Energy Flexible Buildings

IEA EBC Annex 67

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Rehva Brussels Summit
Brussels, November 13, 2018

EBC
Energy in Buildings and Communities Programme

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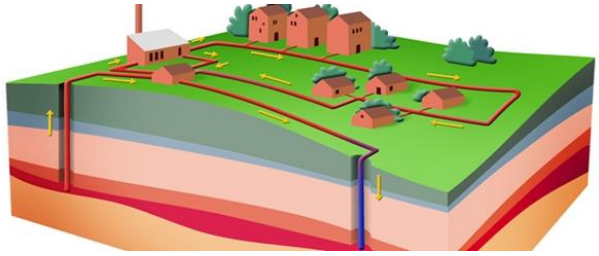
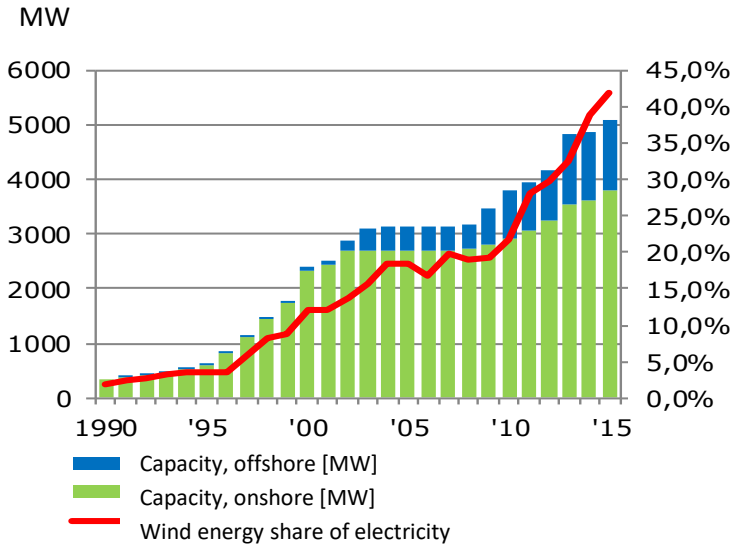
Common understanding that we need to replace fossil fuels with renewable energy



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



Solutions to large share of RES in the energy systems

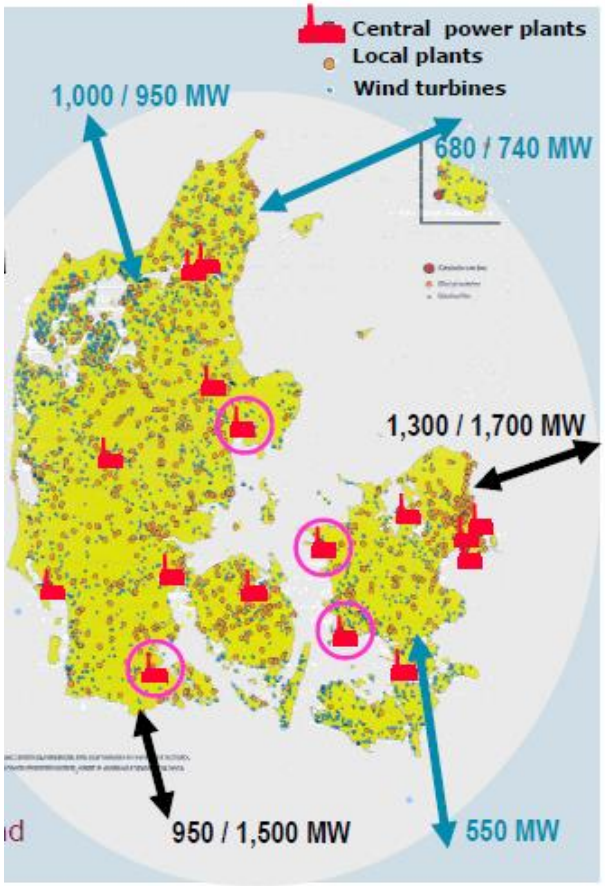
Large interconnectors - export/import

Heat pumps in district heating

Generation of hydrogen and upgrading of biogas

RES based fuel factories

Demand response – industry and buildings



Commercial buildings

ventilation systems

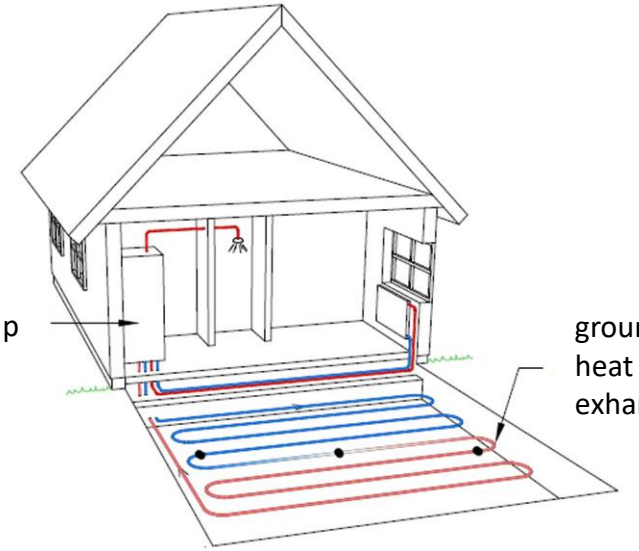
cooling systems

supermarkets

pumps

Electricity demand in households

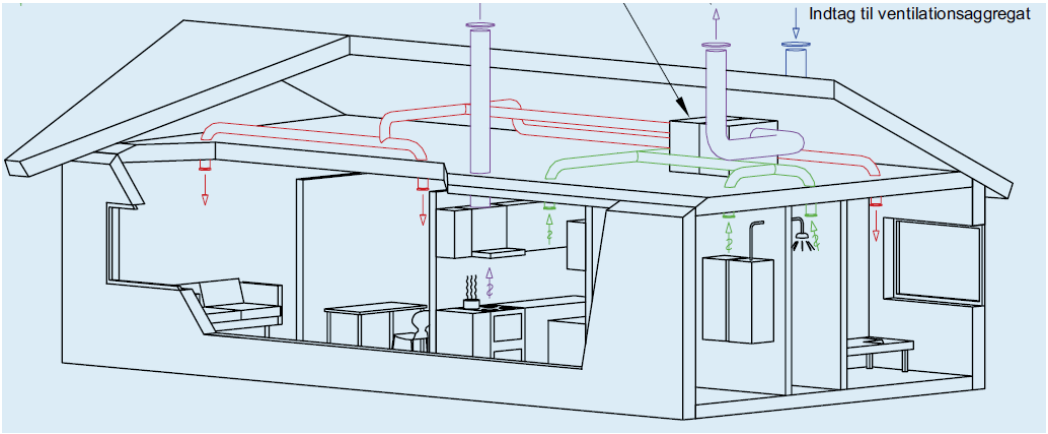
heat pumps (aircondition)



EVs

white goods

ventilation systems



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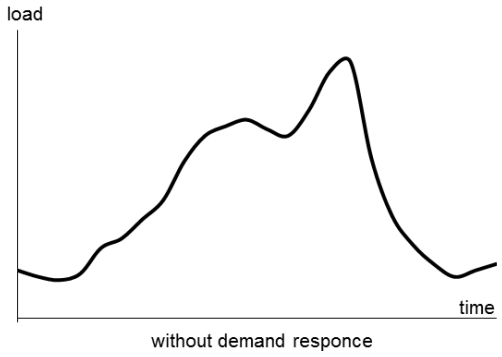
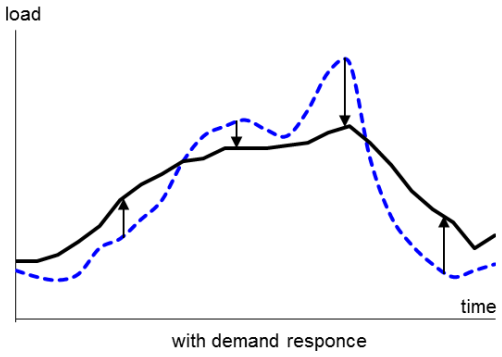
Most buildings have the ability to become energy flexible



without demand responce



with demand responce

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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

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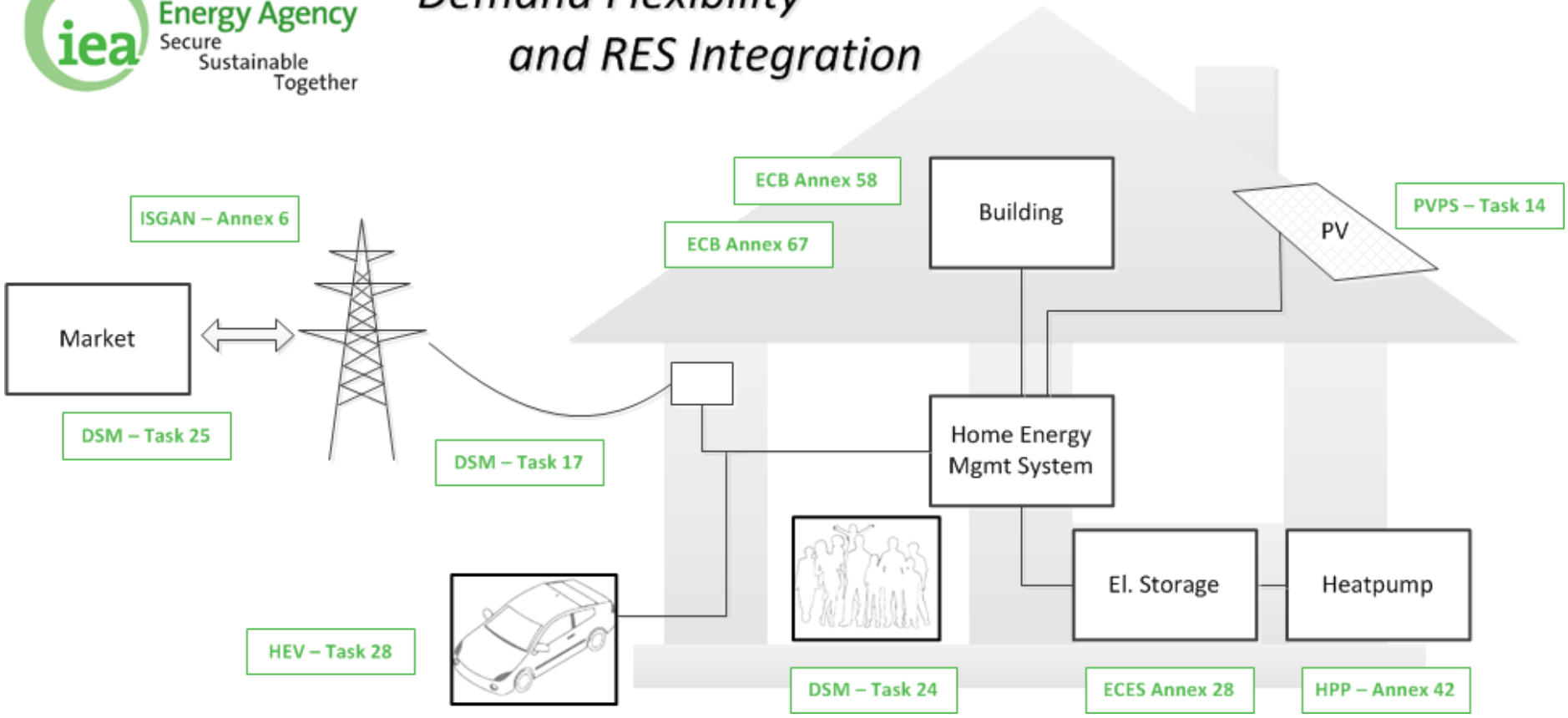
Participating countries (16)

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

Other related IEA activities

International Energy Agency
Secure Sustainable Together

Demand Flexibility and RES Integration



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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.

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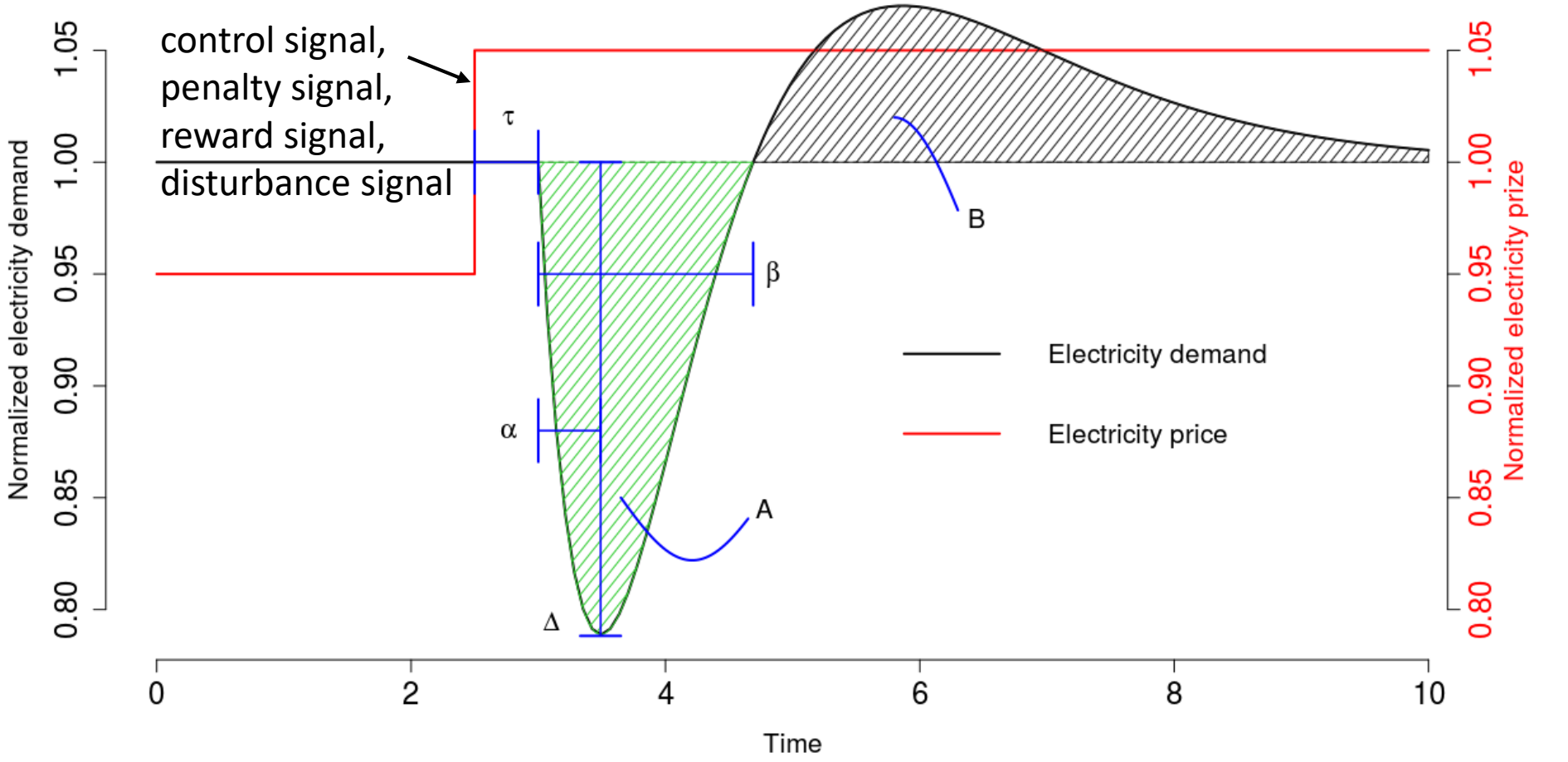
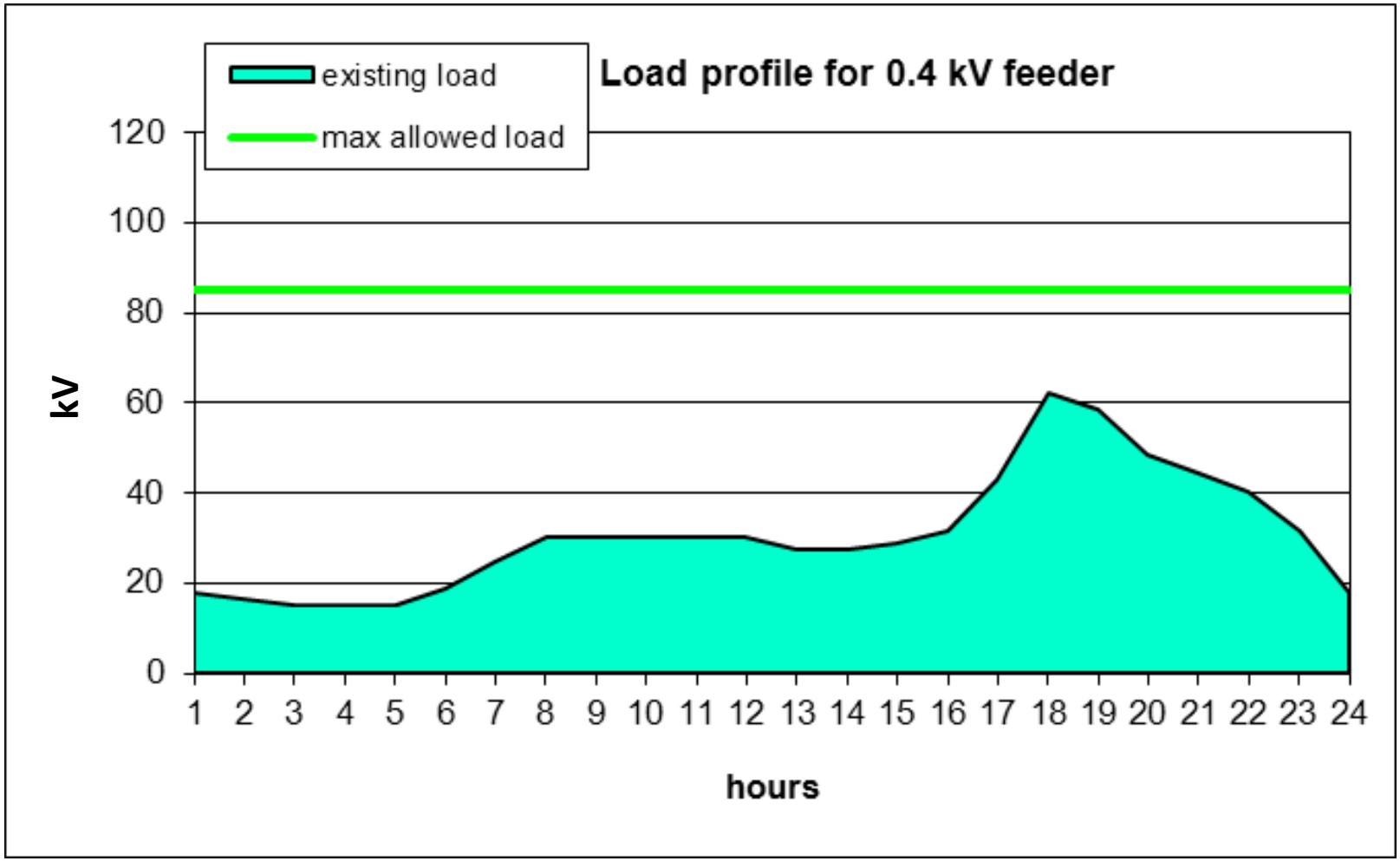
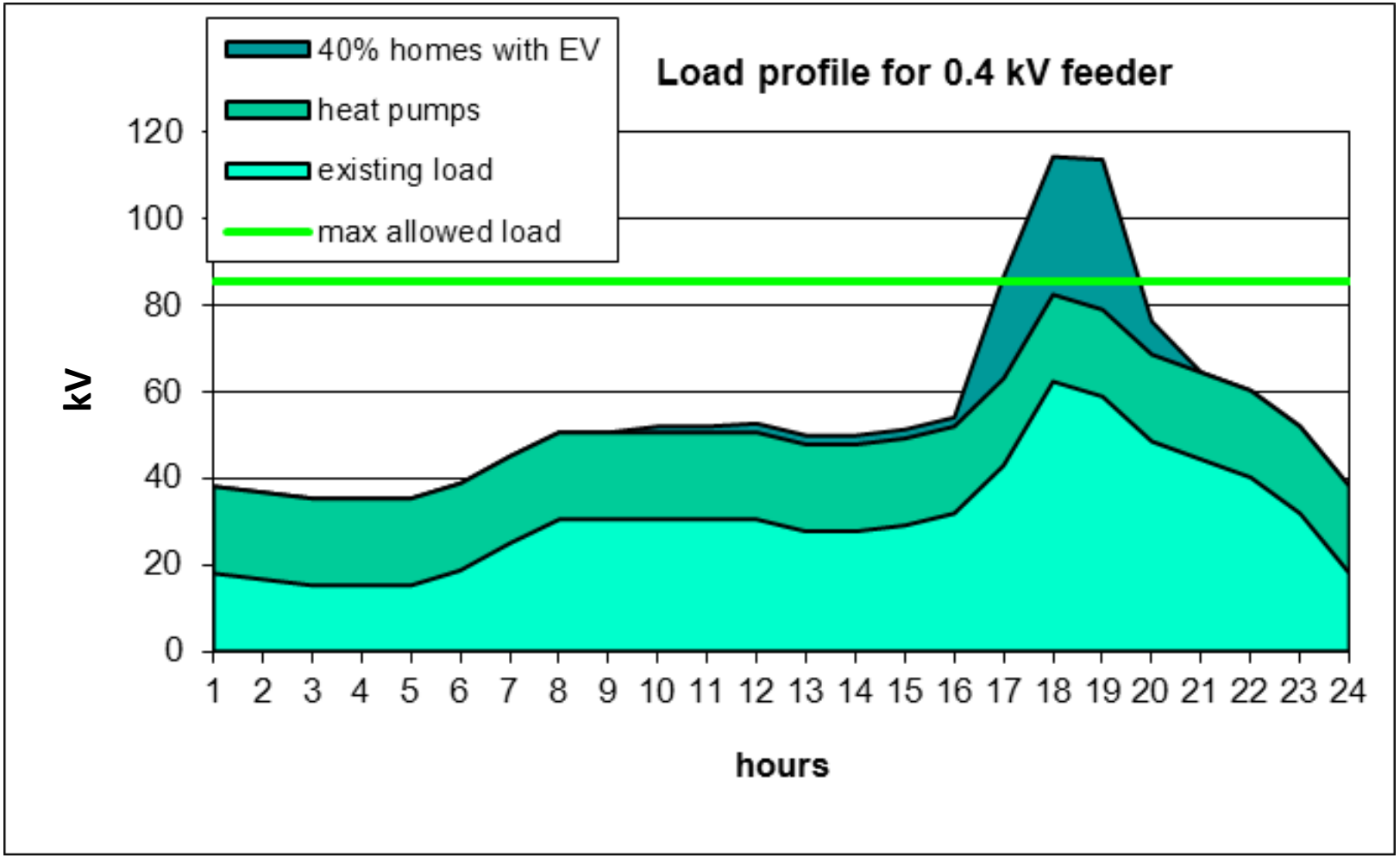
Characterization and labelling of Energy Flexibility in buildings



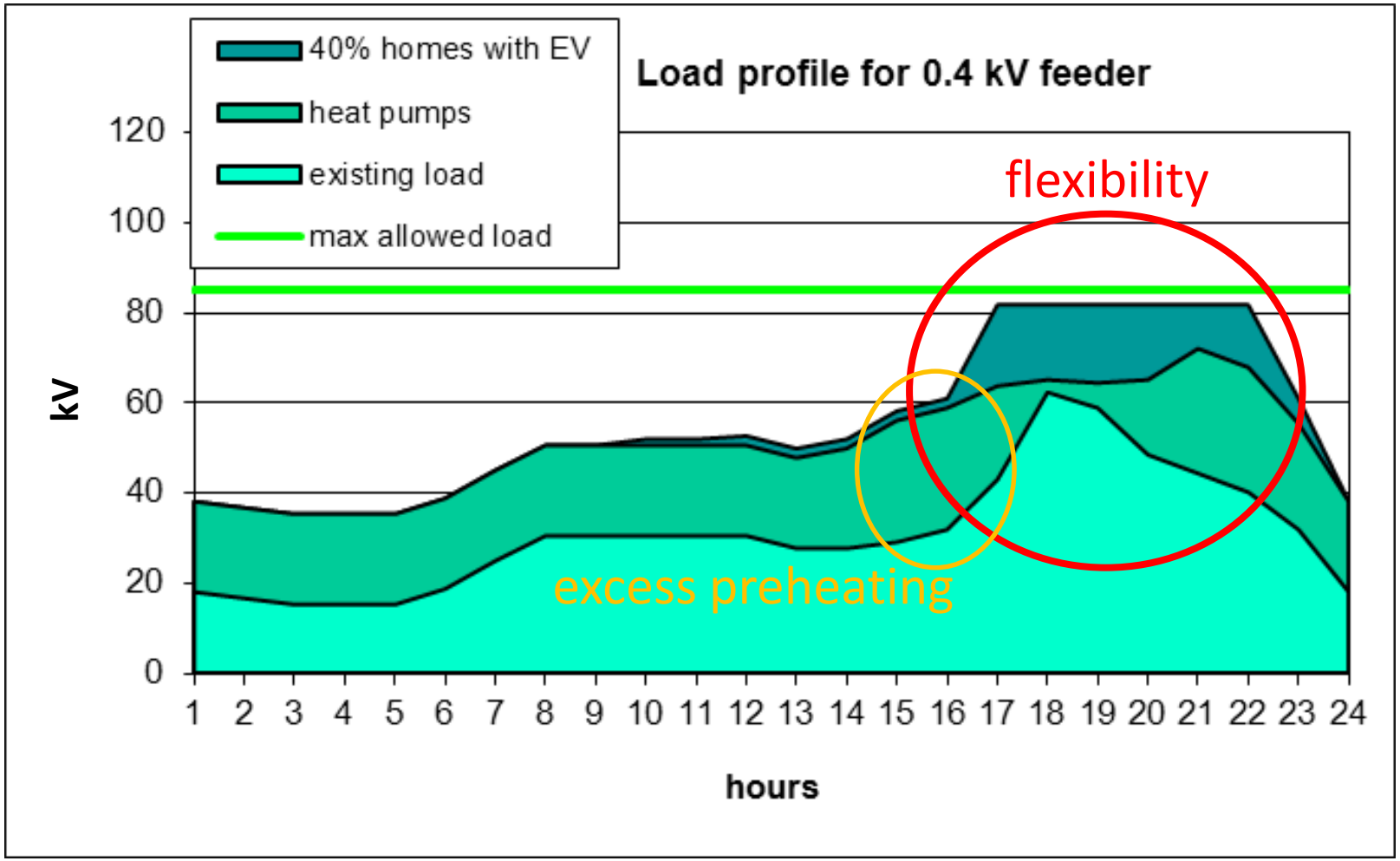
Example 1


existing load
max allowed load
Load profile for 0.4 kV feeder
120
100
80
60
40
20
0
kV
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

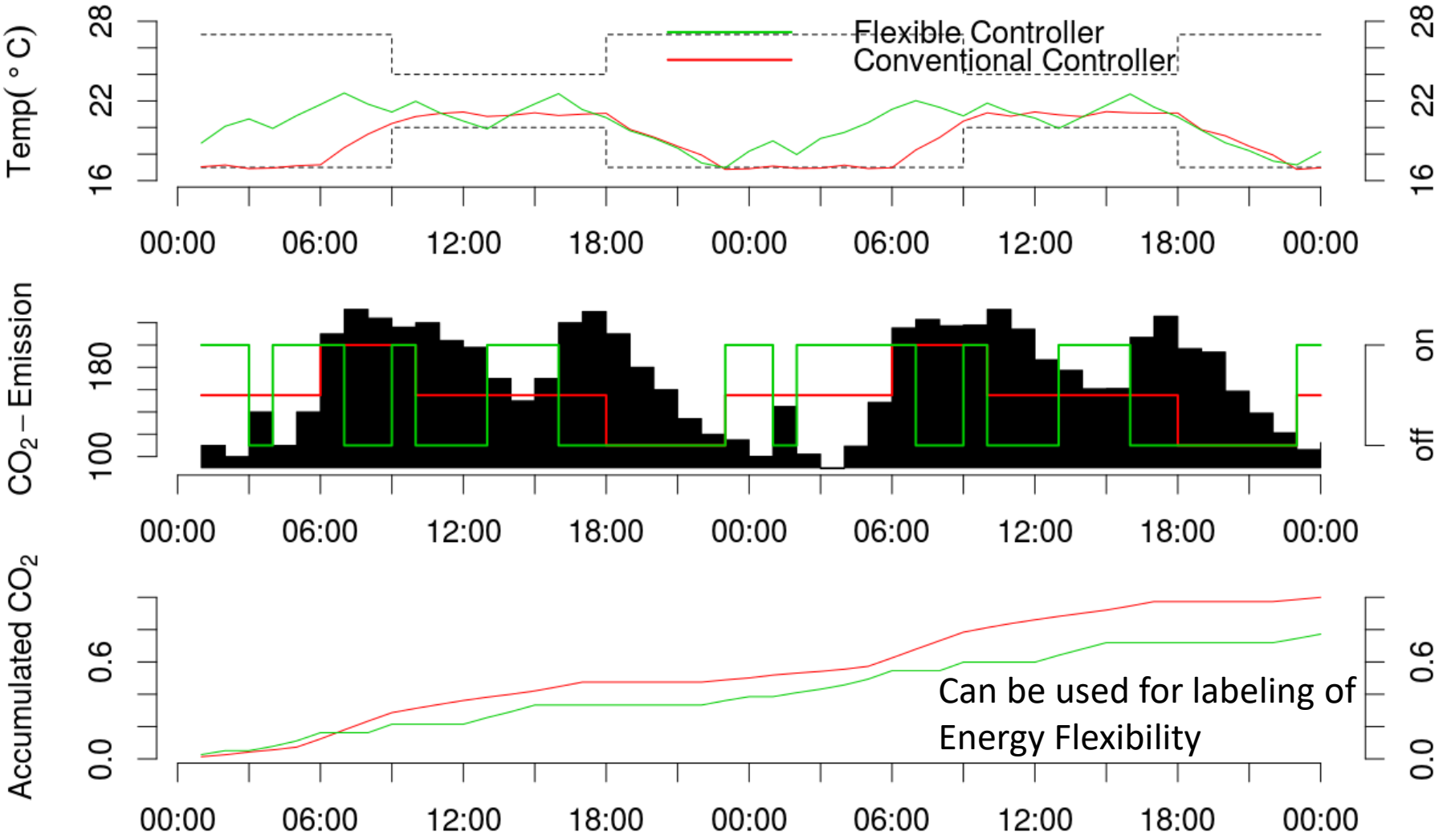
Example 1


40% homes with EV
heat pumps
existing load
max allowed load
Load profile for 0.4 kV feeder
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

Example 1


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

Example 2



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

European Union

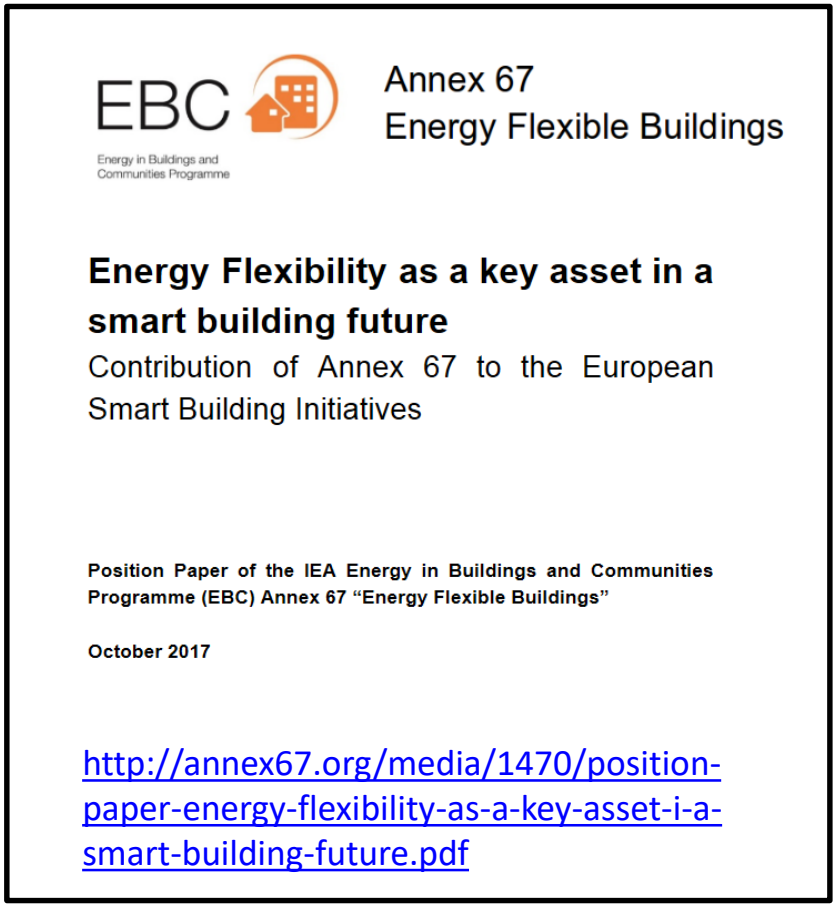
Smartness Indicator in EBPD (Energy Performance in Buildings Directive)

- 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 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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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

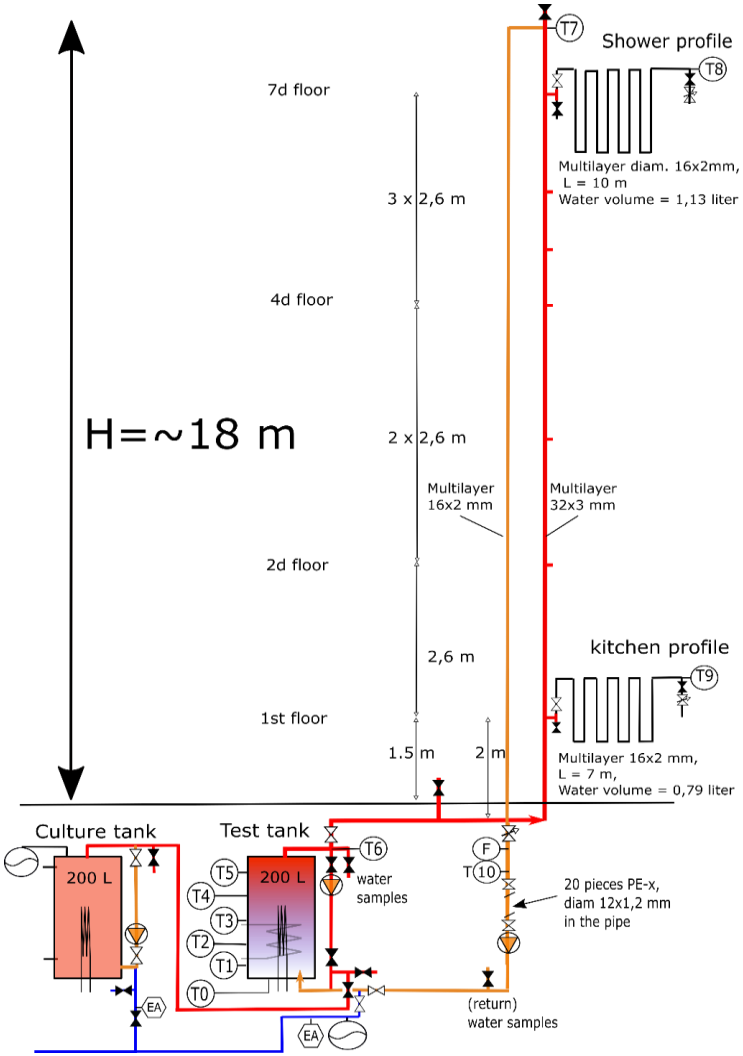
Flexibility potential in DHW systems

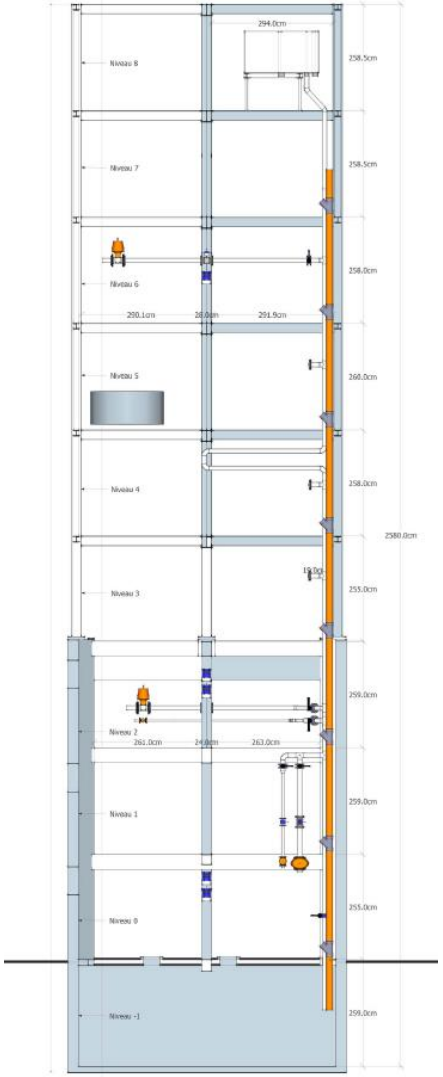
- Energy context:
  - As the energy-use for space heating continues to diminish, *energy-use for domestic hot water* (DHW) becomes *increasingly relevant*
  - *Efficient design* of DHW installations becomes ever more important
  - Pressure to *reduce DHW production temperatures*

- 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

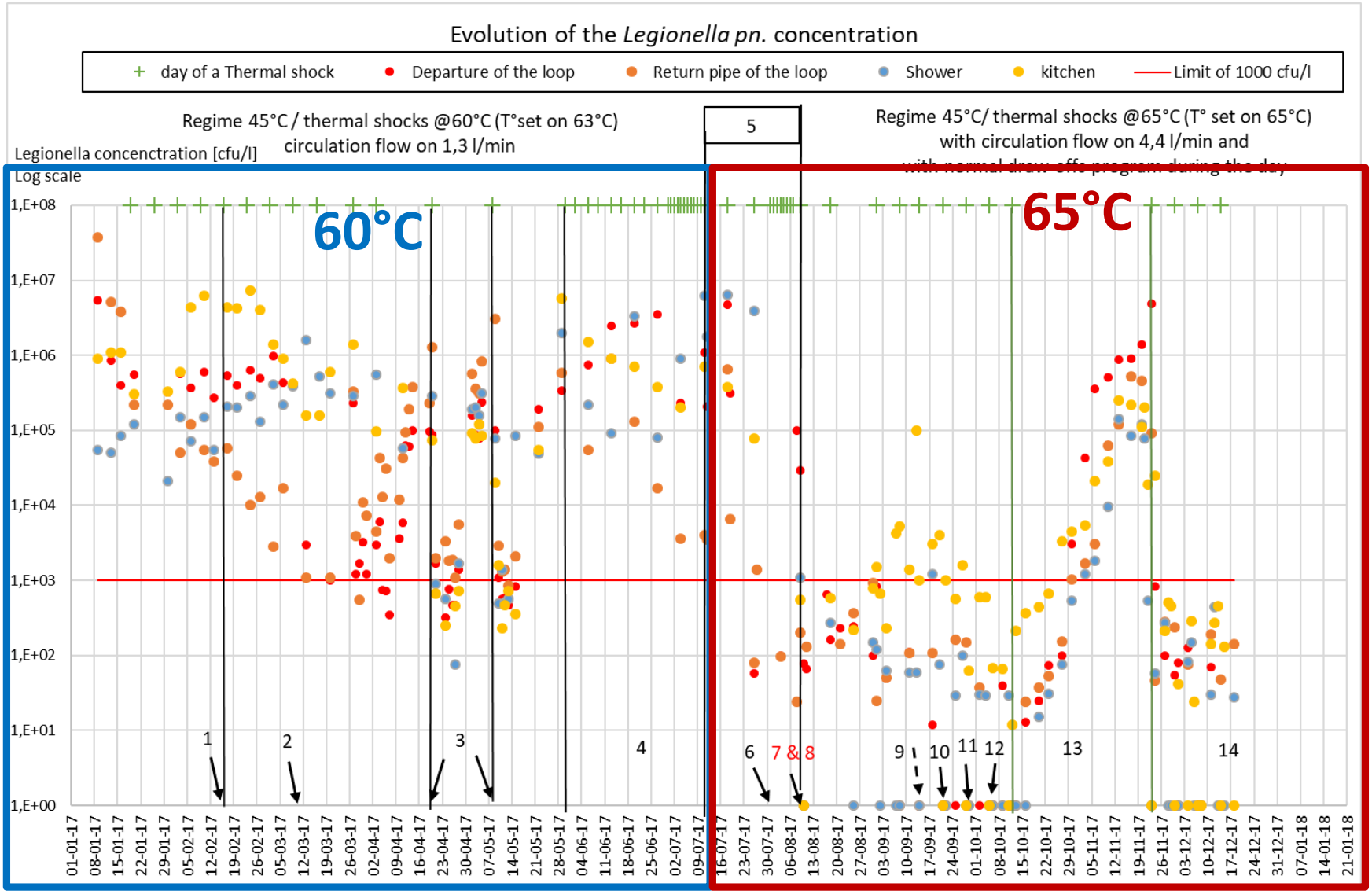




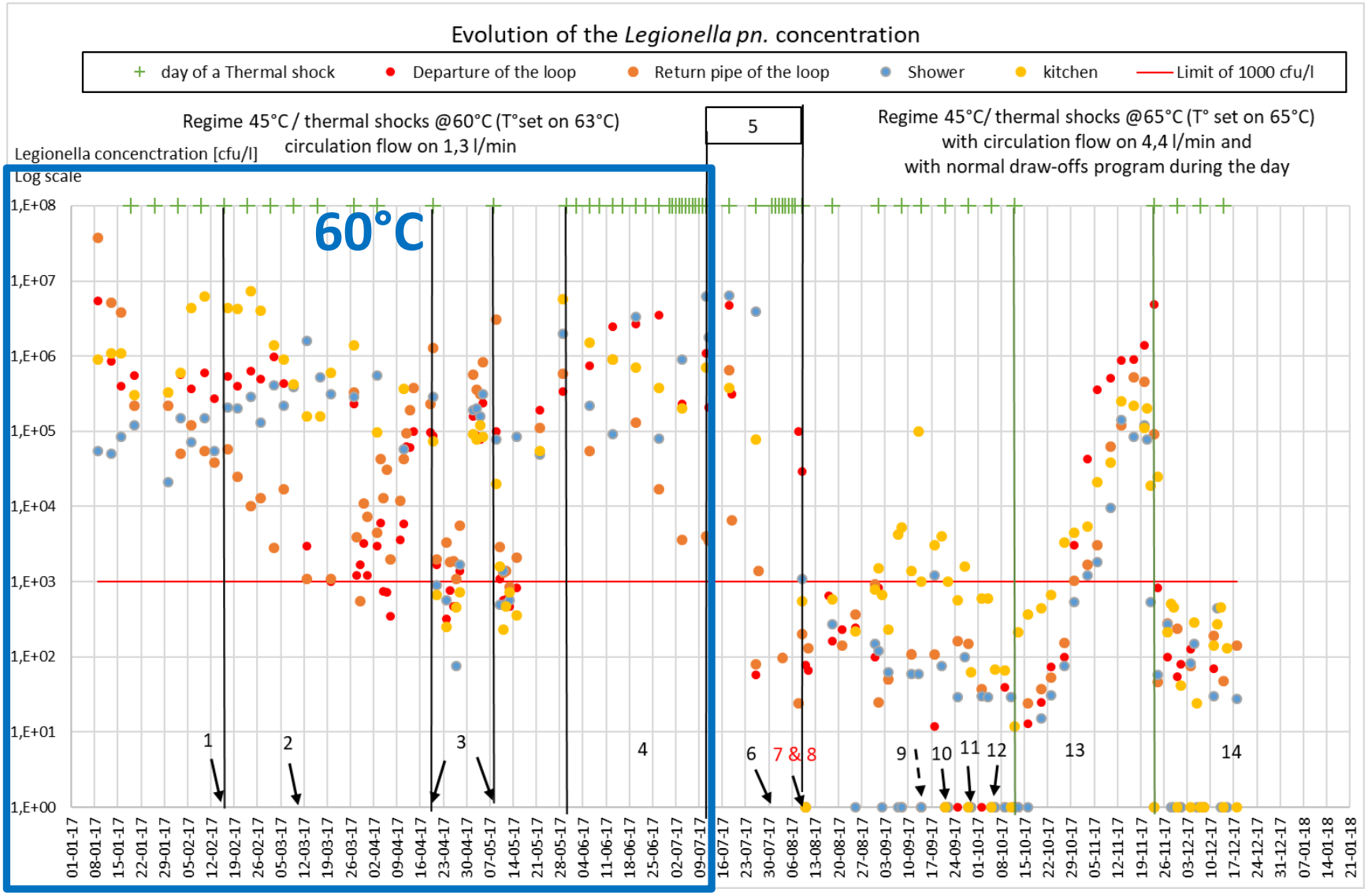
Flexibility potential in DHW systems

T_{prod}	$T_{heating}$	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 desinfection 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 desinfection 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

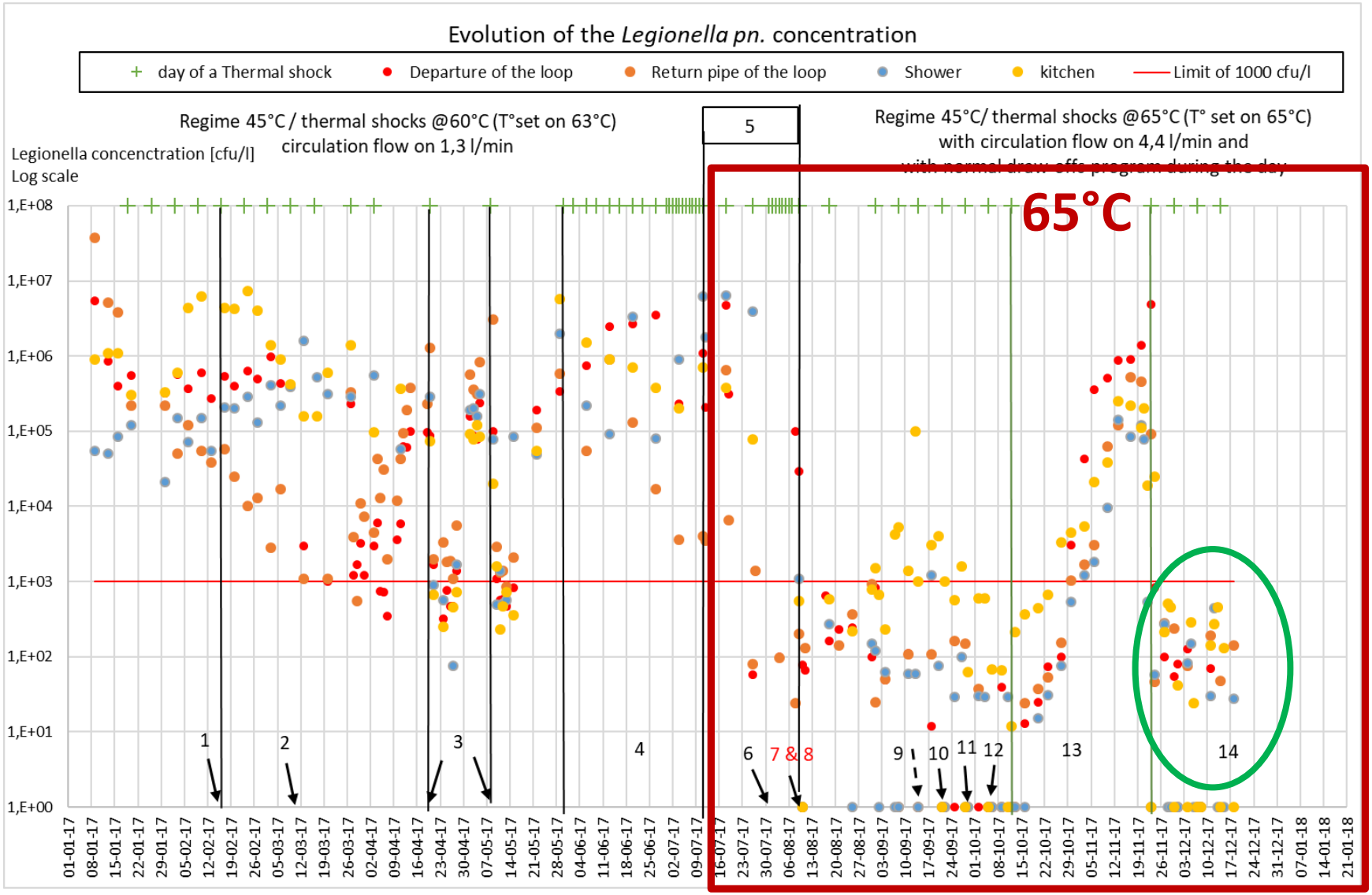
Flexibility potential in DHW systems



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

Website

annex67.org

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Thank you for your attention