Energy Flexible Buildings

IEA EBC Annex 67

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Energy Flexible Buildings
Montreal, October 12, 2018

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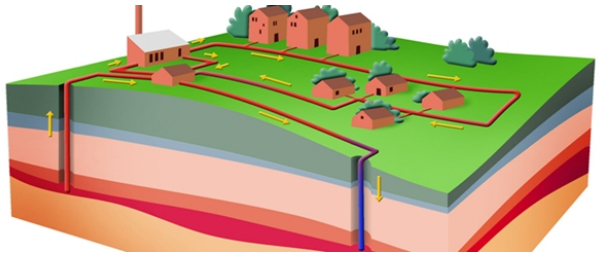
Common understanding that we need to replace fossil fuels with renewable energy



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

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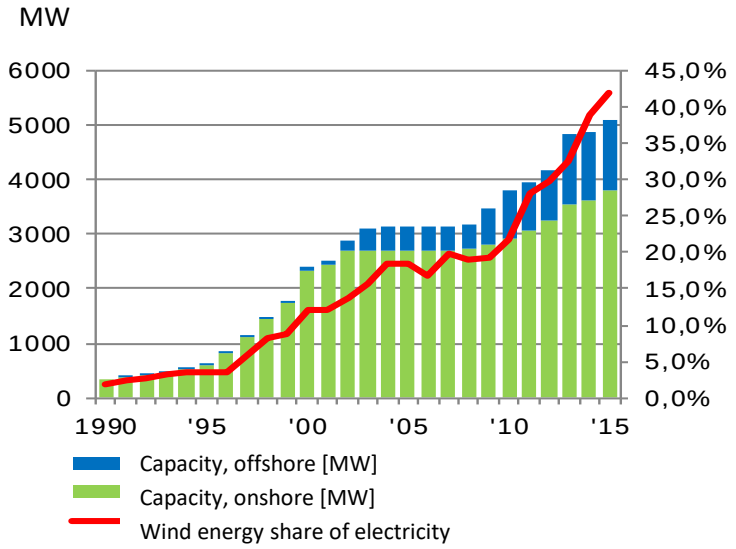
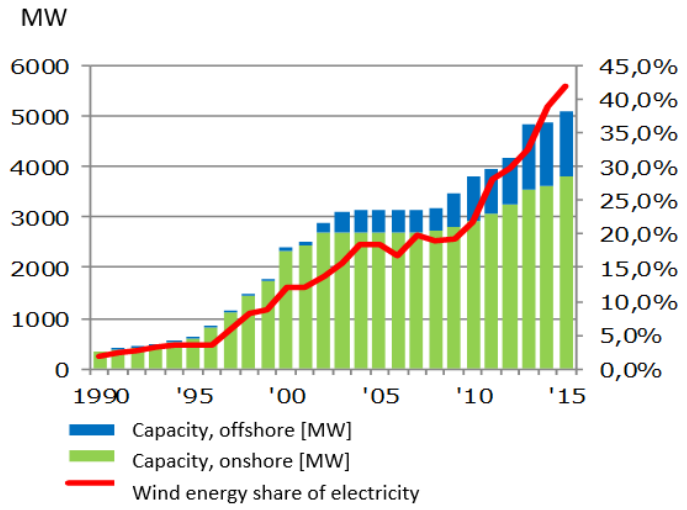
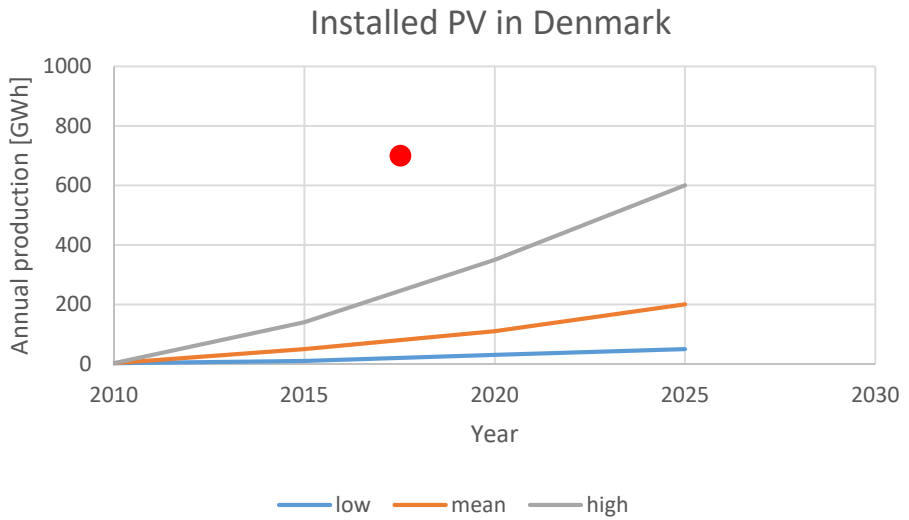
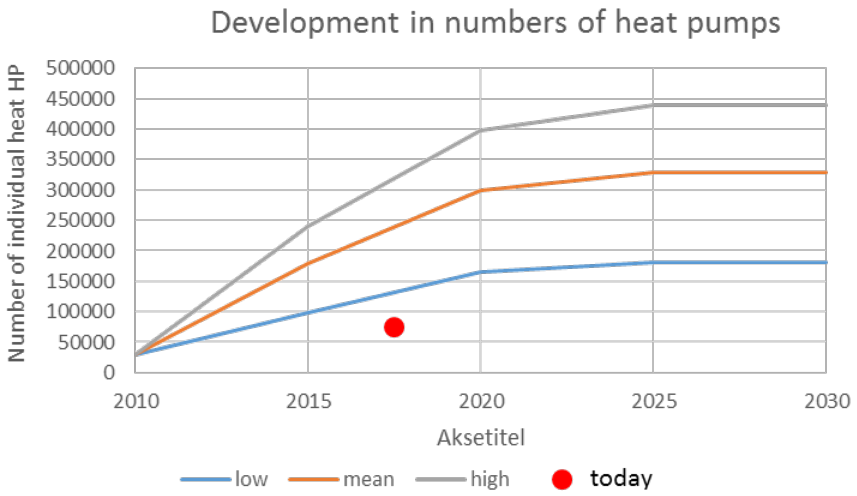
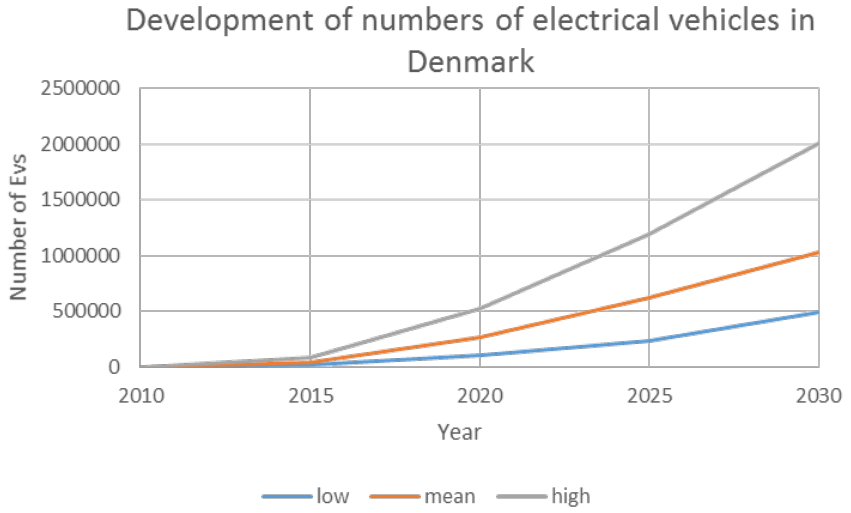


Production and demand are not coincident









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Solutions to large share of RES in the energy systems

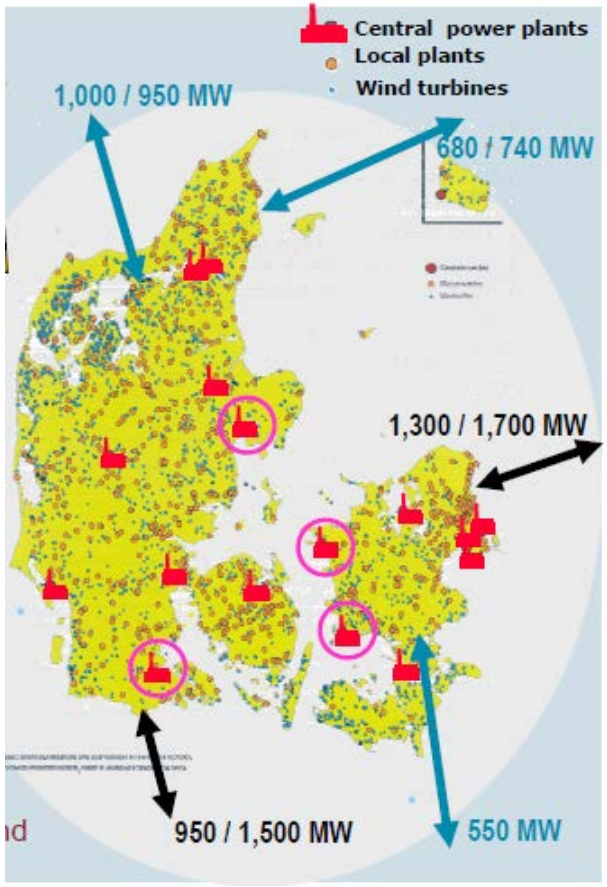
Large interconnectors - export/import

Heat pumps in district heating

Generation of hydrogen and upgrading of biogas

RES based fuel factories

Demand response – industry and buildings



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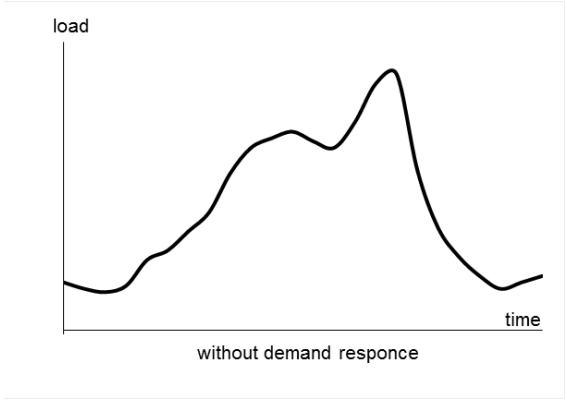
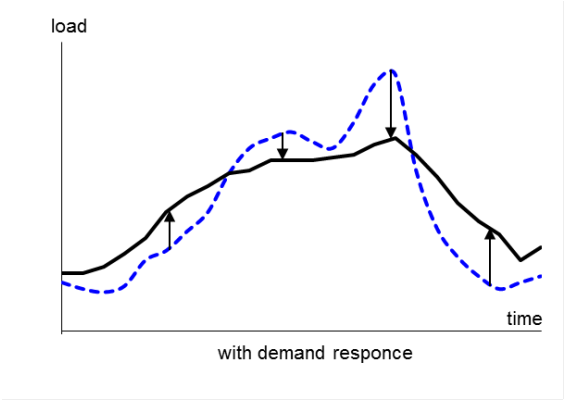
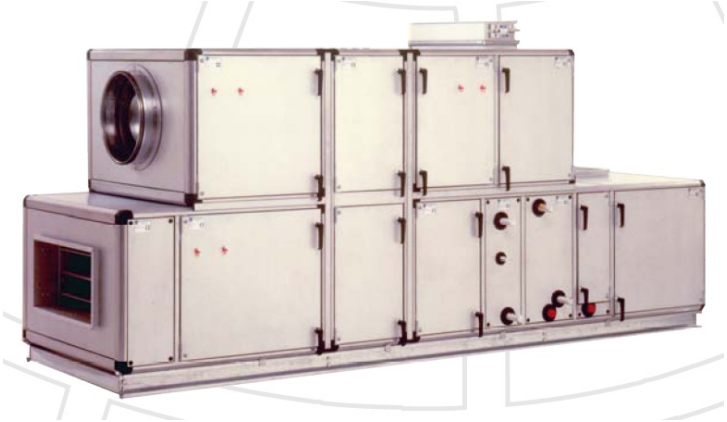
Most buildings have the ability to become energy flexible





Commercial buildings

ventilation systems



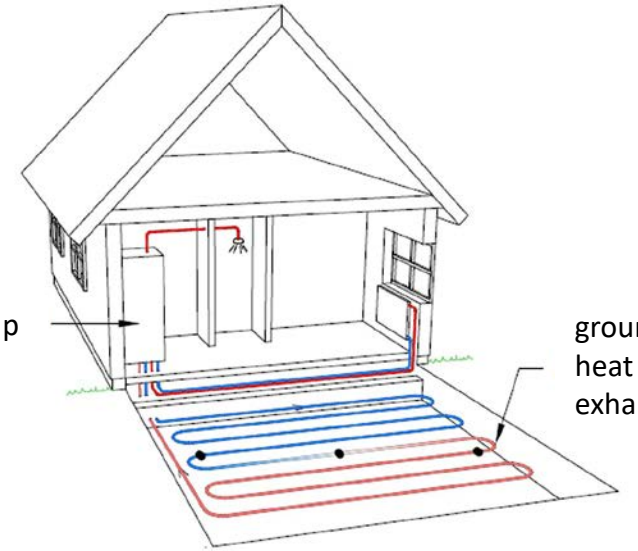
cooling systems

supermarkets

pumps

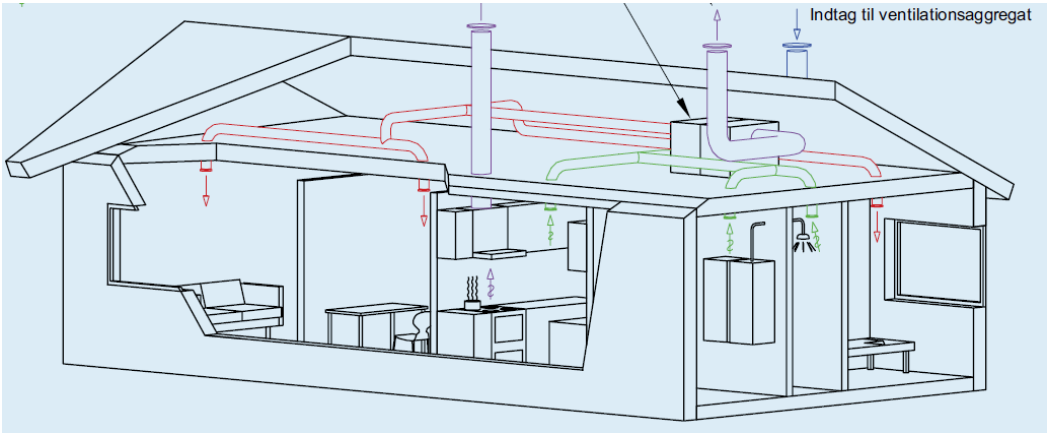
Electricity demand in households

heat pumps (aircondition)



EVs

ventilation systems



white goods

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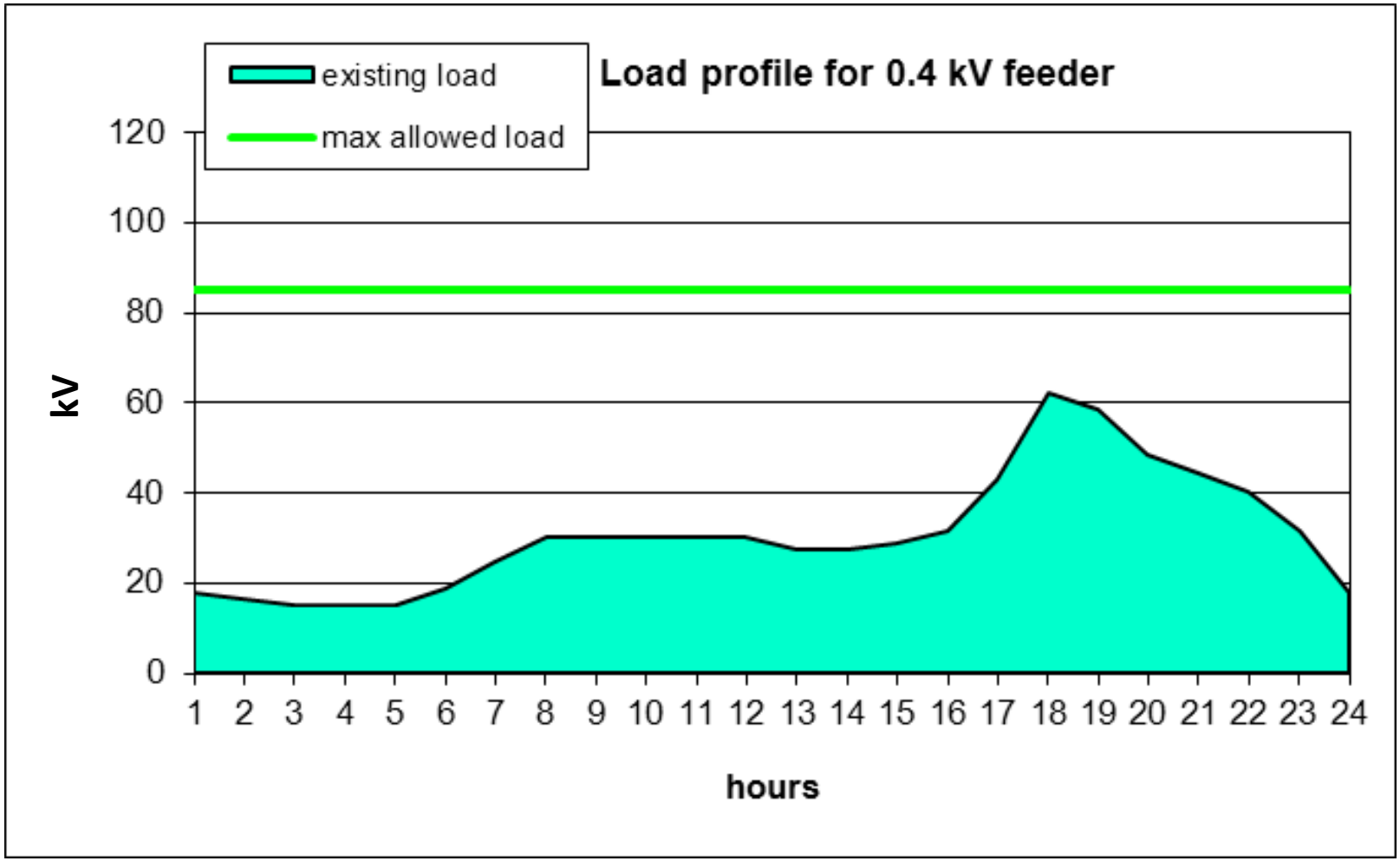
Example



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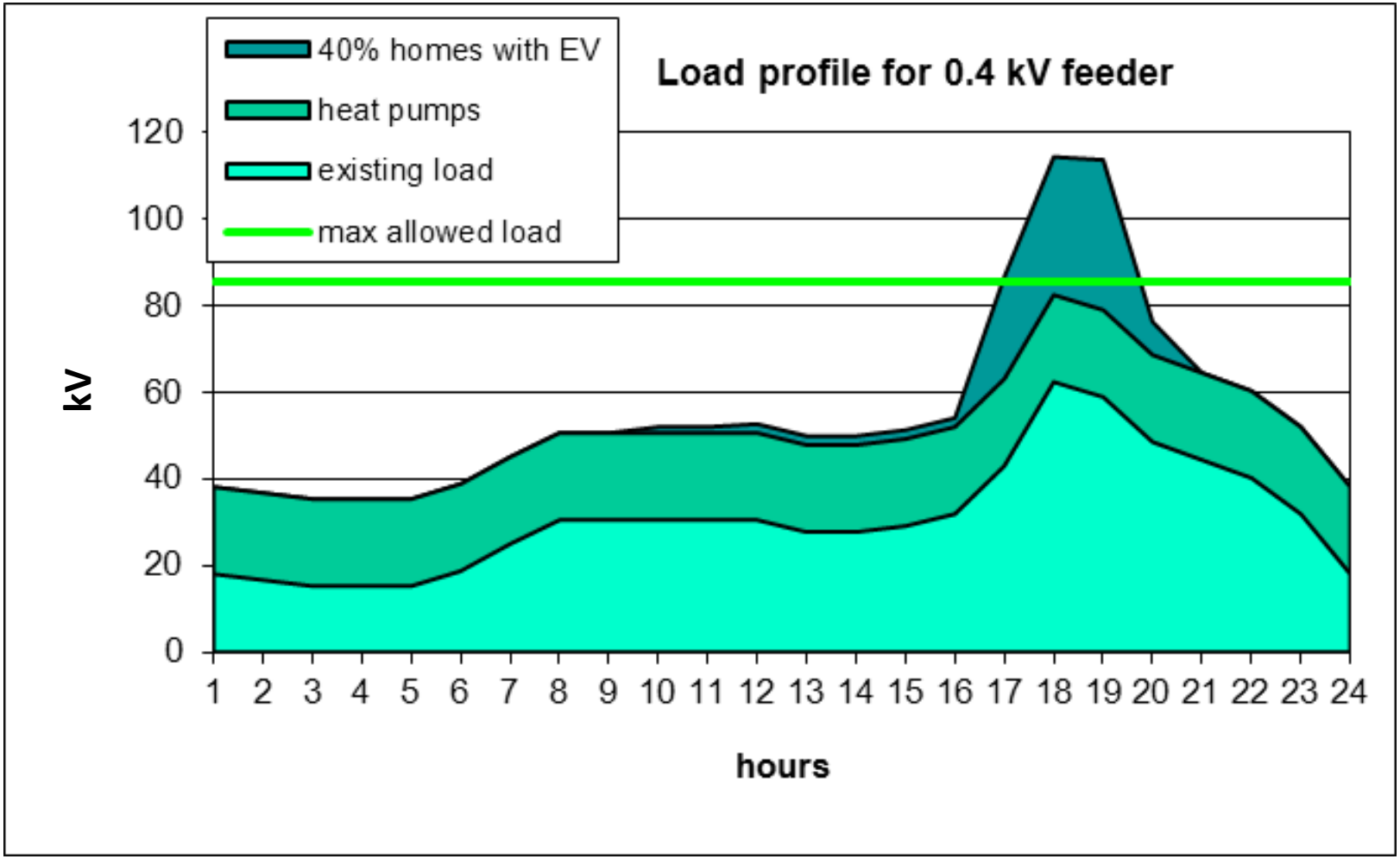
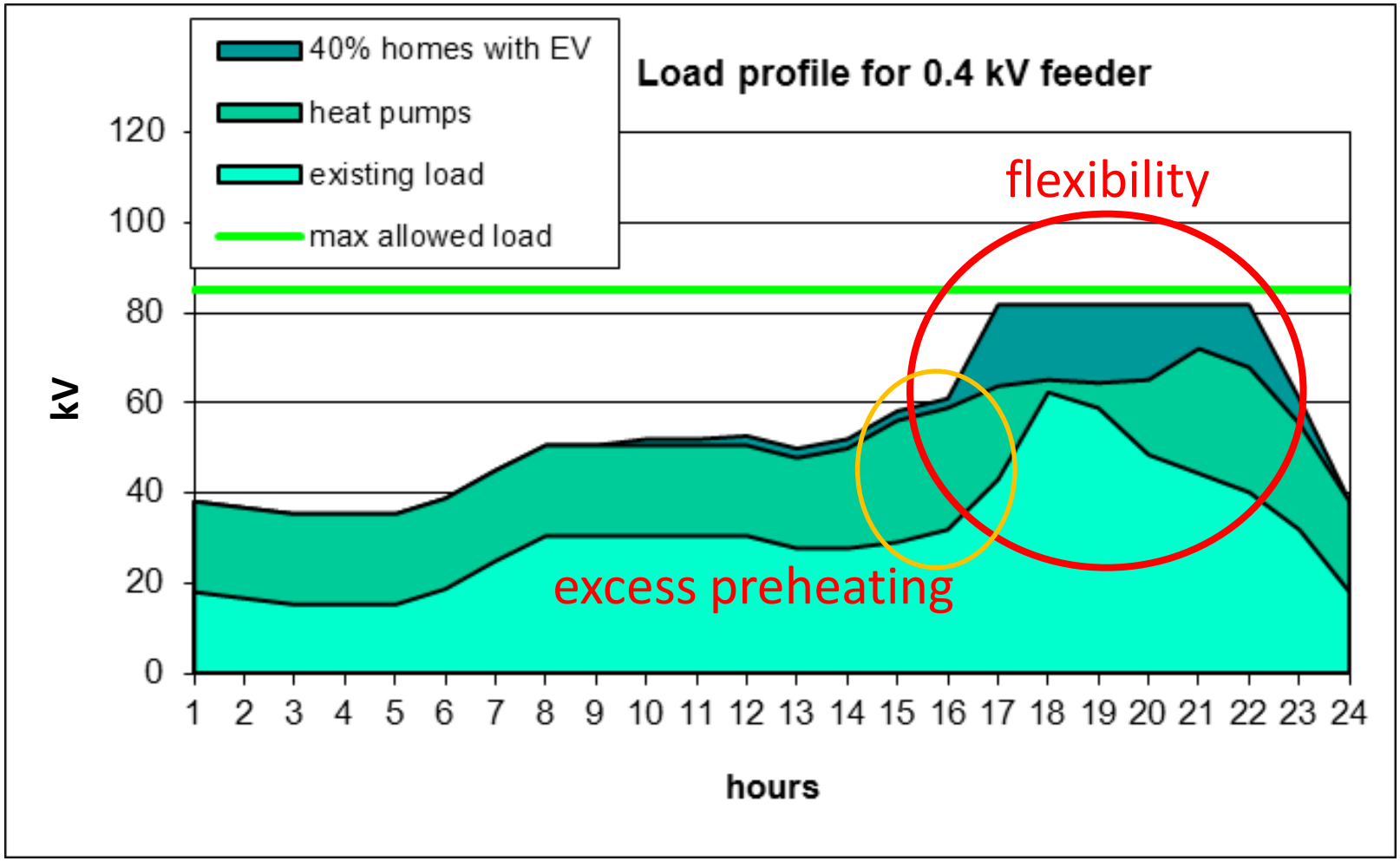
Example



Example


40% homes with EV
heat pumps
existing load
max allowed load
Load profile for 0.4 kV feeder
flexibility
excess preheating
kV
120
100
80
60
40
20
0
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

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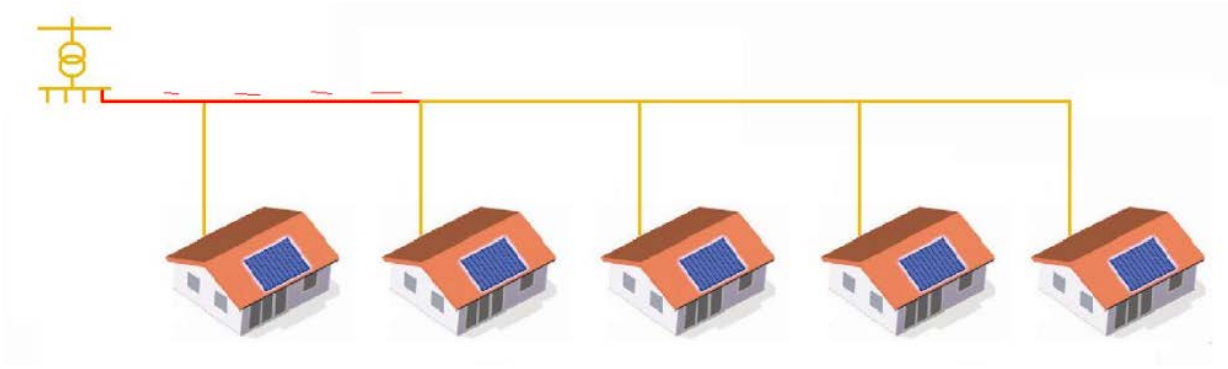
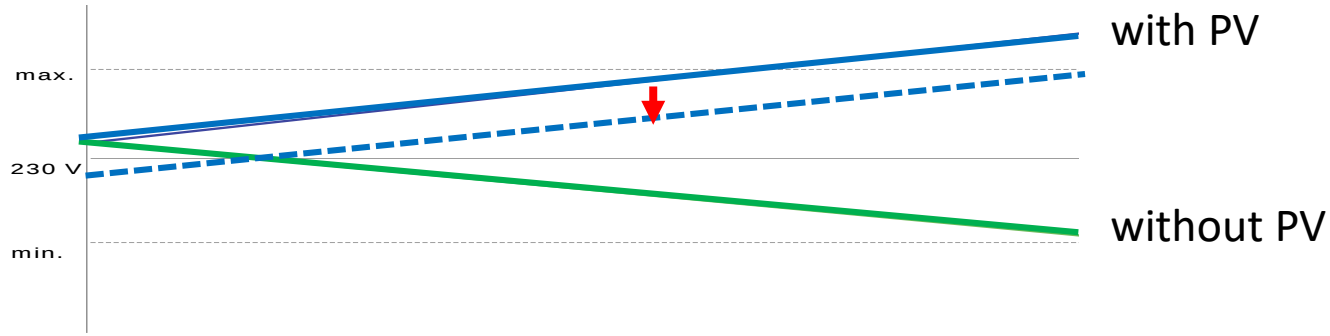
Prosumers

Voltage problems





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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 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.

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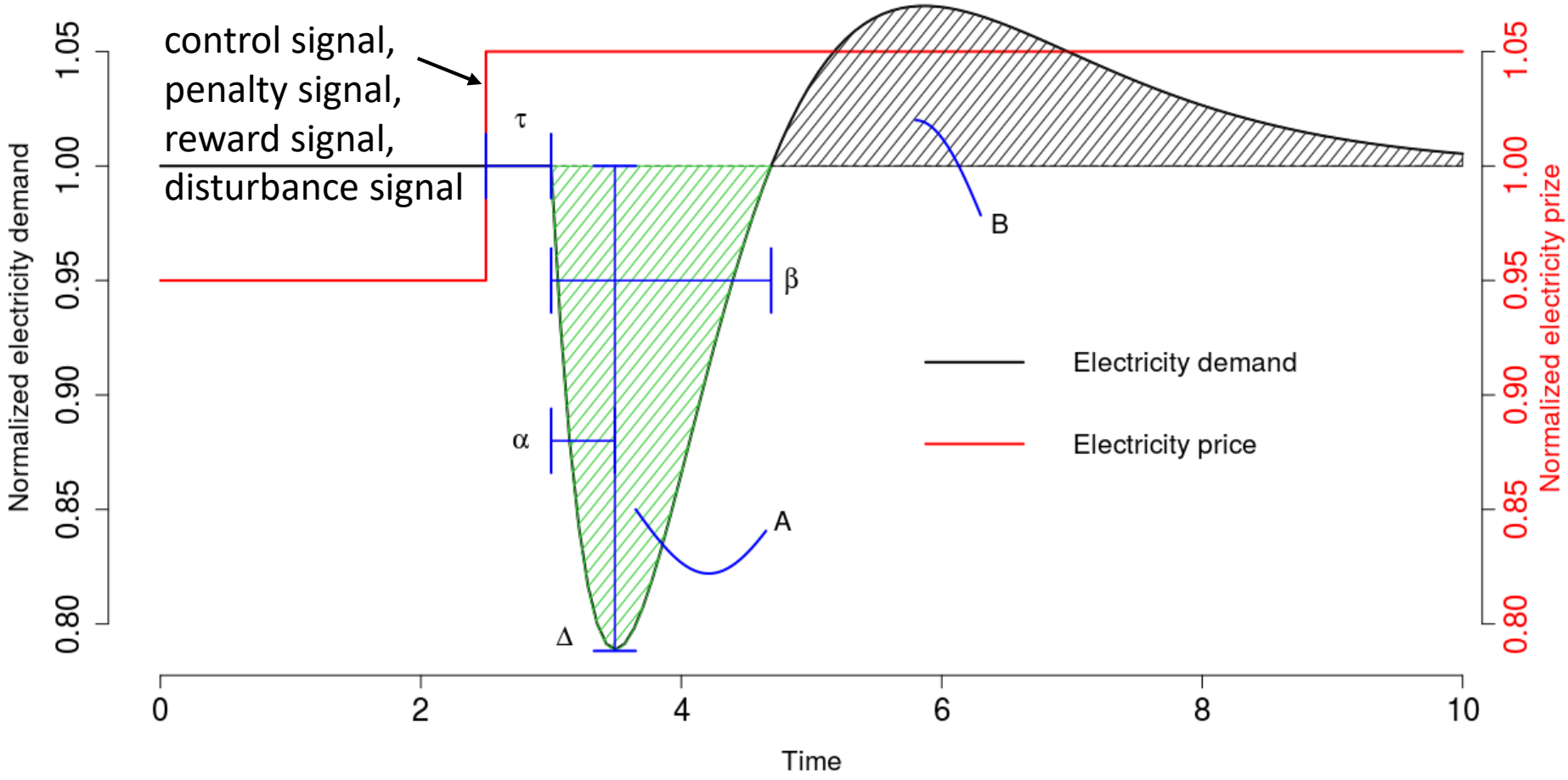
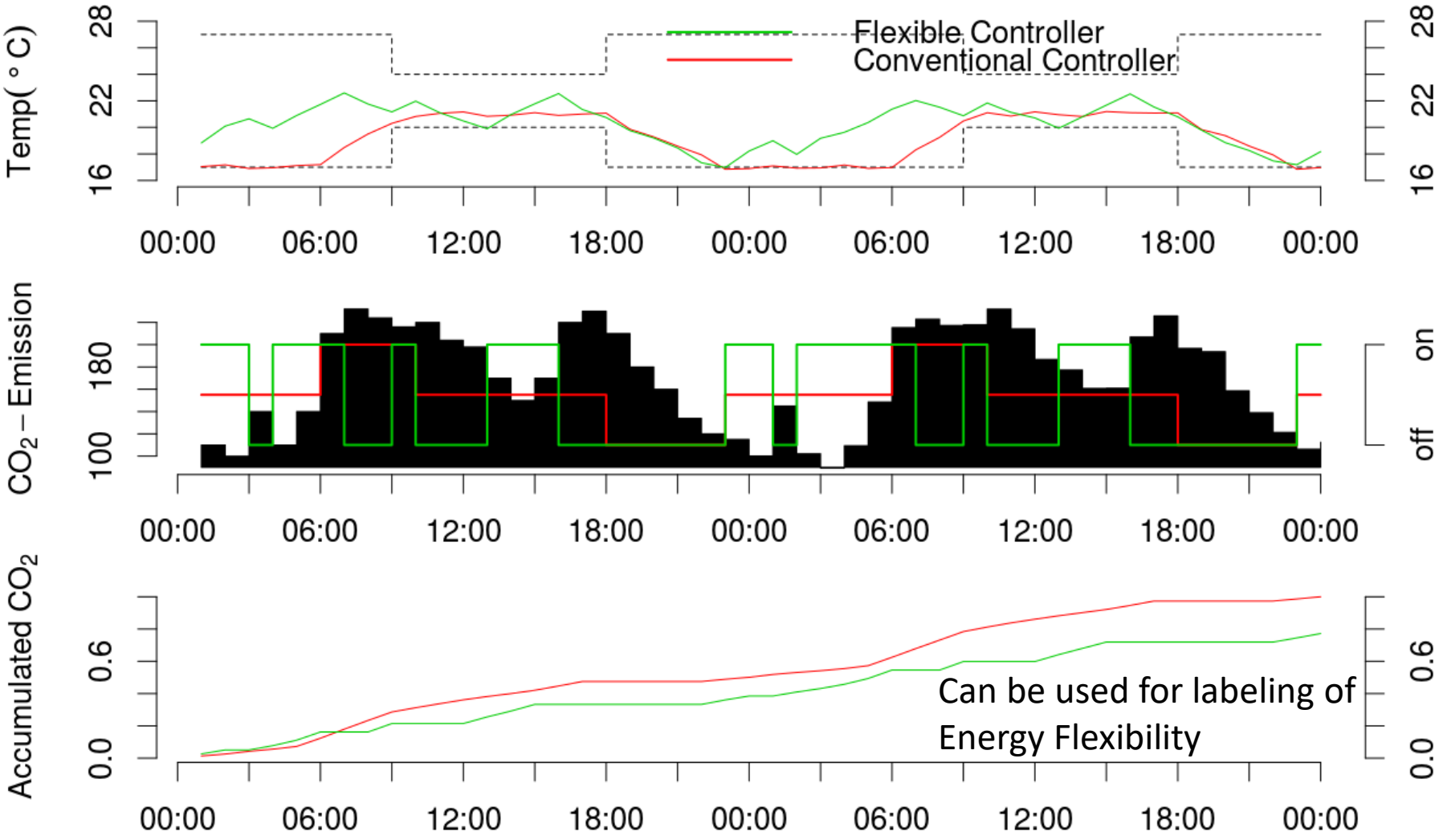
Characterization and labelling of Energy Flexibility in buildings



Energy Flexibility in buildings



Characterizing the Energy Flexibility of Buildings and Districts.
https://www.sciencedirect.com/science/article/pii/S030626191830730X

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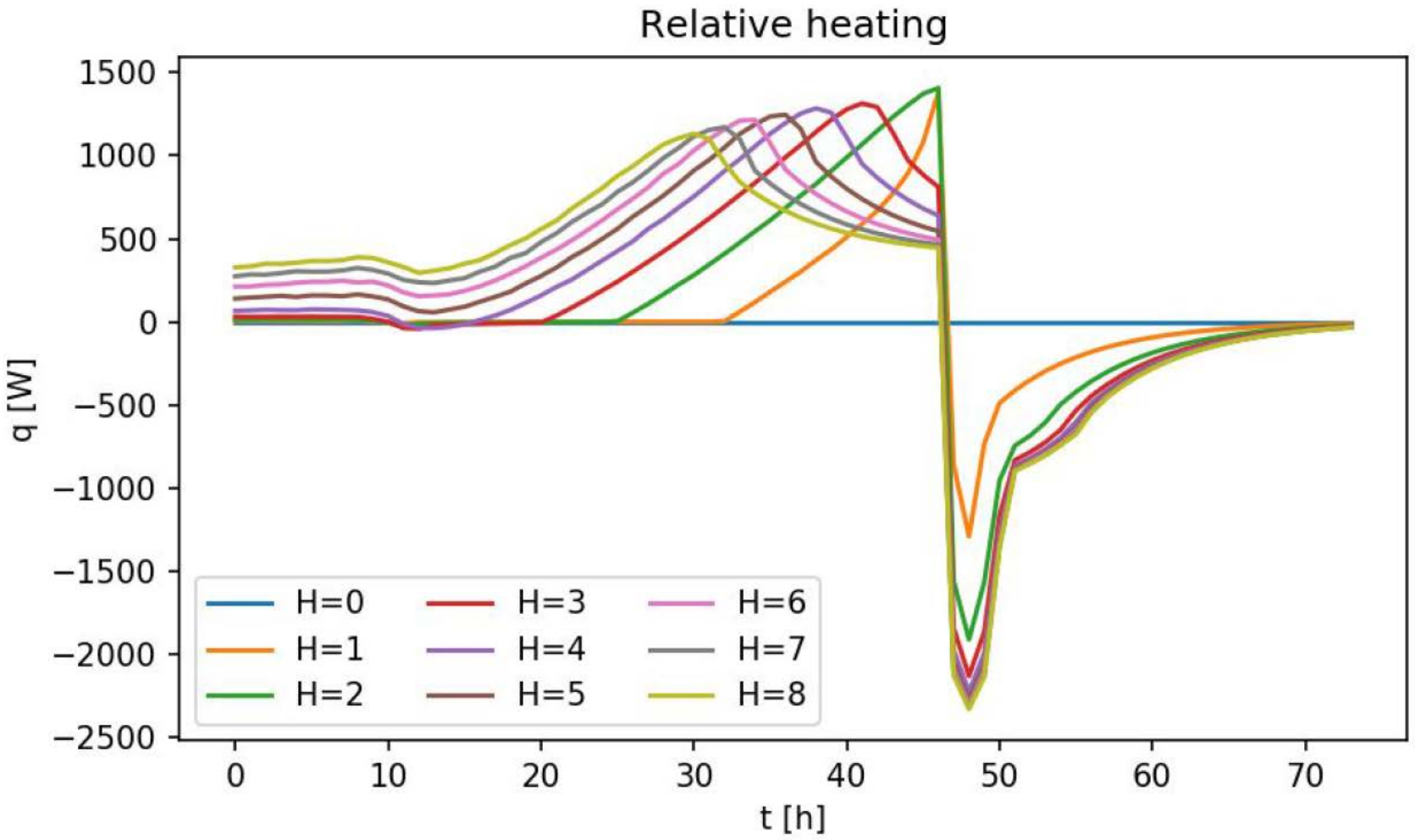
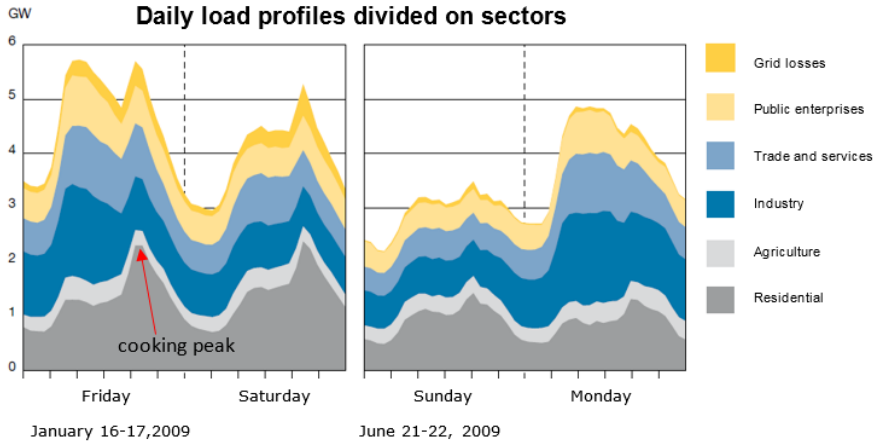
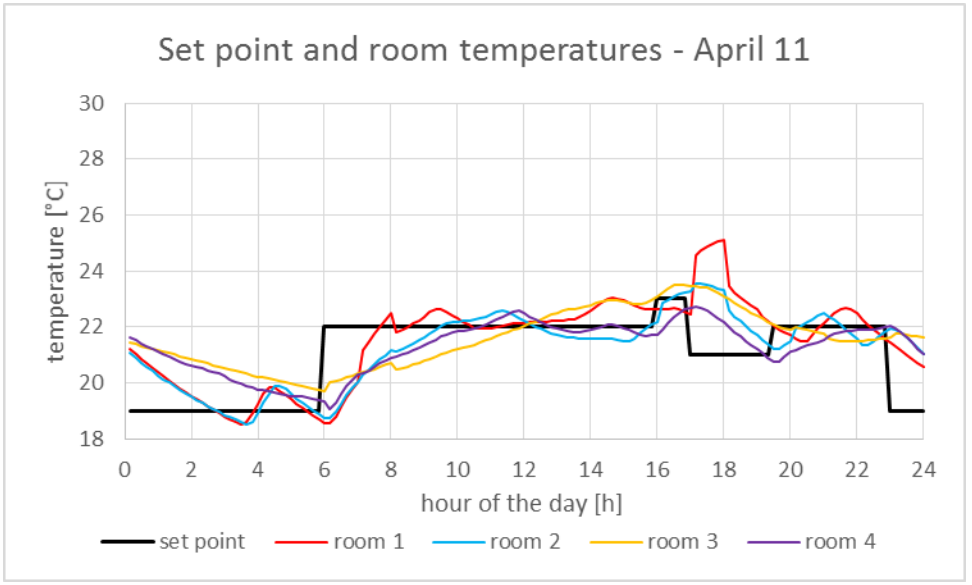
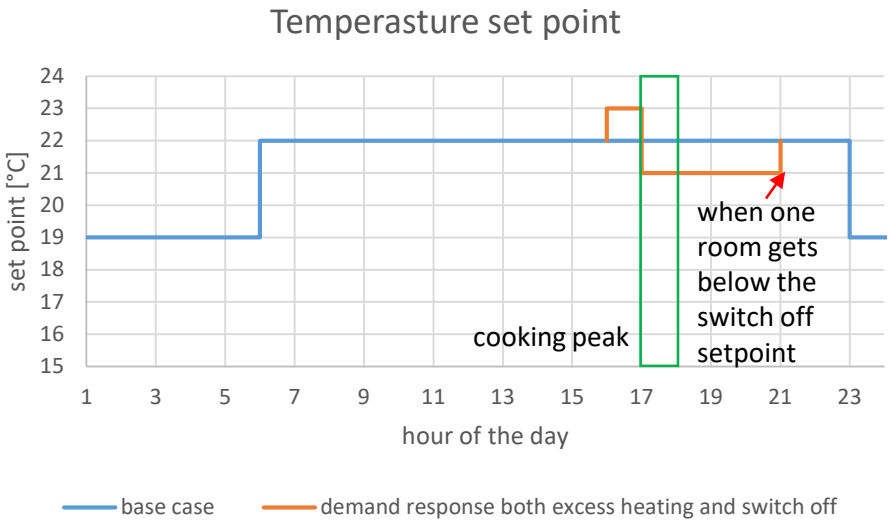
Pre-use of energy

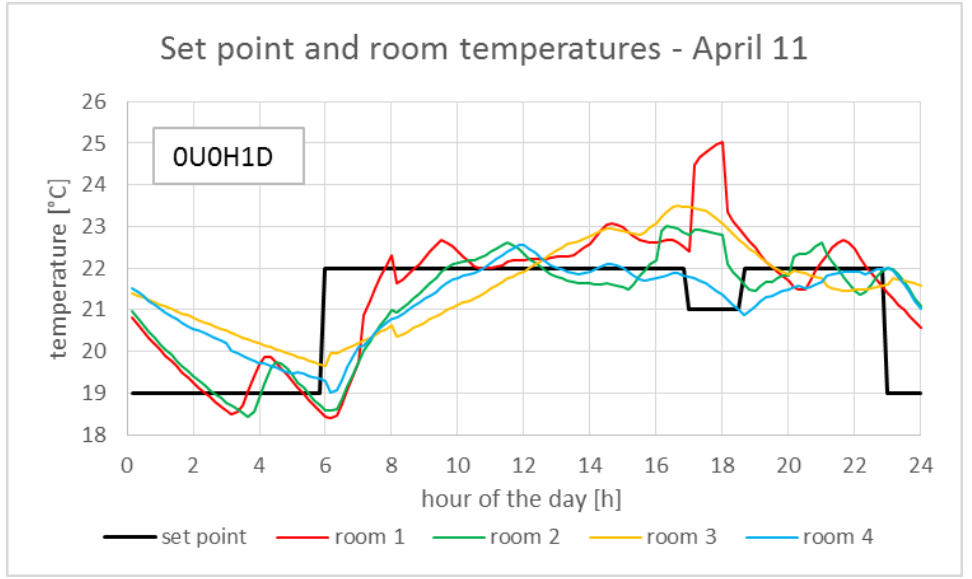


Energy Flexibility in buildings









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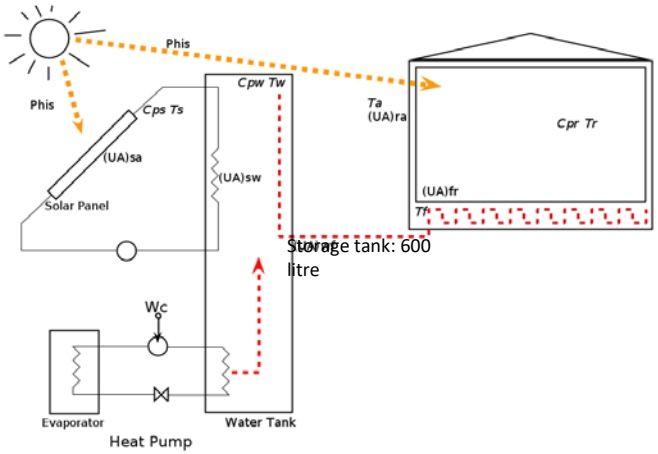
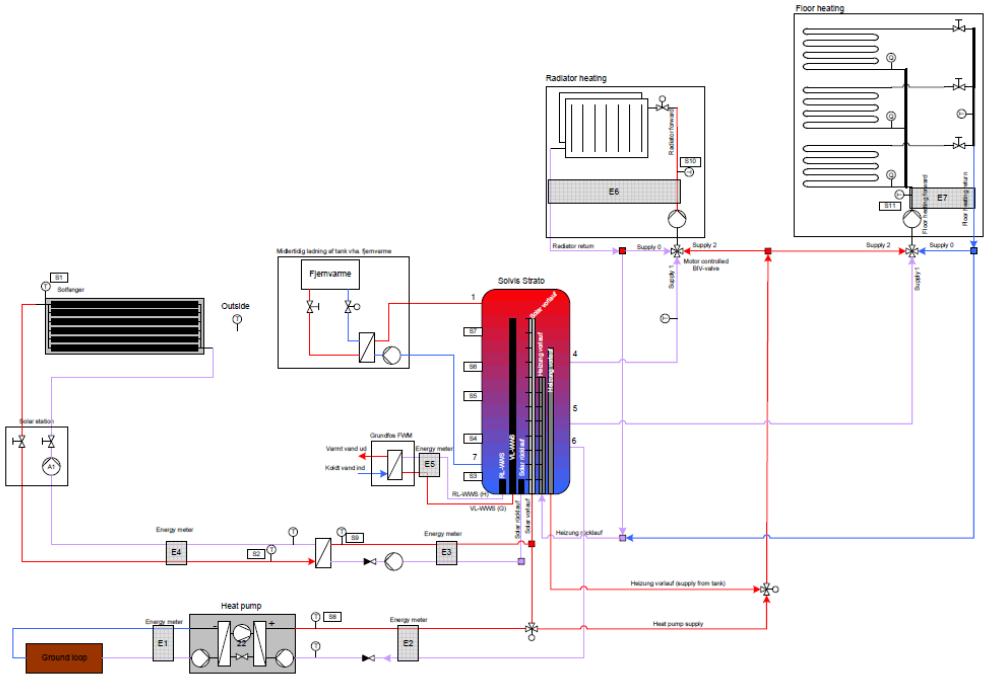
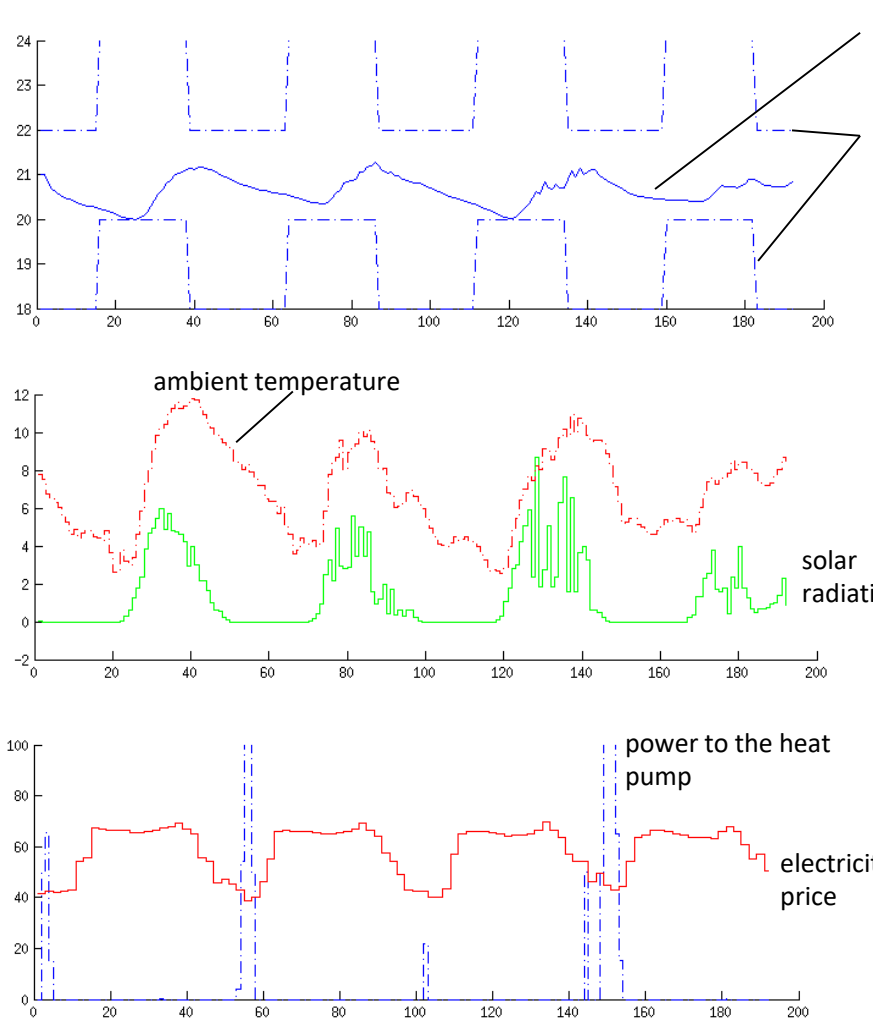
Example of a controller



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 (Publication C)

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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
- …

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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.

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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

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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

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Participating countries

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

Website

annex67.org

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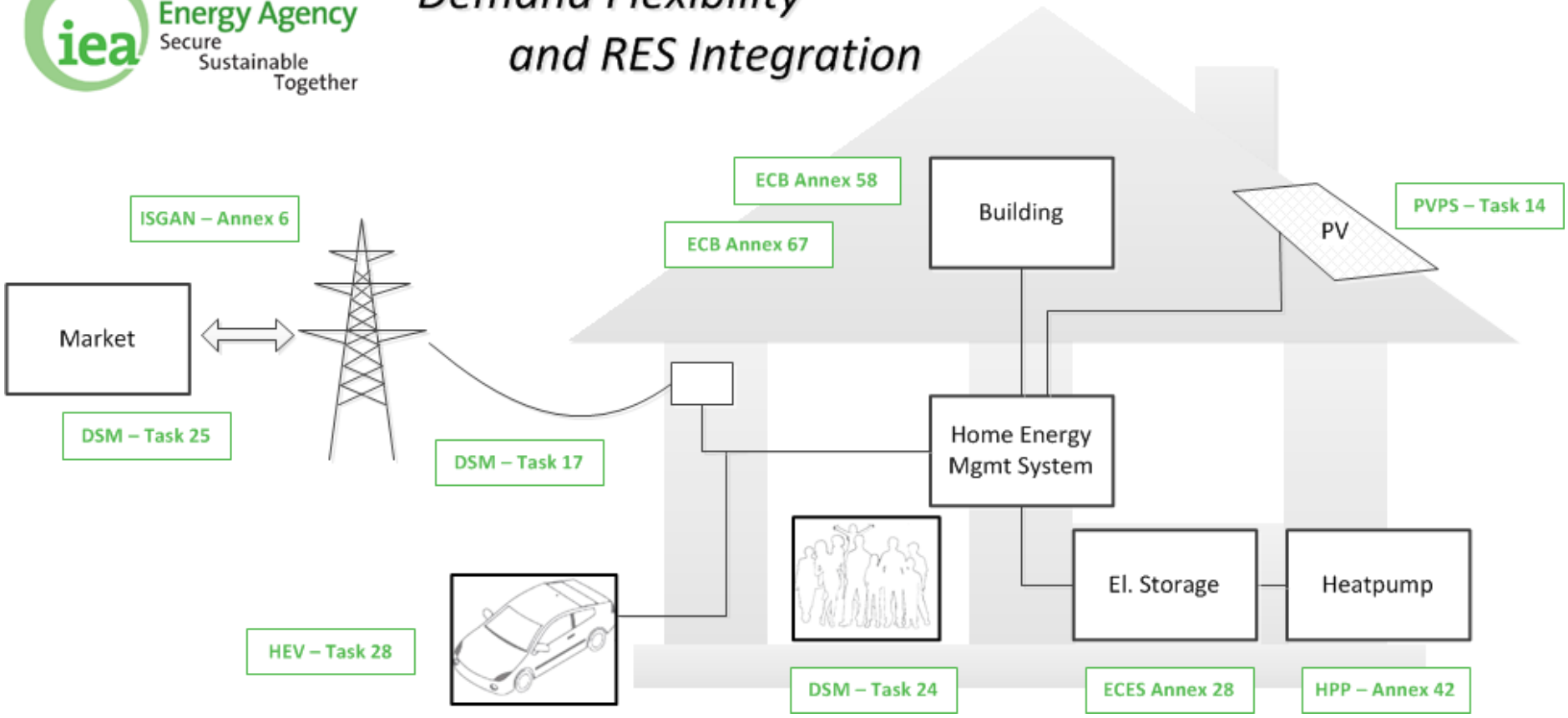
Other related IEA activities

International Energy Agency
Secure Sustainable Together

Demand Flexibility and RES Integration



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GridFWD conference

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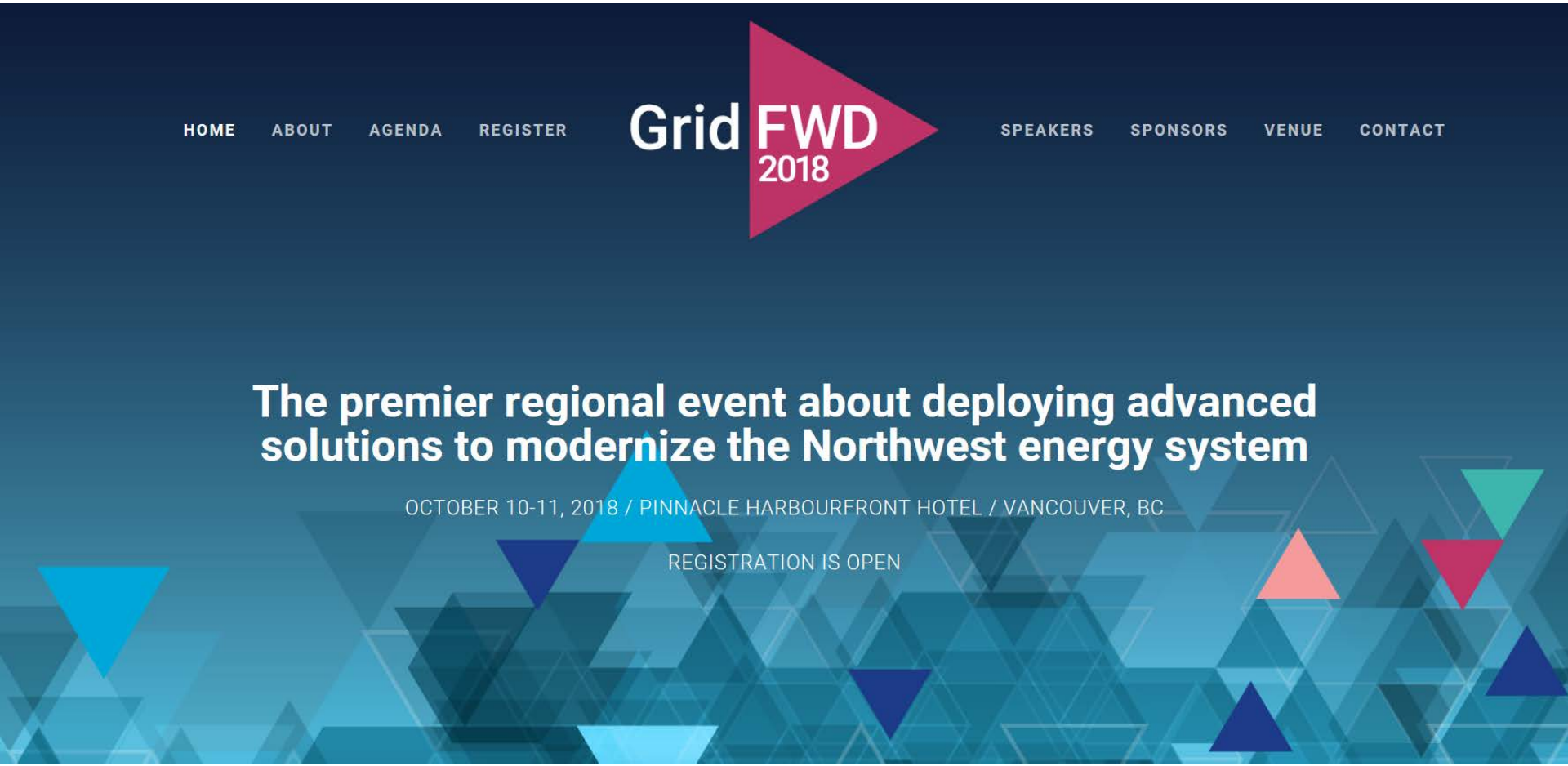

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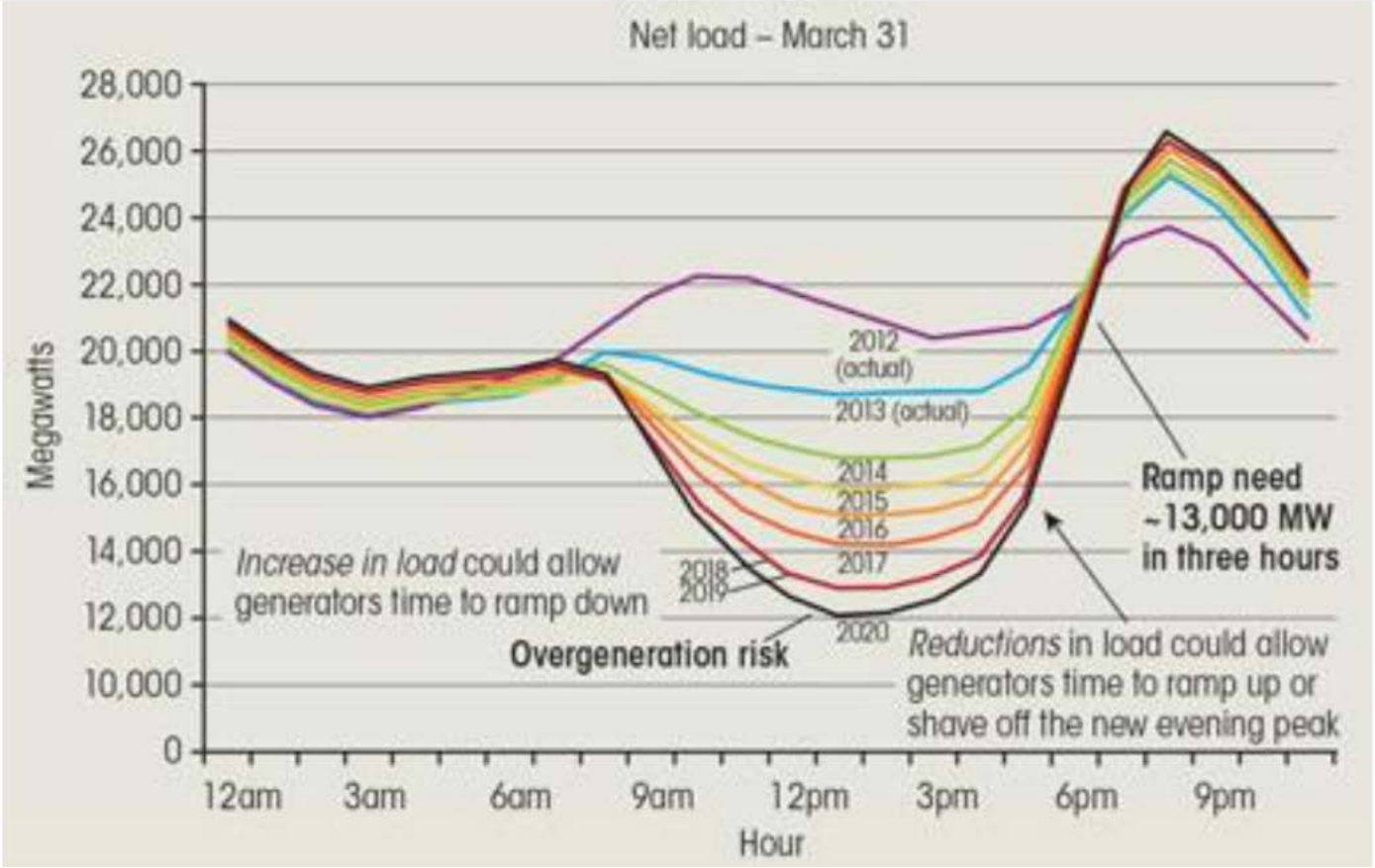
GridOptimal initiative

The Duck Curve

Renewables offset conventional generation without reducing peak load



https://newbuildings.org/resource/gridoptimal/

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Thank you for your attention