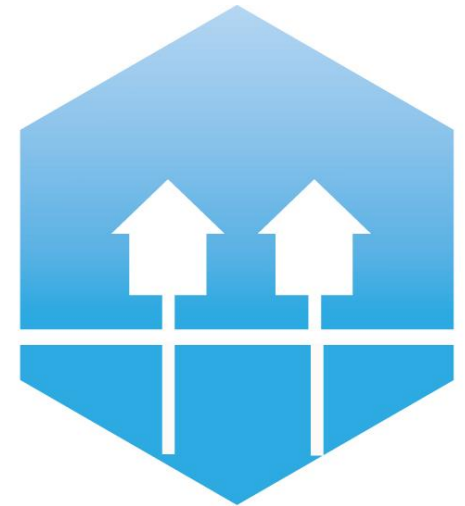
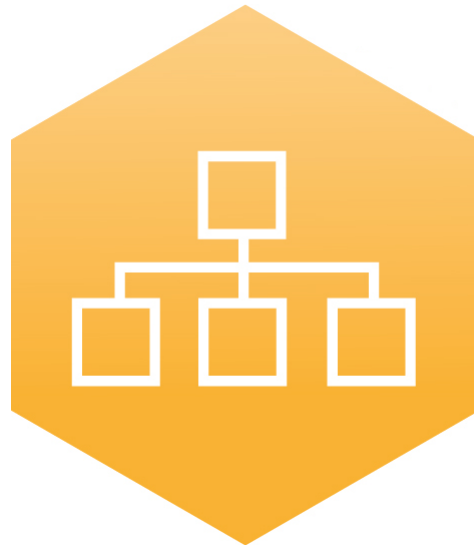


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European Space Cooling Demands

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4DH

4th Generation District Heating
Technologies and Systems

Outline



Background

Availability of data on space cooling demands

Correlation to the European Cooling Index

European map of space cooling demands

National space cooling demands within EU28

Benchmarking with other estimations

Conclusions



Background



1. Information on European space cooling demands is required for modelling and planning purposes
2. But low availability of this information, since cooling outputs from electric cooling devices are very seldom measured
3. Cooling outputs are currently only estimated from electricity inputs and assumed performances for cooling devices
4. However, cooling deliveries are measured in district cooling systems



Availability



1. Only three major sources of electricity inputs for space cooling in European service sector buildings: EECCAC 2003, Aebischer 2007, and INSPIRE 2014.
2. Some aggregated information about EU space cooling demands in four sources: JRC 2012, EURAC 2014, RESCUE 2014, and Kemna 2014
3. Cooling deliveries from twenty European district cooling locations in eight countries have been gathered in this study in order to provide estimations of average European space cooling demands based on measurements.



Correlation

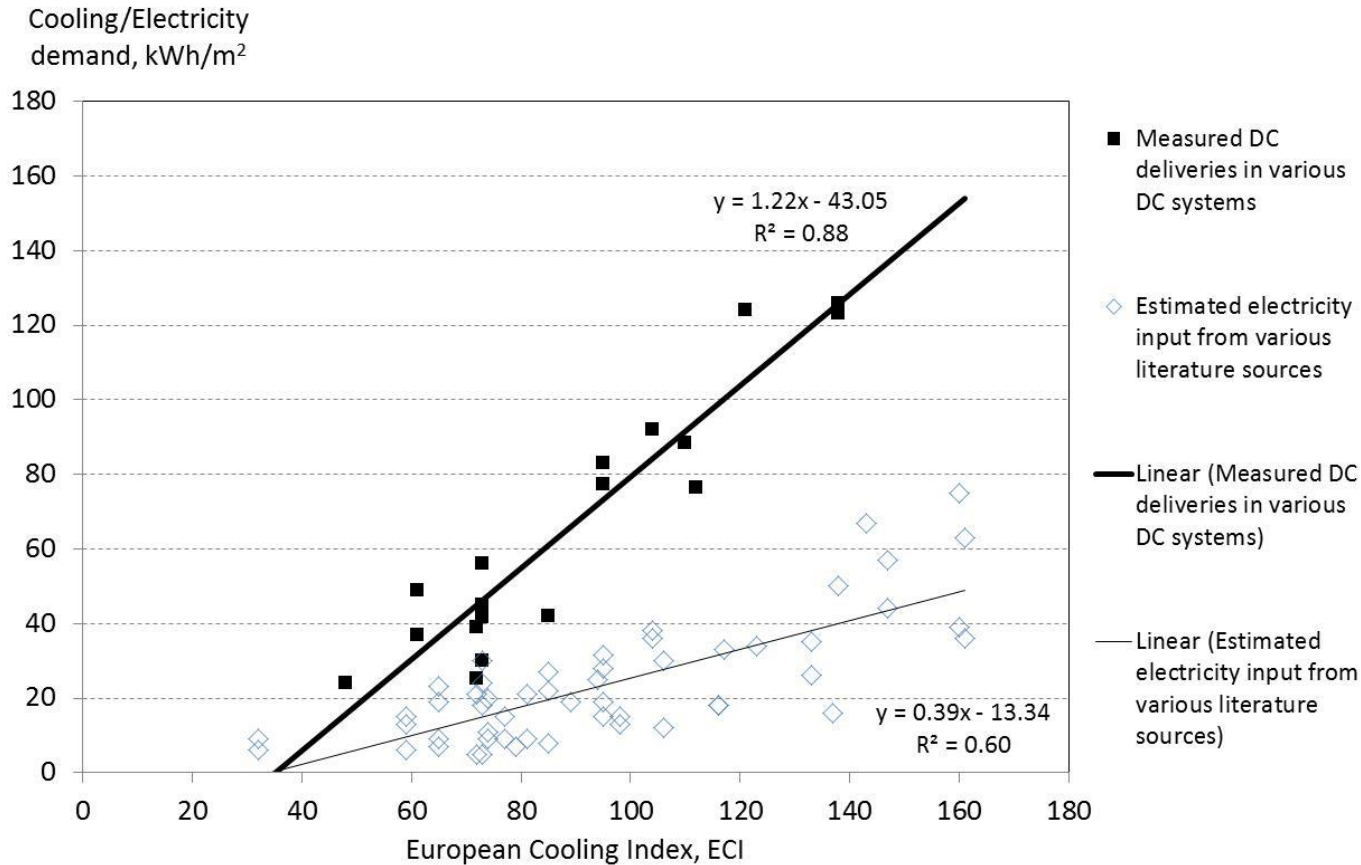
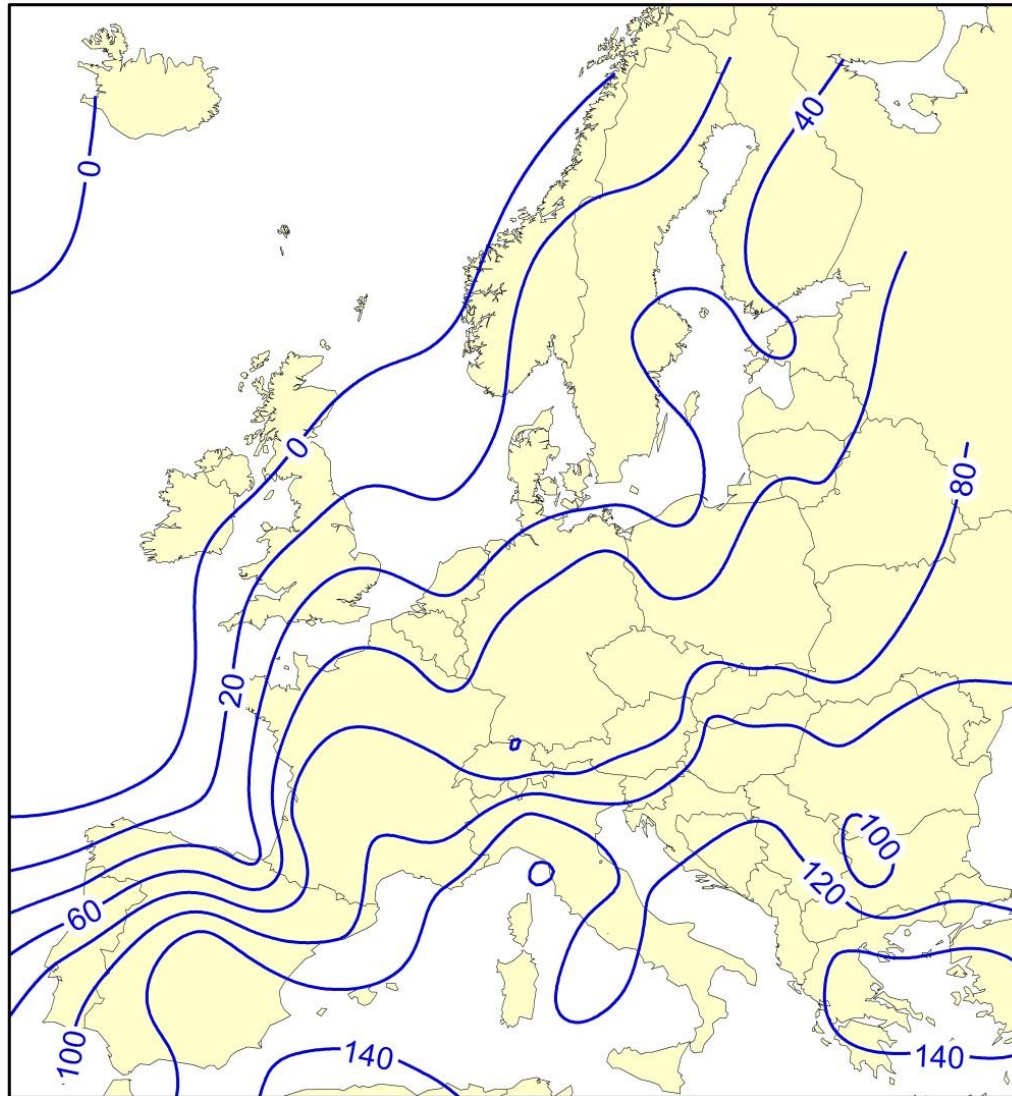


Figure 1. Estimated specific cooling demands for service sector buildings with either direct use of district cooling (DC) supply or use of electricity input to compressor chillers.

European map for service sector buildings

Figure 2. The average specific space cooling demands in kWh/m² for service sector buildings for various locations in Europe. The map has been generated by using the thick average line in Figure 1 together with estimated local values of ECI for 80 different locations according to [4].



National space cooling demands



Country	Total floor areas			ECI	Specific cooling demands			Cooled floor areas			Current cooling supplies		
	Service sector	Residential	Total		Service sector	Residential	Average	Service sector	Residential	Total	Service sector	Residential	Total
	Mm ²	Mm ²	Mm ²		kWh/m ²	kWh/m ²	kWh/m ²	Mm ²	Mm ²	Mm ²	TWh	TWh	TWh
Austria	114	338	452	106	83	38	49	17	6	23	1	0	2
Belgium	105	402	507	77	50	23	28	15	10	25	1	0	1
Bulgaria	64	225	288	116	95	43	54	41	35	76	4	1	5
Croatia	32	149	181	85	59	27	32	3	40	44	0	1	1
Cyprus	8	44	52	160	145	65	77	1	36	37	0	2	2
Czech Republic	89	316	405	89	64	29	37	22	4	27	1	0	2
Denmark	122	295	418	59	30	13	18	10	4	14	0	0	0
Estonia	12	38	50	65	37	16	21	1	0	1	0	0	0
Finland	104	206	310	72	45	20	28	13	4	17	1	0	1
France	911	2571	3482	95	71	32	42	255	110	365	18	4	22
Germany	1594	3723	5317	98	74	33	46	239	58	297	18	2	20
Greece	141	486	627	161	146	66	84	85	49	134	12	3	16
Hungary	99	327	426	123	103	46	59	10	10	20	1	0	1
Ireland	43	174	216	32	0	0	0	7	2	8	0	0	0
Italy	421	2686	3107	133	114	51	60	295	304	599	34	16	49
Latvia	17	68	85	79	53	24	29	2	1	3	0	0	0
Lithuania	30	84	114	85	59	27	35	3	1	4	0	0	0
Luxembourg	5	27	32	81	55	25	29	1	0	1	0	0	0
Malta	4	17	21	143	126	57	70	0	11	11	0	1	1
Netherlands	295	702	997	65	37	16	22	60	30	90	2	0	3
Poland	385	951	1336	95	71	32	43	39	6	44	3	0	3
Portugal	52	619	671	104	81	36	40	23	31	54	2	1	3
Romania	59	442	501	137	119	53	61	7	17	24	1	1	2
Slovak Republic	38	150	188	117	96	43	54	4	1	5	0	0	0
Slovenia	28	67	95	116	95	43	58	3	11	13	0	0	1
Spain	349	2019	2368	147	130	59	69	299	202	501	39	12	51
Sweden	155	451	606	73	46	21	27	22	6	28	1	0	1
United Kingdom	736	2107	2843	74	47	21	28	107	50	157	5	1	6
EU28	6011	19684	25695	103	74	37	45	1584	1039	2623	145	47	192
								26%	5%	10%	33%	7%	16%

Table 3. Estimations of total floor areas, European cooling indices (ECI), specific space cooling demands, cooled floor areas, and current cooling demands by country for the 2010 situation. Each national ECI considers the estimation for each capital city.



Benchmarking: Specific demands

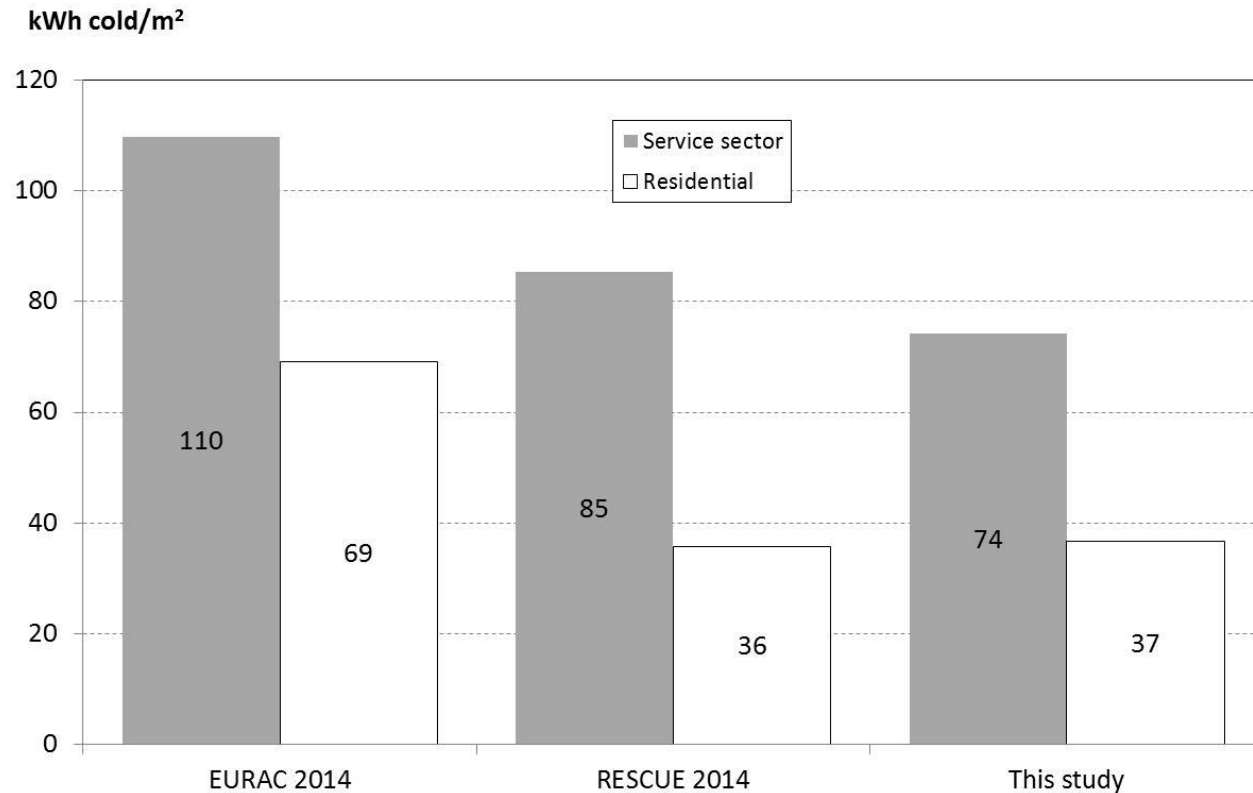


Figure 3. Three different estimations of the average annual specific cooling demands when cooling is applied in EU27 or EU28 close to 2010 from two external sources and the estimations obtained in this study.



Benchmarking: Current demands

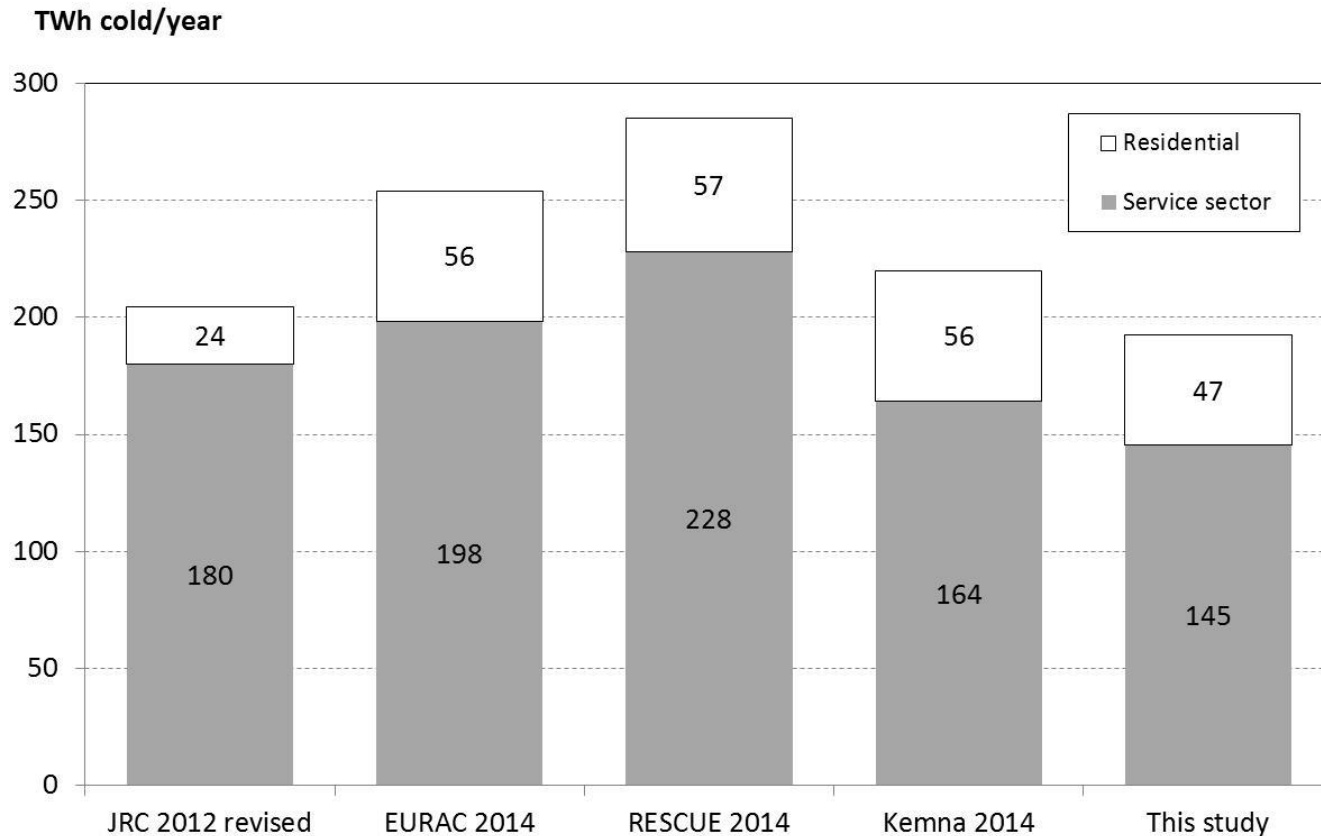


Figure 4. Five different estimations of the current space cooling supplies in EU27 or EU28 close to 2010 from four external sources and the estimations obtained in this study.



Benchmarking: Full potential demands

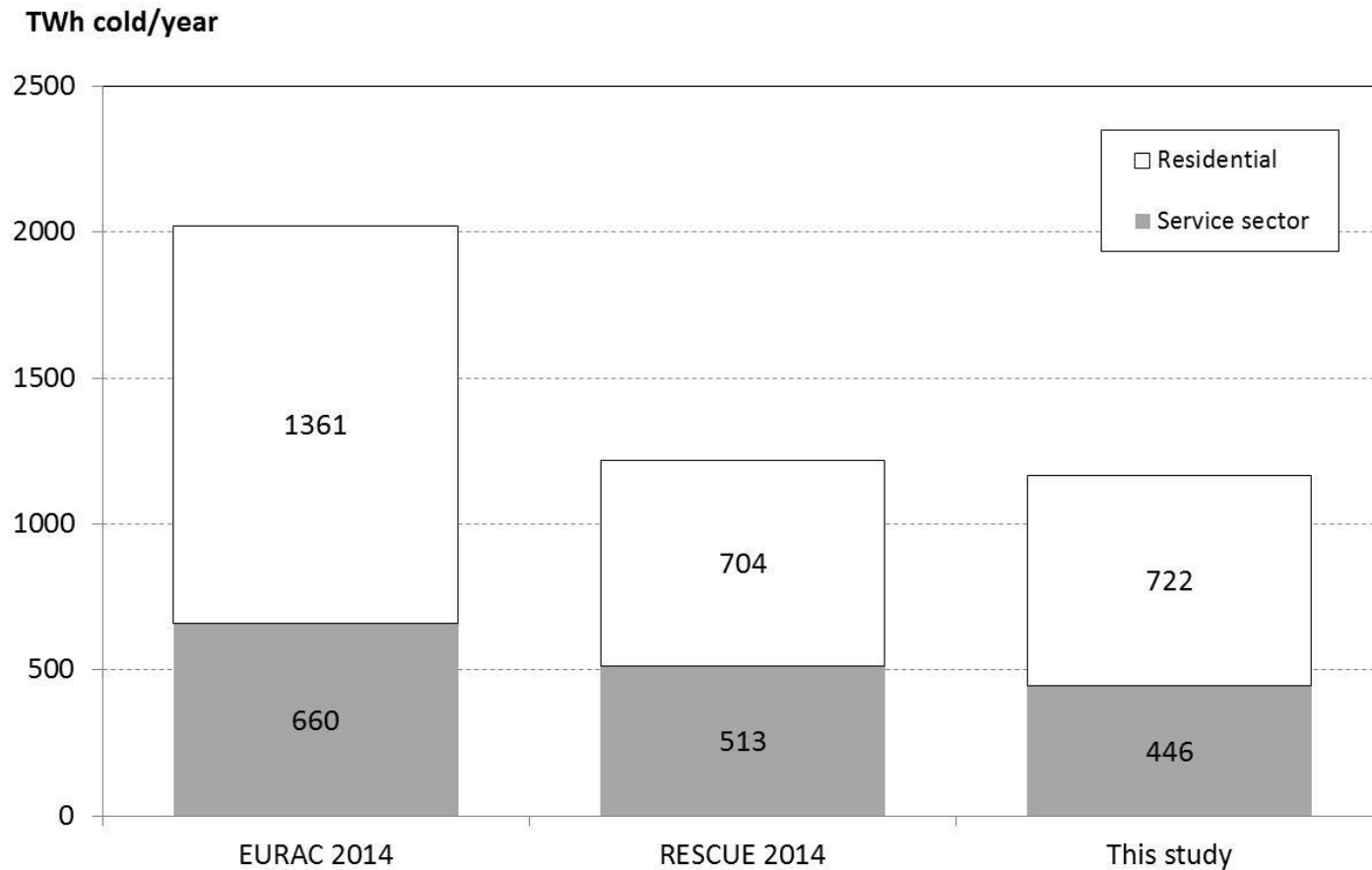


Figure 5. Three different estimations of full potential European space cooling demands close to 2010 by assuming all saturation rates to be 100 percent in EU27 or EU28 from two external sources and the estimations obtained in this study.

Conclusions



1. It was possible to estimate average European specific space cooling demands for service sector buildings from a sample set of twenty observations of district cooling measurements from Portugal, Sweden, Finland, France, Norway, Switzerland, Italy, and Spain. A contour map for European locations has been provided. These estimations were possible to obtain, since the measurements from district cooling systems had high correlation to the European Cooling Index.
2. Aggregated and national space cooling demands have been assessed from a combination of estimated specific space cooling demands and gathered building floor spaces with corresponding saturation rates, but this gathered information has sometimes low quality.
3. The estimated aggregated space cooling demands in this study, based on district cooling measurements, are somewhat lower than other estimations obtained from aggregated electricity inputs and assumed SEERs for cooling devices.



The End



Acknowledgements

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