

# Ecodesign of EuP: Lots 1 & 2

CH-boilers and water heaters

*René Kemna, VHK*



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1. Introduction Ecodesign
2. Relevance Lot 1 & 2 products for EU policy (Art. 15 of 2005/32/EC)
3. Measures
4. Impact on emissions, energy and expenditure
5. Conclusions on savings
6. Q & A

# Content

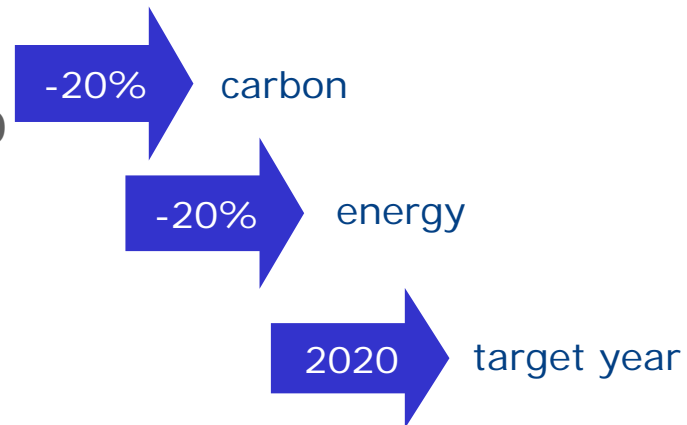
## 1. Introduction Ecodesign

# Directive Energy-using Products (EuP)

## > Challenges EU

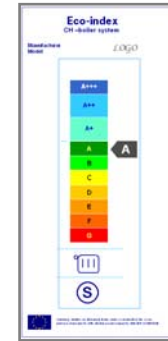
- climate change
- increase of emissions
- growing dependence on import fossil fuels
- increasing energy costs
- falling competitiveness

> **EU target 20/20/20 vs. 1990**  
(and of course Kyoto, NEC, etc.)



# Directive Energy-using Products (EuP)

> Ecodesign of EuP framework directive 2005/32/EC  
 Specific measures: Minimum standards (CE),  
 industry labels (retail labels in 92/75/EC)

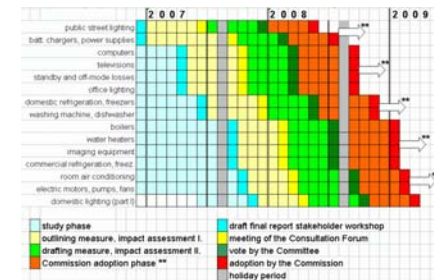


> Legal instrument: CE-marking  
 Legal status of measures:  
 Regulation (=instant implement EU)

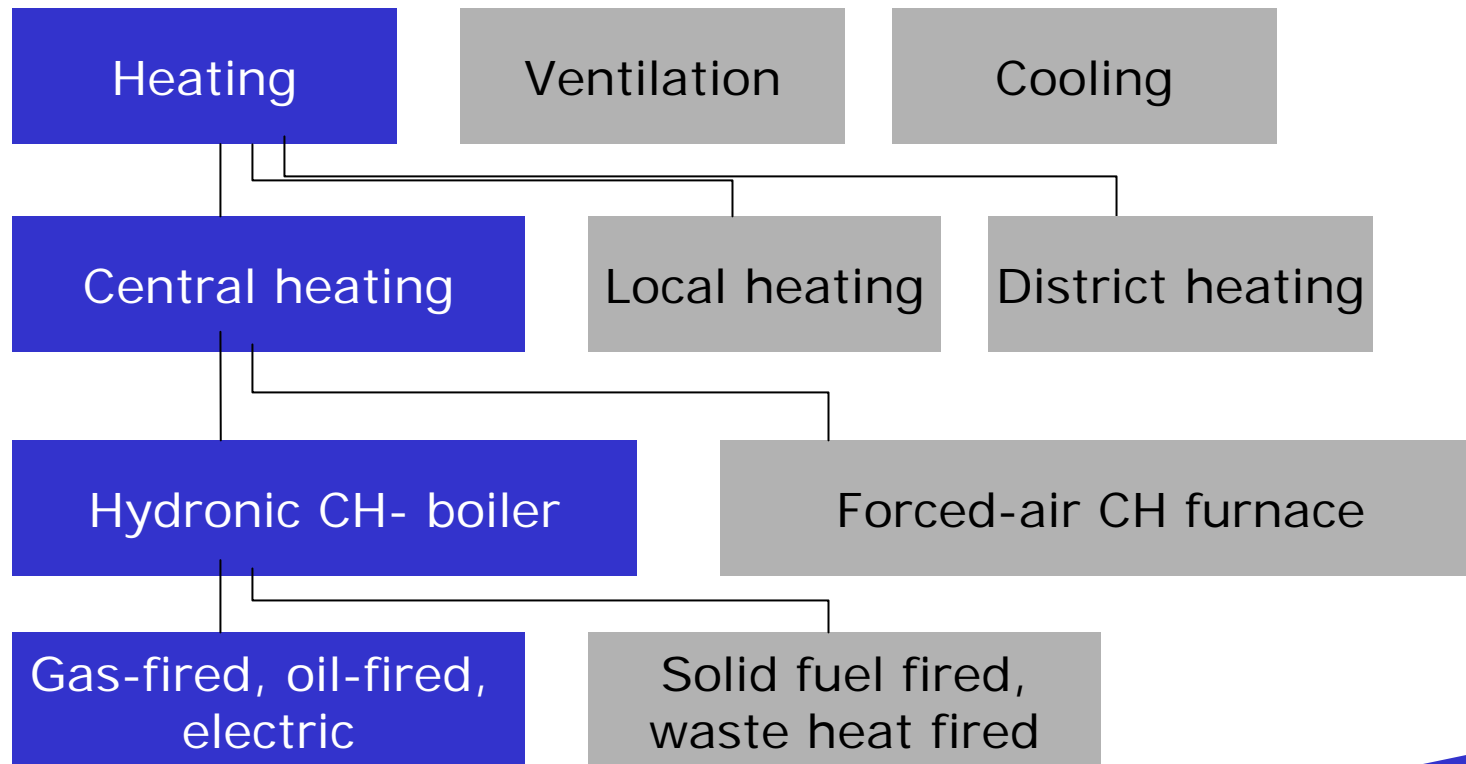


**Immediate implementation in all countries!**

> 20 product groups selected,  
 Lot 1: CH-boilers; Lot 2: Water Heaters



# Scope Lot 1: CH-Boilers



**Ca. 80% of EU heating**

# Content

## 2. Relevance Lot 1 & 2 products for EU policy

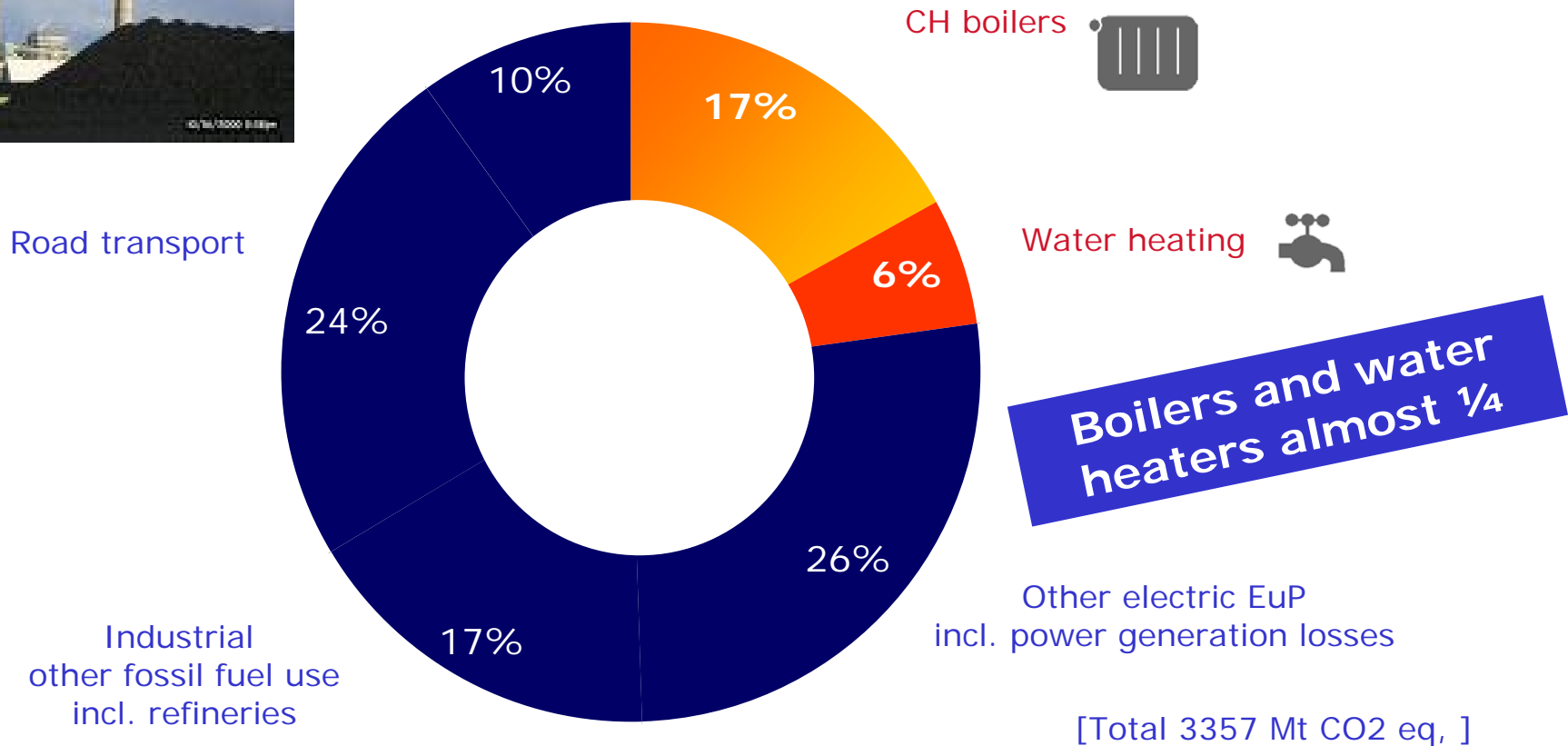
Eligibility for EU policy (Art. 15 of 2005/32/EC)

- Environmental
- Economical
- Improvement potential

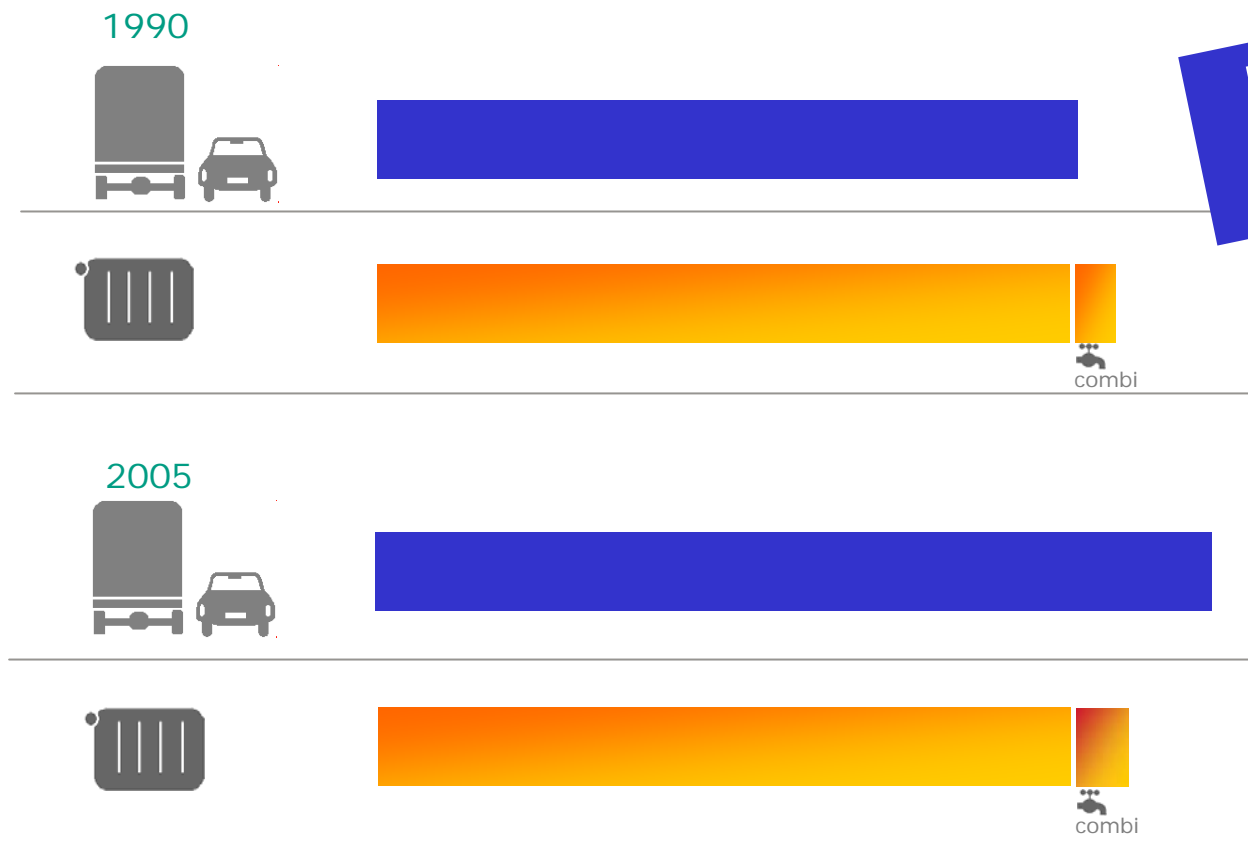
# EU-15 Greenhouse gas [CO2] emissions 2005



Carbon [CO2 eq] emissions EU15 in 2005



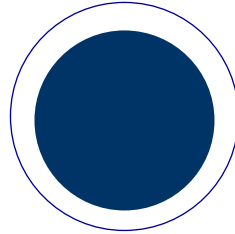
# Boiler carbon emissions: as "big" as road transport



**Boilers, excluding dedicated water heaters**

EU15 total 2005 = 3357 Mt CO<sub>2</sub> pa

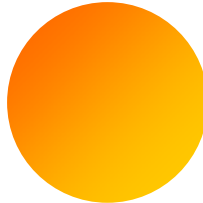
# Energy



Road transport, inner circle: cars ca. 60%

Outside EuP-directive scope

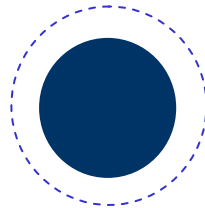
In EuP-scope



CH Boilers (space heating function only)



Water Heaters (incl. boiler water heating)



Other EuP (dotted= scope future studies)

**Heating highest energy use!**

Impact corresponds to circle surface [PJ]

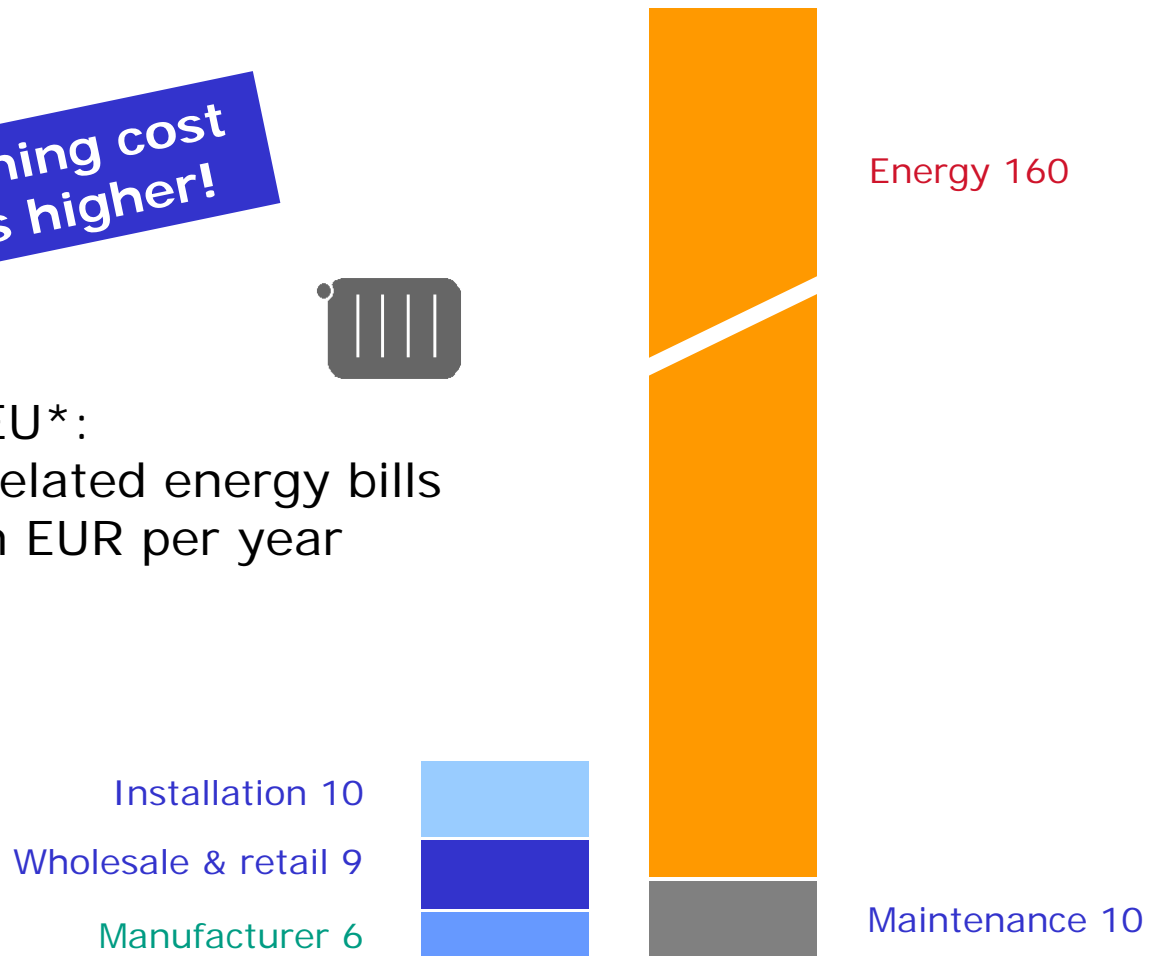
# Economical significance

**Boilers: Running cost seven times higher!**



Expenditure in EU\*:  
On boilers and related energy bills  
appr. 200 Billion EUR per year

\* = EU25 + est. RO/BU



# Not just residential ..

**(semi-) public buildings 20%!**

Space heating heat load EU25

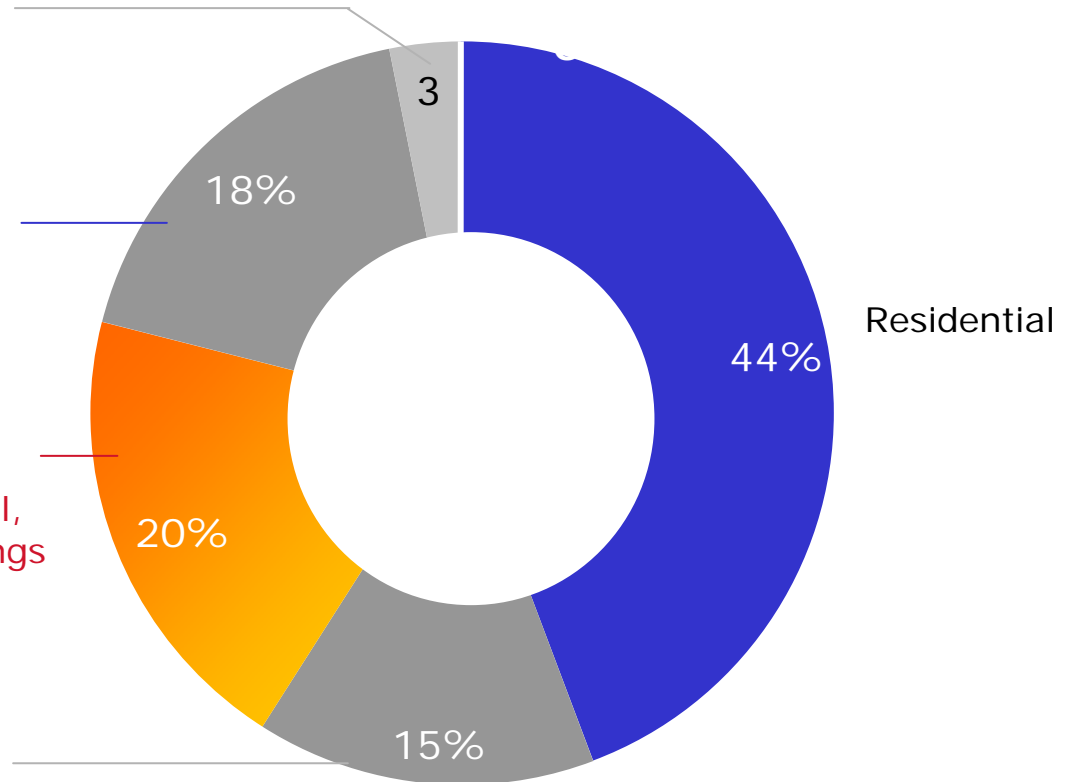


Agricultural

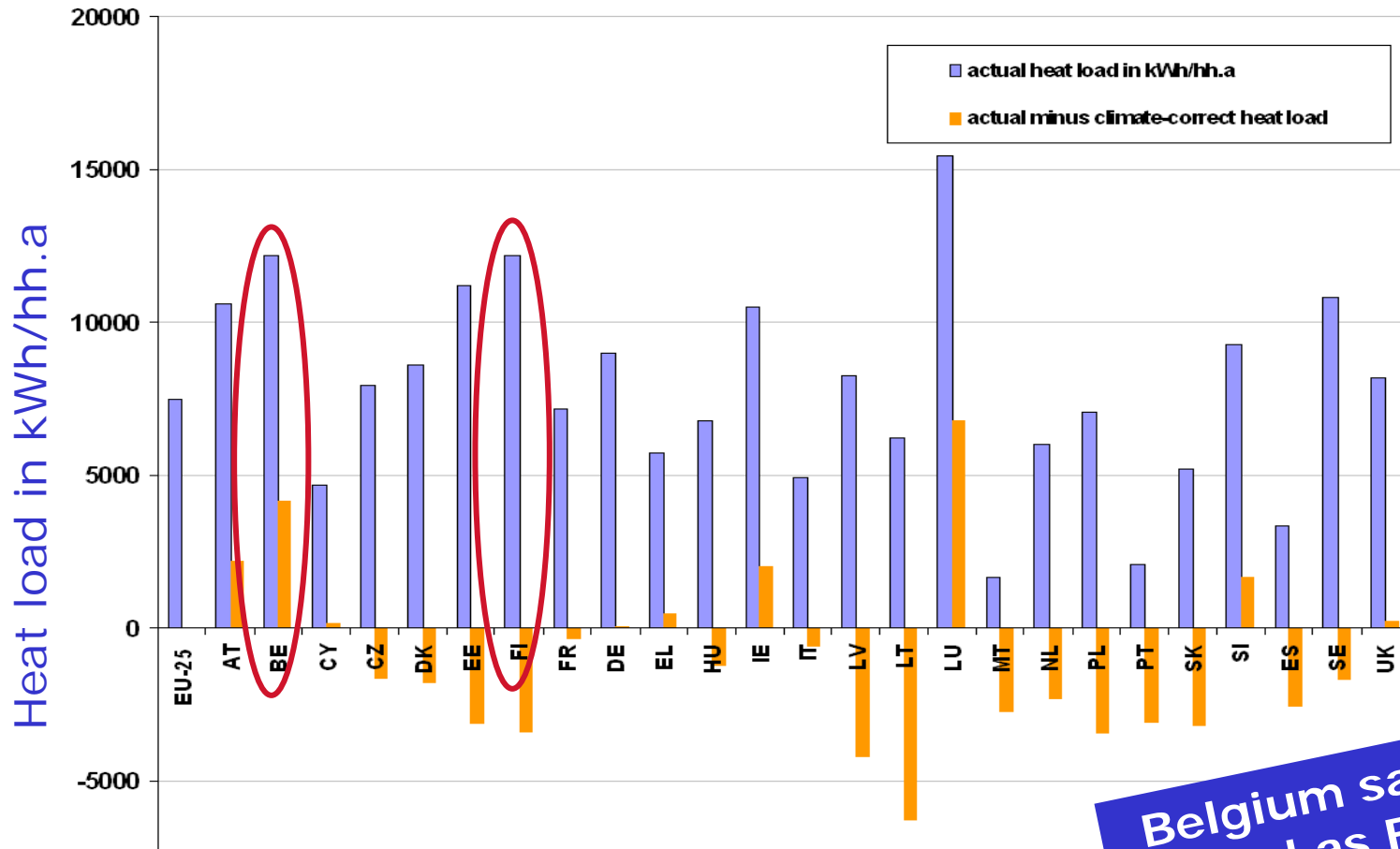
Industrial incl. warehouses

(semi-) public:  
schools, sports, health care, administration, defense, cultural, eclassical buildings

Commercial

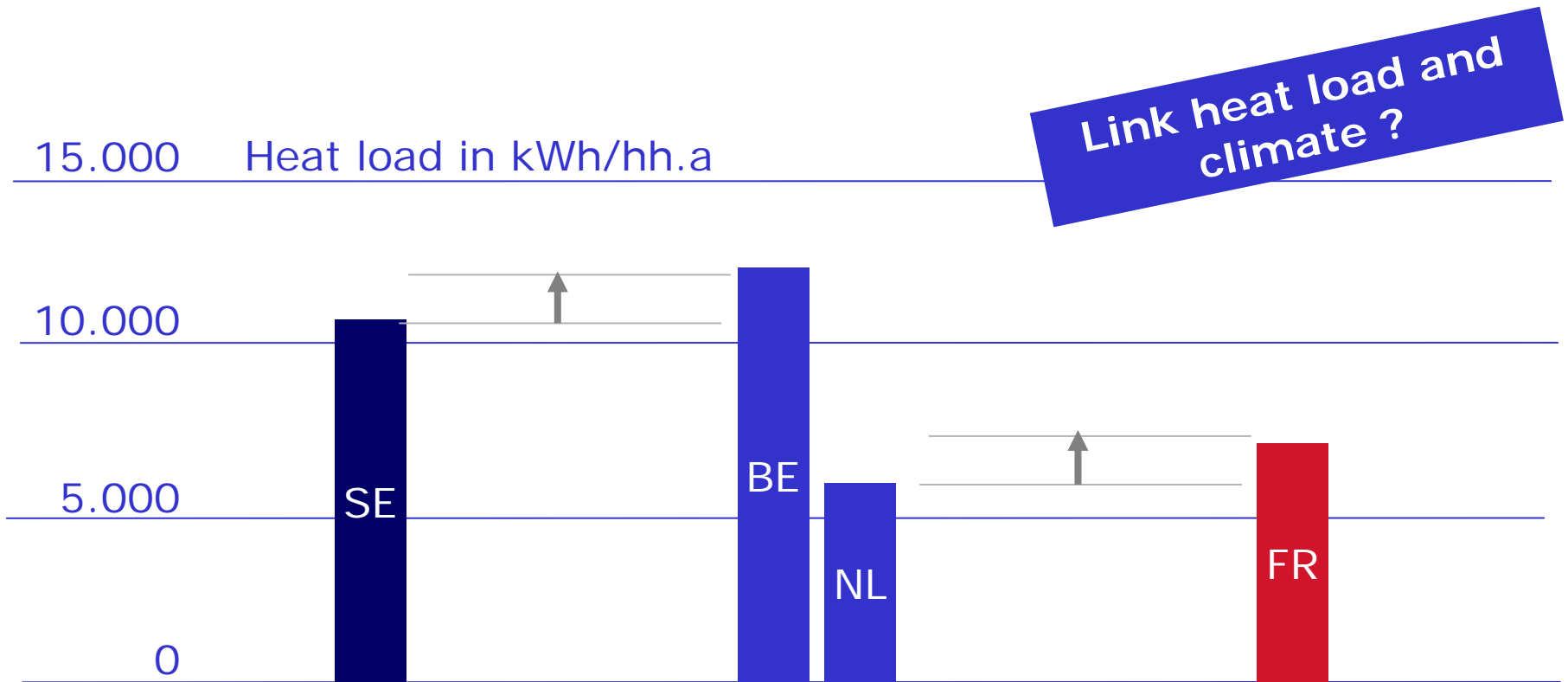


# Not just cold climates ..



**Belgium same heat load as Finland!**

# Not just cold climates ..



# Not just looking at the EU

## Efficiency:

EU limits are **5-7% behind** US, Canada and Japan

China expected to follow Japan (2008?)

**EU to be in front**

## Emissions:

DE NOx limits at 70ppm (gas), California NOx limits 15-20 ppm

## Testing standards & Methodology:

US leading, with ASHRAE 103-1993 standard load profile  
(full/part load/heat-up/cool down/standby)

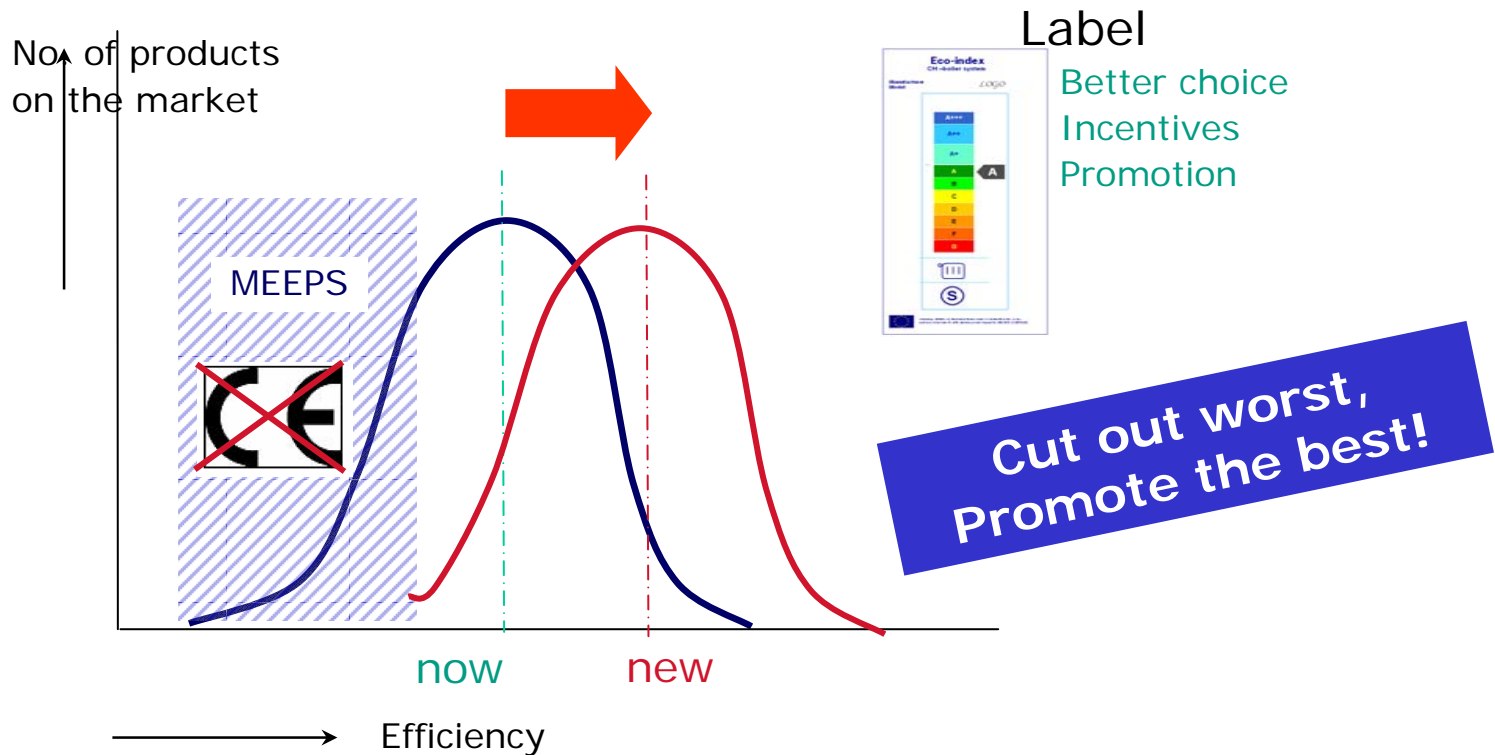
# Content

## 3. Measures

- Approach
- Product definition
- Load Profiles
- The Model
- The Result
- Labelling and MEEPS

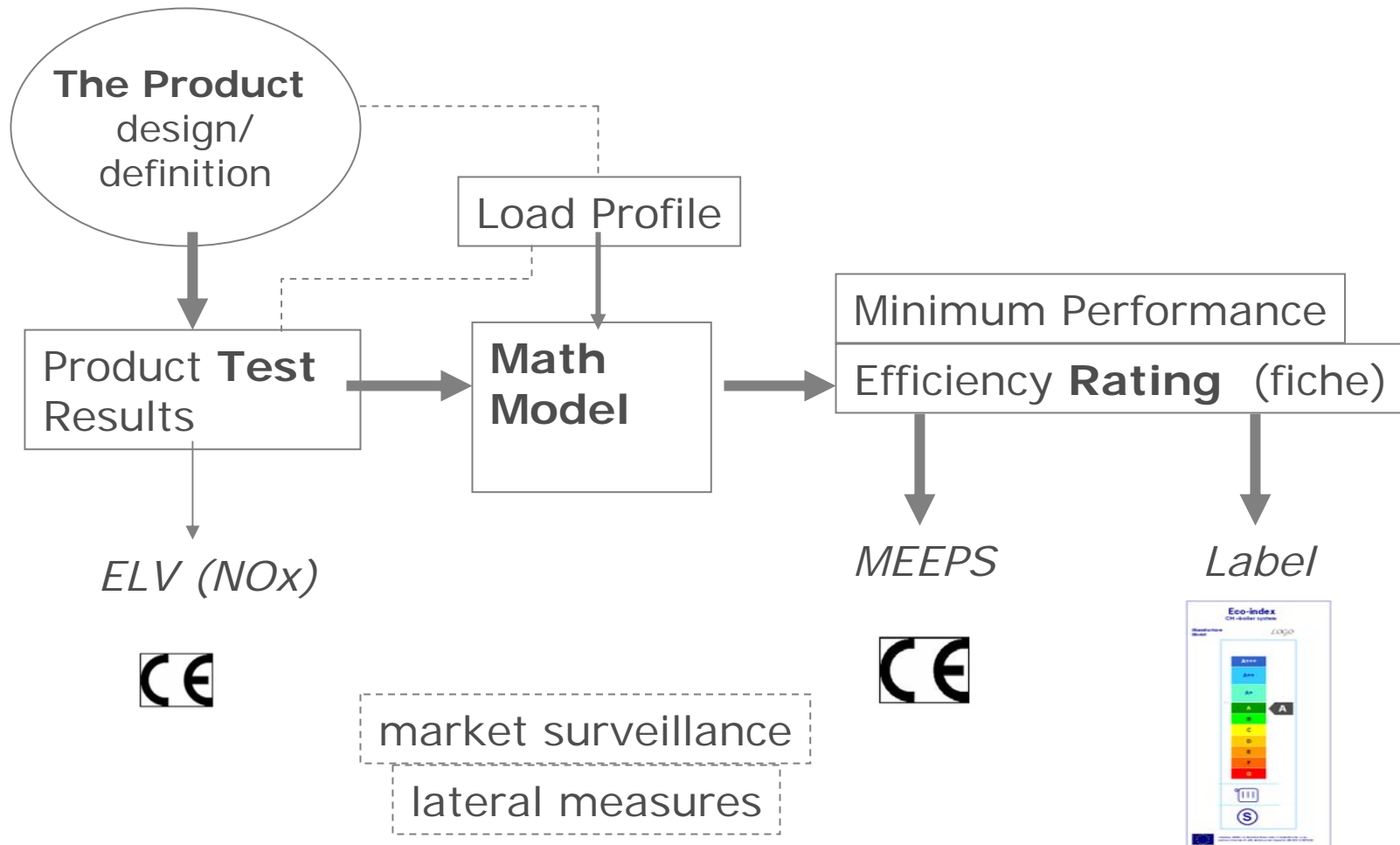
# Tools

## Minimum Energy Efficiency Standards (MEEPS) and Label

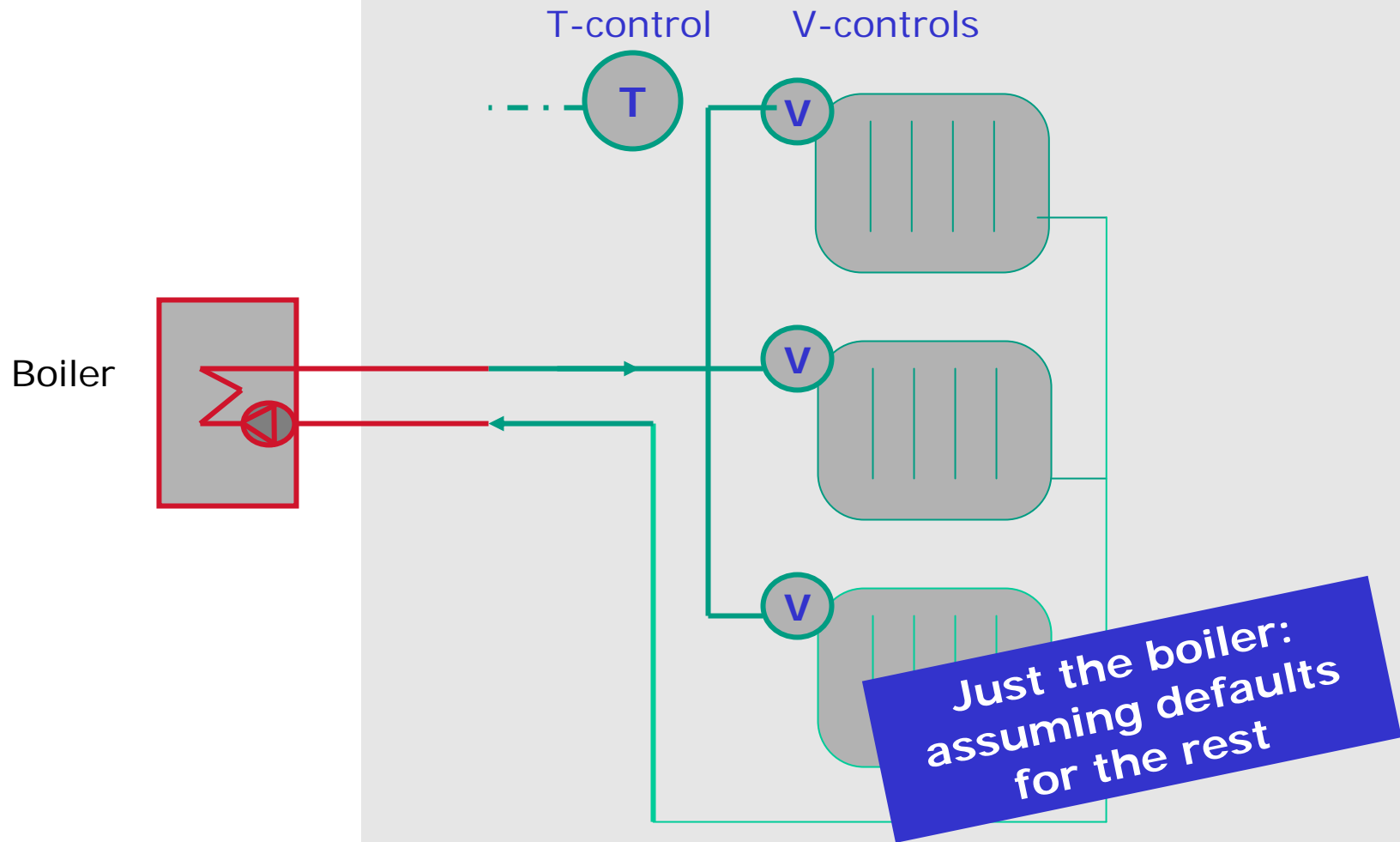


\* = From preparatory study Lot 1 & 2. Not necessarily the view of the European Commission

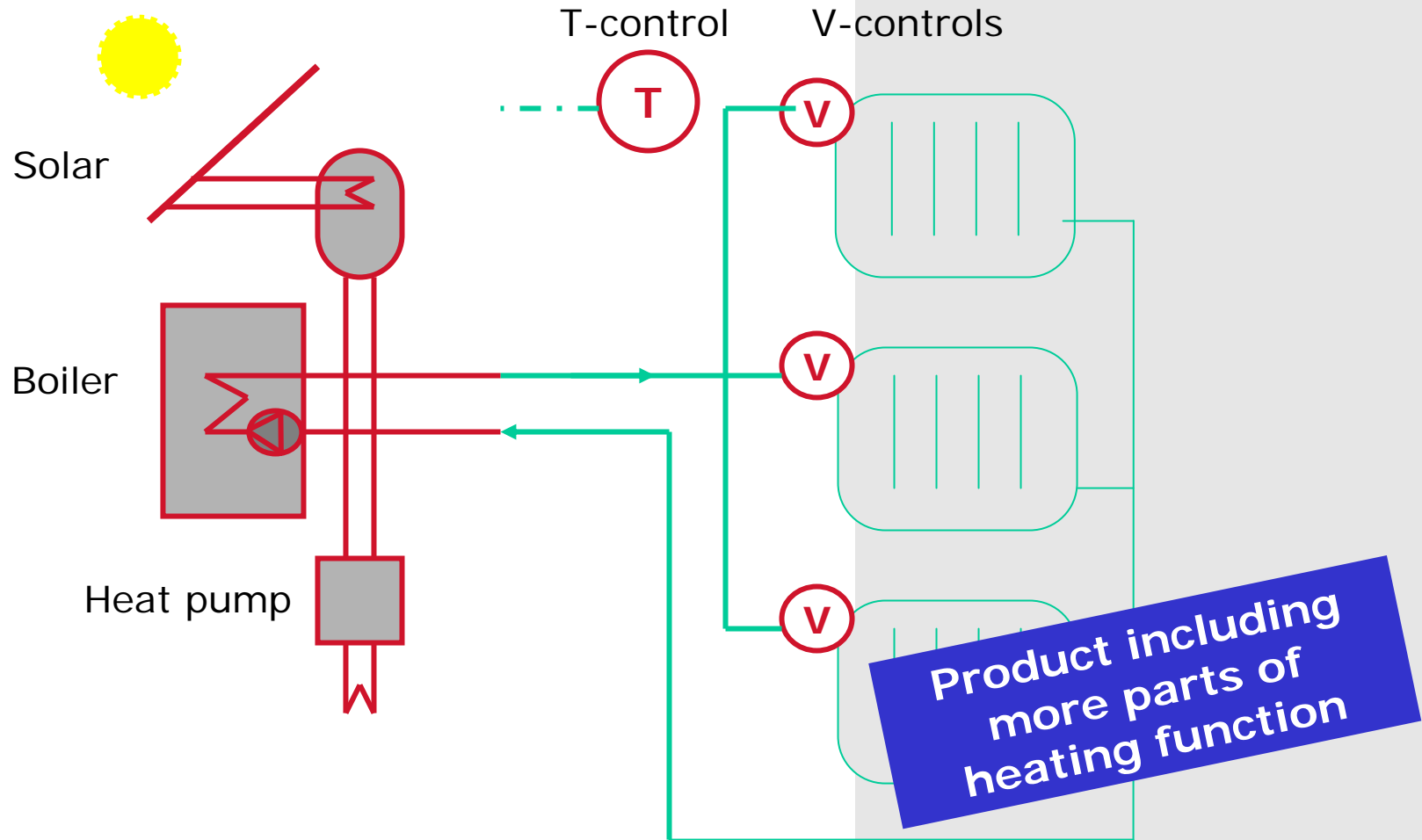
# Approach



# Definition: Your Product, your choice... [1]



# Definition: Your Product, your choice... [2]



# Why this broad product definition ?

- Realistic** assessment of energy use and environmental impact. For hybrids is the only alternative ..
- Innovation** -oriented: Allows maximum flexibility for manufacturers to meet target levels.
- Single market** In line with EPBD common denominators and therefore could be imposed uniformly across EU.
- Easier** to handle for installers and inspectors.
- Better choice** for consumers, also for complex boilers
- Robust basis** for incentives, also for complex products

# Load profiles space heating



New built (example)



Existing (example)

4,9

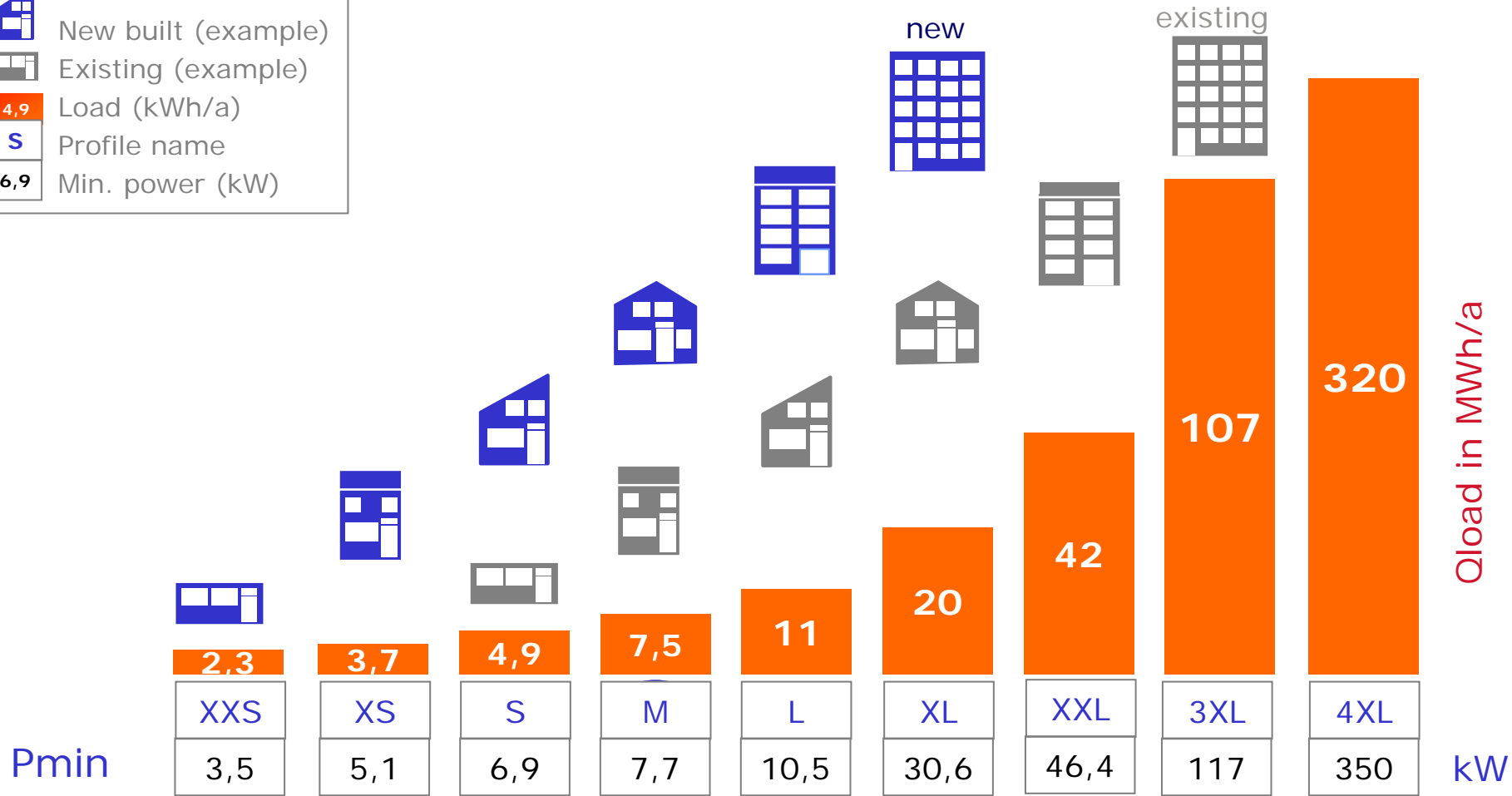
Load (kWh/a)

S





Profile name

6,9

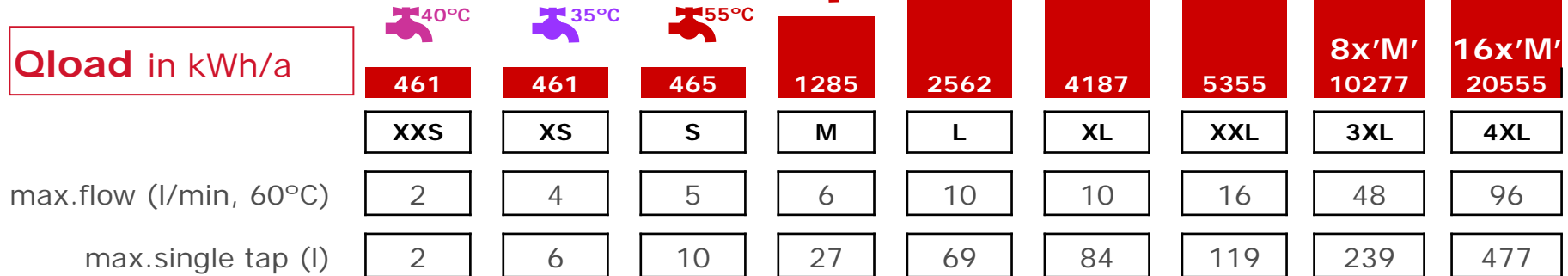
Min. power (kW)



# Load profiles water heating

-  55°C Kitchen tapplings (°C)
-  Shower
-  Bath
-  Bath+shower (simult.)

**Qload** in kWh/a



Derived from prEN 50440 "electric storage" and EN 13203-2/3 "gas/solar"

# EN product test standards inputs Math Model

## gas-fired boilers:

EN 297 (no-fan, <70 kW, B11 and B11BS)

EN 303-3 (fan-assisted, <70 kW)

EN 656 (type B, 70-300 kW)

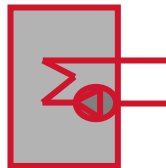
prEN 303-7 (fan-assist, B23, <1000 kW)

prEN 13826 (other type B, 300-1000 kW)

EN 483 (type C, <70 kW)

EN 677 (condensing, <70 kW)

EN 625 (combi, <70 kW)



## oil-fired boilers

EN 303-6 (combi, <70 kW)

EN 304: 1998/A1 1998

EN 15035 (Room-sealed, C13, C33, C53)

EN 15034 (Condensing, <1000 kW)

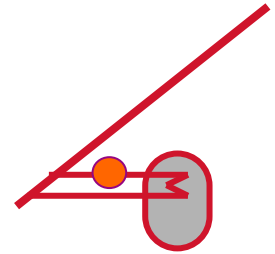
EN 303-2 (fan-assisted, <70 kW)

## Solar:

EN 12975-2

ENV 12977-2

ENV 12977-3



## Heat pump:

EN 14511

EN 12309-2

TS 14825



## Water heater:

EN 13203-2

prEN 50440

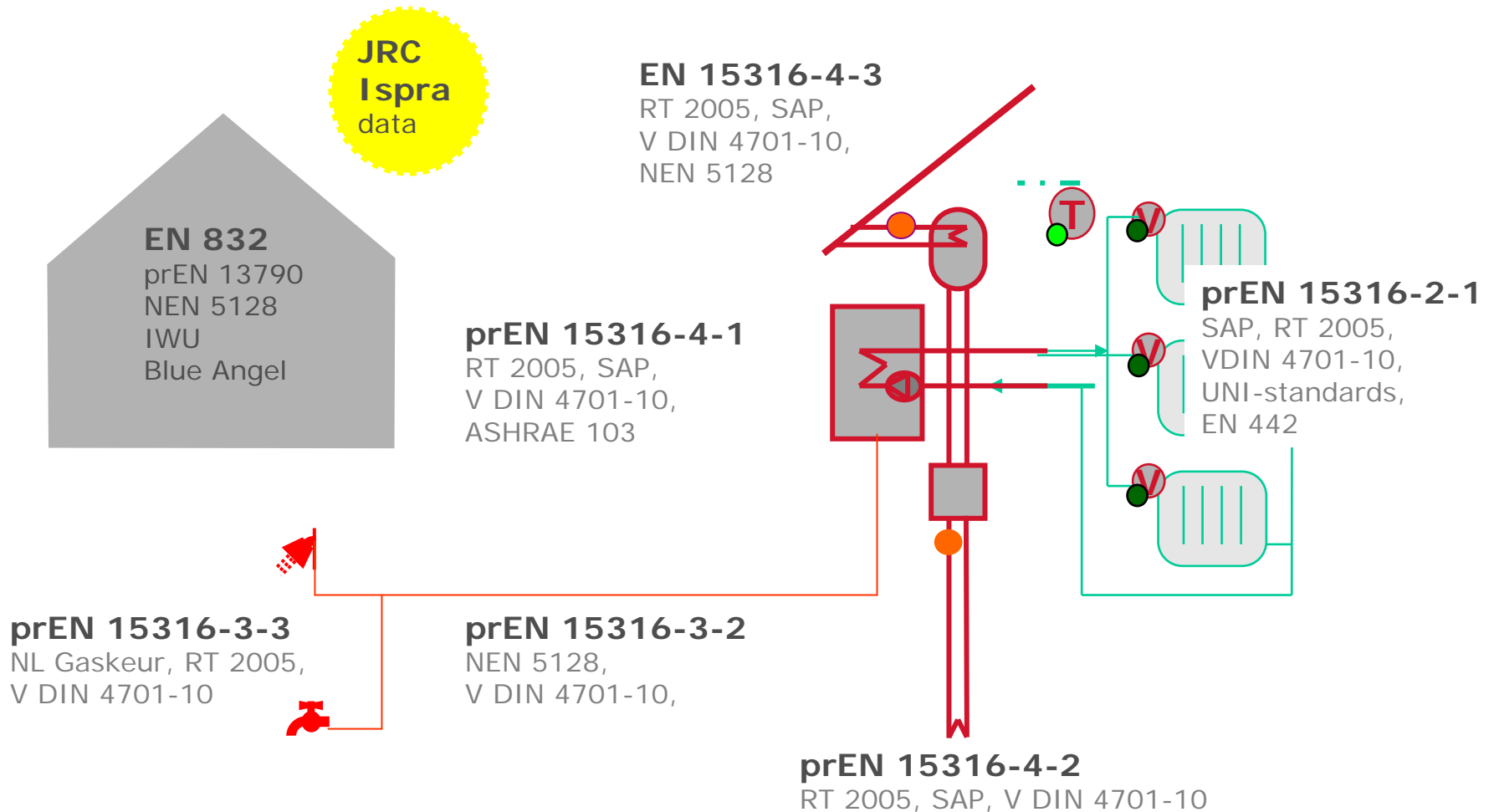
prEN 15332

EN 12897

EN 60379



# EN system standards (EPBD) in Math Model



# Math Model: Boundary Conditions

- Follow EN harmonised product test standards
- Follow (common denominator in) EN harmonised system standards (EPBD)
- Cannot be technology specific ( WTO-rules, condition 2005/32/EC)
- Cannot be country-specific (Art. 95, EU-law)
- Must be correct, i.e. in line with latest insights. The users shall be experts (industry, test institutes) and should be able to handle some degree of complexity in order to simplify life for others: installers, consumers, authorities, legislators (EPBD).
- Must be exact (no iterative programming)
- Must promote innovation and diversification

# Technical Fiche Results & Rating

All possible input test data + the output (eff. + rating) on one single page

Technical fiche keeps the label simple: Link to EPBD

Overall System efficiency for a given load profile

**DATA REPORT CH-BOILERS & WATER HEATERS**

1.1	Manufacturer		1.3	Date	
1.2	Model		1.4	ID	
2.1	SPACE HEATING LOAD	4-M	11.1	WATER HEATING LOAD	4-M
<b>BOILER(S)</b>			<b>WATER HEATER (gas/oil/elec)</b>		
3.1	Qb8060 nominal heat input in kW	pref 9999.99 nopref 9999.99	12.1	Fuel consumption (in GCV ) Qfuel	kWh/d 9999.99
3.2	Turndown ratio turndown	99.9% 99.9%	12.2	Electricity consumption Qelec	kWhe/d 9999.99
3.3	Two-stage burner twostage ?	0-no 0-no	13.1	smart control factor dhwsmart	0-no
3.4	Combi compensation combicomp ?	0-no	13.2	noise (noisew)	dB-A 99
4.1	η8060	99.9% 99.9%	14.1	combustion efficiency ηcomb	% 99%
4.2	η8060min	99.9% 99.9%	14.2	avg. flue gas temp. at tapping Tflue	oC 999
4.3	η5030	99.9% 99.9%	<b>SOLAR ASSIST</b>		
4.4	η5030min	99.9% 99.9%	15.1	Collector aperture area Asol	m2 999.9
5.1	p_bstby standby heat loss % of Qb8060	99.90% 99.90%	15.2	Zero-loss collector efficiency η0	- 0.99
5.2	Pign pilotflame power in kW	99.999 99.999	15.3	First-order loss coefficient a_1	W/(m²K) 9.99
6.1	airfuemix	1-atmospheric	15.4	Second-order loss coefficient a_2	W/(m²K) 9.999
6.2	Fuel dewpoint dpt	1-gas	15.5	Incidence angle modifier IAM	- 9.99
7.1*	Combustion airtake	1-room sealed	15.6	Solar part of tank volume vsol	litr 9999
7.2*	Designated in-/outdoors boilpos?	1-indoors	15.7	UA-value of heatexchanger UAsol	W/K 999
7.3*	Env. Volume volumeb	m3 99.99	15.8	Collector loop pipe length Lpiposol	m 999.9
7.4	Noise (noiseh)	dB-A 99	15.9	Coll. loop loss per m pipe Upipesol_m	W/(m.K) 9.99
8.1	Boiler (empty) massb	kg 999.9	15.10	Tank heat loss coeff UA	W/K 99.9
8.2	Water content massw	kg 999.9	15.11	Solar pump power solaux	W 9.999
9.1	Pump hrs after off tpm	h 24.00	15.12	Tank position solpos	1-indoors
9.2	Pmp hrid setback pmpsb	0-no	15.13	Usage sol usesol (HW, CH or both)	1-CH
9.3	El. pump Pboff elpmp	kW 99.999	<b>BACK-UP HEATER</b>		
9.4	El. at Pboff elstby	kW 99.999	17.1	ELBU el. back-up space heating? hot water back-up additional data	0-no
9.5	El. at Pbnom elmaxon	kW 99.999	18.1	Waterloadmin	1-XXS
9.6	El. at Pbnin elminon	kW 99.999	18.2	Qfuelmin	kWh 999.99
9.7	Variable speed pump varsp	0-no	18.3	Qelecmin	kWhe/h 999.99
9.8	Pump configuration pmpconfig	1-integrated	18.4	Waterloadmax	4-M
9.9	If no pump: pressure drop boiler pdrop	mbar 9999	18.5	Qfuelmax	kWh 999.99
			18.6	Qelecmax	kWhe/h 999.99
<b>CONTROLLERS</b>					
10.1	Automatic timer autotimer?	1-yes	<b>HEAT PUMP</b>		
10.2	Optimiser?	0-no	16	Nominal power Phpnom	kW 999.99
10.3	Valve control Vcontrol	2-RTV 2K	16	turndownhp	% 99.9%
10.4	Temperature control Tcontrol	2-on/off RT	16.3	HPtype (Tsrc/Tsrk)	3-El. air/ water 7/45
10.5	Setting Cgrad 9.99 Cpar 99 CL 99		16.4	Nominal COP COPnom	9.9
			16.5	50% load COP correct COP50	% 999.9%
			16.6	Maximum sink temperature Tsnkmax	oC 99
			16.7	Auxiliary el. consumption hpaux	W 999
16.13T	oC 99 99 99 99 99 99		16.8	Tank volume nominal Vhp	litr 9999
16.13a	99 9.99 9.99 9.99 9.99 9.99 9.99		16.9	Tank ref. heat loss Pstbyhp	W 9999
16.13b	99 9.99 9.99 9.99 9.99 9.99 9.99		16.10	Tank hot water capacity V40hp	frac. Vhp 9.99
16.13c	99 9.99 9.99 9.99 9.99 9.99 9.99		16.11	Use (also) vent. exhaust air ventmix ?	0-no
16.13d	99 9.99 9.99 9.99 9.99 9.99 9.99		16.12	Usage hp usehp (HW, CH or both)	1-CH
16.13e	99 9.99 9.99 9.99 9.99 9.99 9.99		16.13	Testpoints (table left)	
<b>OUTPUT: SPACE HEATING ENERGY</b>			<b>OUTPUT: WATER HEATING ENERGY</b>		
A.1	Space heat load	kWh/a 999.999	B.1	Water heat net load	kWh/a 999.999
A.2	Space heat primary energy use	kWh/a 999.999	B.2	Water heat primary energy use	kWh/a 999.999
A.3	Space heat efficiency	99.9%	B.3	Water heat energy eff.	99.9%
A.4	Energy label Space Heat	A	B.4	Energy label Water Heating	A

# Labelling



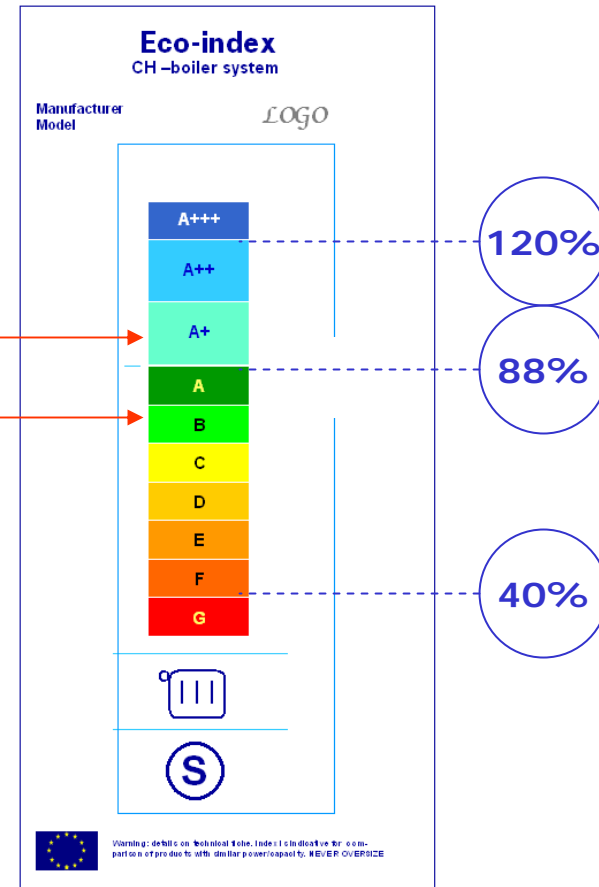
# MEEPS & Label classes CH-Boilers

XXL/3XL/ 4XL:  
**96%** (on GCV)  
[from basecase ca. 45%]

XXS/ XS/ S/ M/ L/ XL:  
**76%** (on Gross Calorific Value  
GCV) [from basecase ca. 54%]

NO<sub>x</sub> :  
< **35 mg/kWh (20 ppm)** without  
renewable component  
< **70 mg/kWh (40 ppm)** with solar  
and/or heat pump as part of product

CO: <400 ppm



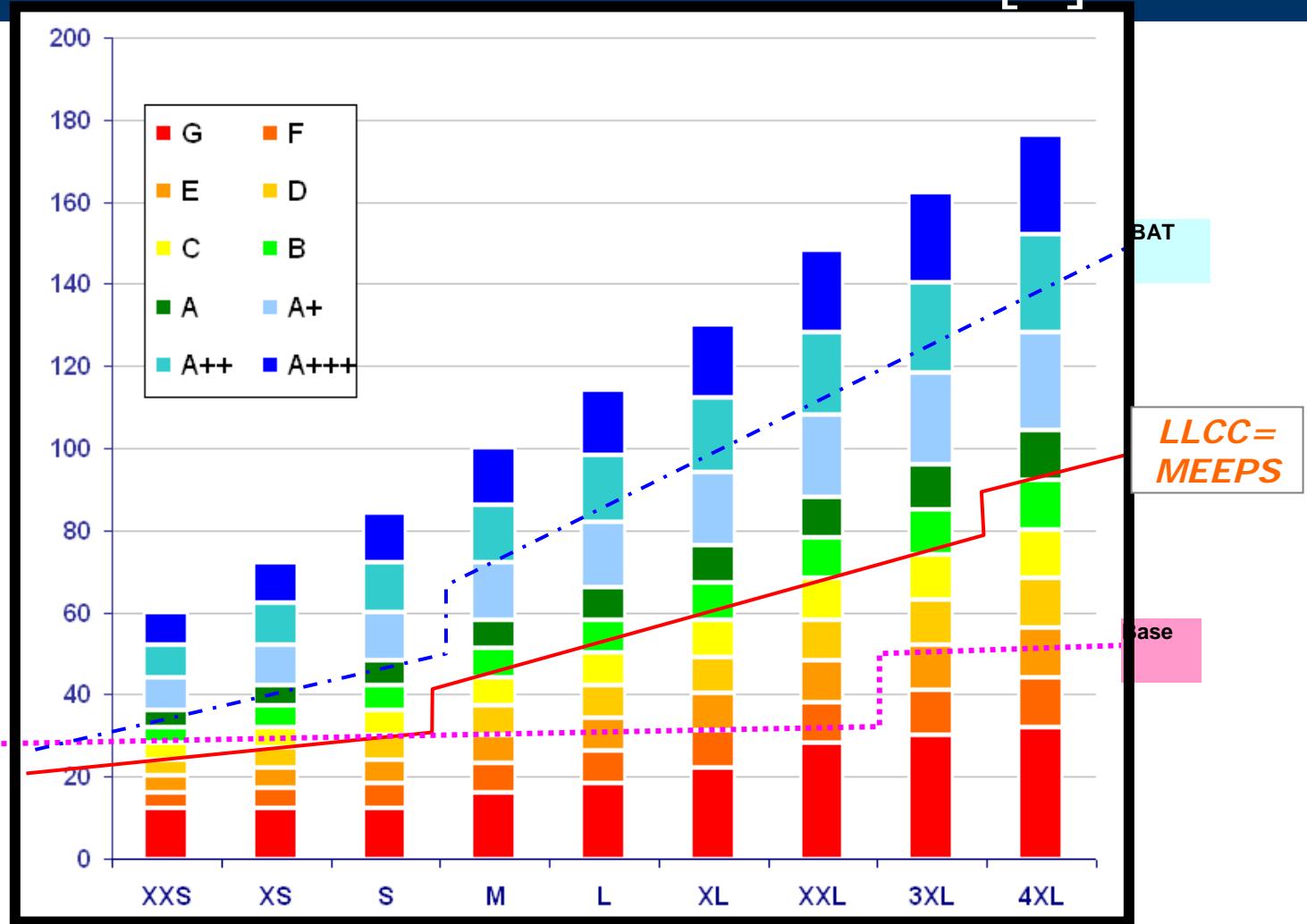
**Class-width A-F: 8%; A+-A++:16%**

# MEEPS & Label Classes Water Heater [1]

	<b>XXS</b>	<b>XS</b>	<b>S</b>	<b>M</b>	<b>L</b>	<b>XL</b>	<b>XXL</b>	<b>3XL</b>	<b>4XL</b>	
<b>A+++</b>	52	62	72	86	98	112	128	140	152	<i>BAT</i>
<b>A++</b>	44	52	60	72	82	94	108	118	128	
<b>A+</b>	36	42	48	58	66	76	88	96	104	
<b>A</b>	32	37	42	51	58	67	78	85	92	<i>LLCC=</i> <i>MEEPS</i>
<b>B</b>	28	32	36	44	50	58	68	74	80	
<b>C</b>	24	27	30	37	42	49	58	63	68	
<b>D</b>	20	22	24	30	34	40	48	52	56	
<b>E</b>	16	17	18	23	26	31	38	41	44	<i>BaseCase</i>
<b>F</b>	12	12	12	16	18	22	28	30	32	
<b>G(startvalue)</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>16</b>	<b>18</b>	<b>22</b>	<b>28</b>	<b>30</b>	<b>32</b>	
<i>class widths</i>	4	5	6	7	8	9	10	11	12	
<i>Base Case</i>	27	27	23	26	33	30	30	52	49	

lower class limits in % efficiency

# MEEPS & Label Classes Water Heater [2]



# Recommended schedule for Boilers

## Realistic scenario

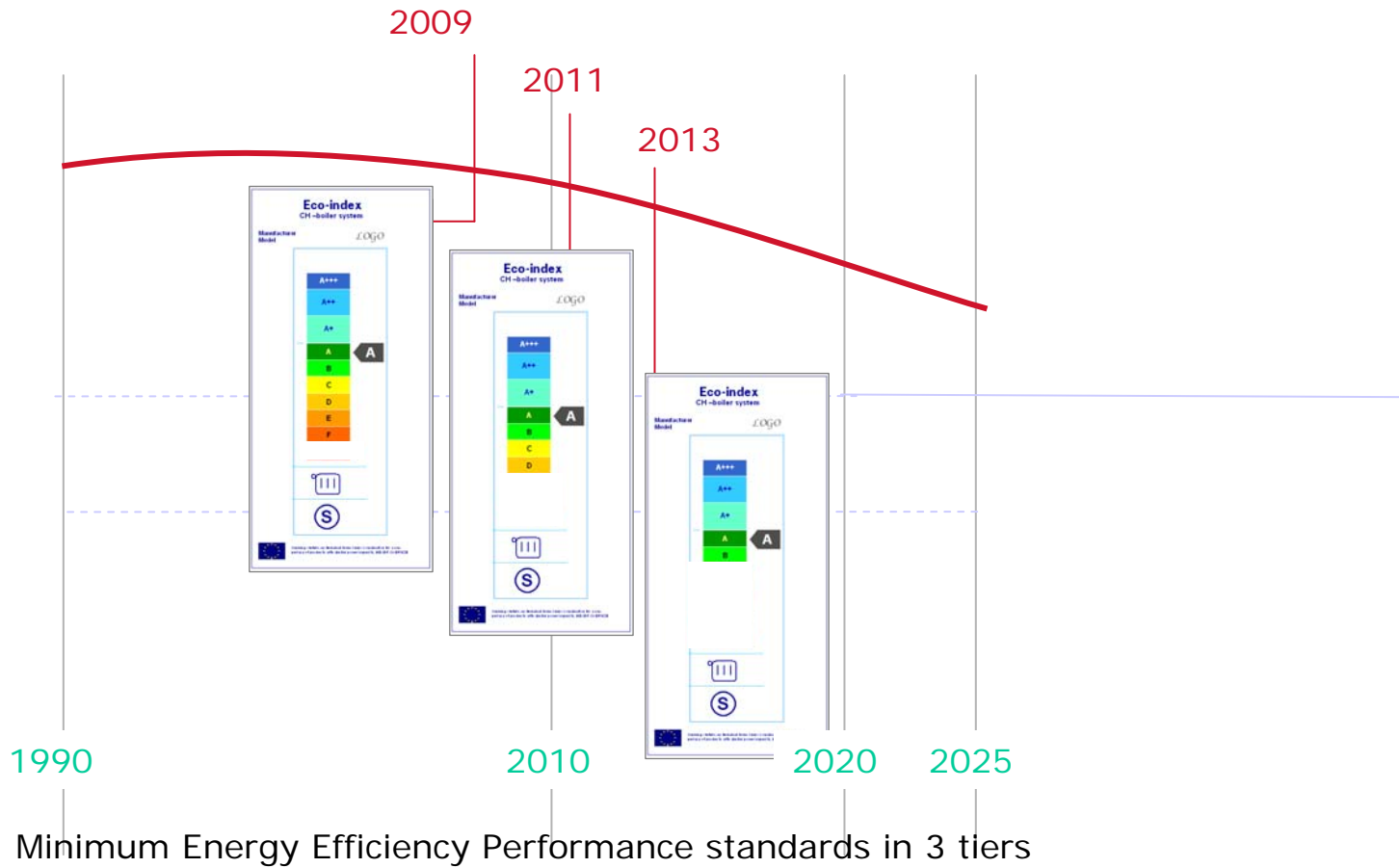
- 2009      Labelling  
            MEPS Tier 1: **G** ☒  
            Mandate to CEN/Cenelec  
            Embedding Ecodesign in EPB  
            Start promotion campaigns in MS
- 2011      MEPS Tier 2: **EF** ☒ for XXS-XL, **DEF** ☒ for XXL-4XL
- 2012      Report/evaluation (standards, innovation)
- Dec.2012      MEPS Tier 3:  
            **CD** ☒ for XXS-XL [MEP is upper half of **B** ☑; >76%]  
            **ABC** ☒ for XXL-4XL [MEP is upper half **A+** ☑; >96%]  
            ELV (fossil only): 20 ppm NOx (other depend on standards)

# Recommendende schedule for Water heaters

## Realistic scenario

- 2009                      Labelling  
                              MEPS Tier 1: to propose  
                              Mandate naar CEN/Cenelec  
                              Implement in EPB  
                              Start promotion campaigns in MS
- 2011                      MEPS Tier 2: to propose
- 2012                      Report / evaluation (standards, innovation)
- Dec.2012                MEPS Tier 3:  
                              XXS to S: D-E-F-G ☒ [MEP at C ☑; >24 to 30%]  
                              M to 3XL: C-D-E-F-G ☒ [MEP at B ☑; > 44 to 74%]  
                              4XL: B-C-D-E-F-G ☒ [MEP at A ☑; > 92%]

# Suggested timing MEEPS



# Specific Measures: Market Surveillance

- **Third Party testing** required for efficiency parameters. Testing costs for a boiler are around € 2.500,- to € 3000,- . For solar-assisted and heat pump installations 50% more. For gas-fired boiler manufacturers, where external testing is already mandatory, these costs constitute less than 3-4% of R&D costs. The R&D costs in turn are around 3-4% of the product price, so the overall effect on the price will be negligible (around 0,1-0,2% higher product price).
- **Market surveillance through spot checks at EU-level**: by an independent body performing 100-150 random spot checks annually. Costs could be limited (ca. € 1 mln. /yr.) and it would avoid discussions on the neutrality of the surveillance. As one CE-marking conformity test usually covers between 10 and 20 models, the 100-150 spot checks could cover around 1000-2000 models annually.
- **Laboratory certification** is recommended, including other measures to improve reliability of test procedure.

# Lateral Measures

Mandate to CEN/ Cenelec for dynamic load testing/emulation (for 2012), possibly to replace (parts of) mathematical model, which is transitory

Embedding Eco-design measures in EPBD [MS & EU] → single market

Completion of labelling under 92/75/EC (retail side) [ EU]

Chimney renovation programme [MS & EU] ☞

Financial incentives [MS] ☞

Other (promotion, support for field test/ market intro, etc.) [MS]

# Lateral Measures (selection)

**Chimney renovation programme [MS & EU]** is a €1 bln. programme to renovate chimneys over the 2009-2012 period in individually owned apartments with shared chimneys, in order for all to adopt condensing technology (*otherwise unaffordable*).

**Financial incentives [MS]** is an advice to Member States to raise their financial incentives for new boilers. Compared to cars (same impact but up to 10 times higher subsidy for take-back) and whitegoods (10 times lower impact, but the same subsidy as for boilers) the **current level is extremely low.**

# Lateral Measures: Chimneys

Max. Scope:  
3,6 mln. apartments per year  
(0,5 mln. buildings) at  
€ 300,-/apartment →  
ca. € 1 bln./year

Period: 4 years

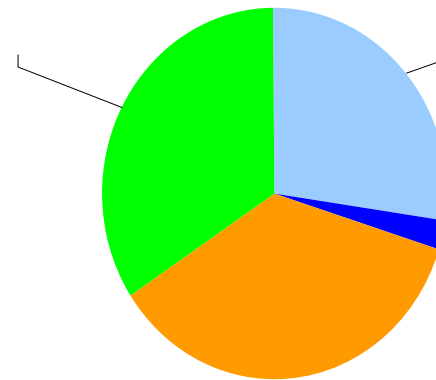
## Number of Heating Systems in Multi-Family Dwellings (ca. 84 mln. primary dwellings, 10,5 mln. Buildings)

**District Heating  
& Electric dry**  
**30 mln.**  
mainly high-rise  
IT (0,3)

**Individual  
Boilers non-  
condensing**  
**ca. 24 mln.**, of  
which

IT (11,8),  
FR (7,6),  
DE (3,3),  
AT+BE+UK+IE  
(1,3) mln.

**Individual  
Boilers  
condensing ca.**  
**2 mln.**, of which  
NL 1,6 mln.



**Collective  
Boilers**  
**ca. 31 mln.**  
IT (4)

# Content

## 4. Impact

- Carbon (CO<sub>2</sub> eq.)
- Energy
- Expenditure
- NO<sub>x</sub>

# Impact analysis : Scenario's up to 2025 at LLCC + lateral measures

## BaU (Business-as-Usual) CH-Boilers

**Negative effects 2005-2020:** increase in number of households (10-12%), increase floor area ( 3-5%), higher heating comfort ( 8-10%),

**Positive effects 2005-2020:** insulation and ventilation measures ( 30% over 2005-2020), increase boiler efficiency through park replacement (5%), extra efficiency through measures (3-5% efficiency points from low-end condensing being 50% of EU-sales in 2010), increase outdoor temperature (1%)

Overall 2005-2020: ca. 18% decrease

## BaU (Business-as-Usual) Water Heating

**Negative effects 2005-2020:** increase in number of households (10-12%), increase comfort ( 8-10%; more and longer showers),

**Positive effects 2005-2020:** increase water heater efficiency through park replacement (5-7%).

**Overall 2005-2020:** ca. 18% increase

# Impact analysis : Scenario's of savings up to 2025 at LLCC)

## Realistic

Staged introduction minimum targets. Final tier 31.12.2012. Labelling per 1.1.2009. Support by labelling, EPBD, ESD, financial incentives, green/white certificates, promotion etc. further boosts efficiency by 3% annually, up till the year 2018. After that, the market is expected to stabilize.

Other scenarios in report Task 7

## Slow.

## Ambitious

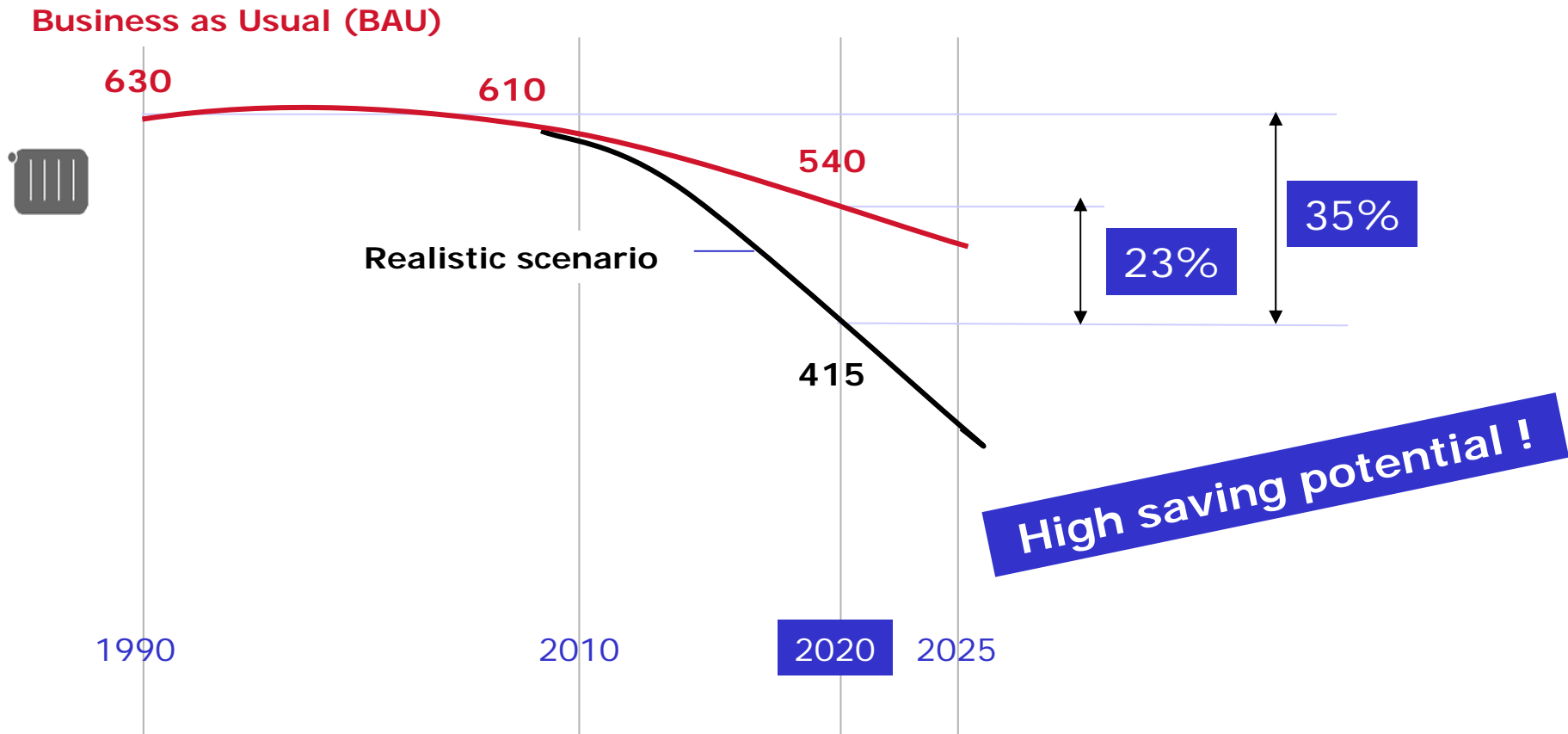
## Ambitious + Early Replacement

## NOx 20 ppm (acidification only)

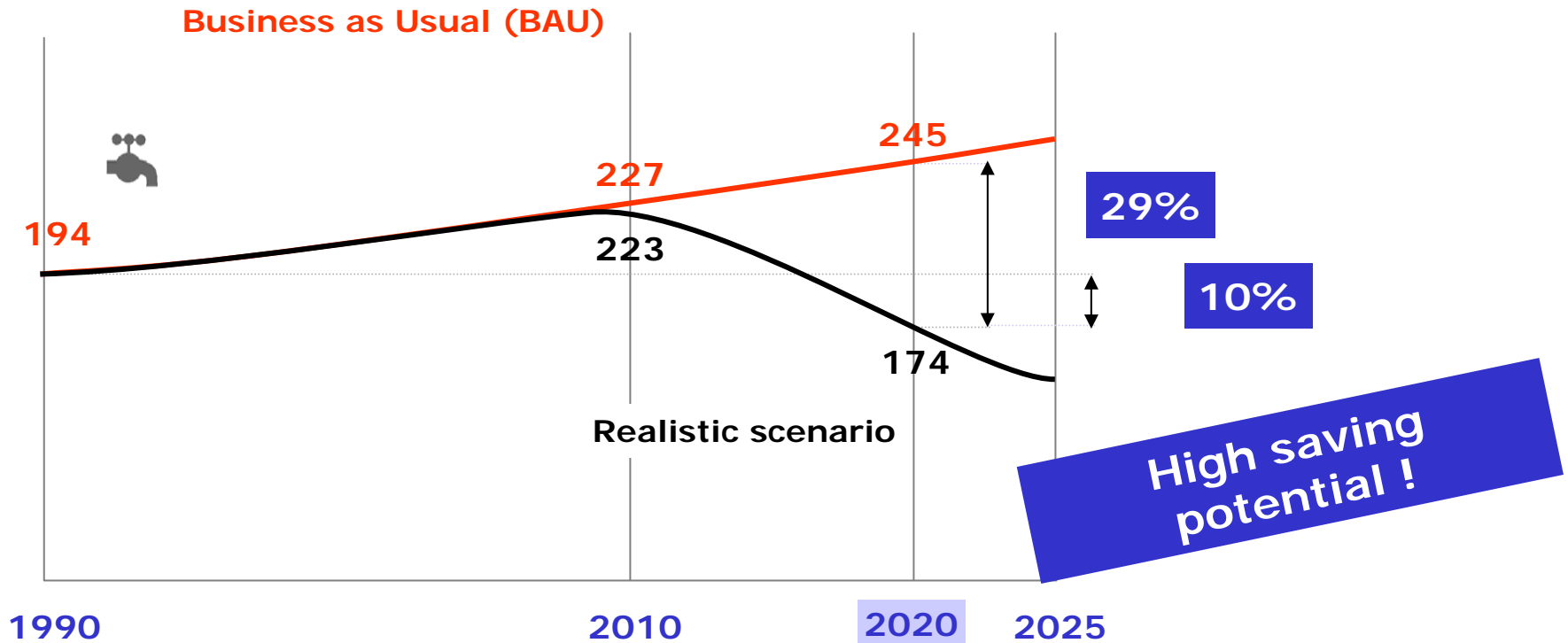
## Freeze 2005

# CO2 emissions CH-Boilers

EU25-emission boilers in Mt CO2 pa. Total EU15 3357; EU ca. 4 Tt



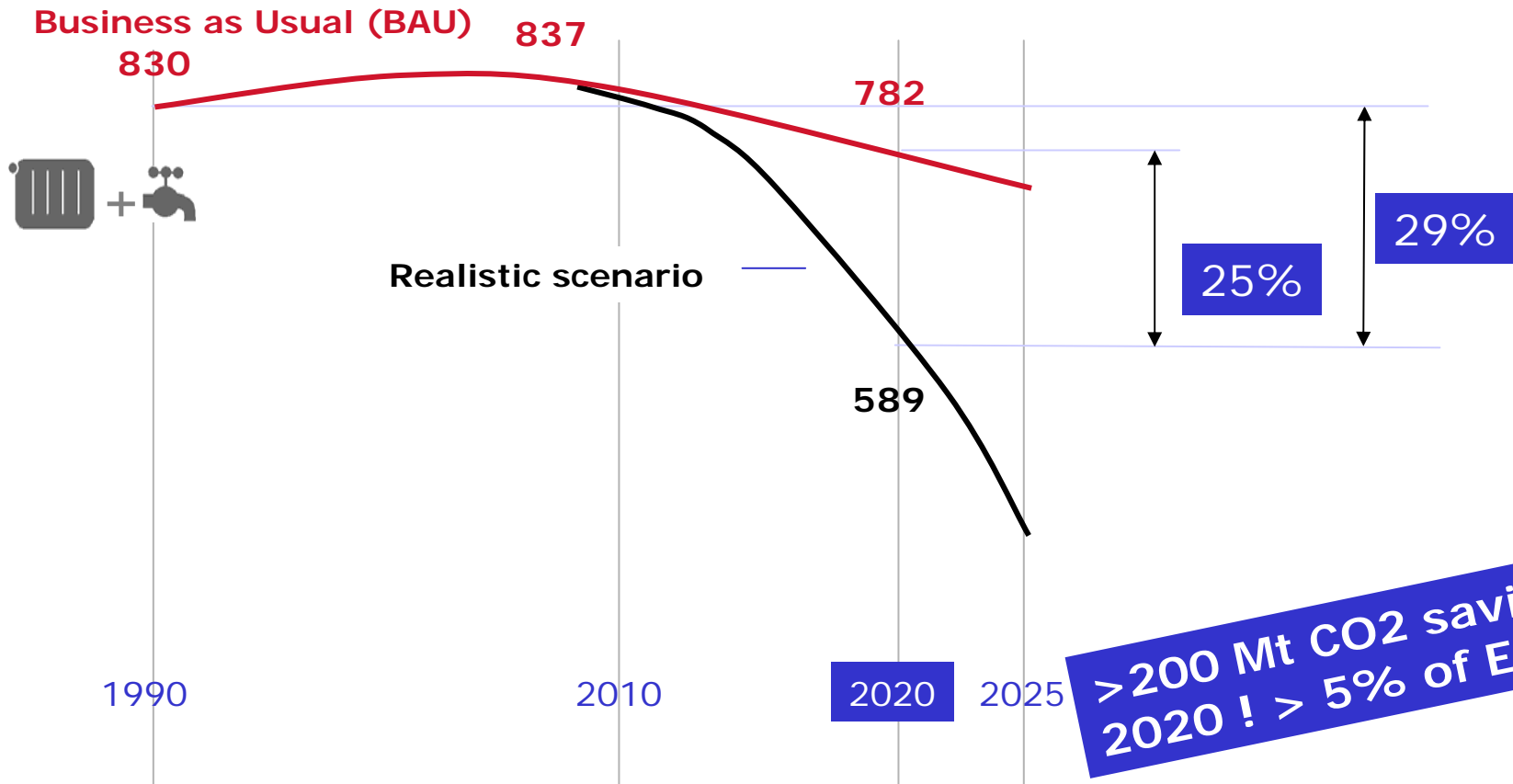
# CO<sub>2</sub> eq. emissions Water Heaters



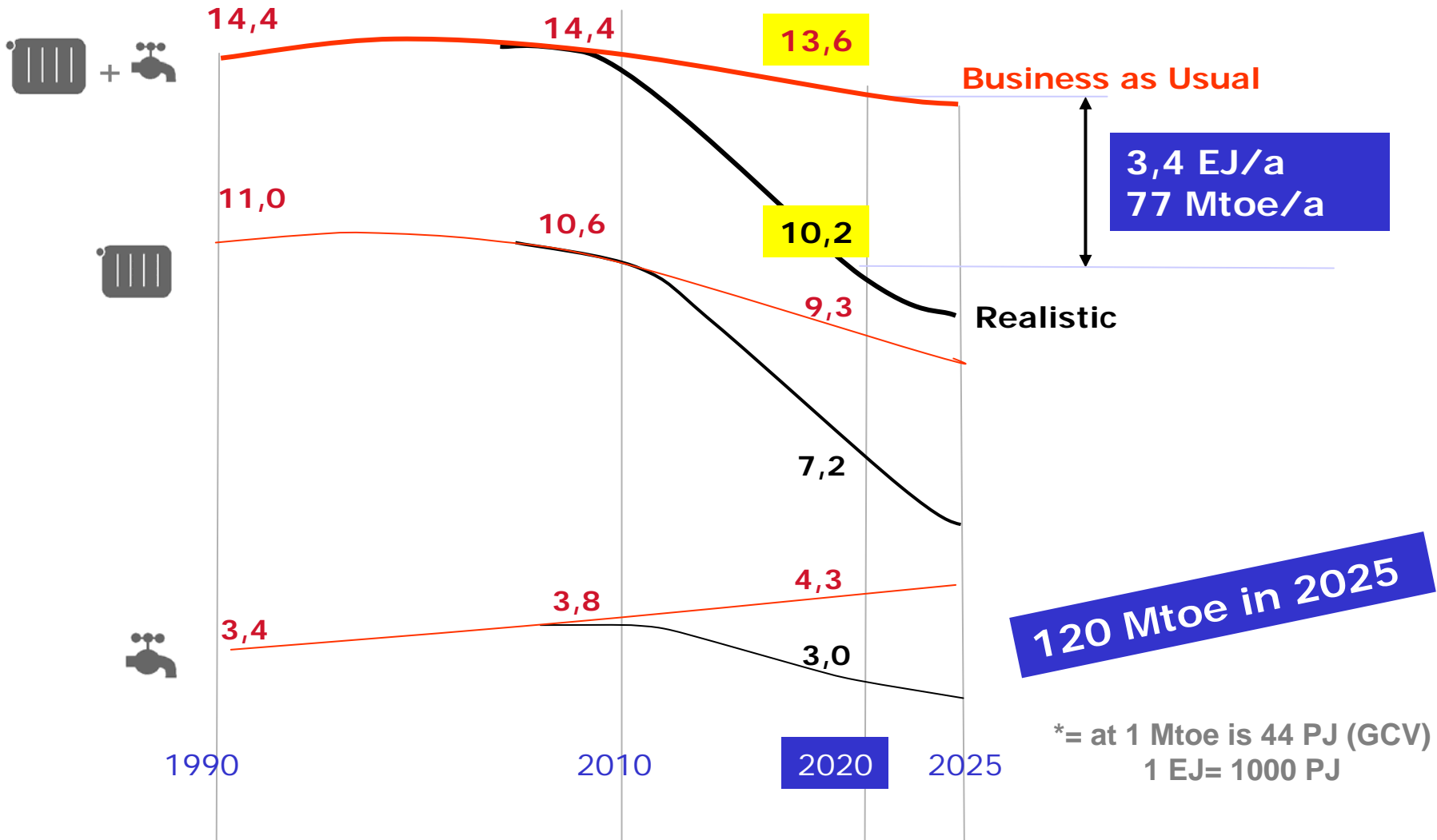
EU25-emission water heaters in Mt CO<sub>2</sub>/a

# CO2 emissions CH-Boilers + Water Heaters

EU25-emission boilers in Mt CO2 pa

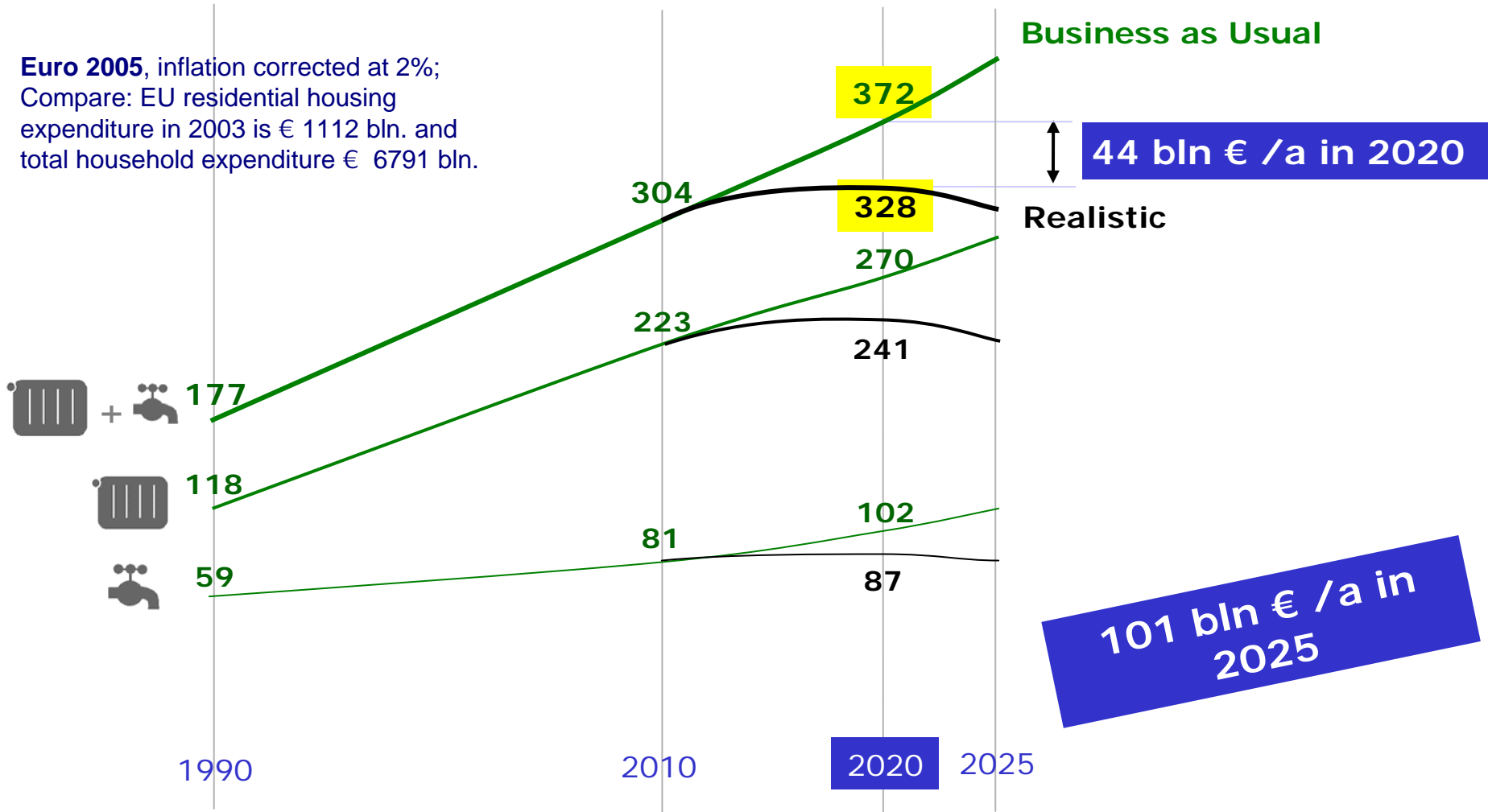


# Impact EU: Energy (in EJ)

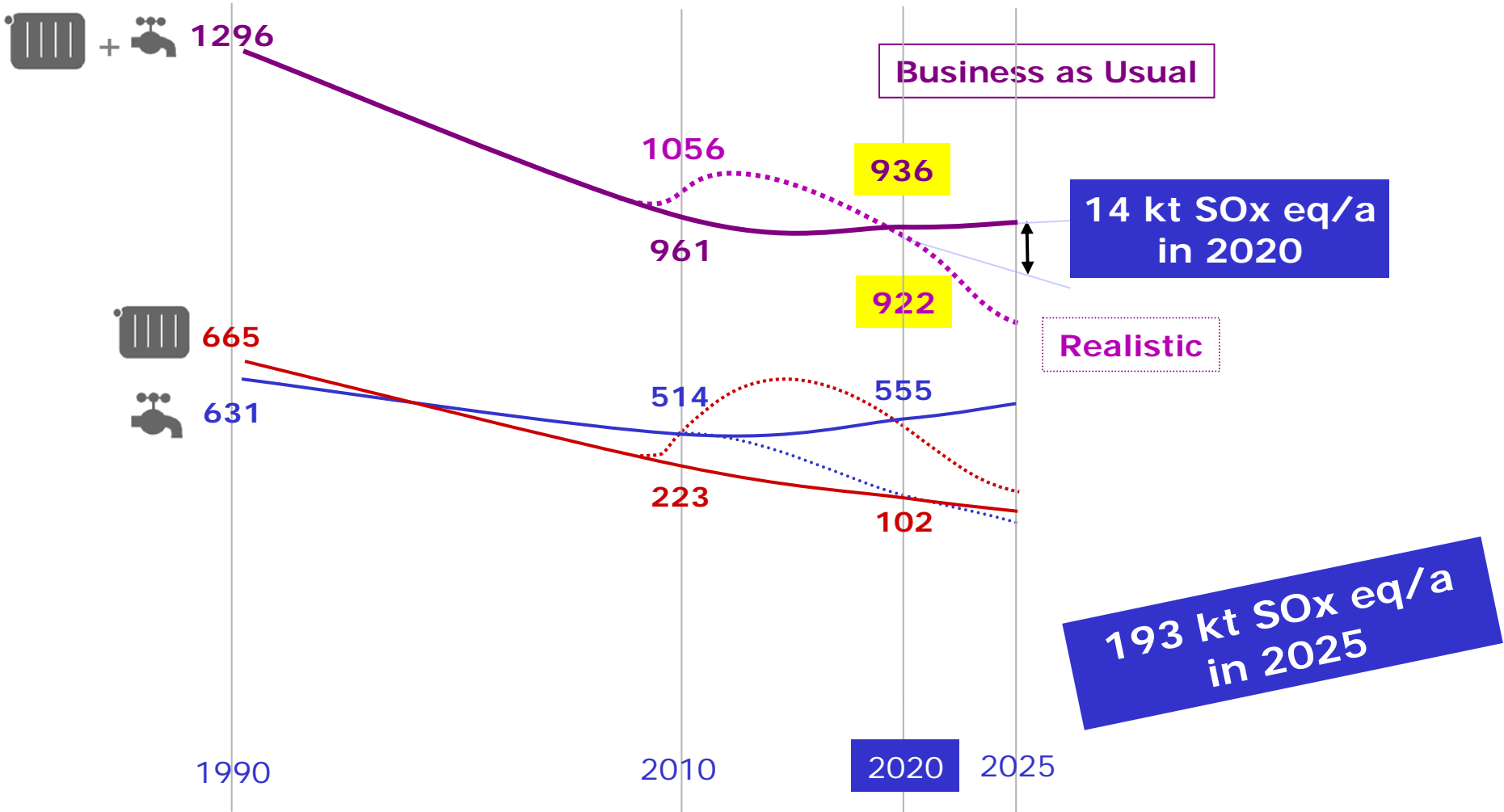


# Impact EU: Expenditure (in bln. €)

Euro 2005, inflation corrected at 2%;  
 Compare: EU residential housing  
 expenditure in 2003 is € 1112 bln. and  
 total household expenditure € 6791 bln.



# Impact EU: Acidification (in kt SOx eq./a)



[ EU-15 total in 2005: 10.945 kt SOx equivalent, from 9015 kt Nox (\*0,7) and 4635 kt SO2 ]

# Content

## 5. Conclusions on savings

# CH-boilers savings

- **CARBON: With respect of BaU close to 5 % savings on all fuel-related CO2 (5% in EU-15 + 4,4% in NMS) → 20-25% contribution in "20/20/20".**
- **CARBON: With respect of 1990: 8% savings on all fuel-related CO2 in 2025 → contribution close to 35-40% in "20/20/20" EU Energy Policy target.**

Boilers (Lot 1) and water heaters (Lot 2): 40-50% of "20/20/20" → almost half, but this assumes also BaU-scenario with continued heavy investments in insulation, ventilation with waste heat recovery, etc.. So, it is a combined effect.

- Similar (5% resp. 8%) in **energy saving** with respect of BaU resp. 1990
- No negative effect on **acidification** (despite increase in electricity)
- 6% saving in residential **housing expenditure**. 1% in **total consumer expenditure**.

# Water heater savings

- **2,2 % savings on all fuel-related CO2** (incl. transport), similar in energy saving → ca. 10% contribution in reaching EU energy efficiency goal (see *intro: "20/20/20"*)
- **2-3% saving on all EU25 acidification-emissions** ("*Gothenburg*", *NEC-dir.*)
- **2% saving in residential housing expenditure.**
- **0,3 % saving in total consumer expenditure.**

## Other ...

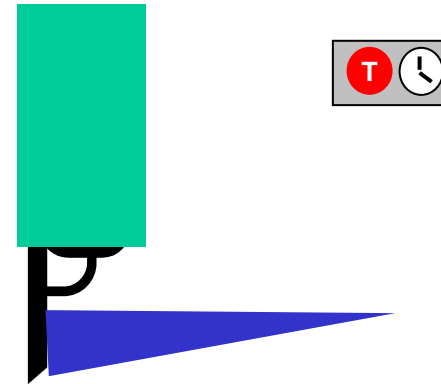
- **Measures put EU back on the global map** in terms of ambitious legislation.
- **Global competitiveness** of the EU-industry will be enhanced rather than diminished, as current EU-legislation is significantly behind Japan, US, Canada, etc.. **Innovation** will be rewarded and made visible (“Lisbon” agenda).
- Enable **single EU-market** through embedding in EPB. No fuel-technology bans. Level playing field at the outset. Future will depend on competition and the innovative power of individual manufacturers (which is as it should be...).
- With pre-set and pre-assembled systems, **installers will now be able to cope with sophisticated systems** (including solar, HP).
- Through the labelling, **governments can now create an appropriate incentive strategy** for all types of boilers, backed up by robust EU-wide legislation.
- **Consumers have one clear and transparent label**, and at the same time –if they are restricted in their energy choice– enough differentiation to choose within a subset.

# Content

## 6. Q & A

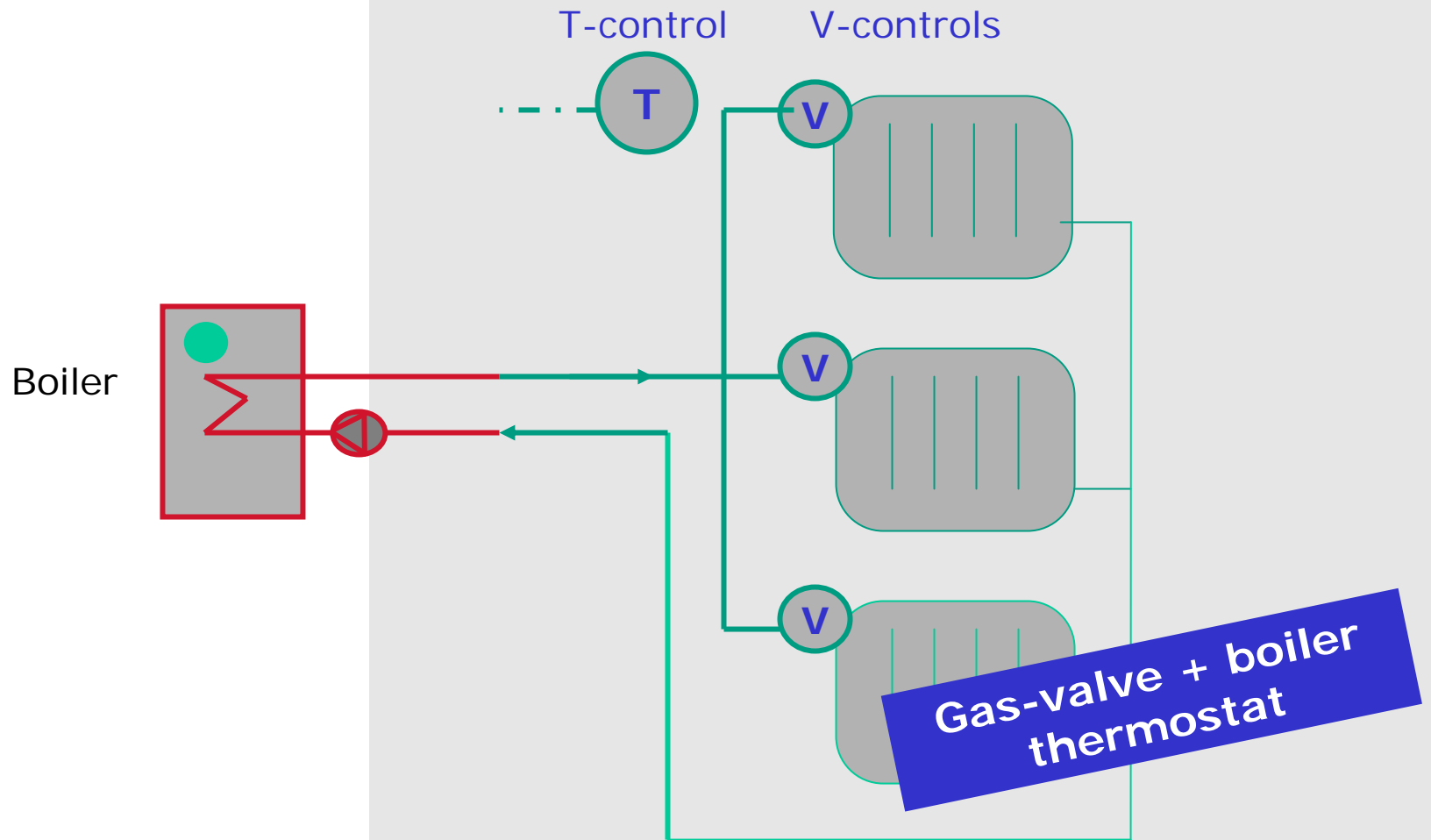
- **Controls**
- **Installer**
- **Building inspector**
- **Electric heat pump**
- **Label design**
- **BAT and BNAT**

# Controls

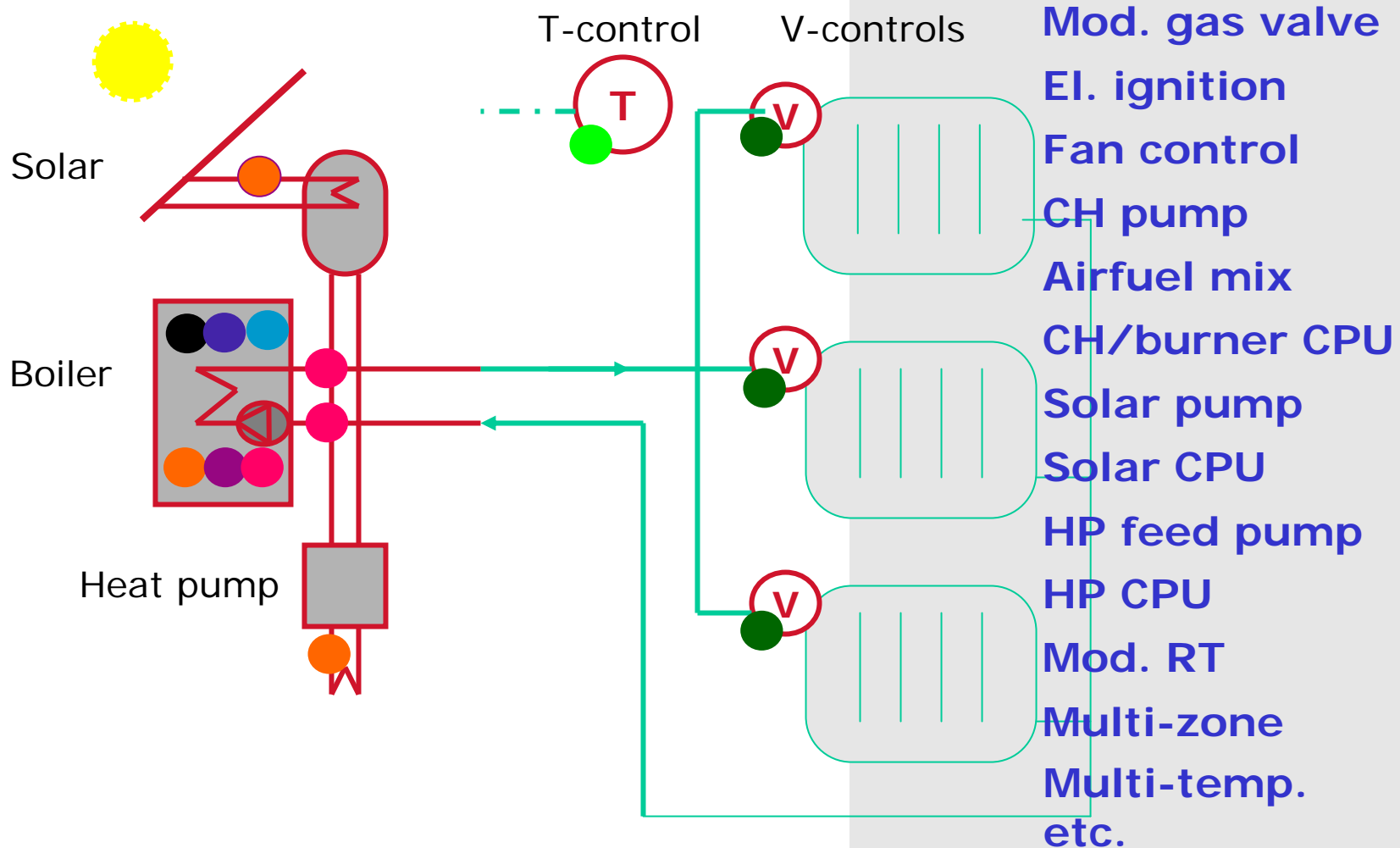


**Controls are essential in (the efficiency of)  
modern boiler technology !**

# Traditional boiler



# Modern boiler technology



# Tcontrols and Vcontrols

- **Tcontrols** (thermostats, weather control incl. programmable timers), **Vcontrols** (valves, hydraulic controls) are especially important for real-life boiler efficiency
- Today many Tcontrols and some Vcontrols (e.g. multi-zone, dual zone) are **already part of the boiler** and water heater products and should be part of the Product efficiency rating.
- But currently EPB national and EN **standards** only give some (often inhomogeneous) look-up values and **no clear guidance**
- **So, how?**







# Recommendations on boiler controls

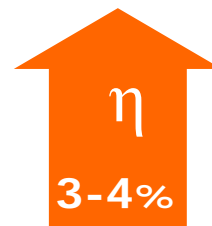
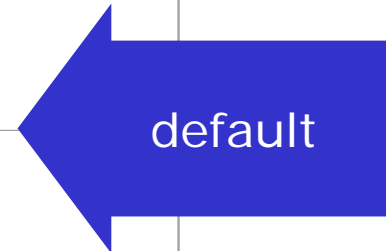
- **6 classes of Tcontrols+5 classes of Vcontrols+ 2 timer features** with requirements and effects that comply with EN look-up values and consensus from control's experts (to be firmed up by certification scheme, EUBAC?)
- **Boiler manufacturer declares** which of these Tcontrols or Vcontrols (if any) is part of the product.
- **Compliance testing (CE-mark)** just involves whether declared T- and/or V-control fulfills requirements of its class.
- As long as this is the case, the boiler manufacturer **can switch brand, design etc.** of the control type **without necessity of new CE-mark**
- **For 3XL, 4XL exception:** T and Vcontrols: no compulsory hardware but inclusion in certification/inspection scheme ( details still to define)

# Recommendations on boiler controls [2]


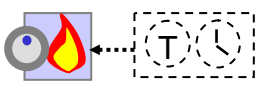

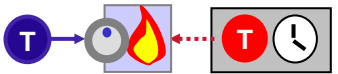
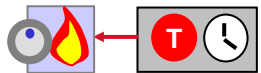

- **10 out of 11** control classes are **defaults** (= do not affect rating) or can be found **in today's boiler-products, plus**
- **1 option (nr. 3, "TRV 1K") is NEW!**  
It addresses not so much the TRV (this is already in default  $V_{\text{control}}=2$ ), but tries to give an incentive to boiler manufacturers to include **a service contract for HYDRAULIC BALANCING and BEST CONTROL SETTING.**
- Hydraulic balancing and good controls settings are **essential** to make good control hardware work properly, **but** both are **very rare** (anecdotal estimate <10%)
- An introduction **kit of 3 TRVs** that goes with it, just helps the instructions and helps the authorities to check compliance (i.e. **To avoid subsidy-fraude**)
- **But  $V_{\text{control}}=3$  will only work if all parties agree...**

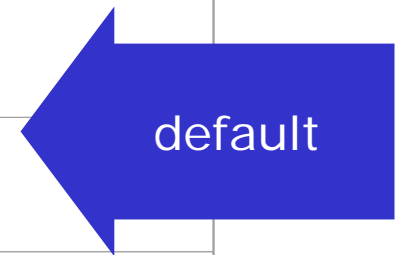
# Timer features

		<b>XXS-XXL</b>	<b><u>3XL-4XL</u></b>
<b>1</b>	<b>None</b> (3XL, 4XL default)		
<b>2</b>	<b>Autotimer</b> (XXS-XXL default)		
<b>3</b>	<b>Optimiser</b>		



# Type of Tcontrols

		hardware	<u>signal</u>
1	<b>fixed BT</b> (3XL, 4XL default)		manual
2	<b>on/off RT</b> (XXS-XXL default)		on/off
3	<b>weather control</b>		analogue
4	<b>weather c. + RT</b>		analogue + on/off
5	<b>modulating RT</b>		digital
6	<b>chrono-prop. RT</b>		on/off + cycletime-limit

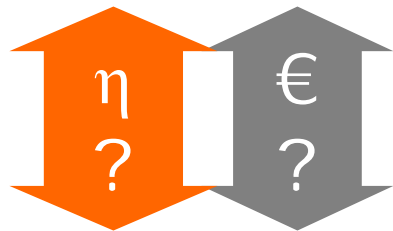
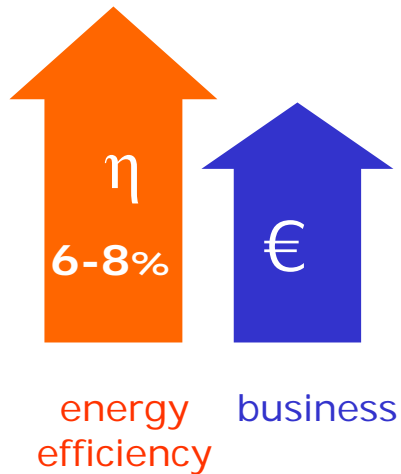


# Type of Vcontrols

		XXS-XXL	3XL-4XL
1	manual		
2	TRV 2K (default)		
3	TRV 1K		
4	Motor + PID		
5	Motor + CPU		



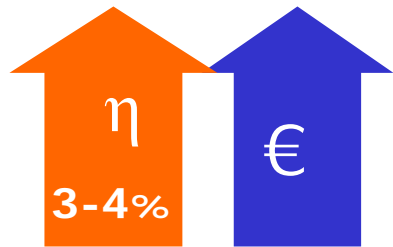
# Impacts: Boiler industry



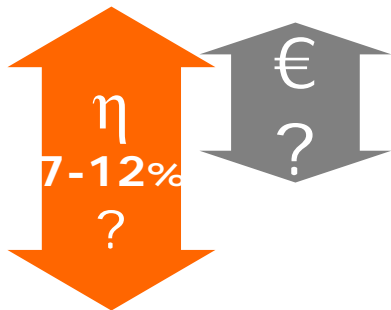
## New options :

- For XXS-XXL: With advanced controls boiler manufacturer can **raise the label class** of his products by **6-8%** → **extra label class**, e.g. From "B" to "A"
- For 3XL, 4XL : Controls scheme **raise the label class by 2**, e.g. from "D" to "B"
- XXS-XXL: For standard controls (up to and including standard on/off thermostats and TRVs) there is **no incentive to include** in the product (are 'defaults' and do not increase label rating)
- **3X, 4XL**: Controls scheme and role boiler-manufacturer **still to define** (insecurity..)

# Impacts: Tcontrols industry

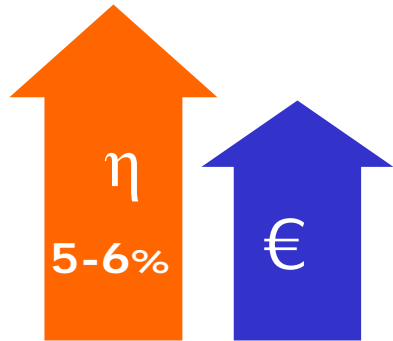


- For XXS-XXL: Market for direct sales of **standard controls** , i.e. to be delivered if boiler product does not include T or Vcontrols is fully open [large part of boilers is still on/off or twostage].
- **For 3XL, 4XL** : Controls scheme and role control-manufacturer **still to define** (insecurity but also opportunity!)
- **OEM-business for advanced controls to grow**. Both in unit sales and added value. Also stronger OEM-leverage if good controls
- **Side-effect: EuP puts controls 'on the map' for retrofit and EPB**

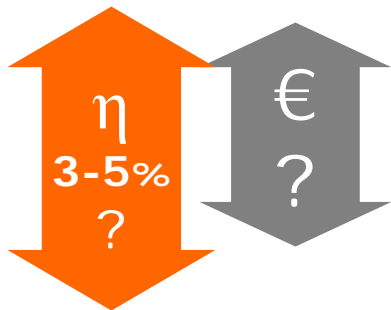


- XXS-XXL: For **advanced controls** (T and Vcontrol types 4 and 5) boiler manufacturers –if they haven't already done so– have a **strong incentive to deliver with the boiler. Loss profit** (direct→OEM).
- **Insecurity: Implementation in EPB, but when, how? Retrofit OK, but** will there be incentives from MS?

# Impacts: Vcontrols industry



- For XXS-XXL: **TRV** is mostly not **sold** with boiler but **with emitter** (**much slower** replacement rate).
- 'TRV 1K' promotes sales with new boiler → **extra OEM market**.
- 'TRV 1K' requires intro-kit of only 3 TRVs, whereas typical house needs 7 or 8 → **promotes direct sales of on average 4 extra TRVs** per new boiler.
- 'Motor' options (4&5) → **extra OEM business**
- Side-effect: TRV 2K option EuP puts controls 'on the map' for **retrofit and EPB**



- Assume 16% of new boilers sold with 'TRV 1K' → 1 mln. Boilers → 3 mln. TRVs → <5% of total TRV market EU? **1-2% loss profit ?(direct→OEM)**.
- **Insecurity: Implementation in EPB, but when, how? Retrofit OK, but will there be incentives from MS?**

# Retrofit controls: Cheapest way to Kyoto

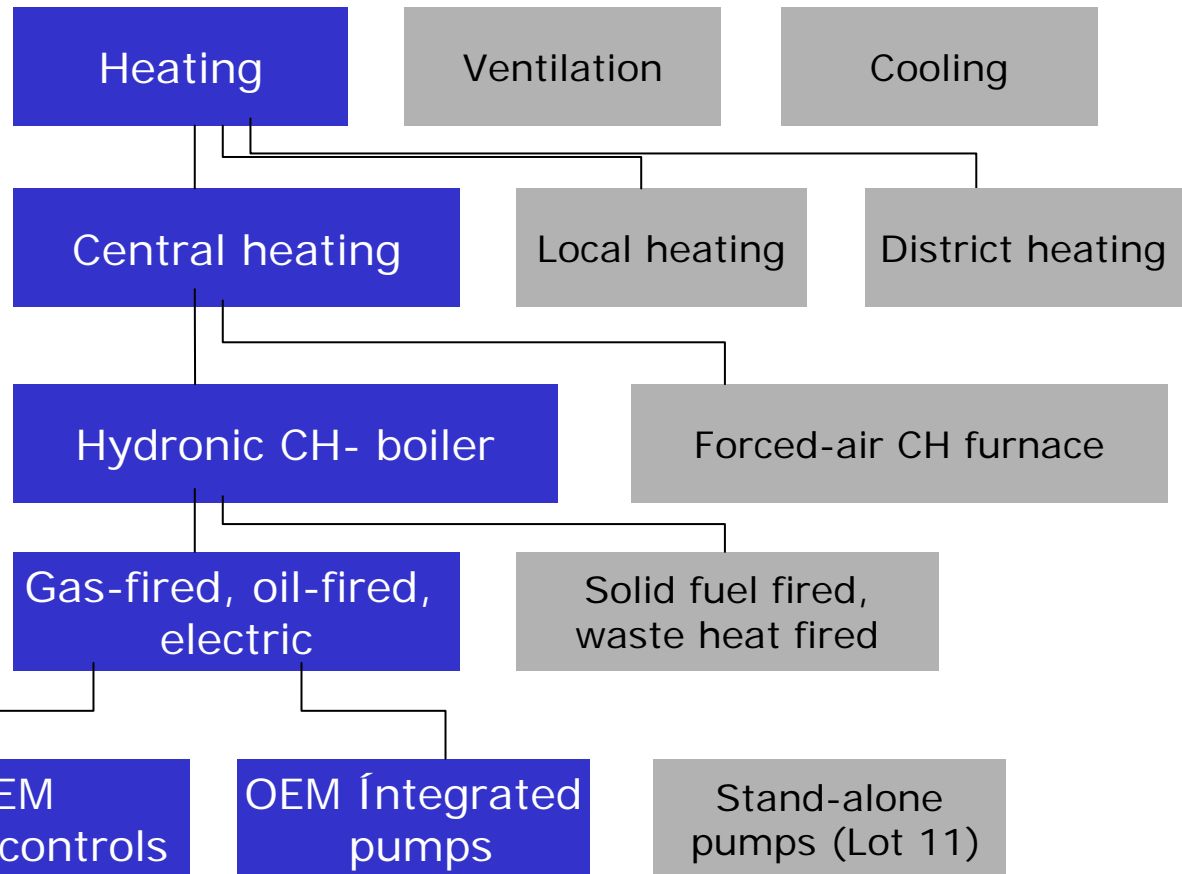
- 40-50% of EU radiator stock **without TRV** (>500 mln. Units)
- >50% of CH-households with **just mechanical** room thermostat (80-100 mln. units)
- 10-20% of (mainly large) boilers with **no controls** (just boiler thermostat). Maximum saving potential !
- 5-10% saving potential → 30-60 Mt CO<sub>2</sub> eq./a
- Controls in EuP-measures for new controls are complementary to measures to promote retrofit controls superfluous. Boiler park replacement takes 15-20 years. Retrofit can save **immediately** and at a **payback time** of 1-2 years.

# Question T/Vcontrols? EuP + EPBD

legend

EPBD

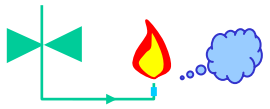
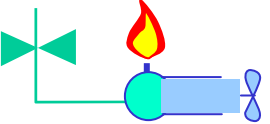
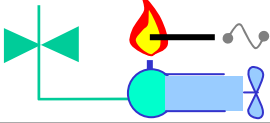
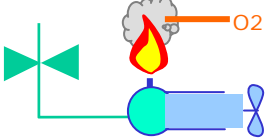
EuP



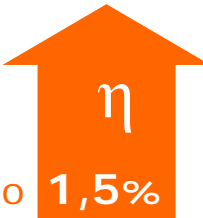
**How? When?**

Directly sold T- / V-controls




# Other: Air-fuel mix controls (integrated)

		hardware
1	atmospheric	
2	pneumatic (basecase)	
3	ionisation	
4	Next generation O2	

Included in fuel/purge loss  
And steady-state efficiency  
(dewpoint)

  
up to 1,5%

# Other: CH-pump controls (integrated)

		hardware
1	Running time after burner off	
2	Night-setback	
3	Variable speed	

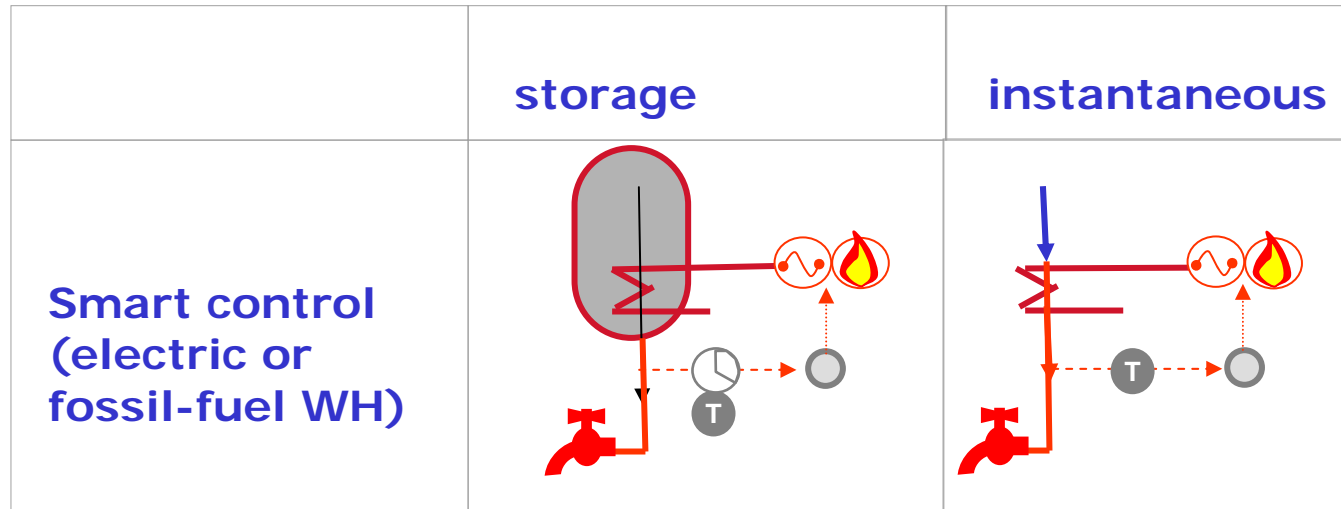
Included in electricity consumption and steady-state efficiency (system temperature)



incl. nom. power up to



# Other: Water heater controls (integrated)



Compliance tests defined

on water heater efficiency



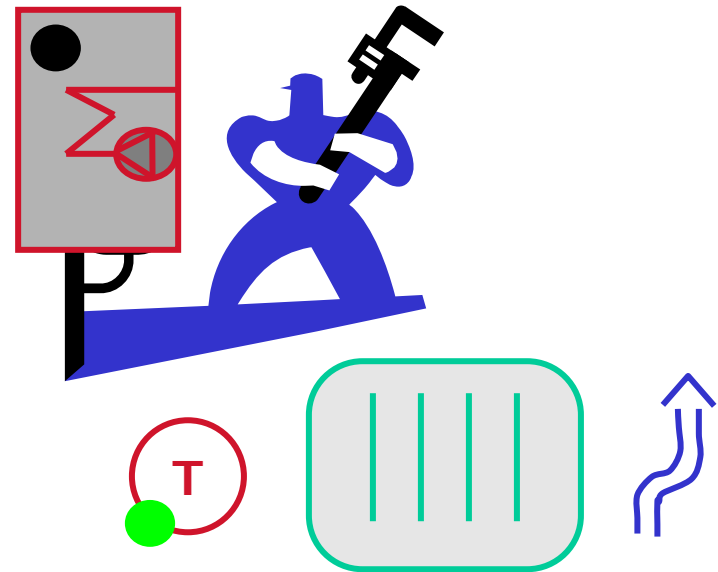
# Installer



# SME installer's ideal situation

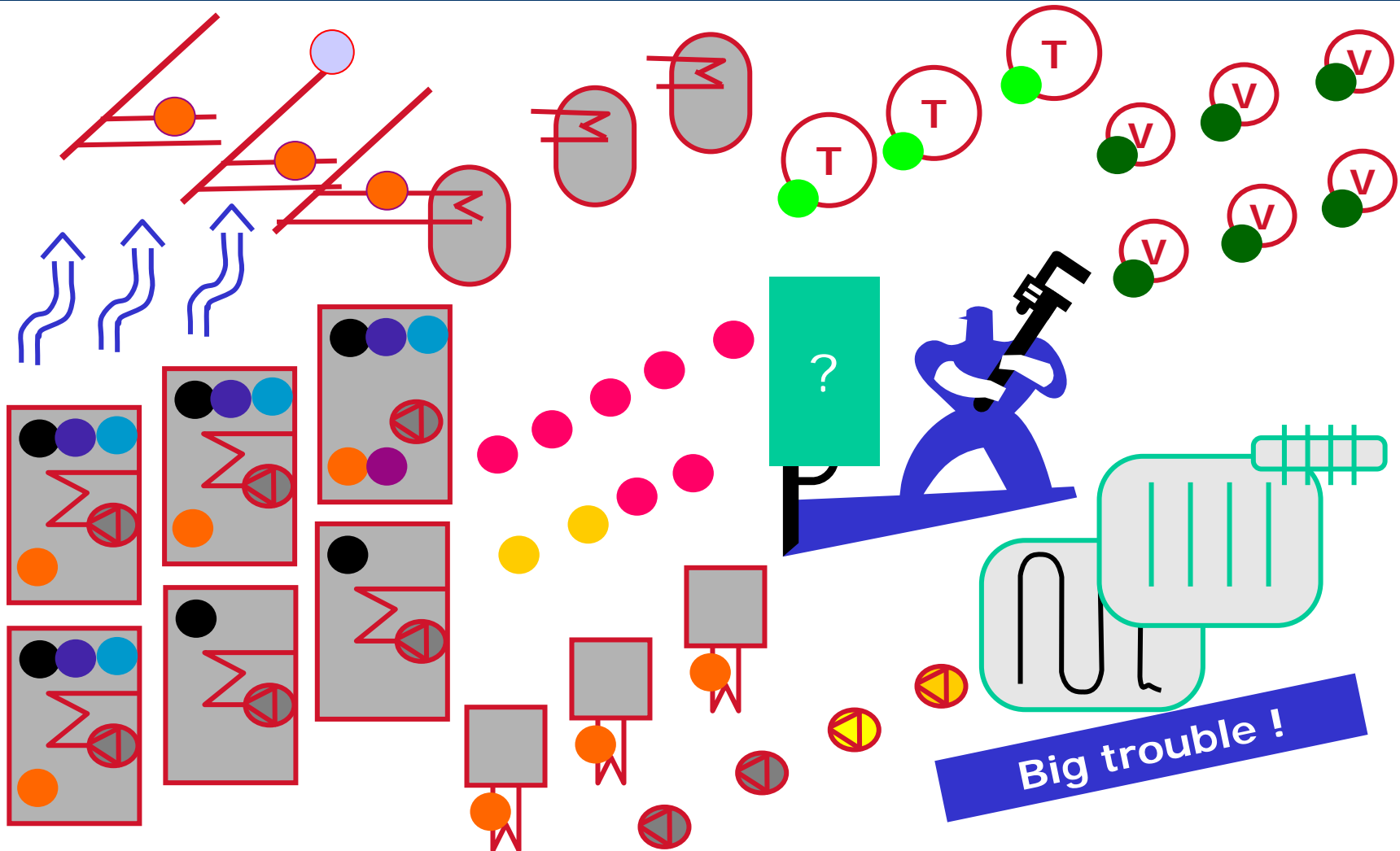
Quick installation  
No return calls  
No chimney problems  
Instant happy client

Basic know-how  
No extra training  
Little/ no stock  
Low cost, good profit  
Happy installer



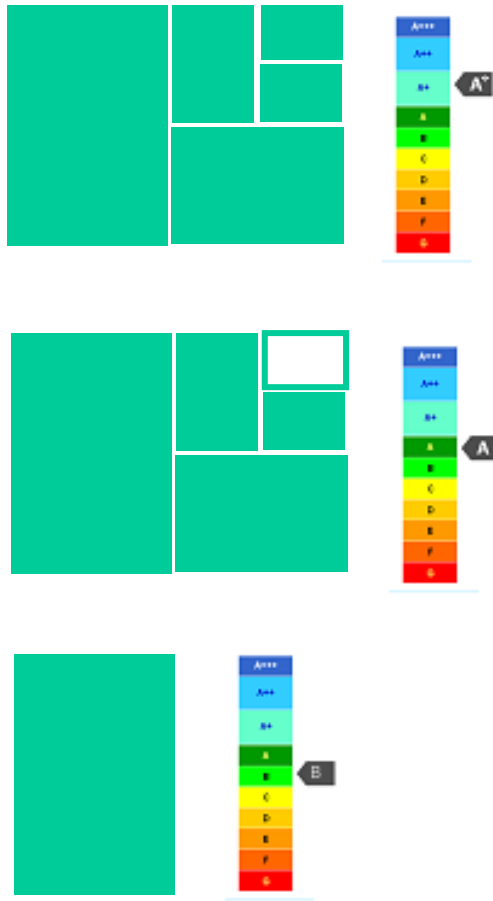
Source: preparatory study, Task 3

# SME installer's nightmare



# SME installer: Ecodesign/EuP approach

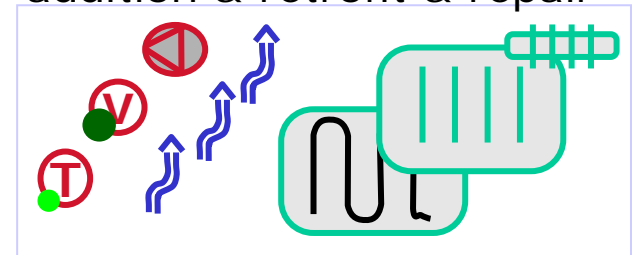
new



## Black box approach

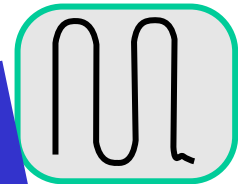
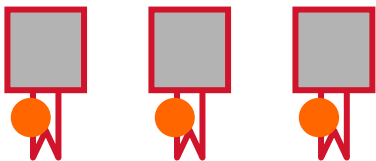
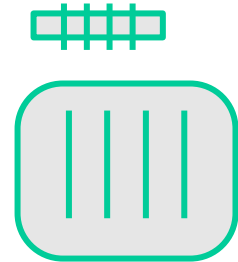
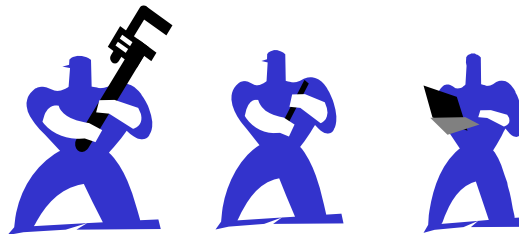
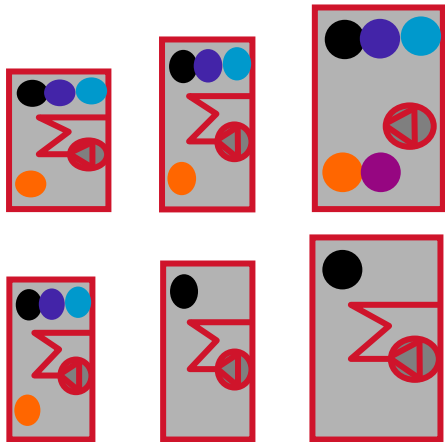
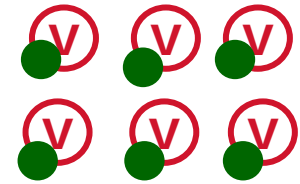
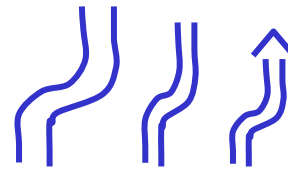
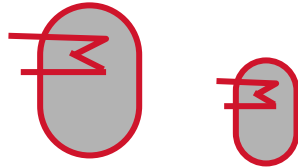
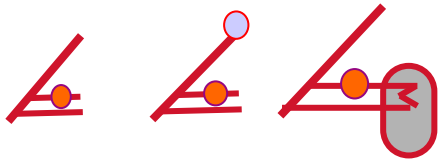


addition & retrofit & repair



# Big installer (for 3XL and 4XL): Can do!

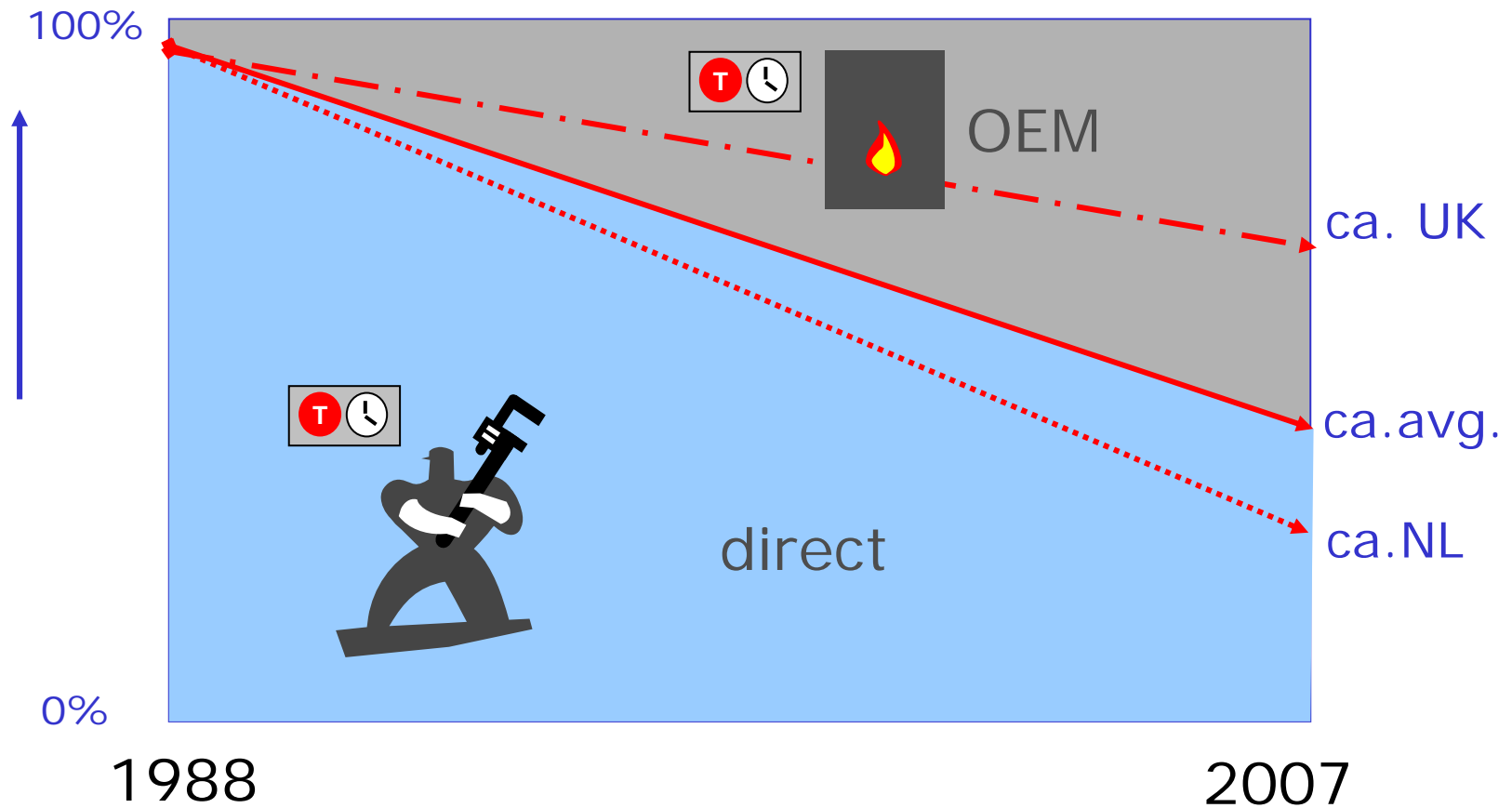
But only bigger projects [3XL, 4XL]



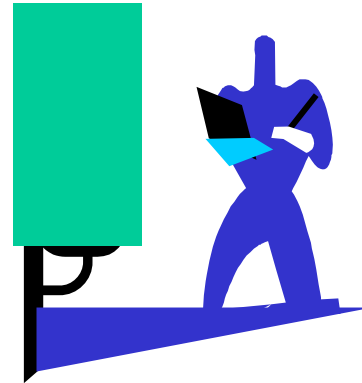
Combine EuP with Certification & Inspection Route ?

# Thermostats: Direct vs. OEM with new boilers

% of new boilers

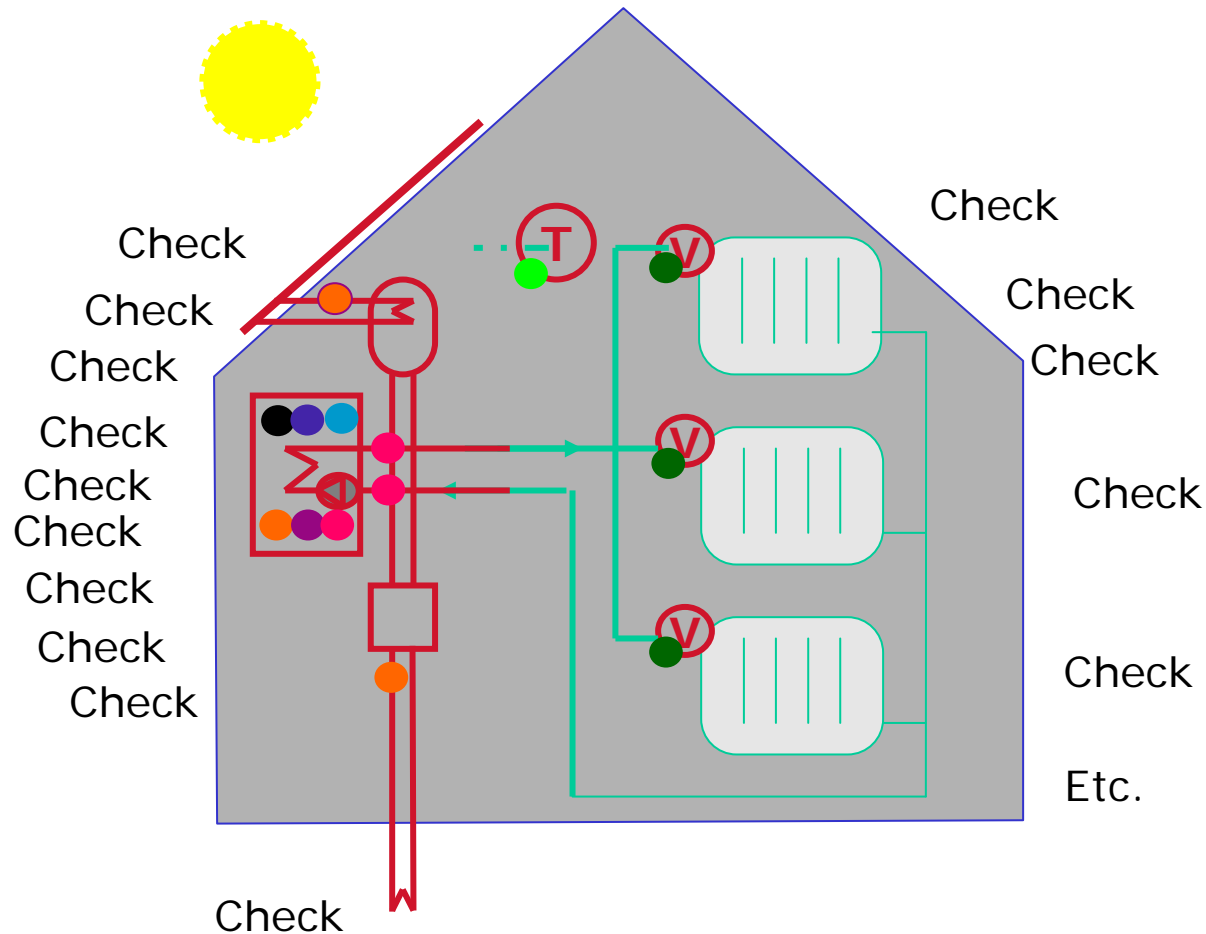


# Building/ boiler inspector



# Building inspection

[all]

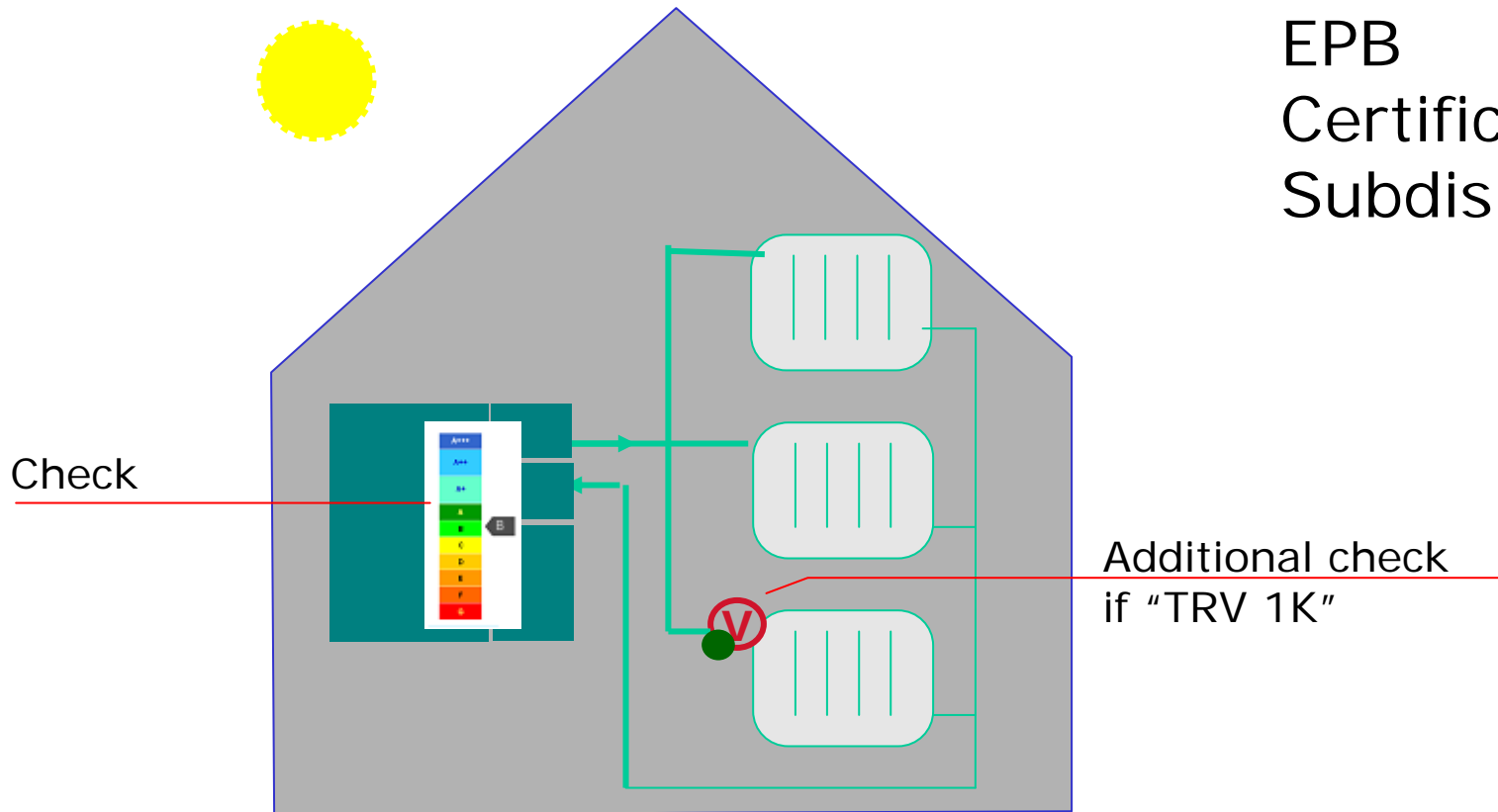


For:  
EPB  
Certificate  
Subsidies

# Or building inspection...

[up to and including XXL, not 3XL/4XL]

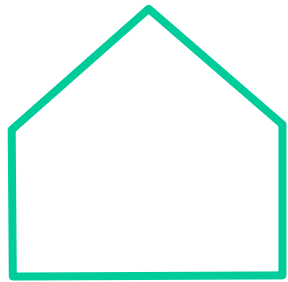
For:  
EPB  
Certificate  
Subsidies



Additional check for EPB correction on off-standard (ca. 20% of cases? e.g. On distribution losses

# Future inspection ?

[up to and including XXL, not 3XL/ 4XL]



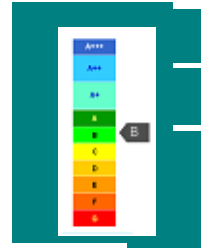
Shell

+



Heating

+



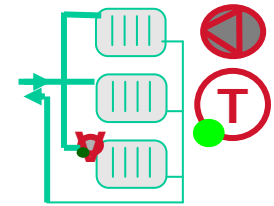
Cooling

+

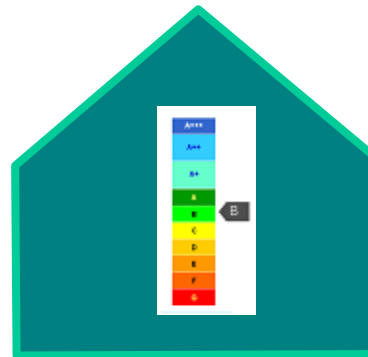
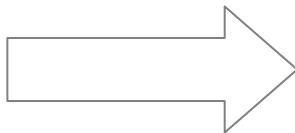


Ventilation

+

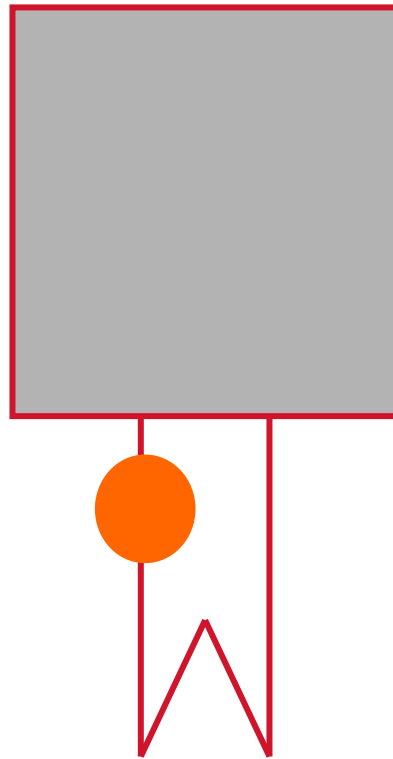


Correction  
off-standard  
+  
electric app.



Whole house/buidling

# Electric heat pumps



# Electric heat pumps in EuP

- **Efficiency assessment follows standards EN 14511 (electric) and prEN 15316-4-2**
- **Takes into account seasonal efficiency** (principle based on BIN method in prEN 15316-4-2 )
- **Takes into account part load/inverter technology** (COP<sub>50</sub> > 100%)
- **Takes into account multi-valent systems** (all combinations with gas/oil/electric resistance/solar are accommodated)
- **Requires limited testing effort through modular approach** (once HP technology is tested it can be combined with other modules and used for other loads without retest)
- **Does not go beyond domain of CE-marking** (manufacturer responsible for factory setting, not beyond)
- Realistic range: **For good 'heat pump boiler' (A+++).**  
**For bad 'heat pump boiler': Could be B or C (<MEEPS)**

# Questions ?

**“Electric air-based heat pumps should be rated much better !”**  
**“some would not even meet MEEPS!”**

*Comment VHK:*

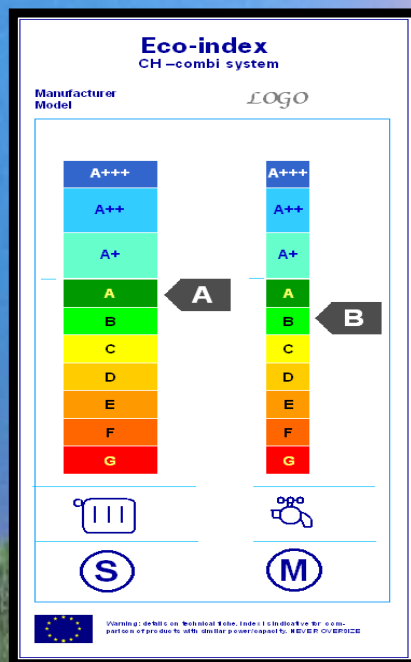
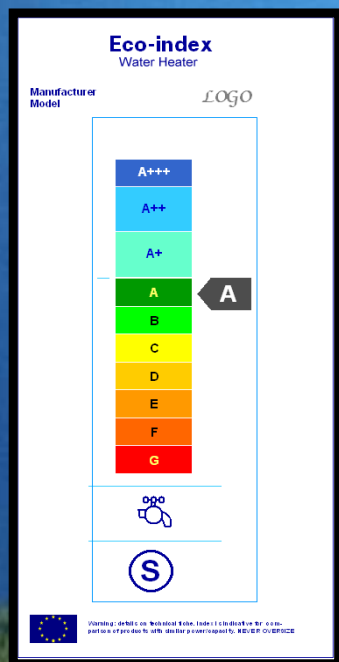
We have strived for realistic evaluation of heat pumps, because in the end unrealistic COP-boosting could be very hurtful for the heat pump industry (see recent German study). Overall, gap between test standard results and reality with heat pumps is too big (also reason why we don't go beyond A+++).

**“Switch to carbon instead of primary energy !”**

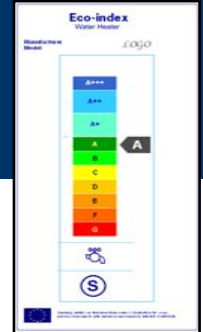
*Implications according to VHK:*

- 1) Go against EPB practice in most EU Member States!
- 2) Ban oil-fired boilers!
- 3) Conversion factor of electricity to primary energy should not be 2,5 but lower !

# Label design: Considerations

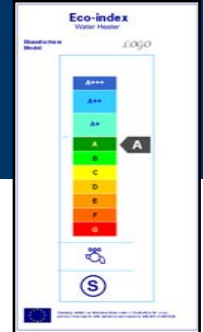


# Label design: Good practice [1]



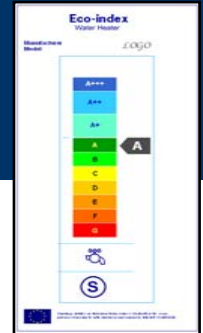
- **Recognisable** and **coherent across products** (redundant style characteristics, like A-G and recognisable colour-scheme)
- **Attractive** (“rainbow”) and **conspicuous** (bright colours), instil confidence (EU flag and some legal small print)
- Easy to understand: Use **symbols, icons, well-known schemes** (S-M-L, A-G, etc.) Technical data not on label but on the *fiche*. (‘Less is More’)
- Performance indications based on the **function** for the consumer, not on the technology involved (=self-evident or additional)
- Be **correct** without over-stating exactness when it isn’t there (→wider bandwidths for renewables)

# Label design: Good practice [2]



- Give a **complete** picture: e.g. if there is an A+, A++, etc. this should be shown (show empty arrows/bars; not like fridge label)
- Scientifically sound, but **proper ranking is the main issue** for a good choice, absolute exact numbers are secondary!
- Classwidths based on achievable **test tolerances** involved (never jump two classes).
- Be **robust in a court of law**, (based on clear rules and test procedures)→ if not, detrimental for credibility and use in incentive-schemes ('tax payer's money').
- Be **ambitious** and **promote innovation** and diversification

# Label design: Good practice [3]



- **Differentiate between existing products** and thereby also trigger improvement in the lower-end products.
- Good comparison between **multi-function and dedicated** products
- coherent with, and possibly applicable in **other existing and future legislation**, notably the EPBD as well as Eco-design measures for related products (e.g. solid fuel boilers, local heaters, space cooling, ventilation, etc.) .

# 'Best Available Technology' and 2008-2010

## BAT gallery

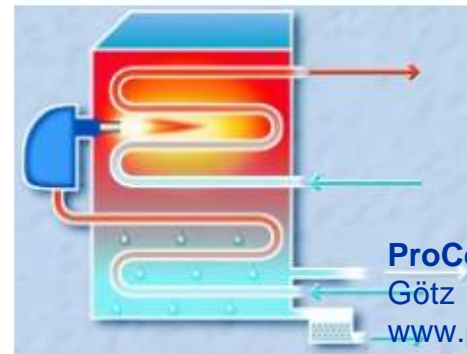
For illustrative purposes only.

Data based on manufacturers' claims. Not all data has been subject to verification by VHK and does not necessarily reflect the view of or a recommendation by the consultant. VHK accepts no liability for the use of this information.

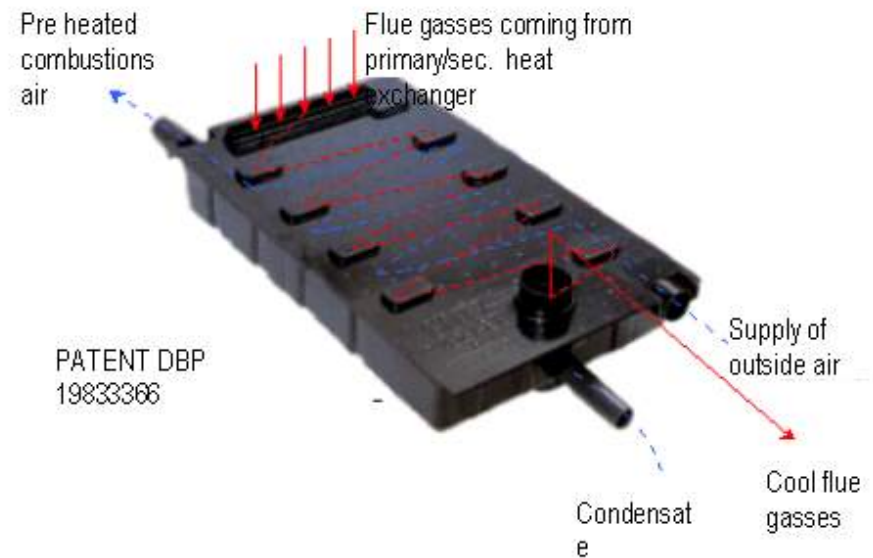
By definition this overview is incomplete and should not be seen as a discrimination against other product technologies or manufacturers not mentioned .

# Improved condensing : Tertiary heat-exchangers

## In space heating

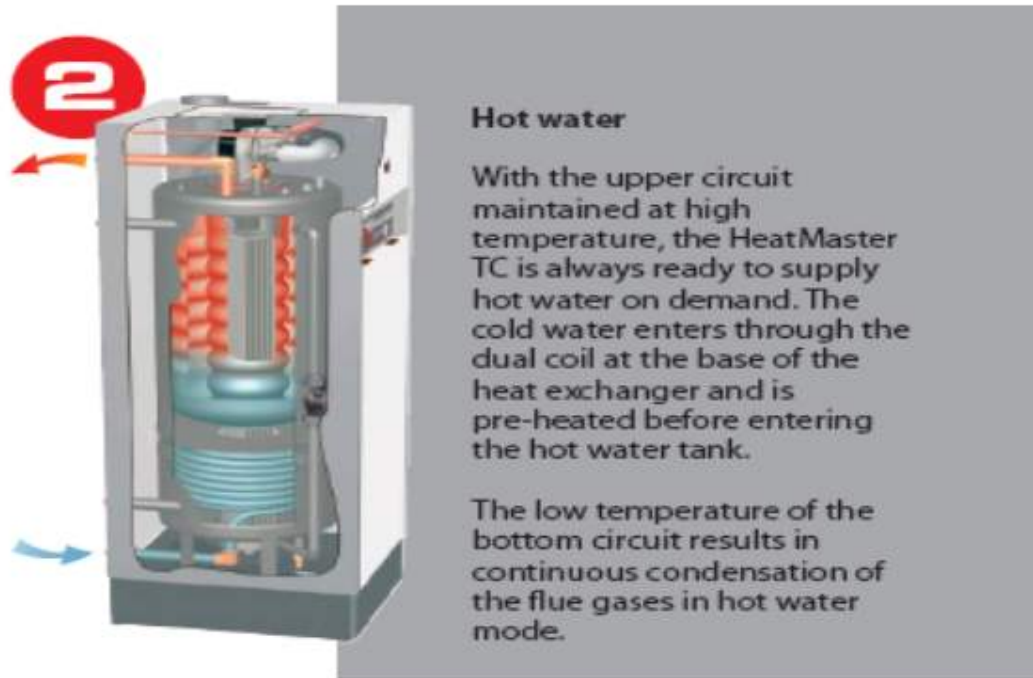


$\eta$   
2-3%

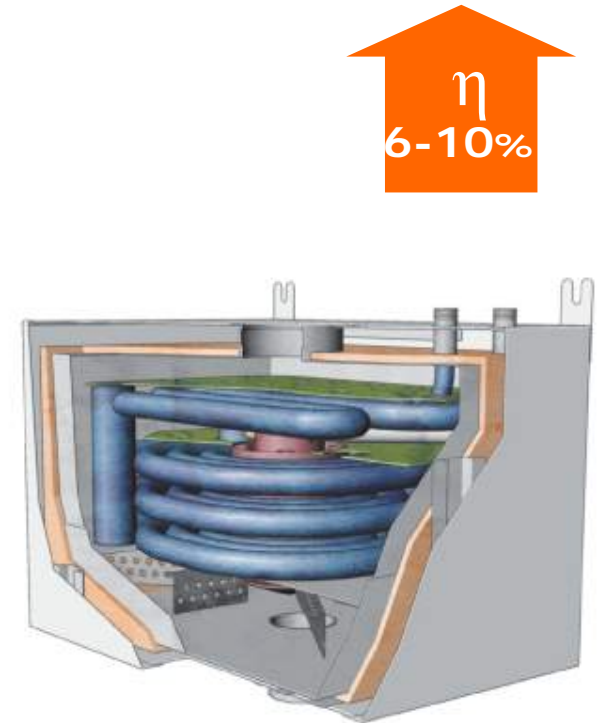


# Improved condensing : Tertiary heat-exchangers

## In water heating

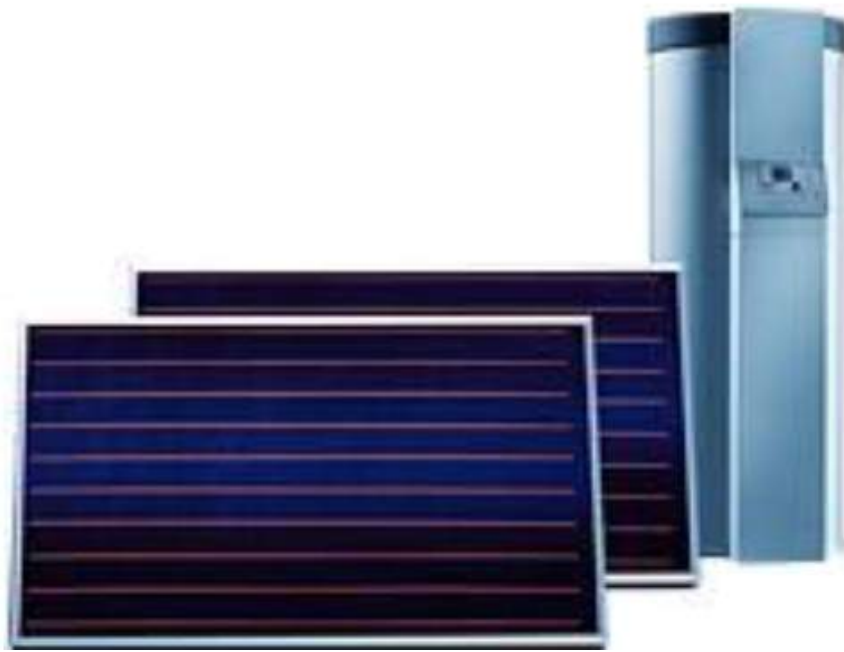


ACV HeatMaster



Zenex GasSaver (economizer to combine with combi-boiler)

# Other Renewables Trend: The package



Vaillant: solar combi

$\eta$   
10-60%



Daalderop ,UHR'  
Combi with el. HP

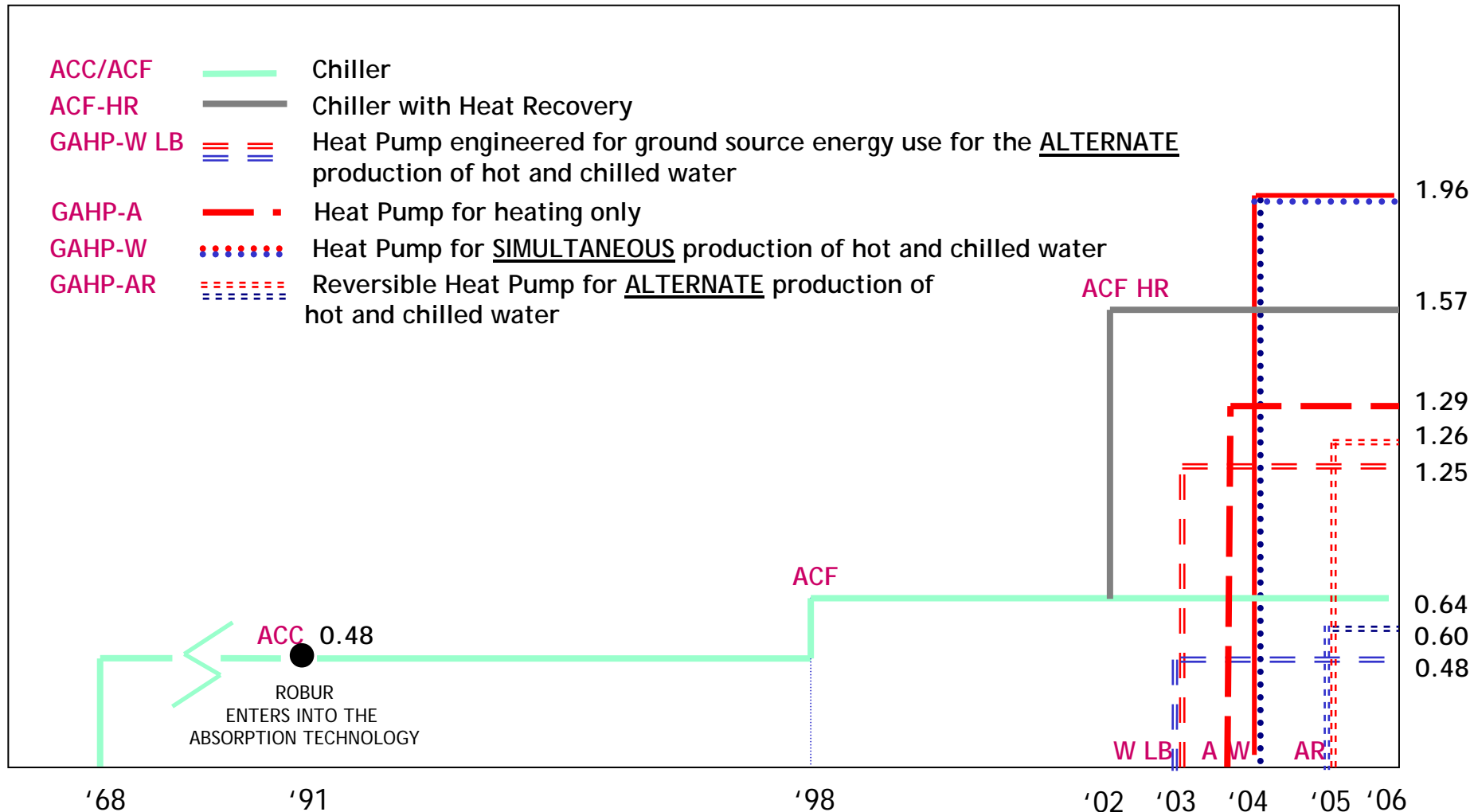
# Larger gas-fired heat pumps

- Gas-fired absorption heat pumps (GAHP)
- Air/ground source to water ('CH-boiler')
- Collective/ light commercial >30 kW output
- COP 2007: 1,25 (air/soil), 1,9 (water)
- **COP 2008: up to ca. 1,7 for air-based**
- Thousands of gas-fired heat pumps sold and installed since 2003
- Primarily in N-Italy. Marketing in Northern Europe since 2007



*Pictures  
with kind permission of  
ROBUR SpA*

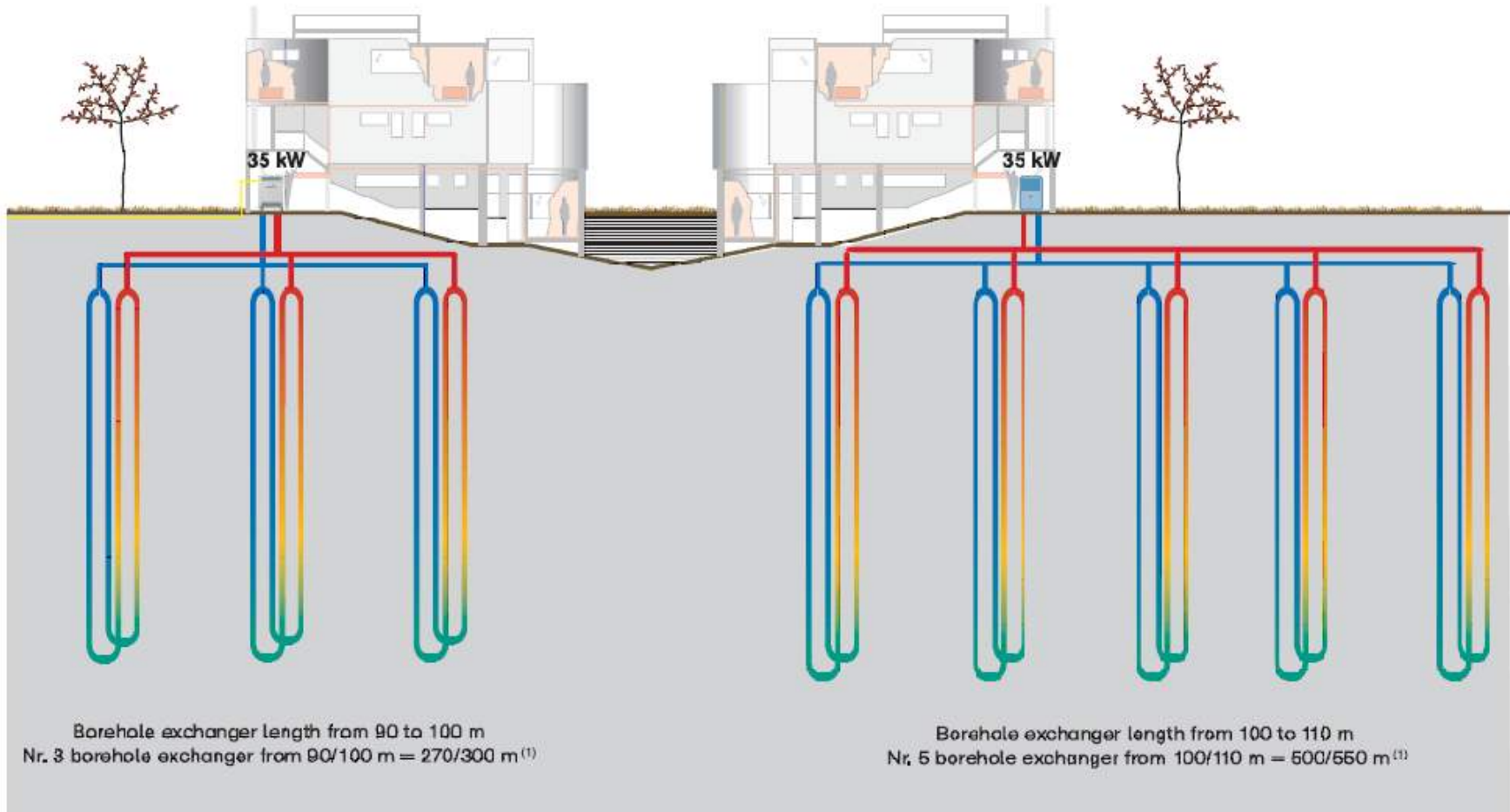
# Water-ammonia gas absorption efficiency evolution



# Saving up to 40% in geothermal borehole exchangers in comparison with electric driven compression heat pumps

System with GAHP-W LB

System with electrical heat pump



# Projects larger GAHP [1]



**Office Bayerische Rhöngas –  
Bad Neustadt, Germany (70 kW )**



**Hotel Oscar – Athens, Greece.  
423 kW heating/ 220 kW cooling**



**Walter Knoll – Herrenberg (Stuttgard),  
Germany. Design furniture manufacturing.  
280 kW heat/ 140 kW cool**

# Projects larger GAHP [2]



**Chamber of Commerce – Padua, Italy.  
1032 kW heat/ 682 kW cool**



**Hotel Zodiaco – Manerba del Garda, Italy,  
106 kW heat/51 kW cool**



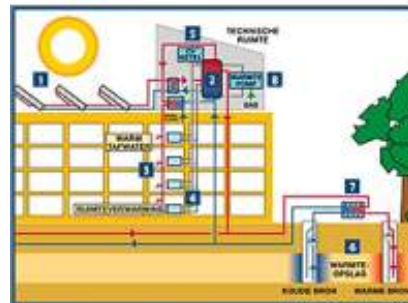
**Gas filling station  
AVIA – Novi Sad, Serbia  
135 kW heat, 34 kW cool**

# Projects larger GAHP [3]



Wohngebäude Kaserne –  
Volkach, Germany, 140 kW heat

2 Megawatt project  
Haarlem, Netherlands  
600 kW heat



# Projects larger GAHP [4]



**Residential: Benny Farm –  
Montréal, Canada.  
Heating 358,200 BTU/h  
Cooling capacity: 138,300  
BTU/h (3 units)**



**Department of Sanitation  
City of New York.  
5,445,000 Btu (90 units)**



# Residential GAHP (<10 kW)

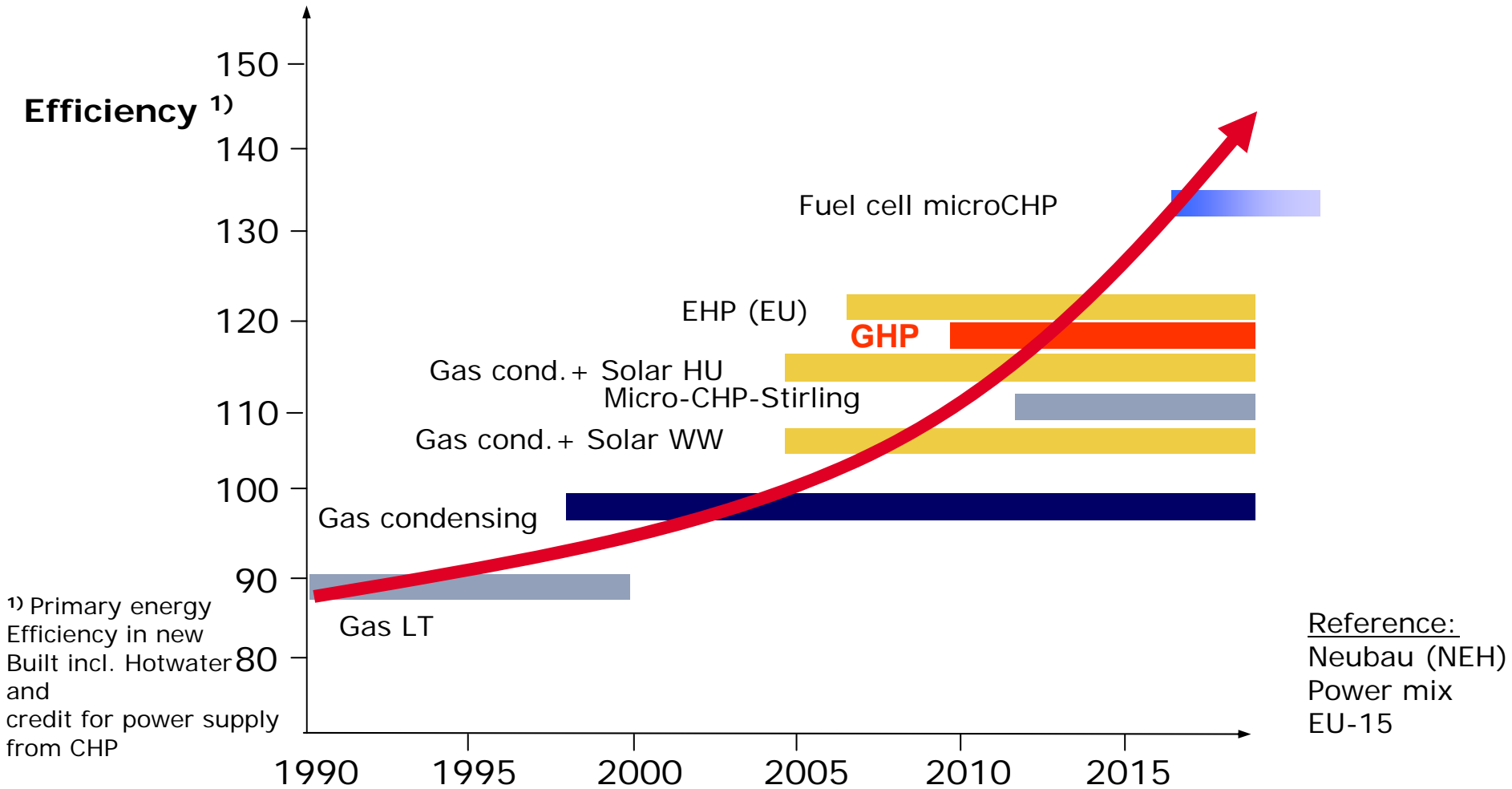


**Initiative Gaswärmepumpe**  
**Konzept zur Entwicklung und Markteinführung**  
**2007, 13.-14.11.2007, Karlsruhe**  
Dr.-Ing. Ekkehard Laqua, BBT Thermotechnik GmbH

*Extract of lecture  
with kind permission from BBT*

# Beyond gas condensing boilers??

## System combinations



# Residential GAHP

Use in one/two family dwellings

Efficiency increase  
CO<sub>2</sub>-reduction ca. 25- 30 %

Silent

Potential follow-up of  
condensing boiler

First in countries with dense gas-grid  
(NL, GB, DE)

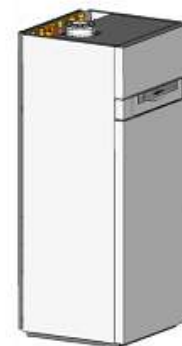
Smaller source required than  
With electrical heat pumps



Quelle: BBT 09.2007



Quelle: Vaillant, 09.2007



Quelle: Viessmann 9.2007

# Gas heat pumps (residential) overview



**Output  
up to 10 kW**

**COP 1,3-1,8**

Anbieter	Vaillant Group	BBT	Japanischer Hersteller	Viessmann
Prinzip	Adsorption Zeolith-Wasser	DAWP NH <sub>3</sub> -H <sub>2</sub> O-He	Absorption	Adsorption Zeolith-Wasser
Heizleistung WP (kW)	1,5 - 10	3,6 - 10	1,2 - 6	1,5 - 6
Kühloption	nein	j	ja	ja
Leistungszahl, Heizung	1,3	1,5	1,8	1,3
Wärmequelle	Luft - Solar	Erdreich, Wasser, Luft	Luft, Erdreich, Wasser	Luft-Solar, Erdreich, Wasser
Abmessungen (cm)	70 x 80 x 165	60 x 60 x 200	60 x 40 x 90	60 x 60 x 160
Gewicht (kg)	190	140	90	150

Source:  
Viessmann  
(GWI Zukunftsforum 2007)

# Residential GAHP in field tests



**„Initiative Gaswärmepumpe“  
Market introduction  
Q4 - 2009**



Source: e-on|Ruhrgas

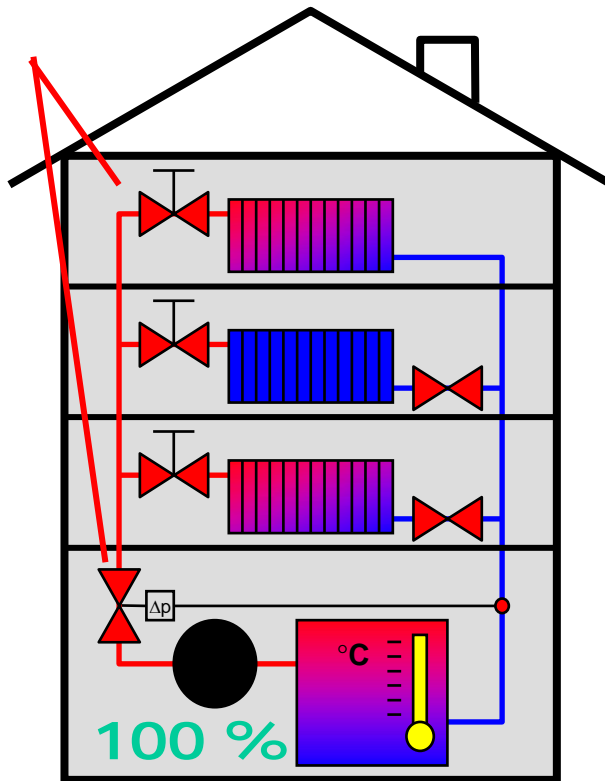
Decentralized Pump System

# Decentralized Pump System



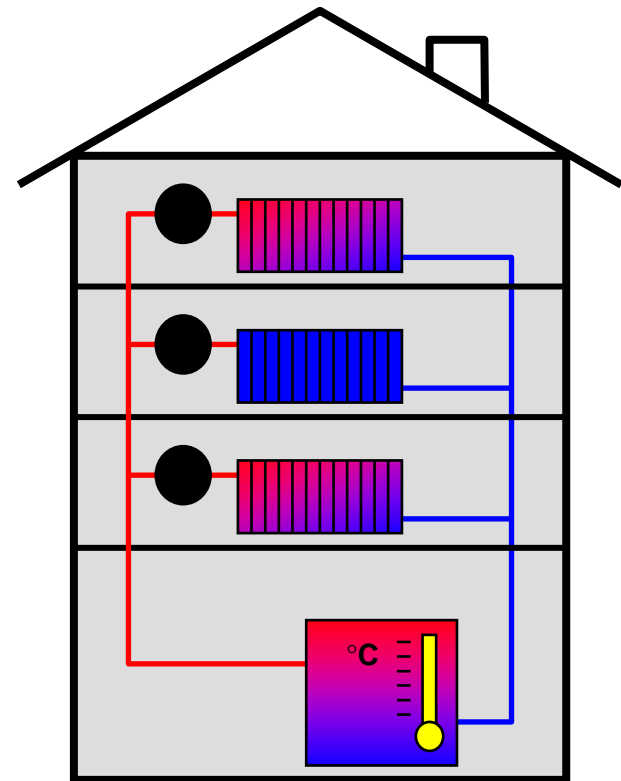
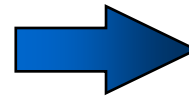
*with kind permission of WILLO*

# System idea: On demand heating



Central Pump

**Throttle Control**



Decentralized Pump System

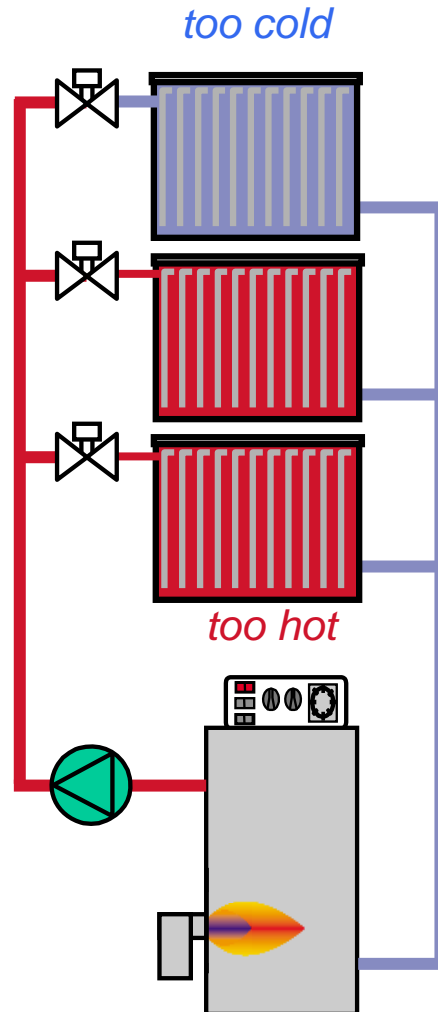
**Pump Control**

# Result: Automatic hydraulic balancing

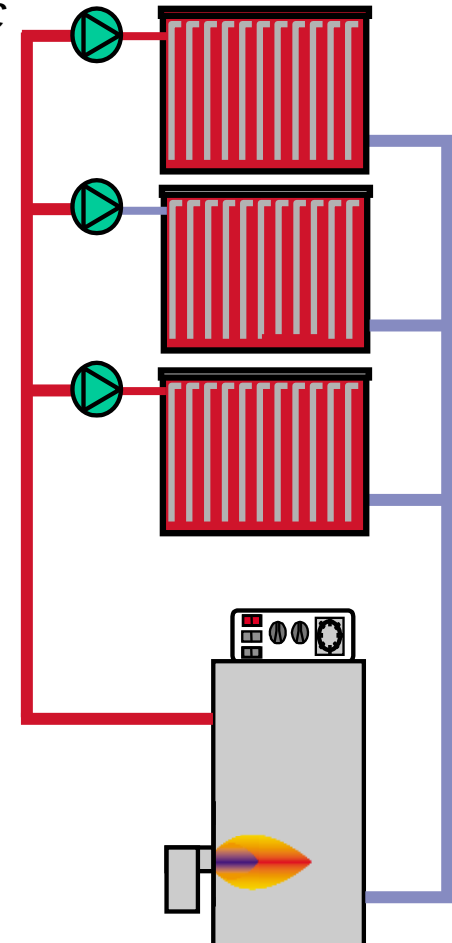
*Incorrect hydraulic Balancing*

→ Higher Energy Consumption

→ Less Comfort



*Automatic hydraulic balancing*



# The components



Master/Controller



Room  
Controller



Central  
Controller

# System idea: On demand heating



video file during presentation

# Application in a one family house



# Thank you !

More info:

[ec.europa.eu/energy/demand/legislation/eco\\_design\\_en.htm](http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm)

[ec.europa.eu/enterprise/environment/index\\_en.htm](http://ec.europa.eu/enterprise/environment/index_en.htm)

[www.ecoboiler.org](http://www.ecoboiler.org)

[www.ecohotwater.org](http://www.ecohotwater.org)

[www.vhk.nl](http://www.vhk.nl)