

E2ReBuild

Industrial Energy Efficient
Retrofitting of Resident
Buildings in Cold Climates



D5.3 Data Input to EU Database

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Partners:	<u>SP</u> ; AALTO, NCCSE, TUM		
Authors:	<u>Carl-Magnus Capener</u> ; Stefan Elfborg		
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Project Participants

- NCCSE NCC AB, Sweden
- MOW Mostostal Warszawa SA, Poland
- Schwörer SchwörerHaus KG, Germany
- Trecodome Trecodome BV, Netherlands
- NCCFI NCC Rakennus Oy, Finland
- Gumpp Gumpp & Maier GmbH, Germany
- Lichtblau Lichtblau Architekten GBR, Germany
- White White Arkitekter AB, Sweden
- SP SP Sveriges Tekniska Forskningsinstitut, Sweden
- EMPA Eidgenössische Materialprüfungs- und Forschungsanstalt, Switzerland
- HSLU T&A Hochschule Luzern Technik & Architektur, Switzerland
- TUM Technische Universität München, Germany
- Aalto Aalto-Korkeakoulusäätiö, Finland
- GWGM GWG Städtische Wohnungsgesellschaft München mbH, Germany
- Opac38 Office Public d’Amenagement et de Construction de l’Isère, France
- PSOAS Pohjois-Suomen Opiskelija-Asuntosäätiö, Finland
- ABV Akelius Bostad Väst AB, Sweden
- Aramis Stichting Alleewonen, Netherlands
- Augsburg Wohnungsbaugesellschaft der Stadt Augsburg GmbH, Germany
- Gallions Gallions Housing Association Limited IPS, United Kingdom

Executive Summary

This deliverable presents the monitored data from all E2ReBuild demonstrations to be submitted to the EU database. The demonstrations included are Augsburg, Halmstad, Munich, Oulu, Roosendaal, and Voiron. The London demonstration, which was not completed within the E2ReBuild timeframe, is excluded. All data have been provided by each participating demonstration and the correctness of these numbers is dependent on the accuracy of each demonstration's implemented monitoring programme.

In the report, the monitored data are presented by demonstration and parameter separately. The monitoring period was set to one year and was carried out over different time periods for the different demonstrations depending on completion of construction work. Some demonstrations have a shorter monitoring period due to late completion of construction.

The collection of data was harmonized to conform to the EU Concerto Premium programme.

The hourly monitored data which is also part of the monitoring programme is evaluated and analysed in E2ReBuild deliverables D5.4 and D5.5.

The evaluation and analysis of monitored data is provided in work package 2 and E2ReBuild deliverables D2.1-2.7.

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1 Introduction

This report presents the monitored data from all demonstration projects of E2ReBuild except for the London demonstration which was not completed within the E2ReBuild timeframe. The monitoring programme and explanation of monitoring parameters can be found in E2ReBuild deliverable D5.1 Monitoring Scheme for Demonstration Projects. The hourly monitored data which is also part of the monitoring programme is evaluated and analysed in E2ReBuild deliverables D5.4 and D5.5.

The monitoring period was set to one year and was carried out over different time periods for the different demonstrations depending on completion of construction work. Some demonstrations have a shorter monitoring period due to late completion of construction.

The collection of data was harmonized to conform to the EU Concerto Premium programme.

The experiences from the E2ReBuild monitoring programme are evaluated in deliverable D5.5 Guidelines to Operators.

1.1 Goal and Objectives

The main goal of this deliverable is to present the measurements from the demonstration buildings to be submitted to the EU database. The measurements have been based on the E2ReBuild deliverable *D5.1 Monitoring Scheme for Demonstration Projects*.

1.2 Contributors

This deliverable presents the monitored data from all E2ReBuild demonstrations. All data have been provided by each participating demonstration and the correctness of these numbers is dependent on the accuracy of each demonstration's implemented monitoring programme.

Measures and data for the different demos were provided by the following contributors and presented in the following sections:

Chiel Boonstra, Trecodome (London, UK+Roosendaal, NL)

Stephen Burke, NCCSE (Halmstad, Sweden)

Benoit Jehl, OPAC38 (Voiron, France)

Stephan Ott, TUM (Augsburg+Munich, Germany)

Simon le Roux, Aalto (Oulu, Finland)

2 Demonstration Projects

Within E2ReBuild, seven full-scale demonstration buildings provide best practice examples of retrofitting strategies for residential buildings in cold climates, from Finland in the north to the alpine region in the Southeast of France. The demonstrations are evaluated and analysed in work package 2 and deliverables D2.1-2.7. More information can be found at www.e2rebuild.eu.



	Units	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Total gross floor area (external)	m ²	4540	-	-	6294	791	-	5373
Total heated/cooled net floor area (internal)	m ²	3324	6178	2493	4727	680	460 ¹ (figure updated to 525 after end of analysis)	4544
Total gross building volume (external)	m ³	21206	-	-	15920	2439	-	13432
Total heated/cooled net volume (internal)	m ³	18728	15309	-	12748	1875	-	11360
Total envelope surface of building	m ²	4869	4186	-	5856	1183	-	5132
Type of ventilation	-	Mechanical supply/exhaust 70%	Mechanical exhaust with Heat pump	Mechanical supply/exhaust 88%	Mechanical exhaust fan	Mechanical supply/exhaust 75,7%	Mechanical supply/exhaust heat recovery	Mechanical exhaust fan
Ventilation rates	l/s/m ²	-	0.35	-	-	0.3	-	-
Ventilation rates	air changes /hour	-	0.5	-	-	0.7	-	0.3
Air tightness	m ³ /h/m ²	-	0.396	-	1.46 air changes	1.2	-	0.63*

Figure 1 Demonstration general data based on monitoring programme. *For the demonstration in Voiron the air tightness was carried out according to the French Q4Pa-surf methodology.

¹ The total area of the Roosendaal demo is 5250 m² in 50 houses. Five of these houses are monitored. Thus the monitored area is 525 m², as indicated in the tables in this report. This figure was originally set to 460 m², and used during the analysis, which is the basis for the reported graphs in this deliverable.

2.1 Munich, Germany

The demonstration in Munich consists of two blocks of residential multi-storey buildings built in 1958. The original buildings were typical examples of the concrete/brick constructions, built throughout Germany in the post-war era. The buildings were old and in poor condition before retrofitting with an unacceptable indoor climate.



Figure 2 Munich before (left) and after (right) renovation (Photo: E2ReBuild, Florian Lichtblau)

The buildings were fully retrofitted in 2012 including the replacement of the attic by an additional upper floor to create more rental space. The envelope was improved by an additional layer of highly insulated, pre-fabricated timber elements (like the TES EnergyFaçade) and by modern highly insulated windows. The façade was cladded with rough sawn, painted spruce boards. Thermal bridges were decreased by cutting off the concrete balconies and replacing them with free standing balconies. The roofs were replaced with prefabricated massive timber elements with mineral wool insulation and a green roof. Solar thermal collectors were installed on the new roofs.

2.2 Halmstad, Sweden

The Halmstad demonstration is an eight-storey building from 1963 with typical features from that time period, i.e. reinforced concrete load bearing frame and façade elements. The building is situated in Halmstad in southern Sweden.



Figure 3 Halmstad before renovation (left) (Photo: Stephen Burke, Thomas Heim)

The original (insulated) sandwich façade is in good condition and it was decided not to modify the external walls or change the look of the building during the renovation. The retrofitting measures include highly insulated windows, increased airtightness and improved adjustments of control systems. The old, inefficient, heat pumps have been replaced with two efficient exhaust air heat pumps and two efficient air-to-water heat pumps. The electricity feed into the building was too old and could not supply adequate electricity to the heat pumps. Hence new electricity lines have been installed. A complete exchange of main pipes for water and sewage has been carried out as well as new kitchens and bathrooms.

2.3 London, United Kingdom

The London demonstration is a linear block of maisonette style dwelling accommodation, built in 1972/1974 and located in Thamesmead, South East London, UK. The original building has a concrete frame construction and the roof is of flat construction using a timber cold deck with mineral felt covering. The construction design suffers from considerable thermal bridges and condensation problems.



Figure 4 London before (left) and after renovation (right) (Photo: Carl-Magnus Capener, SP)

The renovation consists of off-site pre-fabricated timber cassette facades delivered with factory-installed windows, taped 15mm OSB linings and cladding filled with cellulose and wood fibre over studs usually, BUT gypsum board.

The renovation works started in 2013 with the aim to reach the Retrofit Passive house Standard. In order to decrease the thermal bridges and improve the airtightness, prefabricated, highly insulated façade and roof elements have been installed and the windows have been replaced. The natural ventilation has been replaced with a mechanical supply and exhaust air system with efficient heat recovery.

Due to late scheduling, the London demonstration has not provided any monitoring data within the E2ReBuild project, but will follow true the monitoring after construction has been completed.

2.4 Augsburg, Germany

The Augsburg demo contains two multi-storey residential buildings in Augsburg in southern Germany, with typical post-war characteristic features from the 60's and early 70's. The buildings are compact volumes, originally built in brick work with concrete slabs. The buildings used to have big heat losses due to poor building envelopes, leakages around the old windows and joints to the roof and thermal bridges through the balcony slabs.



Figure 5 Augsburg before (left) and after (right) renovation (Photo: Frank Lattke)

The buildings have been fully retrofitted in 2011-2012. The external walls have been replaced with highly insulated, pre-fabricated timber elements based on the TES EnergyFaçade system and linear thermal bridges have been almost eliminated with the new façade wrapping outside the concrete slabs. Windows have been replaced with modern highly insulated windows. The existing balconies were converted into winter gardens and living room extensions and new balconies were put up next to these.

A central pellets heating system (2 x 60 kW), including a storage room in the basement, was installed to replace the old apartment gas ovens for heating and the combi-boilers for domestic hot water (DHW). Mechanical exhaust-air fans were installed to improve the ventilation system.

Additionally, full bathroom renovation was carried out with new surfaces, plumbing, toilets, showers, bathtubs etc. and the old elevators were replaced.

2.5 Oulu, Finland

The Oulu demo is one of five student apartment buildings in a housing corporation at Virkakatu 8AB in Oulu, northern Finland. The two-storey building was completed in 1984 according to a Finnish industrialized building system developed in the 1970's using prefabricated concrete units. The building was in need of a complete renovation since the eight student flats were out of date and lacking in facilities.



Figure 6 Oulu before (left) and after (right) renovation (Photo: Simon le Roux, Aalto; Carl-Magnus Capener, SP)

The building was retrofitted with the aim to reach the energy efficiency level of a passive house according to Finnish standards. The building renovation includes a comprehensive refurbishment of indoor spaces and a façade renovation. The inner concrete core of the old sandwich facades were kept and wrapped in prefabricated timber elements (TES EnergyFaçade) with 300 mm mineral wool

insulation in total. Moreover, windows were replaced and insulation was added in the roof and under the new floor slab.

The mechanical ventilation system was improved with new mechanical supply/exhaust air systems with rotating heat exchangers in each apartment and stairway.

2.6 Roosendaal, the Netherlands

The Roosendaal demo consists of 50 identical, single family terraced houses build in the 60s, at Pootlaan in Roosendaal, the southern Netherlands, of which 5 were fully monitored in E2ReBuild. The original buildings were poorly insulated and the window frames were not well maintained.



Figure 7 Roosendaal before (left) and after (right) renovation (Photo: Chiel Boonstra)

The whole area contains 370 identical houses and the renovation works started in 2010. Both the owner and the tenants were interested in the Passive house concept for renovation. The 50 units that are part of the E2ReBuild project were fully retrofitted with a new building envelope and an upgraded heating and ventilation system. The existing brick façade layer was removed and the concrete foundation was extended to carry the load from the new façade elements. The new, prefabricated timber framed elements have 350 mm cellulose insulation and slate cladding. The elements are high and cover both floors. The new windows are triple glazed with insulated frames. The roof was replaced with prefabricated OSB sandwich elements with 350 mm cellulose insulation and PVC roofing. Solar thermal collectors were installed already in the manufactory. A balanced mechanical ventilation system with heat recovery has been installed and the heating system has been upgraded with solar thermal collectors and a storage tank.

2.7 Voiron, France

The Voiron demo is a multi-storey building with mainly three room apartments at Rue Stendhal in Voiron, in the French Alp region. The original building has a concrete construction with no insulation. The windows are first generation PVC double-glazing from 1999. About 60% of the dwellings had individual gas boilers before renovation and 40% had direct electric heating. The building was natural ventilated.



Figure 8 Voiron before (left) and during (right) renovation (Photo: Carl-Magnus Capener)

The building was retrofitted in 2012, with the aim to reach the current French thermal regulation for new construction. External insulation was added to the concrete walls and the balconies were converted into living space with new external walls, in order to reduce the thermal losses and increase the rental space. The roof and floor were also insulated. A central heating system was installed and solar thermal collectors were installed for hot water production. By the end of 2015, the building will be connected to a district heating system. Moreover, a mechanical ventilation system was installed.

3 Measurement Parameters

The monitored parameters to be submitted to the EU database are:

Parameter	Unit	Interval
<u>Heated/cooled net floor area [internal]</u>	m ²	Before/after
<u>Heated/cooled net volume [internal]</u>	m ³	Before/after
<u>Purchased energy</u>	kWh	Every month
<u>DHW</u>	m ³	Every month
<u>Space heating</u>	kWh	Every month
<u>Cooling</u>	kWh	Every month
<u>Domestic hot water</u>	kWh	Every month
<u>Supply temperature of the DHW</u>	°C	Every hour
<u>Inlet DCW temp</u>	°C	Every hour
<u>Building electricity</u>	kWh	Every month
<u>Household electricity (or gas) each flat or house separately</u>	kWh	Every month
<u>Produced electricity (PV's, wind turbines etc.)</u>	kWh	Every month
<u>Produced heat (solar collectors)</u>	kWh	Every month

Figure 9 Measurement parameters common for all demonstrations.

Explanations of the parameters are to be found in D5.1 – Monitoring Scheme for Demonstration Projects. In D5.1 the corresponding areas and volumes are defined for harmonizing the results between demonstrations. This presented data goes beyond the E2ReBuild description of work only requiring monitoring for space heating, cooling, domestic hot water, building and household electricity.

4 Discussion

The E2ReBuild monitoring scheme has enabled the comparison and evaluation of all demonstrations. When gathering data from demos all over Europe it is important to be specific about what is demanded and describe all parameters in text to avoid misunderstandings.

All monitored data has been harmonized following the metrics used for EU project Concerto Premium in order to enable easy comparison between E2ReBuild demonstrations and beyond.

The E2ReBuild demonstration data has not been submitted to any EU database to this date; however, with the harmonization of data and presentation of results, this will be an easy task in the future when called upon.

For purchased energy the comparison between demonstrations was complicated due to different energy sources. For instance, the use of pellets in the Augsburg demonstration is difficult to evaluate on a monthly basis since the amount of pellets is only registered on delivery and not the actual monthly usage.

Demonstrator Roosendaal indicates: purchased energy in Roosendaal in summer months cannot be allocated to space heating, but must be allocated to system losses of the hot water system. There is no space heat demand during most months of the year, but there is energy demand for DHW.

Space heating was not separated from DHW for the Munich demonstration and thus complicates the analysis of the two parameters. The opposite is true when looking at the parameter domestic hot water for Munich. Also interesting to note is the large variation between demonstrations.

Building electricity is interesting since one of the demonstrations stand out in the figure. In the Halmstad demo, building electricity is used to produce heat for space heating and domestic hot water by an advanced heat pump system with a high degree of COP. Both the exhaust air and outdoor air is used for the heat pumps.

Due to legislation in some participating countries it was not allowed to monitor and collect data on household electricity for all demonstrations. In Halmstad the data was provided as an average over the year for all households.

Produced heat is displayed as a negative value for consistency reasons. Again, Halmstad stands out producing a large amount of energy by their heat pump system.

The evaluation and analysis of the performance for each demonstration is further elaborated on in work package 2 and the corresponding E2ReBuild deliverables, D2.1-2.7.

Appendix A Measured Data per Parameter (tables)

A.1 Energy Use

A.1.1 Heated/cooled net floor area [internal]

(m ²)	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Before	2016	6178		4499			
After	3324	6178	2493	4727	680	460 ²	4544

A.1.2 Heated/cooled net volume [internal]

(m ³)	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Before	16037	15309	-	11434		-	
After	18728	15309	-	12748	1875	-	11360

A.1.3 Purchased energy

kWh/month	<u>Munich</u>	<u>Halmstad</u>	<u>London</u>	<u>Augsburg</u>	<u>Oulu</u>	<u>Roosendaal</u>	<u>Voiron</u>
<u>Month1</u>	-	24681	-	18480	8520	4862	1573
<u>Month2</u>	36310	24324	-	21720	4407	4858	1523
<u>Month3</u>	32910	29039	-	12000	698	4387	1600
<u>Month4</u>	21000	60119	-	0	1872	3652	1840
<u>Month5</u>	15000	96508	-	21440	624	3111	1832
<u>Month6</u>	11000	178093	-	0	772	2432	1895
<u>Month7</u>	5000	177895	-	0	2792	2210	1769
<u>Month8</u>	5740	135823	-	21600	9378	2157	2093
<u>Month9</u>	16360	150295	-	0	12556	2743	-
<u>Month10</u>	23340	67537	-	0	14955	4271	-
<u>Month11</u>	36450	31151	-	24040	13671	3907	-
<u>Month12</u>	49560	24076	-	14840	9659	4246	-

² See note 1 in Chapter 2.

A.1.4 Space Heating

kWh/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	-	2802	-	37851	3140	2099	0
Month2	23500	2508	-	35231	1120	2149	0
Month3	27640	4601	-	34715	40	1701	19947
Month4	15940	40268	-	23001	30	886	58729
Month5	11100	52852	-	17087	0	731	65539
Month6	8700	85818	-	13565	860	111	60934
Month7	6700	79975	-	11178	2230	94	51050
Month8	6900	69356	-	10323	3110	67	40378
Month9	9400	72066	-	12406	4040	562	-
Month10	13200	34916	-	18788	6170	1611	-
Month11	21490	3440	-	27805	4090	1342	-
Month12	22930	123	-	32907	4140	1565	-

A.1.5 Cooling

No measures to present. This was not included in any E2ReBuild demonstration.

A.1.6 Domestic hot water - total amount

m3/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	89,4	168,0	-	-	-	12,2	143,0
Month2	89,4	143,0	-	-	-	12,7	138,4
Month3	89,4	180,0	-	-	-	12,1	145,4
Month4	89,4	210,0	-	-	-	11,6	167,3
Month5	89,4	210,0	-	-	-	11,2	166,5
Month6	89,4	200,0	-	-	-	10,9	172,3
Month7	89,4	227,0	-	-	-	9,0	160,8
Month8	89,4	201,0	-	-	-	10,9	190,3
Month9	89,4	213,0	-	-	-	10,7	1284,1
Month10	89,4	195,0	-	-	-	13,2	0,3
Month11	89,4	184,0	-	-	-	13,2	0,0
Month12	89,4	162,0	-	-	-	13,7	0,0

A.1.7 Domestic hot water – total energy

kWh/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	-	8388	-	11421	974	652	10040
Month2	-	6476	-	10479	817	680	9716
Month3	-	8987	-	11783	718	652	10294
Month4	-	10729	-	11360	830	611	12875
Month5	-	11704	-	11068	733	550	12570
Month6	-	11843	-	10394	792	511	13012
Month7	-	13706	-	10160	835	401	11839
Month8	-	12369	-	9123	670	477	11530
Month9	-	12366	-	9840	533	484	-
Month10	-	10868	-	11213	559	623	-
Month11	-	9614	-	11217	509	628	-
Month12	-	8653	-	12348	542	695	-

A.1.8 Average temp. difference between inlet DCW temp and supply DHW temp, Δtw [°C] Building electricity

°C	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	45	43	-	50	-	45,12	-
Month2	45	39	-	50	-	45,4	-
Month3	45	43	-	50	-	45,62	-
Month4	45	44	-	50	-	44,12	-
Month5	45	48	-	50	-	41,34	-
Month6	45	51	-	50	-	39,88	-
Month7	45	52	-	50	-	37,98	-
Month8	45	53	-	50	-	36,98	-
Month9	45	50	-	50	-	38,2	-
Month10	45	48	-	50	-	39,74	-
Month11	45	45	-	50	-	40,52	-
Month12	45	46	-	50	-	43,26	-

A.1.9 Household electricity (or gas)

kWh/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	-	11816	-	-	2484	1386	-
Month2	-	11816	-	-	1670	1293	-
Month3	-	11816	-	-	1346	1303	-
Month4	-	11816	-	-	1749	1493	-
Month5	-	11816	-	-	1782	1210	-
Month6	-	11816	-	-	1877	1217	-
Month7	-	11816	-	-	2148	1123	-
Month8	-	11816	-	-	2305	1112	-
Month9	-	11816	-	-	2326	1090	-
Month10	-	11816	-	-	1777	1310	-
Month11	-	11816	-	-	1429	1211	-
Month12	-	11816	-	-	1406	1238	-

A.1.10 Building electricity (kWh)

kWh/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	-	16977	-	853	500	282	1785
Month2	-	16275	-	682	500	282	1727
Month3	-	20915	-	803	500	288	1800
Month4	-	33752	-	1063	500	258	1857
Month5	-	29387	-	604	500	288	1845
Month6	-	32024	-	640	500	283	1885
Month7	-	22624	-	344	500	299	1623
Month8	-	38666	-	623	500	300	1788
Month9	-	35500	-	947	500	292	-
Month10	-	35197	-	967	500	298	-
Month11	-	21000	-	402	500	295	-
Month12	-	15700	-	1139	500	288	-

A.1.11 Produced electricity

No measures to present. This was not included in any E2ReBuild demonstration.

A.1.12 Produced heat

kWh/month	Munich	Halmstad	London	Augsburg	Oulu	Roosendaal	Voiron
Month1	-	13902	-	-	-	17	0
Month2	140	13432	-	-	-	0	0
Month3	649	34439	-	-	-	238	3162
Month4	660	84403	-	-	-	448	1831
Month5	940	66059	-	-	-	376	1711
Month6	1820	51788	-	-	-	406	1226
Month7	4960	36980	-	-	-	376	2653
Month8	4167	62904	-	-	-	459	4461
Month9	2458	57486	-	-	-	391	-
Month10	1848	79545	-	-	-	292	-
Month11	627	35761	-	-	-	48	-
Month12	1160	13678	-	-	-	32	-

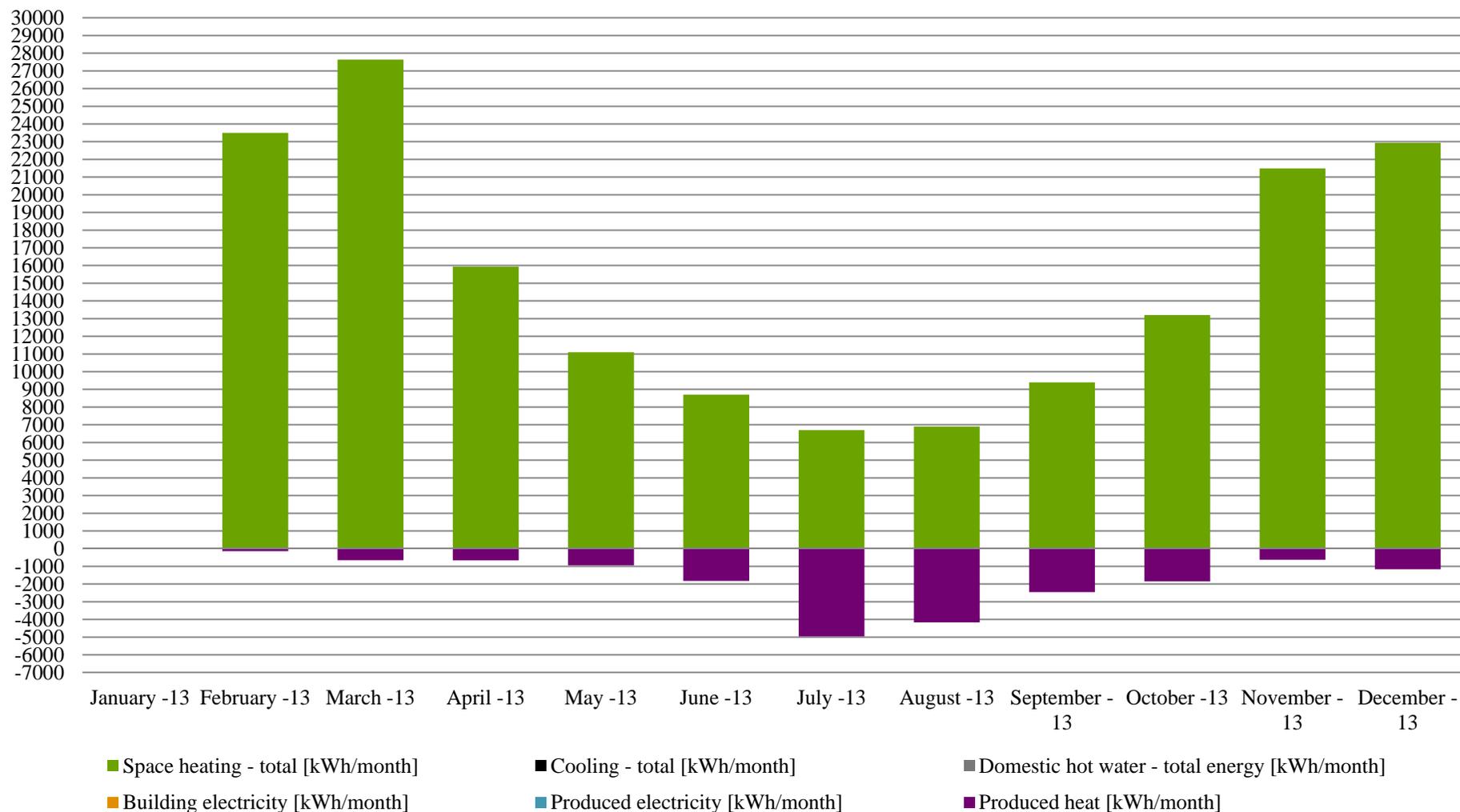
Appendix B Measured Data per Demonstration Building

B.1 Munich, Germany

Total heated/cooled net floor area (internal) 3324

	2013.0 1.01	2013.0 2.01	2013.0 3.01	2013.0 4.01	2013.0 5.01	2013.0 6.01	2013.0 7.01	2013.0 8.01	2013.0 9.01	2013.1 0.01	2013.1 1.01	2013.1 2.01
Purchased energy [kWh/month]	0	36310	32910	21000	15000	11000	5000	5740	16360	23340	36450	49560
Space heating - total [kWh/month]	0	23500	27640	15940	11100	8700	6700	6900	9400	13200	21490	22930
Cooling - total [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total amount [m3/month]	89	89	89	89	89	89	89	89	89	89	89	89
Average temp. difference between inlet DCW temp and supply DHW temp, Δt_w [°C]	45	45	45	45	45	45	45	45	45	45	45	45
Domestic hot water - total energy [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Building electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Household electricity (or gas) [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced heat [kWh/month]	-	-140	-649	-660	-940	-1820	-4960	-4167	-2458	-1848	-627	-1160
Energy demand (SH+SC+DHW+BE) [kWh/month]	-	23500	27640	15940	11100	8700	6700	6900	9400	13200	21490	22930

Energy Demand Munich

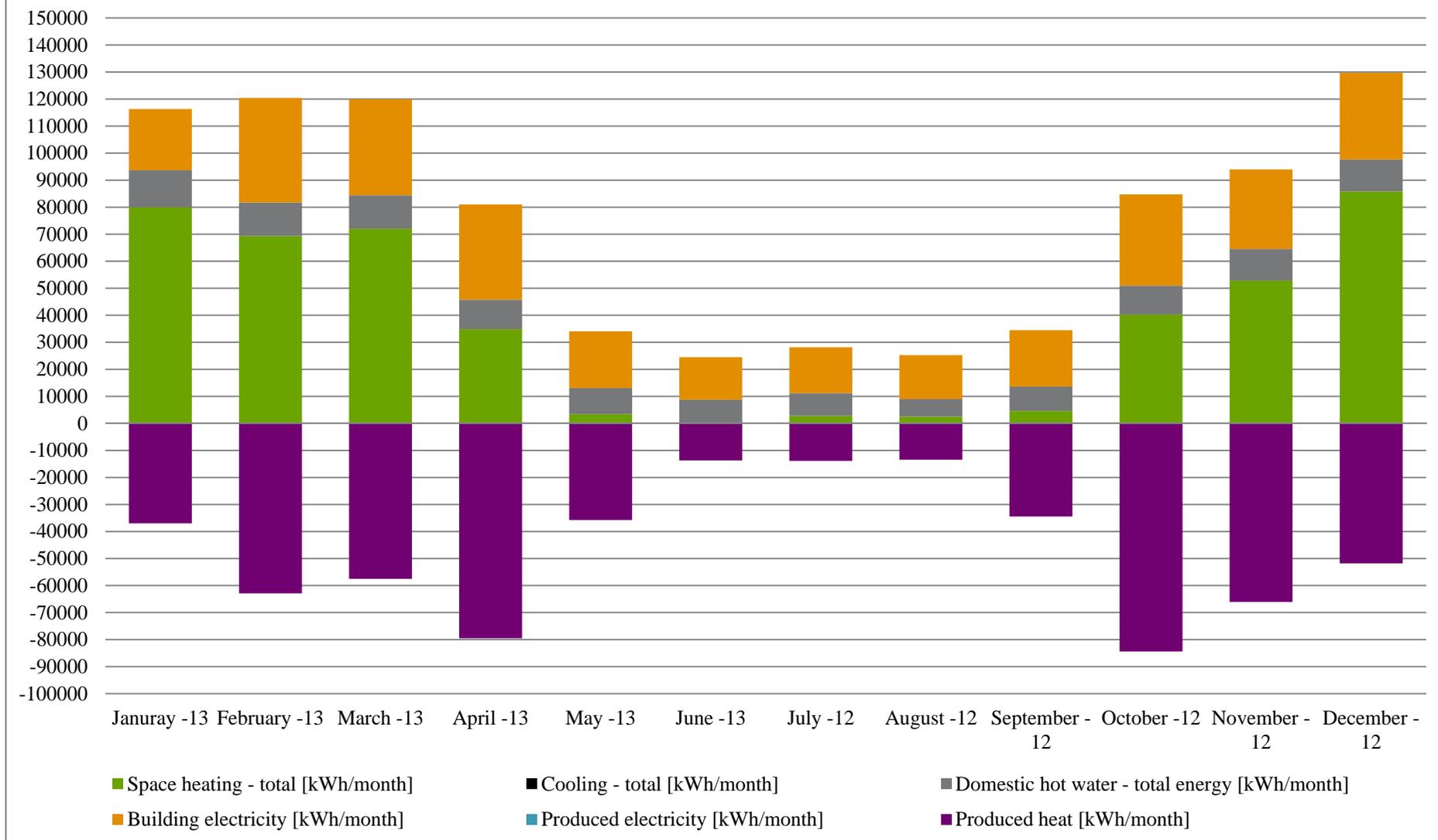


B.2 Halmstad, Sweden

Total heated/cooled net floor area (internal) 6178

	2013.0	2013.0	2013.0	2013.0	2013.0	2013.0	2012.0	2012.0	2012.0	2012.1	2012.1	2012.1
	1.01	2.01	3.01	4.01	5.01	6.01	7.01	8.01	9.01	0.01	1.01	2.01
Purchased energy [kWh/month]	177895	135823	150295	67537	31151	24076	24681	24324	29039	60119	96508	178093
Space heating - total [kWh/month]	79975	69356	72066	34916	3440	123	2802	2508	4601	40268	52852	85818
Cooling - total [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total amount [m3/month]	227	201	213	195	184	162	168	143	180	210	210	200
Average temp. difference between inlet DCW temp and supply DHW temp, Δt_w [°C]	52	53	50	48	45	46	43	39	43	44	48	51
Domestic hot water - total energy [kWh/month]	13706	12369	12366	10868	9614	8653	8388	6476	8987	10729	11704	11843
Building electricity [kWh/month]	22624	38666	35500	35197	21000	15700	16977	16275	20915	33752	29387	32024
Household electricity (or gas) [kWh/month]	11816	11816	11816	11816	11816	11816	11816	11816	11816	11816	11816	11816
Produced electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced heat [kWh/month]	-36980	-62904	-57486	-79545	-35761	-13678	-13902	-13432	-34439	-84403	-66059	-51788
Energy demand (SH+SC+DHW+BE) [kWh/month]	116305	120391	119932	80981	34054	24475	28167	25259	34503	84749	93943	129685

Energy Demand Halmstad



B.3 London, United Kingdom

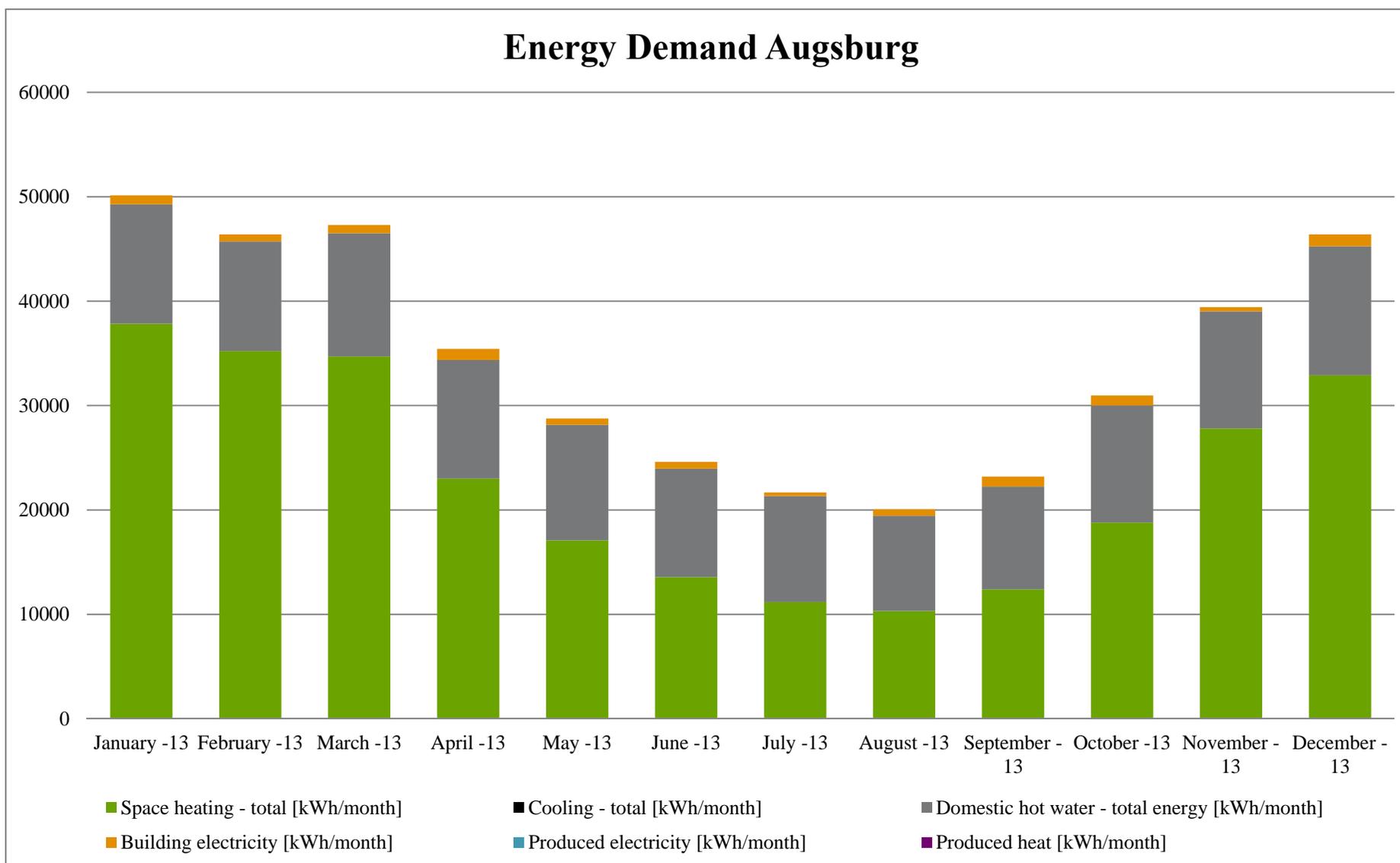
No data to present.

B.4 Augsburg, Germany

Total heated/cooled net floor area (internal) 4727

	2013.01.01	2013.02.01	2013.03.01	2013.04.01	2013.05.01	2013.06.01	2013.07.01	2013.08.01	2013.09.01	2013.10.01	2013.11.01	2013.12.01
Purchased energy [kWh/month]	18480	21720	12000	0	21440	0	0	21600	0	0	24040	14840
Space heating - total [kWh/month]	37851	35231	34715	23001	17087	13565	11178	10323	12406	18788	27805	32907
Cooling - total [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total amount [m3/month]	-	-	-	-	-	-	-	-	-	-	-	-
Average temp. difference between inlet DCW temp and supply DHW temp, Δtw [°C]	50	50	50	50	50	50	50	50	50	50	50	50
Domestic hot water - total energy [kWh/month]	11421	10479	11783	11360	11068	10394	10160	9123	9840	11213	11217	12348
Building electricity [kWh/month]	853	682	803	1063	604	640	344	623	947	967	402	1139
Household electricity (or gas) [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced heat [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Energy demand (SH+SC+DHW+BE) [kWh/month]	50125	46392	47301	35424	28759	24599	21682	20069	23193	30968	39424	46394

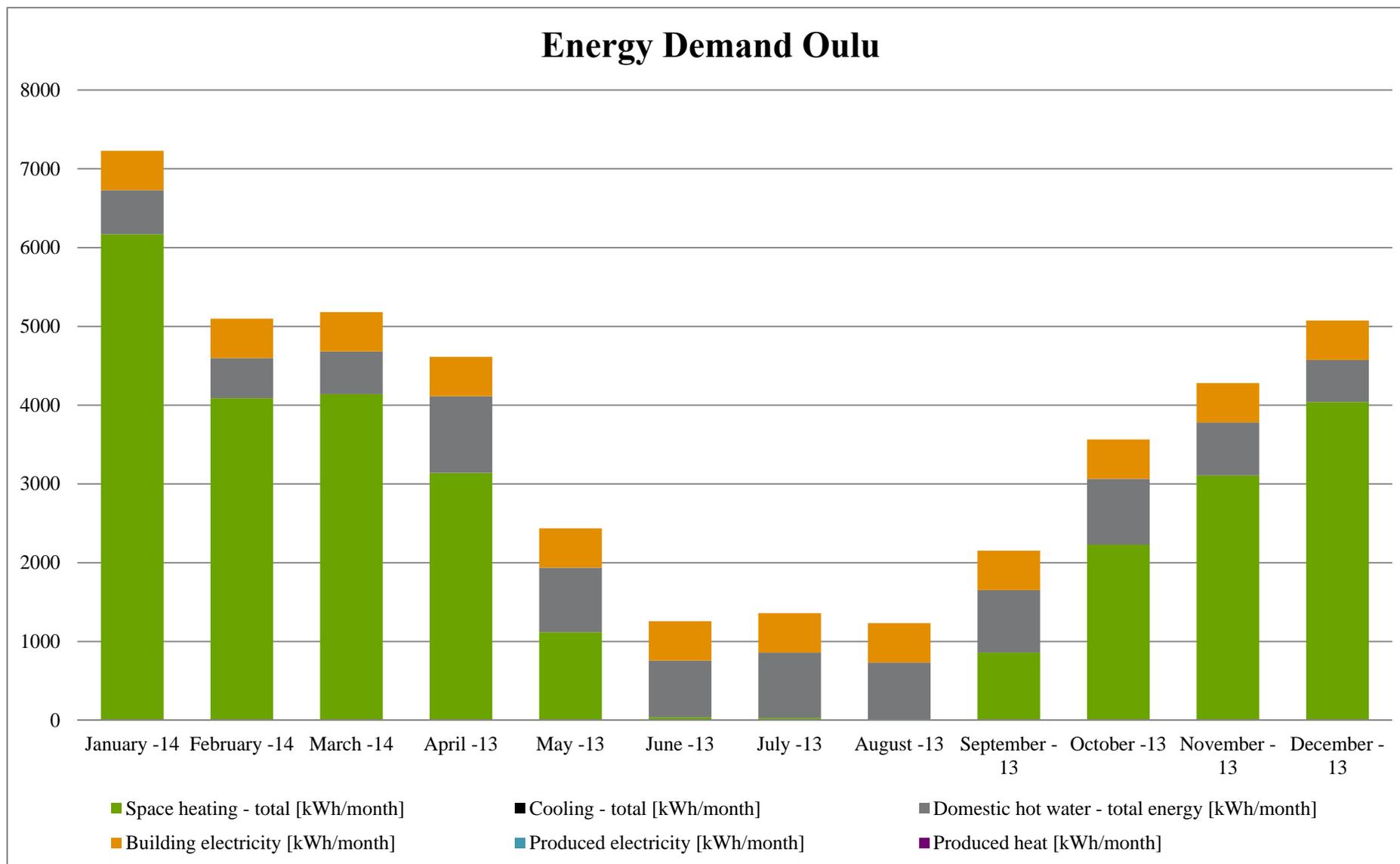
Energy Demand Augsburg



B.5 Oulu, Finland

Total heated/cooled net floor area (internal) 680

	2014.01.01	2014.02.01	2014.03.01	2013.04.01	2013.05.01	2013.06.01	2013.07.01	2013.08.01	2013.09.01	2013.10.01	2013.11.01	2013.12.01
Purchased energy [kWh/month]	14955	13671	9659	8520	4407	698	1872	624	772	2792	93788	12556
Space heating - total [kWh/month]	6170	4090	4140	3140	1120	40	30	0	860	2230	3110	4040
Cooling - total [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total amount [m3/month]	-	-	-	-	-	-	-	-	-	-	-	-
Average temp. difference between inlet DCW temp and supply DHW temp, Δt_w [°C]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total energy [kWh/month]	560	509	542	974	817	718	830	733	792	835	670	533
Building electricity [kWh/month]	500	500	500	500	500	500	500	500	500	500	500	500
Household electricity (or gas) [kWh/month]	1777	1429	1406	2484	1670	1346	1749	1782	1877	2148	2305	2326
Produced electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced heat [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Energy demand (SH+SC+DHW+BE) [kWh/month]	7229	50989	5182	4614	2437	1258	1360	1233	2152	3565	4280	5073

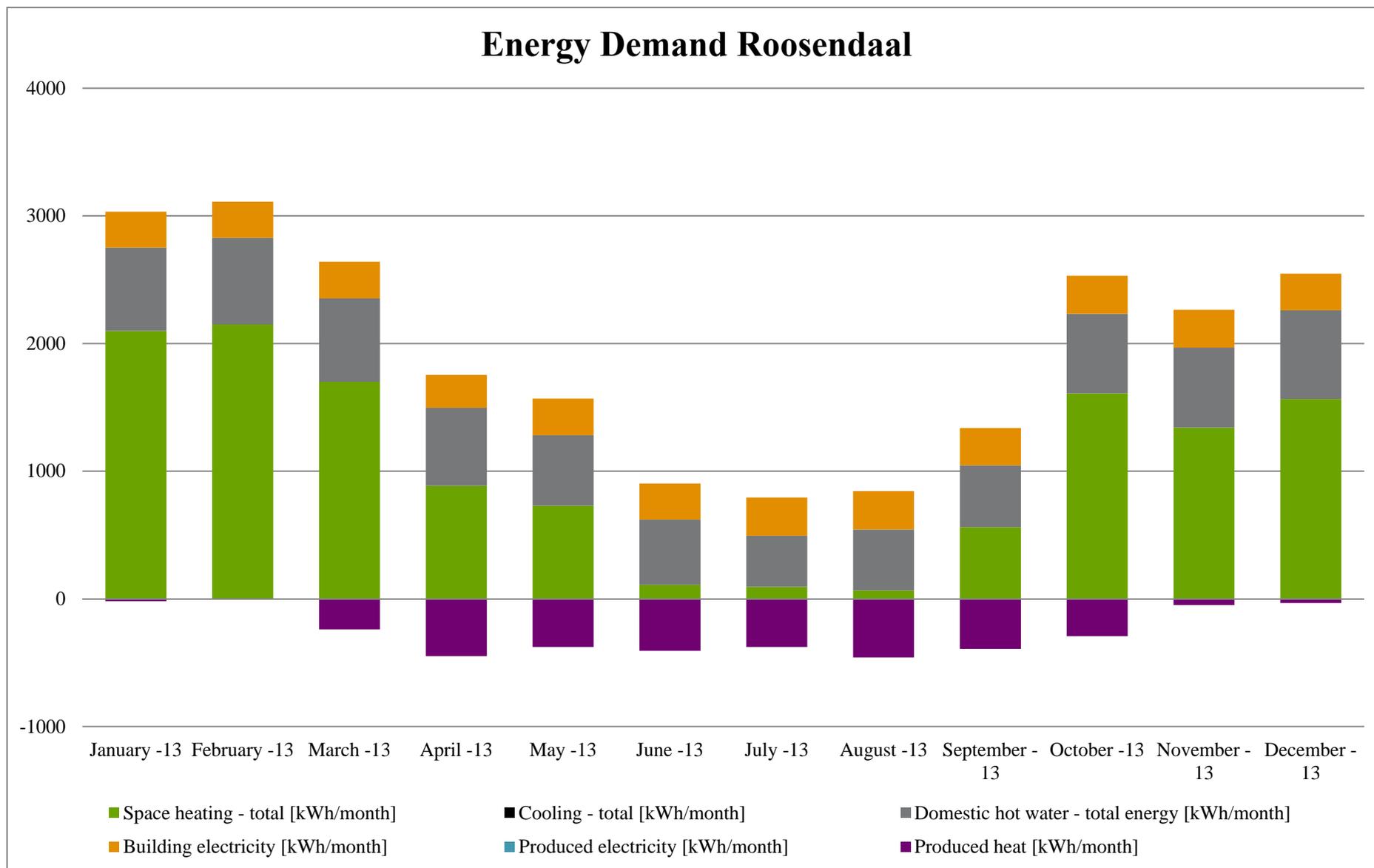


B.6 Roosendaal, the Netherlands

Total heated/cooled net floor area (internal) 460³

	2013.01.01.	2013.02.01.	2013.03.01.	2013.04.01.	2013.05.01.	2013.06.01.	2013.07.01.	2013.08.01.	2013.09.01.	2013.10.01.	2013.11.01.	2013.12.01.
Purchased energy [kWh/month]	4862	4858	4387	3652	3111	2432	2210	2157	2743	4271	3907	4246
Space heating - total [kWh/month]	2099	2149	1701	886	731	111	94	67	562	1611	1342	1565
Cooling - total [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Domestic hot water - total amount [m3/month]	12	13	12	12	11	11	9	11	11	13	13	14
Average temp. difference between inlet DCW temp and supply DHW temp, Δtw [°C]	45	45	46	44	41	40	38	37	38	40	41	43
Domestic hot water - total energy [kWh/month]	652	680	652	611	550	511	401	477	484	623	628	695
Building electricity [kWh/month]	282	282	288	258	288	283	299	300	292	298	295	288
Household electricity (or gas) [kWh/month]	1386	1293	1303	1493	1210	1217	1123	1112	1090	1310	1211	1238
Produced electricity [kWh/month]	-	-	-	-	-	-	-	-	-	-	-	-
Produced heat [kWh/month]	-17	0	-238	-448	-376	-406	-376	-459	-391	-292	-48	-32
Energy demand (SH+SC+DHW+BE) [kWh/month]	3033	3111	2641	1755	1569	905	794	844	1338	2531	2264	2548

³ See note 1 in Chapter 2.



B.7 Voiron, France

Total heated/cooled net floor area (internal) 4544

	2014.01. 01	2014.02. 01	2014.03. 01					2013.08. 01	2013.09. 01	2013.10. 01	2013.11. 01	2013.12. 01
Purchased energy gas = m3/month]	1895	1769	2093					1573	1523	1600	1840	1832
Space heating - total [kWh/month]	60934	51050	40378					0	0	19947	58730	65539
Cooling - total [kWh/month]	-	-	-					-	-	-	-	-
Domestic hot water - total amount [m3/month]	172	161	190					143	138	145	167	167
Average temp. difference between inlet DCW temp and supply DHW temp, Δtw [°C]	-	-	-					-	-	-	-	-
Domestic hot water - total energy [kWh/month]	13012	11839	11530					10040	9716	10294	12875	12570
Building electricity [kWh/month]	1885	1623	1788					1785	1727	1800	1857	1845
Household electricity (or gas) [kWh/month]	-	-	-					-	-	-	-	-
Produced electricity [kWh/month]	-	-	-					-	-	-	-	-
Produced heat [kWh/month]	-1226	-2653	-4461					0	0	-3162	-1831	-1711
Energy demand (SH+SC+DHW+BE) [kWh/month]	75831	64511	53695					11825	11443	32041	73461	79954

Energy Demand Voiron

