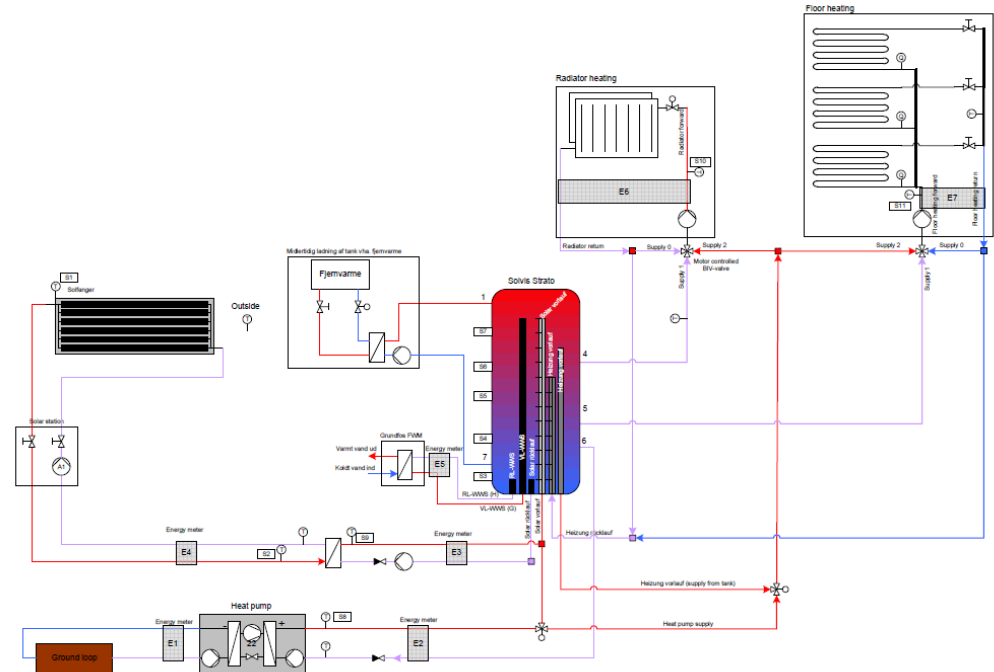
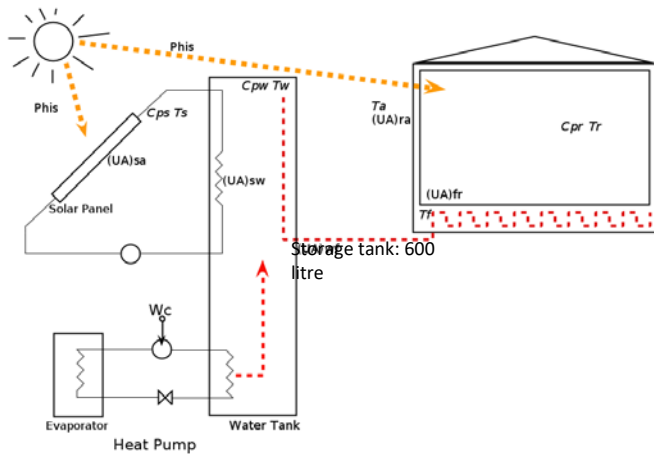
Temperature set point



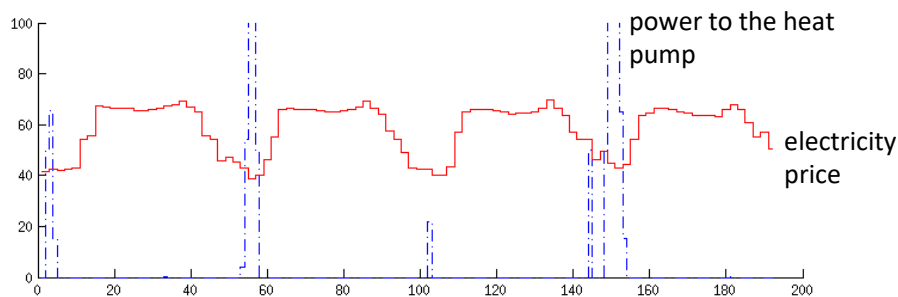
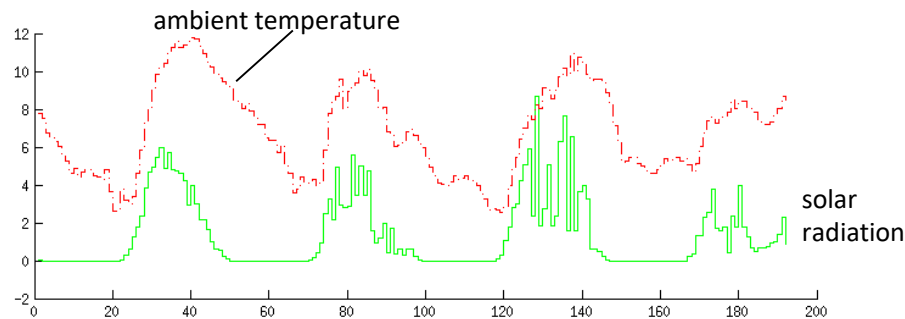
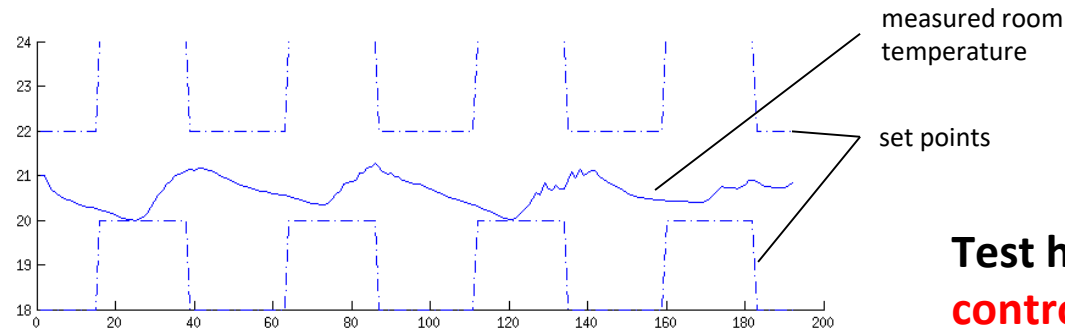
Example of a controller



Test house at Grundfos: **indirect control, price signal, forecast, EMPC**



Example: EMPC



Test house at Grundfos: indirect control, forecast, price signal, EMPC

Simulation with 48 h prediction horizon using perfect forecasts.
Savings: 30 % in DKK but 8 % larger energy demand.

Results from test in the test house during January-May 2014 utilizing 24 h forecast: 16 % cost saving with dynamic tariffs and 8 % cost saving with flat tariffs.

Modeling and Control for Price Responsive Electricity Loads. Jacopo Parvizi

[http://orbit.dtu.dk/en/publications/modeling-and-control-for-price-responsive-electricity-loads\(7ff027e9-cb51-4baa-b28f-d940a9e94a1e\).html](http://orbit.dtu.dk/en/publications/modeling-and-control-for-price-responsive-electricity-loads(7ff027e9-cb51-4baa-b28f-d940a9e94a1e).html) (Publication C)

What is the possible Energy Flexibility in buildings?

It depends

- type of building and energy service systems
- use of the building
- climate
- time of the day and the year
- occupants
- control possibilities
- state of storage (constructions, tank, battery, ...)
- physical max vs. cost optimal energy flexibility
- surrounding grids
- energy tariffs
- ...

Challenge concerning Energy Flexibility of buildings

Currently there is, however, **still** no **real** overview or insight into how much Energy Flexibility different building types and their usage may be able to offer to future energy systems.

There is thus a need for increasing knowledge on and demonstration of the services Energy Flexible Buildings can provide for the energy grids as well to identify critical aspects and possible solutions to manage this Energy Flexibility.

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

Seventh working meeting:

Montreal, October 10-12, 2018

Eight working meeting:

Aalborg, Denmark April 2019

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.

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

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

Website

annex67.org



The screenshot shows a web browser window displaying the homepage of annex67.org. The browser's address bar shows the URL "annex67.org". The website header includes the EBC logo, the text "ANNEX 67", and a search bar. A navigation menu contains links for Home, About Annex 67, Subtasks, Publications, Newsletters, Next meeting, Participants, Contact, and Member login. The main content area features two paragraphs of text and a diagram illustrating the hierarchy of energy flexibility levels. Below the text are two images: one showing a person working on a laptop and another showing a person with a dog. The footer contains a taskbar with various application icons and a system tray with the date and time.

Home About Annex 67 Subtasks Publications Newsletters Next meeting Participants Contact Member login

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
- Workplace
- User

Objectives

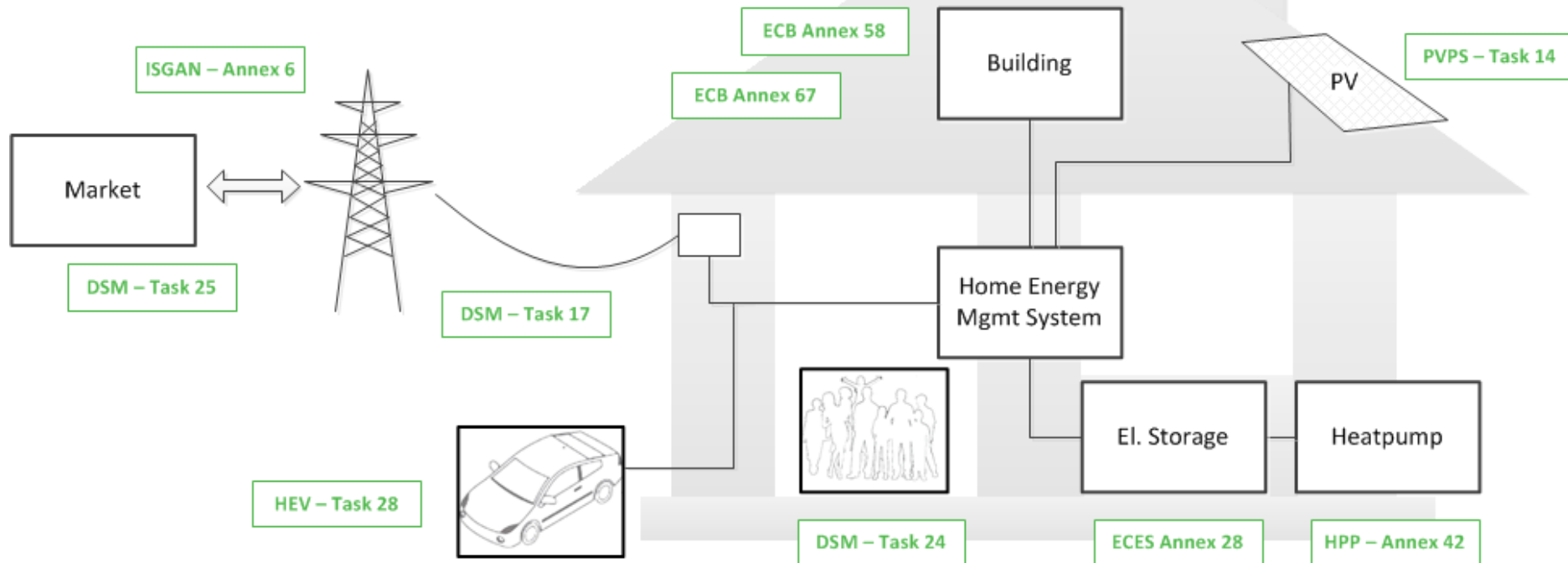
Project beneficiaries

10:08
13/03/2017

Other related IEA activities



Demand Flexibility and RES Integration



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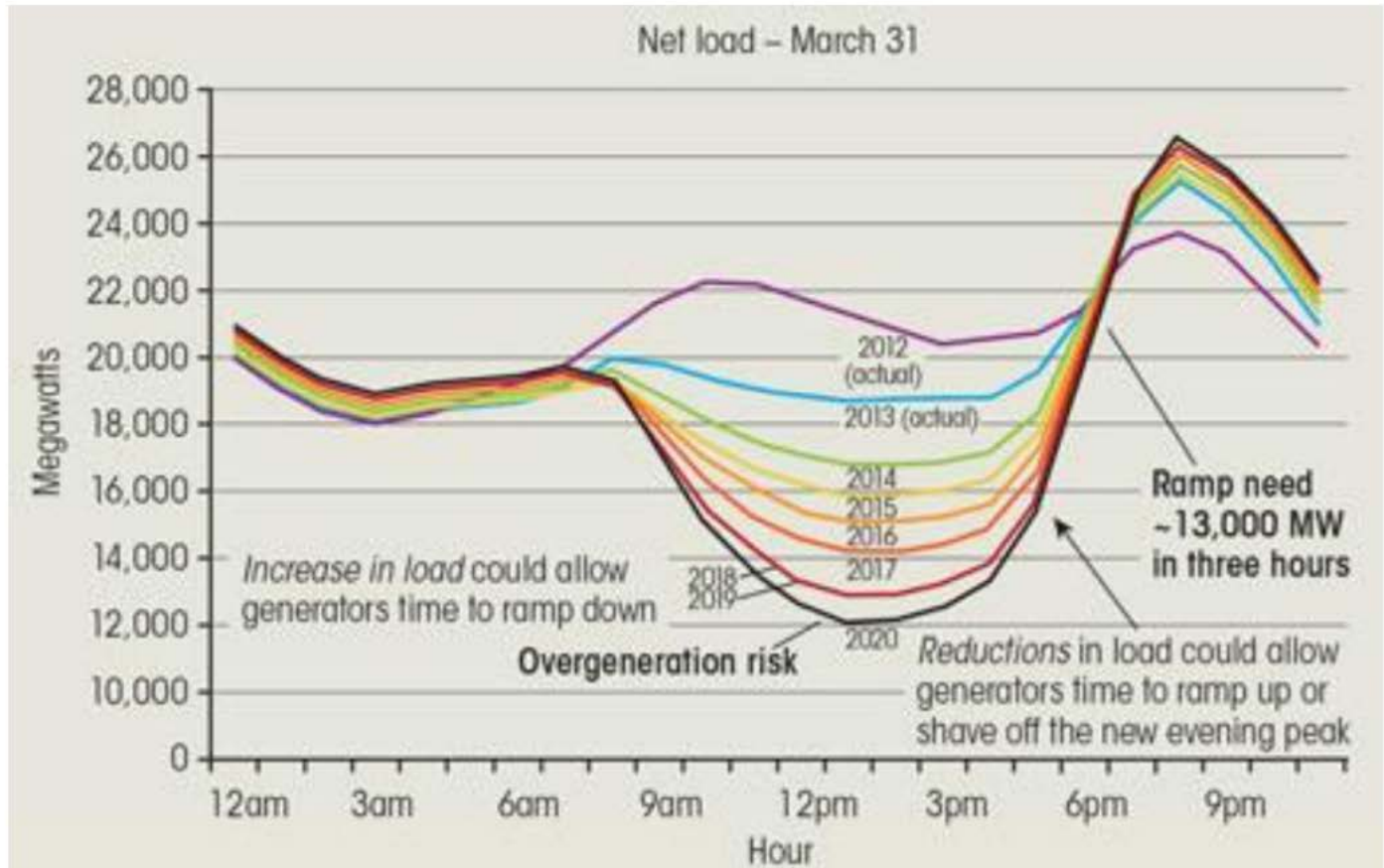
OCTOBER 10-11, 2018 / PINNACLE HARBOURFRONT HOTEL / VANCOUVER, BC

REGISTRATION IS OPEN

GridOptimal initiative

The Duck Curve

Renewables
offset
conventional
generation
without
reducing peak
load



Thank you for your attention