SAVELEC calculation tool – User manual

Document SE_WP2DGC02
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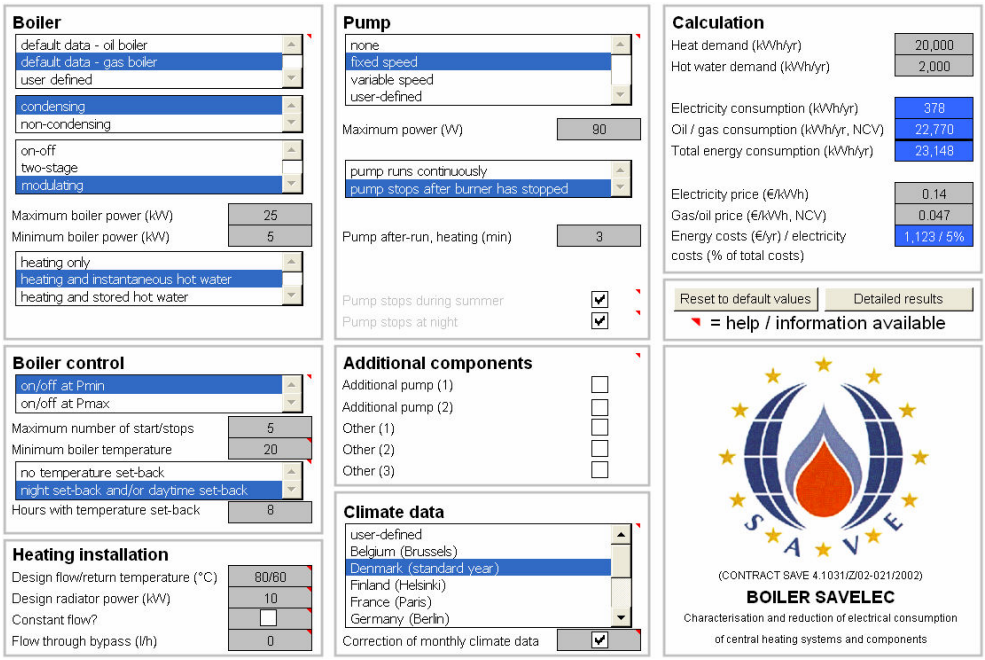
1. Introduction

The SAVELEC calculation method aims to predict the annual electricity consumption of boilers as accurately as possible and to give insight in the consequences of different types of control, different pumps, etc. The results should be considered as an indication of what may be obtained under idealised conditions, rather than as a guaranteed figure. As with any calculation the results depend on both the input parameters and the assumptions made. The background for the calculation and the assumptions are described in document SE_WP1DGC06 (Annnex B of the WP1 report).

The SAVELEC calculation method is available as an Excel spreadsheet. The spreadsheet must be opened with macros in order to obtain full functionality.



The main menu consists of six input field (for boiler, boiler control, heating installation, additional components and climate data) and the main results of the calculation. Detailed results are given on a separate page.

The next sections describe the input field and result pages, as well as the default values used for the calculation.

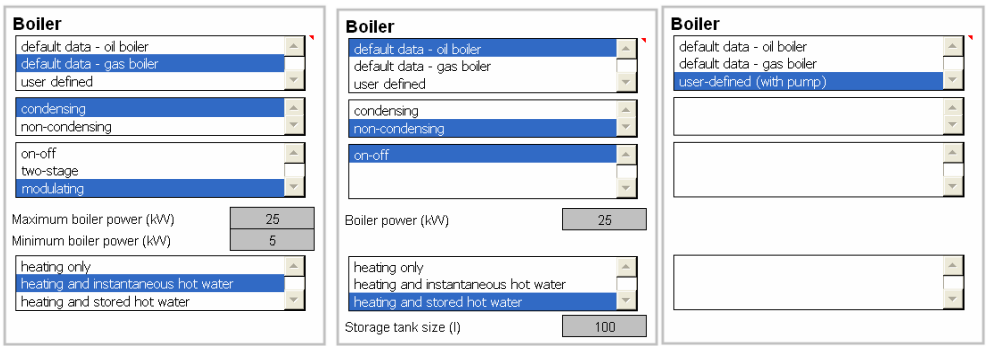
2. Boiler

The SAVELEC spreadsheet contains default values for two oil boilers (one condensing and one non-condensing) and two gas boilers (also condensing and non-condensing). The gas boiler may be on-off controlled, two-stage or modulating. The oil boiler is always on-off controlled.

The type of boiler and control are selected in the 'boiler' section of the main menu. For two-stage and modulating boilers both the minimum and maximum boiler power must be specified. For on-off boilers there is, of course, only one input field.

The boilers may be used for heating only or for heating and hot water production (instantaneous or storage). In case of hot water storage the size of the hot water storage tank must be specified. This value is used for the calculation of the hot water efficiency.

In addition to using default values, it is also possible to use specific boiler data. This option is further described in section 2.1. With user-defined boiler data all information about the boiler is given on a separate sheet. Therefore the remaining part of the 'boiler' section in the main menu is empty.



2.1 User-defined boiler data

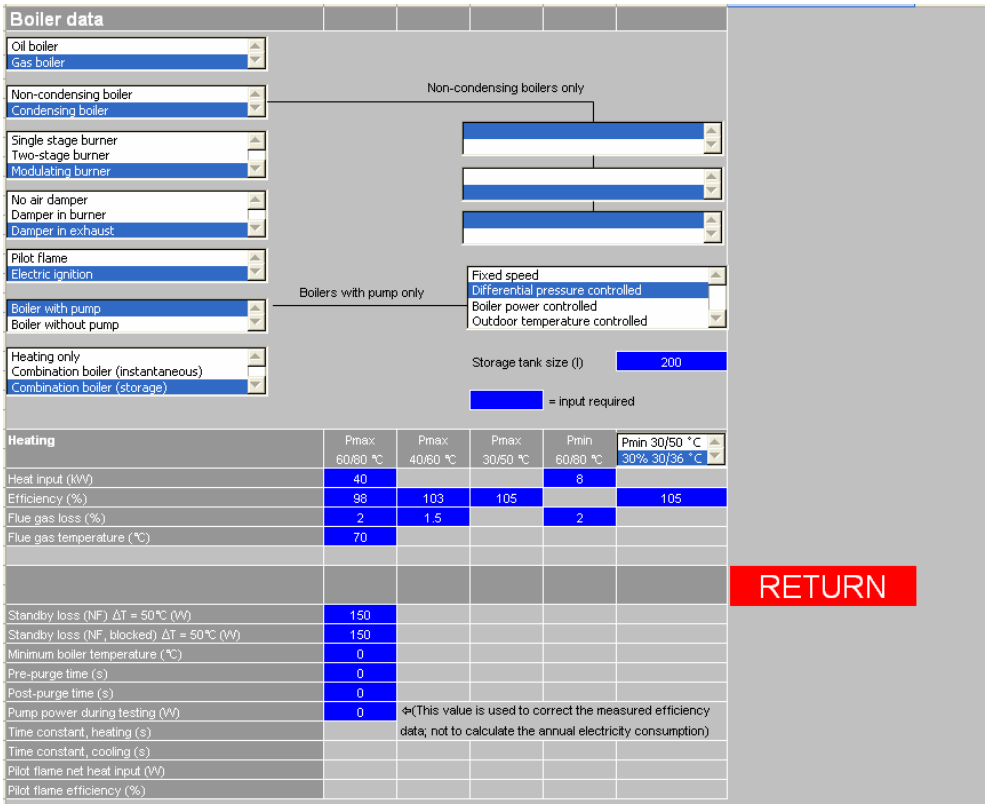
All the blue input fields in sheet boiler data are required.

- Oil boiler / gas boiler: this information is used for the calculation of hot water efficiency
- Non-condensing / condensing, single stage / 2-stage / modulating, no air damper / damper, pilot flame / electric ignition and the three input fields under 'non-condensing boilers only' (fan assisted / not fan assisted, open / closed air supply, forced draught / not forced draught): this information is used in the Boilsim efficiency calculation.
- Boiler with pump / boiler without pump: any pump selected here replaces the pump from the 'pump' section in the main menu (see section 5)
- Fixed speed / differential pressure controlled / boiler power controlled / outdoor temperature controlled: this information is used in the calculation of the pump power at different

operating conditions. There are different input parameters for the four types of pumps (see below).

- Heating only / combination boiler: this information is used for the calculation of hot water efficiency.
- Heat input / efficiency / flue gas losses / flue gas temperature: the input is used for the calculation of Boilsim parameters. The nominal temperatures are used in the calculation.
- Standby loss, minimum boiler temperature, purge times and (for non-condensing boilers) time constants : these parameters are used in the Boilsim efficiency calculation
- Pump power during testing: this parameter is used in the Boilsim calculation to correct the measured efficiency data. The value does not have to be the same as the value used for the calculation of annual electricity consumption (see below)
- pilot flame heat input and efficiency: this input is used in the Boilsim calculation (Boilers with pilot flame only).

For explanation of the various Boilsim input parameters we refer to www.boilsim.com.



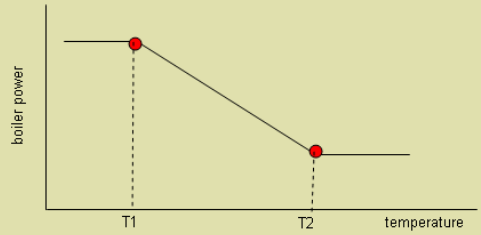
Electricity consumption						
Electricity consumption, Pmax heating (W)	120					
Electricity consumption, Pmin heating (W)	100					
Electricity consumption, Pmax hot water (W)	120	(combination boilers only)				
Electricity consumption, pump after-run heating (W)	90	(value must be equal to standby electricity consumption for boilers without pump)				
Electricity consumption, pump after-run hot water (W)	90	(boilers with storage tank only)				
Standby electricity consumption (W)	0					
Electricity consumption per start/stop operation (Wh)	0					
Additional information, differential pressure controlled pump						
Pump power at nominal flow (W)	80					
Pump power at zero flow (W)	60					

differential pressure control:

The pump power at different flows is interpolated between the power at the nominal flow through the heating installation (i.e. the flow corresponding to the defined radiator power and ΔT) and the power at zero flow. This information can be obtained from the pump curves which are supplied by the pump manufacturer. In case the power at nominal flow is unknown, use the maximum ´pump power. When no value for the power at zero flow is filled in, it is assumed that the power at zero flow is 50 % of the power at nominal flow.

outdoor temperature control:

It is assumed that the pump power decreases linearly between temperatures T1 and T2.
At temperatures below T1 and above T2 the pump power is assumed to be constant.

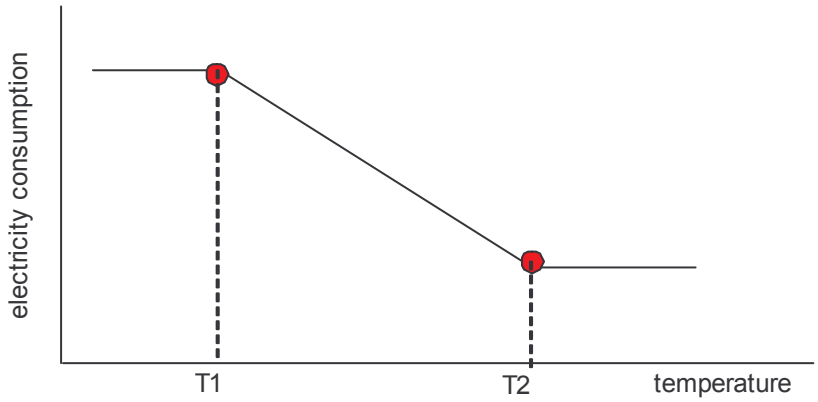


The electricity consumption at different operating conditions is calculated from the consumption at the maximum power for heating, the minimum power for heating (2-stage and modulating boilers), the maximum power for hot water consumption (combination boilers), during pump after-run (boilers with pump), during standby operation and at start/stop of the boiler.

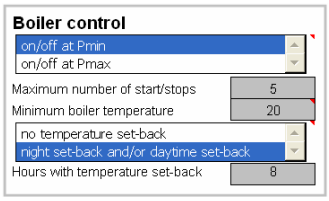
Additional information is required for differential pressure controlled pumps and for outdoor temperature controlled pumps.

For differential pressure controlled pumps the pump power at different flows is interpolated between the power at the nominal flow through the heating installation (i.e. the flow corresponding to the defined radiator power and ΔT, see section 4) and the power at zero flow. This information can be obtained from the pump curves which are supplied by the pump manufacturer. In case the power at nominal flow is unknown, use the maximum pump power. When no value for the power at zero flow is filled in, it is assumed that the power at zero flow is 50 % of the power at nominal flow.

For outdoor temperature controlled umps, it is assumed that the pump power decreases linearly between temperatures T1 and T2. At temperatures below T1 and above T2 the pump power is assumed to be constant.



3. Boiler control



On/off at Pmin / Pmax

This option influences the operating time for modulating boilers only.

"On/off at Pmin" means that the boiler runs at minimum power for short periods of time when the heat demand is lower than Pmin. The number of start/stops of the boiler is determined by the parameter below. Similarly "on/off at Pmax" means that the boiler runs at maximum power when the heat demand is below Pmin. It is assumed that the boiler runs continuously when the heat demand is above Pmin.

Choose "on/off at Pmin" if the boiler starts at minimum power and gradually increases the power until the required temperature is achieved. Otherwise choose "on/off at Pmax".

Maximum number of start/stops

This parameter has a large influence on the result of the calculation when the pump stops after the boiler has stopped (see section 5).

Five start/stops per hour is a reasonable figure for correctly installed boilers that are controlled by a heating curve. The number of starts/stops may be lower for boilers that are controlled by a room thermostat.

For incorrectly installed boilers (e.g. too low flow) the number of start/stops may be as high as 20 per hour.

Minimum boiler temperature

This parameter influences the calculated temperatures and flow in the heating installation. A higher minimum boiler temperature results in a lower flow (provided that the constant flow option is not selected and there is no bypass, see section 4). This reduces the electricity consumption, in particular for differential pressure controlled pumps. However, the higher temperature decreases the boiler efficiency, resulting in increased total energy consumption.

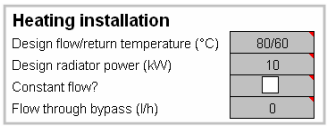
Temperature set-back

When the night set-back and/or daytime set-back option is chosen, the calculation takes into account that the boiler is switched of during for example 8 hours per day. Depending on the selected pump settings, the pump may also be switched off during these 8 hours, resulting in lower electricity consumption.

However, as part of the heat is generated at a relatively high boiler temperature (during reheating in the morning) the boiler efficiency will be lower. The SAVELEC spreadsheet generally calculates a higher total energy consumption when night set-back is applied. **This is only true when the annual heat demand is the same with and without night set-back**.

The user **must** correct for changes in the annual heat demand due the night set-back.

4. Heating installation



Design flow/return temperature

Specify the design temperatures of the heating installation in the format flow temperature/return temperature (e.g. 80/60 or 90/70). The two temperatures must be separated by “/”; other signs are not allowed!

Design radiator power

Specify the radiator power at the design temperatures. Use a lower number if part of the radiators is always closed.

Constant/variable flow

The nominal flow through the heating installation corresponds to the design radiator power and the difference between design flow and return temperature. When the constant flow option is chosen, the model assumes that the flow through the heating installation is always maintained at

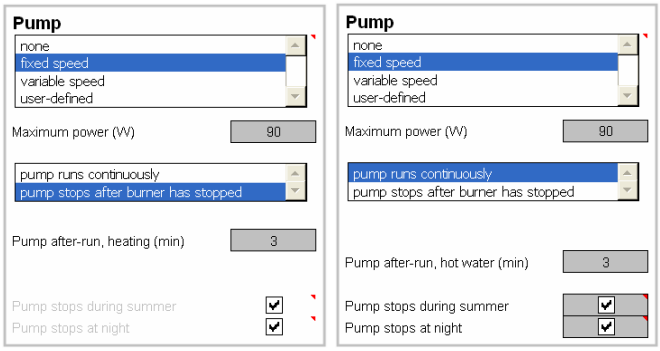
the design value (unless the flow through the bypass is larger; see next option). Otherwise the flow will decrease when the heat demand decreases.

Flow through bypass

This value determines the minimum flow through the radiator system.

When the flow through the bypass is larger than the nominal flow through the radiator system (860 * radiator power / ΔT) the flow will be constant during the whole heating season. Otherwise the flow will be constant at low heat demand and increase at higher heat demand.

5. Pump



Pump: none / fixed speed / variable speed / user-defined

This option is available only in combination with a default oil or gas boilers from the 'boiler' section or in combination with a user-defined boiler without pump (see section 2.1).

For a fixed-speed pump it is assumed that the pump power varies from the specified maximum pump power at the nominal flow through the heating installation to 75 % of the maximum power at zero flow. For a variable speed pump it is assumed that the power decreases down to 50 % of the maximum power at zero flow.

Pump runs continuously / stops when burner stops

The pump control strategy has a major effect on the annual electricity consumption. Please note that it also influences the oil / gas consumption (electricity is replaced by oil / gas and vice versa) and the control strategy may have an effect on comfort. The latter is not included in the SAVELEC model!

For a continuously running pump, it must be specified whether the pump is switched off during summer and / or during night. In case the pump stops after the burner has stopped, the pump after-run time for heating must be given.

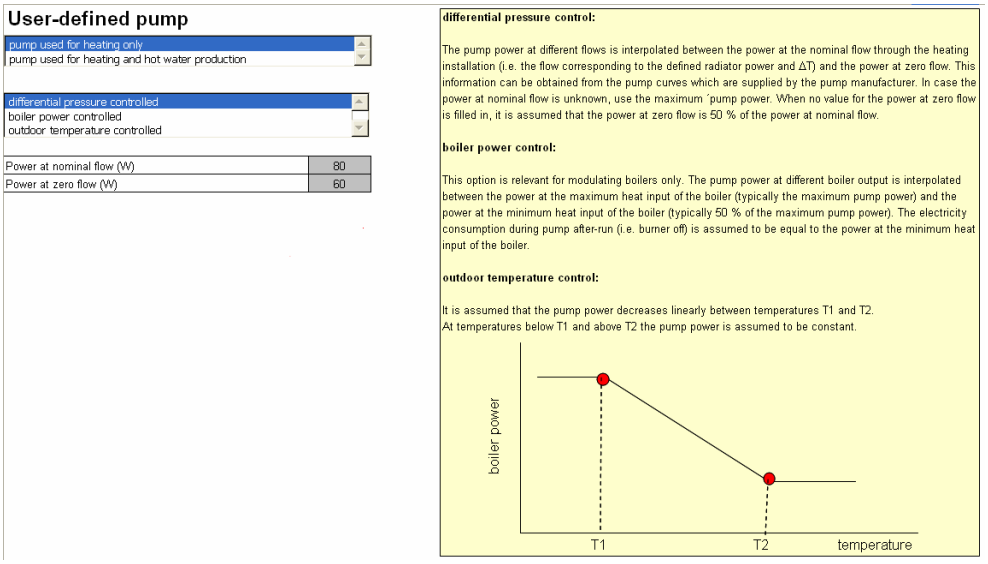
For hot water storage boilers (heating and stored hot water) the pump after-run time for hot water production must always be specified, also for a continuously running pump.

5.1 User-defined pump

The options for the user-defined pump are differential pressure controlled, boiler power controlled and outdoor temperature controlled.

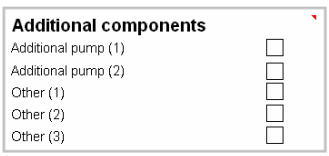
For information about differential pressure or outdoor temperature controlled pumps see section 2.1.

In case of a boiler power controlled pump, the pump power at different boiler output is interpolated between the power at the maximum heat input of the boiler (typically the maximum pump power) and the power at the minimum heat input of the boiler (typically 50 % of the maximum pump power). The electricity consumption during pump after-run (i.e. burner off) is assumed to be equal to the power at the minimum heat input of the boiler.
This option is relevant for modulating boilers only.

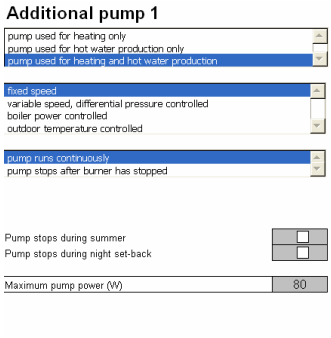


6. Additional components

This option allows for up to 2 additional pumps (e.g. a separate pump for hot water production and an extra pump for a floor heating system) and up to 3 other electrical components.



6.1 Pumps



The parameters for the additional pumps 1 and 2 are specified in 2 separate sheets.

The parameters for the additional pumps are independent of the choices in the main menu. This means that you must specify **for each pump**, whether the pump is running continuously, stops during summer, etc.

The options are the same as for the main pump (see section 5 / 5.1).

6.2 Other components

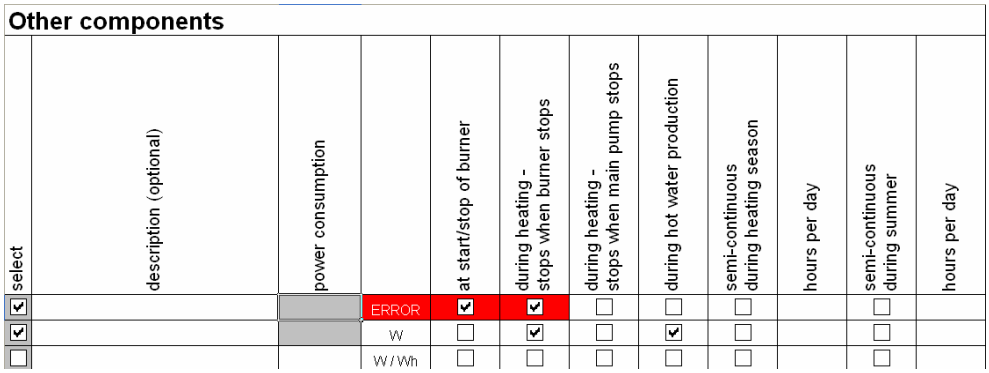
The parameters for the 3 ‘other’ components are specified in a single sheet.

Click on the box(es) under ‘select’ if the component must be included in the calculation. When a description is given (optional) this is also displayed in the main menu.

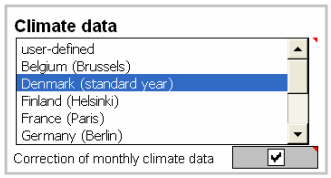
For each of the selected components the power consumption must be given, and it must be specified whether power consumption occurs:

1 at start/stop of the burner
2 during heating, when the burner is on
3 during heating, when the main pump is on
4 during hot water production
5 semi-continuously during the heating season (with an extra input field for the number of hours per day)
6 semi-continuously during summer (with an extra input field for the number of hours per day)

In some cases multiple selections are allowed, e.g. options 2 + 4. When multiple selections are not allowed, this is clearly marked.



7. Climate data



The SAVELEC spreadsheet contains climate data for Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Sweden and United Kingdom. Most of these data are monthly values, which may include a low number of degree days during all or some summer months.

In order to prevent that months with a low number of degree days are considered to be part of the heating season in stead summer, the calculation tool has an option to correct monthly climate data. This option is described in document SE_WP1DGC06 (Annex B of the WP1 report).

In addition to the default climate data it is also possible to define climate data with the heating season divided in up to 20 steps. Monthly climate data **must** be in the order January, February, March, etc. Otherwise the 'correction of monthly climate data' options does not work properly.

Climate data (maximum 20 climate steps)				
reference temperature		17		
design temperature		-12		
annual heat demand (kWh)		20000		(data from sheet SAVELEC)
	number of hours	temperature (°C)	degree hours	heat demand (kW)
heating	744	2.5	10800	4.51
season	672	3.1	9312	4.30
	744	6.1	8112	3.39
	720	8.9	5856	2.53
	744	12.1	3648	1.52
	720	15.0	1440	0.62
	744	17.0	0	0.00
	744	17.0	0	0.00
	720	14.4	1872	0.81
	744	10.6	4752	1.98
	720	5.6	8232	3.55
	744	3.1	10368	4.33
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
	0	0.0	0	0.00
summer	0	17	0	0.00

8. Calculation

Calculation	
Heat demand (kWh/yr)	20,000
Hot water demand (kWh/yr)	2,000
Electricity consumption (kWh/yr)	378
Oil / gas consumption (kWh/yr, NCV)	22,770
Total energy consumption (kWh/yr)	23,148
Electricity price (€/kWh)	0.14
Gas/oil price (€/kWh, NCV)	0.047
Energy costs (€/yr) / electricity costs (% of total costs)	1,123 / 5%

The annual electricity consumption, oil / gas consumption and total energy consumption are calculated for the specified annual heat and hot water demands.

The total energy costs are calculated for the specified electricity and oil/gas prices. The currency (€/kWh and €/yr in the above example) depends on your computer settings.

9. Detailed results

Reset to default values | Detailed results

= help / information available

annual heat demand (kWh)	20000
degree hours	64392
reference temperature	17
design temperature	-12
heat demand per degree hour (kW)	0.311
design radiator size (kW)	10.00
n	1.3
Tflow, nominal	80
Tflow, minimum	20
Treturn	60
Troom	20
design flow	430
constant flow?	☐
minimum flow	0

OIL / GAS CONSUMPTION

	step	number of hours	n_corr1	night set-back	reheating after night	n corr2	degree hours	heat demand	Tflow	Tret	flow	Tamb	load control	cycles per hour	pump power	pump after-run	part-load efficiency
heating season	1	744	737.1	245.7	205.2	286.2	10800	4.55	52.7	36.1	235	20	4.99	1.60	79	180	104.9
	2	672	665.7	221.9	170.5	273.4	9312	4.34	51.6	35.2	228	20	4.99	2.25	78	180	105.0
	3	744	737.1	245.7	127.6	363.8	8112	3.42	46.3	31.1	194	20	4.99	4.32	76	180	106.6
	4	720	713.3	237.8	81.4	394.1	5856	2.55	41.0	27.3	161	20	4.99	5.00	74	180	108.2
	5	744	737.1	245.7	44.6	446.7	3648	1.54	34.2	23.3	121	20	4.99	4.26	74	180	109.0
	6	294	290.9	97.0	17.6	176.3	1440	1.54	34.2	23.3	121	20	4.99	4.26	68	180	108.8
	7	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	8	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	9	293	290.4	96.8	24.2	169.3	1872	2.00	37.4	25.1	140	20	4.99	4.81	75	180	109.1
	10	744	737.1	245.7	61.5	429.9	4752	2.00	37.4	25.1	140	20	4.99	4.81	78	180	109.1
	11	720	713.3	237.8	132.8	342.7	8232	3.58	47.3	31.8	200	20	4.99	4.05	79	180	106.3
	12	744	737.1	245.7	190.6	300.7	10368	4.37	51.7	35.3	229	20	4.99	2.18	68	180	104.9
	13	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	14	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	15	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	16	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	17	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	18	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	19	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
	20	0	0.0	0.0	0.0	0.0	0	0.00	20.0	20.0	0	20	4.99	0.00	0	0	100.0
night set-back	21	0	0.0	2119.7			0	0.00	20.0	20.0		20	0.00	0.00		0	
heating after night set-back	22	0	0.0		1056.1		0	10.00	80	60.0	430	20	10.00	0.00	95	3600	96.4
summer	23	2341	2298.7			2298.7	0	0.00	20.0	20.0	0	20	0.00	0.00		0	

annual efficiency (heating) 101

annual hot water demand (kWh)	2000
hot water efficiency, heating season	98.0
heating efficiency, summer	50.3
annual (hot water) efficiency	78.2
pump after-run, % of time	0.000

	step		number of hours (1)
hot water production	24		102

= climate
= operating times
= operating conditions
= electricity consumption
= efficiency

detailed results, boiler

burner on, reheating		burner on, normal load		burner off, pump on		burner off, pump off		burner	
hours	P (W)	hours	P (W)	hours	P (W)	hours	P (W)	start/stop	Q (Wh)
17.9	27.4	0.0	24.8	0.0	7.0	5.7	7.0	0	0.0
49.8	27.4	0.0	24.2	0.0	7.0	21.1	7.0	0	0.0
15.9	27.4	0.0	23.8	0.0	7.0	7.7	7.0	0	0.0
81.3	27.4	13.2	23.3	0.0	7.0	47.3	7.0	0	0.0
69.7	27.4	24.8	22.9	0.0	7.0	47.3	7.0	0	0.0
167.7	27.4	131.7	22.1	0.0	7.0	149.7	7.0	0	0.0
178.2	27.4	42.1	42.0	66.4	7.0	304.2	7.0	259	0.0
261.2	27.4	79.6	42.0	129.3	7.0	617.2	7.0	444	0.0
170.3	27.4	63.5	42.0	106.3	7.0	558.1	7.0	315	0.0
102.3	27.4	44.7	42.0	76.9	7.0	461.6	7.0	194	0.0
68.3	27.4	34.8	42.0	61.5	7.0	450.0	7.0	125	0.0
24.4	27.4	13.7	42.0	24.8	7.0	220.7	7.0	41	0.0
7.1	27.4	4.9	42.0	9.2	7.0	167.9	7.0	8	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
0.0	27.4	0.0	42.0	0.0	7.0	0.0	7.0	0	0.0
				0.0	7.0	3408.0	7.0		
		101.0	42.0	50.8	7.0				

Detailed results of the calculations are available in a separate sheet. This sheet contains information about the operating time and electricity consumption of all components during all climate steps.

10. Default values

The following default values are implemented in the spreadsheet:

Oil boiler – non-condensing

Heat input, Pmax (kW)	user-defined
Heat input, Pmin (kW)	-- (on/off boiler)
Efficiency, Pmax 60/80 ºC (%)	93
Efficiency, Pmax 40/60 ºC (%)	94
Efficiency, Pmax 30/50 ºC (%)	-- (non-condensing boiler)
Efficiency, 30% 30/36 ºC (%)	-- (non-condensing boiler)
Flue gas loss, Pmax 60/80 ºC (%)	6
Flue gas loss, Pmax ´40/60 ºC (%)	5.5
Flue gas loss, Pmin 60/80 ºC (%)	-- (on/off boiler)
Flue gas temperature, Pmax 60/80 ºC (ºC)	150
Standby loss (W)	170
Standby loss, blocked (W)	150
Minimum boiler temperature (ºC)	user-defined
Pre-purge time (s)	15
Post-purge time (s)	0
Time constant, heating (s)	200
Time constant, cooling (s)	200
Electricity consumption, Pmax heating (W)	280 (boiler without pump)
Electricity consumption, Pmin heating (W)	-- (on/off boiler)
Electricity consumption, Pmax hot water (W)	280
Electricity consumption, pump after-run heating (W)	5
Electricity consumption, pump after-run hot water (W)	5
Standby electricity consumption (W)	5
Electricity consumption per start/stop operation (Wh)	1

Oil boiler – condensing

Heat input, Pmax (kW)	user-defined
Heat input, Pmin (kW)	-- (on/off boiler)
Efficiency, Pmax 60/80 ºC (%)	97
Efficiency, Pmax 40/60 ºC (%)	102
Efficiency, Pmax 30/50 ºC (%)	104
Efficiency, 30% 30/36 ºC (%)	104
Flue gas loss, Pmax 60/80 ºC (%)	2.5
Flue gas loss, Pmax 40/60 ºC (%)	1
Flue gas loss, Pmin 60/80 ºC (%)	-- (on/off boiler)
Flue gas temperature, Pmax 60/80 ºC (ºC)	75
Standby loss (W)	180
Standby loss, blocked (W)	170
Minimum boiler temperature (ºC)	user-defined
Pre-purge time (s)	15
Post-purge time (s)	0
Time constant, heating (s)	-- (condensing boiler)
Time constant, cooling (s)	-- (condensing boiler)
Electricity consumption, Pmax heating (W)	240 (boiler without pump)
Electricity consumption, Pmin heating (W)	155
Electricity consumption, Pmax hot water (W)	-- (on/off boiler)
Electricity consumption, pump after-run heating (W)	20
Electricity consumption, pump after-run hot water (W)	20
Standby electricity consumption (W)	20
Electricity consumption per start/stop operation (Wh)	0.5

Gas boiler – non-condensing

Heat input, Pmax (kW)	user-defined
Heat input, Pmin (kW)	user-defined
Efficiency, Pmax 60/80 ºC (%)	89
Efficiency, Pmax 40/60 ºC (%)	90
Efficiency, Pmax 30/50 ºC (%)	-- (non-condensing boiler)
Efficiency, 30% 30/36 ºC (%)	-- (non-condensing boiler)
Flue gas loss, Pmax 60/80 ºC (%)	9
Flue gas loss, Pmax ´40/60 ºC (%)	8
Flue gas loss, Pmin 60/80 ºC (%)	8 + Pmin/Pmax
Flue gas temperature, Pmax 60/80 ºC (ºC)	140
Standby loss (W)	10*Pmax
Standby loss, blocked (W)	10*Pmax - 10
Minimum boiler temperature (ºC)	user-defined
Pre-purge time (s)	10
Post-purge time (s)	10
Time constant, heating (s)	10
Time constant, cooling (s)	10
Electricity consumption, Pmax heating (W)	standby electricity + Pmax + 10
Electricity consumption, Pmin heating (W)	standby electricity + Pmin + 10
Electricity consumption, Pmax hot water (W)	standby electricity + Pmax + 10
Electricity consumption, pump after-run heating (W)	7 (boiler without pump)
Electricity consumption, pump after-run hot water (W)	7
Standby electricity consumption (W)	7
Electricity consumption per start/stop operation (Wh)	0

Gas boiler – condensing

Heat input, Pmax (kW)	user-defined
Heat input, Pmin (kW)	user-defined
Efficiency, Pmax 60/80 ºC (%)	97
Efficiency, Pmax 40/60 ºC (%)	101
Efficiency, Pmax 30/50 ºC (%)	105
Efficiency, 30% 30/36 ºC (%)	107
Flue gas loss, Pmax 60/80 ºC (%)	2
Flue gas loss, Pmax ´40/60 ºC (%)	1.5
Flue gas loss, Pmin 60/80 ºC (%)	2
Flue gas temperature, Pmax 60/80 ºC (ºC)	60
Standby loss (W)	10*Pmax
Standby loss, blocked (W)	10*Pmax - 10
Minimum boiler temperature (ºC)	user-defined
Pre-purge time (s)	10
Post-purge time (s)	10
Time constant, heating (s)	-- (condensing boiler)
Time constant, cooling (s)	-- (condensing boiler)
Electricity consumption, Pmax heating (W)	standby electricity + Pmax + 10
Electricity consumption, Pmin heating (W)	standby electricity + Pmin + 10
Electricity consumption, Pmax hot water (W)	standby electricity + Pmax + 10
Electricity consumption, pump after-run heating (W)	7 (boiler without pump)
Electricity consumption, pump after-run hot water (W)	7
Standby electricity consumption (W)	7
Electricity consumption per start/stop operation (Wh)	0

Climate data (source: BOILSIM database)

Belgium (Brussels)

Denmark (standard year)

Finland (Helsinki)

France (Paris)

Germany (Berlin)

Greece (Athens)

Italy (Rome)

Netherlands (De Bilt)

Sweden (Stockholm)

United Kingdom (Thames Valley)

degree hours	Belgium	France	Germany	Greece	Italy	Netherlands	Sweden	United Kingdom
January	10193	10800	15384	6840	6994	11208	17633	8136
February	8803	9312	13584	5784	5578	10152	15994	7344
March	8258	8112	12312	4968	4166	9672	15252	6552
April	5616	5856	7896	2112	1656	7608	11376	4872
May	2753	3648	4128	312	0	4392	7142	2760
June	576	1464	1176	0	0	0	3528	1272
July	0	0	600	0	0	0	2455	528
August	0	0	696	0	0	0	3199	576
September	1296	1824	3048	0	0	2760	6264	1344
October	4315	4752	7200	888	0	5976	9672	3144
November	7704	8232	10968	2568	3168	8568	13104	5856
December	10044	10368	14136	5328	6026	10392	16294	7200

Denmark		Finland	
number of hours	/ degree hours	number of hours	/ degree hours
24	648	26	1185
72	1800	96	3736
24	576	207	7071
144	3240	439	12950
144	3053	350	8944
456	8573	725	15867
600	10140	911	16632
1104	16450	1390	21861
912	11765	1033	12719
696	7656	649	5473
624	5554	812	4430
288	2102	679	2115
192	691	603	648

Reset to default values

Condensing boiler
Modulating
Pmax = 25
Pmin = 5
Heating and instantaneous hot water
Default value – gas boiler
On/off at Pmin
Maximum number of start/stops = 5
Minimum boiler temperature = 20
Night set-back
8 hours with temperature set-back
Fixed speed pump
Pump stops after burner has stopped
Pump stops during summer
Pump stops at night
No additional components
Correction of monthly climate data
Design flow/return temperature = 80/60
Design radiator power = 10
Variable flow
Flow through bypass = 0
Maximum pump power = 90
Pump after-run, heating = 3
Pump after-run, hot water = 3
Annual heat demand = 20000
Annual hot water demand = 2000
Electricity price = 0.14
Gas / oil price = 0.047