HARP

Heating Appliances Retrofit Planning

Deliverable 3.2: Guideline for the application of the labelling methodologies for installed appliances October 2020

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1.0	16/10/2020	
1.1	20/11/2020	Introduced missing parameters for the calculation of WH efficiency Corrected nomenclature of one parameter

ABBREVIATIONS AND DEFINITIONS

ABBREVIATION	DESCRIPTION
SH	Space heating
GB	Gas Boiler
WH	Water Heater
GIWH	Gas instantaneous water heater
GSWH	Gas storage water heater
EIWH	Electric instantaneous water heater
ESWH	Electric storage water heater
$H_i\ (or\ LHV\ or\ NCV)$	Lower heat value (or net calorific value)
$H_i\ (or\ HHV\ or\ GCV)$	Upper heat value (or higher heating value, or gross calorific value)
η_{son}	Seasonal "on" efficiency of SH appliance
η_s	Seasonal efficiency of SH appliance
η_{WH}	Water heater efficiency
η_{30}	Efficiency at 30% part-load, defined at lower heat value
η_1	Efficiency at 30% part-load, defined at upper heat value
$P_1 or\ P_{30}$	30% part-load thermal capacity
el_{min}	Electrical consumption at part-load
η_{100}	Efficiency at full load, defined at lower heat value
η_4	Efficiency at full load, defined at upper heat value
$P_4\ or\ P_n$	Full-load thermal capacity
el_{max}	Electrical consumption at full-load
P_{SB}	Electrical consumption at stand-by
P_{stby}	Stand-by heat losses
Q_{ref}	DHW draw-off energy
Q_{fuel}	Fuel consumption of water heater
Q_{el}	Electrical consumption of water heater
CC	Conversion coefficient to primary energy
Q_{ls}	Thermal losses of water heater

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1 PROJECT SUMMARY

The HARP project, Heating Appliances Retrofit Planning, aims at raising consumers awareness to the opportunities underlying the planned replacement of their old and inefficient heating appliance. This will be done by supporting the consumer in the identification of the energy (in)efficiency of their current heating equipment and the saving opportunities deriving from its replacement with a more energy efficient solution. The mission is to accelerate the European replacement rate for heating systems, actively contributing to the reduction of energy demand in buildings, in line with the energy efficiency targets set by the EU.

Now is the time to act and raise consumers' awareness about the opportunities of a planned replacement. Taking advantage of the energy label for space and water heating, we can mainstream the labelling concept to the installed heating stock, allowing to use a well-known support decision tool to communicate and motivate the consumer to replace its heating system with modern high-efficiency and renewable solutions. HARP accompanies the consumer decision process, providing an impartial message, based on the energy label and presenting the market solutions that respond to the consumer's heating needs, providing a quantified approach for economic and non-economic benefits and bridging the gap with the market providers and available national incentives. HARP is promoted by key knowledgeable partners in the fields of consumer behaviour, energy efficiency, heating solutions and business models, working directly with the consumer, or indirectly via professionals who are critical multiplying agents. Promoting dynamic efficient heating communities, where all the agents, from the supply to the demand side are committed to an efficient heating market, supporting the consumer to make smarter choices.

2 EXECUTIVE SUMMARY

This document describes the guideline for the application of the labelling methodologies for installed appliances described in the Deliverable D3.1 "Labelling methodologies and validation report". All the details regarding the methodologies' definition are described in the D3.1.

This document would be a step by step guide for the application of the methodologies.

Section 3 presents the methodology for SH appliances while section 4 presents the methodology for WH appliances.

3 LABELLING FOR INSTALLED SPACE HEATING APPLIANCES

This chapter presents the guideline for the labelling of the installed space heating appliances. The methodology is compliant to the European regulation 811/2013 [1,2].

The description will follow the flowchart of Figure 1. The labelling scheme foresees the possibility of a simplified calculation (for a common user) and a detailed calculation (for a professional user). The implementations of simplified and detailed calculation are described in parallel.

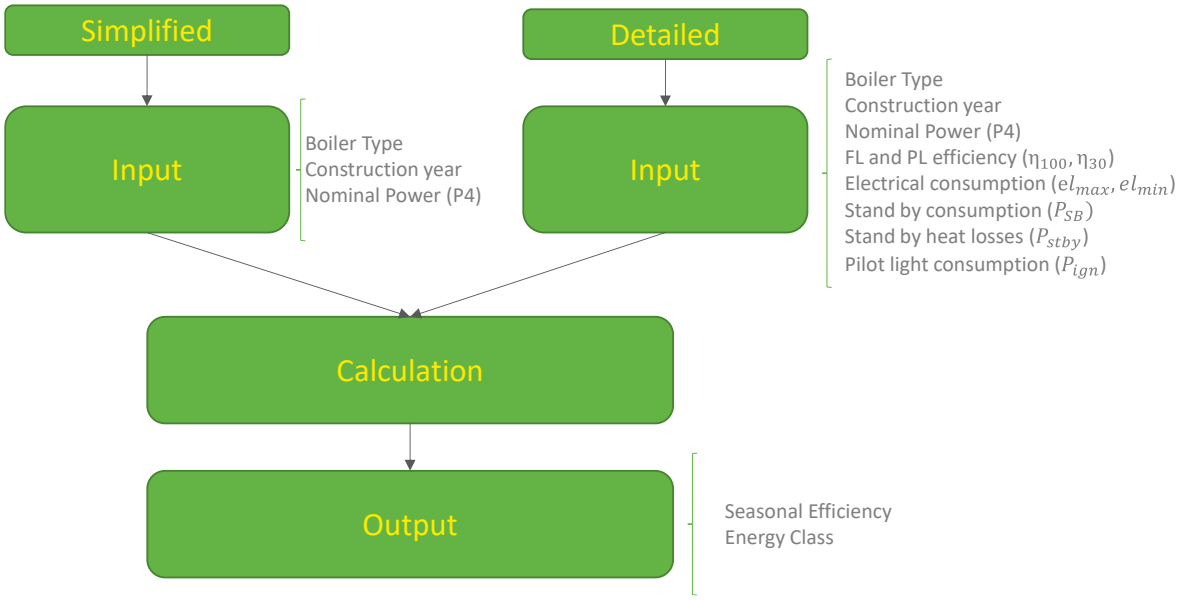

Figure 1 – Flow chart of old SH appliance labelling methodology.

3.1 Inputs

The first step is the collection of inputs.

Table 1 – Inputs of label of old SH appliances

	Simplified	**Detailed**
Input	Fuel Boiler Group Construction year Nominal Power (P4)	Fuel Boiler Group Construction year Nominal Power (P4) Full Load and Part Load efficiency (η_{100}, η_{30}) Electrical consumption (el_{max}, el_{min}) Stand by consumption (P_{SB}) Stand by heat losses (P_{stby}) Pilot light consumption (P_{ign})

The user should indicate which is the **fuel** of the appliance. Then, the user should indicate the **boiler group** that is distinguished into three categories:

- Standard
- Low temperature
- Condensing

The appliance' **construction year** and the **nominal power** are the other two parameters required for the simplified calculation.

Only the professional user, in the detailed calculation, need to indicate other more detailed parameters that can be read in the datasheet of the appliance or in the maintenance book. If in this case the parameter is not known, in the calculation it will be considered the same value of the simplified calculation.

The parameters that the professional user should indicate are

- Full load efficiency (η_{100})
- Part load efficiency (η_{30})
- Maximum electrical consumption at full load (el_{max})
- Minimum electrical consumption at part load (el_{min})
- Stand by consumption (P_{SB})
- Stand by heat losses (P_{stby})
- Pilot light consumption (P_{ign}) – if present the pilot light.

3.2 Calculation

The calculation steps indicated in Figure 2 are needed to calculate the seasonal efficiency.

Figure 2 – Calculation steps of SH appliances.

3.2.1 Default values

The first step in the calculation is the definition of default values that are used for the simplified calculation and for the missing parameters of the detailed calculation. The equations have been taken from EN 15316-4-1 [3] and the coefficients were defined through the validation work (see D3.1).

The default values are calculated according the equations presented in Table 2

Table 2 – Default values for old SH appliances

Part load efficiency	$\eta_{30} = c_3 + c_4 \cdot \log(P_n)$	Eq.1
Full load efficiency	$\eta_{100} = c_1 + c_2 \cdot \log(P_n)$	Eq.2
Thermal losses on stand-by	$P_{stby} = c_5 \cdot (P_n)^{c_6}$	Eq.3
Stand-by electric consumption	$P_{SB} = c_{7,SB} + c_{8,SB} \cdot (P_n)^{n_{SB}}$	Eq.4
Part load electric consumption	$el_{min} = c_{7,P1} + c_{8,P1} \cdot (P_n)^{n_{P1}}$	Eq.5
Full load electric consumption	$el_{max} = c_{7,Pn} + c_{8,Pn} \cdot (P_n)^{n_{Pn}}$	Eq.6
Pilot light consumption	$P_{ign} = 150\ W$	Eq.7

The coefficients c_1, c_2, c_3, c_4, c_5, c_6, c_7, c_8, n are defined in Table 3.

Table 3 – SH appliances. Coefficients used for the default values.

		C1	C2	C3	C4	C5	C6	C7_Pn	C8_Pn	n_Pn	C7_Pi	C8_Pi	n_Pi	C7_P0	C8_P0	n_P0
Standard	y<=1978	80.0	2.0	75.0	3.0	9.0	-0.3	0.0	45.0	0.5	0.0	15.0	0.5	15.0	0.0	0.0
Standard	1978<y<=1987	82.0	2.0	77.5	3.0	7.5	-0.3	0.0	45.0	0.5	0.0	15.0	0.5	15.0	0.0	0.0
Standard	1987<y<=1994	84.0	2.0	80.0	3.0	7.5	-0.3	0.0	45.0	0.5	0.0	15.0	0.5	15.0	0.0	0.0
Standard	y>1994	85.0	2.0	81.5	3.0	8.5	-0.4	0.0	45.0	0.5	0.0	15.0	0.5	15.0	0.0	0.0
Low Temperature	y<=1978	85.5	1.5	86.0	1.5	6.0	-0.3	40.0	0.1	1.0	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	1978<y<=1987	85.5	1.5	86.0	1.5	6.0	-0.3	40.0	0.1	1.0	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	1987<y<=1994	85.5	1.5	86.0	1.5	6.0	-0.3	40.0	0.1	1.0	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	y>1994	88.5	1.5	89.0	1.5	6.1	-0.4	40.0	0.4	1.0	20.0	0.1	1.0	15.0	0.0	0.0
Condensing	y<=1978	89.0	1.0	95.0	1.0	7.0	-0.4	0.0	45.0	0.5	0.0	15.0	0.1	15.0	0.0	0.0
Condensing	1978<y<=1987	89.0	1.0	95.0	1.0	7.0	-0.4	0.0	45.0	0.5	0.0	15.0	0.1	15.0	0.0	0.0
Condensing	1987<y<=1994	92.0	1.0	97.5	1.0	7.0	-0.4	0.0	45.0	0.5	0.0	15.0	0.1	15.0	0.0	0.0
Condensing	y>1994	93.0	1.0	98.0	1.0	4.0	-0.4	0.0	45.0	0.5	0.0	15.0	0.1	15.0	0.0	0.0
Biomass – pellet		Note1						40	2	1	40	1.8	1	15	0	0
Biomass – wood chip								60	2.6	1	70	2.2	1	15	0	0

Note 1: see Standard / low temperature / condensing. It changes only the auxiliar consumption.

3.2.2 Seasonal efficiency

The calculation steps indicated in Figure 3 are needed to calculate the seasonal efficiency.

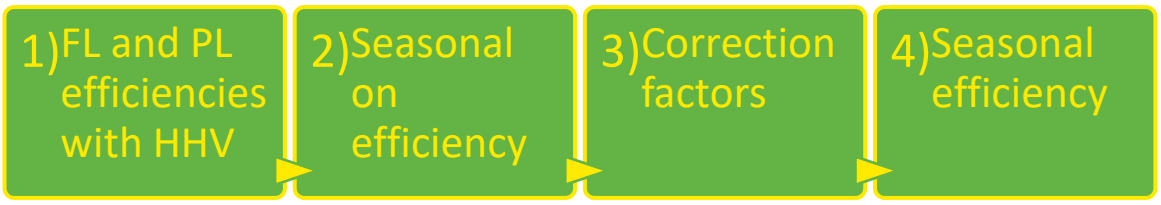

Figure 3 – Seasonal efficiency calculation steps of SH appliances.

3.2.2.1 Full load and Part Load Correction

The datasheets of old appliances and the default values give the full load and part load efficiency calculated with the lower heat value. To be compliant with the regulation 811/2013 the values of part load efficiency and the full load efficiency must be referred to the upper heat value. Therefore, the first step is the correction according to Eq.8 and Eq.9.

$$\eta_1 = \eta_{30} \cdot \frac{H_i}{H_s}$$

Eq.8

$$\eta_4 = \eta_{100} \cdot \frac{H_i}{H_s}$$

Eq.9

Where H_i, H_s represent lower and upper heat values.

As indicated in D3.1, in literature there are used different nomenclatures. To avoid misunderstanding, the following equations show the different possibilities. The subscript 30 represents the 30% of nominal power while the subscript 100 represent the nominal power.

$$P_1 = P_{30}$$

Eq.10

$$P_4 = P_{100} = P_n$$

Eq.11

$$H_i = LHV = NCV$$

Eq.12

$$H_s = HHV = GCV$$

Eq.13

3.2.2.2 Seasonal efficiency in active mode

The seasonal "on" efficiency is calculated weighting the part load efficiency and the full load efficiency according the Eq.14.

$$\eta_{son} = 0.85 \cdot \eta_1 + 0.15 \cdot \eta_4$$

Eq.14

3.2.2.3 Correction factors

The last step before the calculation of the seasonal efficiency, is the calculation of correction factors presented in Table 4.

Table 4 – Correction factors for old SH appliances

Aging coefficient	$C_{age} = f(age) < 1$ See Table 5	Eq.15
no temperature control	$F(1) = 3\%$	Eq.16
auxiliary electricity consumption	$F(2) = \frac{2.5 \cdot (0.15 \cdot el_{max} + 0.85 \cdot el_{min} + 1.3 \cdot P_{SB}) \cdot 100}{0.15 \cdot P_4 + 0.85 \cdot P_1}$	Eq.17
Standby heat losses	$F(3) = \frac{0.5 \cdot P_{stby} \cdot 100}{P_4}$	Eq.18
Pilot light	$F(4) = \frac{1.3 \cdot P_{ign} \cdot 100}{P_4}$	Eq.19

3.2.2.4 Seasonal efficiency

Table 5 – Degradation coefficient as a function of age. SH appliances.

Age	**Gas/Oil Boilers**		**Heat Pumps**		**Electric Boilers**	
Maintenance	Normal	Bad	Normal	Bad	Normal	Bad
<10	1.00	0.86	0.90	0.74	1.00	1.00
10-15	0.98	0.80	0.86	0.63	0.99	0.97
16-20	0.95	0.74	0.82	0.54	0.98	0.96
21-25	0.90	0.69	0.78	0.47	0.97	0.95
26-30	0.88	0.64	0.74	0.40	0.96	0.94
>30	0.87	0.59	0.70	0.34	0.95	0.93

The seasonal efficiency is calculated with Eq.20. The 3% of correction comes from the validation activities presented in the deliverable D3.1.

$$\eta_s = (\eta_{son} \cdot \boldsymbol{C_{age}} - \sum F_{(i)}) - 3\% \qquad \text{Eq.20}$$

3.2.3 Label

The last step is the definition of the label class. The class is defined depending on the seasonal efficiency with the use of Table 6.

Table 6 – Energy Label, classes efficiency boundaries. Source Regulation EU 811/2013.

A+++	$\boldsymbol{\eta > 150}$
A++	$125 \leq \eta < 150$
A+	$98 \leq \eta < 125$
A	$90 \leq \eta < 98$
B	$82 \leq \eta < 90$
C	$75 \leq \eta < 82$
D	$36 \leq \eta < 75$

Sources: Regulation EU 811/2013 – Annex VIII. Communication 2014/C 207/02 [12,13]. EN 15502-1 c.9.5 [20].

3.3 Output

With the calculations done in the previous section, the outputs are:

- Seasonal efficiency
- Energy Class

4 LABELLING FOR INSTALLED WATER HEATING APPLIANCES

This chapter presents the guideline for the labelling of the installed water heating appliances. The methodology is compliant to the European regulation 812/2013 [4].

The description will follow the flowchart of Figure 4. The labelling scheme foresees the possibility of a simplified calculation (for a common user) and a detailed calculation (for a professional user). The implementations of simplified and detailed calculation are described in parallel.

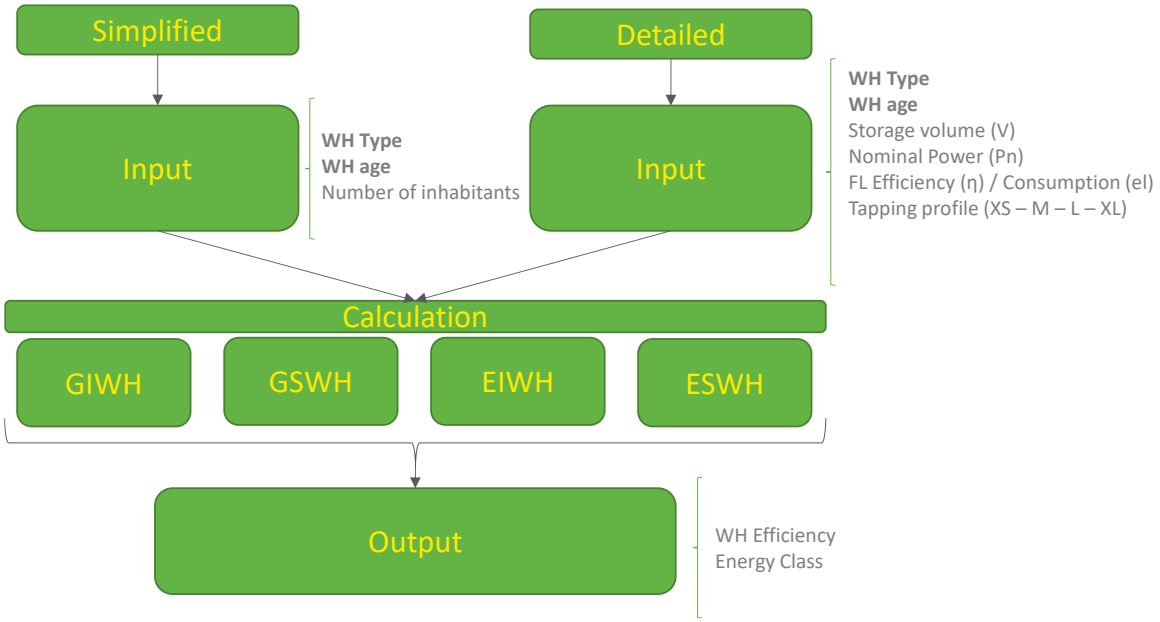

Figure 4 – Flow chart of WH appliances.

4.1 Inputs

The first step is the collection of inputs.

Table 7 – Input of label of WH appliances

	Simplified	**Detailed**
Input	WH type Construction year Number of inhabitants	WH Type Construction year Tapping profile (XS – M – L – XL) Storage volume (V)* Nominal Power (Pn) FL Efficiency (η)* Consumption (el)
** Some of those parameters depends on the WH type.*		

The user should indicate which is the **WH type** that is distinguished into four categories:

- Electric storage water heater ESWH
- Electric instantaneous water heater EIWH
- Gas storage water heater GSWH
- Gas instantaneous water heater GIWH

The appliance' **construction year** and the **number of inhabitants** are the other two parameters required for the simplified calculation.

Only the professional user, in the detailed calculation, need to indicate other more detailed parameters that can be read in the datasheet of the appliance or in the maintenance book. If in this case the parameter is not known, in the calculation it will be considered the same value of the simplified calculation.

The parameters that the professional user should indicate depends on the **WH type**.

Table 8 – Inputs required to a professional user for WH appliances.

ESWH	**EIWH**	**GSWH**	**GIWH**
Tapping profile (XS – M – L – XL).			
Storage volume (V)	Storage volume (V)	Storage volume (V)	*Not applicable*
Nominal Power (Pn)			
Full load efficiency (η_{100})			
Not applicable	*Not applicable*	FL electrical consumption (el_{max})	FL max electrical consumption (el_{max})
Not applicable	*Not applicable*	Stand by consumption (P_{SB})	Stand by consumption (P_{SB})

Note: EIWH always present a small volume of water even if a storage is not present.

4.2 Calculation

The calculation steps indicated in Figure 5 are needed to calculate the seasonal efficiency. Differently from Figure 2, the WHs need to follow a different calculation.

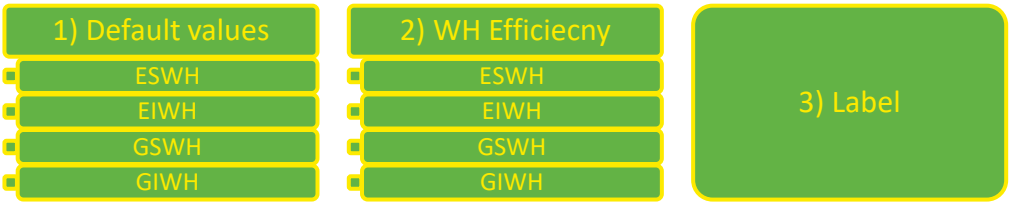

Figure 5 – Calculation steps of WH appliances.

4.2.1 Correlation of tapping profile with the number of inhabitants

The common user would not know which tapping profile is appropriate from the user. Therefore, for the simplified calculation the tapping profile is estimated from the number of inhabitants according to Table 9.

Table 9 – Correlation between tapping profiles and number of inhabitants.

	Energy	**N° of Inhabitants**
S	2.1 kWh/day	0
M	5.85 kWh/day	1 – 2
L	11.7 kWh/day	3 – 5
XL	19.1 kWh/day	6 – 8
XXL	24.5 kWh/day	9+

4.2.2 Default values

4.2.2.1 ESWH

For the simplified calculation, the tapping profile should be associated to the storage volume and the nominal power.

Table 10 – Correlation between tapping profiles and Volume and power of ESWH.

	Volume (L)	**Power (kW)**
XXS	5	1.2
XS	12	1.2
S	30	1.4
M	100	1.5
L	150	2
XL	500	6
XXL	650	8

4.2.2.2 EIWH

For the simplified calculation, the tapping profile should be associated to the internal volume and the nominal power.

Table 11 – Correlation between tapping profiles and Volume and power of EIWH.

	Volume (L)	**Power (kW)**
XXS	12	1.2
XS	12	1.2
S	28	1.5

4.2.2.3 GSWH

For the simplified calculation, the tapping profile should be associated to the storage volume and the nominal power. In the market there are not present GSWH with a tapping profile lower than M. Therefor for XXS to S tapping profiles the same values of M tapping profile can be used.

Table 12 – Correlation between tapping profiles and Volume and power of GSWH.

	Volume (L)	Power (kW)
XXS to S	80	5
M	80	5
L	140	7.5
XL	200	10
XXL	450	34

The default values for full load efficiency, electric consumption and stand-by consumption are the same of section 0.

4.2.2.4 GIWH

For the simplified calculation, the tapping profile should be associated to the nominal power that corresponds to a nominal volumetric flow. Only the nominal power will be used in the calculation.

Table 13 – Correlation between tapping profiles and volumetric flow and power of GIWH.

	Volumetric flow (L/min)	Power (kW)
XXS	5	9
XS	5	9
S	11	19
M	11	20
L	14	24
XL	17	30
XXL	25	55

Default values:

$$\eta_{100} = c_1 + c_2 \cdot \log(P_n)$$

Eq.21

$$el_{max} = c_{7,Pn} + c_{8,Pn} \cdot (P_n)^{n,Pn}$$

Eq.22

$$P_{SB} = c_{7,P0} + c_{8,P0} \cdot (P_n)^{n,P0}$$

Eq.23

$c_1, c_2, c_3, c_4, c_5, c_6, c_7, c_8$ defined in the standard as a function of boiler type

$$\eta_4 = \eta_{100} \cdot H_i/H_s$$

Eq.24

Where H_i, H_s represent lower and upper heat values.

Table 14 – Gas WH appliances. Coefficients used for the default values.

		C1	C2	C7_Pn	C8_Pn	n_Pn	C7_P0	C8_P0	n_P0
Standard	y<=1978	80.0	2.0	0.0	45.0	0.5	15.0	0.0	0.0
Standard	1978<y<=1987	82.0	2.0	0.0	45.0	0.5	15.0	0.0	0.0
Standard	1987<y<=1994	84.0	2.0	0.0	45.0	0.5	15.0	0.0	0.0
Standard	y>1994	85.0	2.0	0.0	45.0	0.5	15.0	0.0	0.0
Low Temperature	y<=1978	85.5	1.5	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	1978<y<=1987	85.5	1.5	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	1987<y<=1994	85.5	1.5	40.0	0.1	1.0	15.0	0.0	0.0
Low Temperature	y>1994	88.5	1.5	40.0	0.4	1.0	15.0	0.0	0.0
Condensing	y<=1978	89.0	1.0	0.0	45.0	0.5	15.0	0.0	0.0
Condensing	1978<y<=1987	89.0	1.0	0.0	45.0	0.5	15.0	0.0	0.0
Condensing	1987<y<=1994	92.0	1.0	0.0	45.0	0.5	15.0	0.0	0.0
Condensing	y>1994	93.0	1.0	0.0	45.0	0.5	15.0	0.0	0.0
Biomass – pellet		Note1		40	2	1	15	0	0
Biomass – wood chip		Note1		60	2.6	1	15	0	0

Note 1: see Standard / low temperature / condensing. It changes only the auxiliar consumption.

4.2.2.5 Thermal losses - WHs with storage

To calculate the energy losses of storage WHs, the equations have been taken from EN 15316-5:

$$H = \frac{1000}{c_4 \cdot c_5} \cdot (c_1 + c_2 \cdot V^{c_3})$$

Eq.25

$$Q_{ls} = f_{sto,dis,ls} \cdot \frac{H}{1000} \cdot (\vartheta_{set} - \vartheta_{amb}) \cdot t$$

Eq.26

Where:
V is the volume

H [W/K] is the heat losses coefficient

$\vartheta_{amb} = 16\ °C$ is the ambient temperature

$\vartheta_{set} = 55\ °C$ is the storge set temperature

$t = 24\ h$ is the time

$f_{sto,dis,ls} = 1$ for new products

$f_{sto,dis,ls} = 3$ for old products

The coefficients c_1, c_2, c_3, c_4, c_5 are defined in Table 15 as a function of WH type.

Table 15 – Default values for heat losses depending on the type of storage.

EN 15316-5	Table B.2 - Default values depending on the type of storage				
Storage Type	**C1**	**C2**	**C3**	**C4**	**C5**
Electric storage heater; V > 75 l	0.939	0.0104	1	45	24
Electric storage heater; V < 75 l	0.1474	0.0719	0.67	45	24
Solar storage	0	0.16	0.5	1000	1
Electric storage heater with back-up	0.1474	0.0719	0.67	45	24

4.2.3 Water heater efficiency

The calculation steps indicated in Figure 6 are needed to calculate the seasonal efficiency.

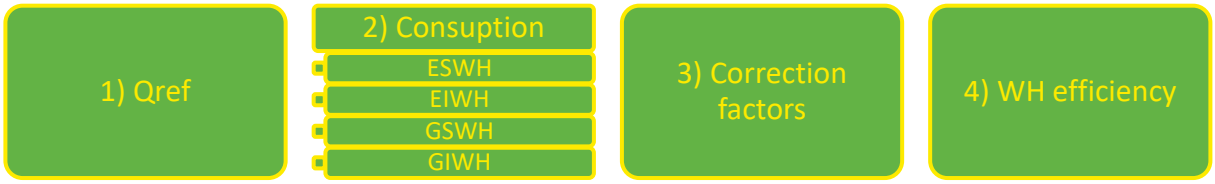

Figure 6 – WH efficiency calculation steps of WH appliances.

4.2.3.1 DHW draw-off energy - Qref

The reference load is taken from the tapping profile.

Table 16 – Correlation between tapping profiles and Volume and power of ESWH.

	Qref (kWh/day)
3XS	0.345
XXS	2.1
XS	2.1
S	2.1
M	5.845
L	11.655
XL	19.07
XXL	24.53

4.2.3.2 EIWH and ESWH consumption

The electrical consumption is calculated with Eq.27 while the fuel consumption is zero. The η can be considered equal to 1.

$$Q_{el} = \frac{Q_{ref} + Q_{ls}}{\eta}$$

Eq.27

4.2.3.3 GSWH consumption

The fuel and electricity consumptions are calculated with the following equations:

$$Q_{fuel} = \frac{Q_{ref} + Q_{ls}}{\eta_4}$$

Eq.28

$$Q_{el} = el_{max} \cdot \vartheta_{on} + P_{sb} \cdot \vartheta_{off}$$

Eq.29

Where $\vartheta_{on} = 2\ h$ and $\vartheta_{off} = 22\ h$.

4.2.3.4 GIWH consumption

The fuel and electricity consumptions are calculated with the following equations:

$$Q_{fuel} = \frac{Q_{ref}}{\eta_4}$$

Eq.30

$$Q_{el} = el_{max} \cdot \vartheta_{on} + P_{sb} \cdot \vartheta_{off}$$

Eq.31

Where $\vartheta_{on} = 2\ h$ and $\vartheta_{off} = 22\ h$. If the water heater is not connected to the electric grid, the Qel can be considered 0.

4.2.3.5 WH correction factors

Table 17 – Correction factors for new WH appliances

Qcorr	Electrical	$Q_{corr} = -k \cdot CC \cdot (Q_{el} - Q_{ref})$	Eq.32
	Conventional	$Q_{corr} = -k \cdot (Q_{fuel} - Q_{ref})$	Eq.33
	Heat Pumps	$Q_{corr} = -k \cdot 24 \cdot P_{stby}$	Eq.34
k	From 3XS to XL k=0.23, for XXL k=0		Eq.35
CC	Conversion coefficient to primary energy CC = 2.5		

Source: Regulation EU 812/2013 – Annex VIII [23].

Table 18 – Degradation coefficient as a function of age. WH appliances.

Age	Gas/Oil Boilers		Heat Pumps		Electric Boilers	
Maintenance	Normal	Bad	Normal	Bad	Normal	Bad
<10	1.00	0.86	0.90	0.74	1.00	1.00
10-15	0.98	0.80	0.86	0.63	0.99	0.97
16-20	0.95	0.74	0.82	0.54	0.98	0.96
21-25	0.90	0.69	0.78	0.47	0.97	0.95
26-30	0.88	0.64	0.74	0.40	0.96	0.94
>30	0.87	0.59	0.70	0.34	0.95	0.93

4.2.3.6 WH efficiency

Finally, the WH efficiency can be calculated.

$$\eta_{WH} = \frac{Q_{ref}}{(Q_{fuel} + CC \cdot Q_{el}) + Q_{corr}} \cdot \boldsymbol{C_{age}}$$

Eq.36

4.2.4 Label

The last step is the definition of the label class. The class is defined depending on the seasonal efficiency and the tapping profile according to Table 19 which presents the lower class limit. For example, an appliance with M tapping profile with $\eta_{WH} = 60\%$ is rated as "B class".

Table 19 – Energy Label, lower class limit. Efficiency [%]. Source Regulation EU 812/2013.

	3XS	XXS	XS	S	M	L	XL	XXL
A+++	62	62	69	90	163	188	200	213
A++	53	53	61	72	130	150	160	170
A+	44	44	53	55	100	115	123	131
A	35	35	38	38	65	75	80	85
B	32	32	35	35	39	50	55	60
C	29	29	32	32	36	37	38	40
D	26	26	29	29	33	34	35	36
E	22	23	26	26	30	30	30	32
F	19	20	23	23	27	27	27	30

4.3 Output

With the calculations done in the previous section, the outputs are:

- Water heater efficiency
- Class

5 REFERENCES

[1] EC, Commission delegated regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device, (2013).

[2] EC, Commission communication in the framework of the implementation of Commission Regulation (EU) No 813/2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters and of Commission Delegated Regulation (EU) No 811/2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device, (2014).

[3] EN 15316-4-1:2017, Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1, European Committee for Standardization, Brussels, Belgium, 2017.

[4] EC, Commission delegated Regulation (EU) No 812/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device, (2013).