

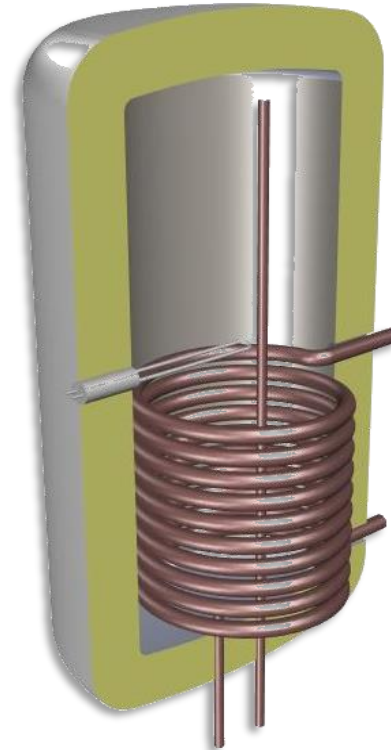
## Space heaters

*(central, hydronic, incl. combi)*



## Water Heaters

*(dedicated)*



## ***Ecodesign and Energy Label***

preparatory review studies

## René Kemna



Review study Commission Regulation (EU) No. **813/2013** [Ecodesign] and  
Commission Delegated Regulation No. (EU) No. **811/2013** [Energy Label]

Review study Commission Regulation (EU) No. **814/2013** [Ecodesign] and  
Commission Delegated Regulation No. (EU) No. **812/2013** [Energy Label]

Studies prepared by VHK (NL) in collaboration with  
BRG Building Solutions, London (UK) for the European Commission DG ENER.

*Project sites:*

**[www.ecoboiler-review.eu](http://www.ecoboiler-review.eu)**

**[www.ecohotwater-review.eu](http://www.ecohotwater-review.eu)**

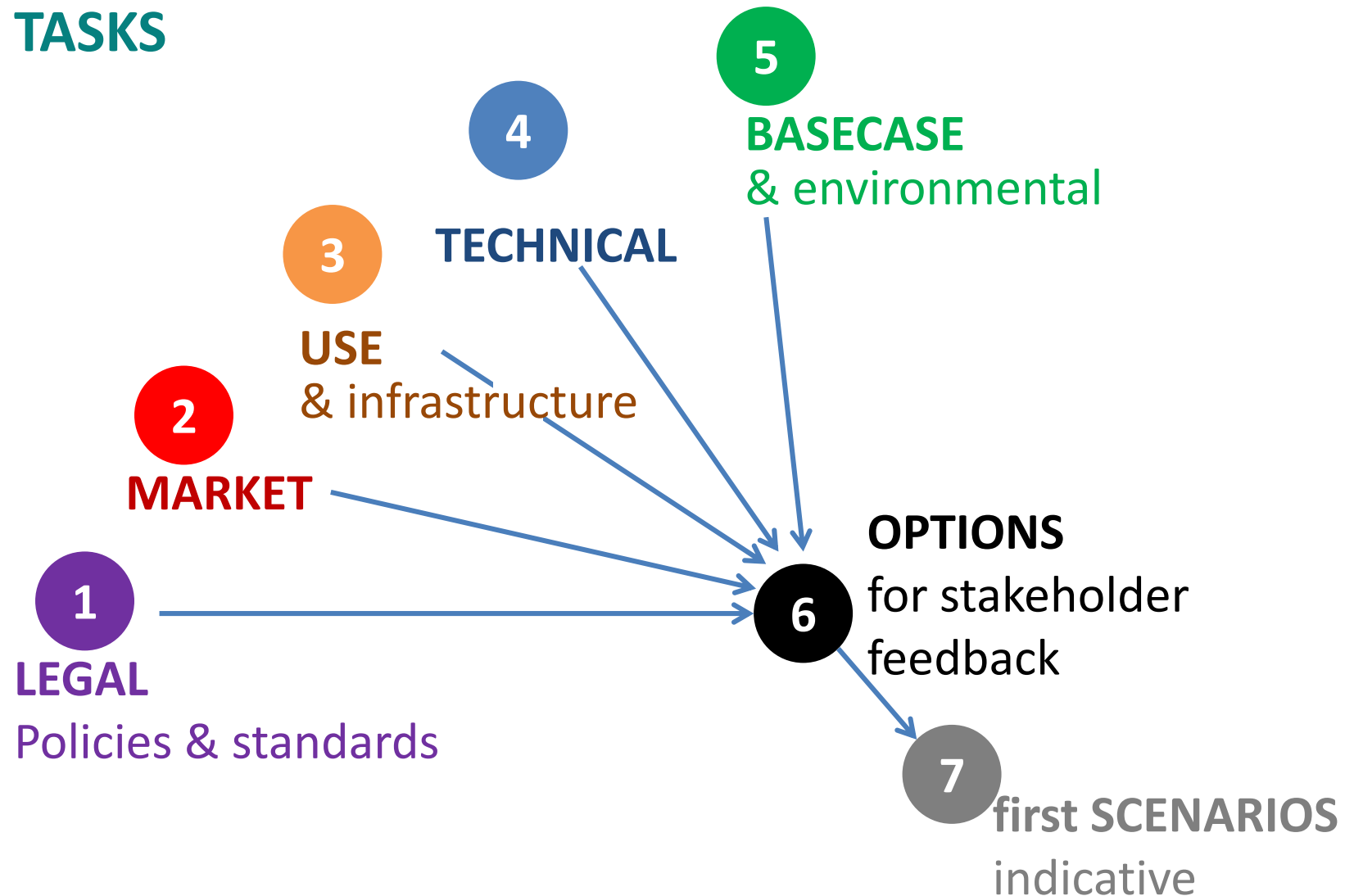
*The information and views set out in this study are those of the author(s) and do not necessarily reflect the official opinion of the European Commission*

# Space heaters

hydronic, central



# TASKS

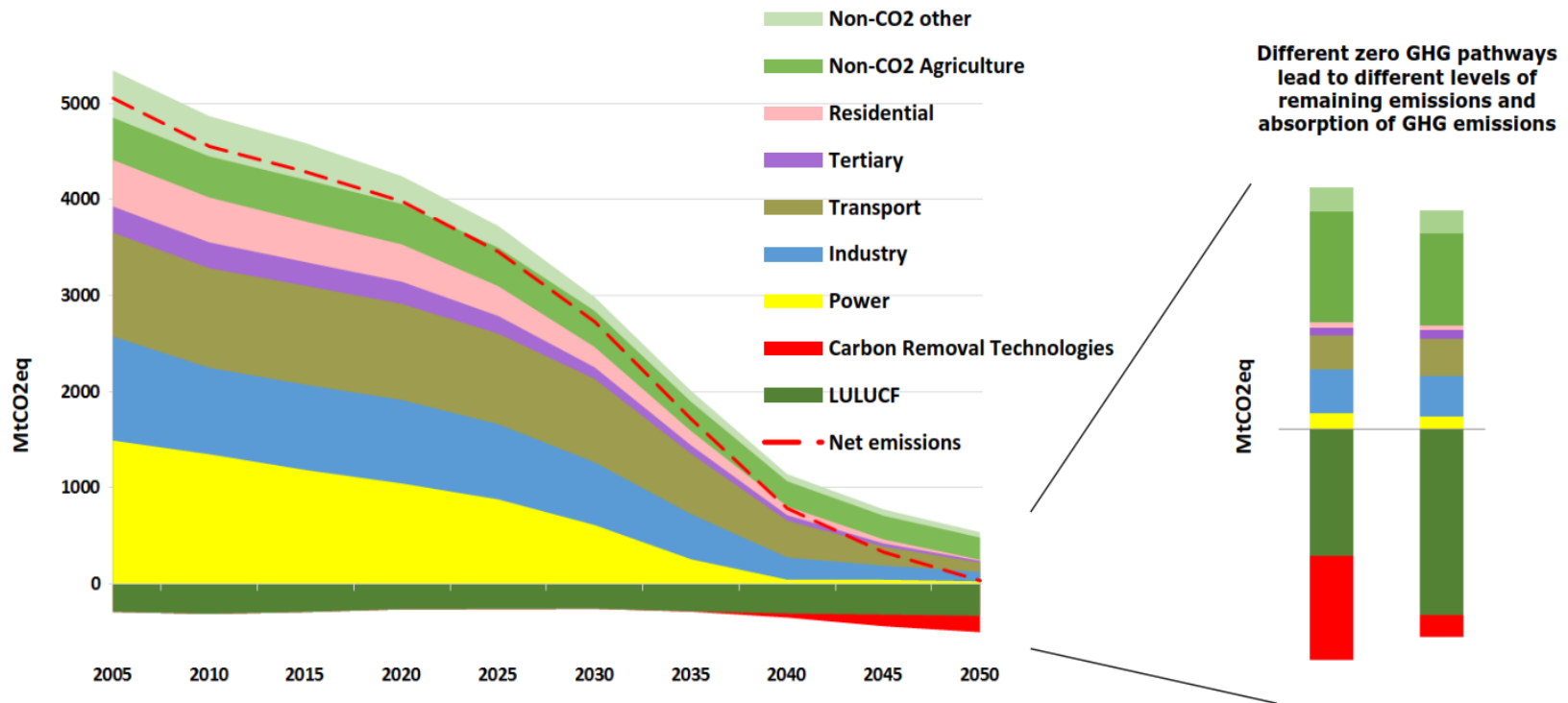


1

# 'Paris': Carbon-neutral in 2050

By far the most ambitious environmental goal ever

## POLICIES



EC vision document 28.11.2018 (for heating):

**Electrification, carbon-neutral gases (hydrogen etc.), biomass, distributed heat, solar**

(source: COM(2018) 773 final, 28.11.2018)

1

# Realistic, Repeatable, Reproducible

## STANDARDS



**ECotest-project**  
Gas-fired (left)  
and oil-fired  
(right) boiler test  
rigs.

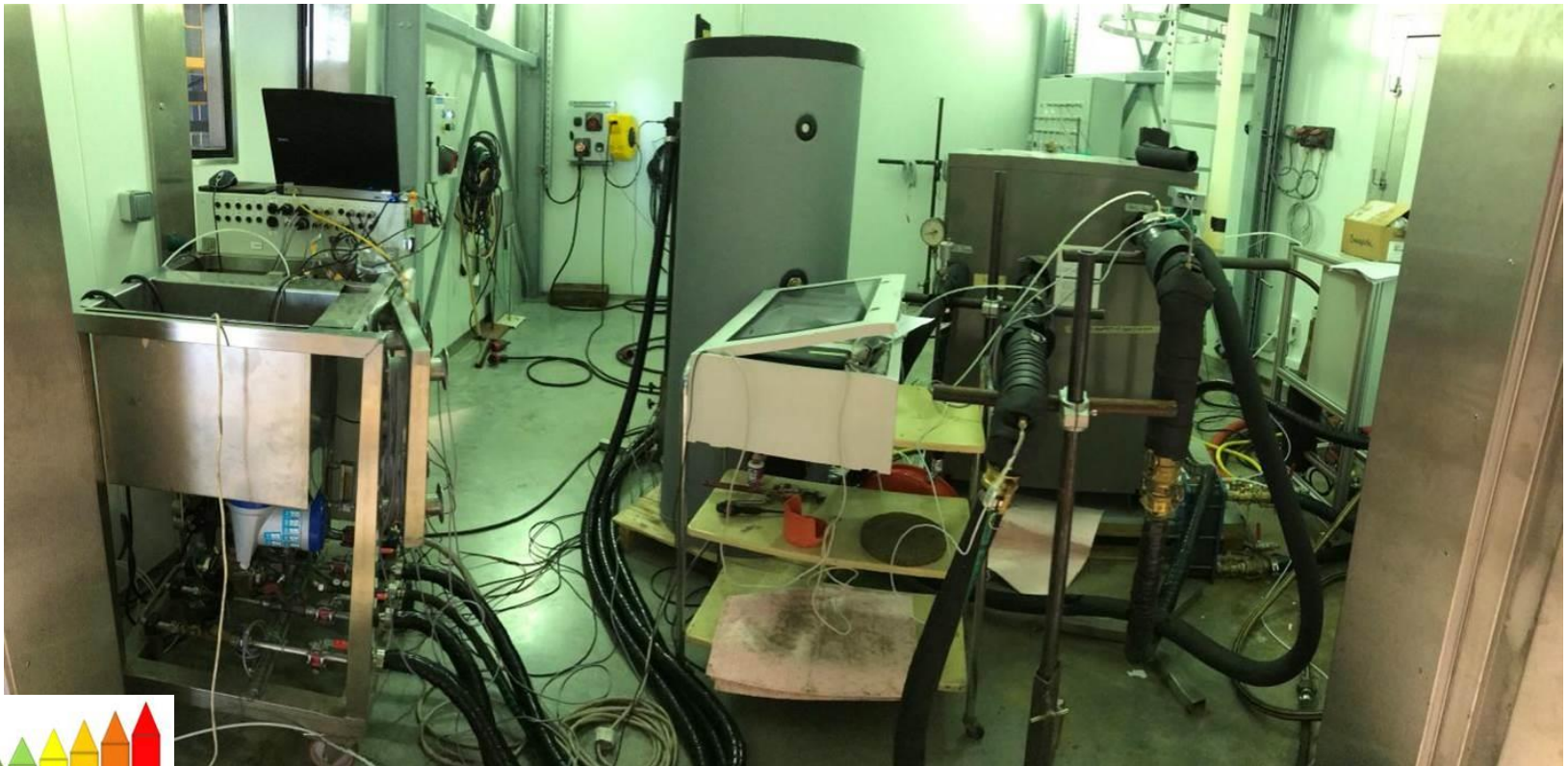


- Verification tolerances (ECotest project),
- Harmonised test conditions and calculations across heat generator types
- Simplification and transparency (e.g. new solar method)
- Hybrids/packages are the new default
- Realistic: Space heating for existing buildings top-priority



1

## STANDARDS



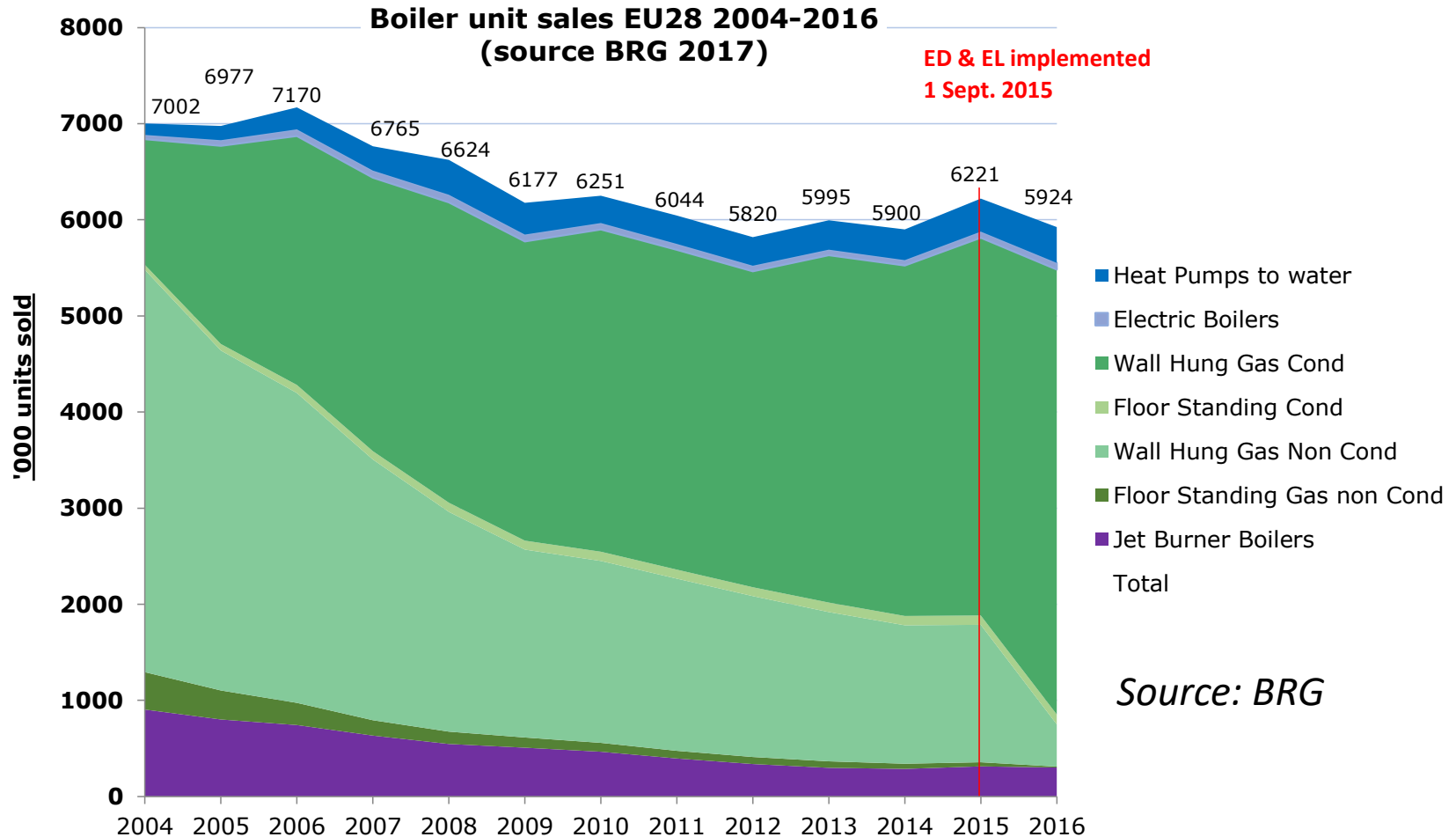
**ECOTest-project** Gas Absorption Heat Pump (GAHP) test rig

2

MARKET

# Better new market data

*unique BRG input, EHI support, new Eurostat data*

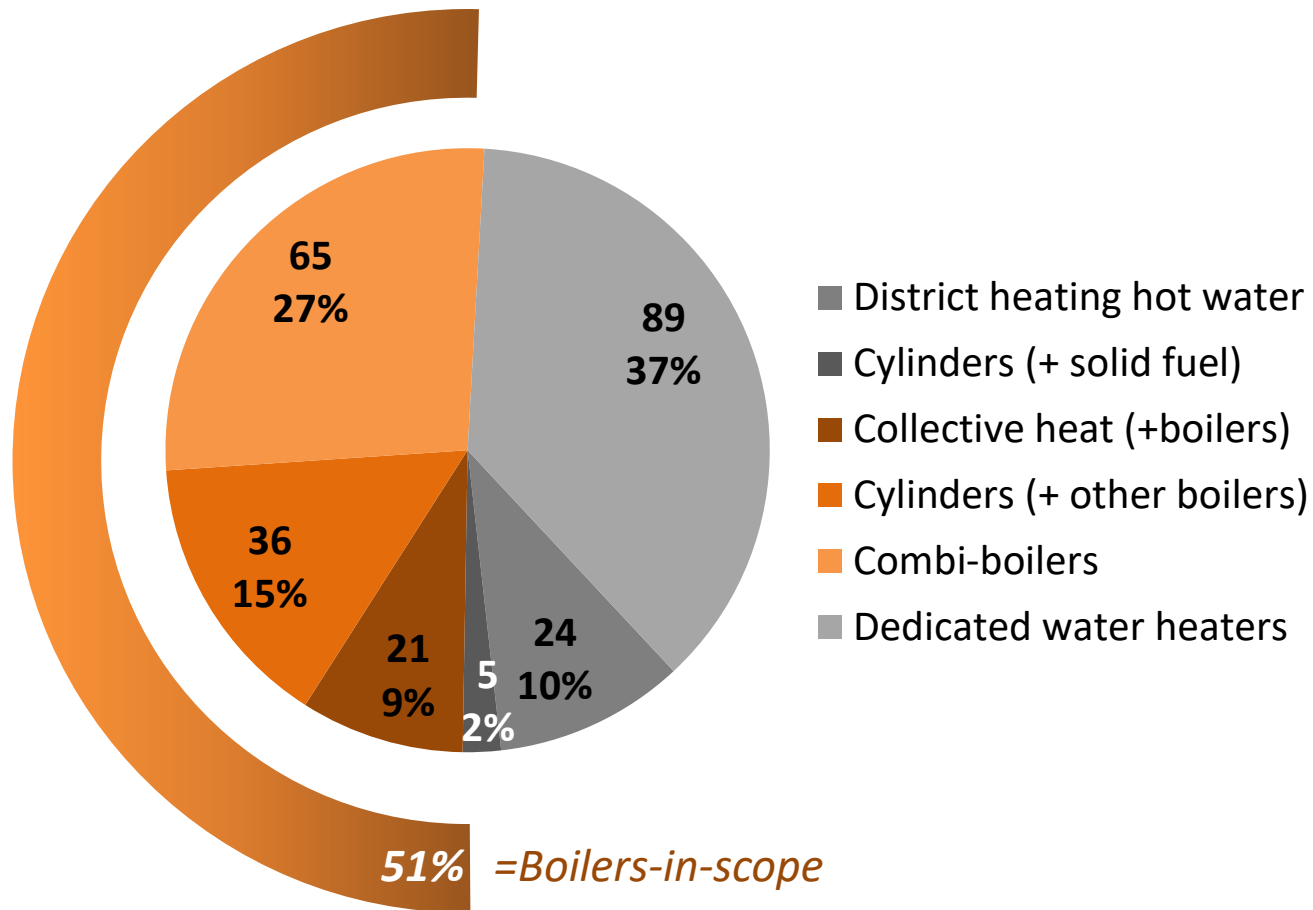




3

USE

# Half of EU dwellings has (combi-) boiler based hot water

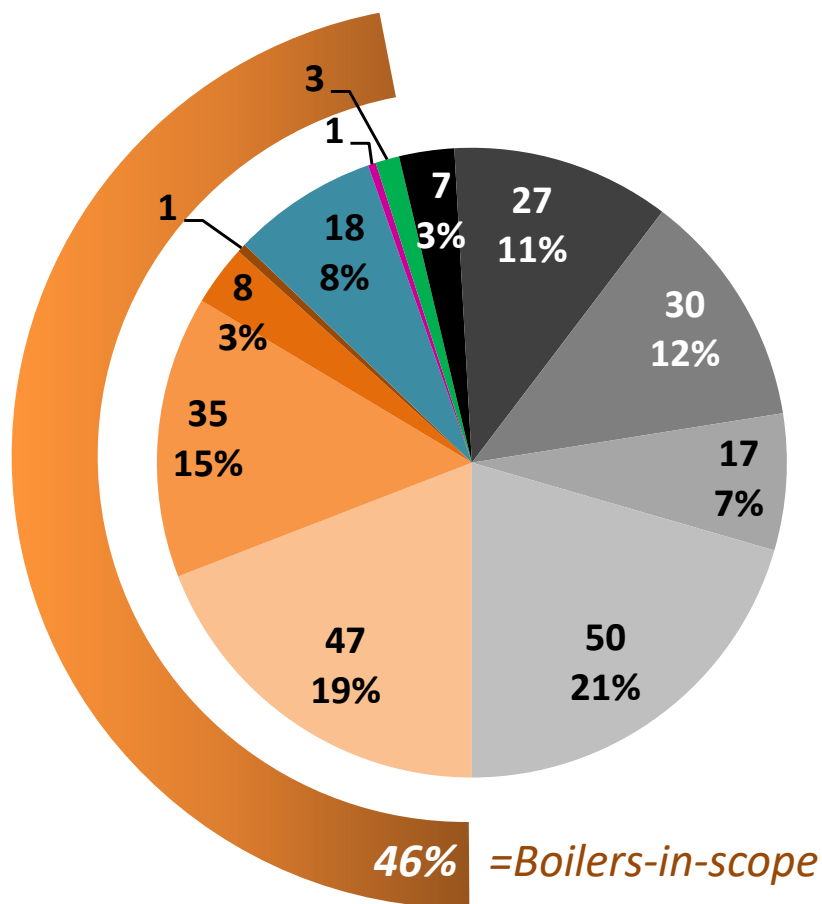


EU-28, 2014, in mln.dwellings, source BRG 2017

3

USE

# Almost half of EU dwellings has boiler based space heating



- GAS Wall Hung non-condensing
- GAS Wall Hung condensing
- GAS Floor Standing non-condensing
- GAS Floor Standing condensing
- OIL/GAS Jet burner (85-90% oil)
- ELECTRIC CH boilers
- ELECTRIC HEAT PUMP CH boilers
- SOLID fuel boilers
- District
- Collective
- Individual dry gas/electric
- No CH (local heating + no heating)

*EU-28, 2014, in mln. dwellings, source BRG 2017*

3

USE

# Space heating is more than only dwellings

EU SPACE HEATING LOAD 2010:  
**2860 TWh**

Data refer to EU-28 heated volumes and surfaces (inner dimensions) at equivalent of 18 °C indoor temperature (24/7);

AG= ground floor area;

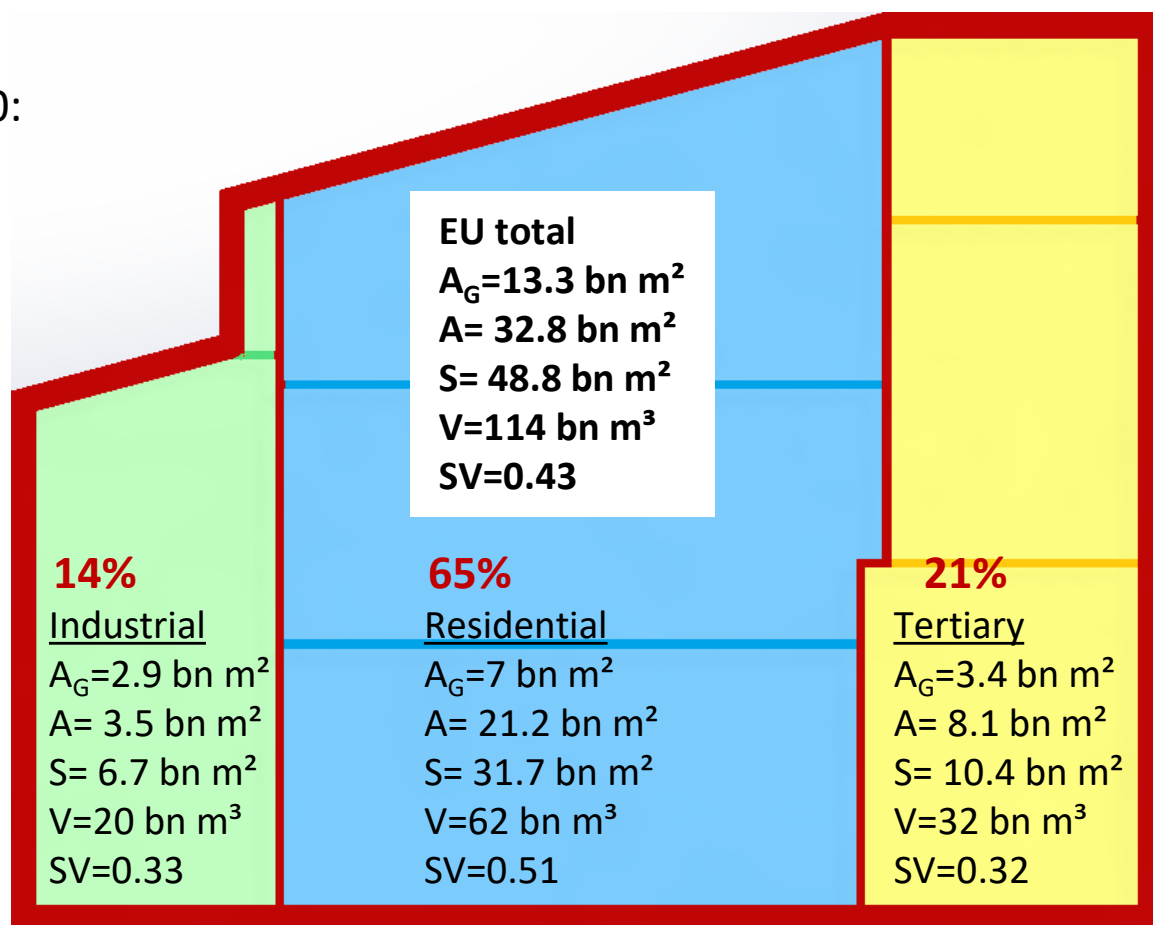
A= total floor area;

**S= shell surface;**

V= volume;

SV= S/V ratio.

bn= 1000 million



4

# Efficiency-numbers too optimistic

## TECHNICAL

- *Emitter Capacity to Heat Load (HL/EC ratio) sets limits,*
- *Flow & temperature controls assumed optimal,*
- *System feed & return temperatures optimised for best testing*
- *Main focus New Built & floorheat, not Existing & radiators*

Project-name		Seasonal Performance Factor (SPF)	N units	Period
		Outdoor air HP    Ground Source HP		
HP <b>Existing</b> Buildings		2.1   2.6   3.3 2.2   3.5   4.3	35 36	2008-2009
<b>New Built</b>	HP Efficiency	2.3   2.9   3.4 3.1   3.9   5.1	18 56	2007-2010
	HP Monitor	2.4   3.1   3.2*   4.2 3.0   4.0   4.3*   5.4	35 45	2012-2013

Fraunhofer Heat Pump Field Test results 2007-2013

4

## TECHNICAL

# Still large innovation potential

- *Storage PFHRDs for water heating*
- *Hybrids (HP&gas&solar) for flexible energy mix and high  $\eta$*
- *Hydrogen-ready boilers & hybrids → Carbon-neutral*
- *TD (Thermally Driven) HPs, Fuel Cells, etc.*



*Intergas: Boiler with storage PFHRDs  
→ 110% efficiency (on GCV)*



*BDR Thermea: 100% Hydrogen Boiler*



*Hydrotop: Integrated HP for sloping roofs*

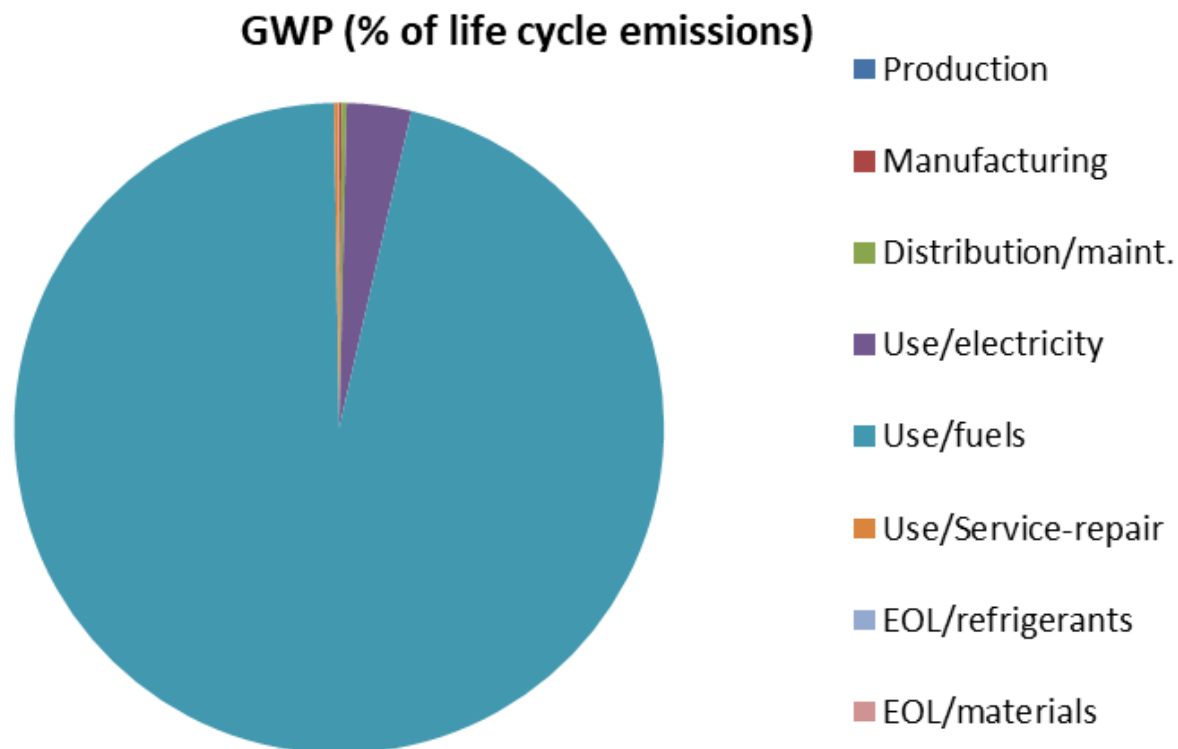
5

BASECASE

& environmental

## Carbon per life cycle stage

Use phase dwarfs the rest



# 6 OPTIONS



## 2021 Label factor & icon

Not for mix-in but **100% = 100%** carbon-neutral  
(Green H<sub>2</sub>, ex-ante CCU possibly in the interim)



**Verification tolerances 2021:** Gas instantaneous can be stricter; storage-based products are possibly critical. New formula for NOx? Follow up needed



**Labelling:** Correction for PEF 2.1. Proposal to use empty energy classes for more differentiation in current A (condensing) and A+ class (see next slide). No convergence with stakeholders yet: Some want no change. Others want more change.

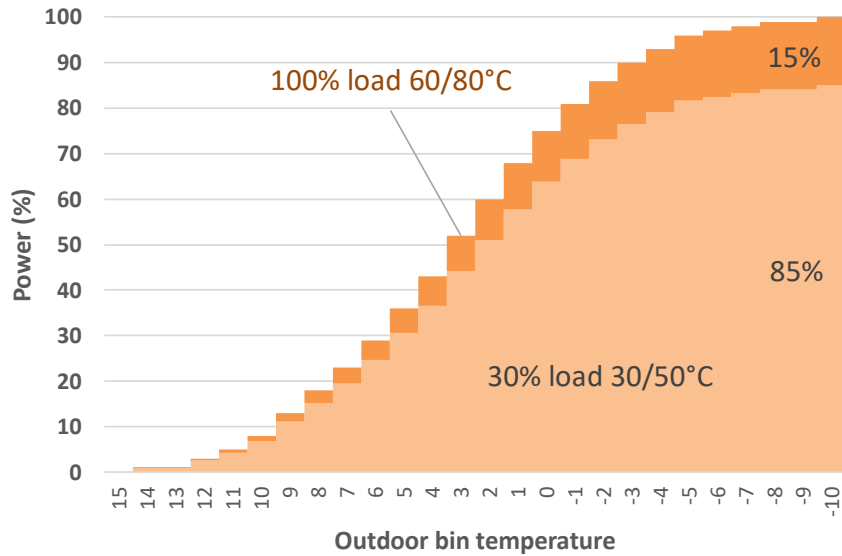
$$\sum_{n=1}^{\infty}$$

**Ecodesign:** No new technology-specific limits. But use progress in HP for higher feed T (65°C) → better for existing buildings & water heating + helps align heat pump and gas boiler → easier to make & calculate hybrids.

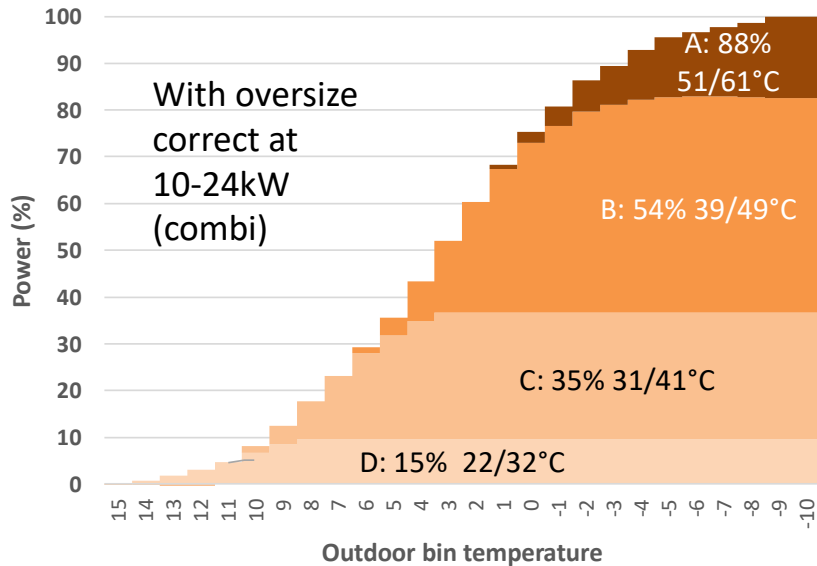
Package-calculation based on bin-method is the new default → calculated ED & EL limits depending on capacity of heat generator(s) in the product.



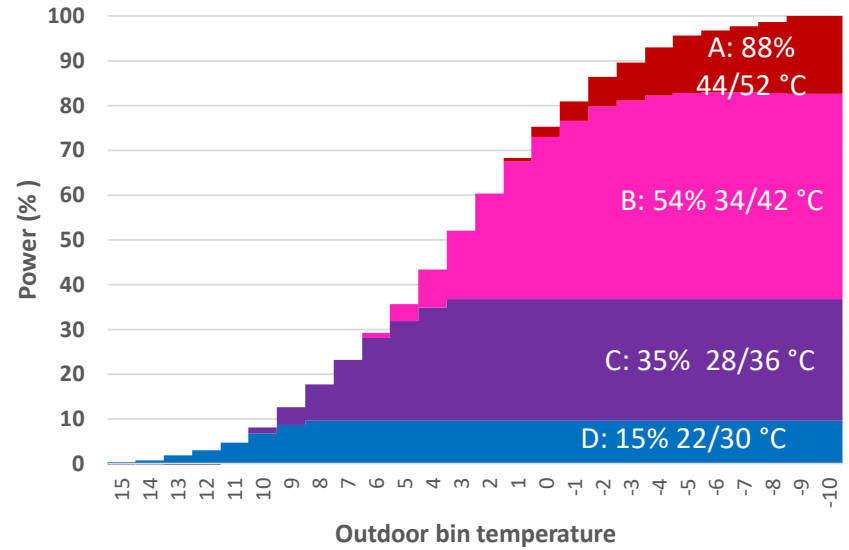
Boiler test points now  
(average climate)



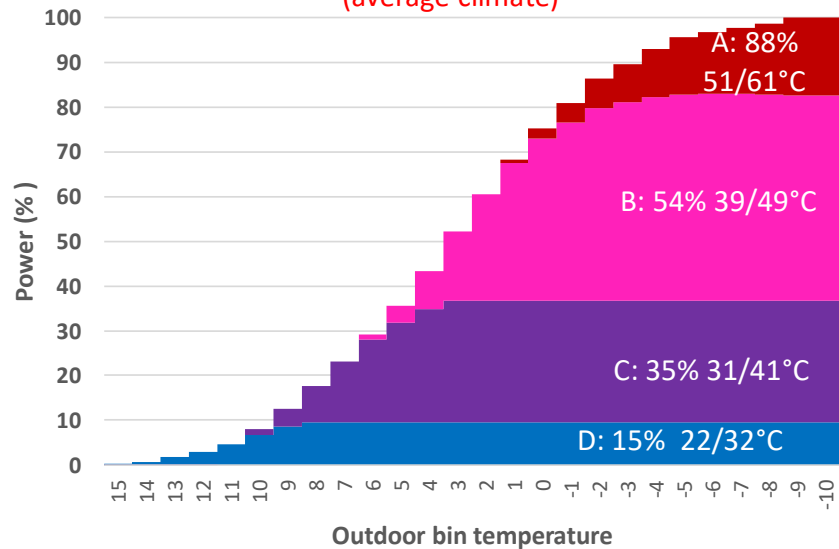
Boiler test point proposed  
(average climate)



HP test points now  
(average climate)



HP test points proposed  
(average climate)



## Low Temperature (35°C) HP & Boiler - test conditions

*UNCHANGED [typical Floor heating, New Built]*

Test Condition	Part Load Ratio in % of nominal capacity P1 (in kW on GCV @60/80°C return/supply temperature)			Indoor heat exchanger return/supply temperatures			
				Fixed outlet °C	Variable outlet**** °C		
	A	W	C	All climates	A	W	C
<b>A</b>	<b>Osize*88</b>	n/a	Osize*61	30/35	<b>29/34</b>	n/a	25/30
<b>B</b>	<b>Osize*54</b>	Osize*100	Osize*37	30/35	<b>25/30</b>	30/35	22/27
<b>C</b>	<b>Osize*35</b>	Osize*64	Osize*24	30/35	<b>22/27</b>	26/31	20/25
<b>D</b>	<b>Osize*15</b>	Osize*29	Osize*11	30/35	<b>19/24</b>	21/26	19/24
<b>G</b>	n/a	n/a	Osize*82	30/35	n/a	n/a	27/32

**Osize** is Oversize factor due to the combi oversizing effect, where Osize=1 for boilers with  $P1 \leq 10\text{kW}$  or  $Osize = 1/2.4$  for boilers with  $P1 > 24\text{kW}$  or  $Osize = 1/[1 + (P1 - 10)/14]$  for boilers with  $10\text{kW} > P1 \leq 24\text{kW}$

For heat pump Osize=1

## Look-up table Average Climate (bin-method):

*When you know  $P$ ,  $T_{biv}$  and  $TOL$  of the heat pump, you know the COP of a heat pump/boiler hybrid in the bin-method*

j	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21
$T_j$ (°C)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
$plr_j$ (%)	0.1	0.4	0.8	1.3	2.0	3.5	4.4	5.2	5.5	6.1	6.2	8	8.6	8.3	7.8	7.2	5.5	5.5	3.1	3.4	2.7	1.1	1.0	1.0	1.2	0
$Pl_j$ (%)	4	8	12	15	19	23	27	31	35	38	42	46	50	54	58	62	65	69	73	77	81	85	88	92	96	100
$h_j$ (h)	74	105	151	169	215	315	335	348	326	330	303	356	357	320	280	240	173	165	89	91	68	27	24	23	25	1
$q_j$ (%)	0	1	1	3	5	8	13	18	23	29	36	43	52	60	68	75	81	86	90	93	96	97	98	99	99	100
$D_j$	0.2	0.7	1.8	3.0	4.6	6.7	8.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
$C_j$	-0.1	-0.2	-0.4	-0.4	0.0	1.4	4.0	8.2	13.6	18.5	22.3	25.4	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
$B_j$										1.2	3.7	8.5	15.4	23.7	30.7	36.2	39.9	43.0	44.4	45.5	46.1	46.2	46.2	46.1	45.9	45.8
$A_j$															0.9	2.4	4.2	6.7	8.4	10.7	12.8	13.8	14.8	15.9	17.4	17.5
$COP(T_j)$	$= (A_j + B_j + C_j + D_j) / (A_j / COP_A + B_j / COP_B + C_j / COP_C + D_j / COP_D)$																									
$eta(T_j)$	$= (A_j + B_j + C_j + D_j) / (A_j / eta_A + B_j / eta_B + C_j / eta_C + D_j / eta_D)$																									

$j$ =bin number

$T_j$ =bin (outdoor) temperature

$plr_j$ (%)= bin part load ratio

$Pl_j$ (%)=accumulated  $plr_j$

$h_j$ =bin hours

$q_j$ =accumulated part load (% of rated output)

$A_j, B_j, C_j, D_j$  = weighting factors for  $COPA, COPB, COPC, COPD$  in bin  $j$  (accumulative)

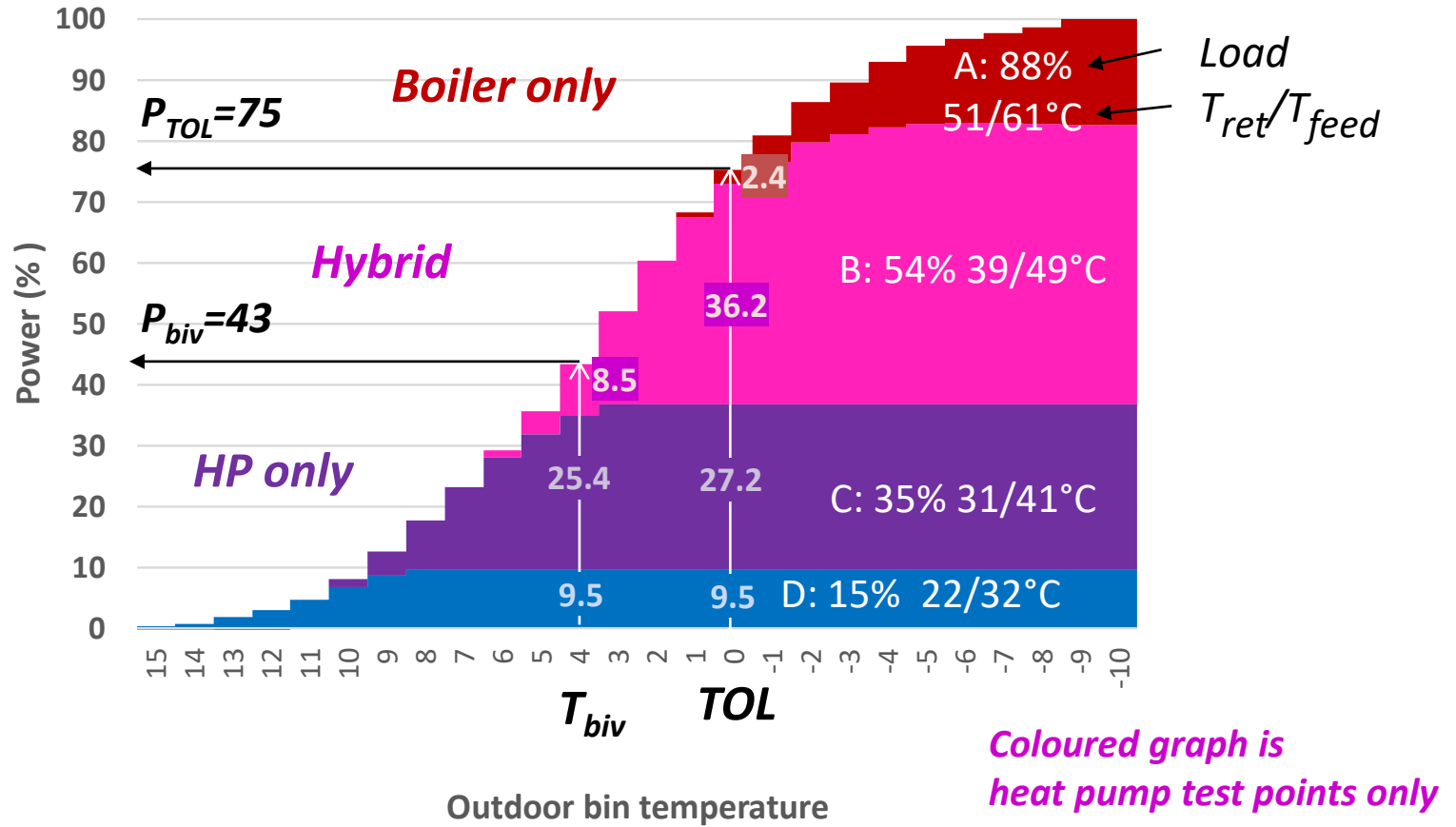
$COPA, COPB, COPC, COPD$  =COP at test conditions A, B, C, D

$COP(T_j)$  = COP in bin  $j$

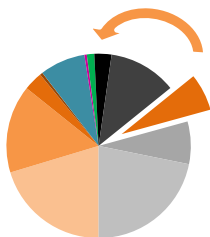
$eta(T_j)$  = eta in bin  $j$  (otherwise etaA etc. as COPA etc.)

## Look-Up Table (illustrative example)

(average climate)



# 6 OPTIONS



**Simpler solar heat (installer) label** : The present label & calculation method isn't helping

**Extend scope from 400kW to 1 MW** : Cover the gap with MCP directive (emissions) and add 15% to energy saving scope

**Extend non-condensing exemption to C4/C8 or support chimney renovation ?** : Report lists arguments and options.

**mCHP efficiency**:  $\text{electric efficiency (kWelectric out/kWin GCV)} \times 2.65 + \text{heating efficiency (kWheat out/kWinGCV)} \times 1$   
Show electricity out etc. on the mCHP label.

**Energy Label 3XL/4XL**: No double testing needed

**NOx limits**: Correction factors on NOx-limits for 3rd family gases

**Sound power limits heat pump**: To be better defined

**OVERALL**: Combi in one water heating regulation with Dedicated WH.

**PFHRD**: Use draft prEN to implement storage type

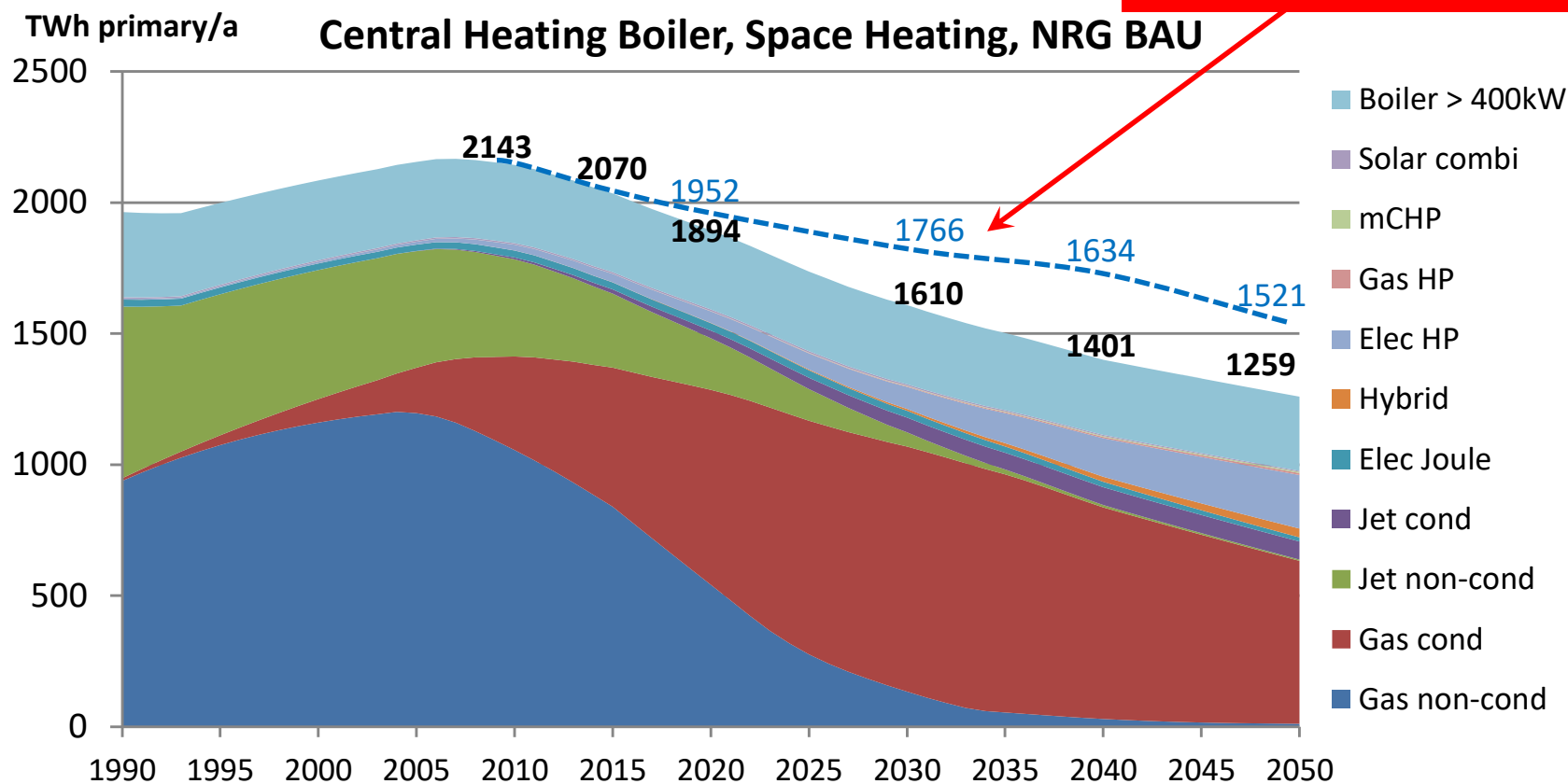
**???**: Solar PVT and PV, 3rd party verification, new ED item: Emitters

## first SCENARIOS

**Business-as-Usual (BAU), Energy**

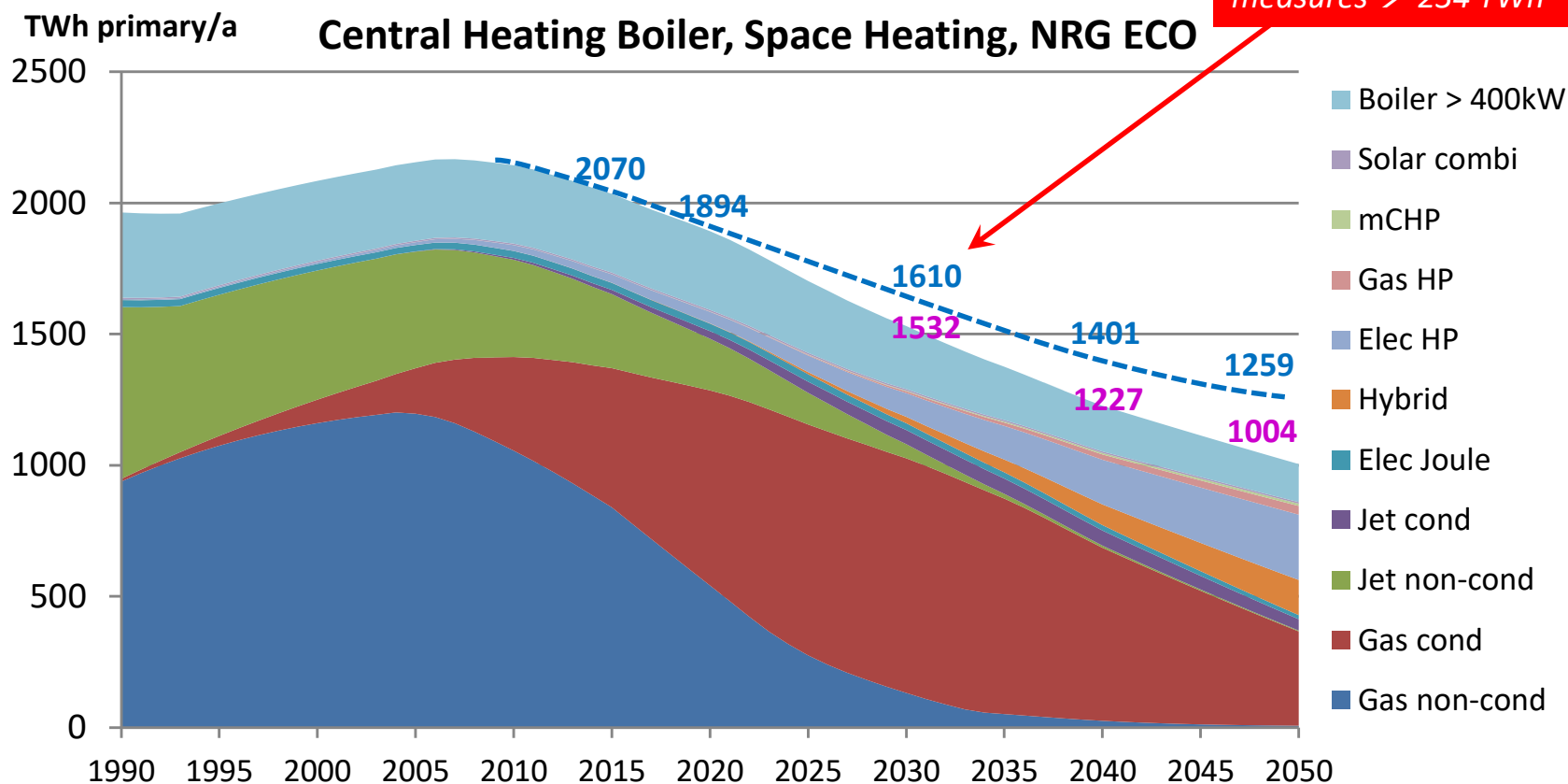
Dotted blue line is primary energy use without current regulation (BAU0).

**156 Twh<sub>prim</sub> in 2030**  
*saving from 2013 measures*



## With new measures (ECO), Energy

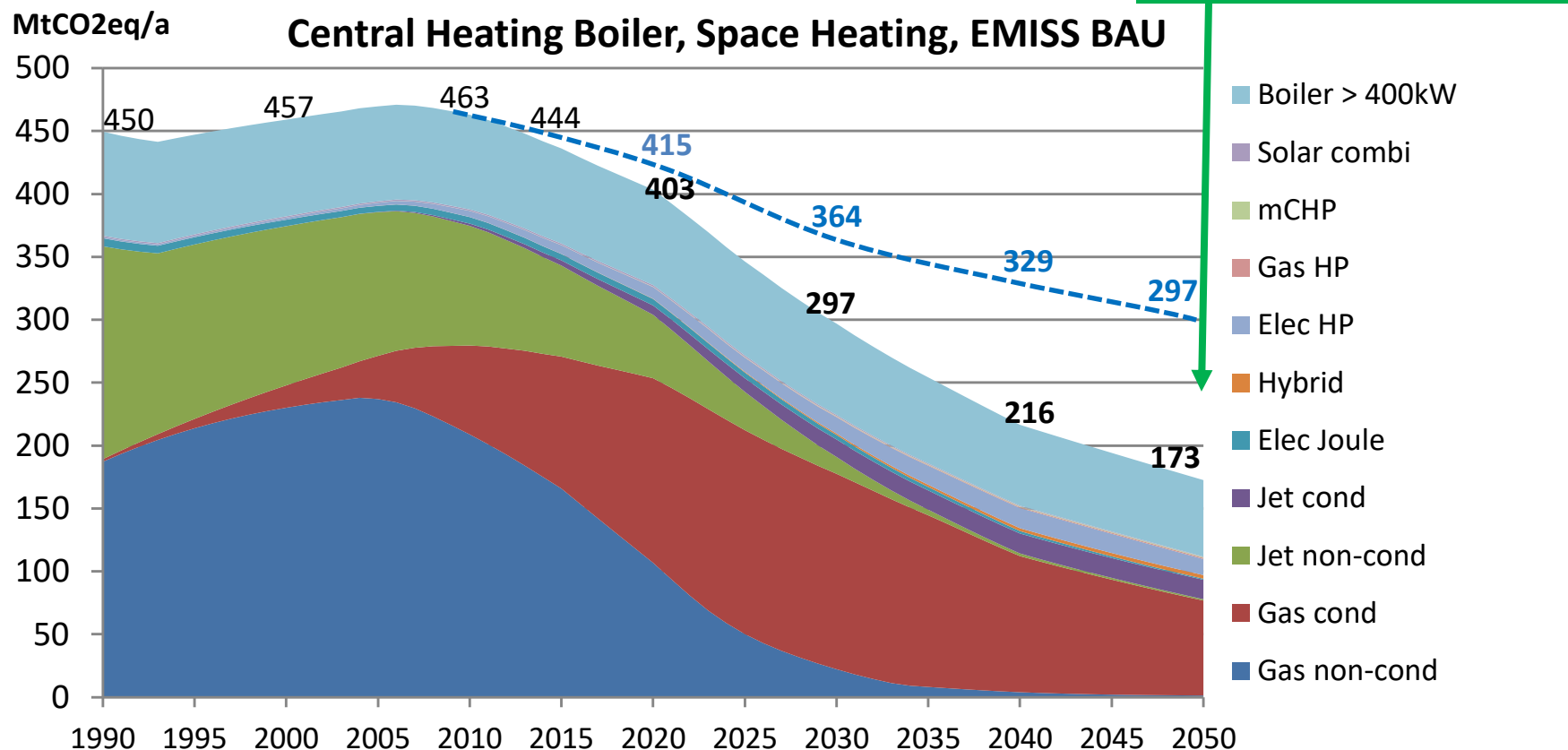
Dotted blue line is BAU. PEF for all years 2.1 (to be corrected when consensual projections will be available).





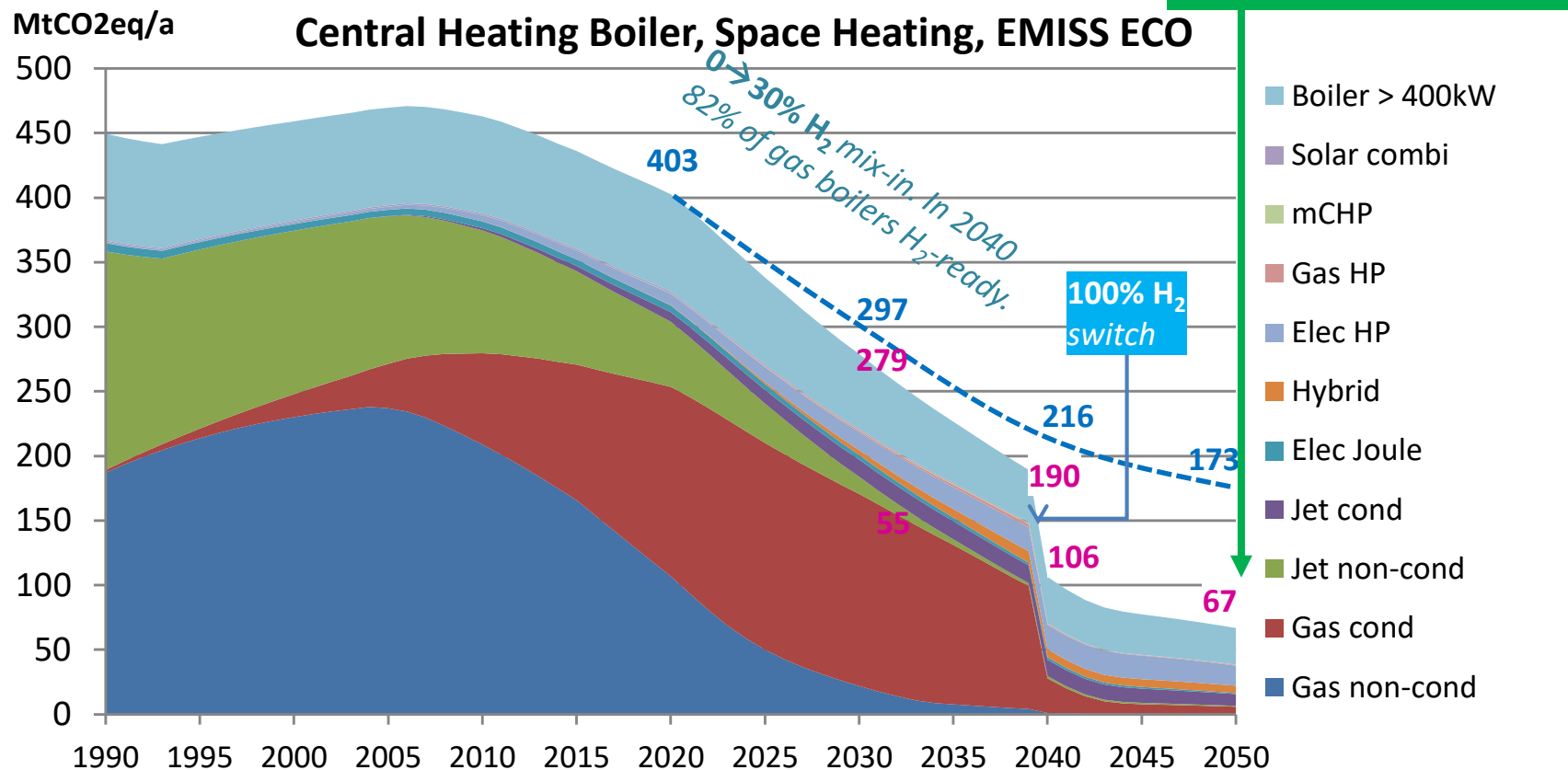
## Business-as-Usual (BAU), GHG Emissions

Dedicated & Combi together. Dotted blue line is primary energy use without current regulation.



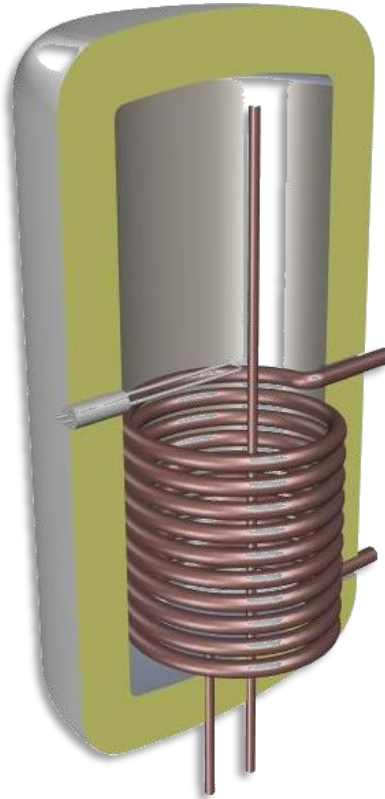
## With new measures (ECO), GHG emissions

Dedicated & Combi together. Dotted line is BAU. PEF for all years 2.1 (to be corrected when consensual projections will be available).



# Water Heaters

dedicated



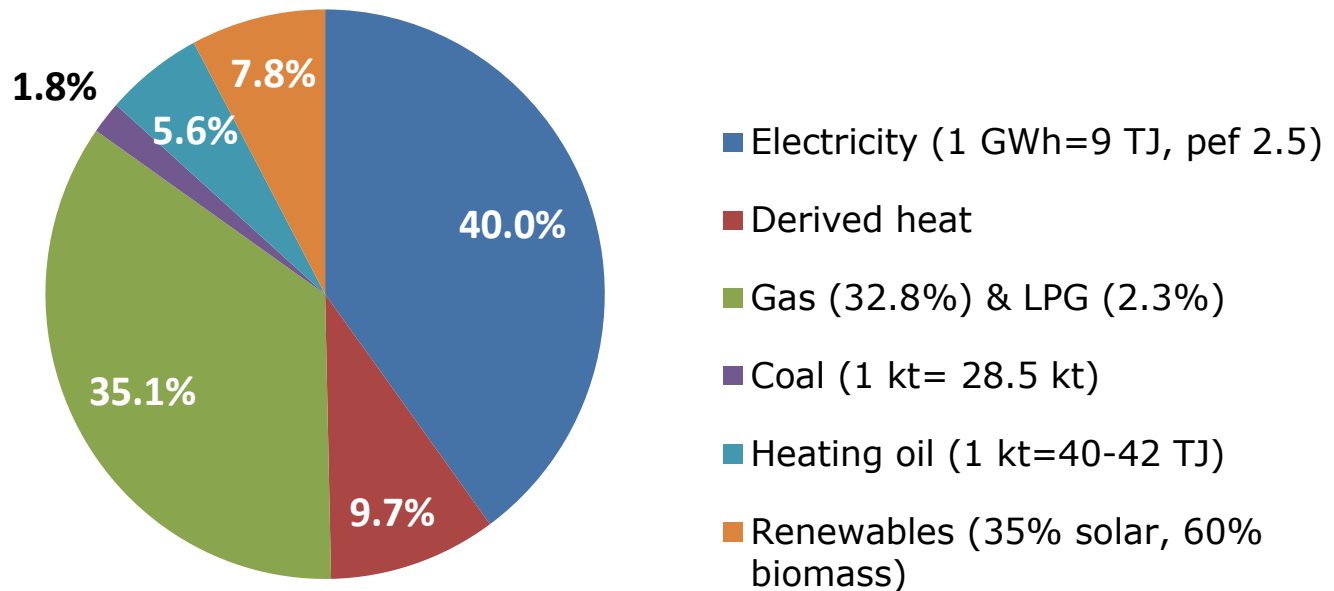
## 2 MARKET

# Better new market data

*unique BRG input, APPLiA support, new Eurostat data*

### EU28 primary energy end use households for water heating 2015

**Total ~2115 PJ=50.5 Mtoe** (VHK on basis Eurostat 2017)



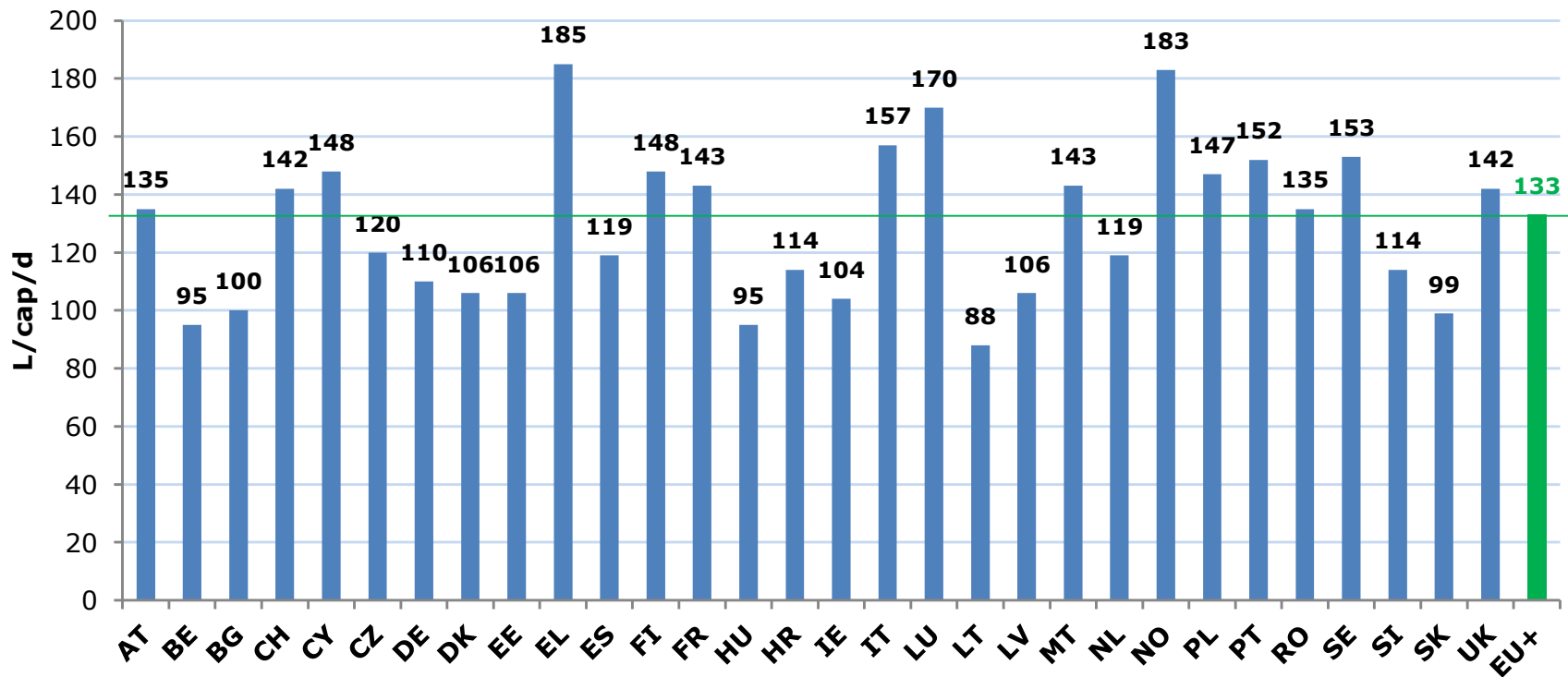
3

USE

# Total water consumption 133 L/cap

*Range 88-185 L (residential). Trend: Declining (due to efficient appliances & toilets, baths → showers)*

Water consumption per country (2012-2017), in Litres/capita/day



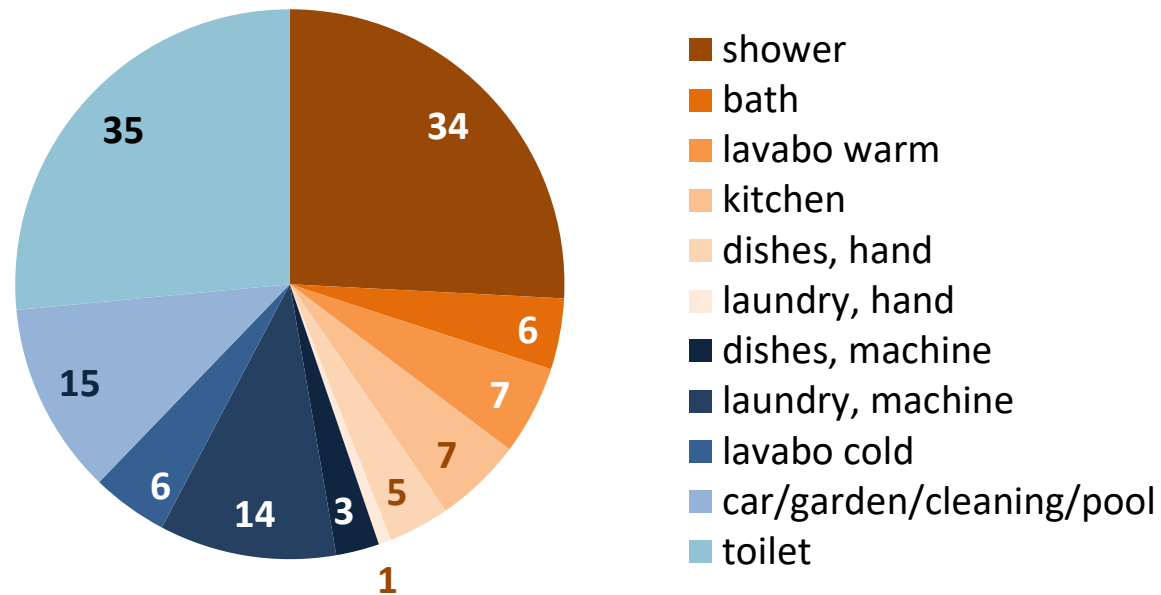
3

USE

# Hot water consumption 60 L/cap

*Trend: Declining (baths → showers, saving shower-heads & taps)*

**Average EU<sup>+</sup> water consumption per capita,**  
133 L/capita/day, of which 60 L warm @ 40°C



Non-residential hot water use adds 12 L → Total 72 Litres @40°C per capita

4

# Still large innovation potential

*But at a price*

## TECHNICAL

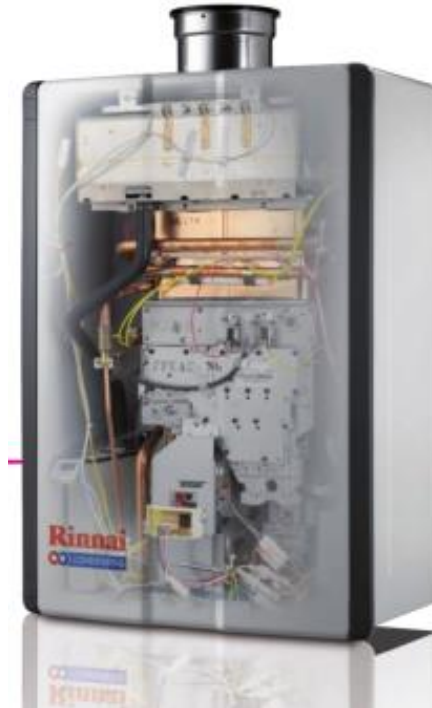


### Fuel Cell Water Heater

Efficiency >200%  
new calculation proposal  
with CC=2.65 for electric  
output. Input 2.48 kW (NCV)-  
-> output 1.5 kW electric (AC)  
+ 0.54 kW useful thermal



Stratified charge  
storage tank  
Hot Water Capacity x 3  
compared to normal indirect  
cylinder.



Condensing Gasfired  
Instantaneous WH: >90% ErP  
water heating efficiency (XXL tapping  
profile)= 9% better than a good  
condensing combi-boiler



4

## TECHNICAL

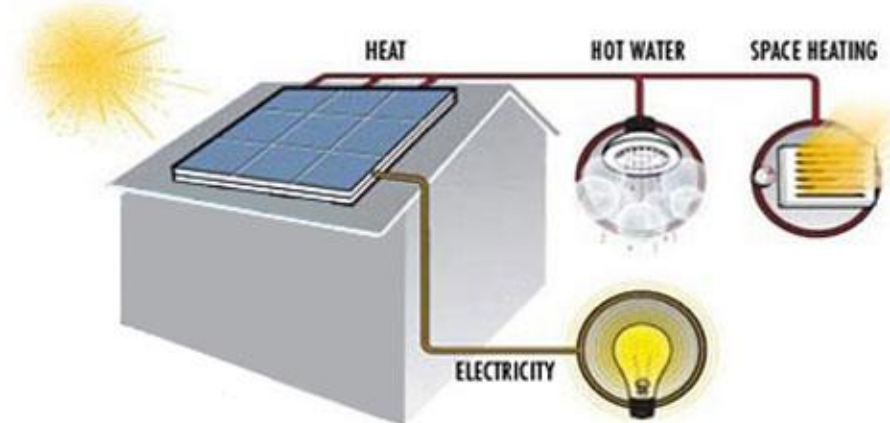


### Shower heat recovery >50% saving

Tube-in-tube

Heat exchange between  
waste water and incoming  
warm water

### PVT Solar panels (heat & PV-electric)



1200 W electric  
resistance

**Hybrid ESWH**  
using indoor 'waste' air  
(M or smaller tapping profile)  
60-90% efficiency

190 W  
heat  
pump

smart

# 6 OPTIONS



## 2021 Label factor & icon

Not for mix-in but **100% = 100%** carbon-neutral  
(Green H<sub>2</sub>, ex-ante CCU possibly in the interim)



**Verification tolerances 2021:** Gas instantaneous can be stricter;  
storage-based products are possibly critical. New formula for NOx?  
Follow up needed



**Labelling:** Adjust class limits of electric WHs for new PEF 2.1.  
A+ etc. class limits more ambitious for tapping patterns S and M  
Simplified solar (installer) label class calculation  
Otherwise labelling scheme is the same

**Ecodesign:** New technology-specific limits *(see next slide)*

Other:

**Storage tank standing heat loss:** EN 12897:2016 and prEN 15322:2016;  
EN 12977-3 might be used only for solar storage tanks.

**Energy Label 3XL/4XL:** No double testing needed

**NOx limits:** Correction factors on NOx-limits for 3rd family gases

**Sound power limits heat pump:** To be better defined

**OVERALL:** Dedicated WH and Combi in one water heating regulation.

**???:** Solar PVT and PV, 'Hybrid' ESWH, Heat recovery, Boiling water function

Follow-up  
discussions  
& study  
needed

## 6

## OPTIONS

Ecodesign: New technology-specific limits (proposal)

Water heating energy efficiency per tapping profile [1]	EIWH [2]	ESWH [3]	GIWH [4]	GSWH [5]	Storage-COMBI [6]	Instant-COMBI [7]	HP WH [8]
3XS-XXS-XS-S tapping profiles	42%	38%	55%	45%	45%	72%	60%
M tapping profile	45%	43%	75%	56%	56%	75%	105%
L tapping profile	45%	44%	80%	67%	68%	82%	114%
XL tapping profile	45%	45%	85%	78%	78%	90%	133%
XXL tapping profile	45%	45%	89%	83%	100%	110%	148%
3XL-4XL	45%	45%	92%	88%	105%	115%	157%

[1]: For oil-fired versions of the GIWH, GSWH and COMBI, multiply the limit values by 0.95

[2]: ELECTRIC INSTANTANEOUS WH: Limits are close to maximum for electronic EIWH, at  $\eta_{\text{ef}}=2.1$ , according to catalogue values.

[3]: ELECTRIC STORAGE WH: Limits for 3XS-XL derived from  $\eta_{\text{ef}}$ -corrected current regulation. For XXL/3XL/4XL they are close to maximum.

[4]: GAS INSTANTANEOUS WH: Own assessment. Limits will eliminate (indirectly) pilot flame use as requested..

[5]: GAS STORAGE WHE: Based on best catalogue data.

[6]: STORAGE COMBI: Limits also apply to gas-fired heat pumps (A7/W55) as well as fossil fuel boilers with external indirect cylinder. Limits derived from instant-combi minus storage standing losses

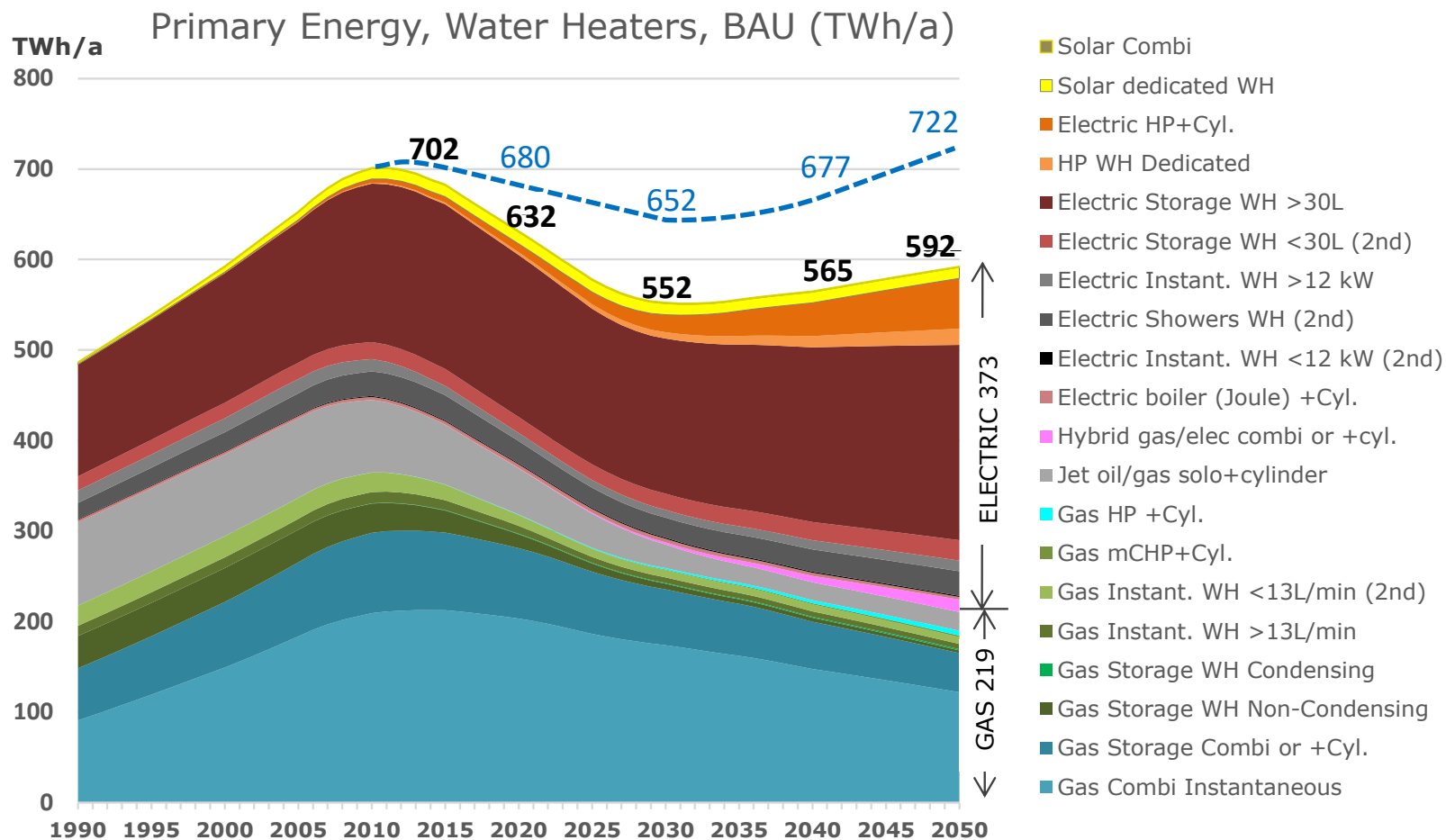
[7]: INSTANTANEOUS COMBI: XL-limit assumes integrated instantaneous PFHRD (PASSIVE FLUE HEAT RECOVERY DEVICE). XXL/3XL/4XL limits assume integrated storage PFHRD (<3L). Example: Intergas Xtreme 36 (XXL, 115% on GCV)

[8]: Monoblock dedicated HEAT PUMP WATER HEATER: Limits based on A7/W55 EN16147. Values derived from catalogue data (mainly Ariston). The S-class value is based on a corrected (downward) value that could be realised by a variation on the Lydos hybrid (currently M with 90% efficiency). Limits also apply to electric heat pumps with indirect cylinder (A7/W55).

## first SCENARIOS

**Business-as-Usual (BAU), Energy**

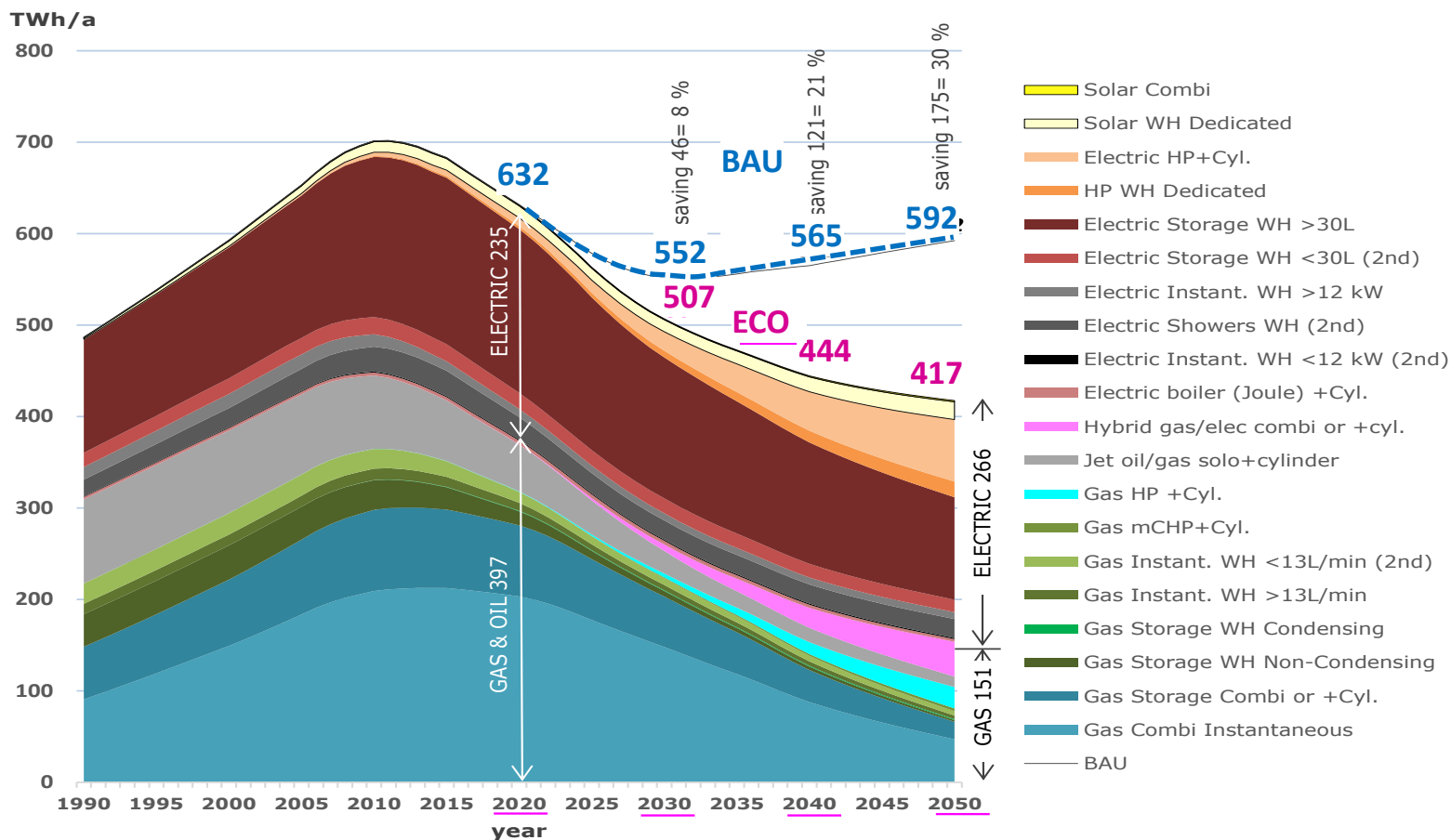
Dedicated & Combi together. Dotted line is primary energy use without current regulation (BAU0).



## With new measures (ECO), Energy

Dedicated & Combi together. Dotted blue line is BAU. PEF for all years 2.1 (to be corrected when consensual projections will be available).

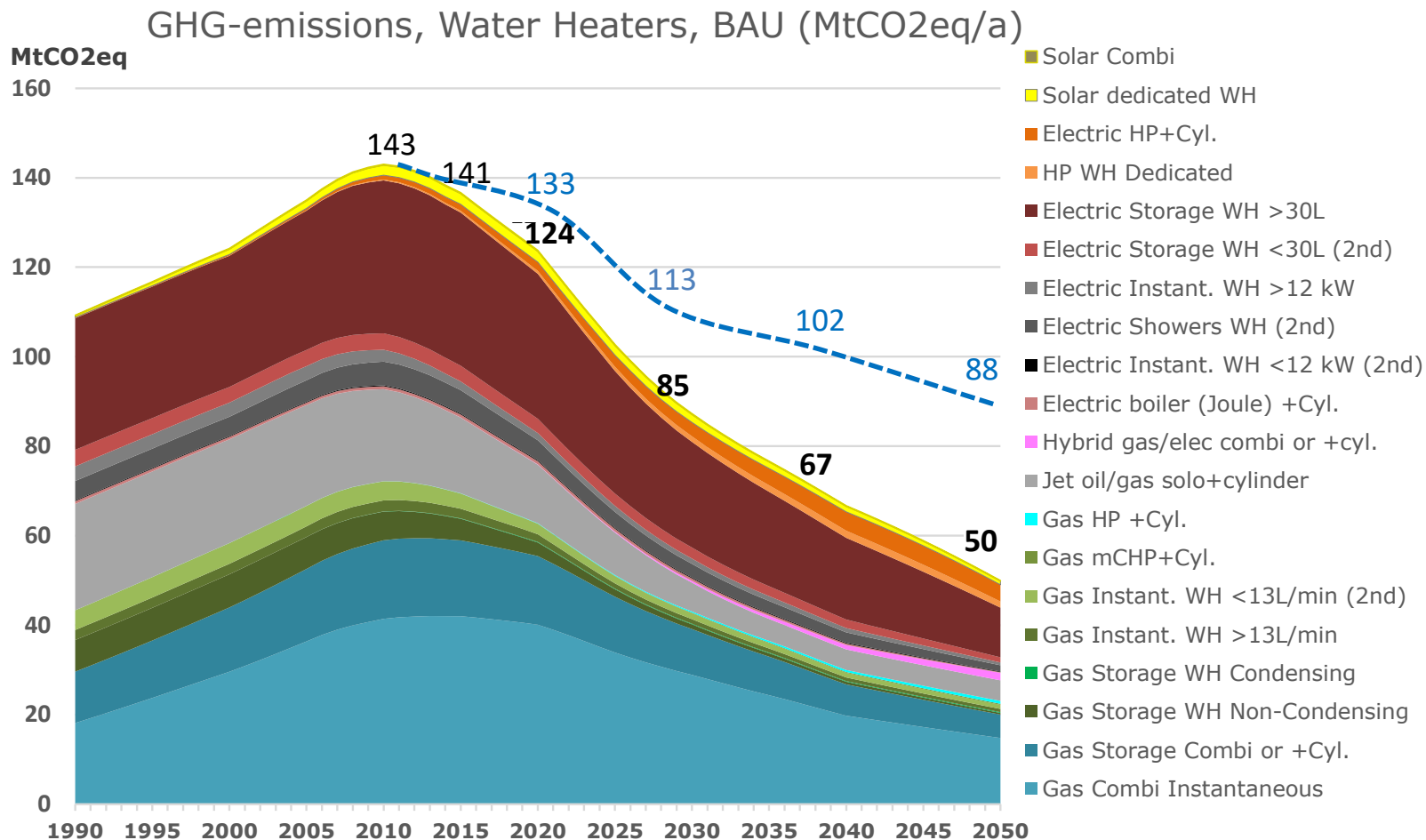
Primary Energy, Water Heating, ECO (TWh/a)



## first SCENARIOS

**Business-as-Usual (BAU), GHG Emissions**

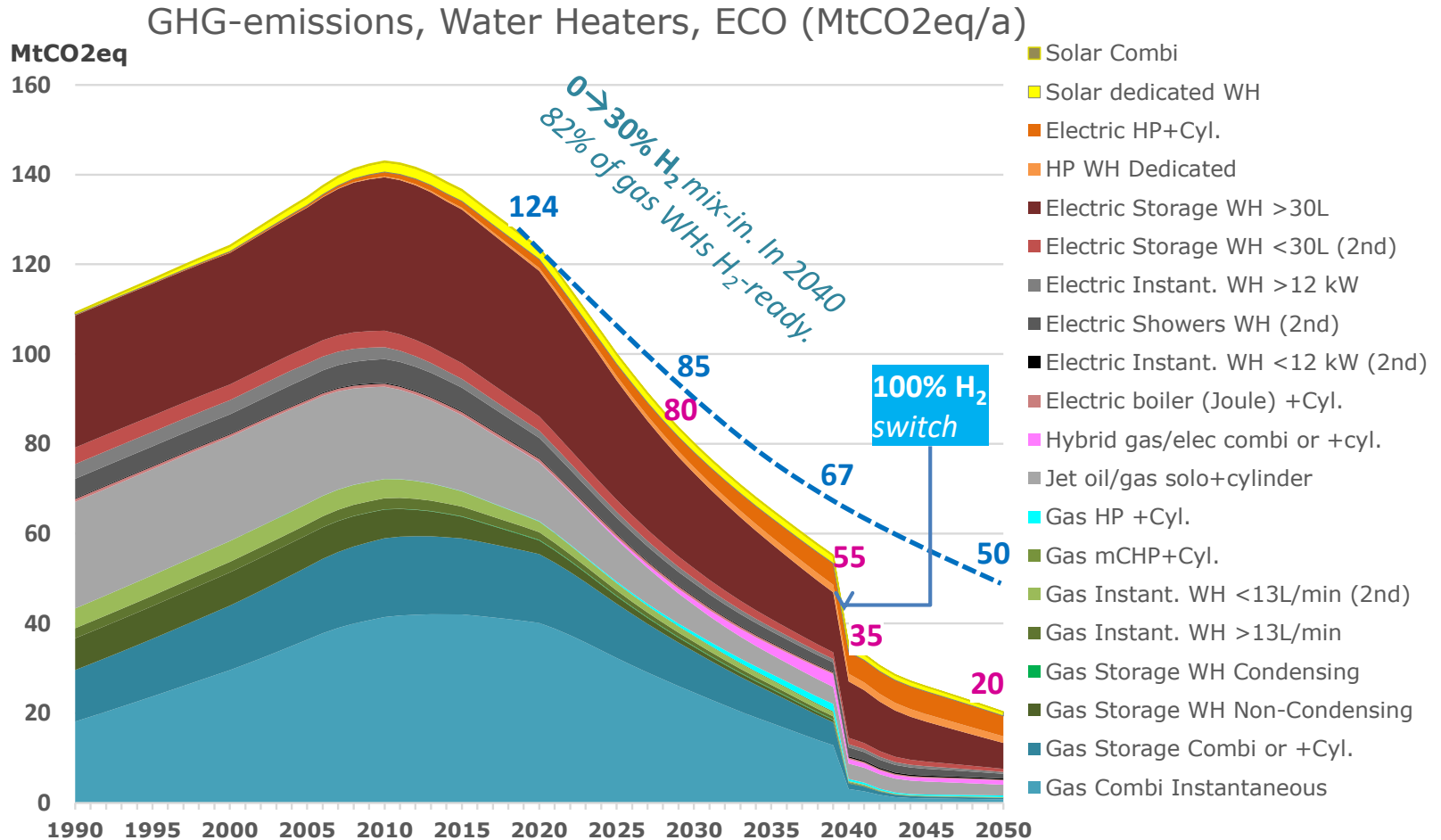
Dedicated & Combi together. Dotted blue line is primary energy use without current regulation.



## first SCENARIOS

### With new measures (ECO), GHG emissions

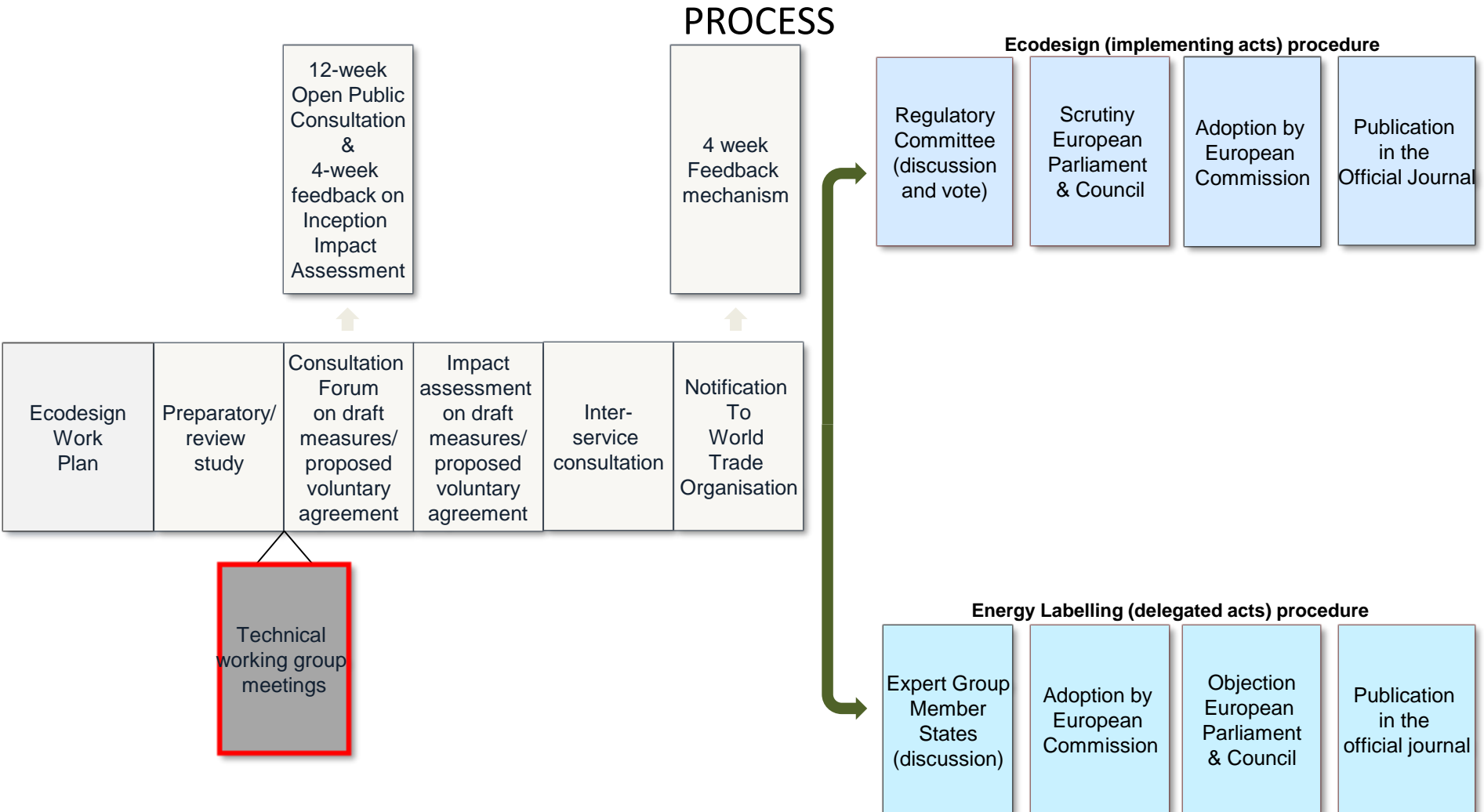
Dedicated & Combi together. Dotted line is BAU. PEF for all years 2.1 (to be corrected when consensual projections will be available).





## Next step: Technical Working Group meetings

To start now, Next 12-14 months, CF water heaters first, CF space heaters after



## Topics technical working group meetings

1. **Hydrogen and biogas promotion** or alternative approaches to achieve the objectives of the **Paris agreement**
2. **Temperature regimes** and other possible ecodesign or energy labelling measures to boost heat pump/hybrid market penetration in **existing buildings**
3. **Streamlined package calculations and ecodesign limits** for all products in the scope, including solar, passive flue heat recovery devices, boiler exemptions, the use of ecodesign requirements as a reliable source for data in other policies (e.g. EPBD)
4. **Differentiated ecodesign limits** per technology for **water heaters**

***Thank you for your attention***

***CHECK Project websites for news:***

**[www.ecoboiler-review.eu](http://www.ecoboiler-review.eu)    [www.ecohotwater-review.eu](http://www.ecohotwater-review.eu)**