

# Energy Flexible Buildings

IEA EBC Annex 67

Operating Agent

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Danish Technological Institute

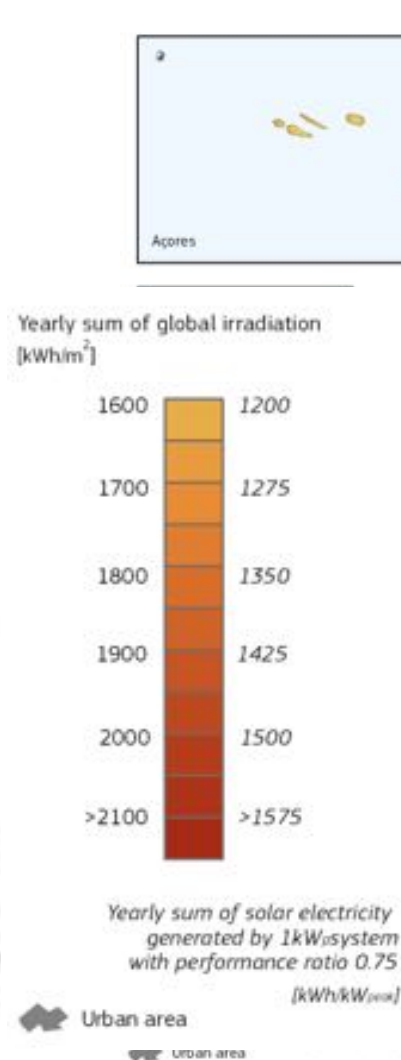
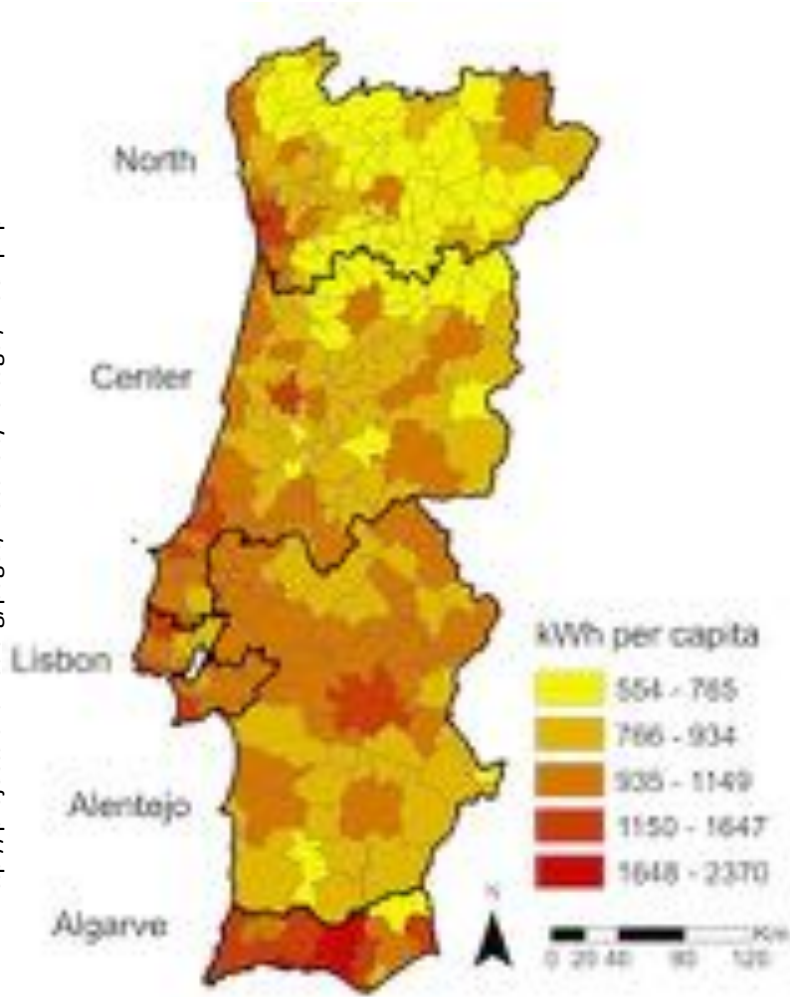
[sdj@teknologisk.dk](mailto:sdj@teknologisk.dk)

2nd NZEB International Conference,

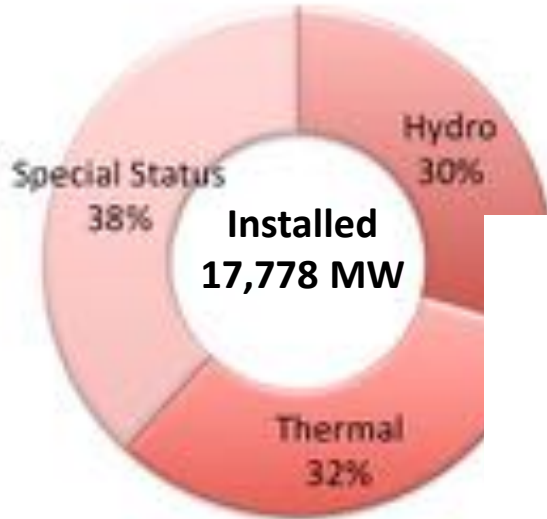
Lisbon, September 29, 2015

# Residential electricity consumption in Portugal

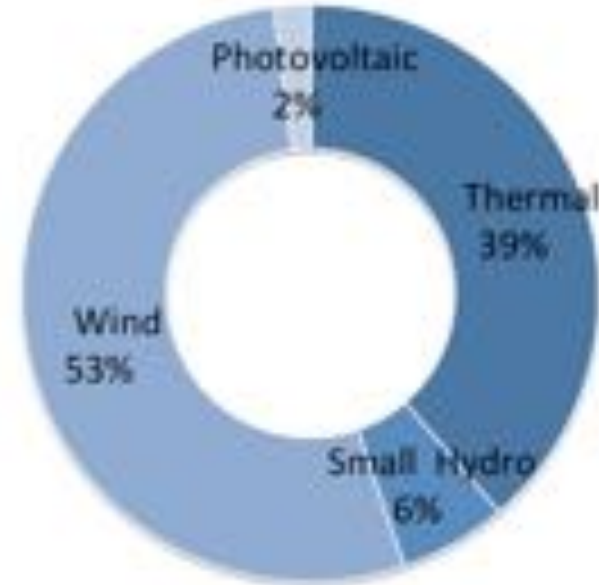
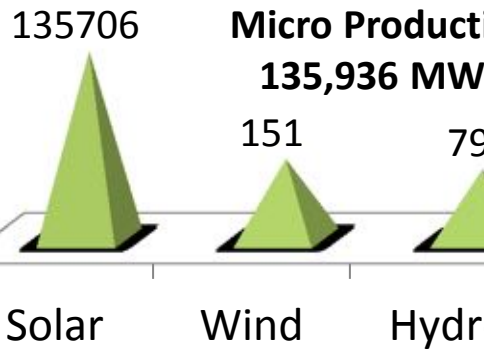
<http://projects.urbm.net.org/pages/ElectricityPortugal/index.php>



# Renewable Energy



Installed Generating Capacity



# National targets for improved energy performance

## National Energy Efficiency Action Plans (PNAEE2016)

PROGRAM	Accumulated Energy savings (toe)		CO2 emissions reduction (tCO2)	
	2016	2020	2016	2020
Residential and service Buildings	320.932	582.727		
Government Energy Efficiency in Public Buildings	112.170	253.988	489.647	1.108.715
Behaviour - Information and communication of energy efficiency	-	-	-	-

## National Renewable Energy Action Plans (PNAEER 2020)

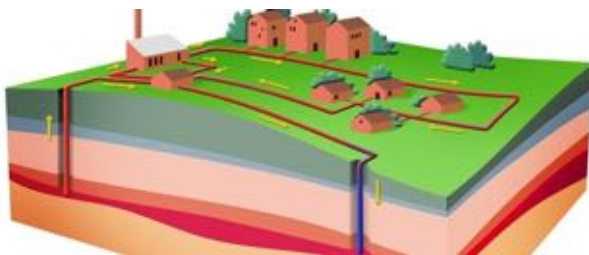
- The program for the use of renewables for heating and cooling sets for 2020 an **increasing of 9%** compared with 2010 taken as reference;
- Major contribute of solar thermal and biomass;
- The total renewable energy use for heating, cooling and transport predicted for **2016 and 2020** is **5.259ktoe and 5.737ktoe**, respectively.

# Portugal

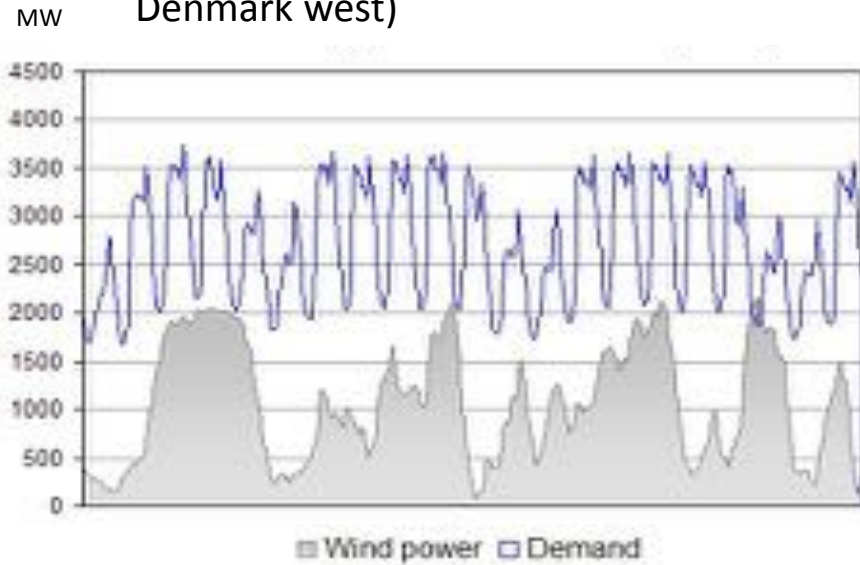


## The goal for the Danish energy system:

**electricity and heating shall by 2035 solemnly be based on renewable energy. By 2050 this will be the case for the entire energy system**

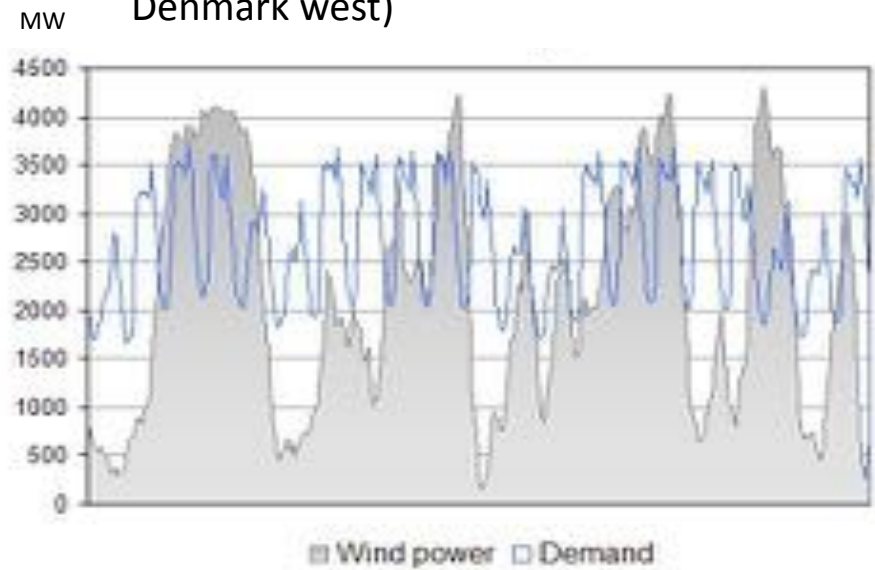


25% wind power (January 2008  
Denmark west)

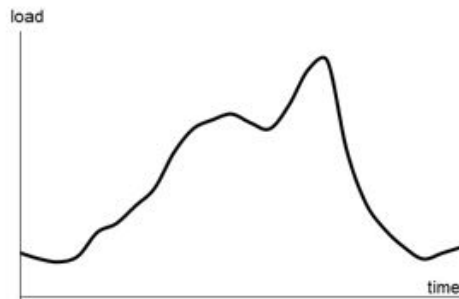


the plan for 2020

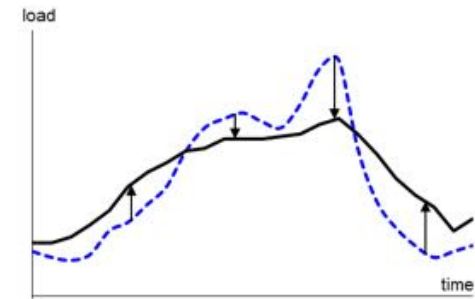
50% wind power (January 2008  
Denmark west)



# Change in the pattern of consumption in accordance with the local grids



without demand response



with demand response



# Commercial buildings

ventilation systems



cooling systems

supermarkets

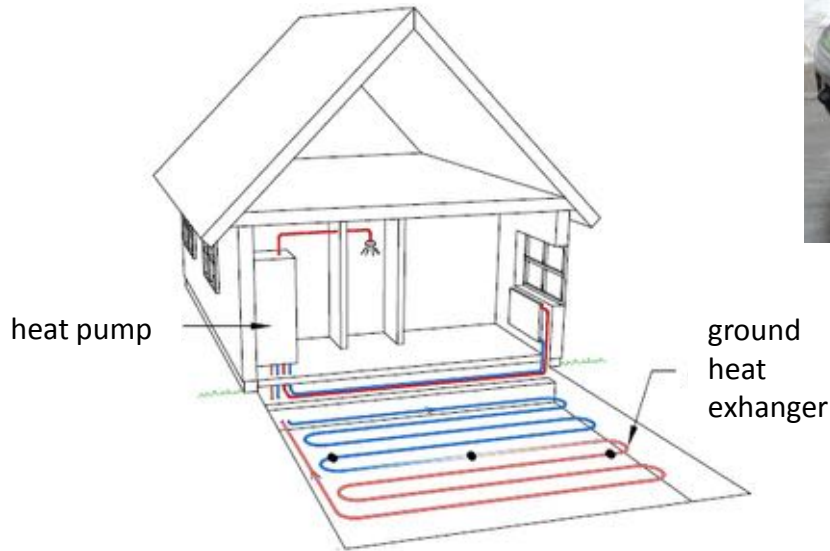


pumps



# Electricity demand in households

## heat pumps

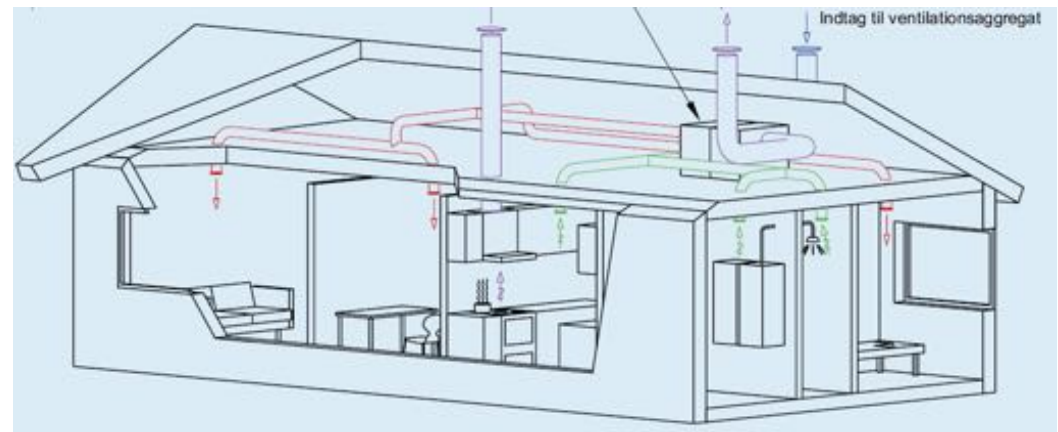


## EVs

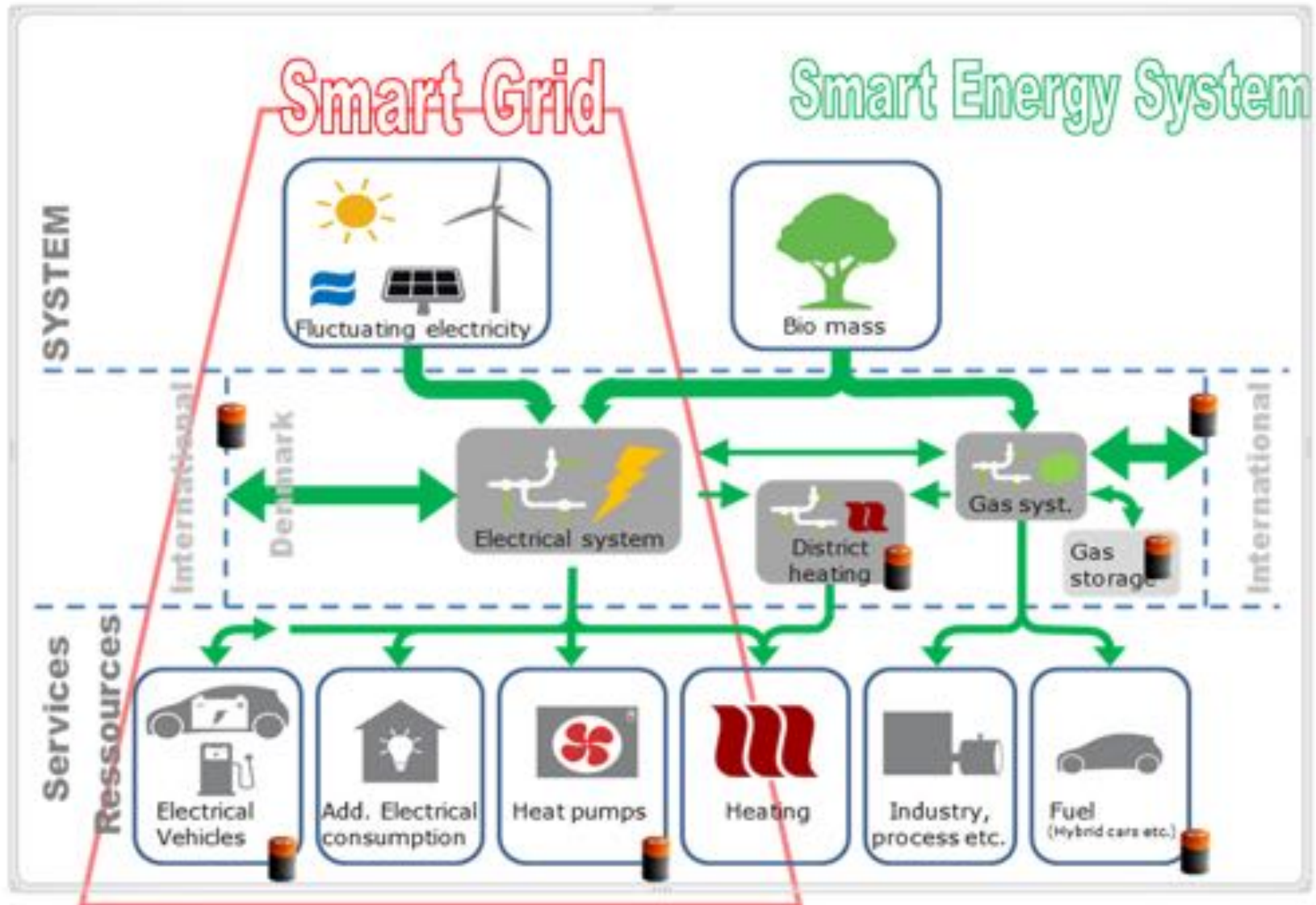
## ventilation systems



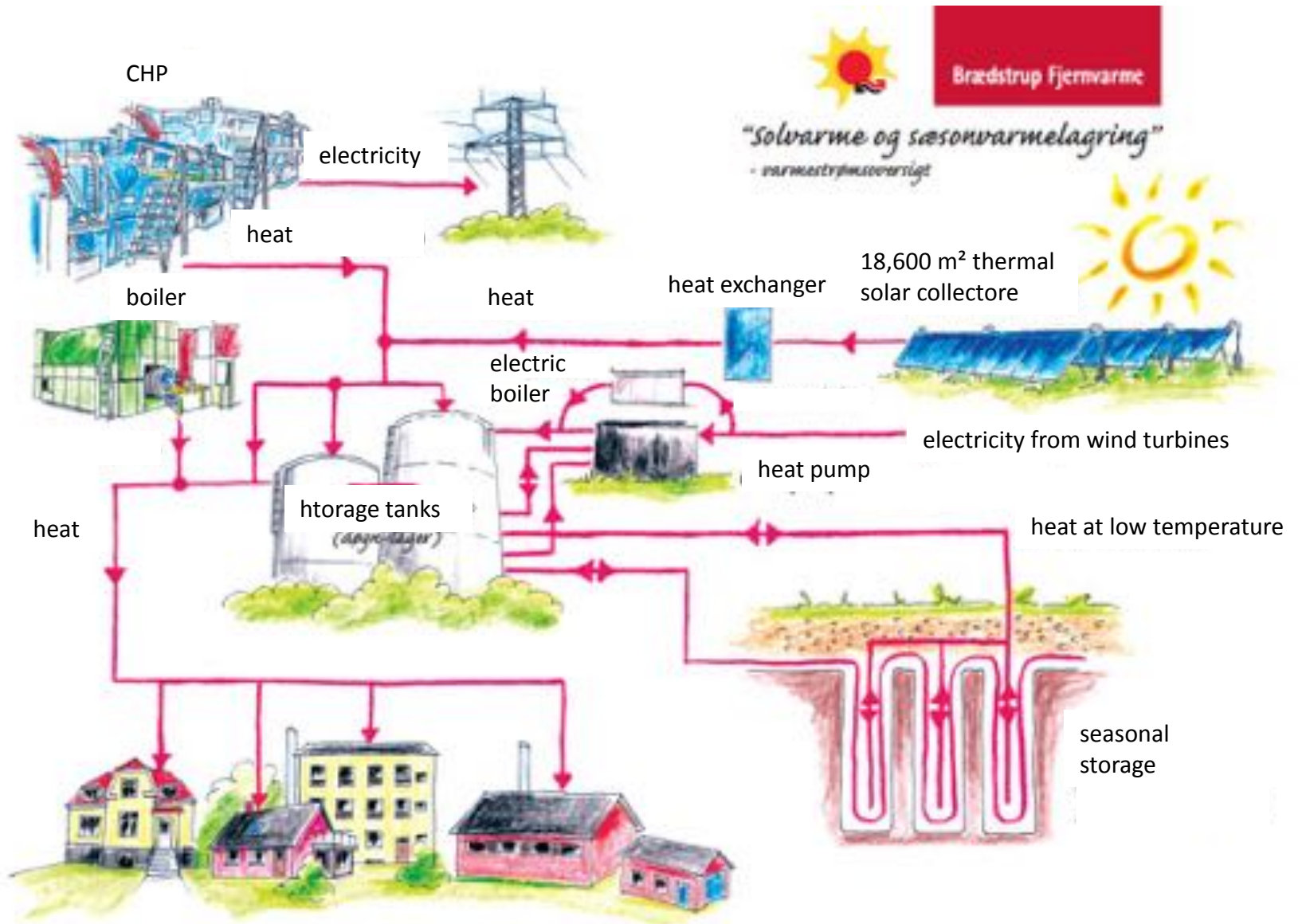
## white goods



# Smart Grid vs Smart Energy






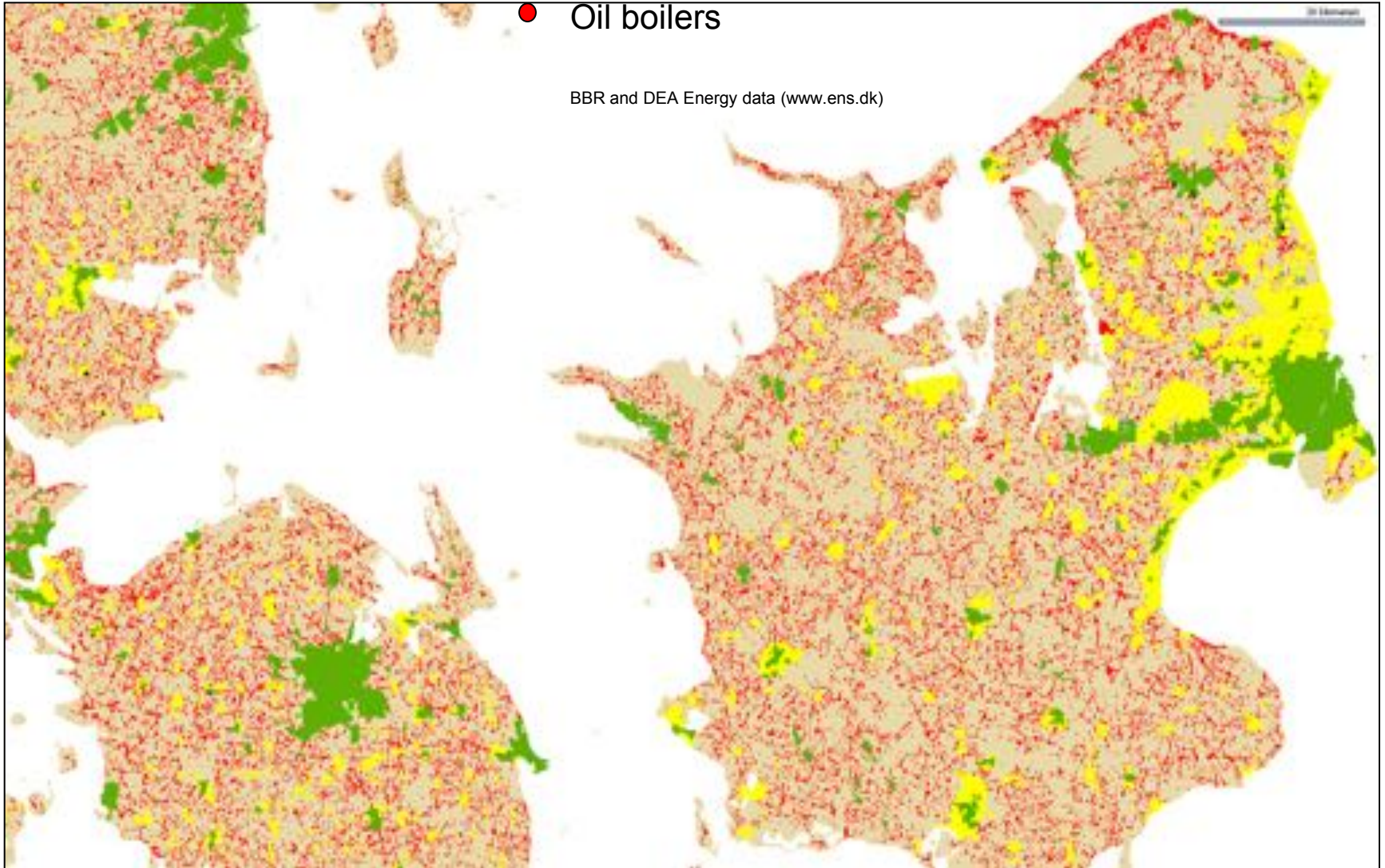
# District heating



# Future Danish heating system

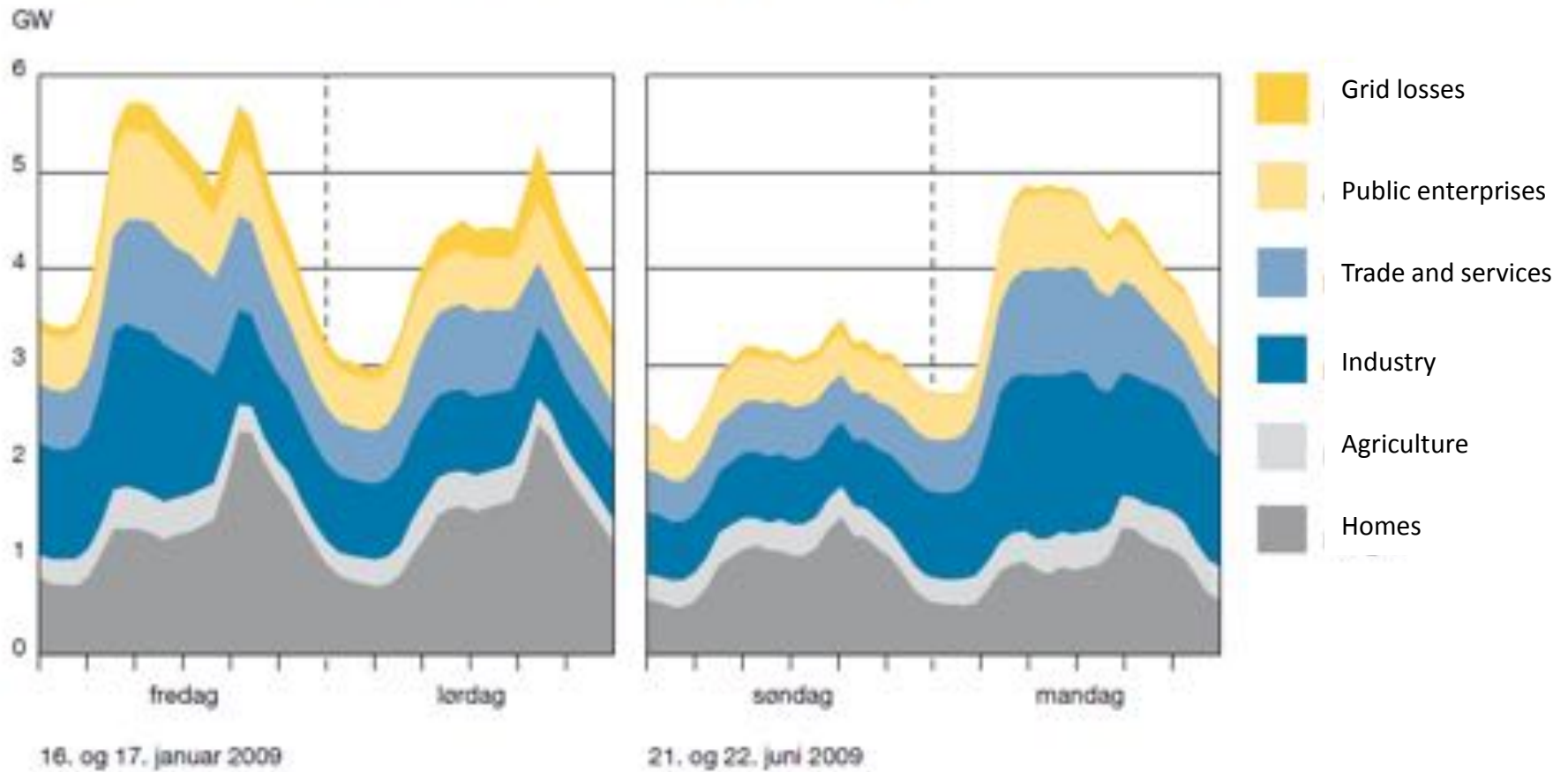
- 65-70 % district heating
- rest mainly heat pumps
- need for 50 % reduction of the heating demand in buildings
- electrification of the heating sector

-  District heating
-  Natural gas boilers
-  Oil boilers



The Danish Energy Agency estimates the potential to 1 mill. heat pumps

## Daily electricity demand profiles divided on sectors

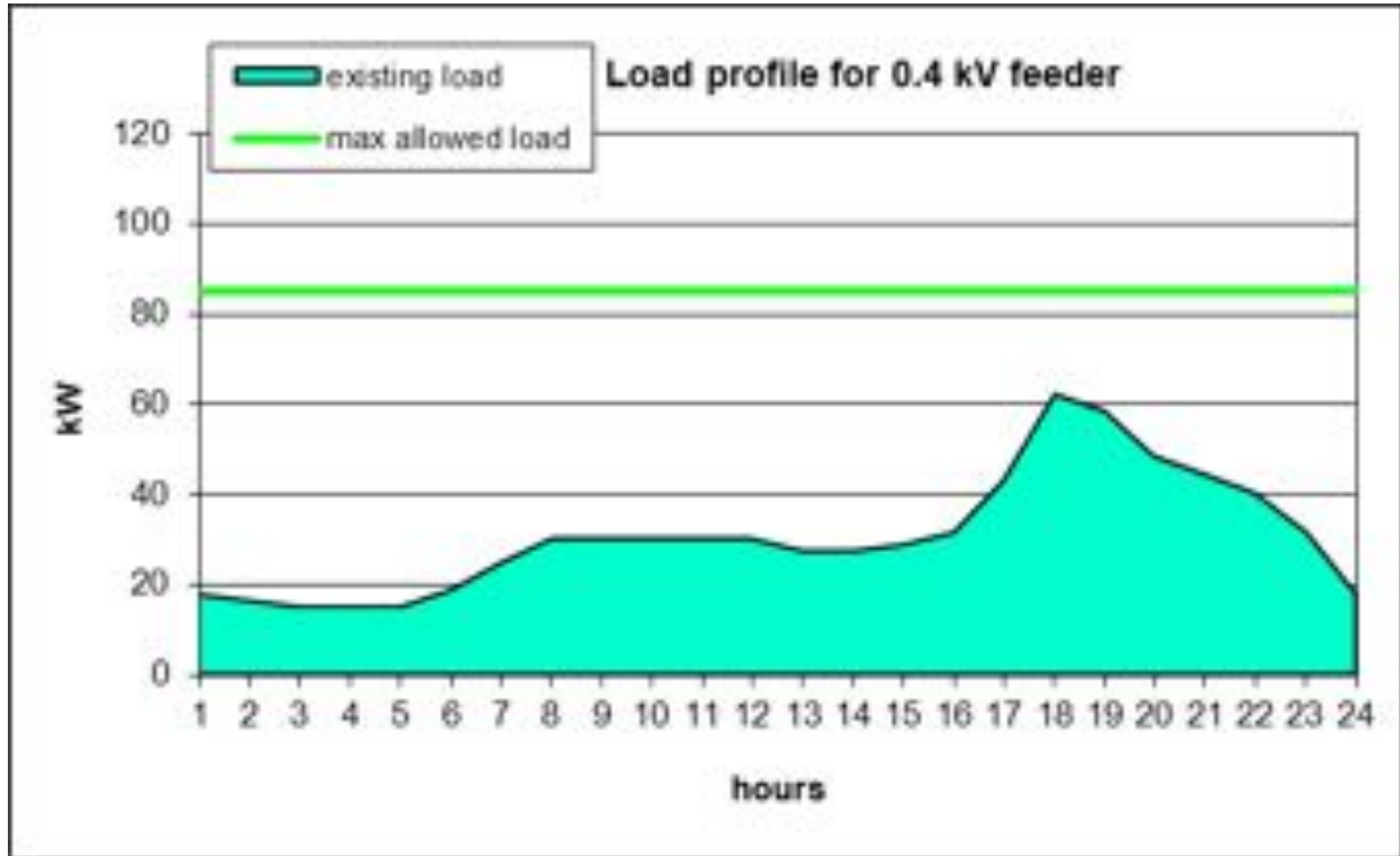




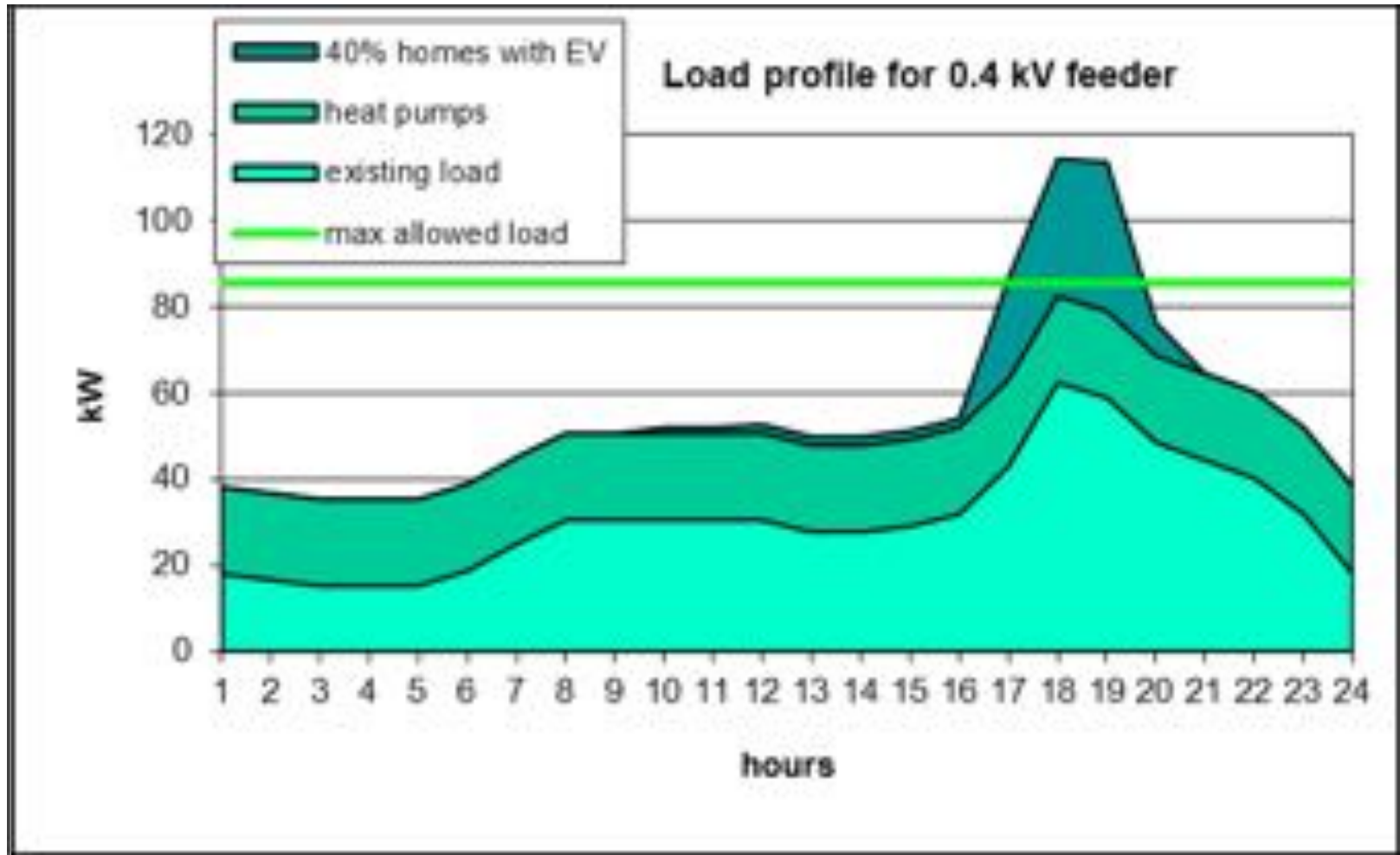
## Electrical Vehicles



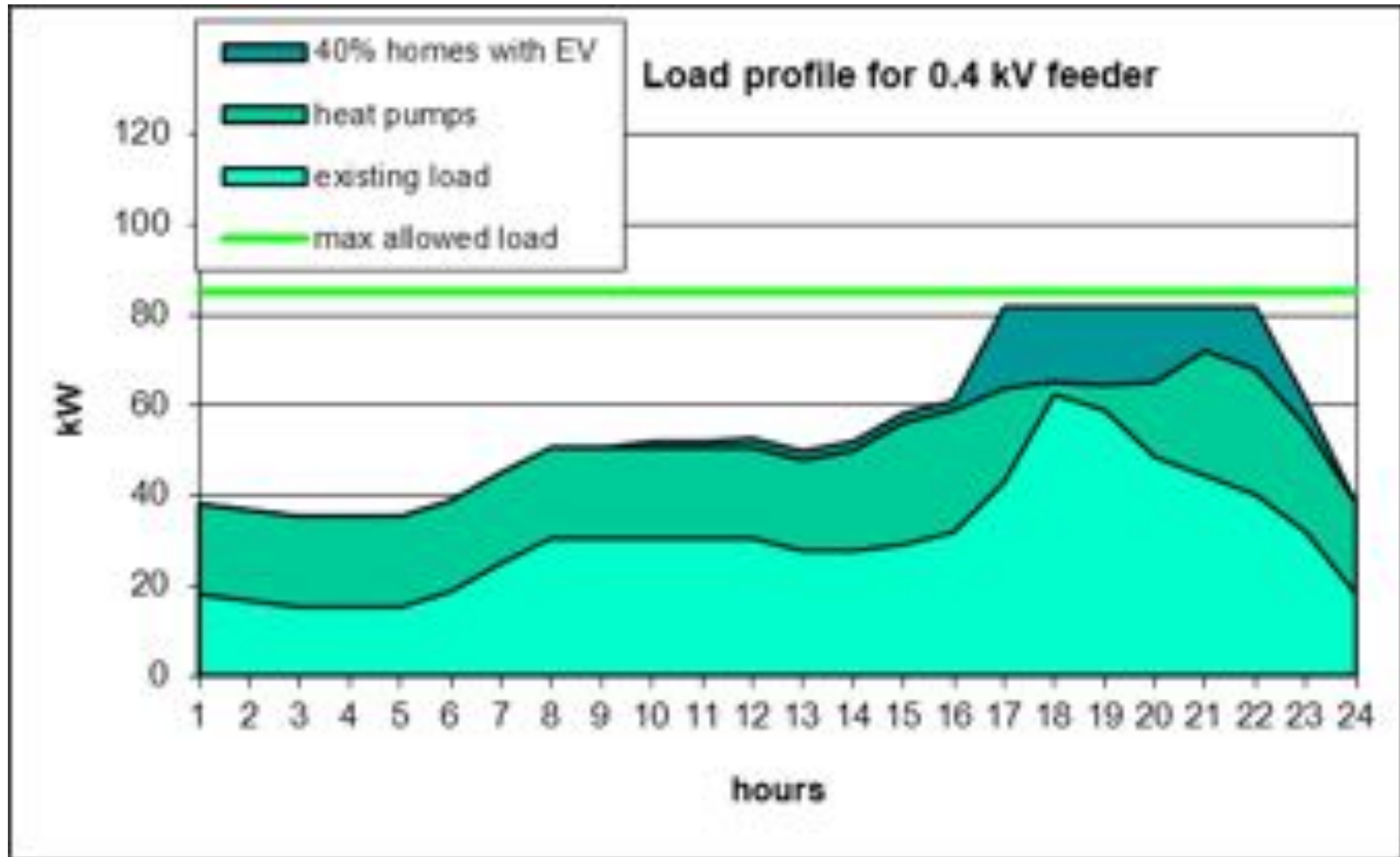
# Example



# Example



# Example



# But!

- increased heat loss
- reduced COP
- extra wear on the heat pump
- electronic thermostats are a necessity
- indoor climate

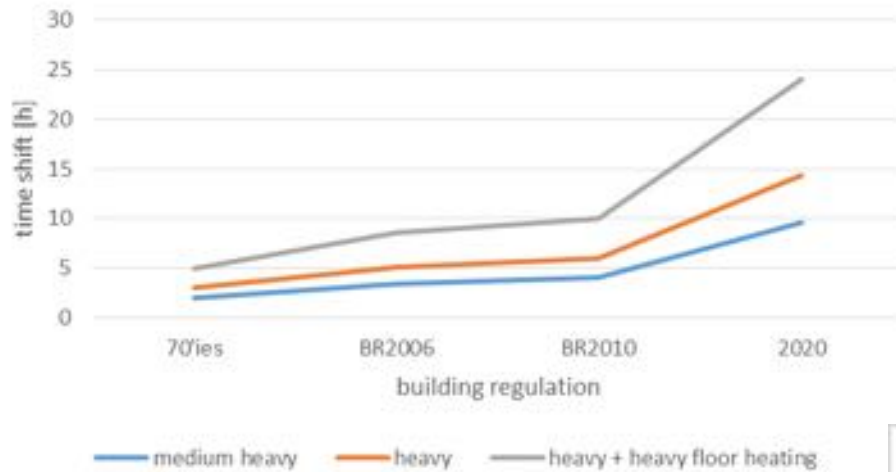
## A.3 Recommended indoor temperatures for energy calculations

Table A.3 — Temperature ranges for hourly calculation of cooling and heating energy in three categories of indoor environment

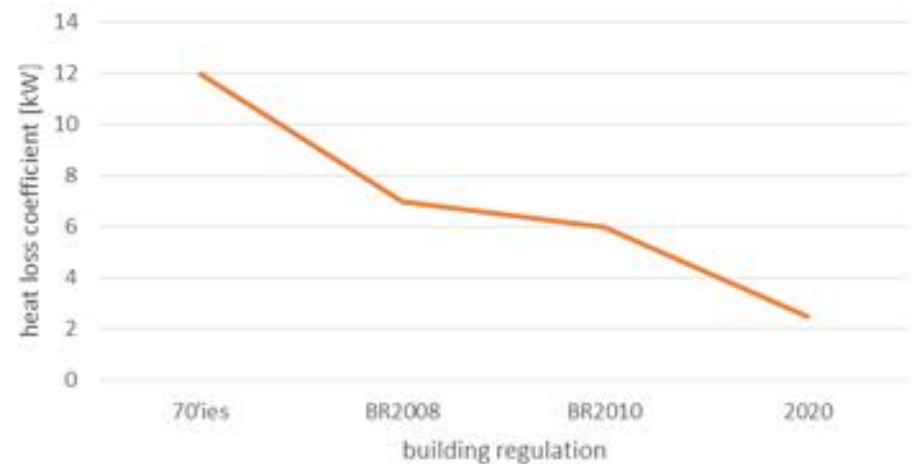
Type of building or space	Category	Temperature range for heating, °C	Temperature range for cooling, °C
		Clothing ~ 1,0 clo	Clothing ~ 0,5 clo
Residential buildings, living spaces (bed room's living rooms etc.) Sedentary activity ~1,2 met	I	21,0 -25,0	23,5 - 25,5
	II	20,0-25,0	23,0 - 26,0
	III	18,0- 25,0	22,0 - 27,0
Residential buildings, other spaces (kitchens, storages etc.) Standing-walking activity ~1,5 met	I	18,0-25,0	
	II	16,0-25,0	
	III	14,0-25,0	

# Energy flexibility in Danish houses

Possible time shift in 150 m<sup>2</sup> detached house



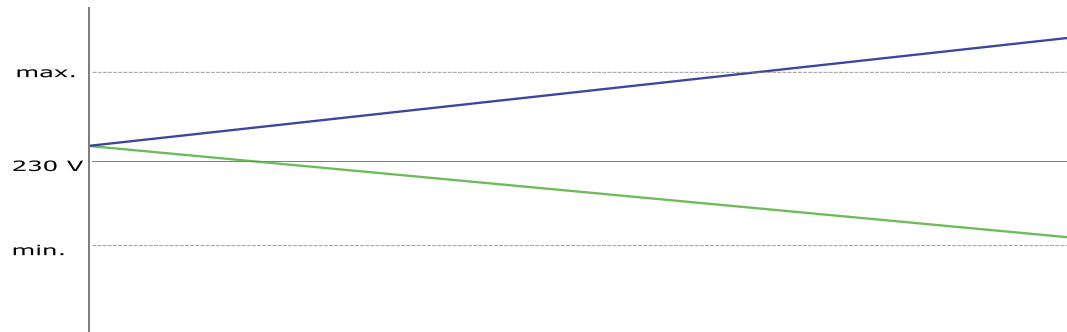
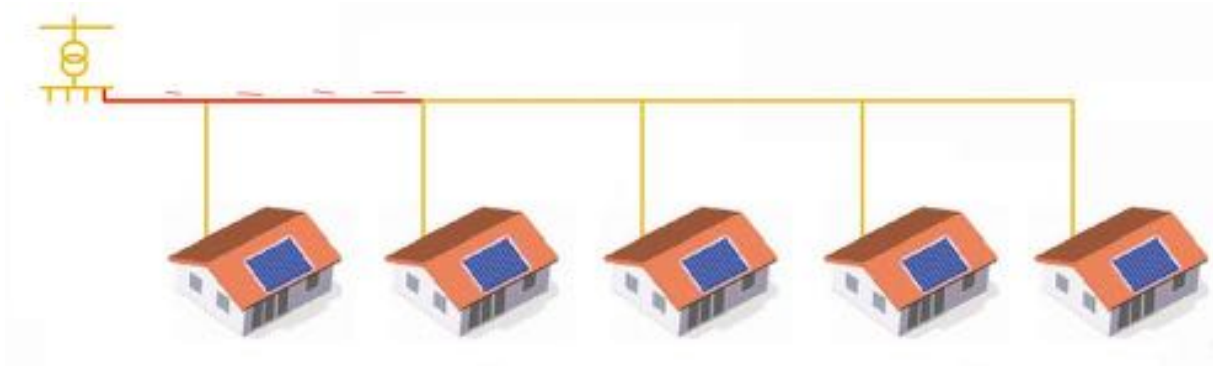
Heat loss coefficient for a 150 m<sup>2</sup> detached house



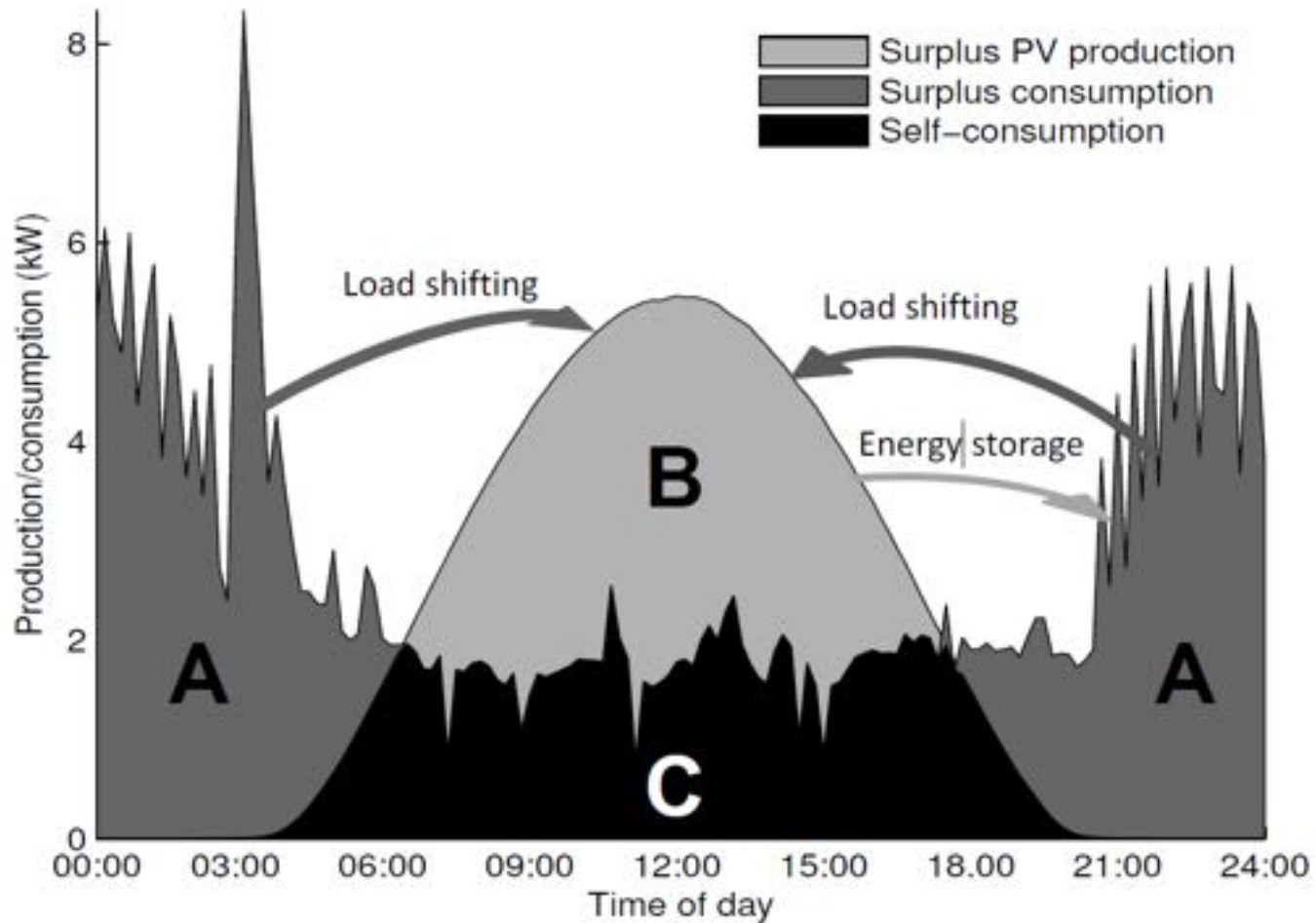
# NZEB = Prosumers



# Prosumers: a challenge for the existing grids

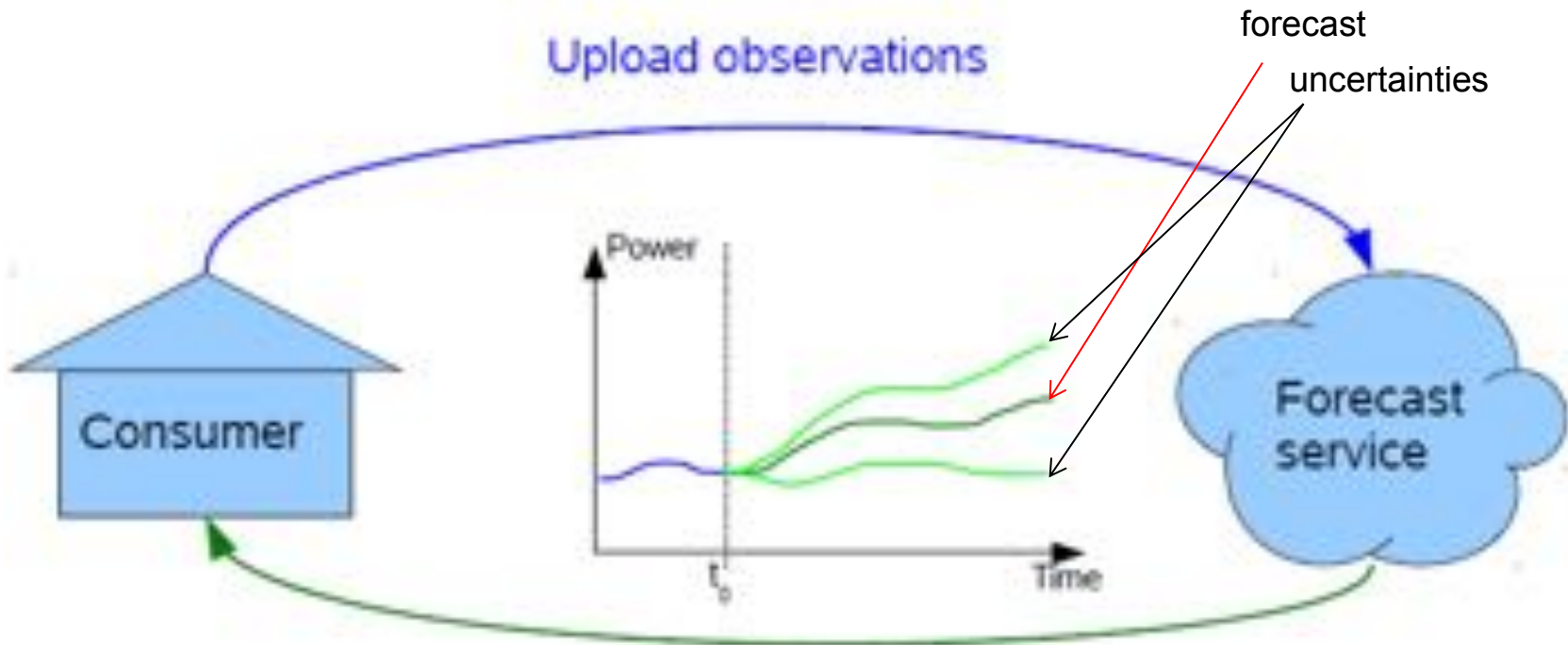


# Self consumption

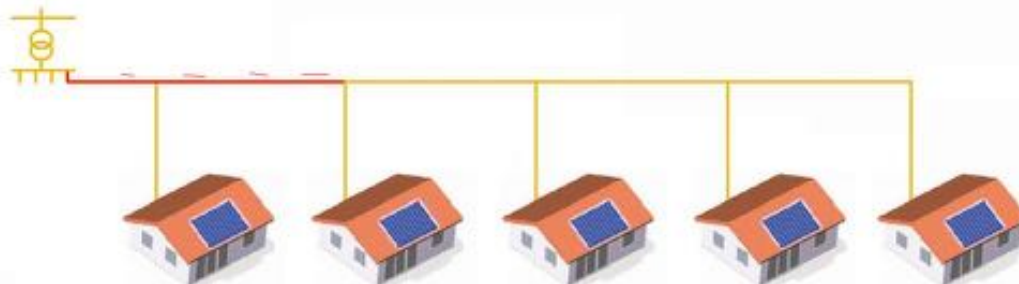




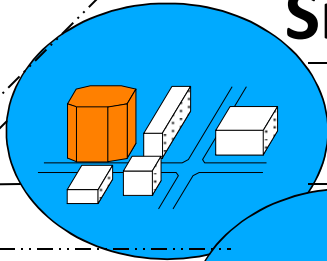
# Forecast



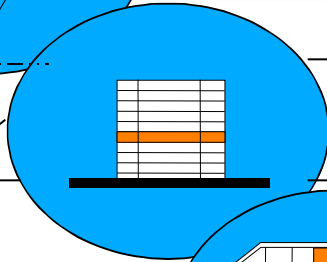
## Download forecast



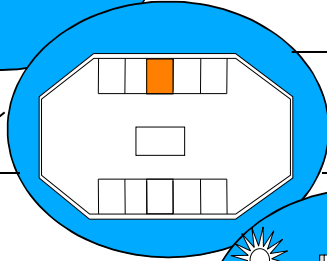
## Smart Grid & other energy infrastructures



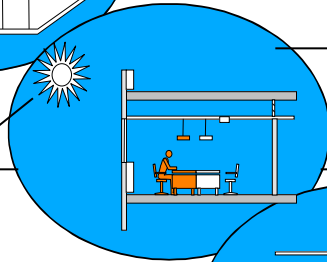
Built environment



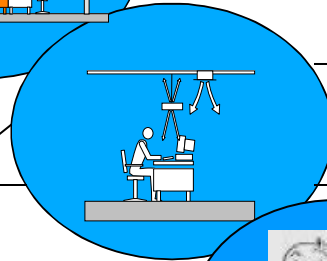
Building



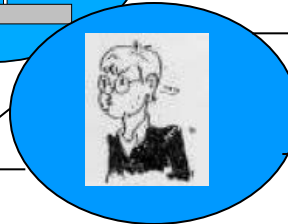
Floor



Room

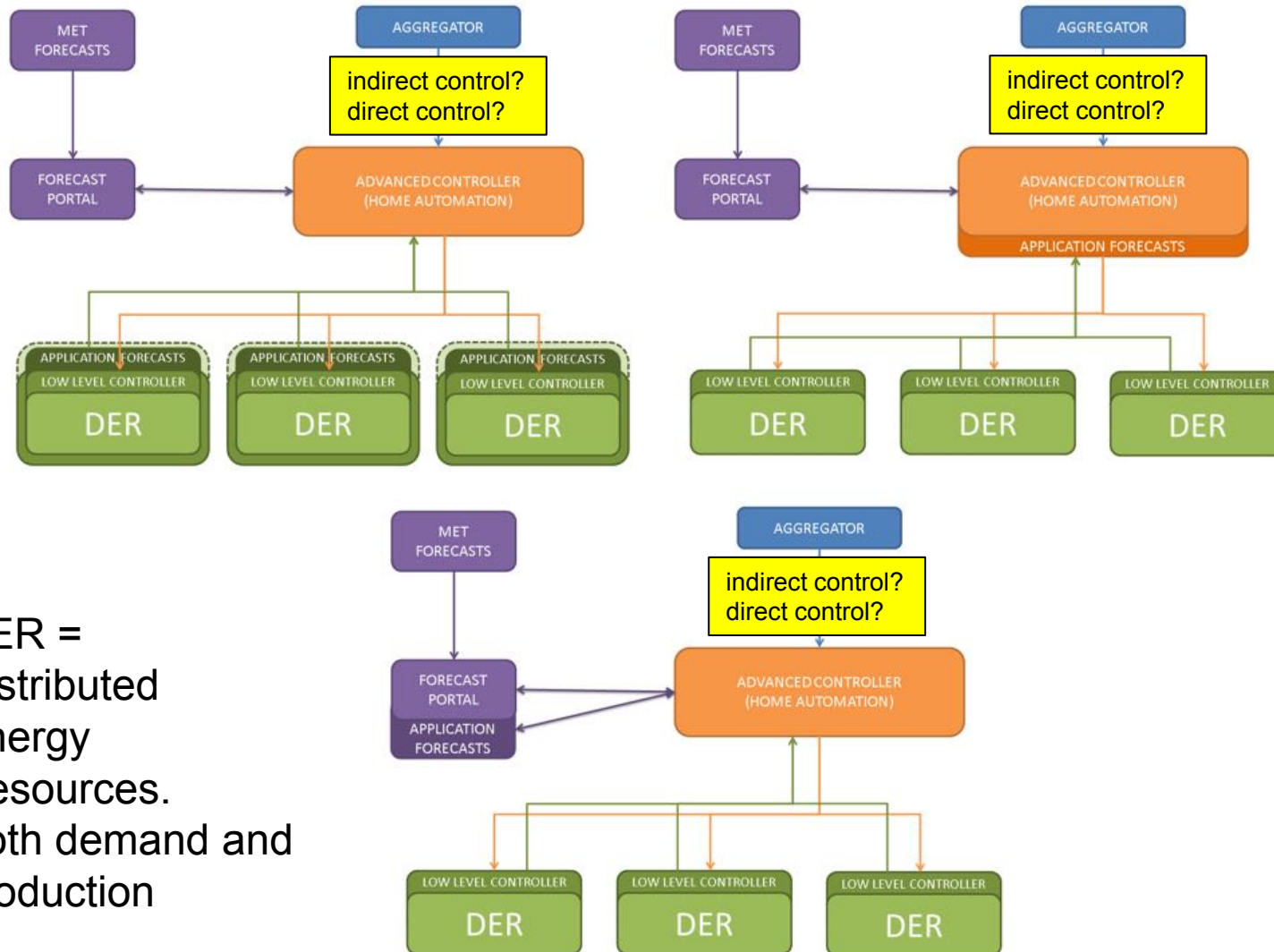


Workingplace



User

# Location of the intelligence



DER =  
Distributed  
Energy  
Resources.  
Both demand and  
production

# IEA EBC Annex 67

## Energy Flexible Buildings

June 2014 – June 2015: Preparation phase: done

June 2015 – June 2018: Working phase

June 2018 – June 2019: Reporting phase

First working meeting:

September 30-October 2, 2015 in Lisbon

## 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.

# Work plan

The Annex will comprise the following subtasks and activities:

## 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

## 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
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Italy
- Norway
- Portugal
- Spain
- Switzerland
- The Netherlands
- UK

**Thank you for your attention**

