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# *Preparatory study for Steam Boilers Ecodesign Task 7*



Stakeholders' meeting  
Brussels, 3<sup>rd</sup> July 2014

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# *Preparatory study*

## *Lot 7 Steam boilers*

### Task 7: Scenarios

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## ***Scenarios***

### Objectives

- The objective of the Task 7 is to provide an understanding of the likely **impacts** of different policy measures.
- **Key aspects**
  - Technology improvements
  - Users
  - Market
- To this end, a **stock model** is developed to estimate **future sales** and **stocks** of steam boilers within different policy scenarios.
- The outcomes are then compared with reference to different baselines.

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# *Scenarios*

## Approach

- **Starting point:** Business-as-usual or reference scenario, which projects current developments without additional policy actions into the future.
- The impact of proposed policy measures can then be compared to this reference case. This reference scenario is a projected future without further policy intervention included beyond those that are already agreed.
- Several reduced environmental impact scenarios can be developed, but should include a scenario that realises the introduction of LLCC level for all new sales/installations within a relatively short period of time.
- A more stringent scenario which assumes all products reach the BAT level within a period of time will define the maximum saving achievable (the potential size of the environmental gain to be achieved from the introduction of products which meet the BAT level). Actual savings will be below this theoretical optimum but the latter serves as an additional reference taking into account actual stock turnovers.
- The scenario task is a key task within this project: It requires the combination of the results of all previous tasks and estimates the actual impact to different policy and design options forming the base for a well-founded decision. Technically, a robust stock model needs to be developed with empirically sound assumptions on techno-economical parameters.

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# *Stock Model*

## Assumptions and inputs

- Production
- Sales
- Stock

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# ***Production data***

## **Pieces and value**

### **Production of steam boilers 1 – 50 MW (pieces)**

<b>Size of boiler (MW)</b>	<b>Water-tube boilers (Prodcom 25.30.11.10)</b>	<b>Vapour generating boilers (Prodcom 25.30.11.50)</b>	<b>Super-heated boilers (Prodcom 25.30.11.70)</b>
1-5 MW	400	<b>1.500</b>	25
5-25 MW	300	<b>750</b>	175
25-50 MW	300	<b>250</b>	50
<b>Total</b>	<b>1000</b>	<b>2.500</b>	<b>250</b>

*Source: BDH – Experts view Survey (March 2014)*

- Production of fire-tube (Base Cases): **2.500** (67% of total steam boilers production)
- Total production of steam boilers: **3.750**

### **Production of steam boilers 1 – 50 MW (€)**

<b>Size of boiler (MW)</b>	<b>Water-tube boilers (Prodcom 25.30.11.10)</b>	<b>Vapour generating boilers (Prodcom 25.30.11.50)</b>	<b>Super-heated boilers (Prodcom 25.30.11.70)</b>
1-5 MW	50.000.000	66.000.000	3.000.000
5-25 MW	200.000.000	110.000.000	9.000.000
25-50 MW	250.000.000	44.000.000	18.000.000
<b>Total</b>	<b>500.000.000</b>	<b>220.000.000</b>	<b>30.000.000</b>

*Source: BDH – Experts view Survey (March 2014)*

# ***EU stock of Steam Boilers 2013***

## **Estimation via GDP**

<b>Country</b>	<b>GDP</b>	<b>Installed Steam boilers (n)</b>	<b>not state of the art (n)</b>
<b>Germany</b>	2.495.000	15.000	7.500
<b>Austria</b>	285.165	1.714,42	857,21
<b>Belgium</b>	355.740	2.138,72	1.069,36
<b>Denmark</b>	236.334	1.420,85	710,42
<b>Finland</b>	178.724	1.074,49	537,25
<b>France</b>	1.936.720	11.643,61	5.821,80
<b>Greece</b>	222.151	1.335,58	667,79
<b>Ireland</b>	158.096	950,48	475,24
<b>Italy</b>	1.551.885	9.329,97	4.664,99
<b>Netherlands</b>	586.789	3.527,79	1.763,89
<b>Poland</b>	354.616	2.131,96	1.065,98
<b>Portugal</b>	172.859	1.039,24	519,62
<b>Spain</b>	1.045.620	6.286,29	3.143,15
<b>Sweden</b>	349.945,	2.103,88	1.051,94
<b>United Kingdom</b>	1.731.809	10.411,68	5.205,84
<b>TOTAL</b>		<b>70.108,95</b>	<b>35.054,00</b>
<b>Total Fire-tube 1-50MW*</b>		<b>46.739,30</b>	<b>23.369,33</b>

Source: BDH, 2013

Estimation of the population of the steam boilers in Europe via GDP on basis of Germany – 2010

\*Fire-tube stock and not-state-of the art are calculated as follows: Total steam boilers x (2500/3750)

# ***Stock and Sales 2013***

## **Fire-tube boilers - Base cases**

### **EU Sales of Fire-tube boilers 1 – 50 MW**

Base case no.	Base case size (MWth)	Annual Production		Export		Import		Annual EU Sales		Stock data (2013)
		pieces	€	pieces	€	pieces	€	pieces	€	pieces
1	2,5	750	33.000.000	150	6.600.000	-	-	600	26.400.000	14021,79
2	2,5	750	33.000.000	150	6.600.000	-	-	600	26.400.000	14021,79
3	7	188	27.500.000	38	5.500.000	-	-	150	22.000.000	3505,4475
4	7	188	27.500.000	38	5.500.000	-	-	150	22.000.000	3505,4475
5	20	188	27.500.000	38	5.500.000	-	-	150	22.000.000	3505,4475
6	20	188	27.500.000	38	5.500.000	-	-	150	22.000.000	3505,4475
7	35	125	22.000.000	25	4.400.000	-	-	100	17.600.000	2336,965
8	35	125	22.000.000	25	4.400.000	-	-	100	17.600.000	2336,965
		<b>2.500</b>	<b>220.000.000</b>	<b>500</b>	<b>44.000.000</b>	-	-	<b>2.000</b>	<b>176.000.000</b>	<b>46739,3</b>

Source: PwC estimation

#### **Assumptions:**

- Production of base cases is equally distributed in the respective ranges of size;
- Steam boilers production is equivalent to the sales. The overall steam boilers sales in EU can be calculated from Production + Imports – Exports (Y+M-X), representing the apparent consumption;
- Export assumptions : 20% of total production ;
- Import assumptions: not significant
- Stock data are calculated as total fire-tube produced / total steam boilers produced (3.750) x overall stock BDH (70108,95)



# ***Stock and Sales 2013***

## **Water-tube and super-heated boilers**

### **EU Sales of water- tube boilers 1 – 50 MW**

Range case size (MW)	Annual Production		Export*		Import*		Annual EU Sales *		Stock data **
	pieces	€	pieces	€	pieces	€	pieces	€	pieces
1- 5	400	50.000.000	80	10.000.000	0	0	320	40.000.000	7478,288
5 – 25	300	200.000.000	60	40.000.000	0	0	240	160.000.000	5608,716
25 – 50	300	250.000.000	60	50.000.000	0	0	240	200.000.000	5608,716
<b>Total</b>	<b>1.000</b>	<b>500.000.000</b>	<b>200</b>	<b>100.000.000</b>	<b>0</b>	<b>0</b>	<b>800</b>	<b>400.000.000</b>	<b>18695,72</b>

Source: PwC estimation

\*Export assumptions : 20% of total production : \*Import assumptions : not significant

\*\* Stock data are calculated as total water-tube produced / total steam boilers produced (3.750) x overall stock BDH (70108,95)

### **EU Sales of super-heated boilers 1 – 50 MW**

Range case size (MW)	Annual Production		Export*		Import*		Annual EU Sales *		Stock data**
	pieces	€	pieces	€	pieces	€	pieces	€	pieces
1- 5	25	3.000.000	5	600.000	0	0	20	2.400.000	467,393
5 - 25	175	9.000.000	35	1.800.000	0	0	140	7.200.000	3271,751
25 - 50	50	18.000.000	10	3.600.000	0	0	40	14.400.000	934,786
<b>Total</b>	<b>250</b>	<b>30.000.000</b>	<b>50</b>	<b>6.000.000</b>			<b>200</b>	<b>24.000.000</b>	<b>4673,93</b>

Source: PwC estimation

\*\* Stock data are calculated as total super-heated boilers produced / total steam boilers produced (3.750) x overall stock BDH (70108,95)

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# ***Stock Model to 2030***

## **Inputs and assumptions**

### **Inputs**

- EU Stock Fire-tube boilers 2013: **23.369 pieces** (not-state-of-the-art pieces)
- EU Sales Fire-tube boilers 2013: **2.000 pieces**

### **Assumptions**

- Maximum replacements 2013 = maximum EU sales without economic growth 2013 = 2.000 pieces;
- EU sales growth, connected with European GDP growth, imposed at 1,5% up to 2030;
- Exports: 20% of production flat rate to 2030;

### **Replacement rate estimation**

Additional pieces driven by economic growth (demand)

EU stock 2013 is replaced in about 12 years (2024)

From 2025 on, the state-of-the-art will start being replaced.

*therefore*

**with no-growth, production is stable and devoted to replacement only with 1,5% economic growth, the new production is absorbed by new demand.**

# ***Stock Model to 2030***

## **Results – overall steam boilers**

	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>
<b>Installed</b>	<b>46.739</b>	<b>46.769</b>	<b>46.830</b>	<b>46.922</b>	<b>47.045</b>	<b>47.200</b>	<b>47.387</b>	<b>47.607</b>	<b>47.861</b>
<i>- Replaced</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>
<b>Production</b>	2.500	2.538	2.576	2.615	2.654	2.694	2.734	2.775	2.817
<b>Export</b>	500	508	515	523	531	539	547	555	563
<b>EU sales</b>	<b>2.000</b>	<b>2.030</b>	<b>2.061</b>	<b>2.092</b>	<b>2.123</b>	<b>2.155</b>	<b>2.187</b>	<b>2.220</b>	<b>2.254</b>

	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>
<b>Installed</b>	<b>48.148</b>	<b>48.470</b>	<b>48.827</b>	<b>49.219</b>	<b>49.647</b>	<b>50.112</b>	<b>50.614</b>	<b>51.153</b>	<b>51.731</b>
<i>- Replaced</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>	<i>2.000</i>
<b>Production</b>	2.859	2.902	2.946	2.990	3.035	3.081	3.127	3.174	3.222
<b>Export</b>	572	580	589	598	607	616	625	635	644
<b>EU sales</b>	<b>2.287</b>	<b>2.322</b>	<b>2.357</b>	<b>2.392</b>	<b>2.428</b>	<b>2.465</b>	<b>2.502</b>	<b>2.539</b>	<b>2.578</b>

# ***Stock Model to 2030***

## **Results for Base Case 1 and 2 (2,5MW)**

	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>
<b>Installed</b>	<b>14.022</b>	<b>14.031</b>	<b>14.049</b>	<b>14.076</b>	<b>14.113</b>	<b>14.159</b>	<b>14.215</b>	<b>14.281</b>	<b>14.356</b>
<b>- Replaced</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>
<b>Production</b>	750	761	772	784	796	808	820	832	844
<b>Export</b>	150	152	154	157	159	162	164	166	169
<b>EU sales</b>	<b>600</b>	<b>609</b>	<b>618</b>	<b>627</b>	<b>637</b>	<b>646</b>	<b>656</b>	<b>666</b>	<b>675</b>

	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>
<b>Installed</b>	<b>14.442</b>	<b>14.538</b>	<b>14.644</b>	<b>14.761</b>	<b>14.888</b>	<b>15.026</b>	<b>15.176</b>	<b>15.337</b>	<b>15.509</b>
<b>- Replaced</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>
<b>Production</b>	857	870	883	896	909	923	937	951	965
<b>Export</b>	171	174	177	179	182	185	187	190	193
<b>EU sales</b>	<b>686</b>	<b>696</b>	<b>706</b>	<b>717</b>	<b>727</b>	<b>738</b>	<b>750</b>	<b>761</b>	<b>772</b>

# ***Stock Model to 2030***

## **Results for Base Case 3 – 4 (7MW) and 5 – 6 (20 MW)**

	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>
<b>Installed</b>	<b>3.505</b>	<b>3.507</b>	<b>3.511</b>	<b>3.518</b>	<b>3.527</b>	<b>3.539</b>	<b>3.553</b>	<b>3.569</b>	<b>3.588</b>
<b>- Replaced</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>
Production	187	190	193	196	199	202	205	208	211
Export	37	38	39	39	40	40	41	42	42
<b>EU sales</b>	<b>150</b>	<b>152</b>	<b>154</b>	<b>157</b>	<b>159</b>	<b>162</b>	<b>164</b>	<b>166</b>	<b>169</b>

	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>
<b>Installed</b>	<b>3.609</b>	<b>3.633</b>	<b>3.659</b>	<b>3.687</b>	<b>3.718</b>	<b>3.751</b>	<b>3.787</b>	<b>3.825</b>	<b>3.866</b>
<b>- Replaced</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>
Production	214	217	220	223	226	229	232	235	239
Export	43	43	44	45	45	46	46	47	48
<b>EU sales</b>	<b>171</b>	<b>174</b>	<b>176</b>	<b>178</b>	<b>181</b>	<b>183</b>	<b>186</b>	<b>188</b>	<b>191</b>

# ***Stock Model to 2030***

## **Results for Base Case 7 – 8 (35MW)**

	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>
<b>Installed</b>	<b>2.337</b>	<b>2.339</b>	<b>2.342</b>	<b>2.347</b>	<b>2.353</b>	<b>2.361</b>	<b>2.371</b>	<b>2.382</b>	<b>2.395</b>
<b>- Replaced</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Production</b>	125	127	129	131	133	135	137	139	141
<b>Export</b>	25	25	26	26	27	27	27	28	28
<b>EU sales</b>	100	102	103	105	106	108	110	111	113

	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>
<b>Installed</b>	<b>2.409</b>	<b>2.425</b>	<b>2.443</b>	<b>2.462</b>	<b>2.483</b>	<b>2.505</b>	<b>2.529</b>	<b>2.555</b>	<b>2.582</b>
<b>- Replaced</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Production</b>	143	145	147	149	151	153	155	157	159
<b>Export</b>	29	29	29	30	30	31	31	31	32
<b>EU sales</b>	<b>114</b>	<b>116</b>	<b>118</b>	<b>119</b>	<b>121</b>	<b>122</b>	<b>124</b>	<b>126</b>	<b>127</b>

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# *Scenarios*

## Next steps

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# ***Scenarios***

## **Next analyses**

### **Subtask 7.1: Policy analysis**

From the previous tasks, different sets of clearly defined sets policy options have to be developed. These will enter into the modelling approach and need to be translated to product details (subtask 1.1 and others).

### **Subtask 7.2: Scenario analysis (unit stock/sale & environmental)**

Scenarios will include at least the following: business as usual, minimal Ecodesign requirements, labelling, a combination of minimal Ecodesign requirements plus labelling and a scenario “technical diffusion” for the maximally possible technical savings by restricting sales (new or replacements sales) to BAT, thus yielding fastest possible stock diffusion.

### **Subtask 7.3: Socio economic impact analysis (depending on the available information)**

The implemented stock model will be used to estimate socio-economic impacts. This will include expenditures and revenues for EU-27 for the different scenarios on a time horizon 1990-2030 with an outlook to 2050. The results from this analysis add important information to the environmental impact and allow a wholesome impact assessment of the different policy and design options developed.

### **Subtask 7.4: Sensitivity analysis**

A sensitivity analysis is performed to understand the complex interplay and dependence of the outcome with respect to changing important parameters such as energy prices and other economic parameters (also taking into account the effects from time delay via slow stock turnover). This generates insight into (a) the main drivers influencing the success of different design options and (b) the robustness of the stock model results. Sensitivity analysis will comprehend all main scenarios and main parameters (such as prices and usage patterns). Further details will be agreed upon with the Commission.