Energy Flexible Buildings

IEA EBC Annex 67

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

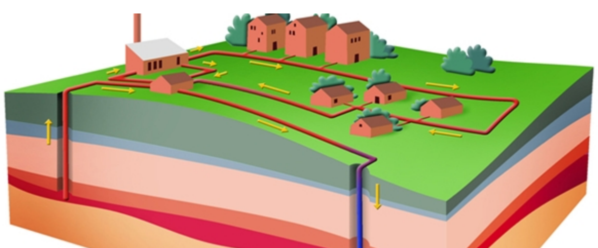
Meeting in CITIES,
Lyngby, April 23, 2018

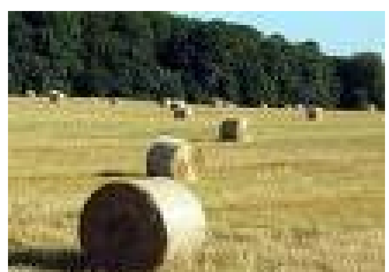
EBC
Energy in Buildings and Communities Programme

IEA EBC Annex 67

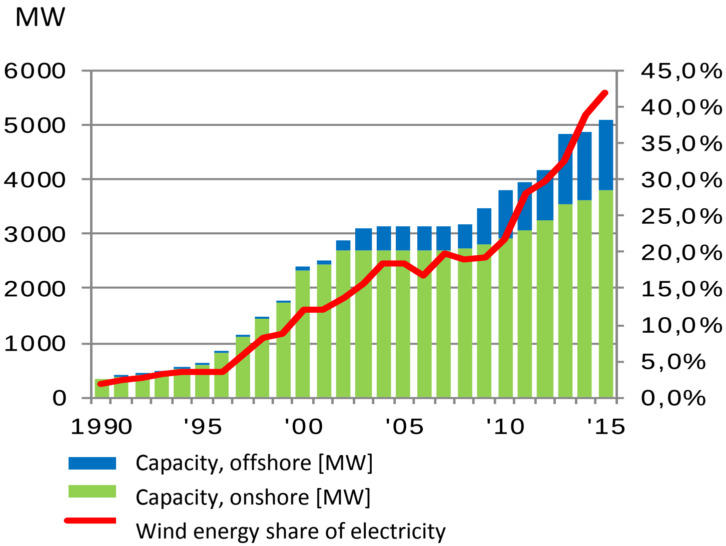
DANISH TECHNOLOGICAL INSTITUTE

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



EBC Energy in Buildings and Communities Programme

DANISH TECHNOLOGICAL INSTITUTE

Solutions to large share of RES in the energy systems

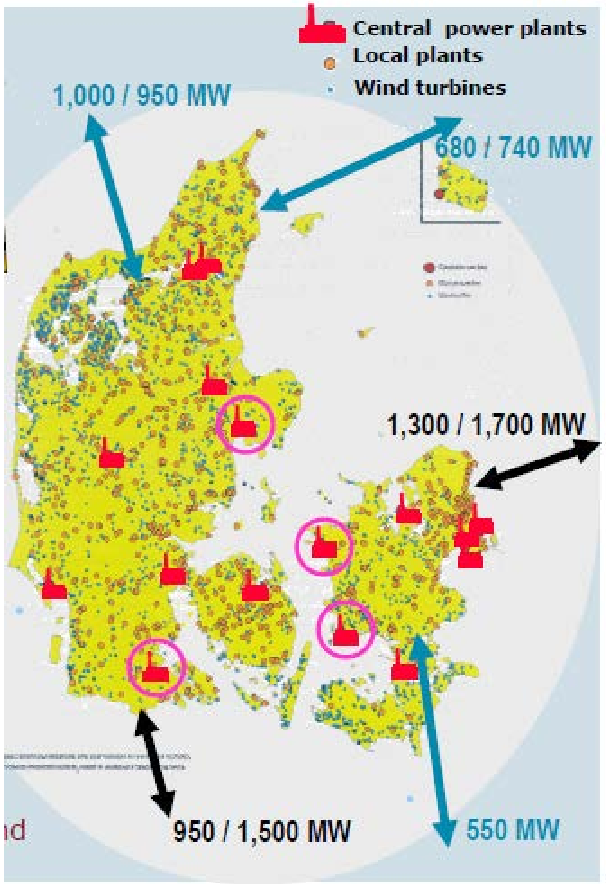
Large interconnectors - export/import

Heat pumps in district heating

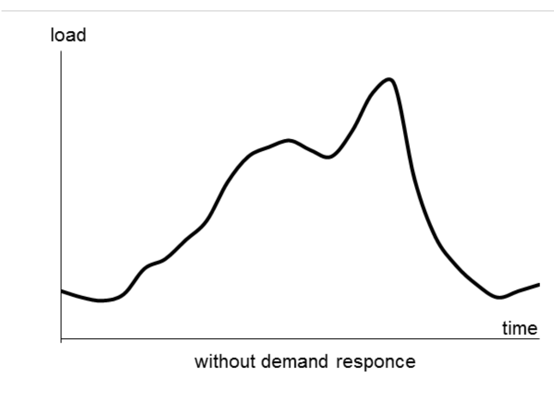
Generation of hydrogen and upgrading of biogas

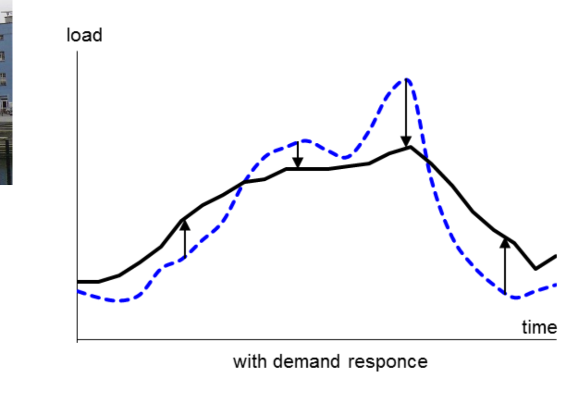
RES based fuel factories

Demand response – industry and buildings



Most buildings have the ability to become energy flexible





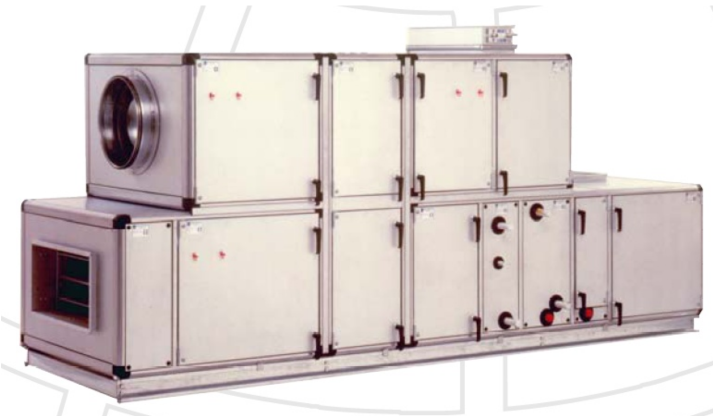
EBC
Energy in Buildings and Communities Programme

Commercial buildings

DANISH
ECHNOLOGICAL
NSTITUTE

cooling systems

ventilation systems

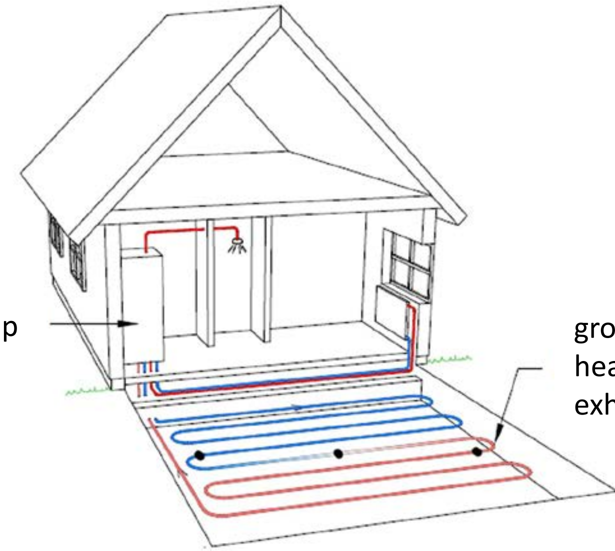


supermarkets

pumps

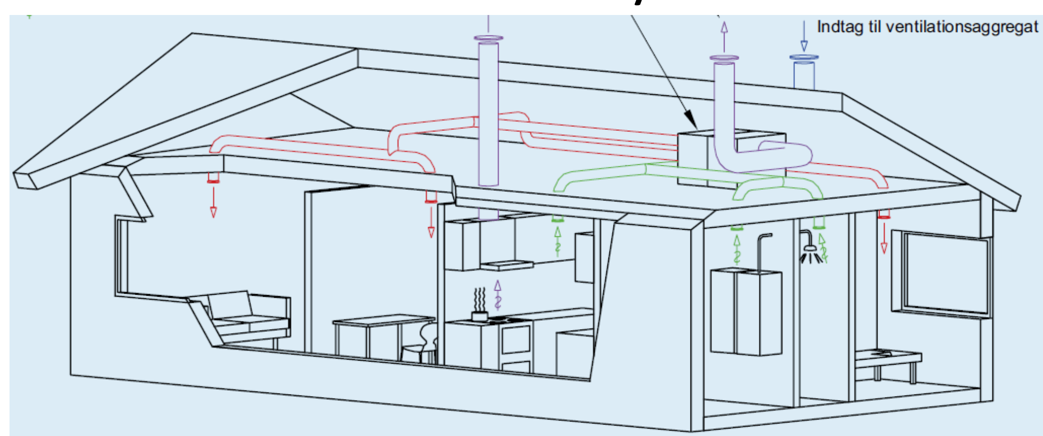
Electricity demand in households

heat pumps (aircondition)



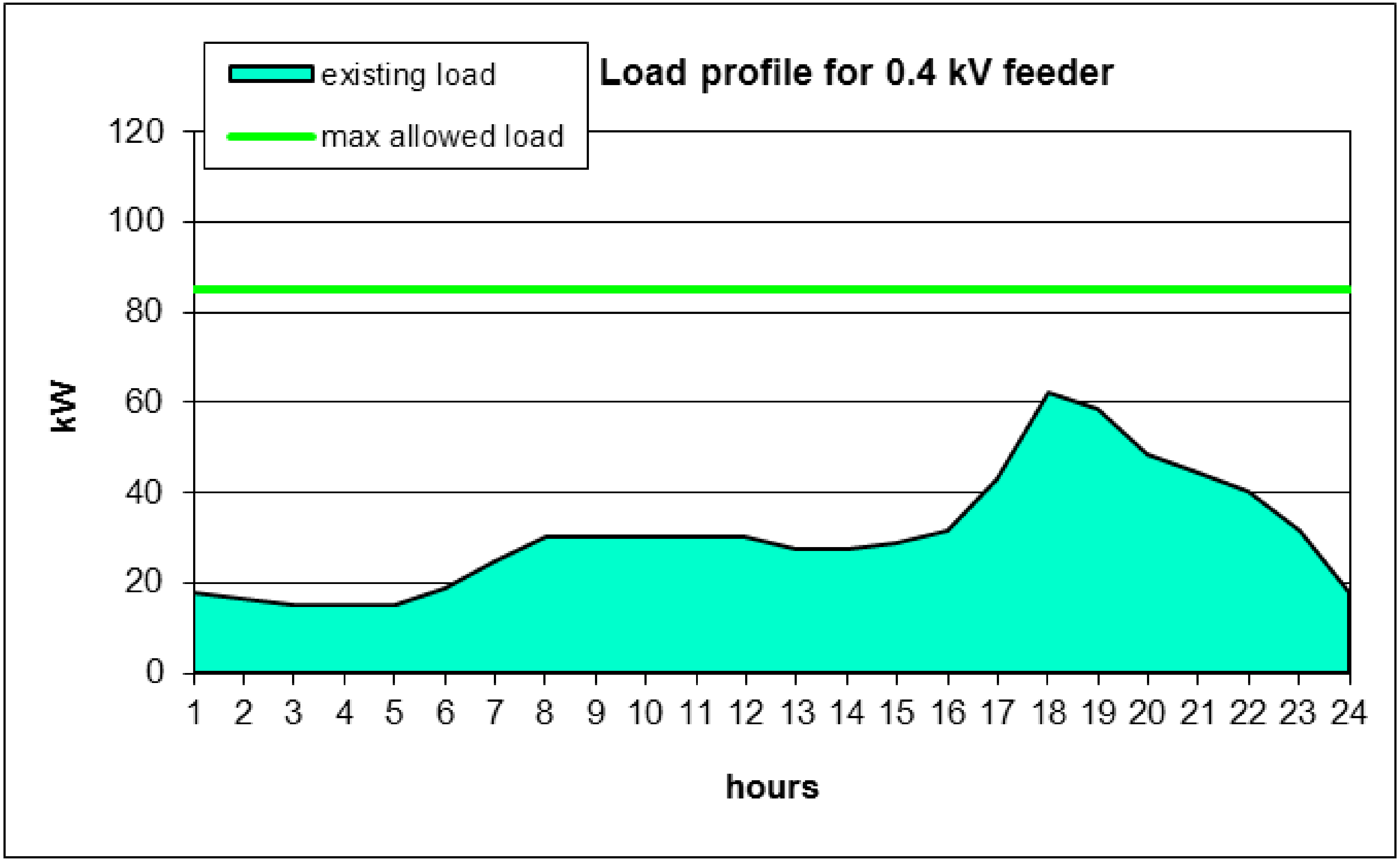
EVs

ventilation systems

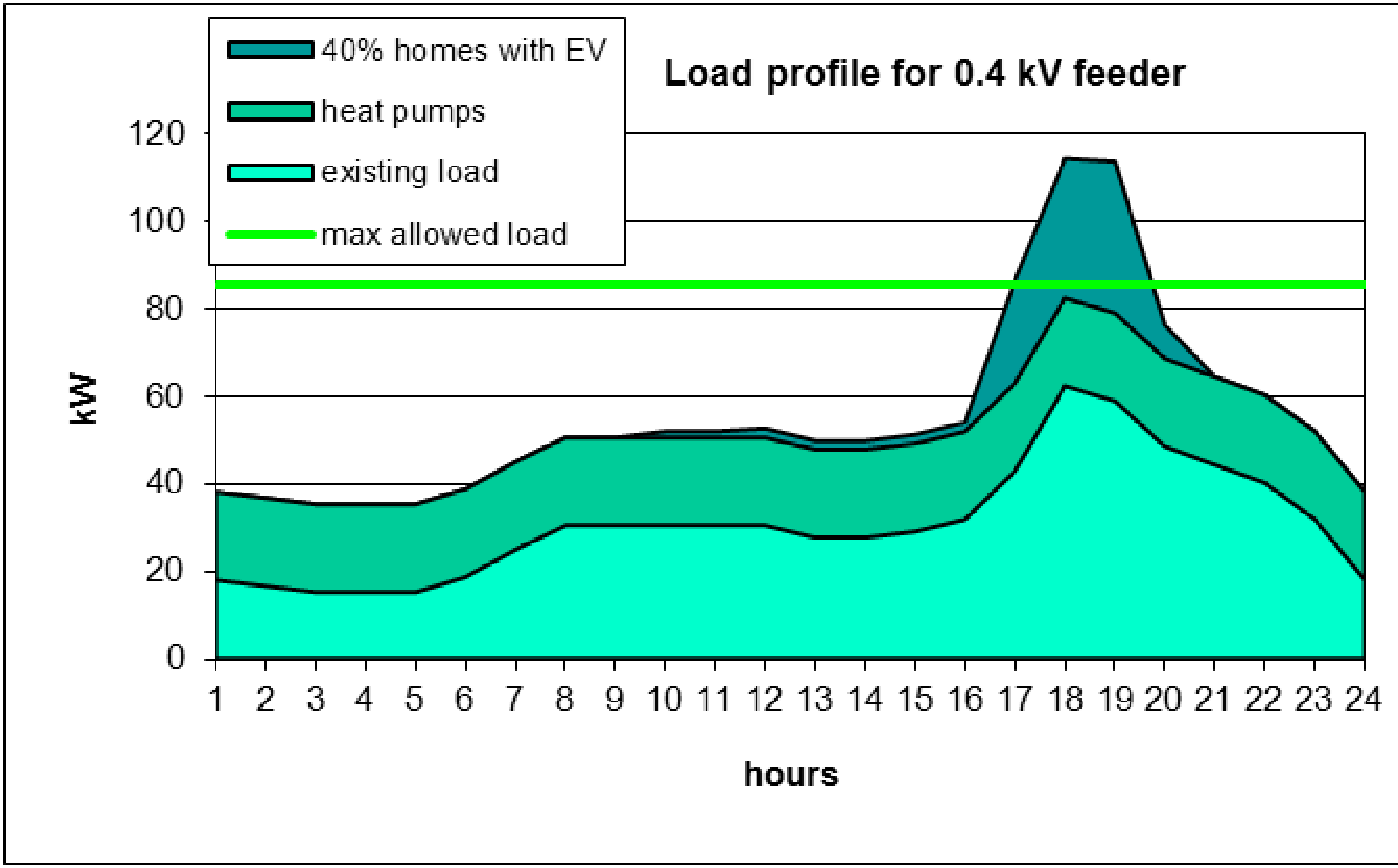


white goods

Example

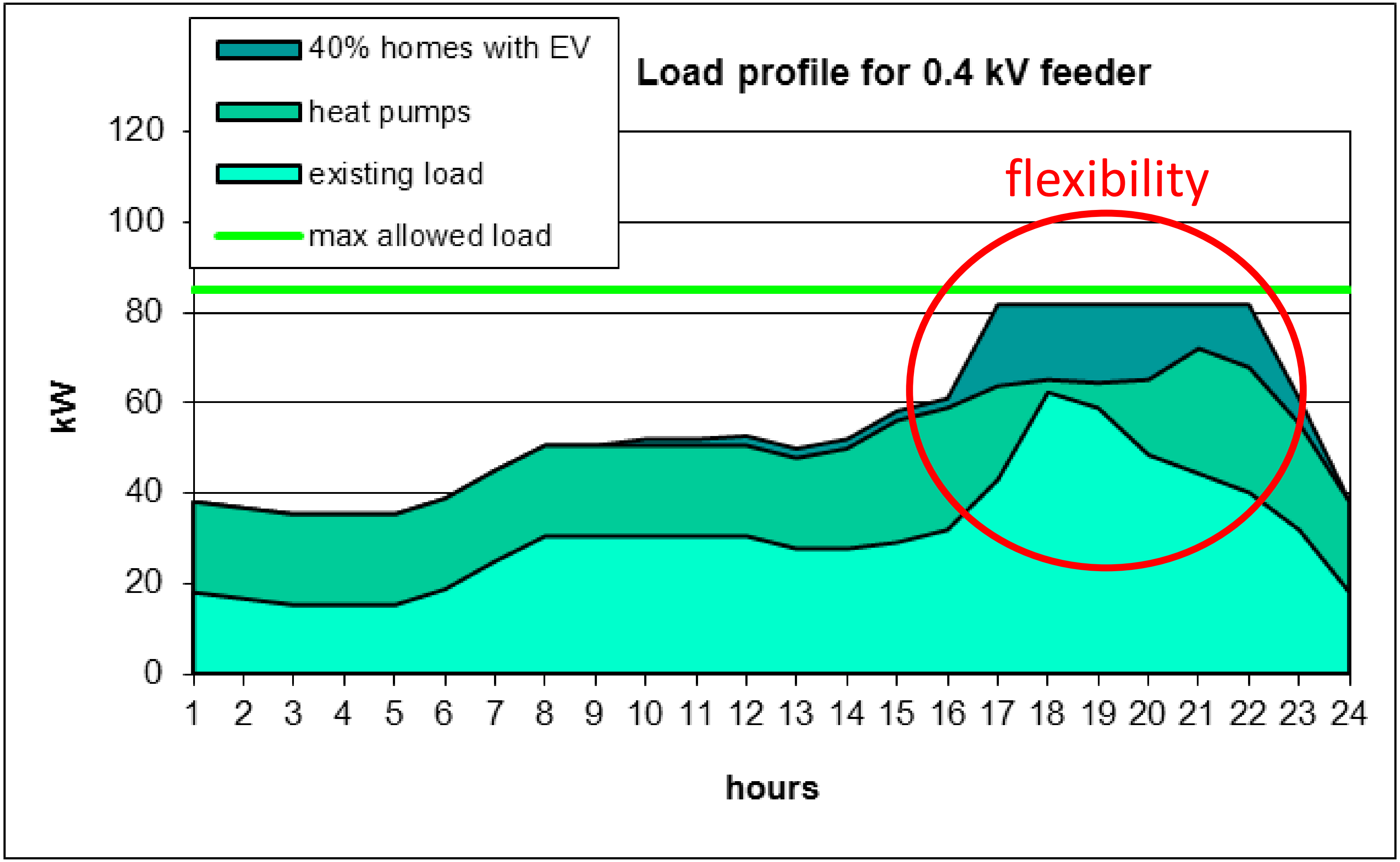

existing load
max allowed load
Load profile for 0.4 kV feeder
120
100
80
60
40
20
0
kW
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
hours

Example



40% homes with EV
heat pumps
existing load
max allowed load
Load profile for 0.4 kV feeder
120
100
80
60
40
20
0
kW
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
hours

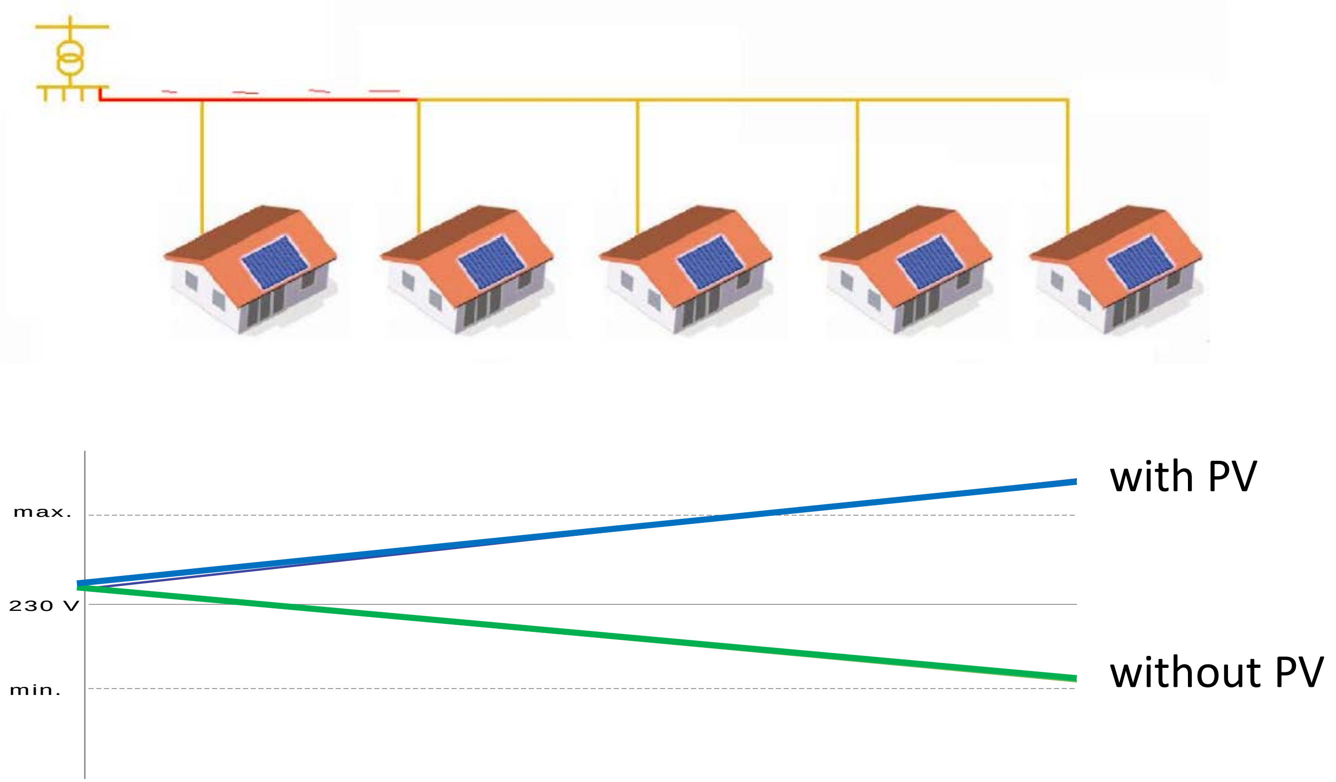
Example



40% homes with EV
heat pumps
existing load
max allowed load
Load profile for 0.4 kV feeder
flexibility
kW
0
20
40
60
80
100
120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
hours

Prosumers

Voltage problems



EBC
Energy in Buildings and Communities Programme

DANISH TECHNOLOGICAL INSTITUTE

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

EBC
Energy in Buildings and Communities Programme

DANISH TECHNOLOGICAL INSTITUTE

Smart readyness 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_2 emission in the overall energy networks rather than optimize the energy efficiency of the single energy components in a building.

EBC
Energy in Buildings and Communities Programme

Annex 67
Energy Flexible Buildings

Energy Flexibility as a key asset in a smart building future

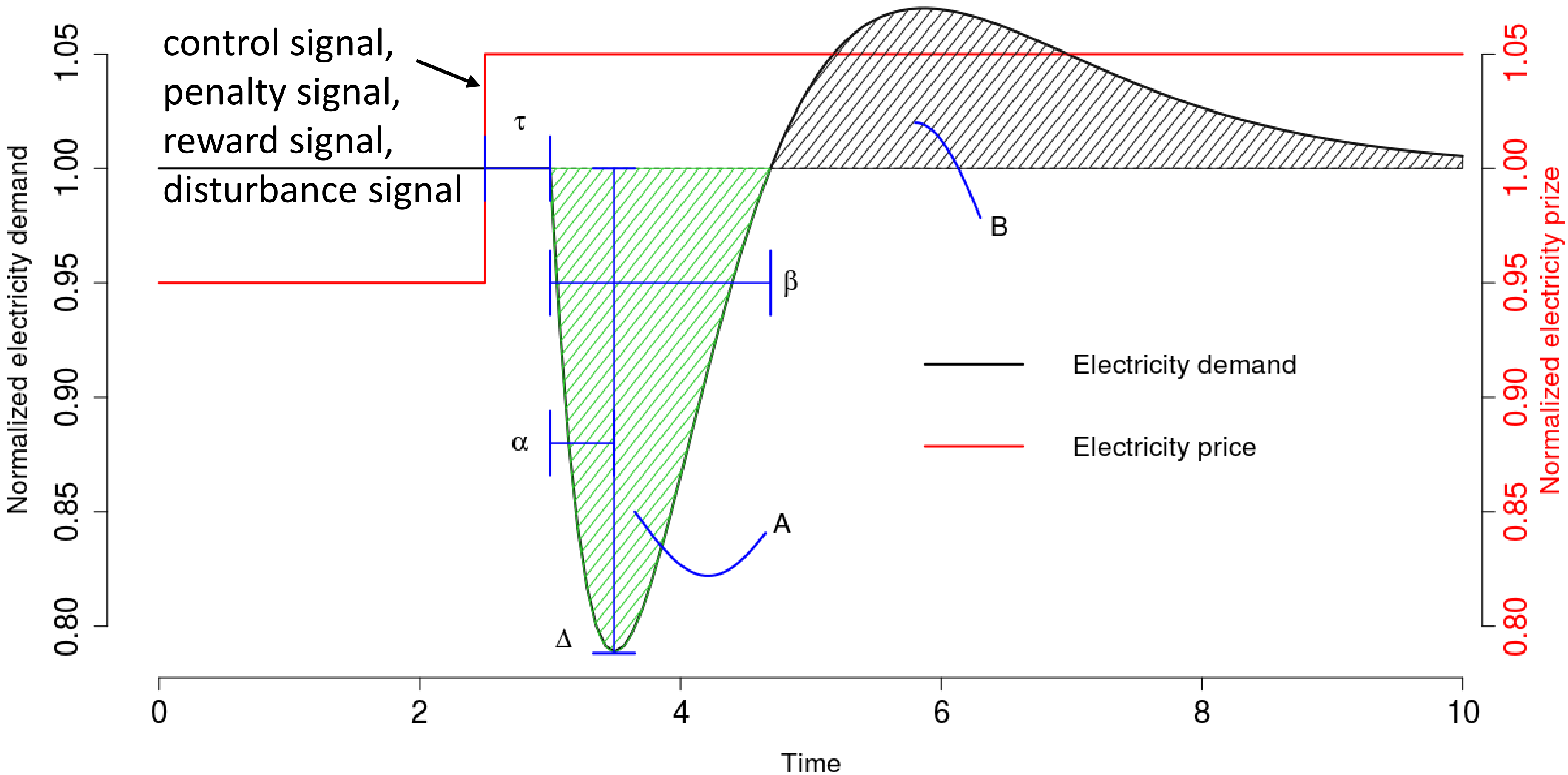
Contribution of Annex 67 to the European Smart Building Initiatives

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

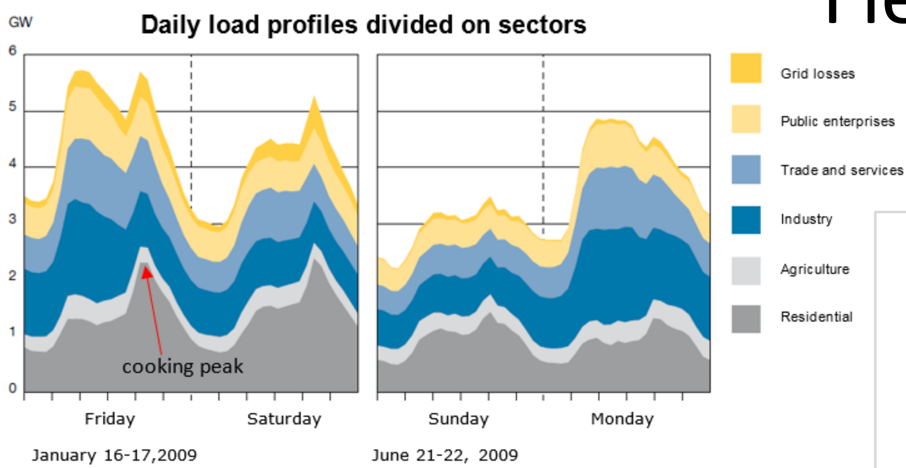
October 2017

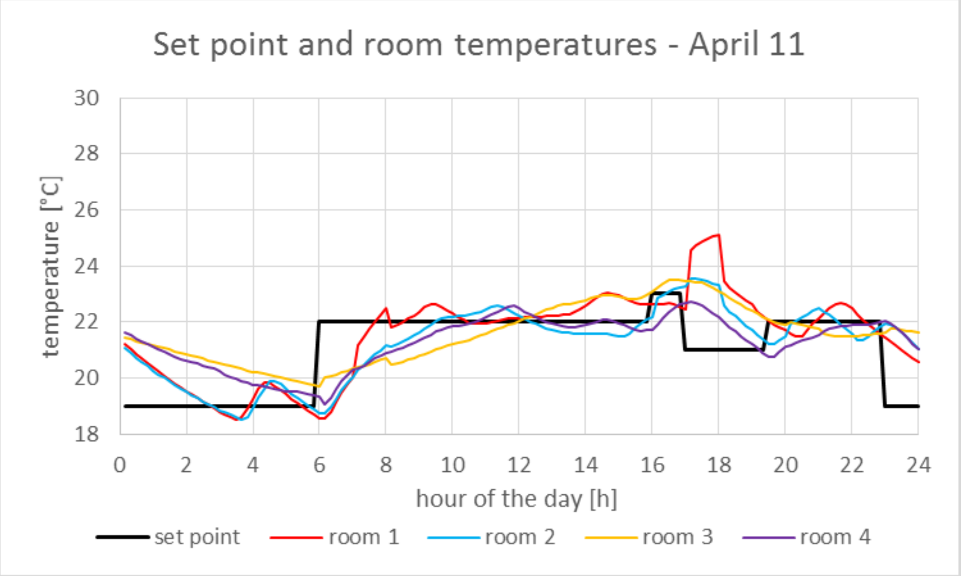
http://annex67.org/media/1470/position-paper-energy-flexibility-as-a-key-asset-i-a-smart-building-future.pdf

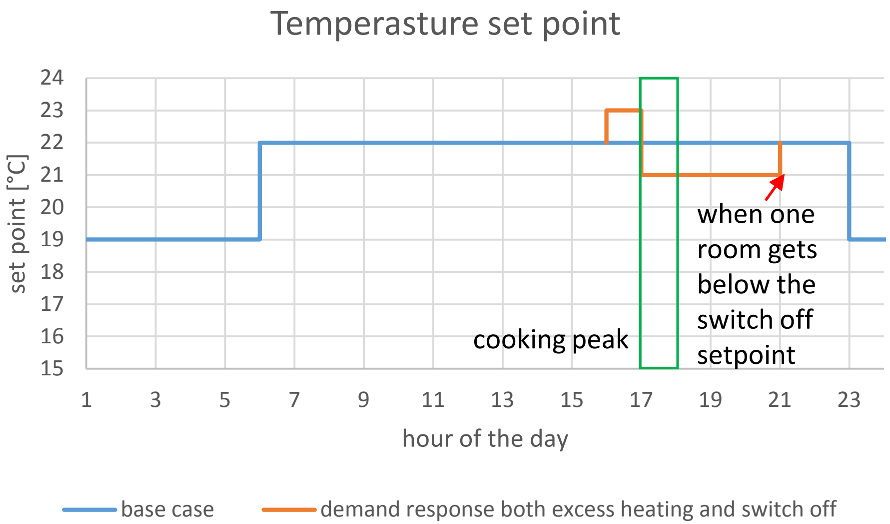
Characterization and labelling of Energy Flexibility in buildings



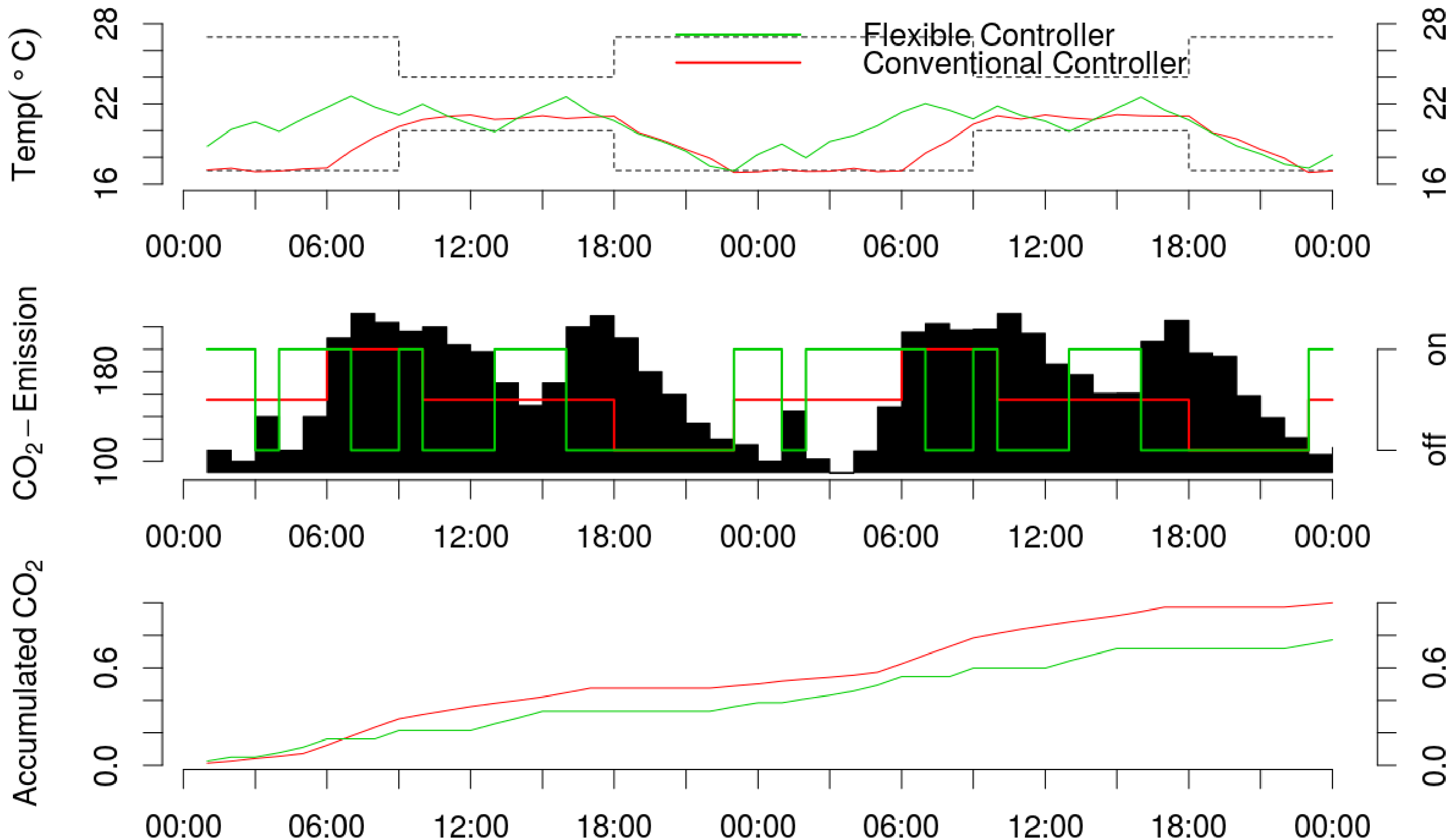
Characterization and labelling of Energy Flexibility in buildings







Characterization and labelling of Energy Flexibility in buildings



What is the possible Energy Flexibility in buildings

It depends

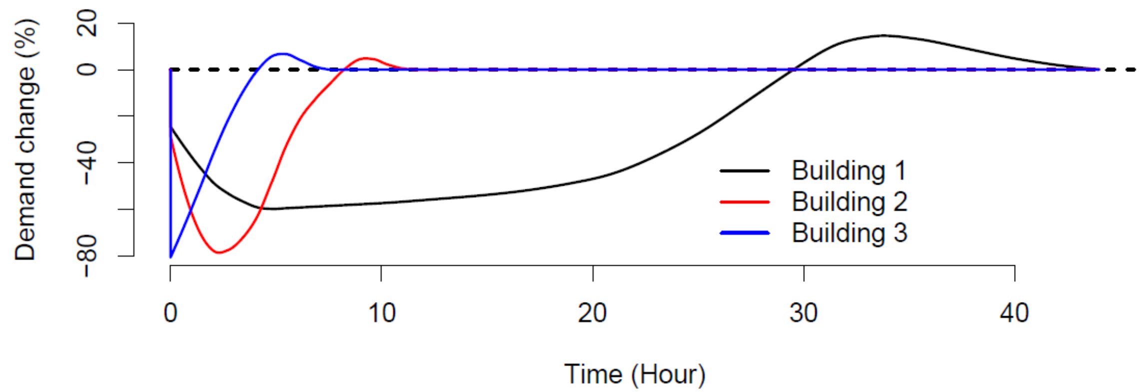
- type of building and energy service systems
- use of the building
- climate
- time of the day and the year
- occupants
- control possibilities
- state of storage (constructions, tank, battery, …)
- physical max vs. cost optimal energy flexibility
- surrounding grids
- energy tariffs
- …

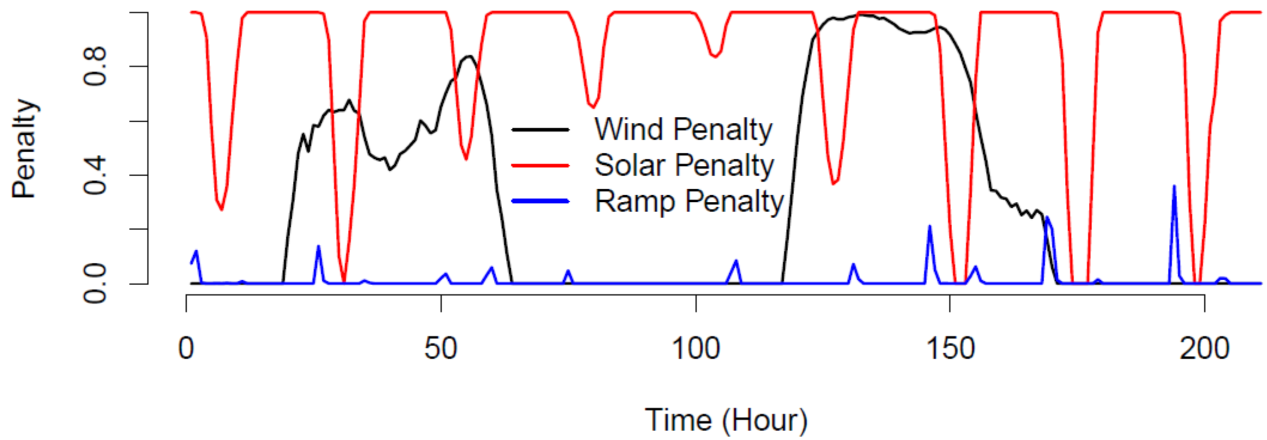
What is the possible Energy Flexibility in buildings

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
- …

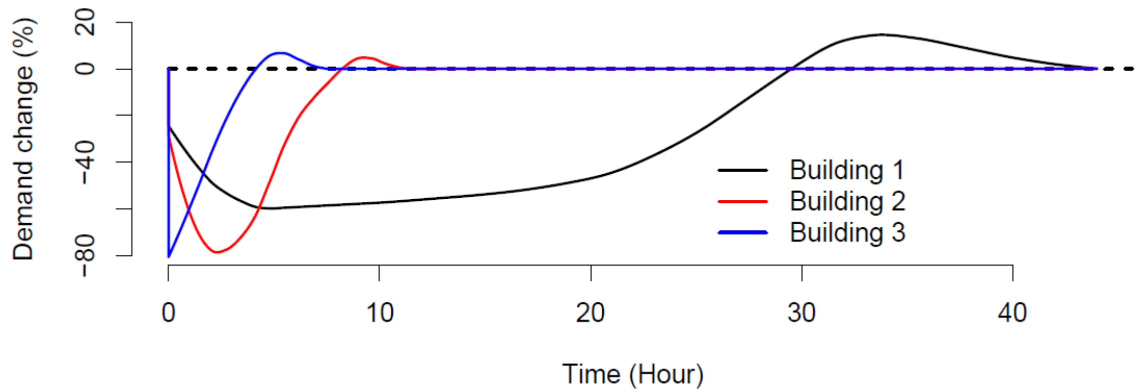
Expected Flexibility Saving Index

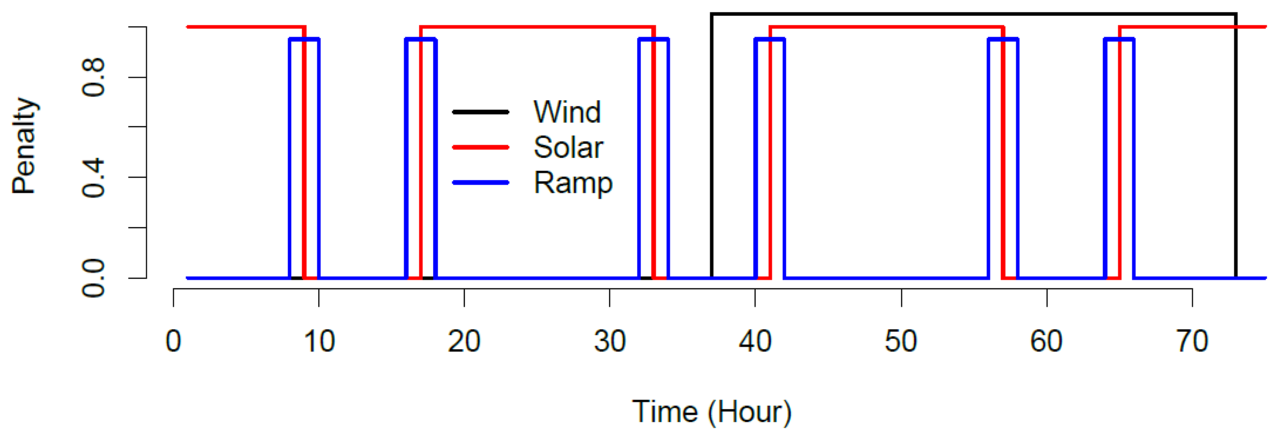




	Wind (%)	Solar (%)	Ramp (%)
Building 1	11.8	3.6	1.0
Building 2	4.4	14.5	5.0
Building 3	6.0	10.0	18.4

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

Characterizing the Energy Flexibility of Buildings and Clusters
Submitted to: Applied Energy

Challange

Currently there is, however, still little 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.

Energy in Buildings and Communities Programme

DANISH TECHNOLOGICAL INSTITUTE

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

Sixth working meeting:

Montreal, 10-12 October 2018

EBC

Energy in Buildings and
Communities Programme

DANISH
TECHNOLOGICAL
INSTITUTE

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.

EBC
Energy in Buildings and Communities Programme

Annex 67 work plan

DANISH TECHNOLOGICAL INSTITUTE

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

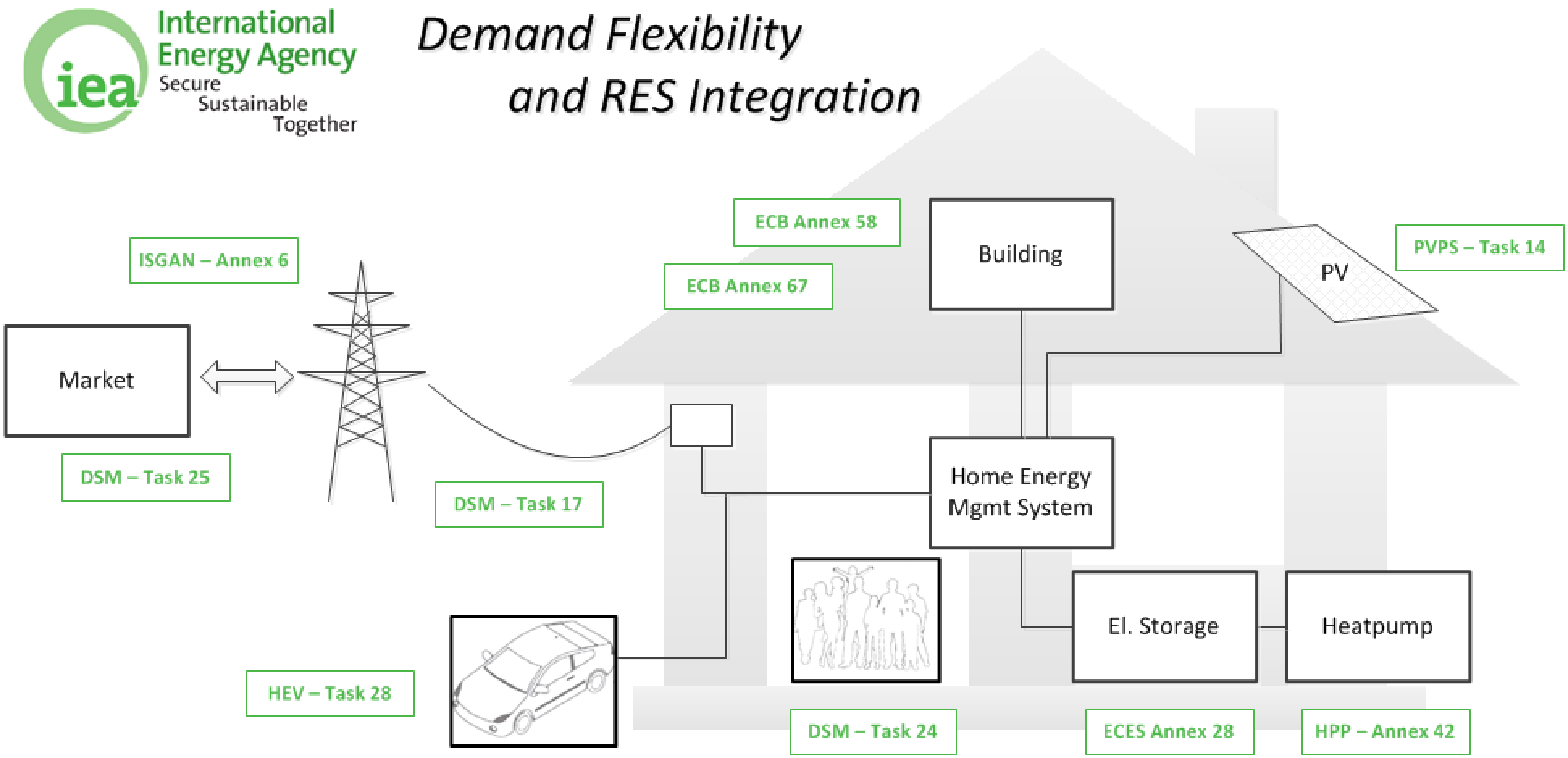
EBC
Energy in Buildings and Communities Programme

DANISH TECHNOLOGICAL INSTITUTE

Website

annex67.org

Other related IEA activities



Thank you for your attention