10th REHVA WORLD CONGRESS

All Seasons

CLIMATE COMFORT

Heating

Air Conditioning

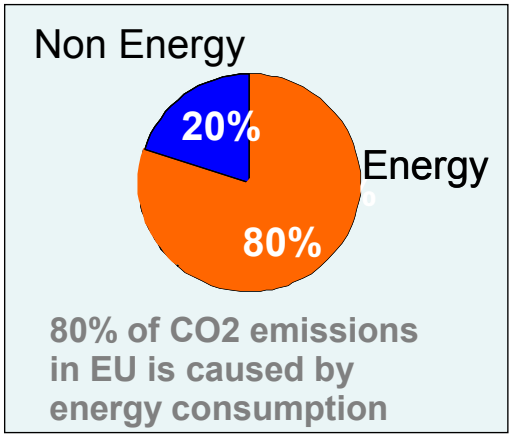
Applied Systems

Refrigeration

New trends in HVAC systems and equipment

Martin Dieryckx
Environment research center
Daikin Europe NV

EU policies "20 – 20 – 20"



80% of CO_2 emissions in EU is caused by energy consumption

20% less primary energy use compared to 2020 projections

Economy

Global Warming

ENERGY

Security of supply

CO_2 eq. emissions :

20% reduction by 2020

New proposal = 30% by 2020

(DG climate May 2010)

20% share of Renewable Energy sources by 2020

How is policy translated ?

20% less primary energy

1. Revision of Energy performance of Buildings directive
2. Development criteria for Energy related products: water heaters, boilers, air conditioners, windows,…
3. Revision of Energy labels
4. Ecolabel : the EU ecoflower
5. Energy Service Directive

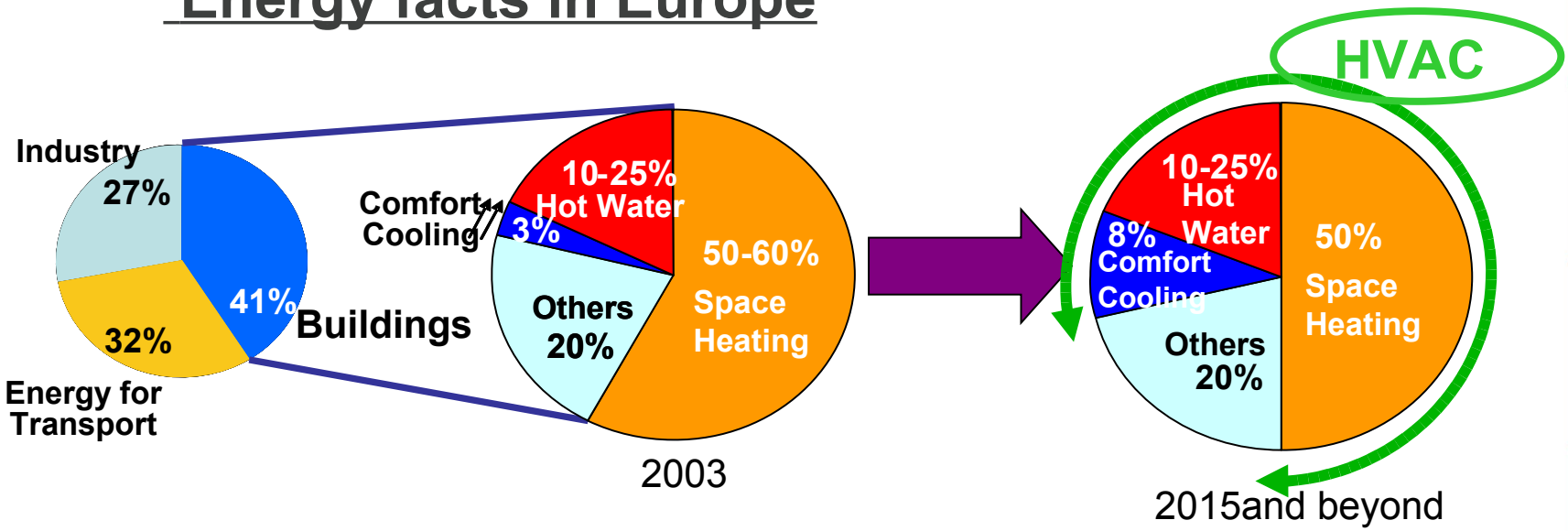
20% less CO_2 emissions

5. Regulation on fluorinated greenhouse gases (F gas regulation)

20% share renewable energy

6. the Renewable Energy Source directive, incl. aerothermal, hydrothermal & geothermal energy

Energy facts in Europe



Main portion (41%) of energy consumption is related to buildings

→**Energy Performance of Buildings directive**

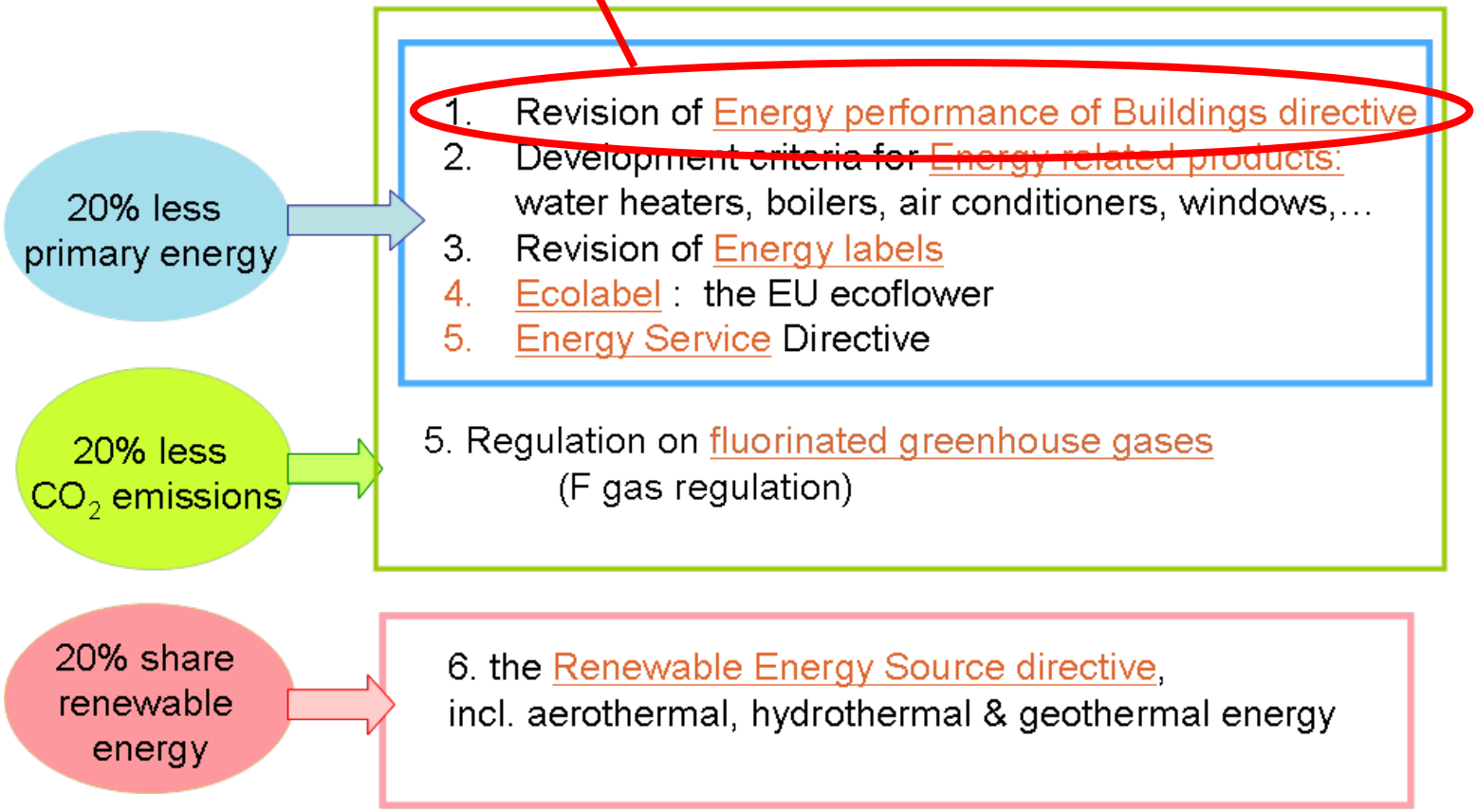
HVAC sector (33%) is largest energy consumer in the EU.

Space heating and hot water heating are the major part while comfort cooling has a strong increase.

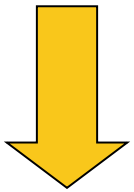
To minimise the impact, we require drastic Energy efficiency improvements for hot water heating, space heating and comfort cooling equipment.

→ **Energy related product requirements in the EU**

Energy performance of Buildings directive



Energy performance of buildings (EPBD) in the EU



Direction is set towards

net Zero Energy Buildings (nZEB)

&

Scope is extended

before: more than1000 m2

Now : all buildings

Nearly Zero Energy Buildings

Level has to be defined by every member state

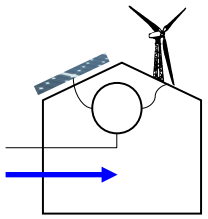
Target newest EPBD : nearly Zero Energy Building (2020)

Energy conservation

e.g. Passive house

Generation of renewable energy on site

e.g. Photovoltaic, wind energy,…



Net ZERO ENERGY BUILDING

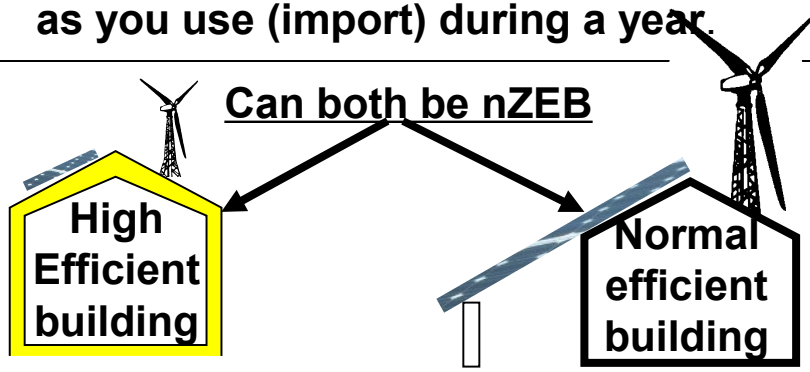
Simplified definition:
Produce as much primary energy (export) as you use (import) during a year.

Remark:

for residential: HVAC-energy
for commercial: HVAC-energy + lighting

See next page for literal definition

Can both be nZEB



Large energy savings
→ low energy consumption
→ small production needed

Standard energy savings
→ standard energy consumption
→ Large production needed

DEFINITION "nearly zero energy building"
means a building that has a very high energy performance, determined in accordance with Annex I.
The **nearly zero or very low amount** of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby

Annex I: The methodology shall be laid down taking into consideration at least the following aspects:

(a) the following actual thermal characteristics of the building (including its internal partitions).
(i) thermal capacity; (ii) insulation; (iii) passive heating;
(iv) cooling elements; and (v) thermal bridges;

(b) **heating** installation and **hot water** supply, including their insulation characteristics;

(c) **air-conditioning** installations

(d) natural and mechanical **ventilation**, which may include air-tightness

(e) built-in **lighting** installation (mainly in the non-residential sector);

(f) the design, positioning and orientation of the buildings, including outdoor climate;

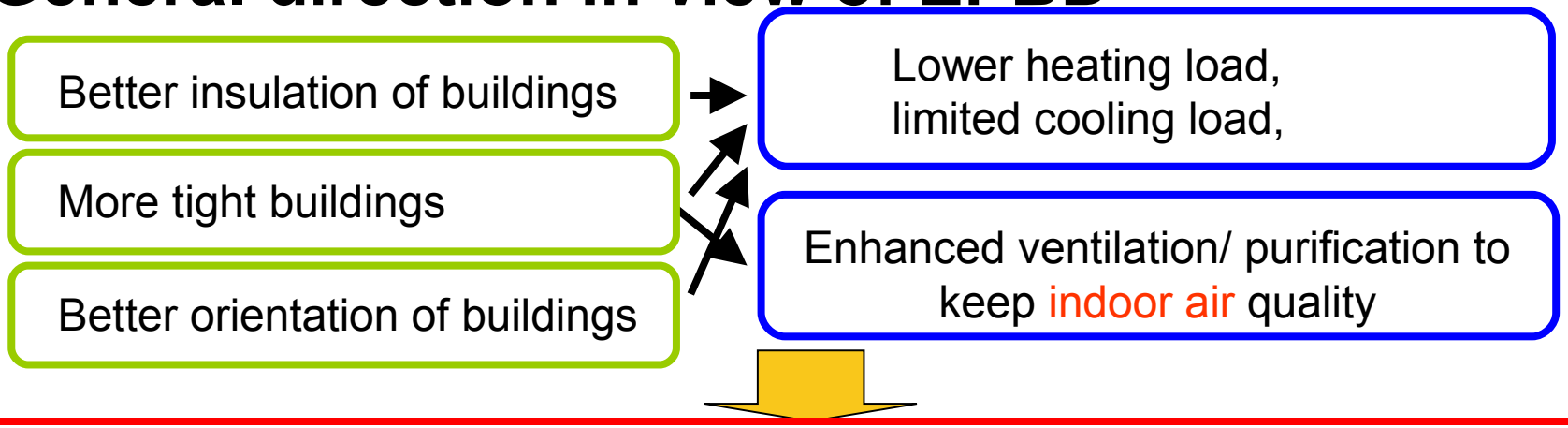
Timing EPBD

2015: certain percentage of the buildings should be 'nearly zero energy'
→ shall be defined by the member states

2018: all new public buildings have to be 'nearly zero energy'

2020: all new buildings have to be 'nearly zero energy'

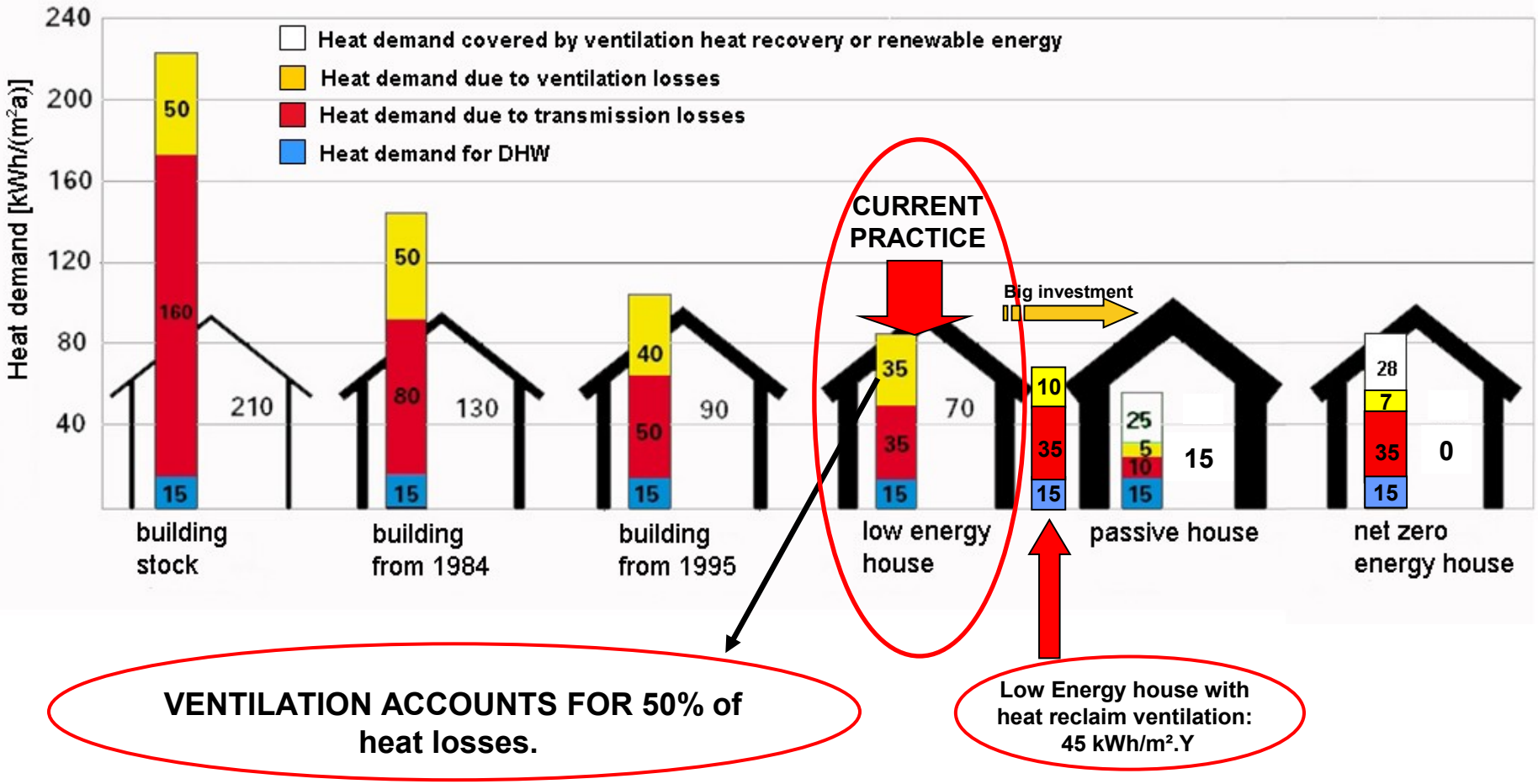
General direction in view of EPBD



High efficient ventilation/purification and hot water production including recovery techniques become more important

COMPARISON HEATING LOADS AND HEATING SYSTEM

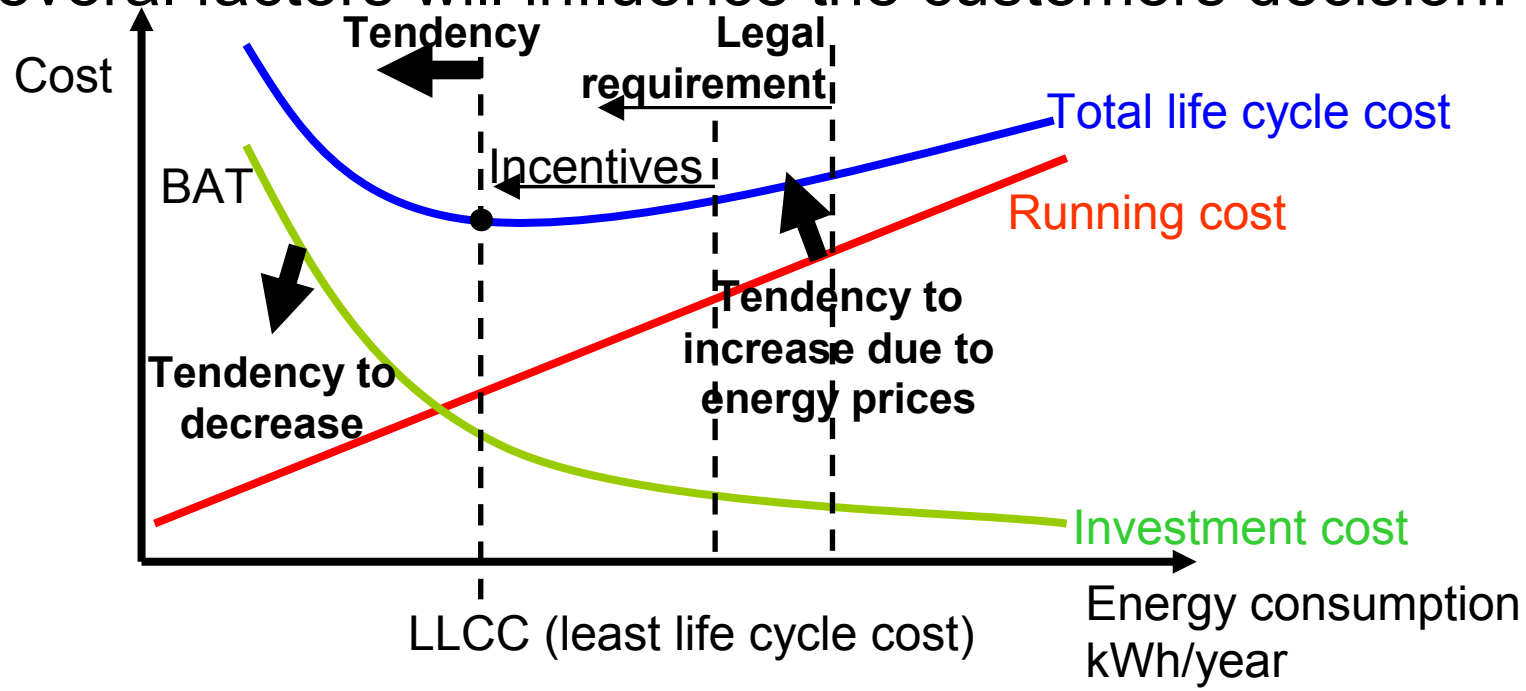
Comparison heating loads (Source: IEA HPP Annex 32)



What is the trend?

-Most important for business = customers decision

-Several factors will influence the customers decision:



-Complex➔ Customer perception of these factors will decide

-Investment cost is always an important factor

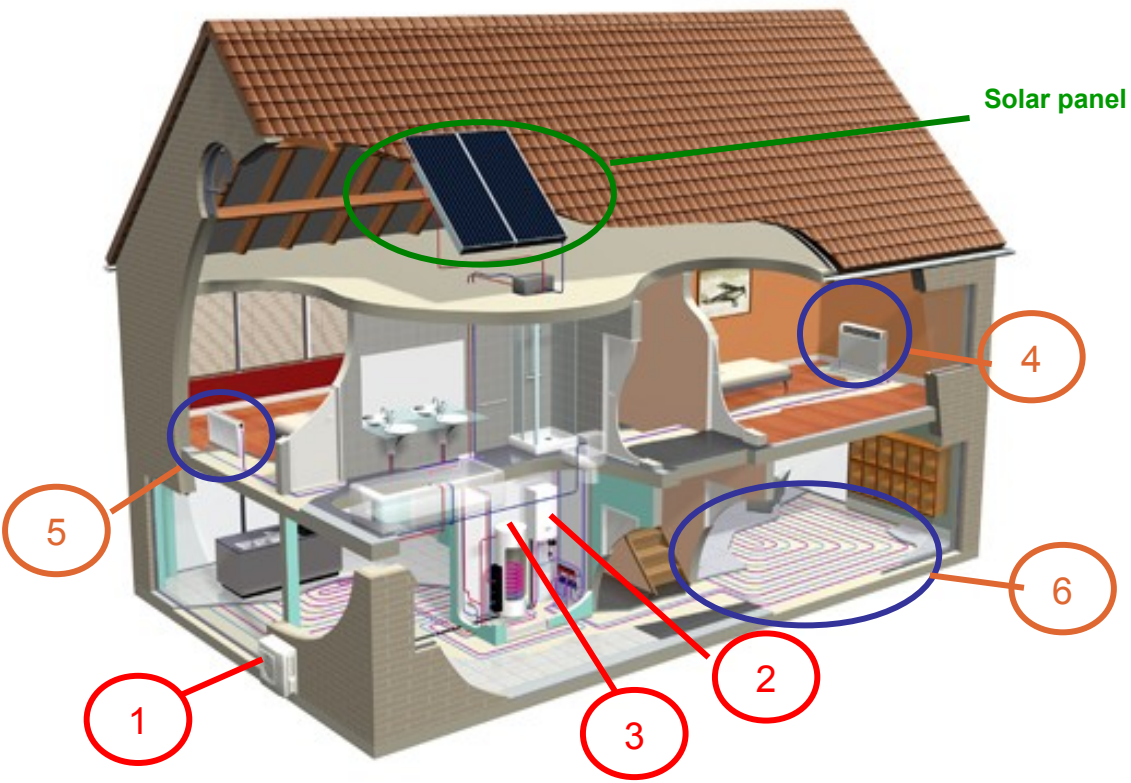
→ Legal requirements and incentives to move towards LLCC.

Heating Example

"Daikin Altherma, the intelligent way to comfort"

CAPACITY RANGE:

- room heating : 5.7 – 16.0 kW
- domestic hot water: 150 – 300 l
- room cooling: 5.1 - 13.0 kW



COMPONENTS:

1. Outdoor unit (6 types)
2. Indoor unit = Hydrobox
3. Domestic hot water tank (optional)

EMITTERS

4. Fan Coils
5. LT radiators
6. Floor heating

Daikin launches a NEW heatpump series

Heating

Leaving water temperatures up to 80°C

Cooling

Leaving water temperatures starts from 5°C

Domestic hot water

Tank temperatures up to 70°C

First system in the world !

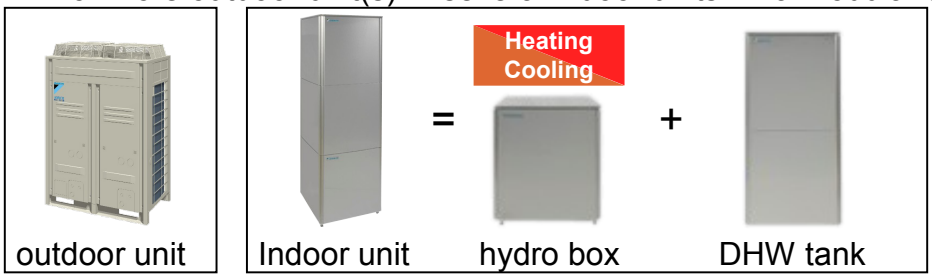
concept explanation

Layout of the product: apartment with indoor unit and outdoor unit.

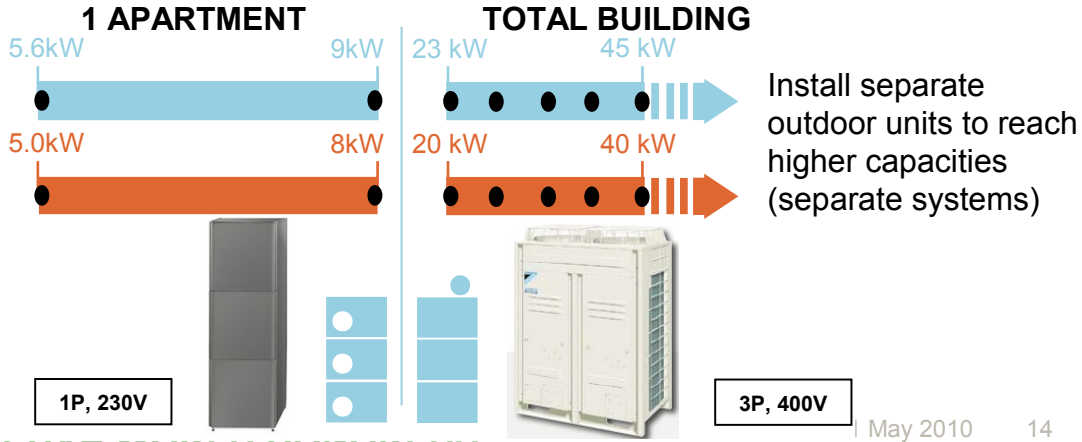
1 or more in/outdoor units

Daikin altherma HT for apartment buildings and collective housing

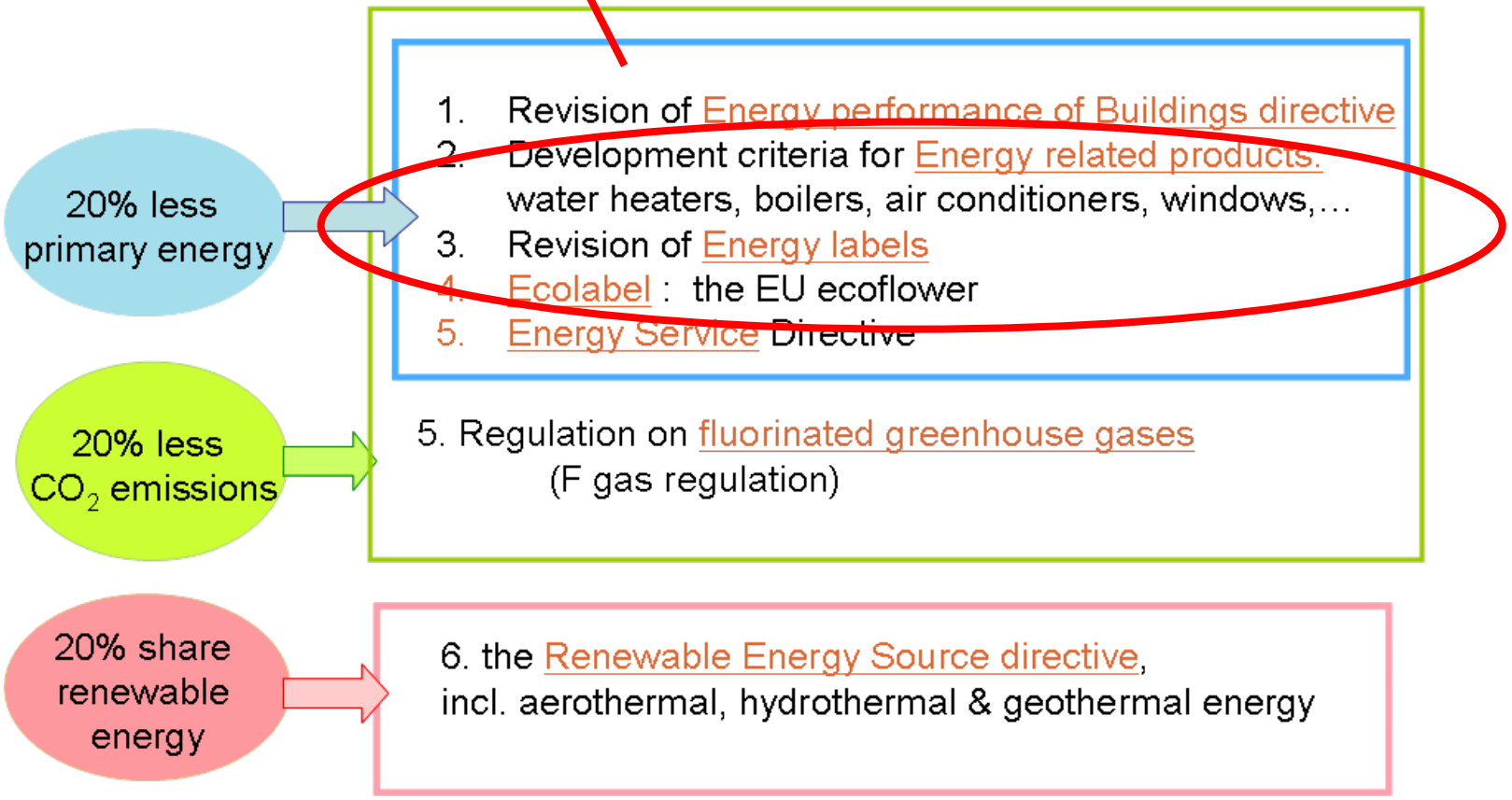
= 1 or more outdoor unit(s) + several indoor units => a modular system



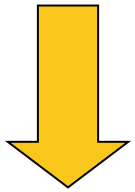
Modular system



Energy related products directive and energy labels



Eco-design for energy using products (EUP) in the EU



EU target = Top runner on global level

Energy label as driver

Extended to energy related products (ERP)

Framework directive 2009/125/EC

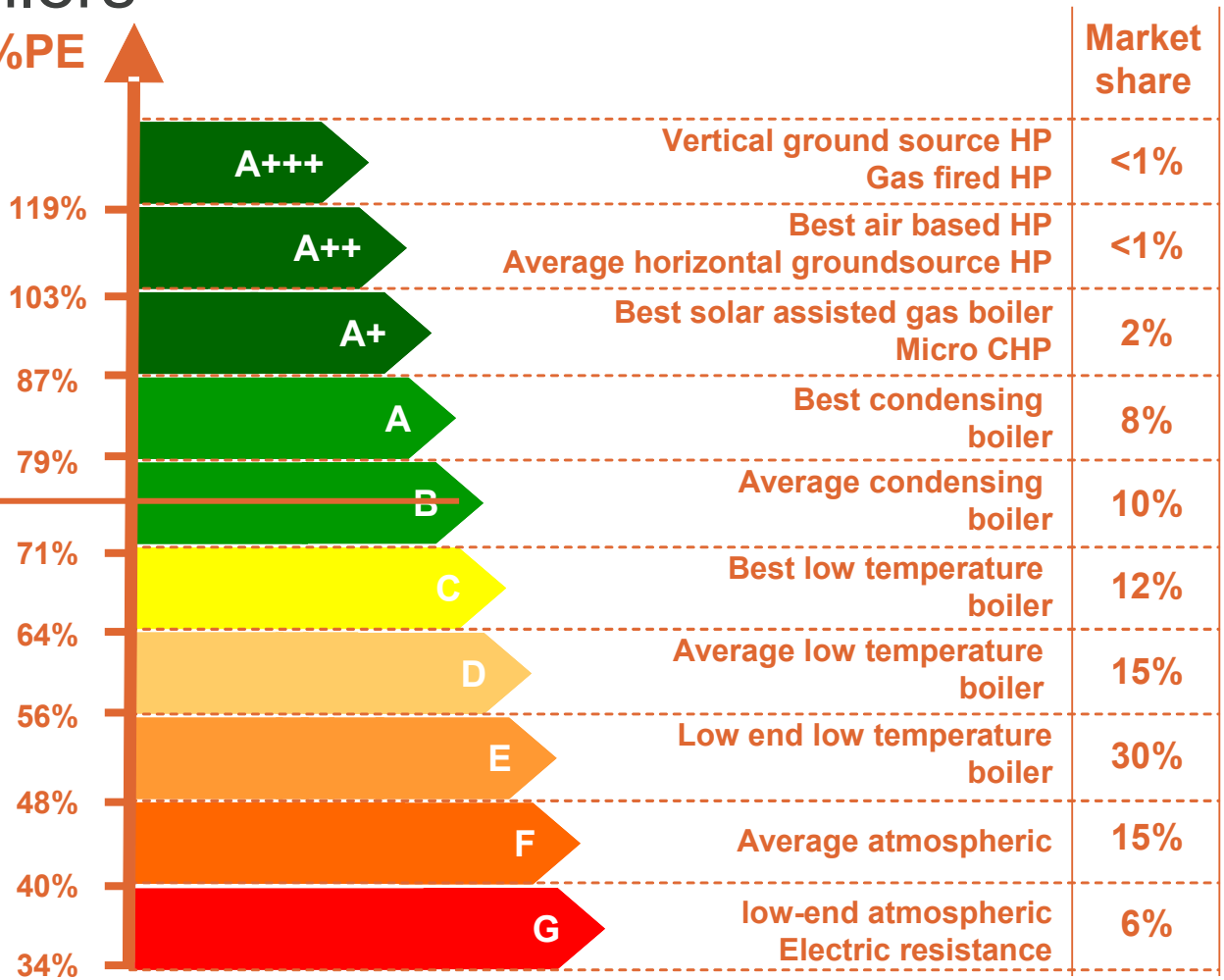
Commissions Energy (ENER) and Enterprise (ENTR)

1. boilers	10.Airconditioner<12kW	20. Local room heating prod.	ENTR 6 airco and ventilation
2. waterheaters	11. motors, fans,..	21. Central heat. prod hot air	
3. PC	12. comm. Refriger.	22. ovens	
4. copiers	13. dom. Refriger	23. Hobs & grills	
5. TV, …	14. dishwashers	24. prof.washing machines, dryers, dishwashers	
6. Stand by loss	15. Fossil fuel burner	25. Non tertiary coffee mach.	
7. Battery charger	16. Laundry driers	26. Networked stand by loss	
8. Office lights	17. Vacuum cleaners	ENTR 1 refrigeration	
9. Street lights	18. Set top boxes	ENTR 2 transformers	
	19. Domestic lighting	ENTR 3 mulitmedia	

Studies finished | Ongoing

EUP – lot 1- boilers

All technologies in 1 label on primary energy efficiency



*based on available information, in EUP lot 1

Ban in 2015

Improve energy efficiency = push for renewable energy

EUP – lot 10 - cooling

present

Rescaling of energy label.
Ban of non inverter technology

	EER @ 35°C
A	3,2
B	3
C	2,8
D	2,6
E	2,4
F	2,2
G	2,2

inverter

Non inverter

Future 2013
EUP A/C≤12kW

	Seasonal EER including standby and off mode
A+++	7
A++	6,4
A+	5,9
A	5,2
B	4,3
C	3,6
D	3,1
F	2,7
G	2,3

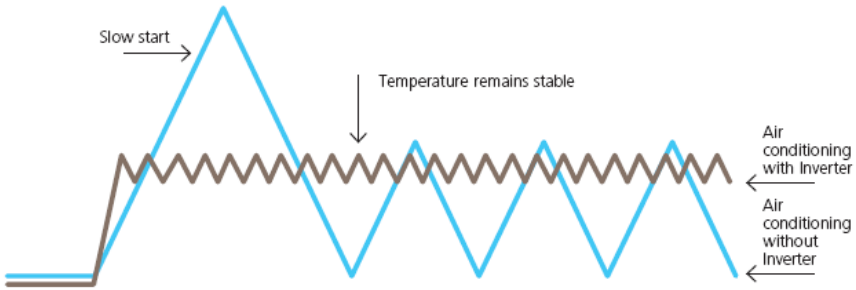
A	7
B	6,4
C	5,9
D	5,2 ← Ban 2015
E	4,3 ← Ban 2013
F	3,6
G	3,1

Ururu Sarara

Highest efficiency in its segment

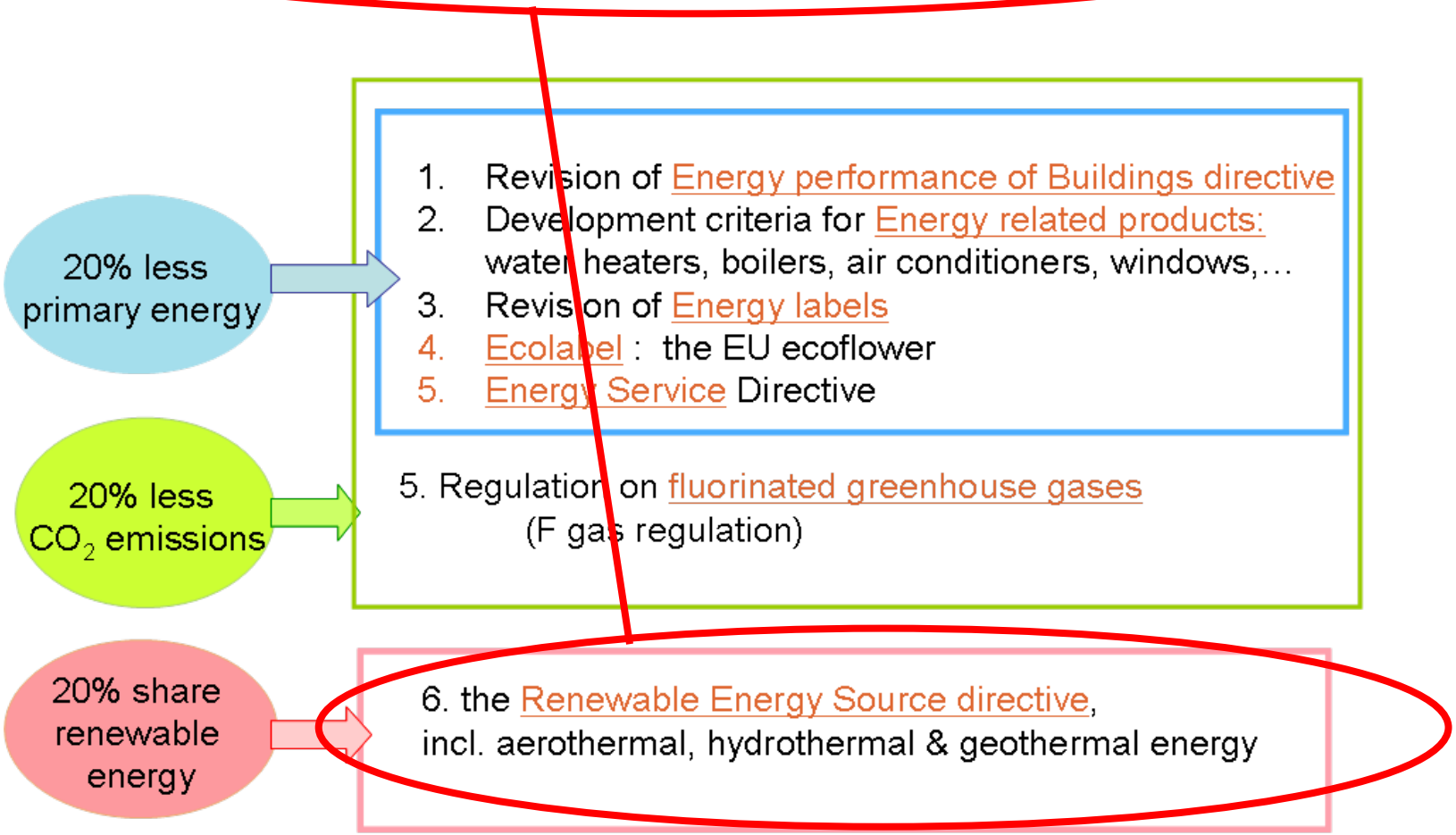
Split type unit

Inverter controlled

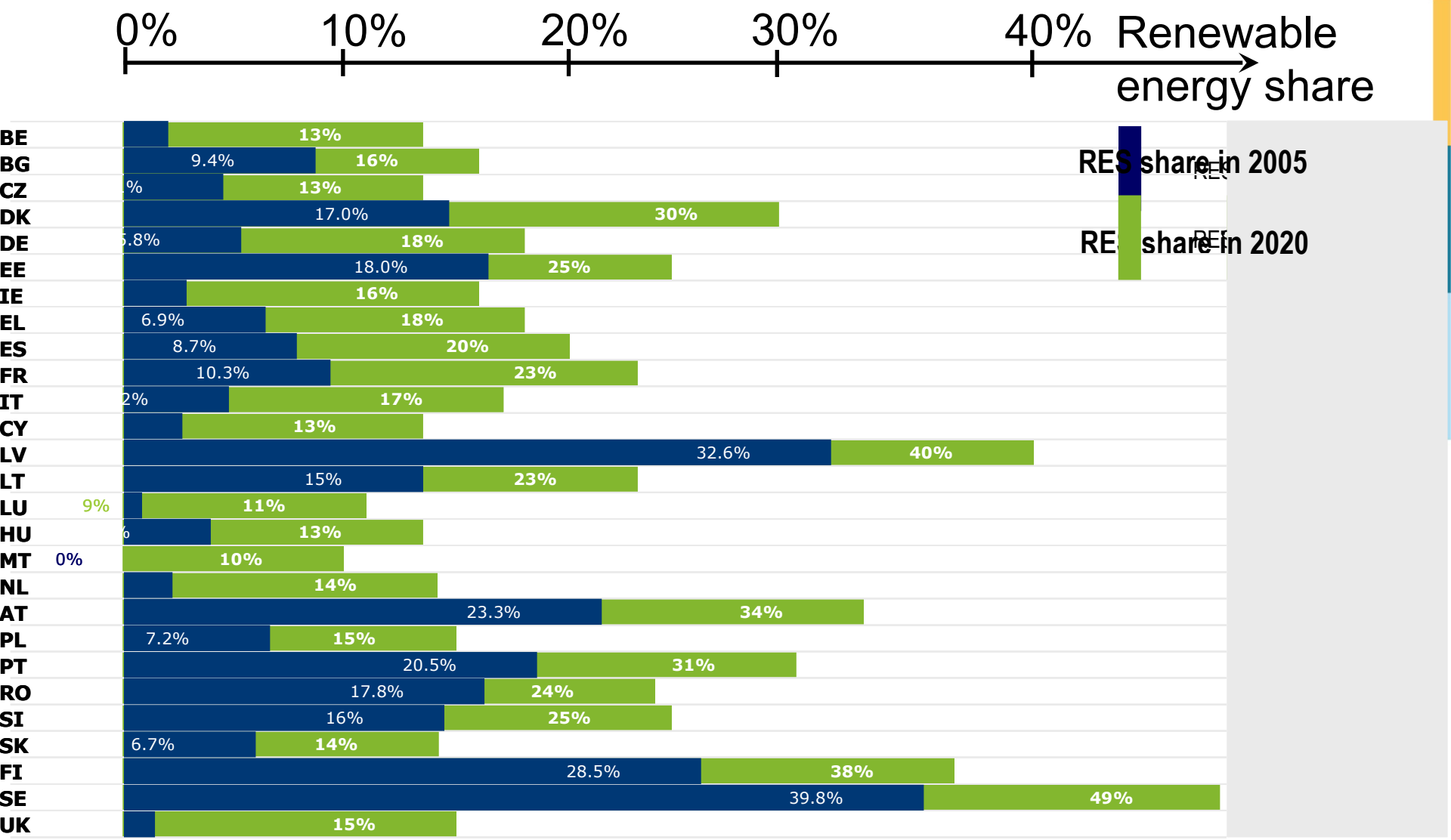


- Temperature control
- Humidity control
- Ventilation

Renewable energy source directive



National targets for 2020

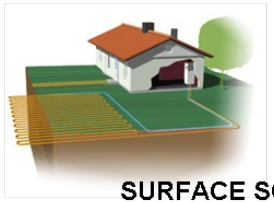


Air-, ground- and water energy are recognised as renewable energy

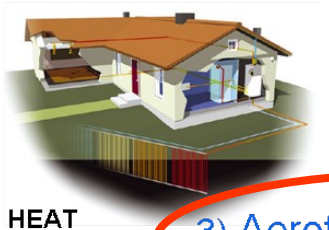
Heat pumps are a tool to exploit these sources

1)geothermal energy

BEDROCK HEAT



SURFACE SOIL HEAT

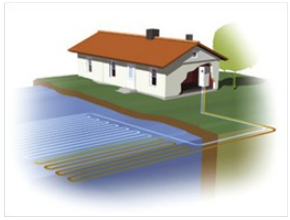


3) Aerothermal energy

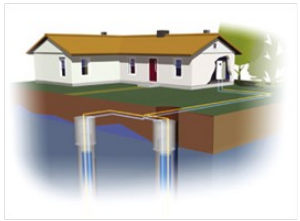
AMBIENT AIR HEAT

Air-Air HP

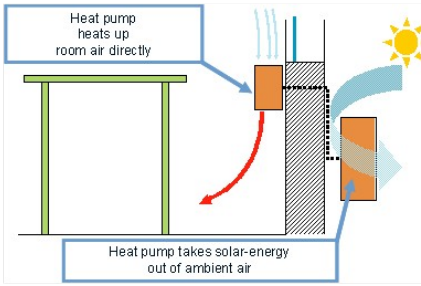
2) hydrothermal energy



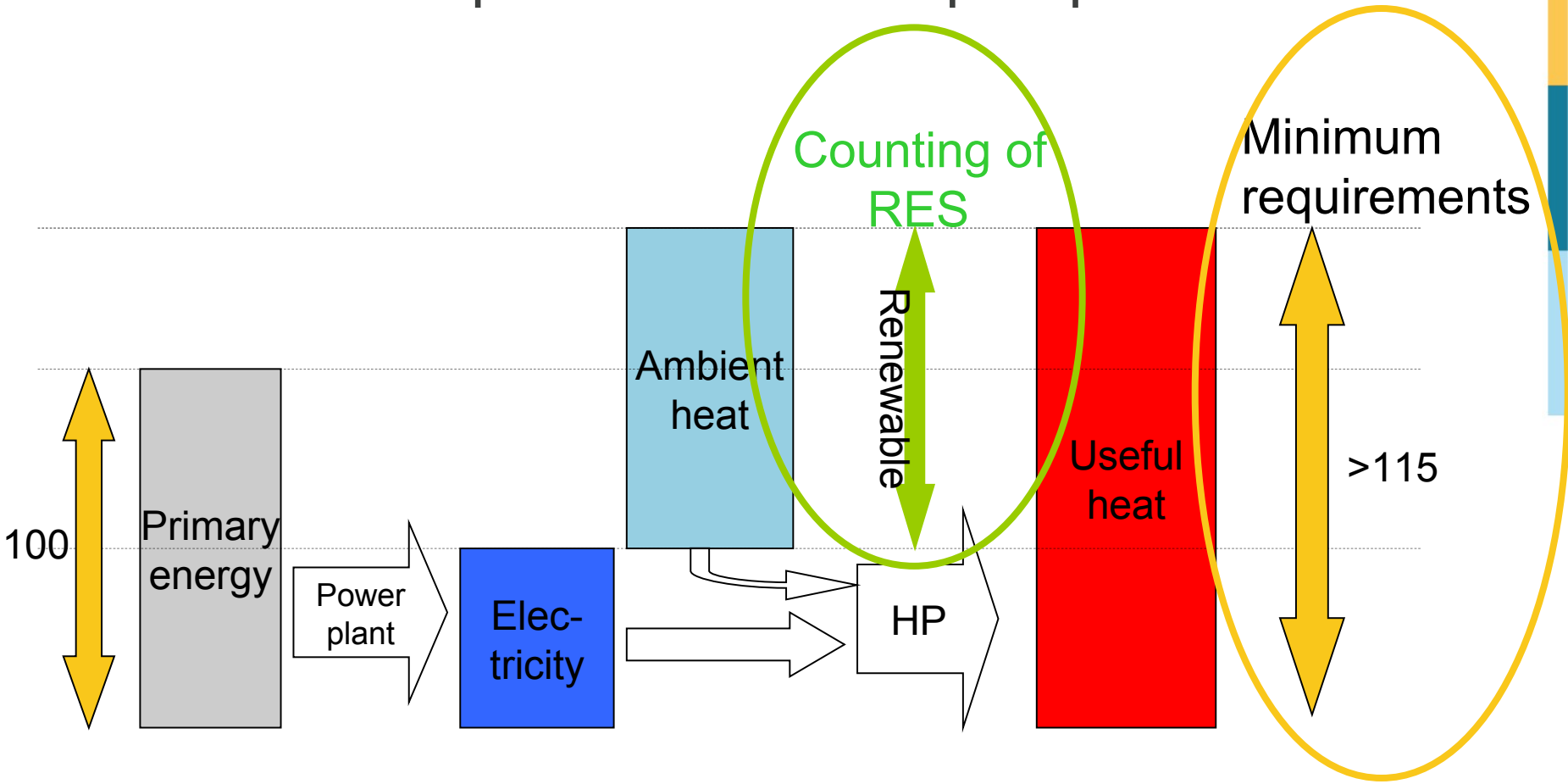
LAKE or RIVER WATER HEAT



GROUND WATER HEAT

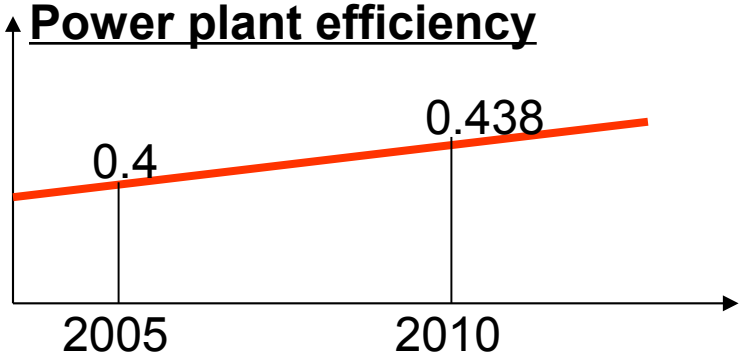


How to count air-, ground- and water energy exploited with heat pumps



Impact to the heat pump market

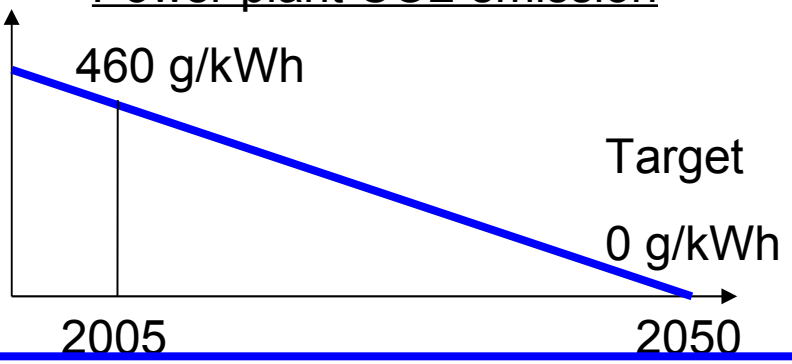
Power plant efficiency



Power plant efficiency is increasing

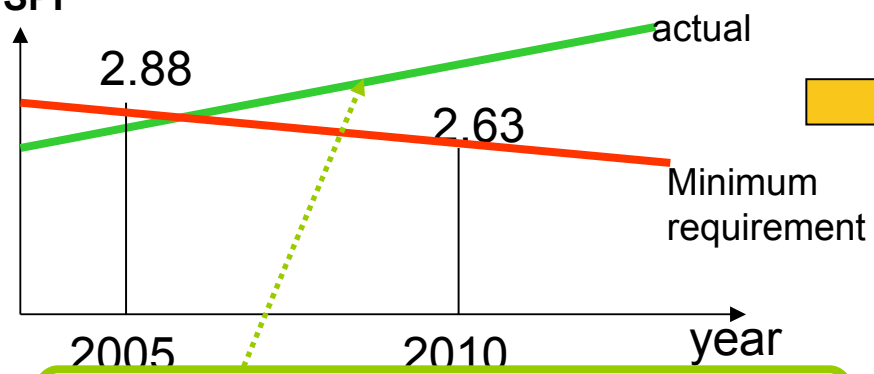
Minimum requirement for SPF is decreasing

CO2/kWh Power plant CO2 emission



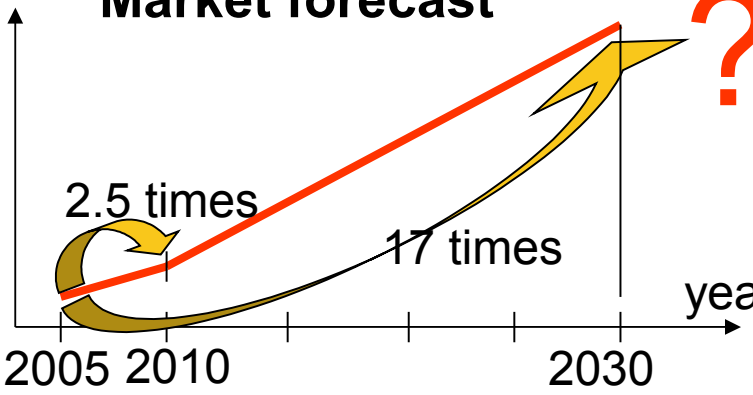
CO2 emissions per kWh is dropping with zero emission target for 2050

SPF



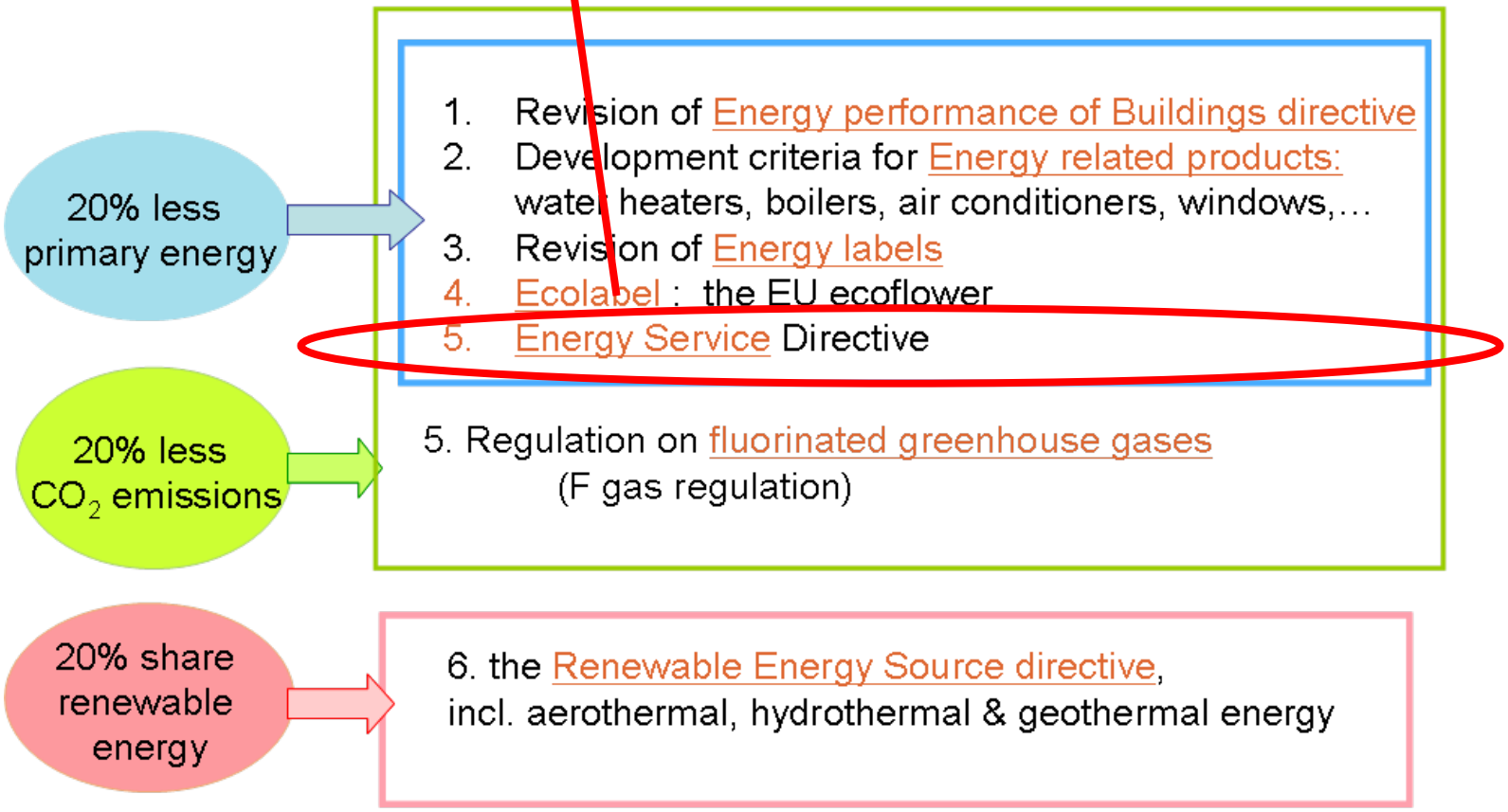
Seasonal efficiency of heat pumps is increasing due to energy label

Hydronic Heat pump Market forecast



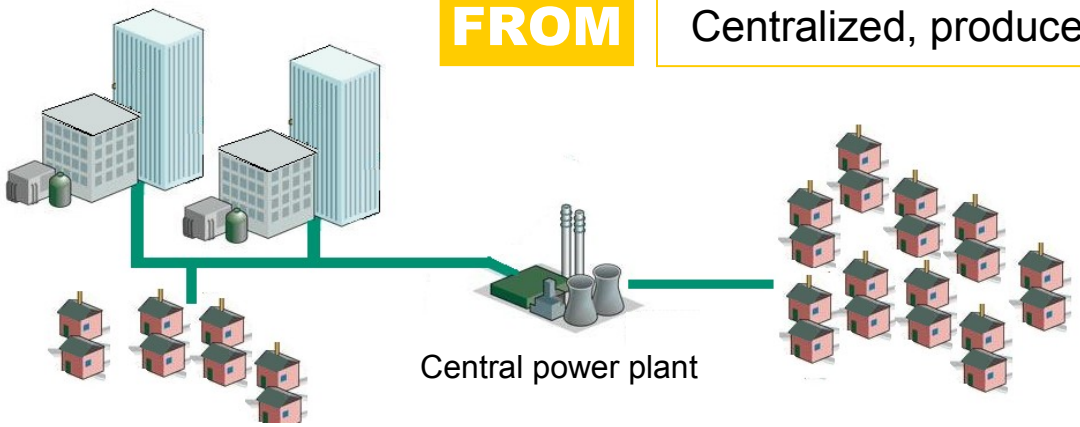
Depend on oil and gas price ?

Energy service directive



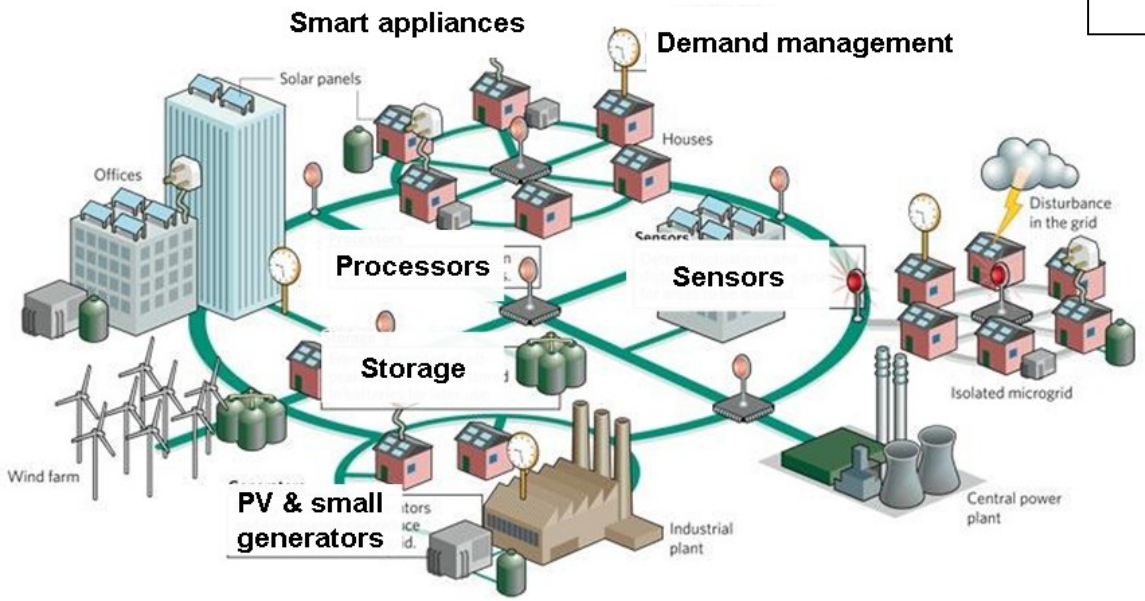
CURRENT GRID

FROM Centralized, producer-controlled network



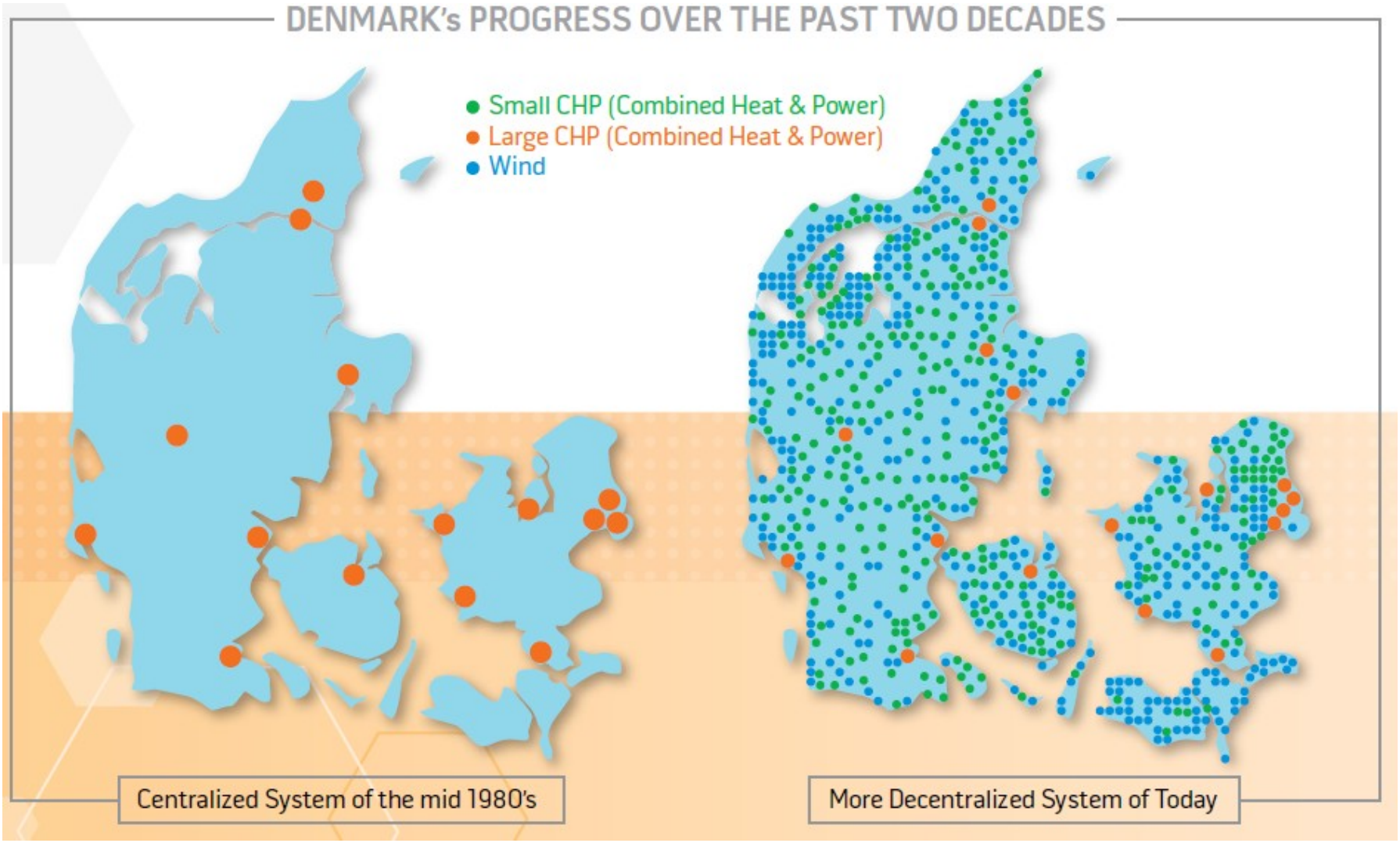
SMART GRID

Merging of electricity infrastructure and communication infrastructure



TO

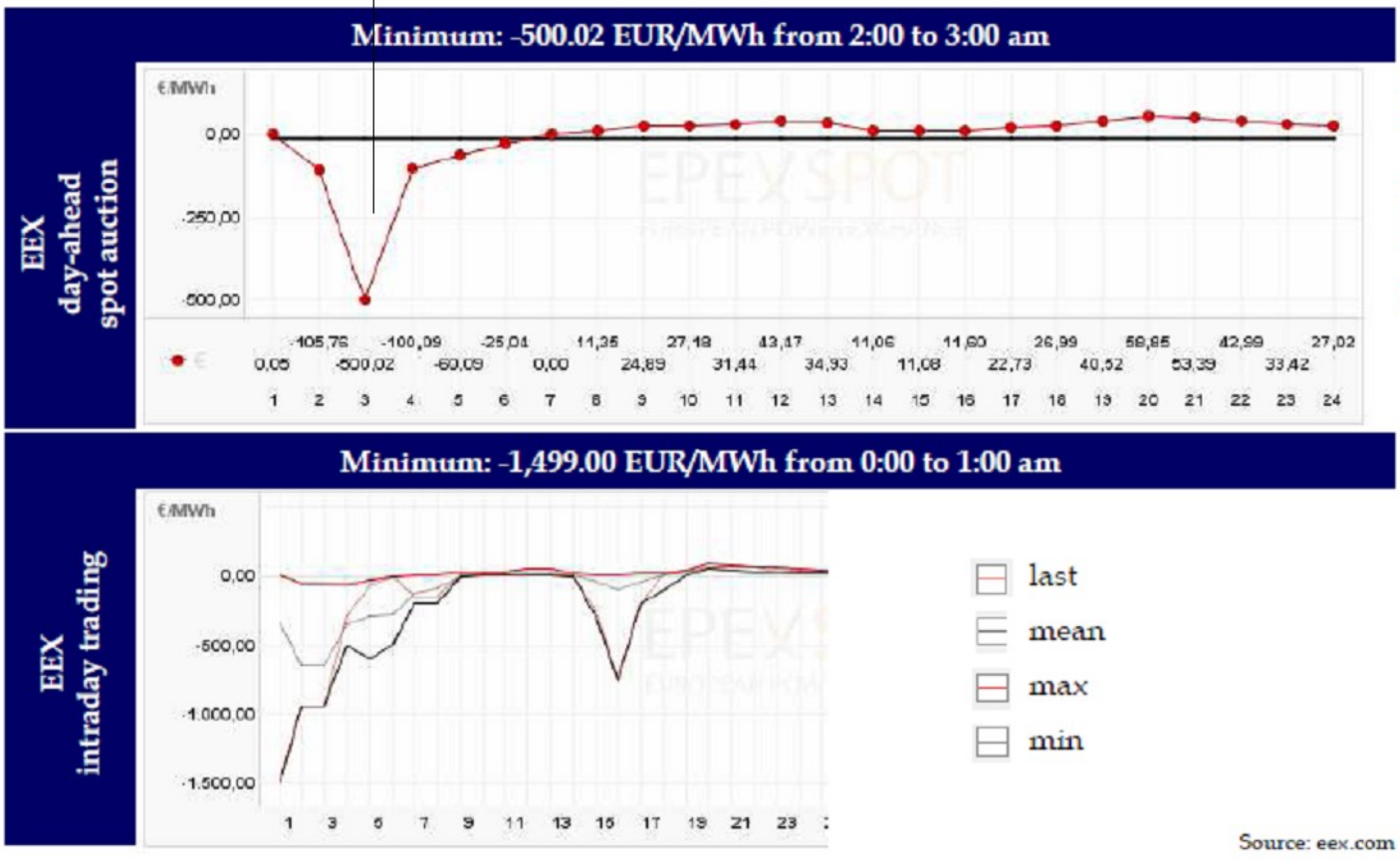
Less centralized and more consumer-interactive network


DENMARK's PROGRESS OVER THE PAST TWO DECADES
Small CHP (Combined Heat & Power)
Large CHP (Combined Heat & Power)
Wind
Centralized System of the mid 1980's
More Decentralized System of Today

18x negative prices at EEX in 2009

Source VDI

October 4th, 2009: Extreme negative spot market prices



REASON: Temporally enormous wind over-supply

Source: E.ON

What role can the HVAC industry play ?

Adaptation of the electricity use to the intermitted electricity supply will become in important criteria for competitiveness in the market.

The smart Grid requires smart Consumers.

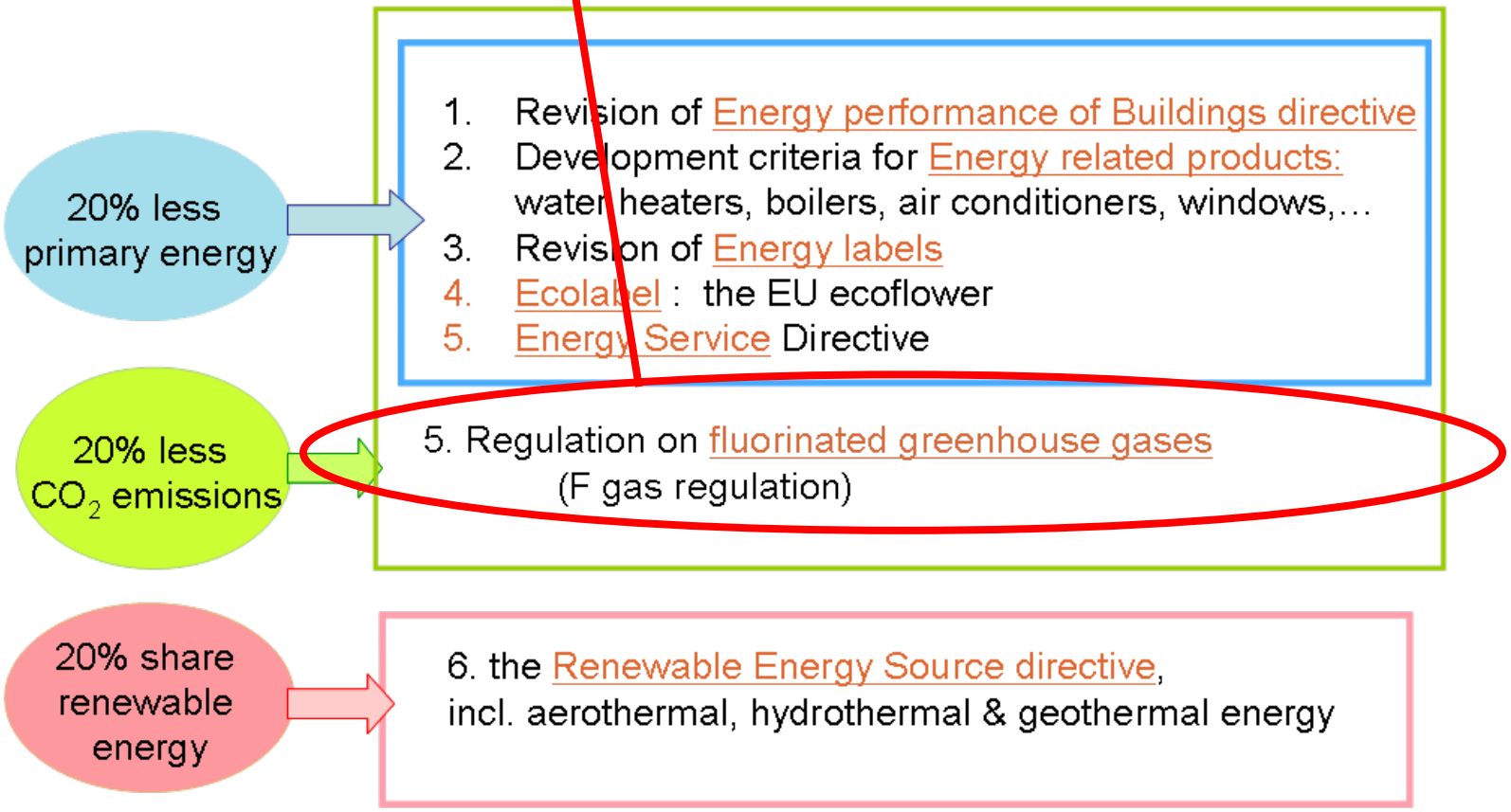
Building inertia can be considered as a huge energy battery

Heat pumps can provide efficient hot water production and thermal energy storage

-Intelligent use of the available electricity and energy storage technologies will become a key factor for HVAC systems.

-The most economic solution will be the winner

Regulation on fluorinated gases

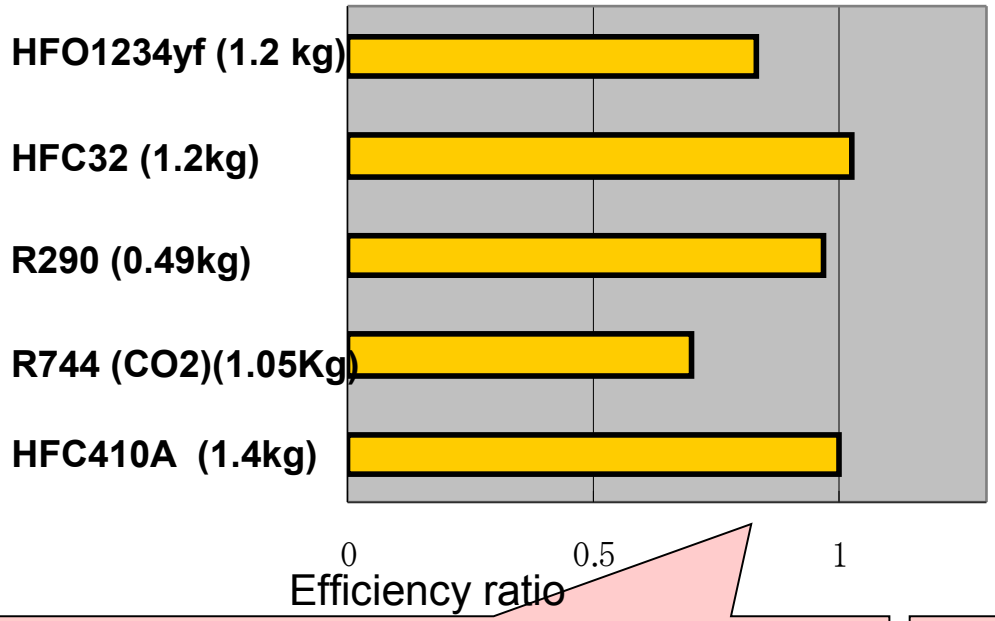


In case of
Residential A/C
Commercial A/C

Energy-efficiencies

•Annual efficiency (APF) comparison

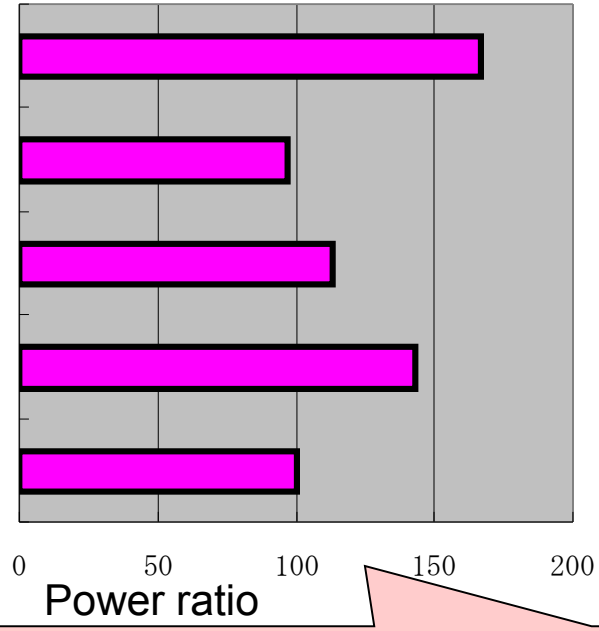
(R410A ratio) Case of 4kW Room A/C by JRAIA



Consideration:
As for annual efficiency of APF, CO2 is the worst, HFO needs further optimization, and the rest of the candidates are equivalent to R410A.

•Peak power comparison

(R410 ratio) under cooling condition
Outside 35°C, room 27°CDB/19.5° CWB



Consideration:
A big difference exists in the peak power under cooling condition. HFO and CO2 will cause the peak power problem in large cities.

Calculation conditions: HFO1234yf A/C is modified to improve efficiency, such as an increase in the pipe size of heat exchanger.

Note: for cold climates CO2 shows good performance

Total overview of candidates

Nedo conference (Feb '10) : Daikin view for refrigerant candidates :			
Application	Exist. refrigerant	Possible new refrigerant	
MAC	HFC134a	HFO1234yf , CO_2	
Direct expansion AC	HFC410A	High outdoor temperature, warm area	HFC32 Other
		Cold area	HFC32 CO_2
Positive displacement chiller	HFC134a	Large size	HFO1234yf
	HFC407C HFC410A	Medium to small size	HFC32 Other
Centrifugal water chiller	HFC134a	HFO1234yf	
Water heater, hot water heating	HFC134a	Hot water heating	HFO1234yf
	HFC407C HFC410A	Water heater & hot water heating	HFC32 Other
	CO_2	Hot water supply only	CO_2

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New trends in HVAC systems and equipment

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