Project ECOTEST **Deliverables** **D8.4 Analysis of the results and report** **D8.5 Proposal to CEN and communication**	 *ECO_WP8_XXX_WP8-RRT6_V2*

WP	WP 8 Solar
Type	Annex to WP8 final report
Title	**Annex 1.6** **Extended RRT results and analysis** **RRT6 Combi system** **EN 12977-4 // ISO 9806 // EN 12977-2** **SOLTHERM method**
Author	A. Bohren
Dissemination	Free

Version	Status	Date	Comments
A	Internal for discussion in the WP	16.12.2018	
B	Version sent as progress report Dec. 2018		
C	Version sent as progress report Feb. 2019	26.02.2019	
D	Final version after steering group meeting for approval by WP8 testing laboratories	09.05.2019	
E	Final Report	02.06.2019	

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1 Introduction

1.1 Context of the test

For the WP8-RRT6 a solar combisystem is simulated using the results from WP8-RRT1 (collectors) and WP8-RRT3 (combi store) using the SOLCAL method as defined in the transitional methods (2014/C 207/03). Therefore WP8-RRT6 is a purely computational RRT which is based on components measurements and no additional measurements were required. The system consists of 5 collectors as tested in WP8-RRT1 and the combi store as tested in WP8-RRT3.

1.2 Time period

See WP8-RRT1, WP8-RRT3

1.3 Laboratories involved

The following labs have been involved in the test of the collector:

ISE
TestLab Solar Thermal Systems
Division Thermal Systems and Building Technologies (TSB)
Fraunhofer-Institut für Solare Energiesysteme ISE
Heidenhofstrasse 2, 79110 Freiburg, Germany

SPF
SPF Institute for Solar Technology
Hochschule für Technik Rapperswil HSR
Oberseestrasse 10, 8640 Rapperswil, Switzerland

IGTE/ITW
Institute for Building Energetics, Thermotechnology and Energy Storage (IGTE)
Former Institute of Thermodynamics and Thermal Engineering (ITW)
Research and Testing Centre for Thermal Solar Systems (TZS)
University of Stuttgart
Pfaffenwaldring 6, 70550 Stuttgart, Germany

2 Appliance tested

2.1 Main features of the appliance tested.

See report WP8-RRT1 and WP8-RRT3

2.2 Picture of the appliance

See WP8-RRT1, WP8-RRT3 for pictures of the appliances.
For WP8-RRT6 two software tools were used, screenshots are found below.

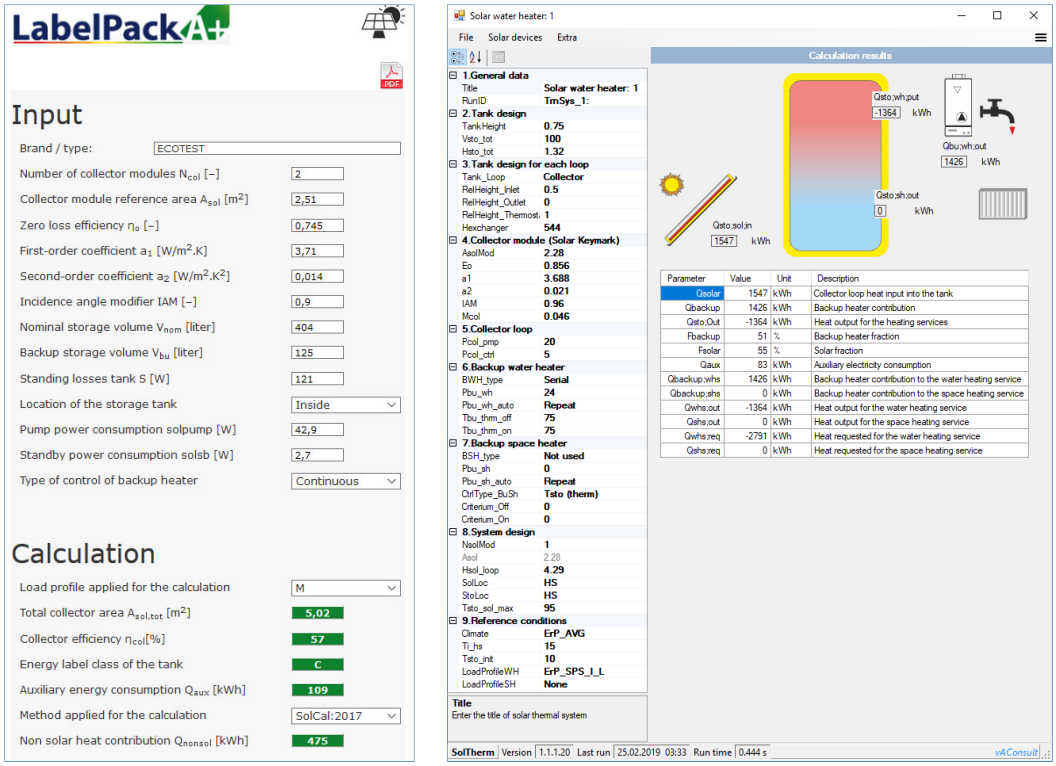


Figure 1: User interface of SOLCAL (left) and SOLTHERM (right)

2.3 Origin of appliances used for the RRT

See WP8-RRT1 and WP8-RRT3
The SOLCAL software used to compute the results is publicly available, either described in the transitional methods (2014/C 207/03), or readily implemented under http://www.label-pack-a-plus.eu/solcal-tool/ which has been developed in the framework of the Labelpack A+ project (GA 649905).
The SOLTHERM software is publicly available[1] for the time being as it was developed in a project funded by the SOLAR KEYMARK Certification Fund.

[1] http://www.vaconsult.net/Software/SolTherm/SolTherm_UK.htm

3 Testing programme & testing equipment of labs

3.1 Programme

No testing required

3.2 Test protocol(s) used

The WP8-RRT6 consist of applying the SOLCAL method described in the transitional methods (2014/C 207/03) using the measured data in WP8-RRT1 (collector parameters) and WP8-RRT3 (combi store parameters).
It is important to note that RRT5 and RRT6 shall not be misunderstood as simple "entering-data-into-a-software" RRTs. RRT5 and RRT6 are summarizing the components tests RRT1-RRT3 and partly RRT4 into an annual performance prediction which is then the basis for the rating of a system.

3.3 Overview of the main test equipment used by labs

See WP8-RRT1 and WP8-RRT3

3.4 Test conditions

N/A

3.5 Other

N/A

4 Definitions used for the statistical analysis (common to ECOTEST)

1. Median value
   The values are ranked from the smallest to the highest or from the highest to the lowest then the value just in the middle is the median value (if the number is odd) and arithmetic average of n/2 and (n/2+1) if n is even
2. Deviation from median value (Delta)
   Difference between any value and the median value
3. Arithmetic mean value
   Arithmetic mean of all value (sum of all values divided by the number of values)
4. Deviation from arithmetic mean value
   Difference between any value and the arithmetic mean value
5. Repeatability standard deviation sr
   The standard deviation of the values measured by each lab (in the column of each lab) and the standard deviation of all the values (in the column "total of all the labs)
6. Reproducibility Standard deviation (*) sR
   The standard deviation of the arithmetic values (if repeatability tests performed) or the value declared by each lab if no repeatability tests
7. Difference between maxi and mini arithmetic mean values.
   The difference between the maximum arithmetic average value and the minimum arithmetic average value (if repeatability test are done) or just the difference between the maximum value and minimum value of the declared values.

5 Measurement results of laboratories, statistics and analyse.

5.1 Overview Table of data measured

In this chapter the test results of the three participating test laboratories are presented as received. The laboratories are name 1, 2, 3 to avoid linking to the M, S, and T that are used in the text.

5.1.1 Solar water heater performance

Solar water heater data

LABORATORY		1	2	3	
EN 12975-1 / EN 12977-4 / EN 12976-2 / EN 12977-2 / SOLCAL 2013					
Ann. non-solar heat contribution at av. climate conditions for load profile M	Q_{nonsol}	1332	1278	1209	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile L	Q_{nonsol}	1563	1487	1467	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile XL	Q_{nonsol}	1897	1770	1858	kWh/a
Ann. non-solar heat contribution at av. climate - conditions for load profile XXL	Q_{nonsol}	2224	2058	2267	kWh/a
Power consumption pump	$P_{solpump}$	57	39.3	56.1	W
Standby power consumption controller	P_{solsb}	2.5	2.6	2.6	W
Annual auxiliary heat consumption	Q_{aux}	136	102.2	135	kWh/a
EN 12975-1 / EN 12977-4 / EN 12976-2 / EN12977-2 / SOLCAL 2017					
Ann. non-solar heat contribution at av. climate conditions for load profile M	Q_{nonsol}	158	147	157	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile L	Q_{nonsol}	524	473	548	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile XL	Q_{nonsol}	1099	1003	1168	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile XXL	Q_{nonsol}	1571	1445	1700	kWh/a
Power consumption pump	$P_{solpump}$	57	39.3	56.1	W
Standby power consumption controller	P_{solsb}	2.5	2.6	2.6	W
Annual auxiliary heat consumption	Q_{aux}	136	102.2	135	kWh/a
EN 12975-1 / EN 12977-4 / EN 12976-2 / EN12977-2 / SOLTHERM					
Ann. non-solar heat contribution at av. climate conditions for load profile M	Q_{nonsol}	1086	1019	1305	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile L	Q_{nonsol}	1786	1740	2104	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile XL	Q_{nonsol}	2726	2689	3086	kWh/a
Ann. non-solar heat contribution at av. climate conditions for load profile XXL	Q_{nonsol}	3452	3413	3978	kWh/a
Power consumption pump	$P_{solpump}$	57	39.3	56.1	W
Standby power consumption controller	P_{solsb}	2.5	2.6	2.6	W
Annual auxiliary heat consumption for M profile only (SOLTHERM is computing Q_{Aux} depending on the load profile)	Q_{aux}	119	85	117	kWh/a

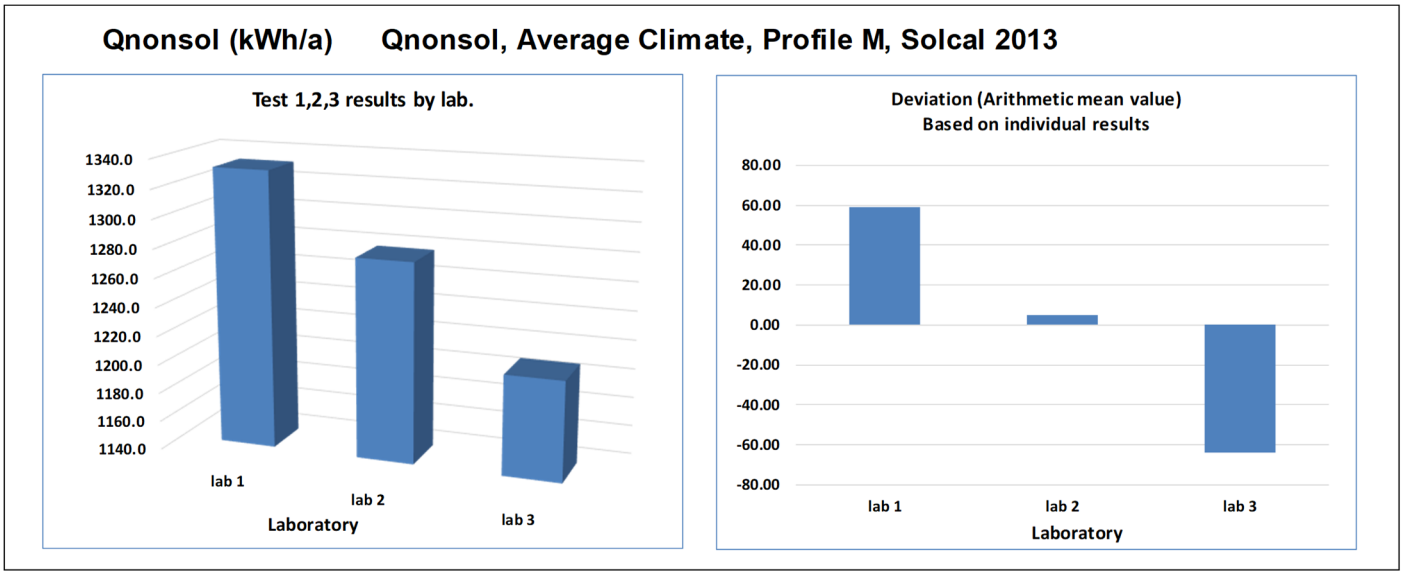
Table 1: Measured parameters submitted by the participating test laboratories (final results)

5.2 Statistics on the main parameters

In this chapter the relevant parameters as determined by the participating testing laboratories are presented in the standard format required by the ECOTEST project. Comments and explanations in chapter 0. As there were only three testing laboratories the statistical relevance of the presented numbers is limited. Using directly these data for statistical purposes is not appropriate and should be avoided.

5.2.1 SOLCAL:2013 Annual non-solar heat contribution at av. climate conditions for load profile M

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile M, Solcal 2013		
universal statistical evaluation v3.4.SLG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1332.00	1278.00	1209.00
Number of test results		1	1	1
Median value	1278	1332.00	1278.00	1209.00
Deviation from median value (Delta)		54.00	0.00	-69.00
Arithmetic mean value	1273	1332.00	1278.00	1209.00
Deviation from arithmetic mean value		59.00	5.00	-64.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	61.652			
Max - Min (arithmetic mean value)	123.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	123.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

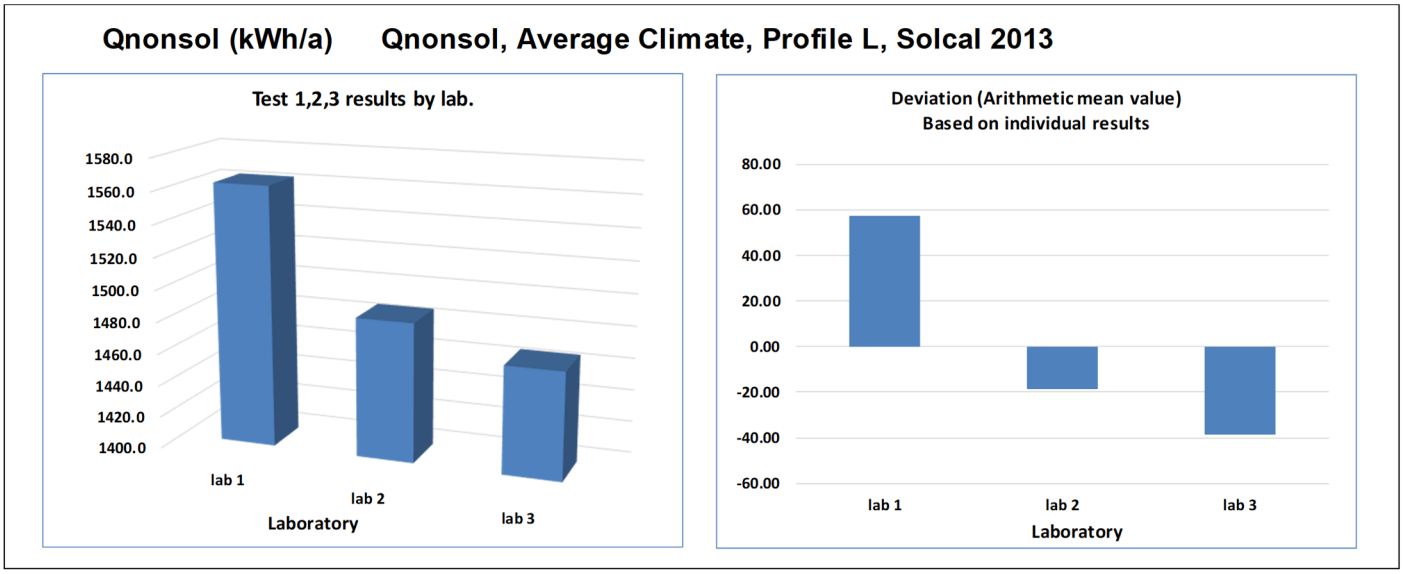


STATISTICS		
Median	1278.0	kWh/a
Arh. mean value	1273.0	kWh/a
R STD	61.7	kWh/a
r STD	-	
Max - Min (M-m)	123.0	kWh/a

Figure 2: ECOTEST statistical representation of the results Q_{nonsol} for load profile M computed with SOLCAL:2013

5.2.2 SOLCAL:2013 Annual non-solar heat contribution at av. climate conditions for load profile L

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile L, Solcal 2013		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1563.00	1487.00	1467.00
Number of test results		1	1	1
Median value	1487	1563.00	1487.00	1467.00
Deviation from median value (Delta)		76.00	0.00	-20.00
Arithmetic mean value	1506	1563.00	1487.00	1467.00
Deviation from arithmetic mean value		57.33	-18.67	-38.67
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	50.649			
Max - Min (arithmetic mean value)	96.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	96.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

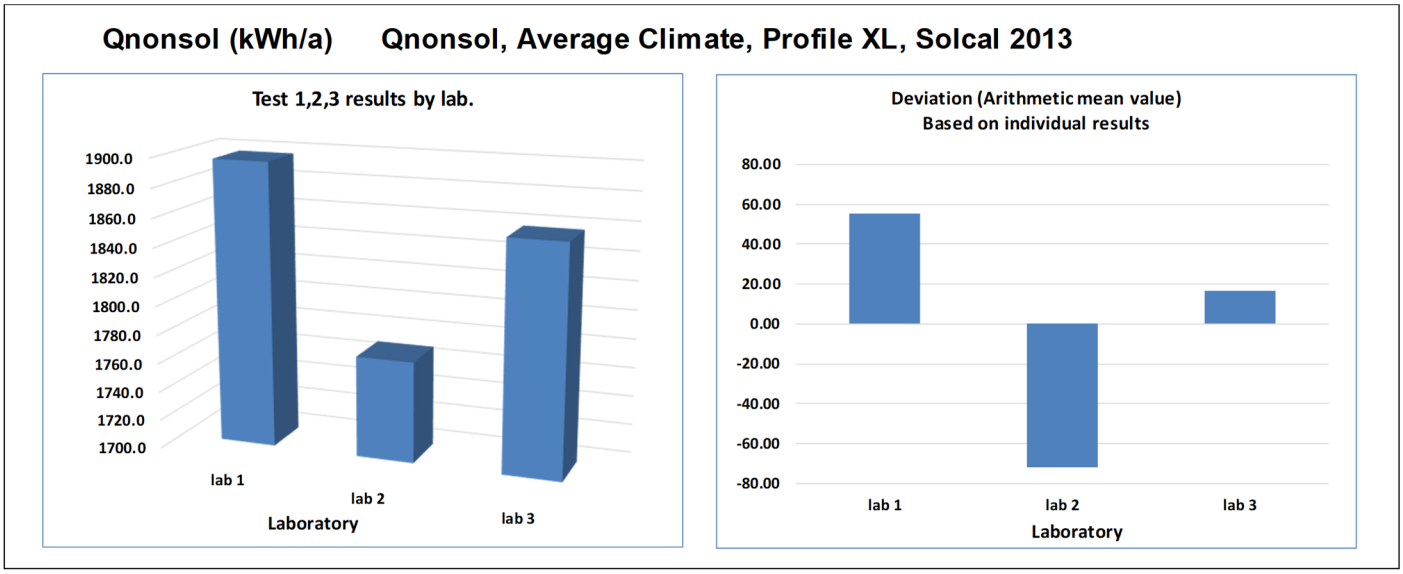


STATISTICS	
Median	1487.0 kWh/a
Arh. mean value	1505.7 kWh/a
R STD	50.6 kWh/a
r STD	-
Max - Min (M-m)	96.0 kWh/a

Figure 3: ECOTEST statistical representation of the results Q_{nonsol} for load profile L computed with SOLCAL:2013

5.2.3 SOLCAL:2013 Annual non-solar heat contribution at av. climate conditions load profile XL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XL, Solcal 2013		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1897.00	1770.00	1858.00
Number of test results		1	1	1
Median value	1858	1897.00	1770.00	1858.00
Deviation from median value (Delta)		39.00	-88.00	0.00
Arithmetic mean value	1842	1897.00	1770.00	1858.00
Deviation from arithmetic mean value		55.33	-71.67	16.33
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	65.056			
Max - Min (arithmetic mean value)	127.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	127.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

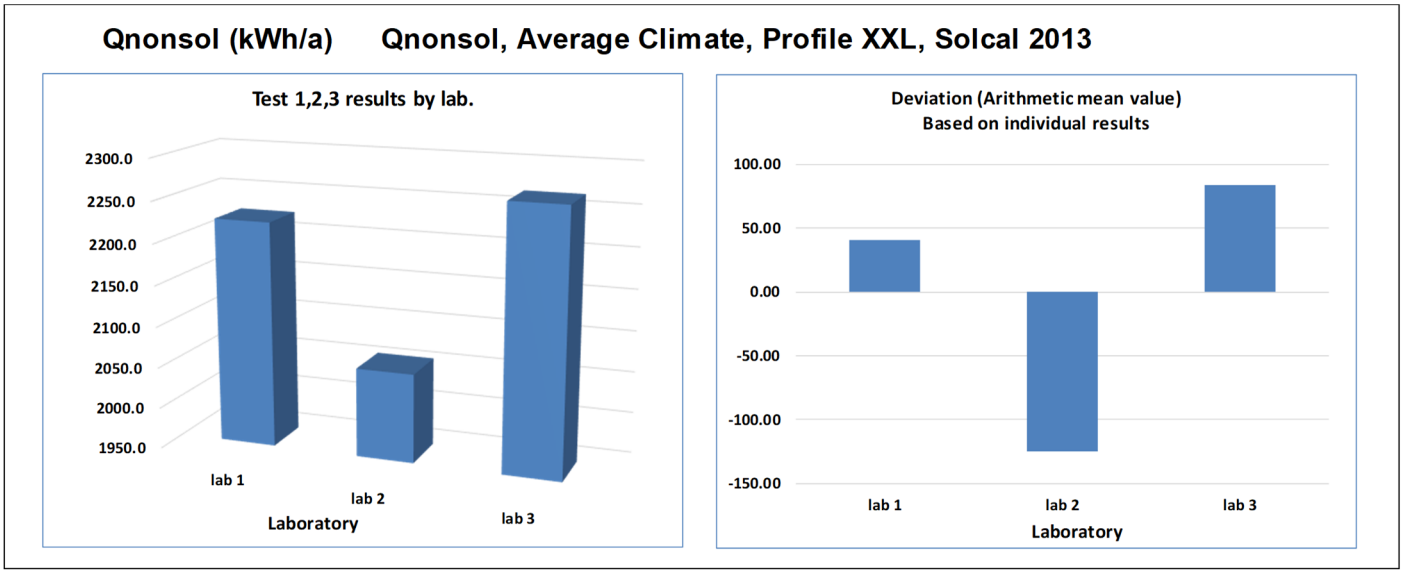


STATISTICS	
Median	1858.0 kWh/a
Arh. mean value	1841.7 kWh/a
R STD	65.1 kWh/a
r STD	-
Max - Min (M-m)	127.0 kWh/a

Figure 4: ECOTEST statistical representation of the results Q_{nonsol} for load profile XL computed with SOLCAL:2013

5.2.4 SOLCAL:2013 Annual non-solar heat contribution at av. climate conditions load profile XXL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XXL, Solcal 2013		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	2224.00	2058.00	2267.00
Number of test results		1	1	1
Median value	2224	2224.00	2058.00	2267.00
Deviation from median value (Delta)		0.00	-166.00	43.00
Arithmetic mean value	2183	2224.00	2058.00	2267.00
Deviation from arithmetic mean value		41.00	-125.00	84.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	110.368			
Max - Min (arithmetic mean value)	209.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	209.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

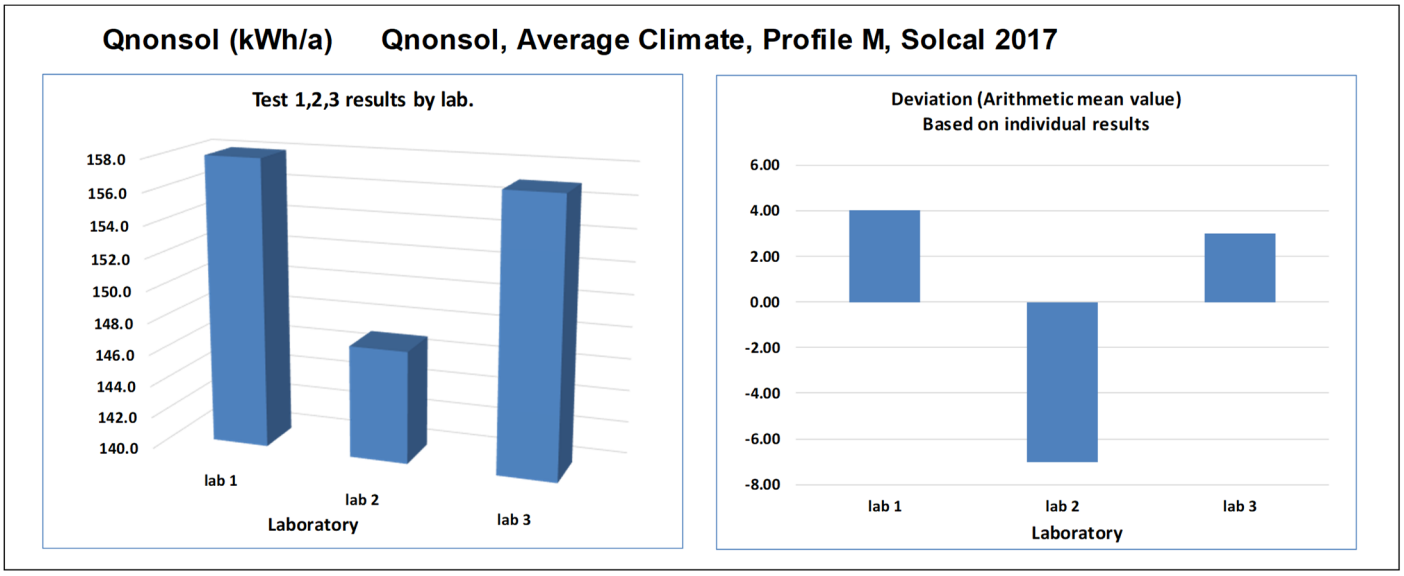


STATISTICS	
Median	2224.0 kWh/a
Arh. mean value	2183.0 kWh/a
R STD	110.4 kWh/a
r STD	-
Max - Min (M-m)	209.0 kWh/a

Figure 5: ECOTEST statistical representation of the results Q_{nonsol} for load profile XXL computed with SOLCAL:2013

5.2.5 SOLCAL:2017 Annual non-solar heat contribution at av. climate cond. for load profile M

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile M, Solcal 2017		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	158.00	147.00	157.00
Number of test results		1	1	1
Median value	157	158.00	147.00	157.00
Deviation from median value (Delta)		1.00	-10.00	0.00
Arithmetic mean value	154	158.00	147.00	157.00
Deviation from arithmetic mean value		4.00	-7.00	3.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	6.083			
Max - Min (arithmetic mean value)	11.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	11.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	outlier	correct	outlier	correct

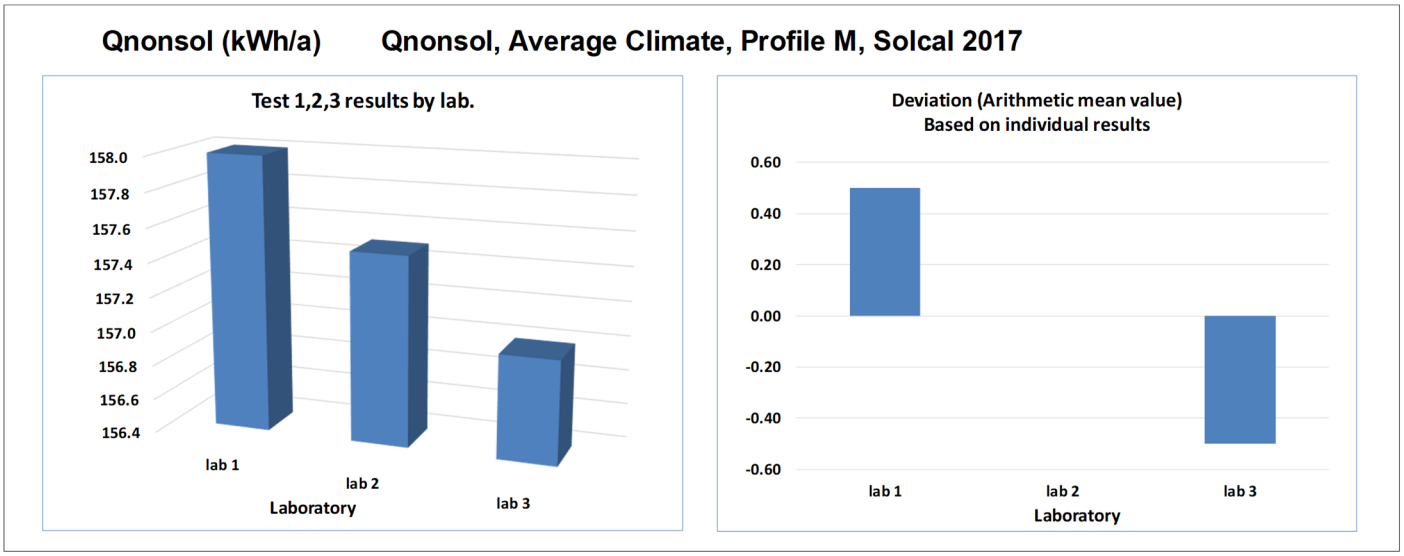


STATISTICS	
Median	157.0 kWh/a
Arh. mean value	154.0 kWh/a
R STD	6.1 kWh/a
r STD	-
Max - Min (M-m)	11.0 kWh/a

Figure 6: ECOTEST statistical representation of the results Q_{nonsol} for load profile M computed with SOLCAL:2017

5.2.6 SOLCAL:2017 Annual non-solar heat contribution at av. climate cond. for load profile M (removed outlier)

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile M, Solcal 2017		
universal statistical evaluation v3.4.SLG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	158.00	157.50	157.00
Number of test results		1	1	1
Median value	158	158.00	157.50	157.00
Deviation from median value (Delta)		0.50	0.00	-0.50
Arithmetic mean value	158	158.00	157.50	157.00
Deviation from arithmetic mean value		0.50	0.00	-0.50
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	0.500			
Max - Min (arithmetic mean value)	1.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	1.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

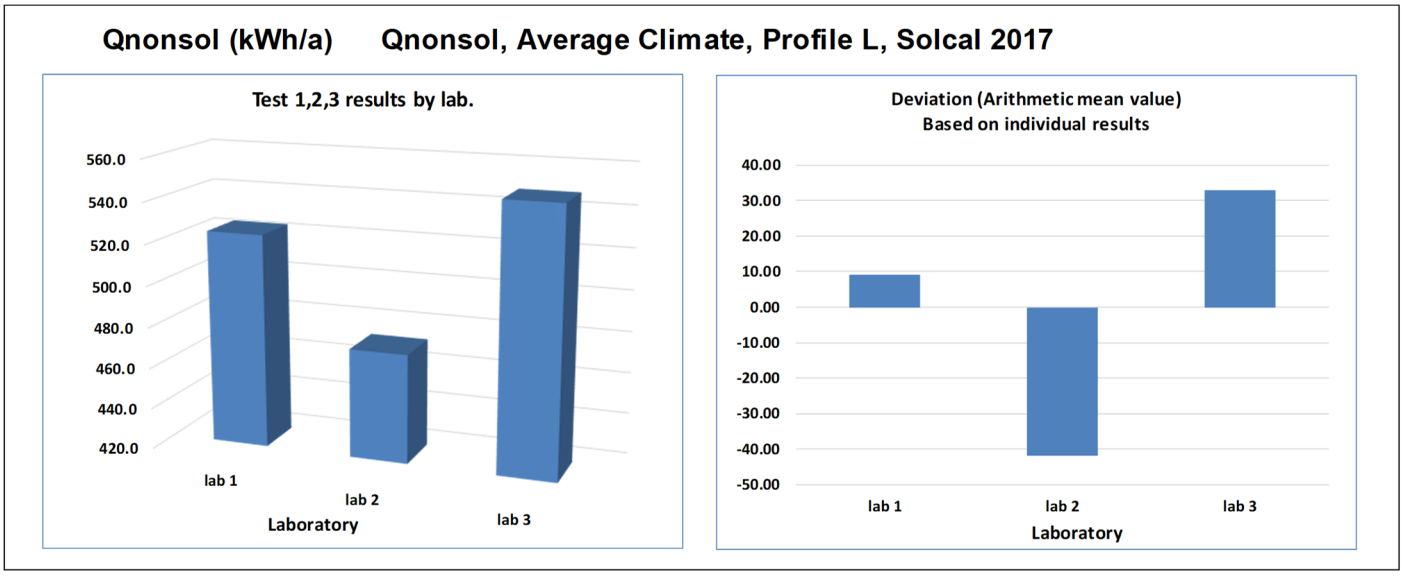


STATISTICS	
Median	157.5 kWh/a
Arh. mean value	157.5 kWh/a
R STD	0.5 kWh/a
r STD	-
Max - Min (M-m)	1.0 kWh/a

Figure 7: ECOTEST statistical representation of the results Q_{nonsol} for load profile M computed with SOLCAL:2017, not considering the outlier result (see clause 7.1).

5.2.7 SOLCAL:2017 Annual non-solar heat contribution at av. climate cond. for load profile L

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile L, Solcal 2017		
universal statistical evaluation v3.4.SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	524.00	473.00	548.00
Number of test results		1	1	1
Median value	524	524.00	473.00	548.00
Deviation from median value (Delta)		**0.00**	**-51.00**	**24.00**
Arithmetic mean value	515	524.00	473.00	548.00
Deviation from arithmetic mean value		**9.00**	**-42.00**	**33.00**
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	38.301			
Max - Min (arithmetic mean value)	75.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	75.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

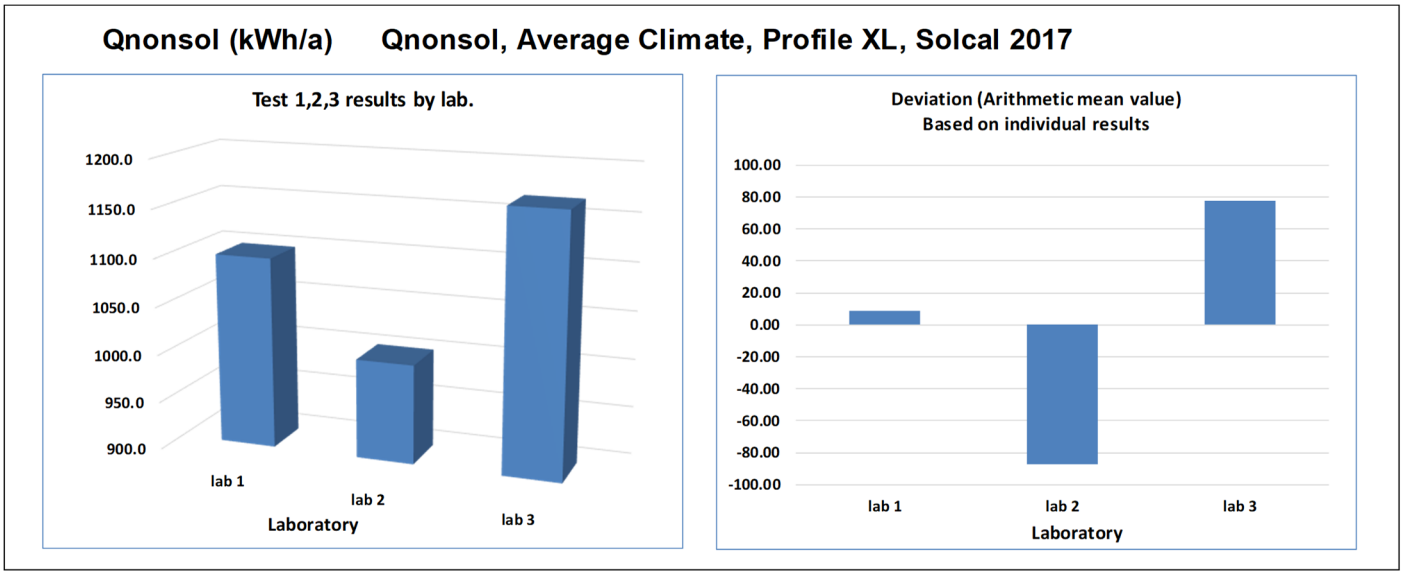


STATISTICS	
Median	524.0 kWh/a
Arh. mean value	515.0 kWh/a
R STD	38.3 kWh/a
r STD	-
Max - Min (M-m)	75.0 kWh/a

Figure 8: ECOTEST statistical representation of the results Q_{nonsol} for load profile L computed with SOLCAL:2017

5.2.8 SOLCAL:2017 Annual non-solar heat contribution at av. climate cond. for load profile XL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XL, Solcal 2017		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1099.00	1003.00	1168.00
Number of test results		1	1	1
Median value	1099	1099.00	1003.00	1168.00
Deviation from median value (Delta)		0.00	-96.00	69.00
Arithmetic mean value	1090	1099.00	1003.00	1168.00
Deviation from arithmetic mean value		9.00	-87.00	78.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	82.867			
Max - Min (arithmetic mean value)	165.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	165.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

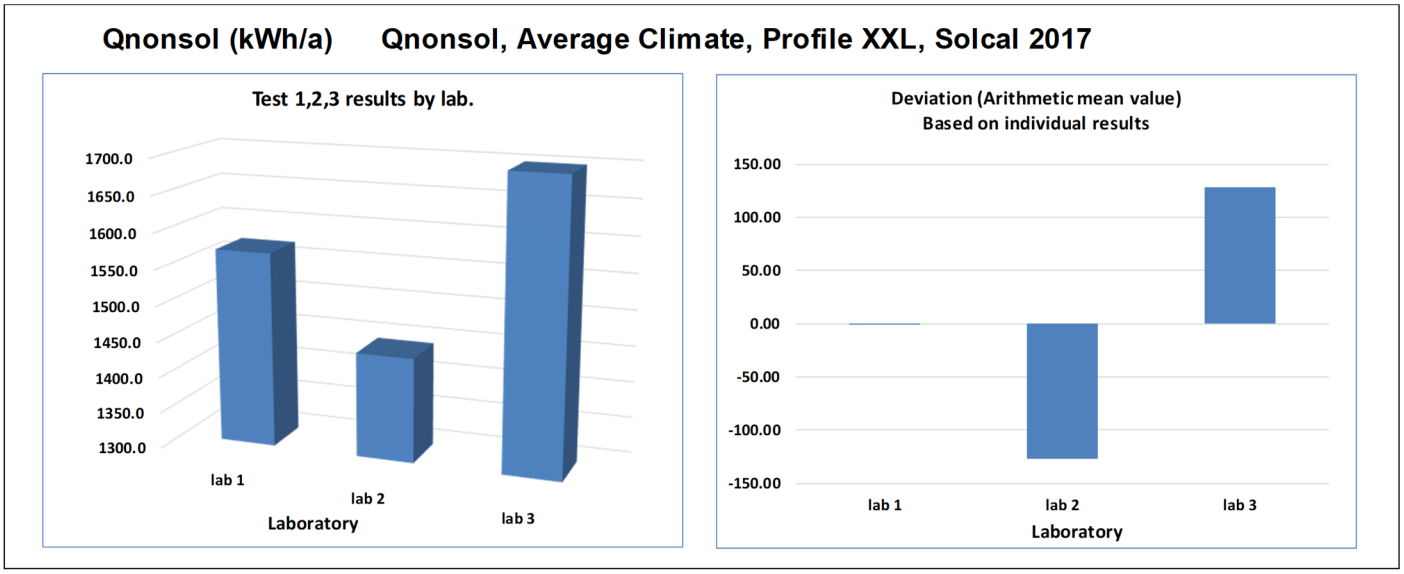


STATISTICS	
Median	1099.0 kWh/a
Arh. mean value	1090.0 kWh/a
R STD	82.9 kWh/a
r STD	-
Max - Min (M-m)	165.0 kWh/a

Figure 9: ECOTEST statistical representation of the results Q_{nonsol} for load profile XL computed with SOLCAL:2017

5.2.9 SOLCAL:2017 Annual non-solar heat contribution at av. climate cond. for load profile XXL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XXL, Solcal 2017		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1571.00	1445.00	1700.00
Number of test results		1	1	1
Median value	1571	1571.00	1445.00	1700.00
Deviation from median value (Delta)		0.00	-126.00	129.00
Arithmetic mean value	1572	1571.00	1445.00	1700.00
Deviation from arithmetic mean value		-1.00	-127.00	128.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	127.503			
Max - Min (arithmetic mean value)	255.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	255.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

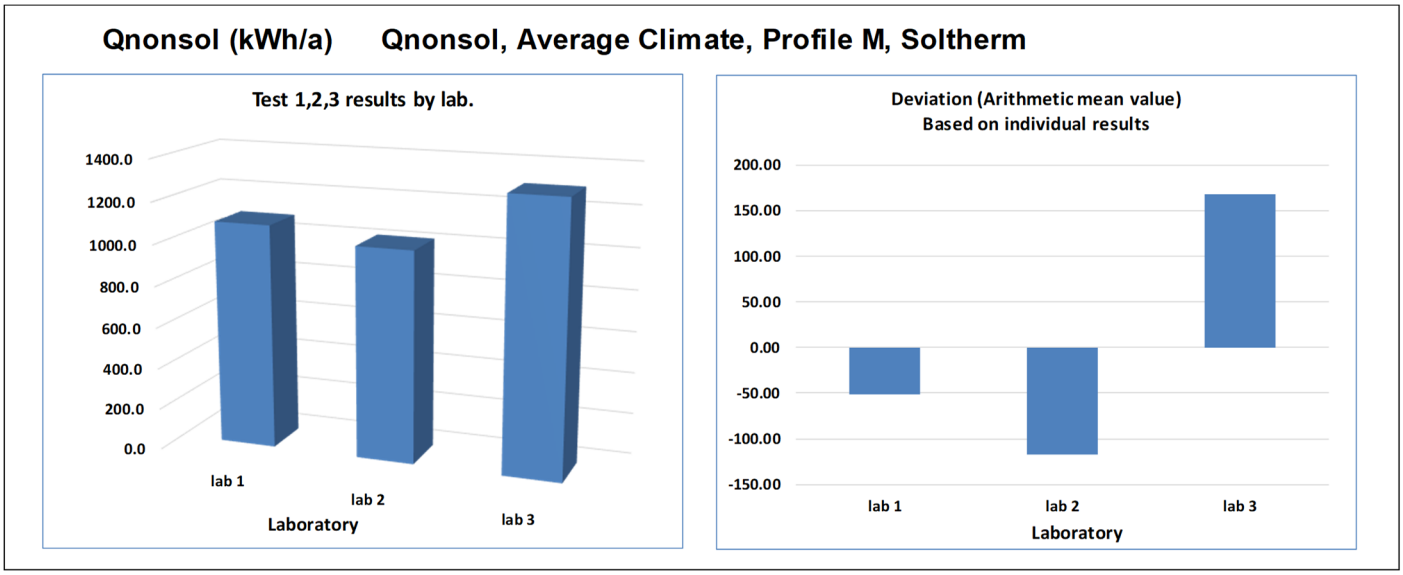


STATISTICS	
Median	1571.0 kWh/a
Arh. mean value	1572.0 kWh/a
R STD	127.5 kWh/a
r STD	-
Max - Min (M-m)	255.0 kWh/a

Figure 10: ECOTEST statistical representation of the results Q_{nonsol} for load profile XXL computed with SOLCAL:2017

5.2.10 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile M

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile M, Soltherm		
universal statistical evaluation v3.4.5LG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1086.00	1019.00	1305.00
Number of test results		1	1	1
Median value	1086	1086.00	1019.00	1305.00
Deviation from median value (Delta)		0.00	-67.00	219.00
Arithmetic mean value	1137	1086.00	1019.00	1305.00
Deviation from arithmetic mean value		-50.67	-117.67	168.33
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	149.581			
Max - Min (arithmetic mean value)	286.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	286.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

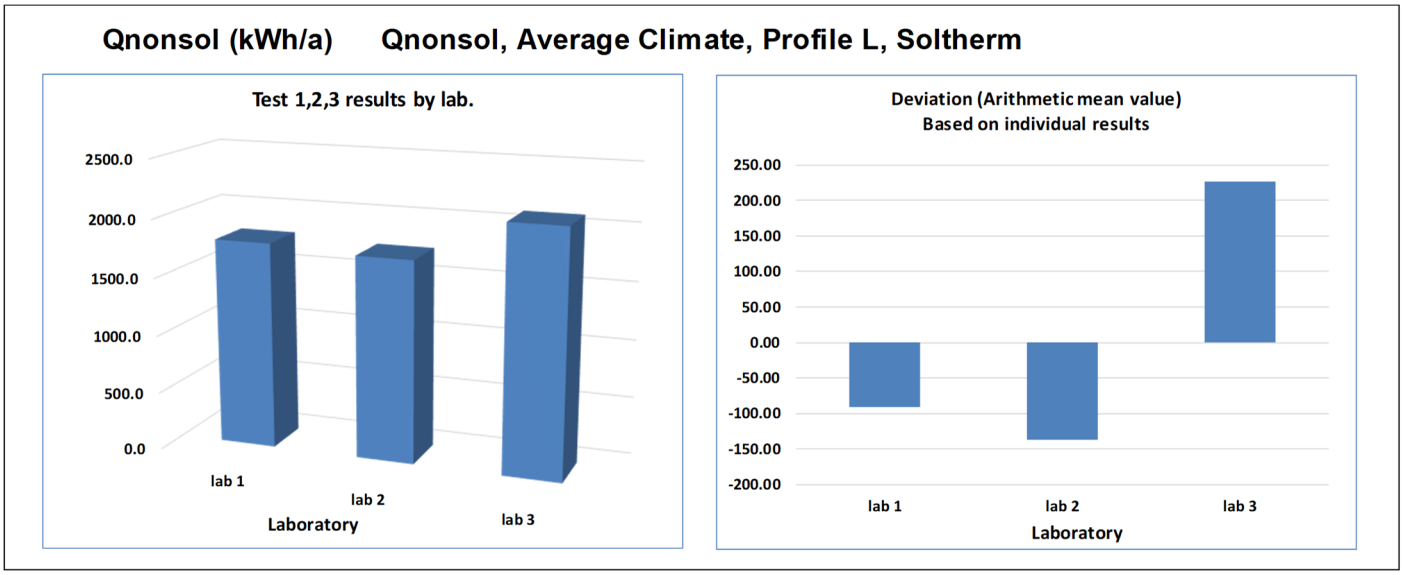


STATISTICS		
Median	1086.0	kWh/a
Arh. mean value	1136.7	kWh/a
R STD	149.6	kWh/a
r STD	-	
Max - Min (M-m)	286.0	kWh/a

Figure 11: ECOTEST statistical representation of the results Q_{nonsol} for load profile M computed with SOLTHERM

5.2.11 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile L

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile L, Soltherm		
universal statistical evaluation v3.4.5LG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	1786.00	1740.00	2104.00
Number of test results		1	1	1
Median value	1786	1786.00	1740.00	2104.00
Deviation from median value (Delta)		0.00	-46.00	318.00
Arithmetic mean value	1877	1786.00	1740.00	2104.00
Deviation from arithmetic mean value		-90.67	-136.67	227.33
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	198.215			
Max - Min (arithmetic mean value)	364.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	364.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

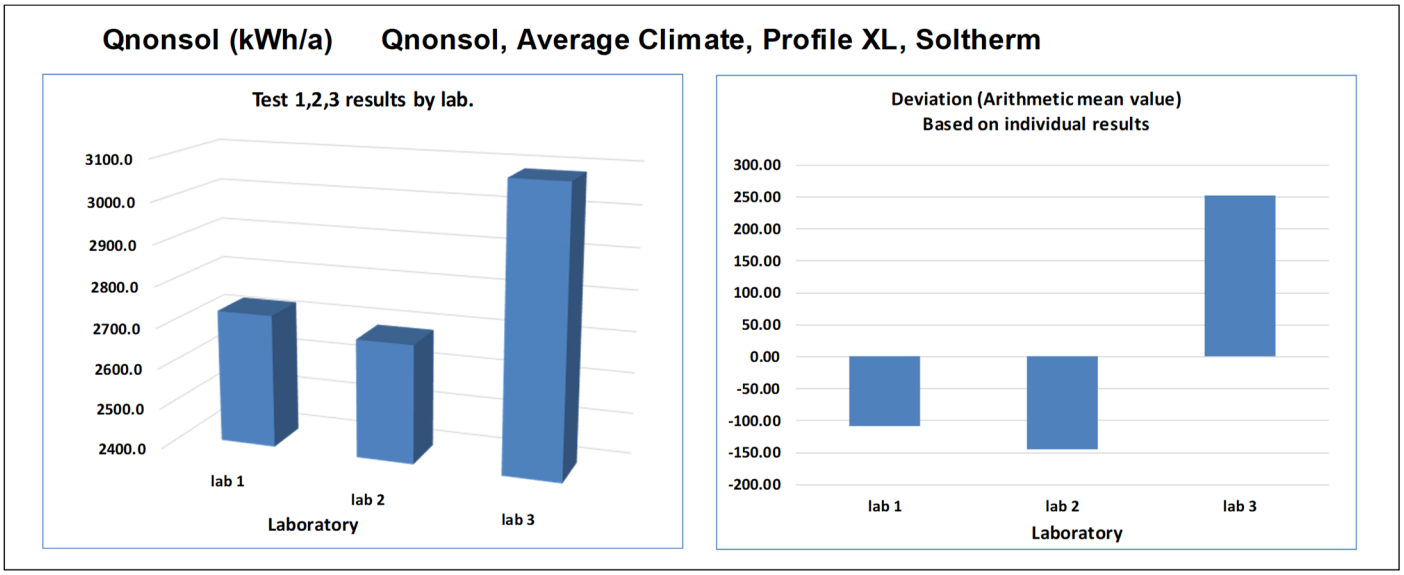


STATISTICS		
Median	1786.0	kWh/a
Arh. mean value	1876.7	kWh/a
R STD	198.2	kWh/a
r STD	-	
Max - Min (M-m)	364.0	kWh/a

Figure 12: ECOTEST statistical representation of the results Q_{nonsol} for load profile L computed with SOLTHERM

5.2.12 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile XL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XL, Soltherm		
universal statistical evaluation v3.4.SLG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	2726.00	2689.00	3086.00
Number of test results		1	1	1
Median value	2726	2726.00	2689.00	3086.00
Deviation from median value (Delta)		0.00	-37.00	360.00
Arithmetic mean value	2834	2726.00	2689.00	3086.00
Deviation from arithmetic mean value		-107.67	-144.67	252.33
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	219.309			
Max - Min (arithmetic mean value)	397.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	397.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	outlier	correct	correct	outlier

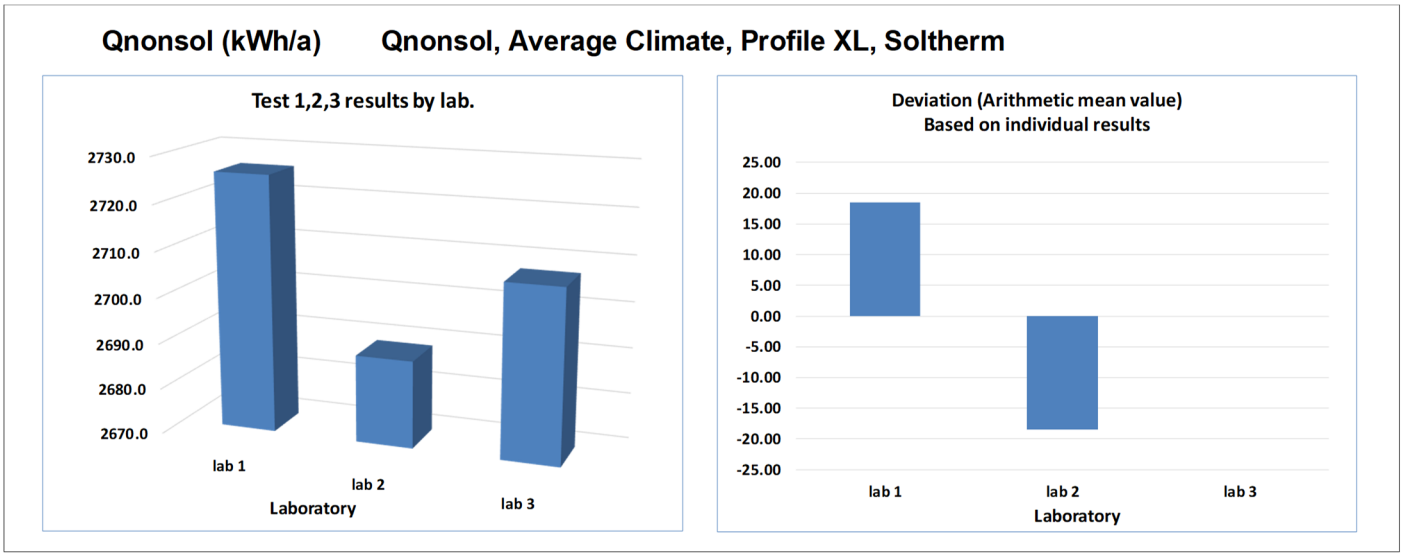


STATISTICS		
Median	2726.0	kWh/a
Arh. mean value	2833.7	kWh/a
R STD	219.3	kWh/a
r STD	-	
Max - Min (M-m)	397.0	kWh/a

Figure 13: ECOTEST statistical representation of the results Q_{nonsol} for load profile XL computed with SOLTHERM

5.2.13 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile XL (removed outlier)

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XL, Soltherm		
universal statistical evaluation v3.4 SLG by ACLI	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	2726.00	2689.00	2707.50
Number of test results		1	1	1
Median value	2708	2726.00	2689.00	2707.50
Deviation from median value (Delta)		18.50	-18.50	0.00
Arithmetic mean value	2708	2726.00	2689.00	2707.50
Deviation from arithmetic mean value		18.50	-18.50	0.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	18.500			
Max - Min (arithmetic mean value)	37.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	37.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

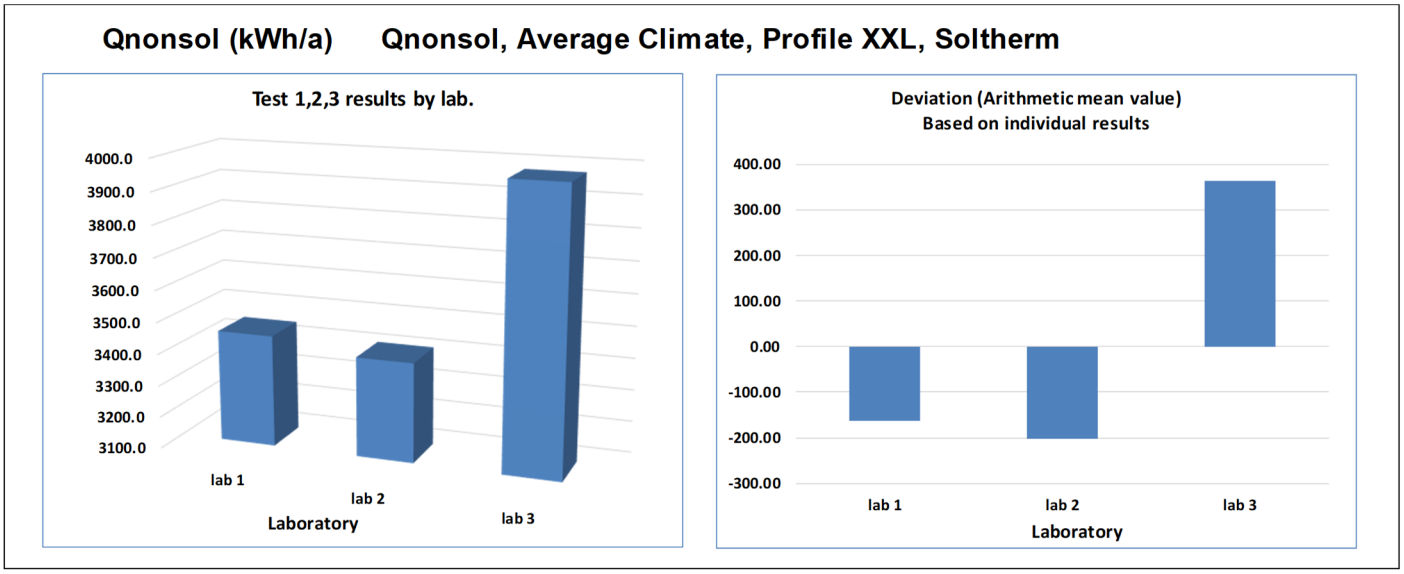


STATISTICS	
Median	2707.5 kWh/a
Arh. mean value	2707.5 kWh/a
R STD	18.5 kWh/a
r STD	-
Max - Min (M-m)	37.0 kWh/a

Figure 14: ECOTEST statistical representation of the results Q_{nonsol} for load profile XL computed with SOLTHERM without considering the outlier result (see clause 7.1)

5.2.14 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile XXL

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XXL, Soltherm		
universal statistical evaluation v3.4 SLG by ACU	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	3452.00	3413.00	3978.00
Number of test results		1	1	1
Median value	3452	3452.00	3413.00	3978.00
Deviation from median value (Delta)		0.00	-39.00	526.00
Arithmetic mean value	3614	3452.00	3413.00	3978.00
Deviation from arithmetic mean value		-162.33	-201.33	363.67
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	315.548			
Max - Min (arithmetic mean value)	565.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	565.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	outlier	correct	correct	outlier

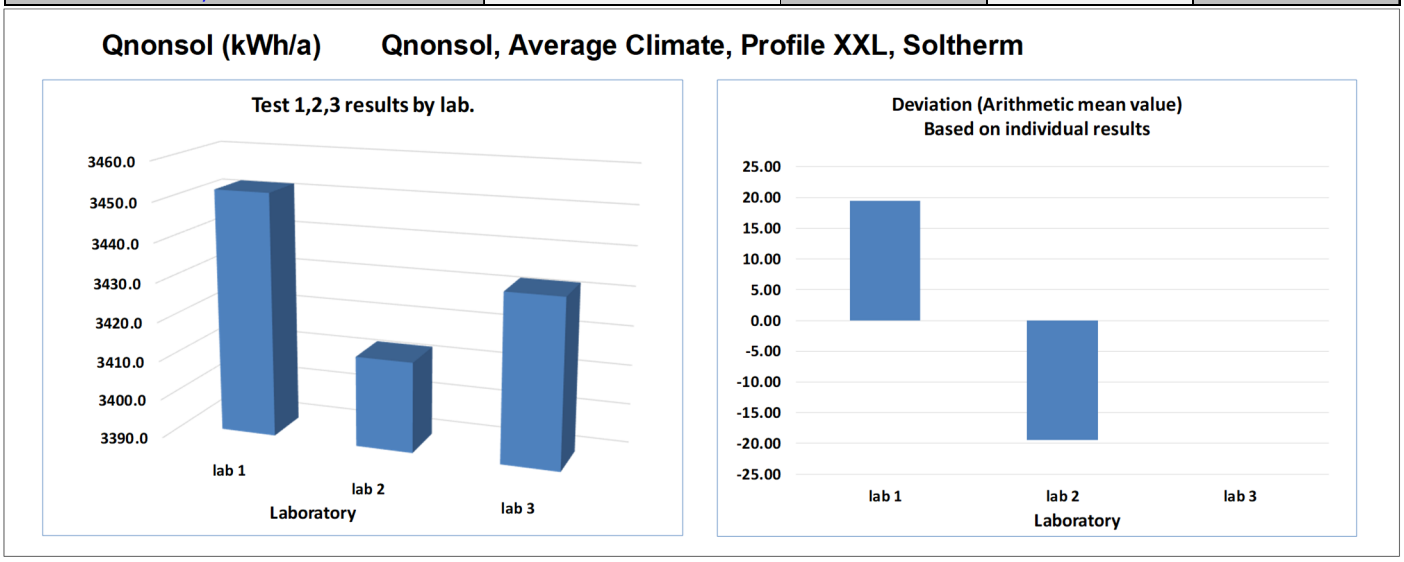


STATISTICS	
Median	3452.0 kWh/a
Arh. mean value	3614.3 kWh/a
R STD	315.5 kWh/a
r STD	-
Max - Min (M-m)	565.0 kWh/a

Figure 15: ECOTEST statistical representation of the results Q_{nonsol} for load profile XXL computed with SOLTHERM

5.2.15 SOLTHERM Annual non-solar heat contribution at av. climate cond. for load profile XXL (removed outlier)

Parameter	Qnonsol (kWh/a)	Qnonsol, Average Climate, Profile XXL, Soltherm		
universal statistical evaluation v3.4.SLG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	3452.00	3413.00	3432.50
Number of test results		1	1	1
Median value	3433	3452.00	3413.00	3432.50
Deviation from median value (Delta)		19.50	-19.50	0.00
Arithmetic mean value	3433	3452.00	3413.00	3432.50
Deviation from arithmetic mean value		19.50	-19.50	0.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	19.500			
Max - Min (arithmetic mean value)	39.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	39.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	correct	correct	correct	correct

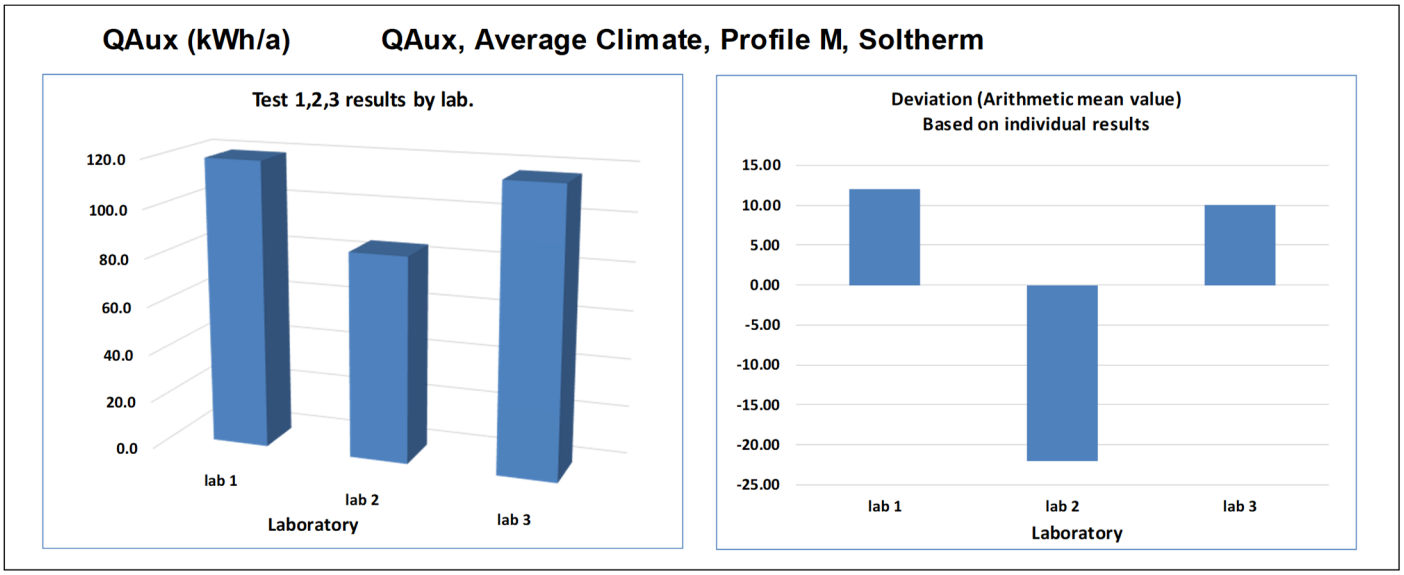


STATISTICS	
Median	3432.5 kWh/a
Arh. mean value	3432.5 kWh/a
R STD	19.5 kWh/a
r STD	-
Max - Min (M-m)	39.0 kWh/a

Figure 16: ECOTEST statistical representation of the results Q_{nonsol} for load profile XXL computed with SOLTHERM without considering the outlier result (see clause 7.1)

5.2.16 SOLTHERM Q_{Aux} for Profile M

Parameter	QAux (kWh/a)	QAux, Average Climate, Profile M, Soltherm		
universal statistical evaluation v3.4.SLG by ACLi	Total over all labs	lab 1	lab 2	lab 3
test result 1	Test1	119.00	85.00	117.00
Number of test results		1	1	1
Median value	117	119.00	85.00	117.00
Deviation from median value (Delta)		2.00	-32.00	0.00
Arithmetic mean value	107	119.00	85.00	117.00
Deviation from arithmetic mean value		12.00	-22.00	10.00
Repeatability standard deviation s_r	-	-	-	-
Reproducibility Standard deviation (*) s_R	19.079			
Max - Min (arithmetic mean value)	34.000	Diff between max and min of the arithmetic means measured by all labs		
Max - Min (arithmetic mean value)	34.000	Diff between the max and min of all measured values by all labs		
(*) based on the arithmetic mean values				
Between-lab consistency - assumed classif.	outlier	correct	outlier	correct



STATISTICS	
Median	117.0 kWh/a
Arh. mean value	107.0 kWh/a
R STD	19.1 kWh/a
r STD	-
Max - Min (M-m)	34.0 kWh/a

Figure 17: ECOTEST statistical representation of the results Q_{Aux} for load profile M computed with SOLTHERM

6 Comments and explanation on the data tables of this report.

6.1 Journal of corrections made

See WP8-RR5

7 Comments and analysis

7.1 Comments and additional information on the table and figure

See Report WP8-RRT5

8 Iterative test results

There were no iterative test or additional tests planned. However the use of different methods (SOLCAL 2013, SOLCAL 2017 and SOLTHERM) can be understood as supplementary iterative test.
All findings from WP8-RRT5 apply in a similar way to RRT6.

9 Procedures of standards that need to be modified and justification

9.1 Result from the brainstorming on standard

The brainstormes of WP8 RRT1-RRT5 apply.

9.2 Procedures of standards that need to be modified and justification

See WP8-RRT5 report.

9.3 Recommendations to CEN

Future systems will be more and more systems which are combined systems consisting of more than one component/appliance. As a very common example for such a system in central Europe: Solar combined Heatpump, where "Solar" can be Solar thermal and/or PV. Many other combinations are possible and reasonable - depending on the location and the user requirements. In Figure 18 a typical modern system is shown in the representation of the IEA Task 44. Without going into details: It is evident that single component parameters such as standing loss of the store or PVT performance are important parameters. The overall efficiency is however also (or probably mainly) defined by the proper matching and interaction of the components, including a correct installation and operation of course. Furthermore it is evident that more complex systems can be expected with the advent of new/other technologies such as home batteries, district heating and more: There will be simply more options in Figure 18.

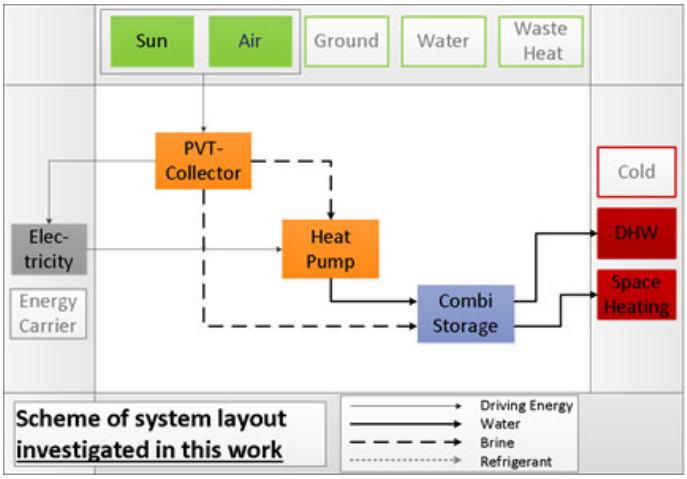


Figure 18: Schematic representation of the energy flows in a combined system

It is therefore important to establish performance rating tools which are not limited to isolated appliances such as "solar". Rating tools (such as the tools used in WP8 SOLCAL, SOLICS, and SOLTHERM) must be designed in a much more modular way considering also the interaction between different technologies. Furthermore these tools must be developed so that they can be adapted to new technologies. This implies furthermore that standards must be developed in such a way that they can serve these simulation tools. This can be partly improved by better communication/harmonisation between the TCs as well as between the TCs and the commission. It may however be necessary to develop completely new rating tools and new standards to be able to keep track with the technical development of heating systems.

10 Conclusion

See reports "WP8-RRT5" and "WP8-Executive summary and proposals"