

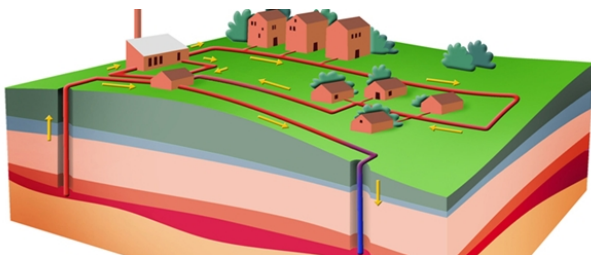
# Energy Flexible Buildings

## IEA EBC Annex 67

Operating Agent  
Søren Østergaard Jensen  
Danish Technological Institute  
[sdj@teknologisk.dk](mailto:sdj@teknologisk.dk)

IEA Experts' Group on R&D Priority Setting and Evaluation  
meeting on System Resiliency and Flexibility  
May 13-14, Vienna, Austria

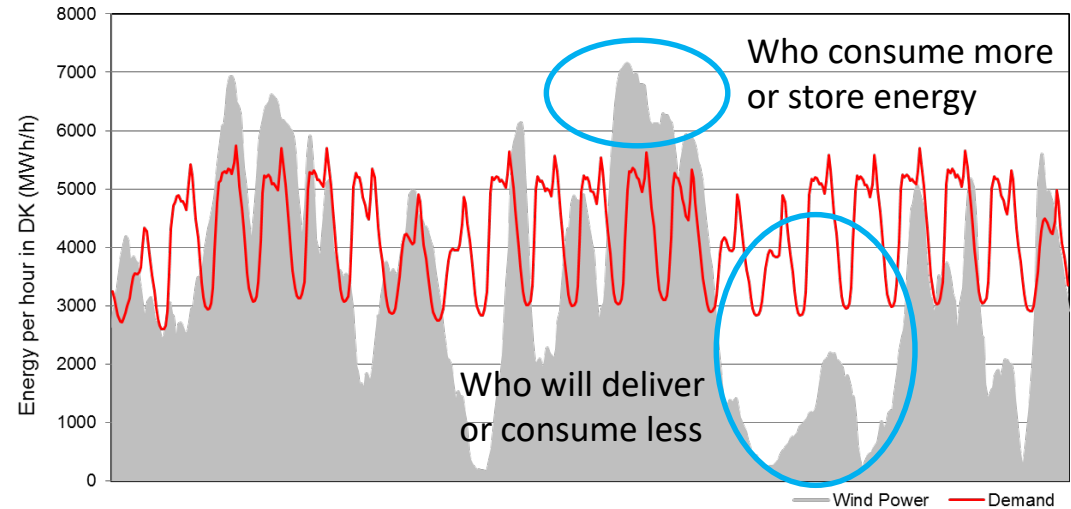
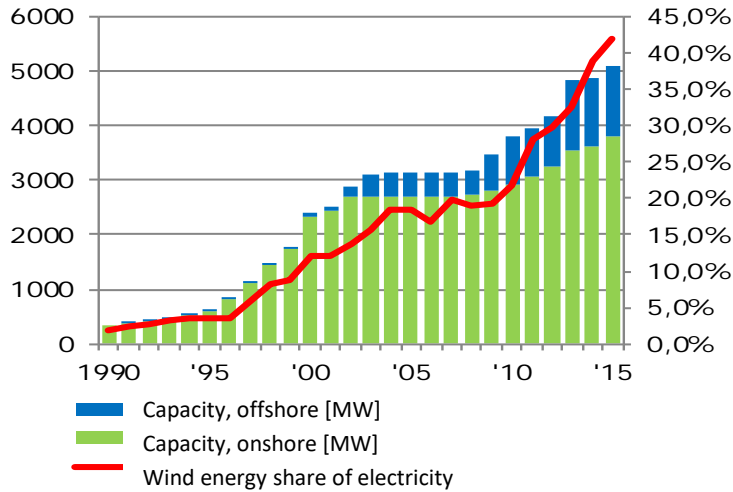
# Common understanding that we need to replace fossil fuels with renewable energy



# Example: Demnark

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

MW



## Solutions

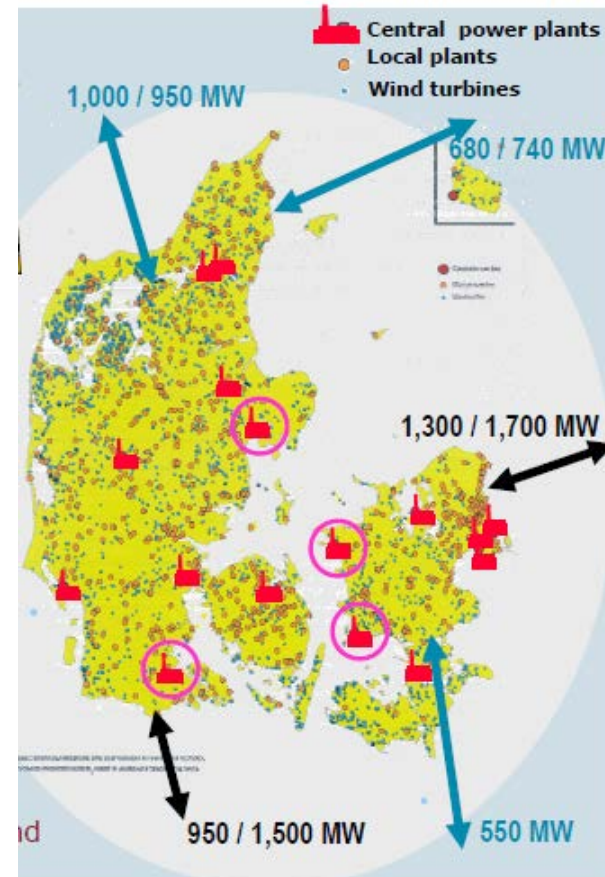
Large interconnectors - export/import

Heat pumps in district heating

Generation of hydrogen and  
upgrading of biogas

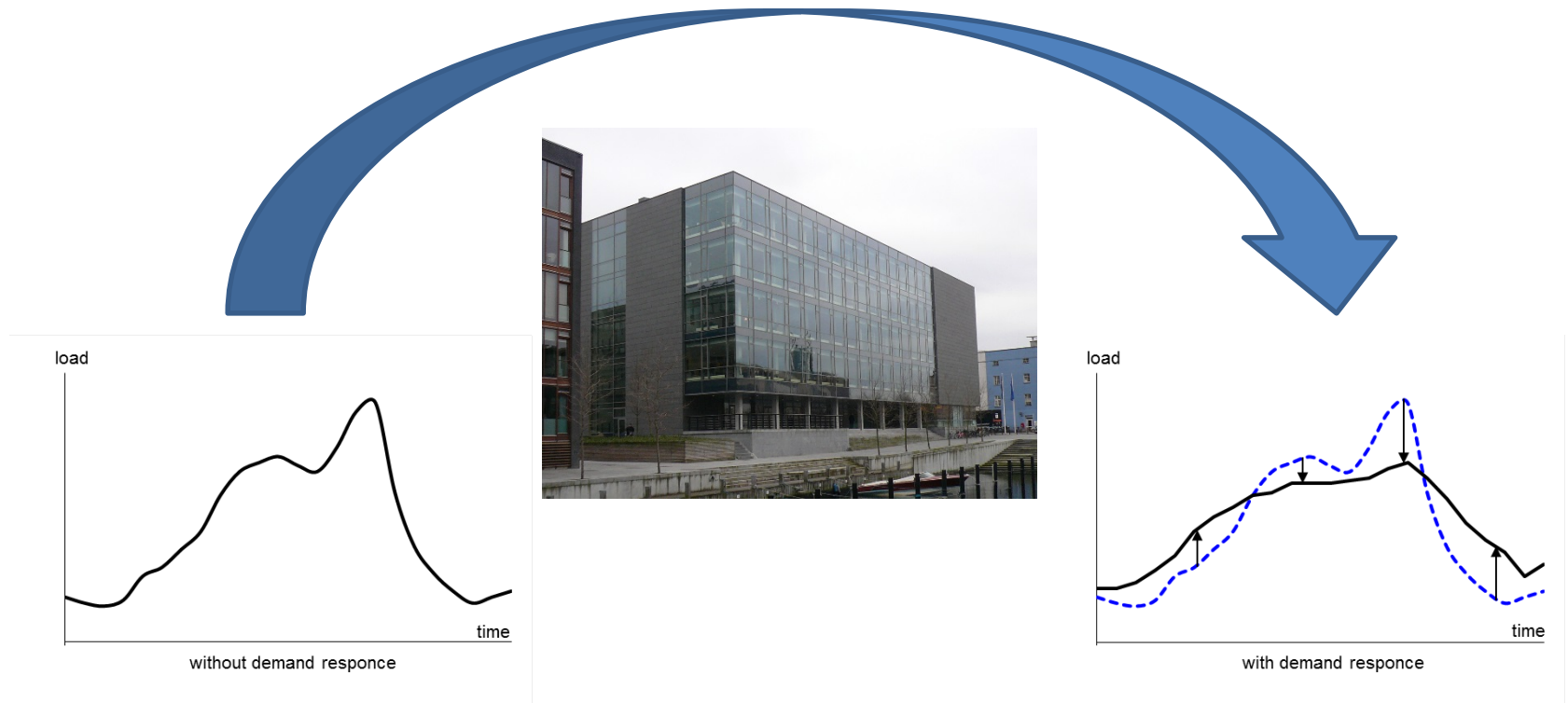
Fuel factories

Demand response – industry and  
buildings



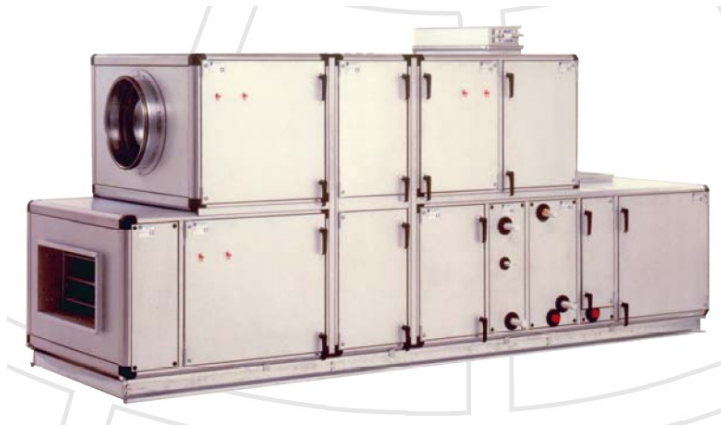


# Most buildings have the ability to become energy flexible



# Commercial buildings

ventilation systems



PAC 128 HF-A

cooling systems

supermarkets

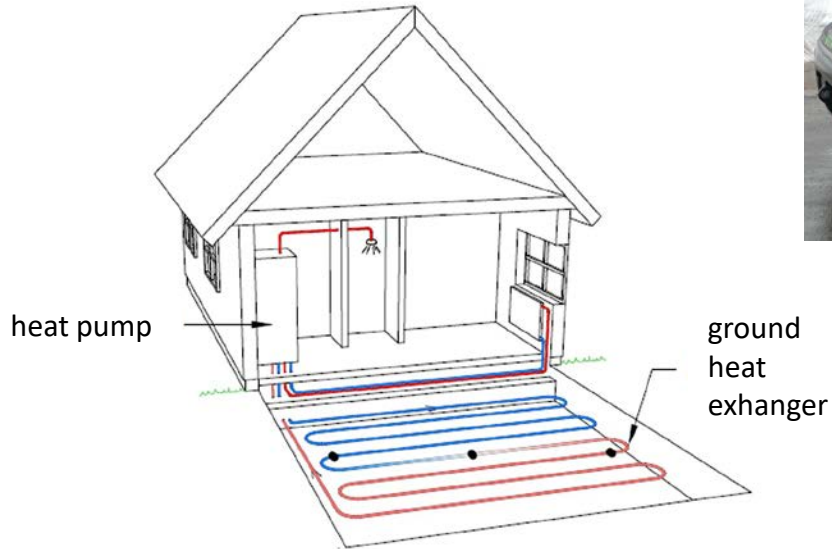


pumps



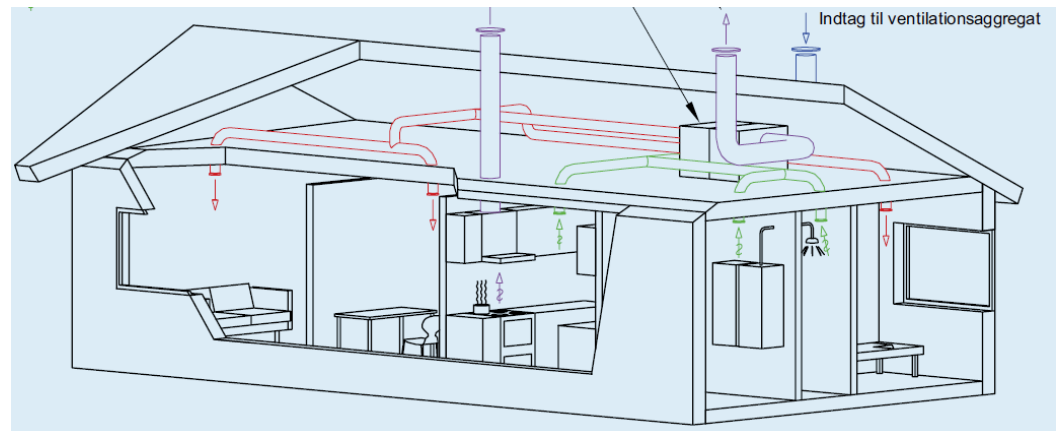
# Electricity demand in households

## heat pumps (aircondition)



## EVs

## ventilation systems



## white goods

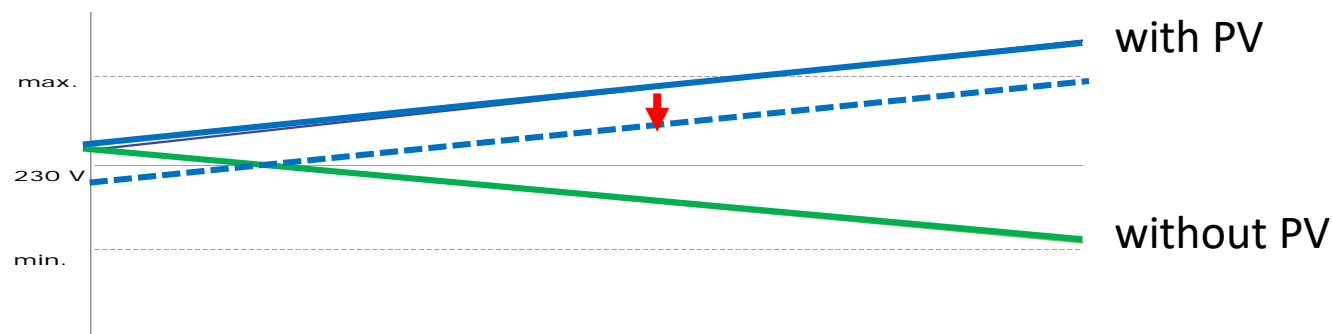
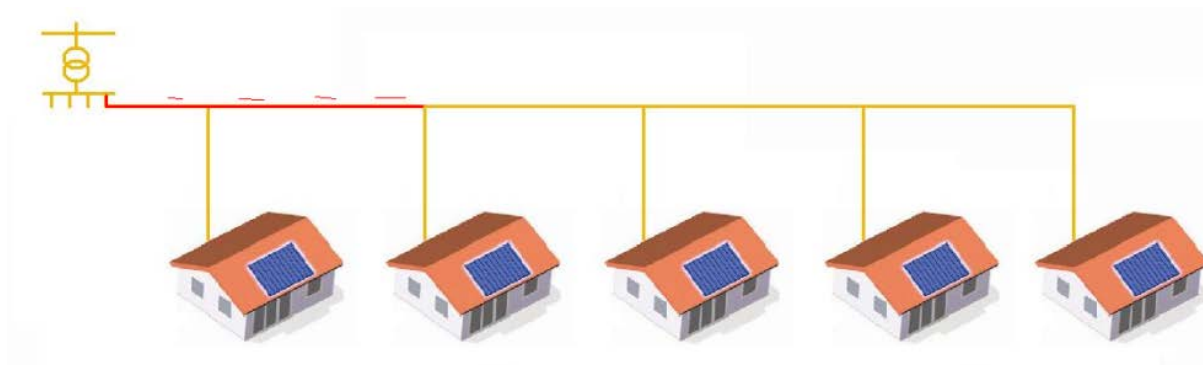


# Prosumers





# Voltage problems



# 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.

# European Union

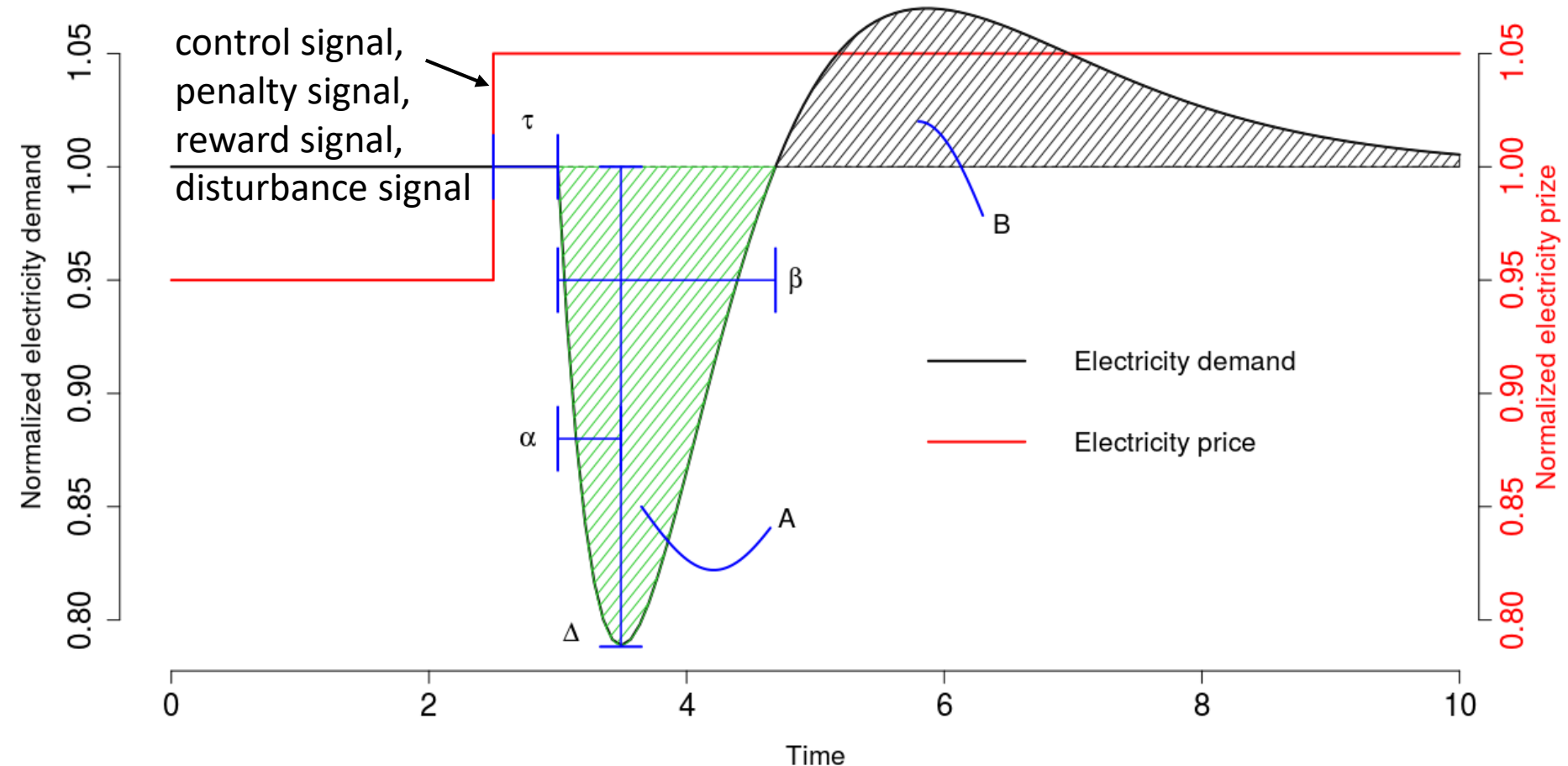
## Smart Readiness Indicator (SRI) in EBPD (Energy Performance in Buildings Directive)

- 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

Annex 67 Position Paper:

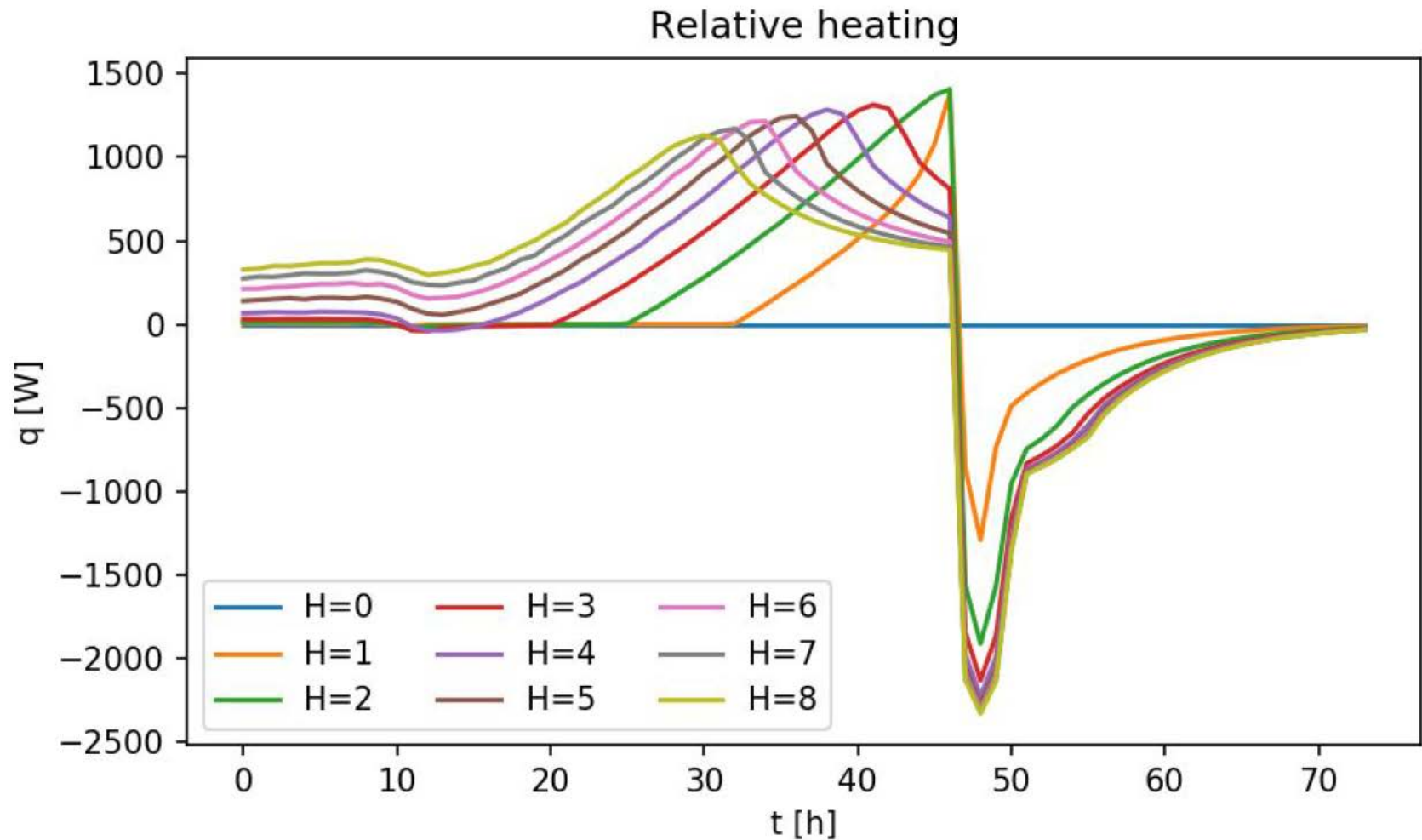
<http://www.annex67.org/media/1470/position-paper-energy-flexibility-as-a-key-asset-i-a-smart-building-future.pdf>

# Characterization and labelling of Energy Flexibility in buildings

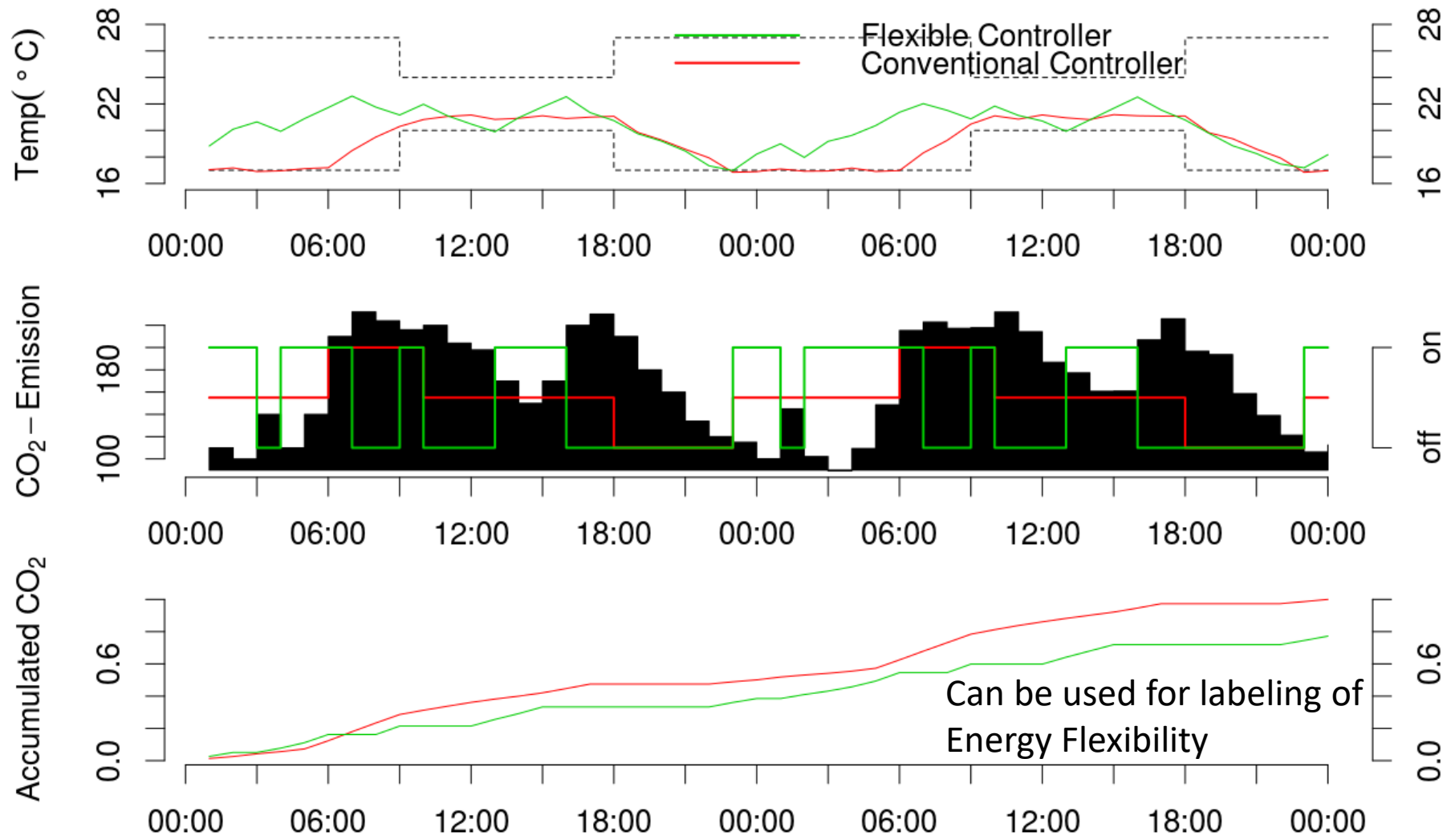




# Pre-use of energy



# Energy Flexibility in buildings



Characterizing the Energy Flexibility of Buildings and Districts.

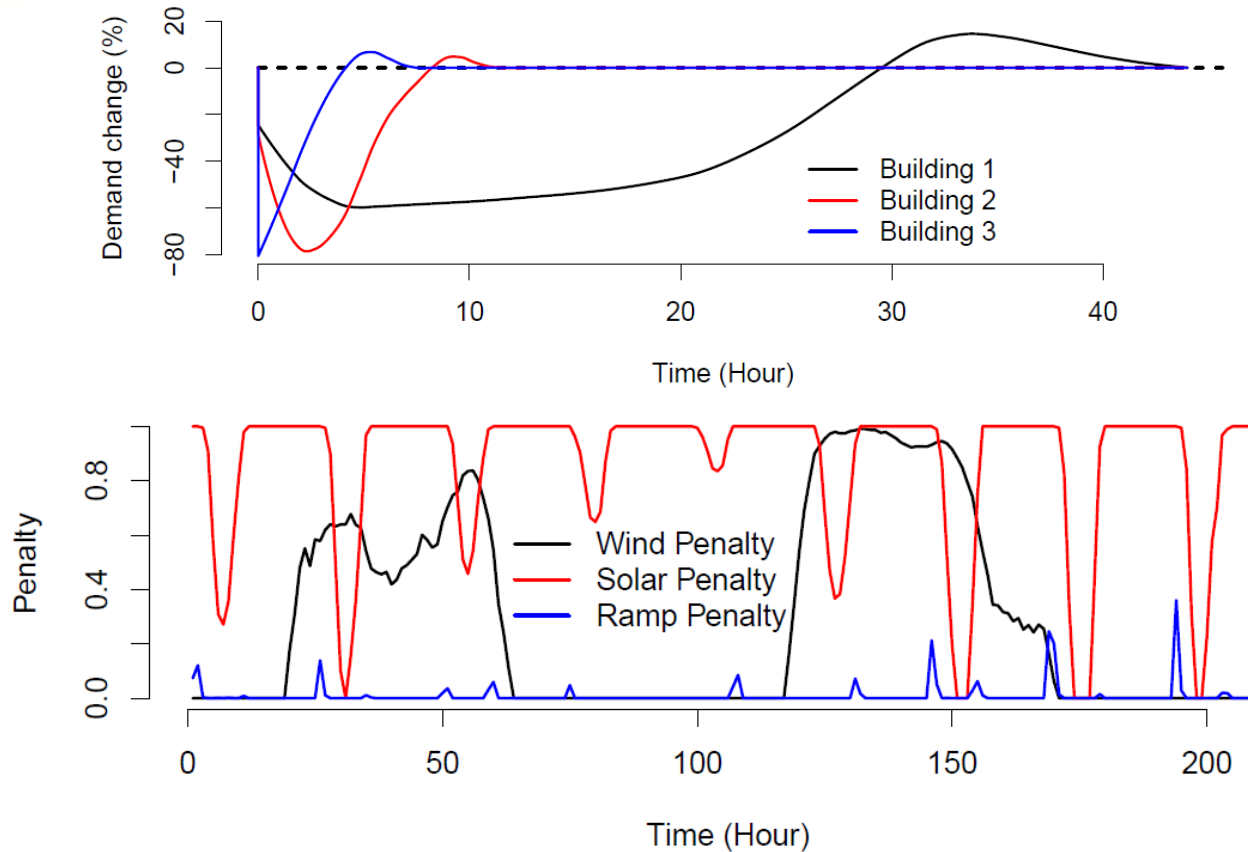
<https://www.sciencedirect.com/science/article/pii/S030626191830730X>

# 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
- ...

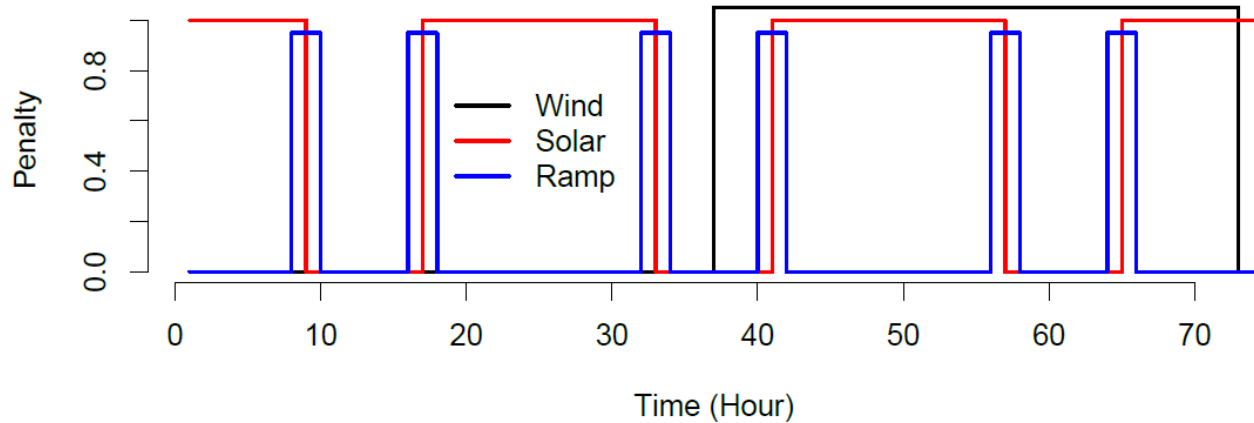
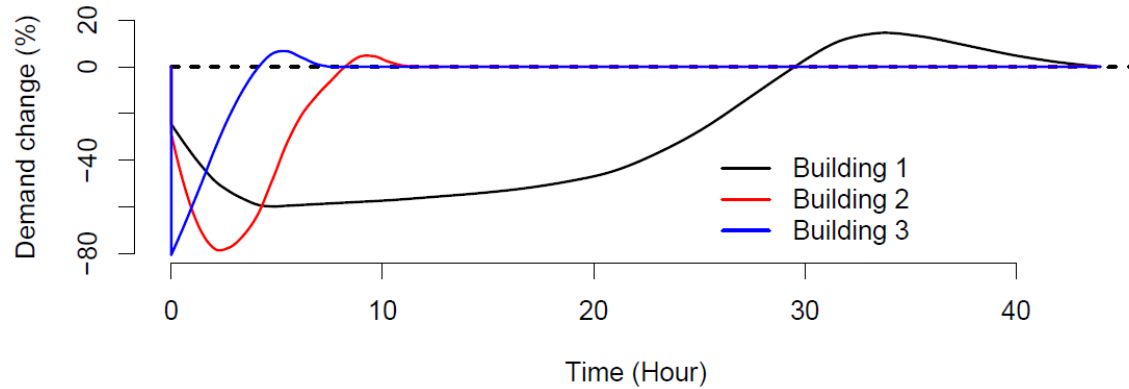
# Flexibility Saving Index



	Wind (%)	Solar (%)	Ramp (%)
Building 1	11.8	3.6	1.0
Building 2	4.4	14.5	5.0
Building 3	6.0	10.0	18.4



# Flexibility Index



	Wind (%)	Solar (%)	Ramp (%)
Building 1	36.9	10.9	5.2
Building 2	14.4	47.9	22.3
Building 3	17.9	35.6	67.5

# Expected Flexibility Saving Index vs. Flexibility Index

	Wind (%)	Solar (%)	Ramp (%)
Building 1	11.8	3.6	1.0
Building 2	4.4	14.5	5.0
Building 3	6.0	10.0	18.4

	Wind (%)	Solar (%)	Ramp (%)
Building 1	36.9	10.9	5.2
Building 2	14.4	47.9	22.3
Building 3	17.9	35.6	67.5

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

# Output from Annex 67

- **Principles of Energy Flexible Buildings** summarizes the main findings of Annex 67 and targets all interested in what Energy Flexibility in buildings is, how it can be controlled, and which services it may provide.
- **Characterization of Energy Flexibility in Buildings** presents the terminology around Energy Flexibility, the existing indicators used to evaluate the flexibility potential and how to characterize and label Energy Flexibility.
- **Stakeholder perspectives on Energy Flexible buildings** displays the view point of different types of stakeholders towards Energy Flexible Buildings.
- **Control strategies and algorithms for obtaining Energy Flexibility in buildings** reviews and evaluates control strategies for Energy Flexibility in buildings.
- **Experimental facilities and methods for assessing Energy Flexibility in buildings** describes several test facilities including experiments related to Energy Flexibility and draws recommendations for future testing activities.
- **Examples of Energy Flexibility in buildings** summarizes different examples on how to obtain Energy Flexible Buildings.
- **Project Summary Report** brief summary of the outcome of Annex 67.

# Website

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

The screenshot shows a web browser window with the address bar displaying "annex67.org". The website header features the EBC logo and "ANNEX 67" text, with a search bar and links for "Newsletter signup" and "Login". A navigation menu includes "Home", "About Annex 67", "Subtasks", "Publications", "Newsletters", "Next meeting", "Participants", "Contact", and "Member login".

The main content area contains two paragraphs of text and a diagram. The first paragraph states: "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."

The second paragraph states: "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."

Below the text is a link: "Read more about Annex 67, [click here](#)".

To the right of the text is a diagram titled "Smart Grid & other energy infrastructures" showing a hierarchy of energy flexibility levels: "Built environment", "Building", "Floor", "Room", "Workplace", and "User". Each level is represented by a blue circle with an icon, connected by a dashed line.

At the bottom of the website, there are two images: "Objectives" (a person working on a laptop) and "Project beneficiaries" (a person lying down).

The browser's taskbar at the bottom shows various application icons and the system clock indicating 10:08 on 13/03/2017.



# Participating countries

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

# Key messages

- Energy flexibility from buildings may help to stabilize the future energy grids based entirely on renewable energy
- The available energy flexibility of buildings is dependent on the building, the users and the conditions in the grids
- Energy flexibility from buildings should be considered at an aggregated level

**Thank you for your attention**