


Documentation of dataset: weather data Schiphol 2009-2018 and energy demand for a case study building.

Authors: S.I.(Saskia) Rutten¹, S.C. (Sabine) Jansen¹, W.H. (Willem) van der Spoel¹, P.I. (Paula) van den Brom¹ 

¹ Delft University of Technology, faculty of Architecture and the Built Environment, Department of Architectural Engineering & Technology (AE+T)
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Summary

This document contains the description of the dataset 'weather data Schiphol 2009-2018 and energy demand for a case study building' and a description of the input parameters used to create the data. For this dataset the weather data for Schiphol for the years 2009 to 2018 and the TRNSYS reference year are simulated in TRNSYS 17 and the energy demand for a case study building for these years is calculated. The results include the weather data regarding temperature and solar radiation for different orientations, and the heating and cooling demand for a case study building.

The weather data for the years 2009 to 2018 are distributed by the KNMI as hourly weather data¹. These weather data is transformed into a TM2 file compatible with TRNSYS, containing the following output values: solar radiation (global, normal and diffuse horizontal), total sky cover, opaque sky cover, dry bulb temperature, dew point temperature, relative humidity, atmospheric pressure, wind direction and wind speed. For solar radiation, the KNMI weather file provided only the global radiation. The normal and diffuse horizontal radiation are obtained according to the method in NEN 5060:2018² appendix D. The TRNSYS reference year is a TM2 year from Amsterdam Schiphol (Latitude: 52.3oN; Longitude 4.77 oE, Elevation 2 m), as distributed by TRNSYS³.

In chapter 1 the inputs for the weather data reader and the case study building are explained. The case study building is a terraced house with a pitched roof with average insulation, calculated as a 1-zone model. In chapter 2 the results are shown for the weather data and the energy demand for the case study building per climate year. The weather data include the average temperature and radiation per month per orientation for the different climate years. The energy demand results include the simulated heating and cooling demand per month for the different climate years.

The complete data set contains the hourly data and monthly average of the weather files and the hourly energy data for the simulated building as .csv file. The dataset also contains charts of the documented weather data per year.

¹ <https://www.knmi.nl/nederland-nu/klimatologie/uurgegevens>

² NEN 5060:2018 nl Hygrothermische eigenschappen van gebouwen – Referentieklimaatgegevens. (in Dutch).

³ TRNSYS 17 Manual, Volume 08 Weather data

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1 Input parameters and calculation methods

1.1 Weather

The TM2 weather data files are read in the TRNSYS type 15-2 from the TRNSYS 16 library. For the sky model for diffuse radiation the Perez-model is used (mode 4 in type 15-2). This model is usually considered as the best available model. It also gave comparable results to the results obtained with other simulation software like DesignBuilder. The simulations in this document are performed in TRNSYS 17.

1.2 Case study building inputs

One case study building is used to compare the heating and cooling demands for the different climate years. The case study building used is a terraced house with a pitched roof with average insulation. A 1-zone model was used for the simulations. The building properties of the case study building are shown below.. Following, the setpoints for heating, cooling, ventilation and infiltration, and internal heat gains are presented.

Properties	
Width	5,7 m
Depth	8 m
Height ground floor	2,8 m
Height 1st floor	2,5 m
Height 2nd floor	4 m
Roof type	pitched
Roof width	5,7 m
Area ground floor	45,6 m ²
Area 1st floor	45,6 m ²
Area 2nd floor (eff.)	31,92 m ²
Total floor area	123,12 m ²



1 zone model:	
Volume:	333
Boundary:	Ground temperature, calculated with: $(20+2 \cdot T_e)/3$ ⁴
ground floor	gr_fl_02 45,6 m ²
<u>seperation walls</u>	
ground floor (2x)	sep_wall 22,4 m ²
1st floor (2x)	sep_wall 20 m ²
2nd floor (2x)	sep_wall 16 m ²
<u>seperation floors</u>	
(2x)	sep_floor 45,6 m ²
internal walls	int_wall 60 m ²



⁴ The calculation of the ground temperature is a simplified approach taking into account the fact that the ground is heated up by the heat transfer through the floor. By also considering the outdoor temperature, an unrealistic cooling effect in summer is avoided.

Table 1: Building envelope properties

Closed envelope	Wall types	m ² (inc. Window)		m ²	Glass type	% frame
<u>Ground floor</u>	gr_fl_02					
<u>Front (North)</u>						
Façade ground floor	cavity_02	13,2	window	6,1	HRPLUS_15	15%
Door ground floor	door	2,7	window	1,7	HRPLUS_15	15%
Façade 1st floor	fac_pan_02	14,3	window	8,0	HRPLUS_15	15%
<u>Back (South)</u>						
Façade ground floor	cavity_02	16,0	window	10,3	HRPLUS_15	15%
Façade 1st floor	fac_pan_02	14,3	window	10,3	HRPLUS_15	15%
<u>Dormer</u>						
dormer roof	Dormer_02	5,8				
dormer sides	Dormer_02	5,8	window	3,4	HRPLUS_15	15%
dormer front	Dormer_02	3,4				
dormer slice (roof cut-out)		4,8				
<u>Roof</u>						
Roof (north tilted)	Roof_01	32,2	window	1,4		15%
Roof (south tilted)	Roof_01 (excl. dormer)	27,5				

Table 2: Wall and window types

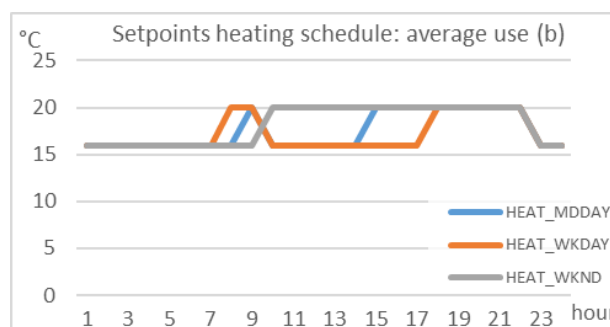
Wall/window	Description	Rc-value m ² K/W	U-value W/m ² K
CAVITY_02	Insulated cavity wall (5cm insulation)	1,55	0,58
GR_FL_02	Insulated concrete floor (10cm insulation)	2,77	0,34
FAC_PAN_02	Wooden front (5 cm insulation)	1,39	0,64
ROOF_01	Insulated roof (12 cm insulation)	3,40	0,28
DORMER_02	New dormer(15 cm insulation)	4,00	0,24
HRPLUS_15 (glazing)	HR+ glazing		1,24
HRPLUS_15 (frame)	15% window frame (c-value, without radiation + transmittion coefficient)		2,27

The following setpoints for heating, cooling and internal heat gain were used:

1.2.1 Heating setpoints

A weekly schedule is used for the heating, based on the use for heating per day. The heating schedule per day is shown below, including the three different heating schedules.

Monday	HEAT_MDDAY
Tuesday	HEAT_WKDAY
Wednesday	HEAT_MDDAY
Thursday	HEAT_WKDAY
Friday	HEAT_MDDAY
Saturday	HEAT_WKND
Sunday	HEAT_WKND



1.2.2 Cooling

The following setpoint for cooling is used: 26.5 °C. This setpoint is chosen based on a 80% satisfaction value regarding the PMV. In addition, a cooling effect of summer ventilation is included, by assuming that additional ventilation happens when the outdoor temperature is between 18 and 24,5 degrees, with an air change rate of 2. It should be noted that the selection of summer ventilation and related air change rate as well as solar shading (not assumed in these simulations) has a very significant effect on the total cooling demand. This means the numbers for cooling provided in this dataset should be considered very indicative and not a fixed number.

1.2.3 Ventilation and infiltration

The following air change rates (1/h) for ventilation and infiltration were used:

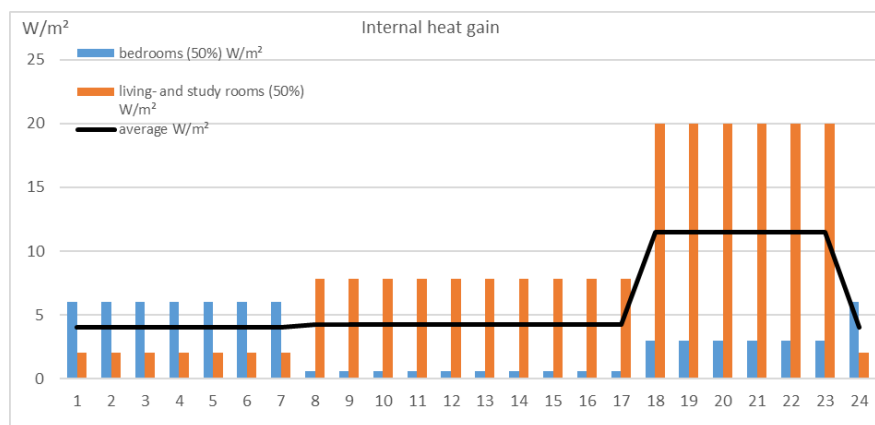
Infiltration: 0,2 /h | constant schedule

Ventilation (no heat recovery): 0,7/h | constant schedule

Summer comfort ventilation: 2/h | when the outdoor temperature is between 18 and 24,5 degrees

1.2.4 Internal heat gain schedules

The following internal heat gain schedules were used, resulting in a 24-hour average of 6 W/m²:



1.3 Note

The input parameters related to the use of the building (such as internal gains, heating setpoints etc) greatly influence the resulting heat demand. Hence, the actual heating demand for different users in this type of building – even with the same insulation values – can vary greatly. The results are therefore mainly aimed to compare the effect of different climate years.

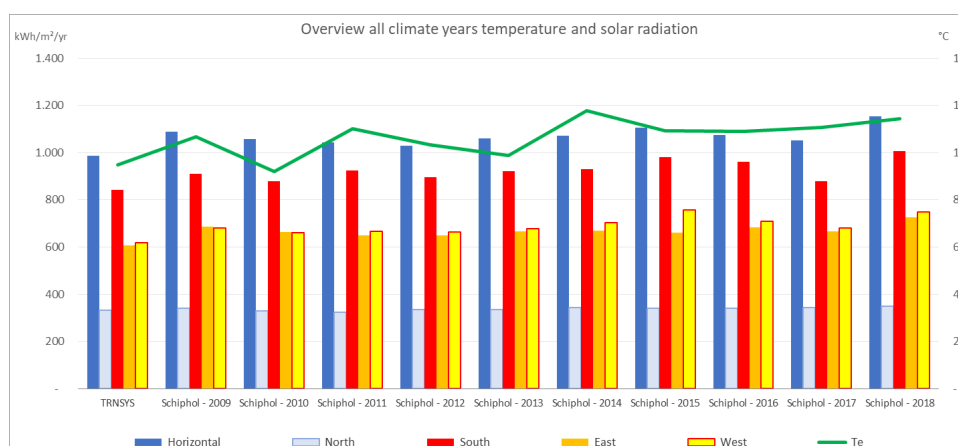
2 Results

2.1 Overall results

An overview of the overall results regarding the different climate years and the energy use per year for the dwelling is given below.

	Climate year results							
Weather file	Temperature	Te °C	Radiation	Horizontal kWh/m²/yr	North kWh/m²/yr	South kWh/m²/yr	East kWh/m²/yr	West kWh/m²/yr
TRNSYS		9,47		987	331	842	607	619
Schiphol - 2009		10,66		1.088	340	910	687	682
Schiphol - 2010		9,19		1.056	330	878	663	660
Schiphol - 2011		11,01		1.044	324	925	651	667
Schiphol - 2012		10,33		1.028	334	897	650	665
Schiphol - 2013		9,87		1.061	336	922	665	677
Schiphol - 2014		11,77		1.070	344	930	669	703
Schiphol - 2015		10,92		1.107	342	981	660	756
Schiphol - 2016		10,91		1.075	340	961	683	708
Schiphol - 2017		11,08		1.053	344	879	667	680
Schiphol - 2018		11,43		1.154	351	1.006	727	750
Average		10,6		1.066	338	921	666	688

	Energy demand							
Weather file	Energy demand	Heating kWh/m²/yr	Cooling kWh/m²/yr	Peak power	Heating w	cell 100 W	cell 50 W	Cooling w
TRNSYS		51	2		11.364	7.022	7.856	3.944
Schiphol - 2009		46	4		11.364	7.022	7.856	3.944
Schiphol - 2010		61	4		11.614	8.133	8.936	4.022
Schiphol - 2011		36	3		9.836	6.286	7.086	3.775
Schiphol - 2012		43	5		11.097	6.467	7.400	4.697
Schiphol - 2013		49	5		11.183	6.897	7.853	4.522
Schiphol - 2014		31	4		9.819	5.842	6.650	4.636
Schiphol - 2015		31	5		10.375	5.483	6.503	4.092
Schiphol - 2016		39	6		9.694	6.150	7.083	5.017
Schiphol - 2017		41	4		10.394	6.650	7.497	3.961
Schiphol - 2018	39	11	10.542	6.256	6.978	5.528		
Average		42	5		10.662	6.564	7.427	4.376

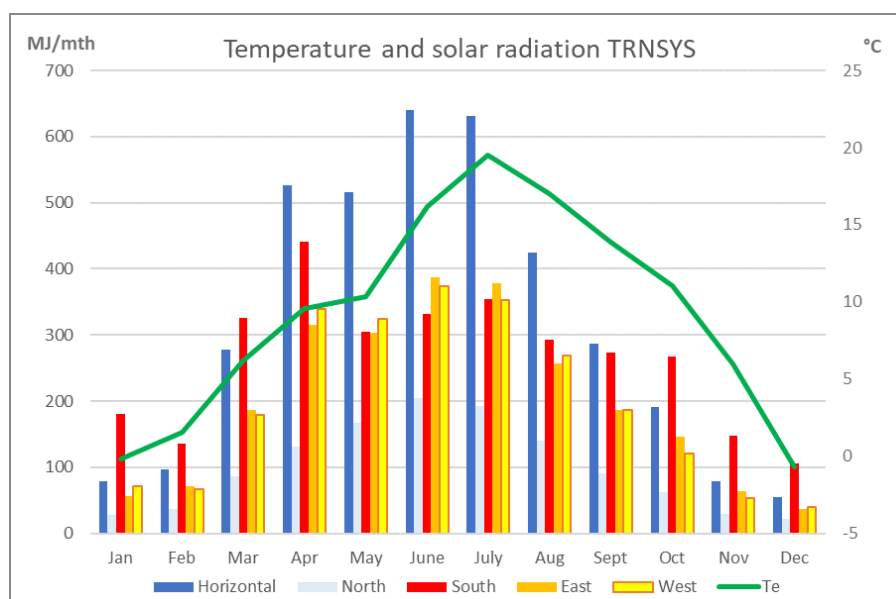


2.2 Overview of all climate years

2.2.1 Weather data TRNSYS

The weather data for the TRNSYS - Schiphol standard weather file is shown below regarding temperature and solar radiation.

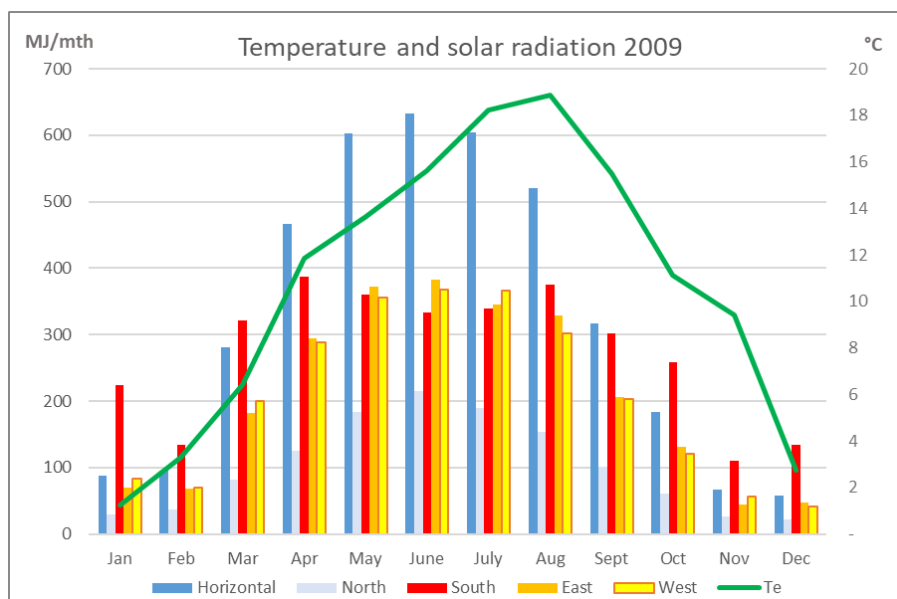
		Climate year TRNSYS							
Year	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
		9,5		MJ/yr	3.553	1.192	3.032	2.185	2.229
				kWh/m²/yr	987	331	842	607	619
Month									
Jan		2,60		MJ/mth	68	26	142	49	53
Feb		2,66			144	47	231	103	98
Mar		4,99			244	80	261	163	159
Apr		7,77			402	124	309	253	252
May		12,33			534	182	314	319	319
June		14,72			518	183	276	286	295
July	16,44		542	186	304	306	315		
Aug	16,84		466	147	330	279	280		
Sept	14,12		302	99	289	191	205		
Oct	11,02		186	61	274	129	143		
Nov	6,43		92	34	182	69	68		
Dec	3,77		55	22	120	38	42		



2.2.2 Weather data KNMI Schiphol 2009

The weather data for the KNMI 2009 (Schiphol) weather file is shown below regarding temperature and solar radiation.

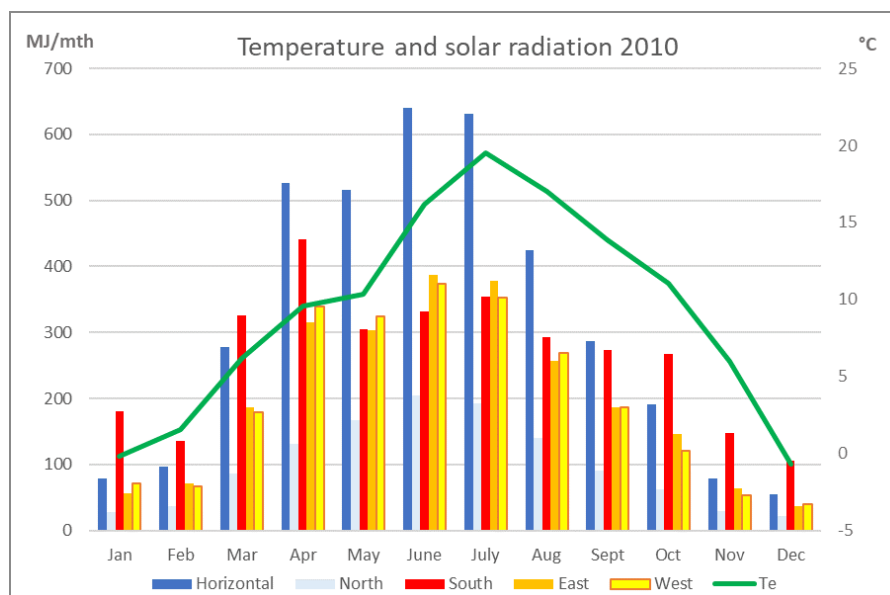
Year	Temperature	Climate year 2009							
		Te (°C)	Radiation	Horizontal	North	South	East	West	
10,7		MJ/yr		3.918	1.225	3.277	2.473	2.456	
kWh/m²/yr		1.088		340	910	687	682		
Month									
Jan		1,23		MJ/mth	88	29	224	69	84
Feb		3,32		95	37	134	69	69	
Mar		6,42		281	82	321	183	201	
Apr		11,87		467	125	387	294	288	
May		13,64		603	184	360	373	356	
June	15,63	633		214	333	382	368		
July	18,23	605	189	339	346	366			
Aug	18,85	520	154	375	329	302			
Sept	15,50	317	102	302	207	203			
Oct	11,13	184	60	259	131	121			
Nov	9,40	67	27	110	44	57			
Dec	2,74	58	22	134	47	41			



2.2.3 Weather data KNMI Schiphol 2010

The weather data for the 2010 (Schiphol) weather file is shown below regarding temperature and solar radiation.

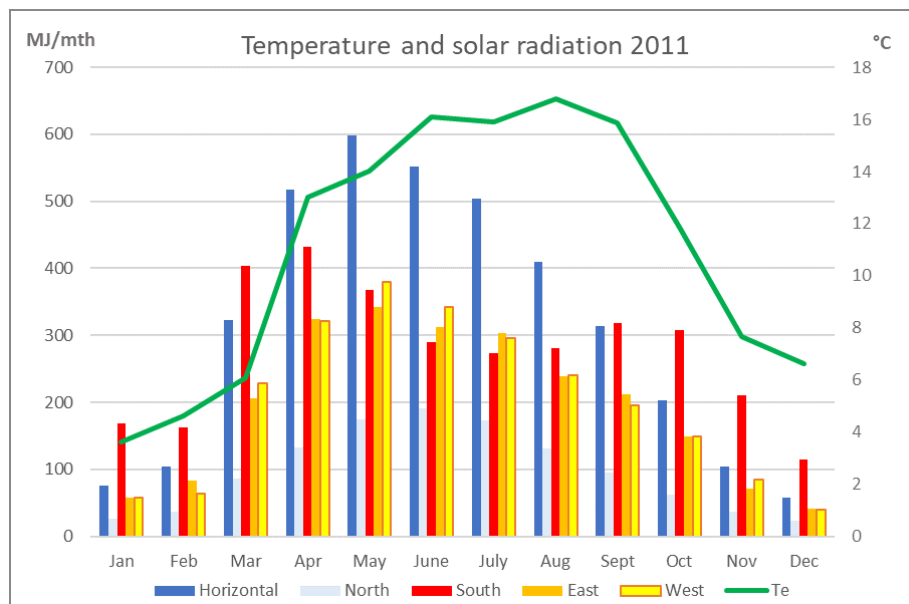
Year	Temperature	Climate year 2010						
		Te (°C)	Radiation	Horizontal	North	South	East	West
		9,2		MJ/yr	3.803	1.189	3.161	2.388
		kWh/m²/yr	1.056	330	878	663	660	
Month								
Jan		-0,20	MJ/mth	78	27	181	57	71
Feb		1,54		96	37	135	71	66
Mar		6,20		277	86	326	186	179
Apr		9,56		526	132	441	316	340
May		10,36		516	167	304	303	325
June	16,17		641	205	332	387	373	
July	19,50		632	192	354	378	353	
Aug	17,03		424	140	293	257	268	
Sept	13,87		287	91	273	186	186	
Oct	11,03		192	62	267	147	121	
Nov	5,96		78	30	148	64	54	
Dec	-0,72		55	22	105	37	39	



2.2.4 Weather data KNMI Schiphol 2011

The weather data for the 2011 (Schiphol) weather file is shown below regarding temperature and solar radiation.

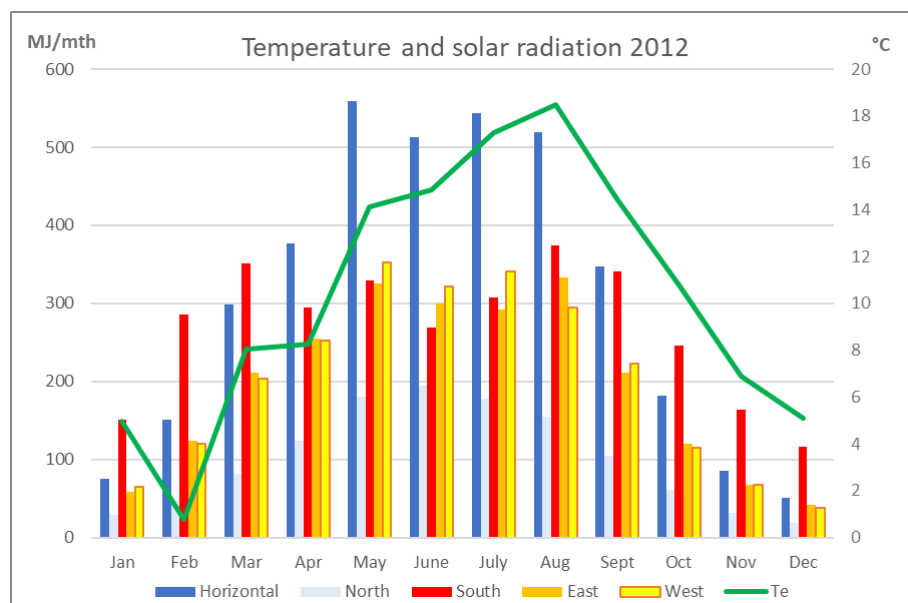
	Climate year 2011								
	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
Year		11,0		MJ/yr	3.760	1.168	3.329	2.344	2.401
				kWh/m²/yr	1.044	324	925	651	667
Month									
Jan		3,62		MJ/mth	75	26	168	58	59
Feb		4,64			104	36	162	83	64
Mar		6,08			323	86	404	207	229
Apr		13,02			517	132	432	324	321
May		14,02			598	175	367	342	380
June		16,08			552	191	291	313	342
July		15,91			503	173	274	303	296
Aug		16,77			409	132	281	240	240
Sept		15,87			313	96	318	212	196
Oct		11,86			203	62	308	149	149
Nov		7,68			104	36	210	72	85
Dec		6,61			57	23	114	41	39



2.2.5 Weather data KNMI Schiphol 2012

The weather data for the 2012 (Schiphol) weather file is shown below regarding temperature and solar radiation.

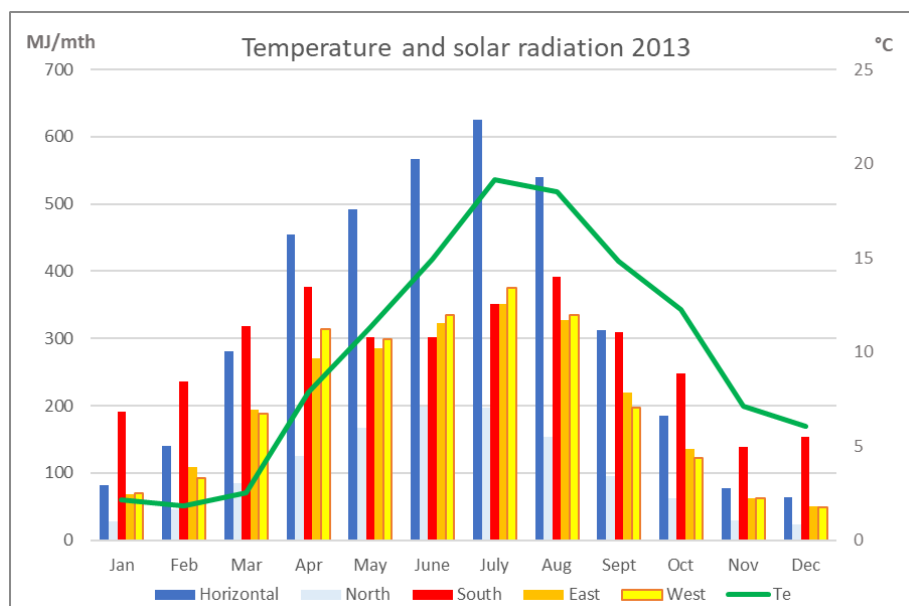
		Climate year 2012							
Year	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
		10,3		MJ/yr	3.701	1.204	3.231	2.340	2.394
				kWh/m²/yr	1.028	334	897	650	665
Month									
Jan		4,96		MJ/mth	75	29	151	58	65
Feb		0,77			151	46	285	124	121
Mar		8,05			299	81	351	212	203
Apr		8,25			376	124	294	254	253
May		14,12			559	180	330	325	353
June		14,84			513	194	269	300	322
July	17,28		544	178	308	292	340		
Aug	18,49		519	155	374	333	294		
Sept	14,47		347	104	341	212	223		
Oct	10,77		181	61	246	120	115		
Nov	6,88		85	32	163	68	68		
Dec	5,11		51	19	117	42	38		



2.2.6 Weather data KNMI Schiphol 2013

The weather data for the 2013 (Schiphol) weather file is shown below regarding temperature and solar radiation.

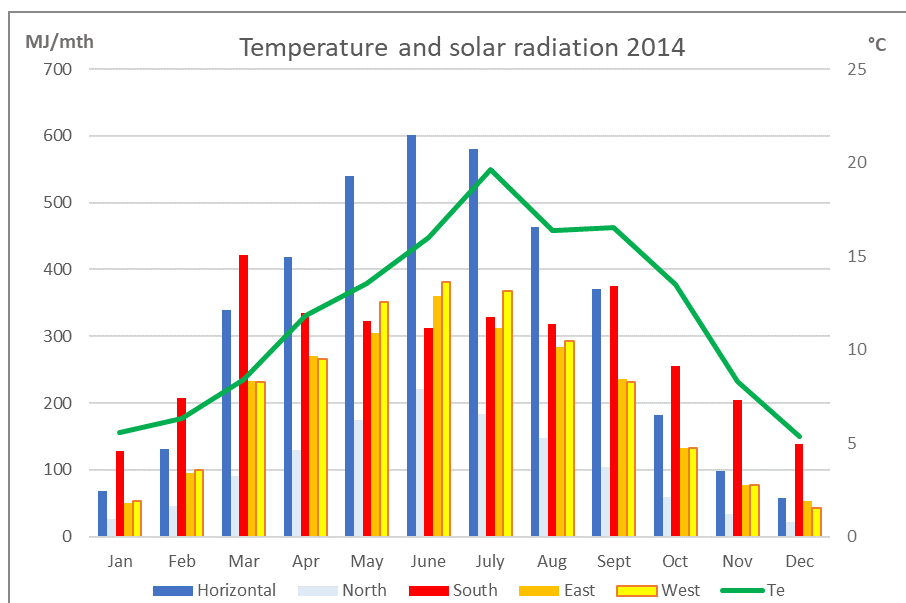
		Climate year 2013							
	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
Year		10,3		MJ/yr	3.701	1.204	3.231	2.340	2.394
				kWh/m²/yr	1.028	334	897	650	665
Month									
Jan		4,96		MJ/mth	75	29	151	58	65
Feb		0,77			151	46	285	124	121
Mar		8,05			299	81	351	212	203
Apr		8,25			376	124	294	254	253
May		14,12			559	180	330	325	353
June		14,84			513	194	269	300	322
July		17,28			544	178	308	292	340
Aug		18,49			519	155	374	333	294
Sept		14,47			347	104	341	212	223
Oct		10,77			181	61	246	120	115
Nov		6,88			85	32	163	68	68
Dec		5,11			51	19	117	42	38



2.2.7 Weather data KNMI Schiphol 2014

The weather data for the 2014 (Schiphol) weather file is shown below regarding temperature and solar radiation.

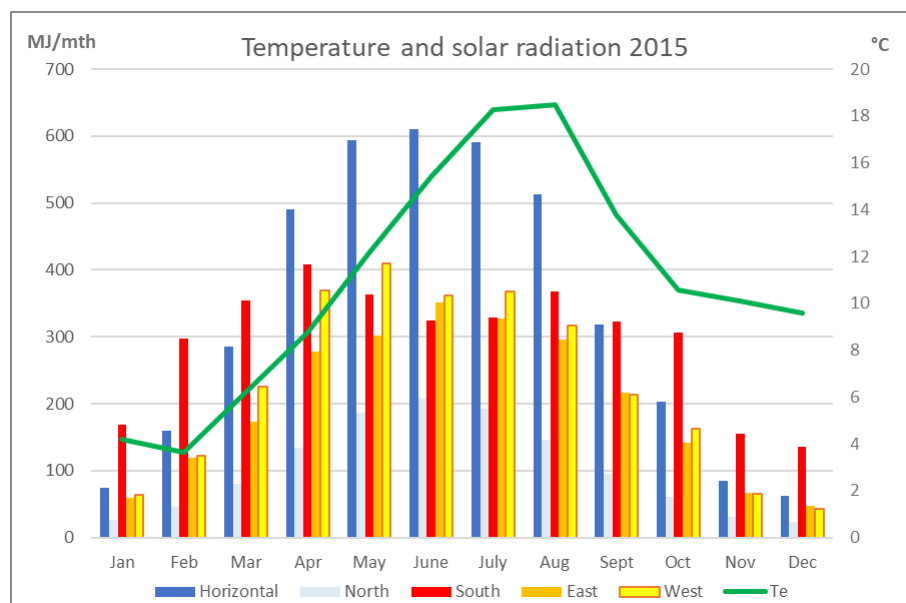
Year	Temperature	Climate year 2014							
		Te (°C)	Radiation	Horizontal	North	South	East	West	
11,8		MJ/yr		3.853	1.237	3.347	2.407	2.531	
		kWh/m²/yr		1.070	344	930	669	703	
Month									
Jan		5,59		MJ/mth	68	27	129	50	53
Feb		6,29			132	45	208	95	100
Mar		8,41			340	90	422	233	232
Apr		11,85			418	130	335	270	267
May		13,51			540	174	323	305	352
June	15,97			602	221	312	360	381	
July	19,61		581	183	328	312	367		
Aug	16,36		464	147	318	284	293		
Sept	16,51		371	104	375	236	232		
Oct	13,46		183	60	255	133	133		
Nov	8,27		98	33	205	77	78		
Dec	5,36		57	22	138	53	43		



2.2.8 Weather data KNMI Schiphol 2015

The weather data for the 2015 (Schiphol) weather file is shown below regarding temperature and solar radiation.

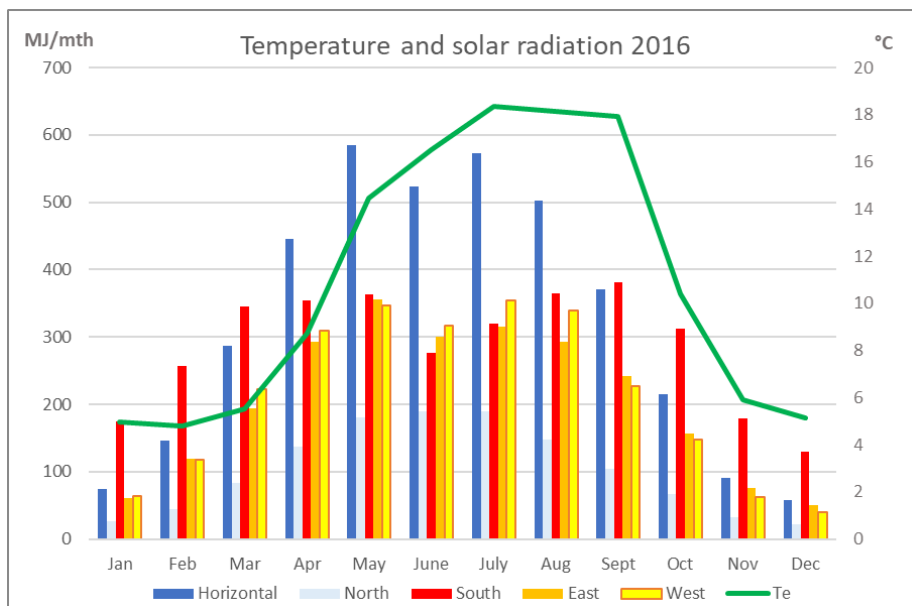
		Climate year 2015							
Year	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
		10,9		MJ/yr	3.985	1.232	3.533	2.378	2.722
		kWh/m²/yr		1.107	342	981	660	756	
Month									
Jan		4,18		MJ/mth	74	26	168	60	64
Feb		3,64			160	46	297	120	122
Mar		6,20			286	80	355	172	226
Apr		8,78			491	135	409	277	369
May		12,16			594	187	363	302	409
June		15,41			610	208	324	351	361
July	18,28		591	193	329	327	368		
Aug	18,49		513	146	368	296	317		
Sept	13,76		318	96	323	217	214		
Oct	10,55		203	60	306	141	163		
Nov	10,09		84	31	156	66	65		
Dec	9,57		62	24	136	48	43		



2.2.9 Weather data KNMI Schiphol 2016

The weather data for the 2016 (Schiphol) weather file is shown below regarding temperature and solar radiation.

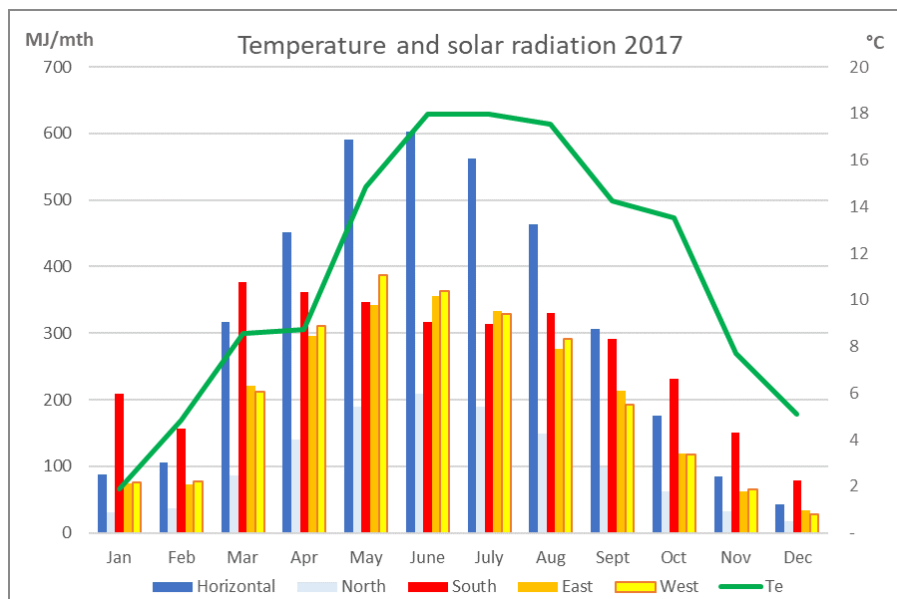
	Climate year 2016								
Year	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
		10,9		MJ/yr	3.871	1.224	3.461	2.459	2.550
				kWh/m²/yr	1.075	340	961	683	708
Month									
Jan		4,96		MJ/mth	75	26	175	61	64
Feb		4,81			147	45	257	119	118
Mar		5,53			287	83	346	194	222
Apr		8,74			445	137	354	294	309
May		14,48			585	181	363	355	347
June		16,52			524	190	277	301	318
July	18,34		573	189	320	315	354		
Aug	18,15		503	147	365	294	339		
Sept	17,93		370	104	382	243	227		
Oct	10,41		215	67	312	157	148		
Nov	5,92		91	33	179	76	63		
Dec	5,12		58	22	130	51	40		



2.2.10 Weather data KNMI Schiphol 2017

The weather data for the 2017 (Schiphol) weather file is shown below regarding temperature and solar radiation.

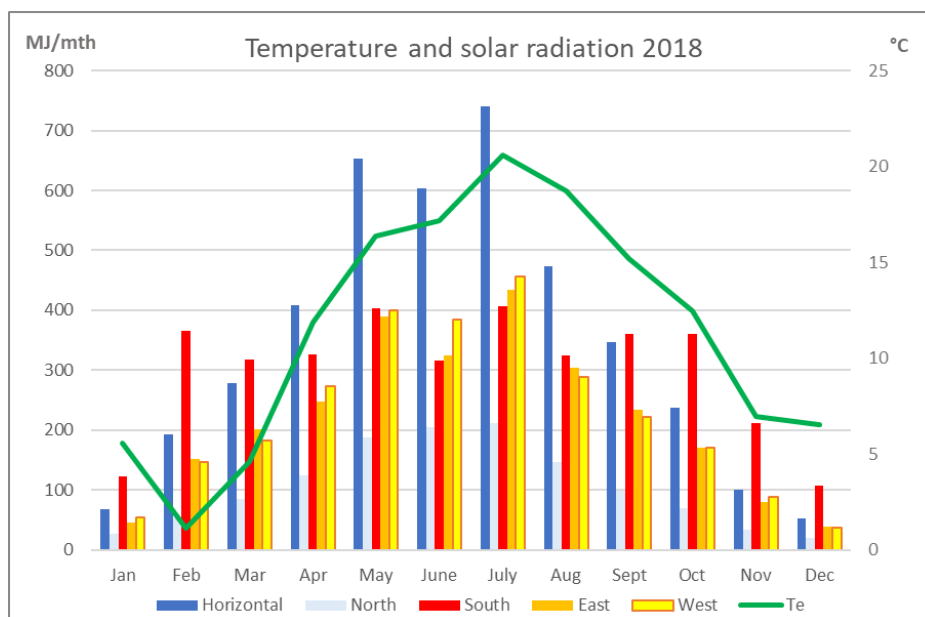
Climate year 2017								
Year	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West
				MJ/yr				
		11,1		3.792	1.240	3.163	2.403	2.448
Month				kWh/m²/yr				
Jan		1,89		87	30	209	75	75
Feb		4,84		105	38	157	72	77
Mar		8,58		318	86	377	220	211
Apr		8,72		452	139	361	296	310
May		14,83		590	189	347	342	387
June		17,97		603	209	316	356	363
July		17,95		563	189	314	334	329
Aug		17,55		464	149	330	277	291
Sept		14,26		306	98	291	214	193
Oct		13,52		176	63	232	120	118
Nov		7,72		85	32	151	63	65
Dec		5,08		43	18	78	34	28



2.2.11 Weather data KNMI Schiphol 2018

The weather data for the 2018 (Schiphol) weather file is shown below regarding temperature and solar radiation.

	Climate year 2018								
	Temperature	Te (°C)	Radiation	Horizontal	North	South	East	West	
Year		11,4		MJ/yr	4.153	1.262	3.621	2.617	2.700
				kWh/m²/yr	1.154	351	1.006	727	750
Month									
Jan		5,58		MJ/mth	67	27	122	46	54
Feb		1,11			193	52	366	151	147
Mar		4,63			278	86	317	201	182
Apr		11,90			409	124	326	248	274
May		16,35			653	187	403	389	399
June		17,16			604	205	317	324	384
July	20,58		740	212	406	434	455		
Aug	18,70		473	147	324	304	289		
Sept	15,20		346	99	360	234	222		
Oct	12,49		236	70	360	170	170		
Nov	6,96		101	34	211	79	88		
Dec	6,54		53	21	108	38	37		

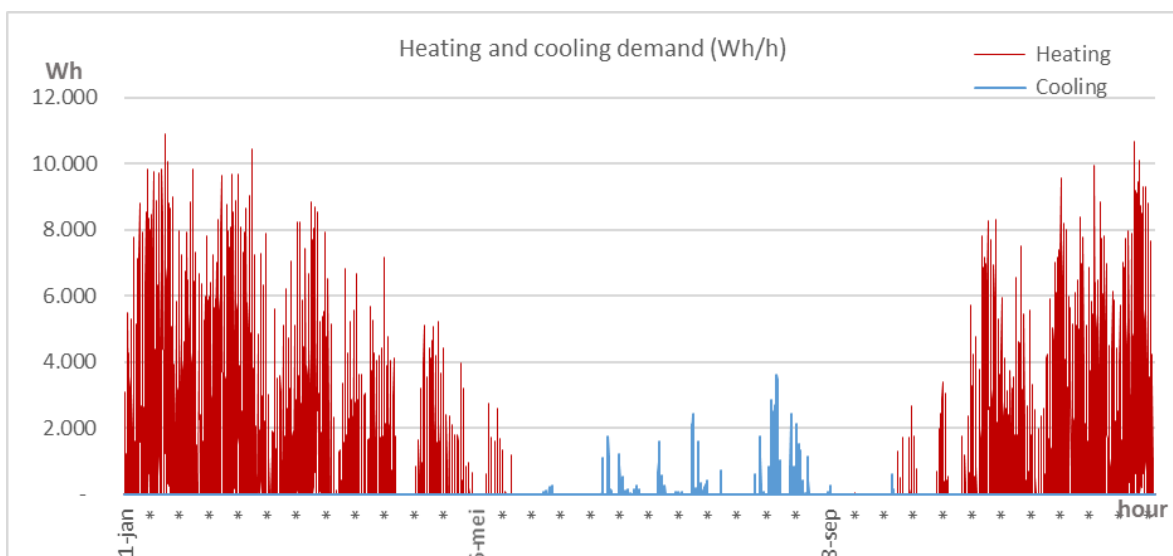
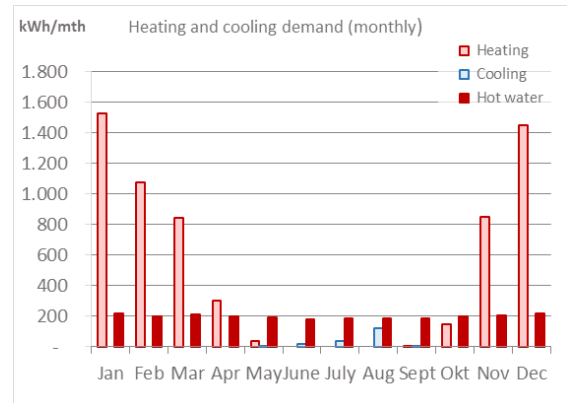
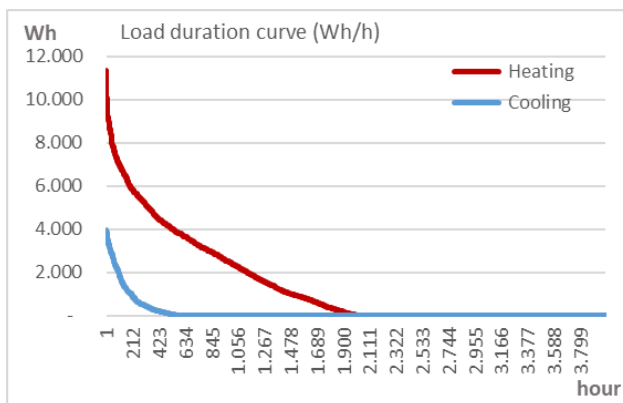


2.3 Overview of all energy results

2.3.1 Energy results TRNSYS

In the following figures the energy results for the dwelling simulated with the TRNSYS-weather file are shown.

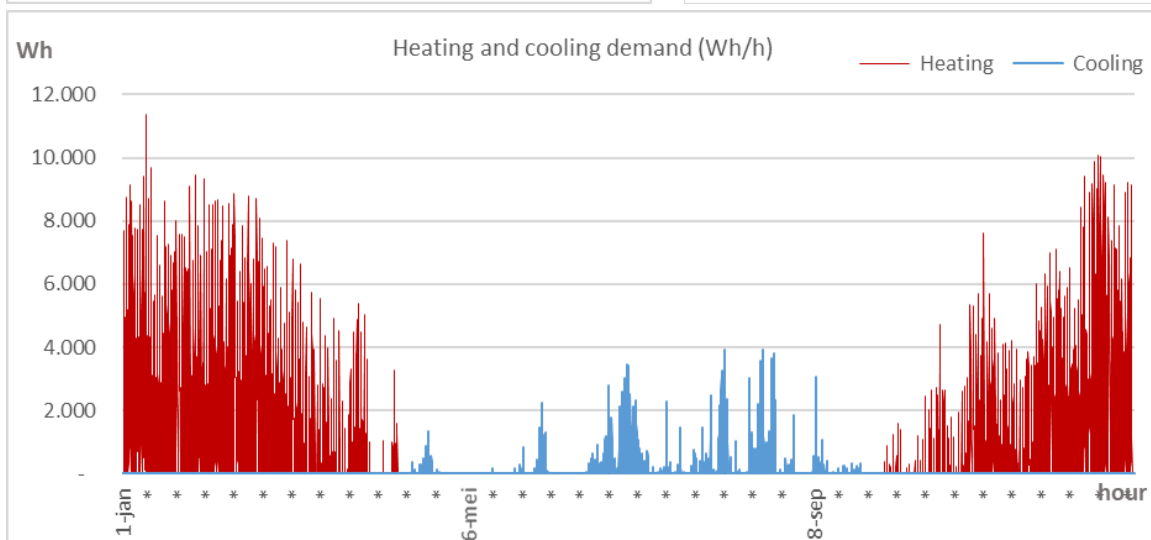
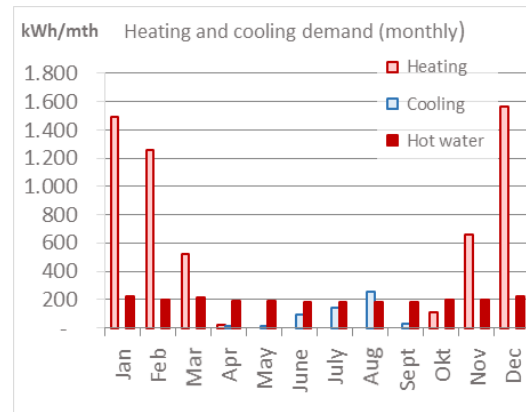
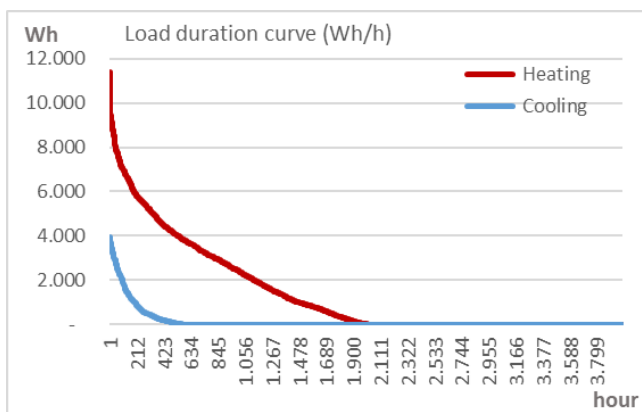
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	9,5	20,9	MJ/yr	22.450	666	8.576	kWh/yr	6.236	185	2.382
			MJ/m ² /yr	182	5	70	kWh/m ² /yr	51	2	19
Jan	2,6	18,2	MJ/mth	5.500	-	792	kWh/mth	1.528	-	220
Feb	2,7	18,4		3.876	-	716		1.077	-	199
Mar	5,0	18,9		3.047	-	774		847	-	215
Apr	7,8	19,9		1.094	-	724		304	-	201
May	12,3	21,9		127	1	700		35	0	194
June	14,7	23,4		-	73	654		-	20	182
July	16,4	24,6		-	144	660		-	40	183
Aug	16,8	24,5		-	440	660		-	122	183
Sept	14,1	23,0		0	7	665		0	2	185
Okt	11,0	21,0		523	-	717		145	-	199
Nov	6,4	18,9		3.059	-	733		850	-	204
Dec	3,8	18,2		5.223	-	781		1.451	-	217



2.3.2 Energy results 2009

In the following figures the energy results for the dwelling simulated with the 2009-weather file are shown.

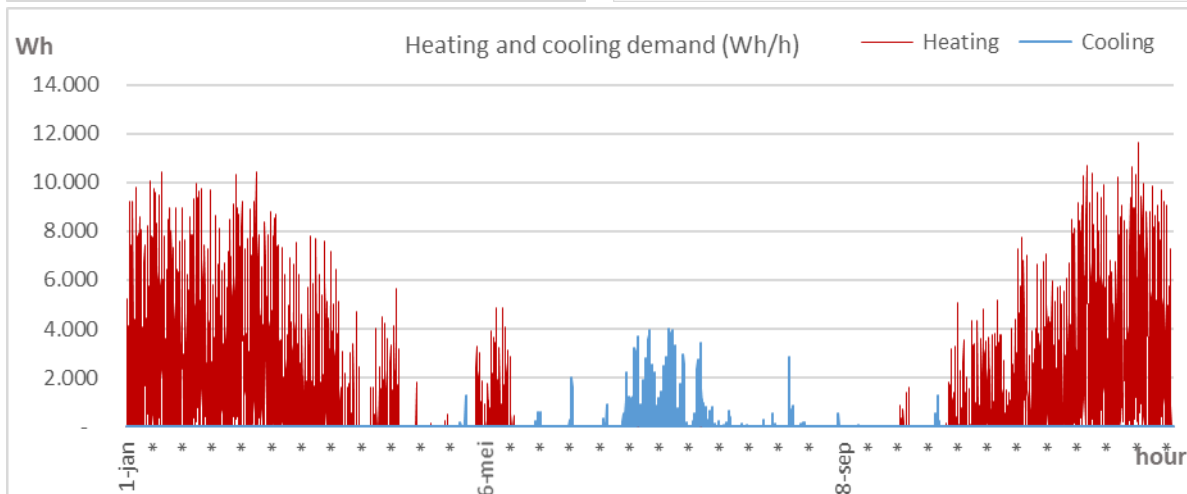
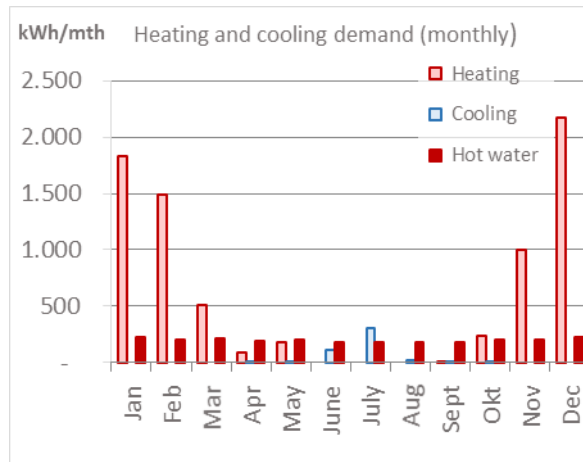
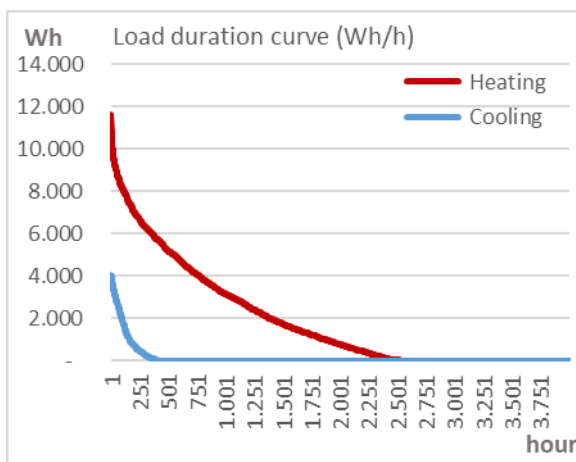
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	10,7	21,6	MJ/yr	20.232	1.918	8.426	kWh/yr	5.620	533	2.341
			MJ/m ² /yr	164	16	68	kWh/m ² /yr	46	4	19
Jan	1,2	18,1	MJ/mth	5.379	-	804	kWh/mth	1.494	-	223
Feb	3,3	18,2		4.515	-	708		1.254	-	197
Mar	6,4	19,3		1.865	-	760		518	-	211
Apr	11,9	22,8		68	37	687		19	10	191
May	13,6	23,6		-	47	687		-	13	191
June	15,6	24,7		-	328	644		-	91	179
July	18,2	25,4		-	508	642		-	141	178
Aug	18,9	25,4		-	905	641		-	251	178
Sept	15,5	24,3		-	93	652		-	26	181
Okt	11,1	20,3		380	-	712		106	-	198
Nov	9,4	18,9		2.382	-	701		662	-	195
Dec	2,7	18,2		5.643	-	788		1.567	-	219



2.3.3 Energy results 2010

In the following figures the energy results for the dwelling simulated with the 2010-weather file are shown.

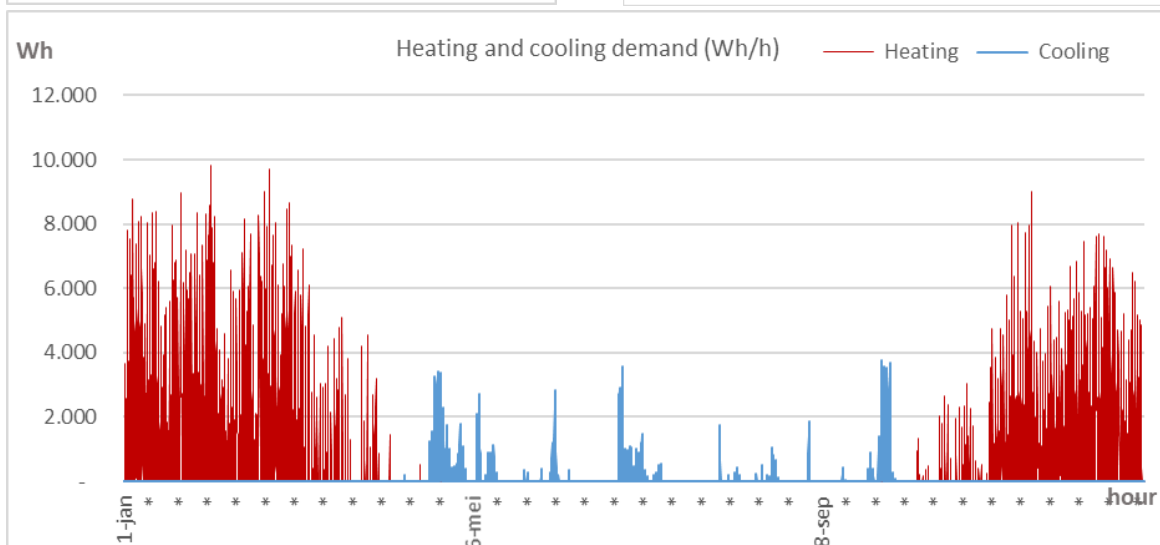
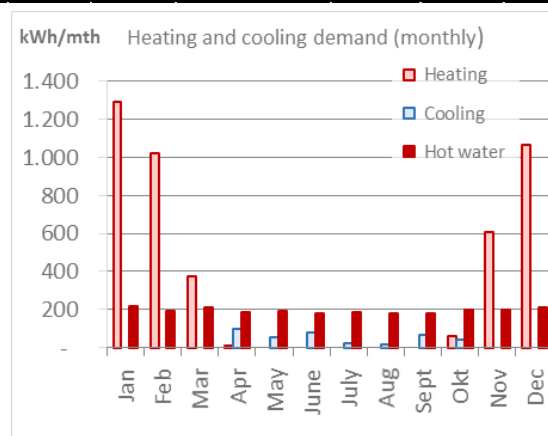
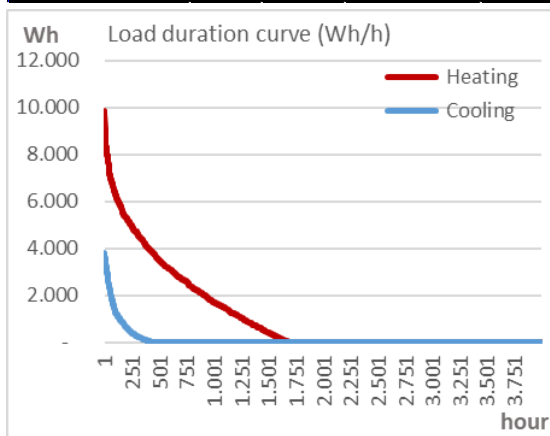
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	9,2	21,1	MJ/yr	27.043	1.641	8.585	kWh/yr	7.512	456	2.385
			MJ/m ² /yr	220	13	70	kWh/m ² /yr	61	4	19
Jan	-0,2	17,9	MJ/mth	6.576	-	816	kWh/mth	1.827	-	227
Feb	1,5	18,0		5.360	-	723		1.489	-	201
Mar	6,2	19,3		1.837	-	764		510	-	212
Apr	9,6	21,9		318	16	710		88	5	197
May	10,4	21,4		636	12	717		177	3	199
June	16,2	24,4		-	399	640		-	111	178
July	19,5	25,5		-	1.116	630		-	310	175
Aug	17,0	24,4		-	74	654		-	21	182
Sept	13,9	22,8		24	4	665		7	1	185
Okt	11,0	20,8		842	19	713		234	5	198
Nov	6,0	18,6		3.611	-	735		1.003	-	204
Dec	-0,7	17,9		7.838	-	819		2.177	-	227



2.3.4 Energy results 2011

In the following figures the energy results for the dwelling simulated with the 2011-weather file are shown.

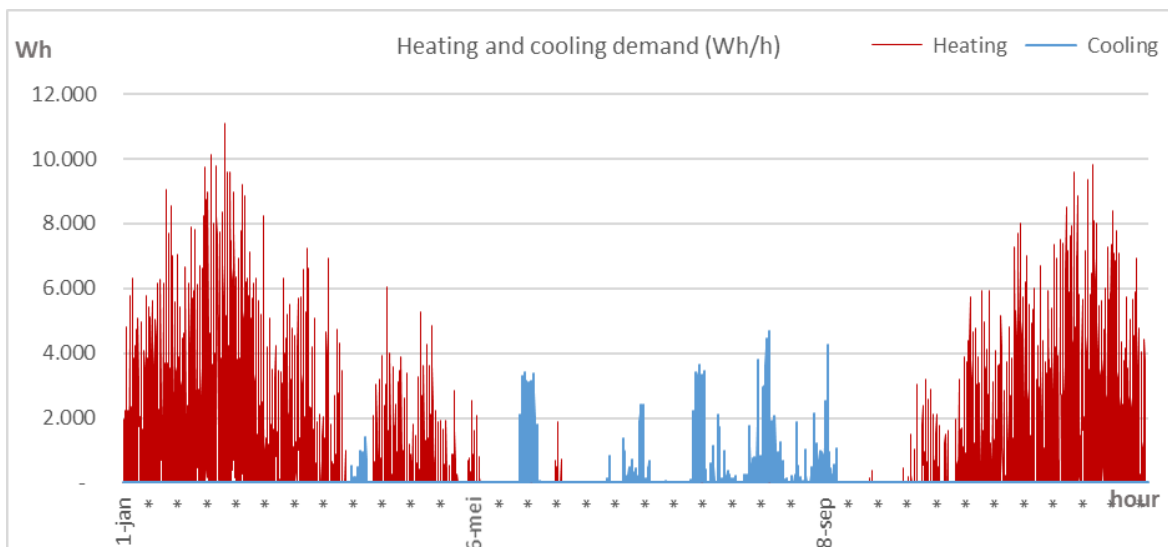
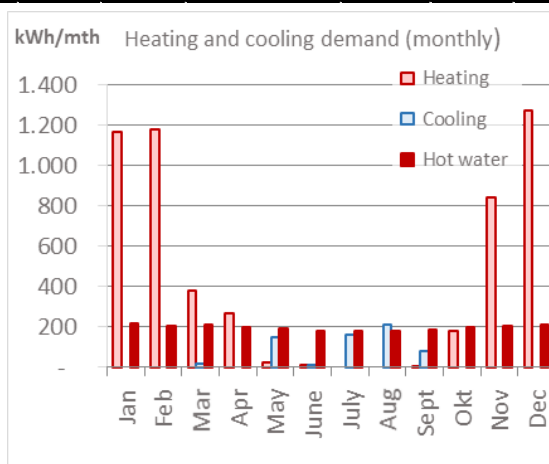
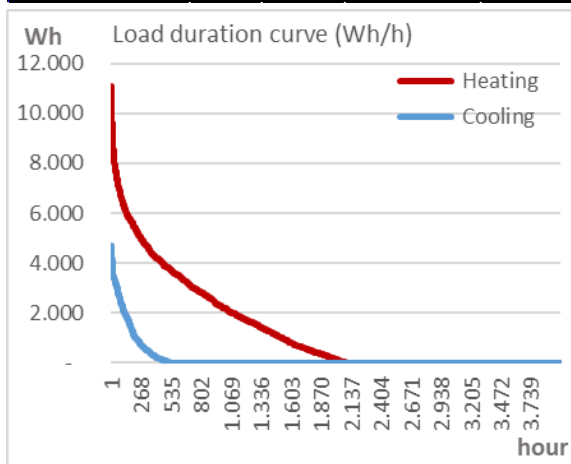
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	11,0	21,6	MJ/yr	15.981	1.352	8.391	kWh/yr	4.439	376	2.331
			MJ/m ² /yr	130	11	68	kWh/m ² /yr	36	3	19
Jan	3,6	18,3	MJ/mth	4.664	-	781	kWh/mth	1.296	-	217
Feb	4,6	18,4		3.682	-	696		1.023	-	193
Mar	6,1	19,8		1.348	-	767		374	-	213
Apr	13,0	23,2		42	362	679		12	101	189
May	14,0	24,2		-	184	685		-	51	190
June	16,1	24,4		-	281	639		-	78	178
July	15,9	24,1		-	89	663		-	25	184
Aug	16,8	24,1		-	65	657		-	18	182
Sept	15,9	23,9		-	227	647		-	63	180
Okt	11,9	21,6		219	144	707		61	40	197
Nov	7,7	19,1		2.189	-	720		608	-	200
Dec	6,6	18,6		3.838	-	749		1.066	-	208



2.3.5 Energy results 2012

In the following figures the energy results for the dwelling simulated with the 2012-weather file are shown.

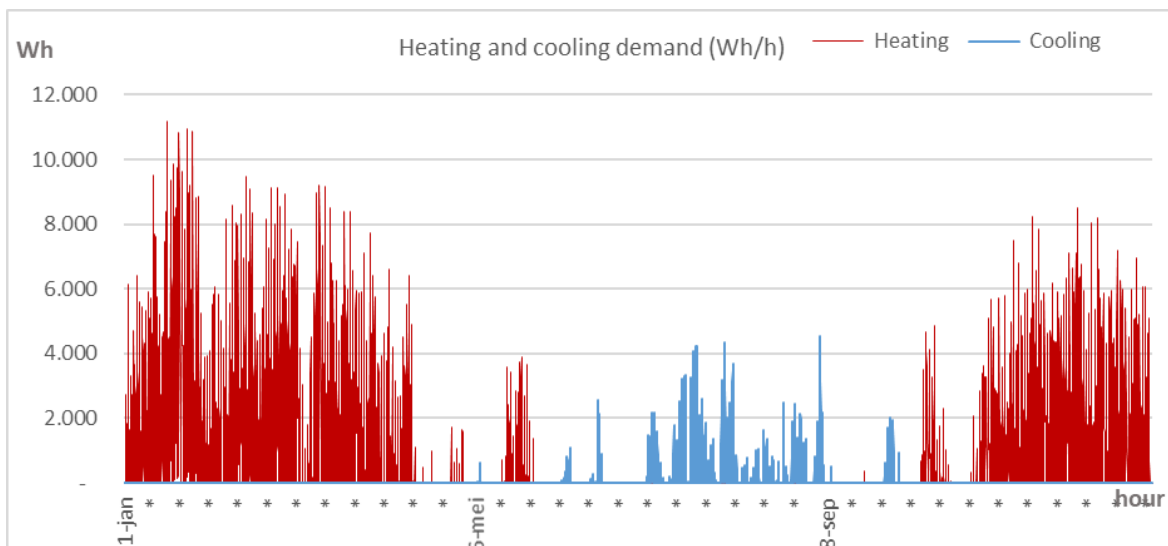
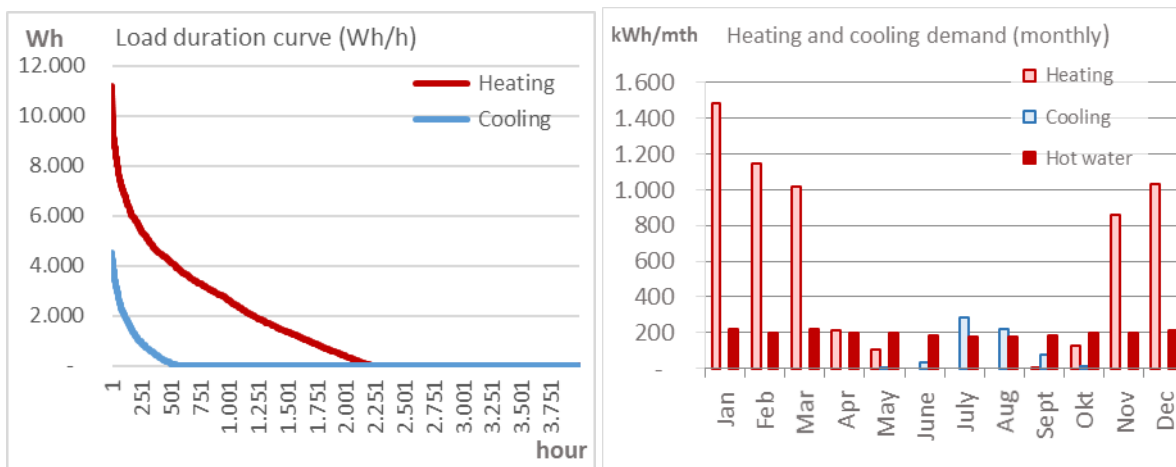
	Temperature			MegaJoule				kiloWattHour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	10,3	21,2	MJ/yr	19.146	2.226	8.451	kWh/yr	5.318	618	2.348
			MJ/m ² /yr	156	18	69	kWh/m ² /yr	43	5	19
Jan	5,0	18,4	MJ/mth	4.204	-	768	kWh/mth	1.168	-	213
Feb	0,8	18,4		4.260	-	723		1.183	-	201
Mar	8,1	20,5		1.369	54	748		380	15	208
Apr	8,2	19,5		954	-	717		265	-	199
May	14,1	22,8		83	524	683		23	145	190
June	14,8	23,4		25	34	652		7	9	181
July	17,3	24,9		-	567	650		-	157	180
Aug	18,5	25,4		-	766	644		-	213	179
Sept	14,5	23,7		3	281	662		1	78	184
Okt	10,8	20,5		636	-	716		177	-	199
Nov	6,9	18,7		3.026	-	726		840	-	202
Dec	5,1	18,4		4.586	-	764		1.274	-	212



2.3.6 Energy results 2013

In the following figures the energy results for the dwelling simulated with the 2013-weather file are shown.

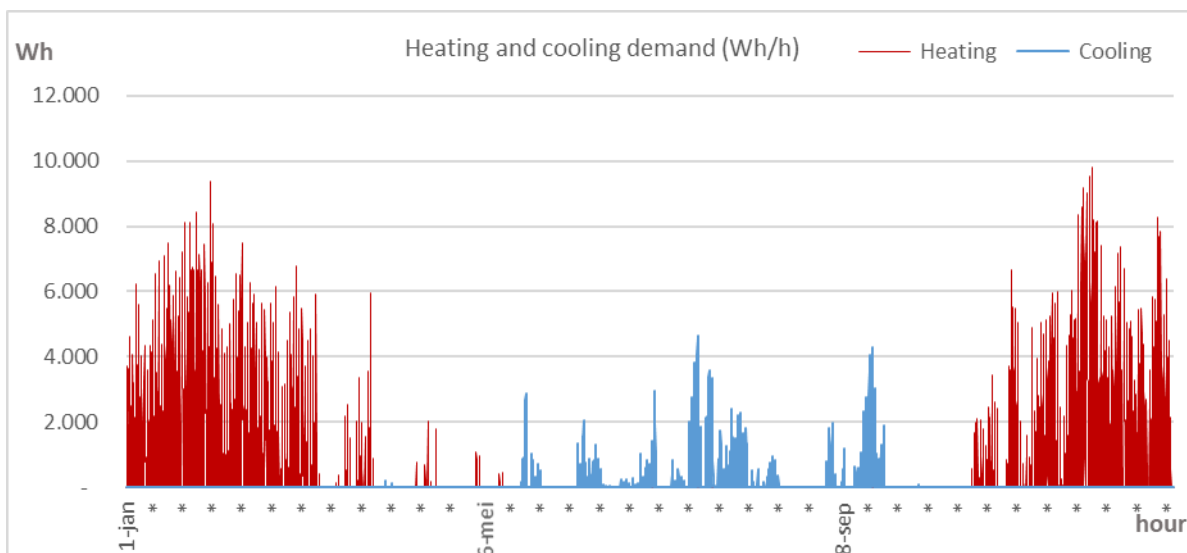
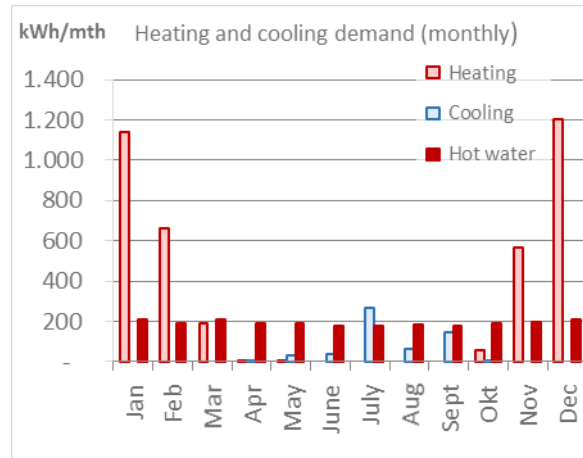
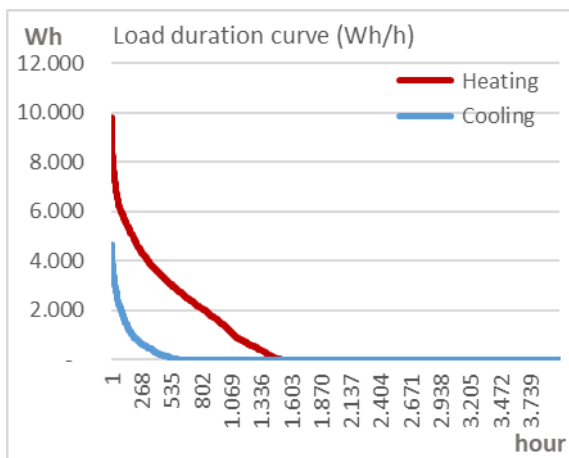
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	9,9	21,2	MJ/yr	21.552	2.260	8.508	kWh/yr	5.987	628	2.363
			MJ/m ² /yr	175	18	69	kWh/m ² /yr	49	5	19
Jan	2,1	18,3	MJ/mth	5.349	-	792	kWh/mth	1.486	-	220
Feb	1,8	18,3		4.139	-	721		1.150	-	200
Mar	2,5	18,6		3.672	-	796		1.020	-	221
Apr	7,9	20,3		751	-	721		209	-	200
May	11,3	21,5		381	3	709		106	1	197
June	14,9	24,0		-	118	651		-	33	181
July	19,2	25,5		-	1.033	632		-	287	176
Aug	18,5	25,5		-	797	644		-	221	179
Sept	14,8	23,4		2	271	657		1	75	183
Okt	12,3	21,5		461	38	702		128	10	195
Nov	7,1	18,7		3.095	-	724		860	-	201
Dec	6,0	18,5		3.701	-	758		1.028	-	210



2.3.7 Energy results 2014

In the following figures the energy results for the dwelling simulated with the 2014-weather file are shown.

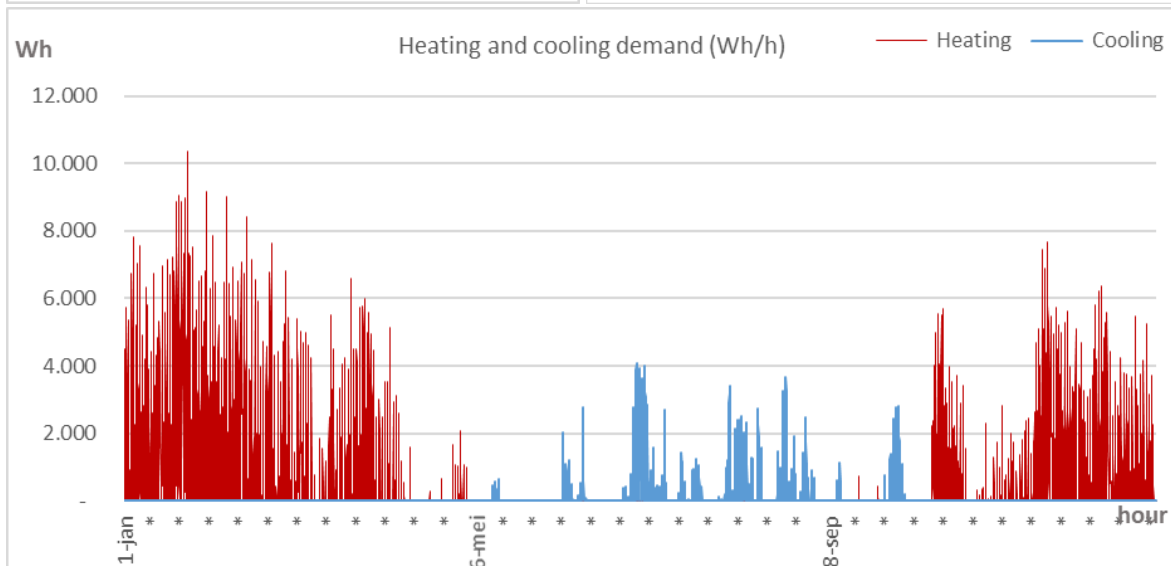
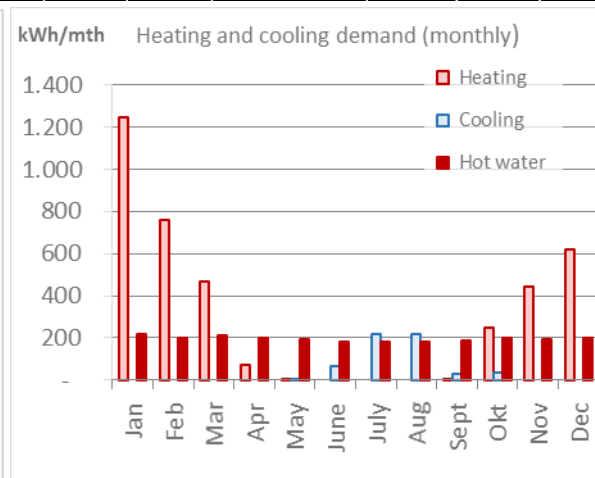
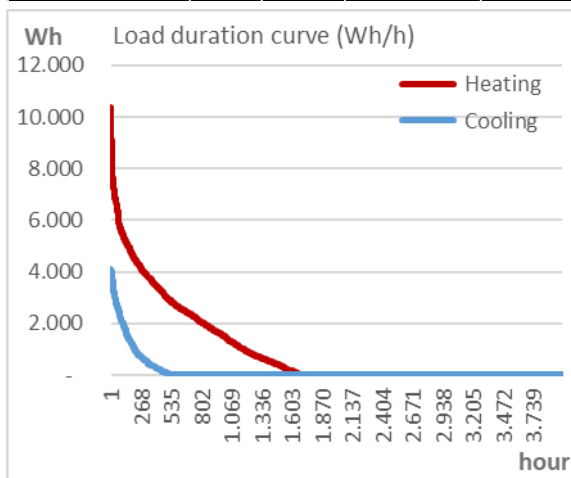
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	11,8	21,8	MJ/yr	13.785	1.947	8.304	kWh/yr	3.829	541	2.307
			MJ/m ² /yr	112	16	67	kWh/m ² /yr	31	4	19
Jan	5,6	18,4	MJ/mth	4.099	-	761	kWh/mth	1.139	-	211
Feb	6,3	18,7		2.394	-	685		665	-	190
Mar	8,4	20,7		681	-	744		189	-	207
Apr	11,8	22,4		31	1	685		9	0	190
May	13,5	22,8		16	104	686		4	29	191
June	16,0	24,8		-	133	641		-	37	178
July	19,6	25,3		-	960	629		-	267	175
Aug	16,4	24,4		-	228	662		-	63	184
Sept	16,5	24,9		-	520	644		-	144	179
Okt	13,5	22,0		199	0	690		55	0	192
Nov	8,3	19,3		2.039	-	713		567	-	198
Dec	5,4	18,5		4.326	-	763		1.202	-	212



2.3.8 Energy results 2015

In the following figures the energy results for the dwelling simulated with the 2015-weather file are shown.

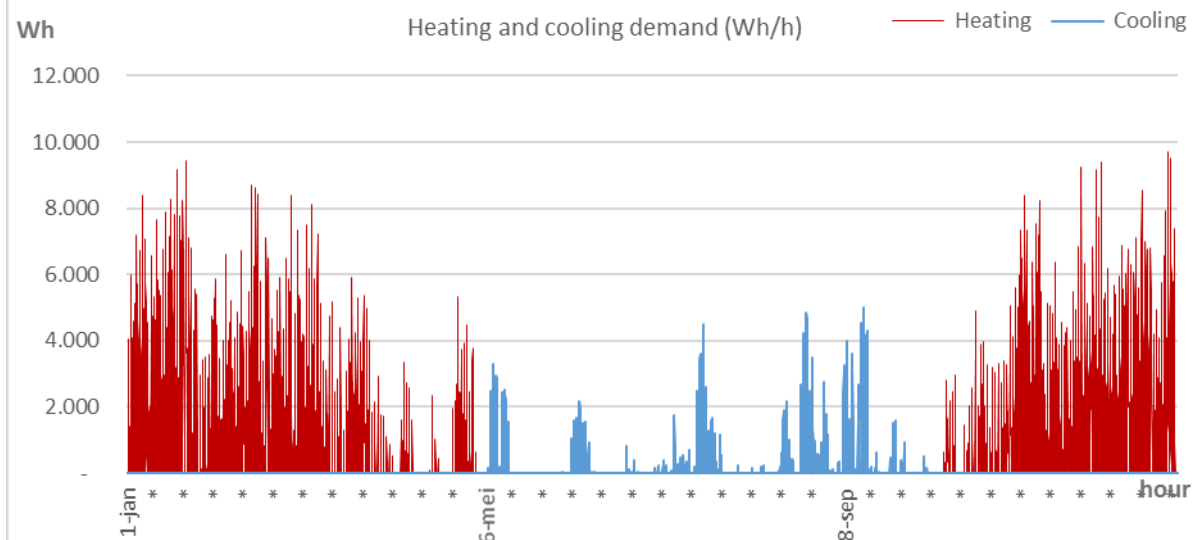
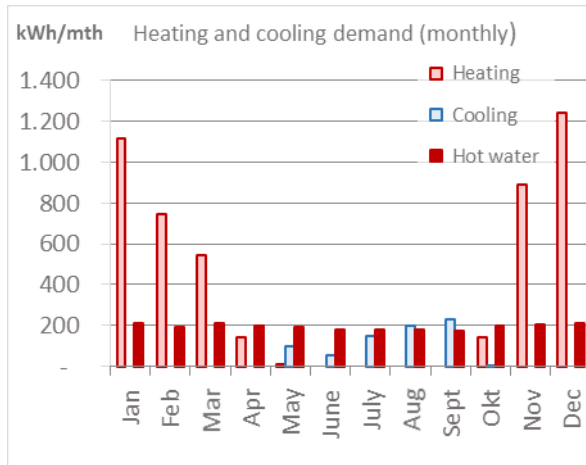
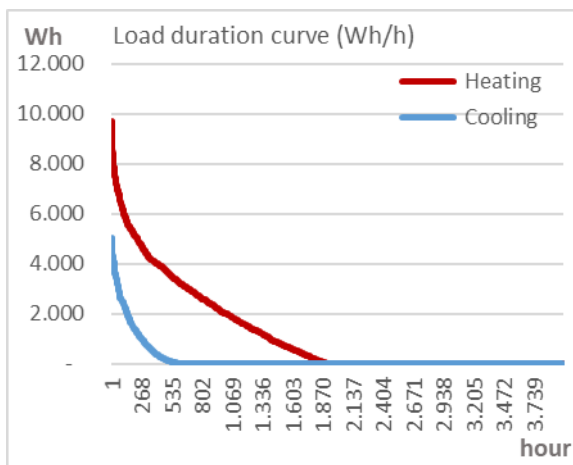
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	10,9	21,5	MJ/yr	13.888	2.058	8.397	kWh/yr	3.858	572	2.332
			MJ/m ² /yr	113	17	68	kWh/m ² /yr	31	5	19
Jan	4,2	18,4	MJ/mth	4.492	-	774	kWh/mth	1.248	-	215
Feb	3,6	18,7		2.739	-	708		761	-	197
Mar	6,2	19,5		1.671	-	763		464	-	212
Apr	8,8	21,1		251	-	715		70	-	199
May	12,2	23,2		12	17	701		3	5	195
June	15,4	24,2		-	243	646		-	68	179
July	18,3	25,2		-	792	641		-	220	178
Aug	18,5	25,2		-	777	643		-	216	179
Sept	13,8	23,2		5	103	668		2	29	185
Okt	10,6	21,4		890	124	720		247	35	200
Nov	10,1	19,5		1.593	-	696		443	-	193
Dec	9,6	19,0		2.234	-	722		620	-	201



2.3.9 Energy results 2016

In the following figures the energy results for the dwelling simulated with the 2016-weather file are shown.

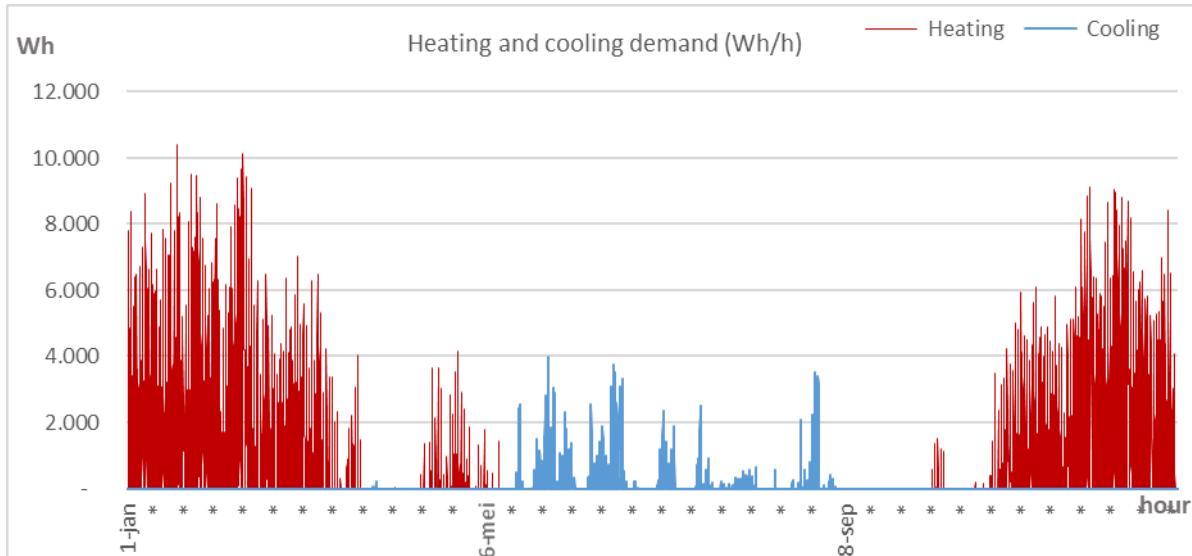
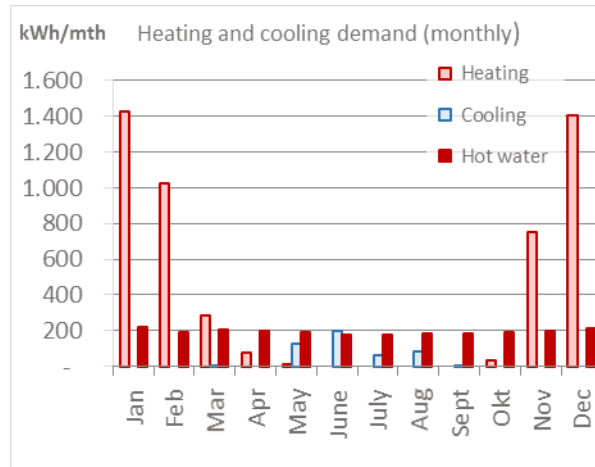
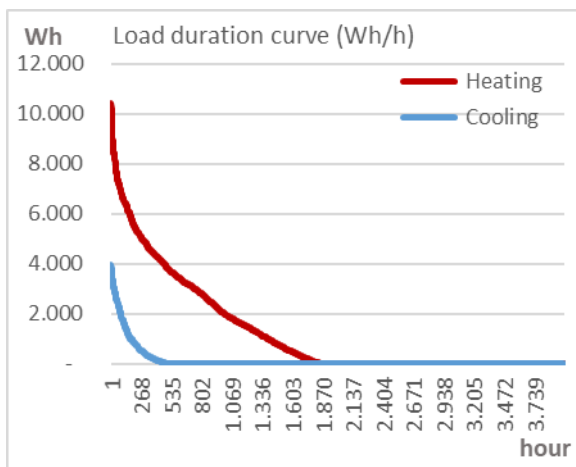
	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	10,9	21,5	MJ/yr	17.346	2.595	8.406	kWh/yr	4.818	721	2.335
			MJ/m ² /yr	141	21	68	kWh/m ² /yr	39	6	19
Jan	5,0	18,5	MJ/mth	4.014	-	767	kWh/mth	1.115	-	213
Feb	4,8	18,7		2.680	-	697		744	-	194
Mar	5,5	19,2		1.952	-	768		542	-	213
Apr	8,7	20,7		501	-	713		139	-	198
May	14,5	23,4		31	356	680		9	99	189
June	16,5	24,5		-	185	638		-	51	177
July	18,3	25,1		-	522	640		-	145	178
Aug	18,1	24,9		-	702	645		-	195	179
Sept	17,9	25,2		-	825	632		-	229	175
Okt	10,4	21,1		499	4	723		139	1	201
Nov	5,9	18,6		3.194	-	737		887	-	205
Dec	5,1	18,5		4.475	-	766		1.243	-	213



2.3.10 Energy results 2017

In the following figures the energy results for the dwelling simulated with the 2017-weather file are shown.

	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	11,1	21,5	MJ/yr	18.030	1.703	8.377	kWh/yr	5.008	473	2.327
			MJ/m ² /yr	146	14	68	kWh/m ² /yr	41	4	19
Jan	1,9	18,1	MJ/mth	5.134	-	798	kWh/mth	1.426	-	222
Feb	4,8	18,5		3.682	-	696		1.023	-	193
Mar	8,6	20,6		1.022	1	741		284	0	206
Apr	8,7	20,6		271	-	713		75	-	198
May	14,8	23,4		49	456	676		14	127	188
June	18,0	25,3		-	717	622		-	199	173
July	18,0	25,0		-	229	645		-	64	179
Aug	17,5	24,9		-	296	652		-	82	181
Sept	14,3	23,3		-	4	664		-	1	184
Okt	13,5	21,5		116	-	687		32	-	191
Nov	7,7	18,8		2.703	-	719		751	-	200
Dec	5,1	18,3		5.052	-	764		1.403	-	212



2.3.11 Energy results 2018

In the following figures the energy results for the dwelling simulated with the 2018-weather file are shown.

	Temperature			MegaJoule				kiloWatt-hour		
	Te	Tair		Heating	Cooling	DHW		Heating	Cooling	DHW
Annual average	11,4	21,9	MJ/yr	17.264	4.738	8.347	kWh/yr	4.796	1.316	2.318
			MJ/m²/yr	140	38	68	kWh/m²/yr	39	11	19
Jan	5,6	18,4	MJ/mth	4.163	-	761	kWh/mth	1.156	-	211
Feb	1,1	18,5		3.151	-	730		875	-	203
Mar	4,6	18,8		2.583	-	778		717	-	216
Apr	11,9	22,1		390	209	686		108	58	190
May	16,3	24,5		47	695	662		13	193	184
June	17,2	25,1		-	455	631		-	126	175
July	20,6	25,9		-	2.107	621		-	585	172
Aug	18,7	24,8		-	909	641		-	252	178
Sept	15,2	24,1		0	123	656		0	34	182
Okt	12,5	22,9		366	240	703		102	67	195
Nov	7,0	19,0		2.582	-	727		717	-	202
Dec	6,5	18,6		3.981	-	751		1.106	-	209

