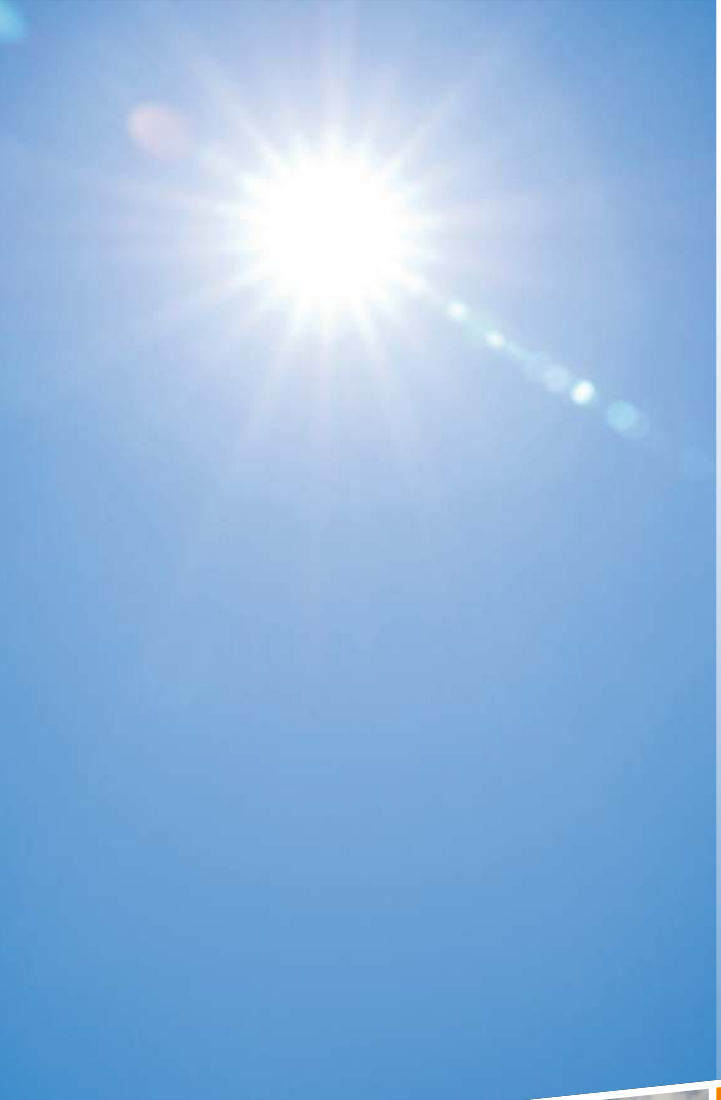


Solar Heat Europe
ESTIF

Solar Heat Markets in Europe

Trends and Market Statistics 2016
Summary (November 2017)

Data Highlights of 2016

Total installed capacity in operation:
34.5 GW_{th}

Total installed capacity in 2015:
1.8 GW_{th}

Annual energy generation (estimated):
24.3 TWh_{th}

(Estimated) sector turnover
2.2 EUR billion

Numbers of jobs (estimated):
22 400

Estimated
6.49 Mt CO_2
emission savings

Market size in terms of Solar Thermal Capacity (KW_{th}) and in terms of Collector Area (m^2)

	Market (=Newly Installed)							In Operation[2]		
	2014	2015	2016				Annual Evolution of the Market	2016		Annual Evolution of the Total Installed Capacity
	Total Glazed	Total Glazed	Flat Plate	Vacuum Collectors	Total Glazed		Total Glazed	Total Glazed		Total Glazed
	m^2	m^2	m^2	m^2	m^2	kW_{th}[1]	%	m^2	kW_{th}	%
Austria	153 440	136 580	109 600	1 440	111 040	77 728	-18.7%	4 129 021	2 890 315	-1.8%
Belgium	52 000	45 000	39 000	7 500	46 500	32 550	3.3%	583 333	408 333	8.4%
Bulgaria *	5 600	5 600	5 100	500	5 600	3 920	-	137 500	96 250	-
Croatia *	21 527	21 500	19 000	2 500	21 500	15 050	-	210 092	147 064	-
Cyprus *	19 467	18 600	18 000	600	18 600	13 020	-	665 434	465 804	-
Czech Republic	38 243	31 000	22 000	9 000	31 000	21 700	0.0%	561 769	393 238	5.1%
Denmark	179 221	260 161	478 297	0	478 297	334 808	83.8%	1 612 317	1 128 622	37.4%
Estonia *	2 000	2 000	1 000	1 000	2 000	1 400	-	14 520	10 164	-
Finland *	4 000	4 000	3 000	1 000	4 000	2 800	-	50 923	35 646	-
France (4)	150 500	101 376	62 800	3 100	65 900	46 130	-35.0%	2 582 476	1 807 733	2.6%
Germany	900 000	806 000	677 000	67 000	744 000	520 800	-7.7%	18 775 000	13 142 500	2.6%
Greece	270 600	271 600	271 400	600	272 000	190 400	0.1%	4 475 900	3 133 130	2.0%
Hungary *	16 000	15 650	11 000	5 570	16 570	11 599	-	286 034	200 224	-
Ireland	24 524	22 650	11 200	8 550	19 750	13 825	-12.8%	364 332	255 032	5.7%
Italy	268 500	229 330	183 647	25 043	208 690	146 083	-9.0%	4 365 569	3 055 899	4.6%
Latvia *	2 360	1 910	1 500	300	1 800	1 260	-	12 332	8 632	-
Lithuania *	2 200	2 200	800	1 400	2 200	1 540	-	14 800	10 360	-
Luxembourg *	5 486	5 450	4 200	700	4 900	3 430	-	60 136	42 095	-
Malta *	1 520	931	650	150	800	560	-	54 370	38 059	-
Netherlands	31 411	21 519	20 137	5 179	25 316	17 721	17.6%	577 905	404 534	1.5%
Poland	260 100	277 000	111 700	3 700	115 400	80 780	-58.3%	2 137 990	1 496 593	5.7%
Portugal*	50 967	46 134	45 300	800	46 100	32 270	-0.1%	1 018 002	712 601	3.9%
Romania *	18 500	17 800	6 800	11 000	17 800	12 460	-	174 150	121 905	-
Slovakia	5 500	5 300	8 000	1 600	9 600	6 720	81.1%	160 100	112 070	3.8%
Slovenia	4 500	2 800	2 300	400	2 700	1 890	-3.6%	146 800	102 760	-7.7%
Spain	251 249	237 259	201 793	7 076	208 869	146 208	-12.0%	3 478 163	2 434 714	6.0%
Sweden	6 673	6 571	2 763	336	3 099	2 169	-52.8%	327 495	229 247	-2.4%
Switzerland	113 147	91 760	51 150	9 895	61 045	42 732	-33.5%	1 451 033	1 015 723	2.7%
United Kingdom	36 552	24 289	10 900	3 010	13 910	9 737	-42.7%	798 169	558 719	0.7%
EU28 + Switzerland	2 895 752	2 711 970	-	-	2 558 986	1 791 290	-5.6%	49 225 664	34 457 965	3.6%

Solar Heat Europe/ESTIF would like to thank the solar thermal associations and other national sources for providing the data for these statistics, in particular: AEE Intec; Association pour Techniques Thermiques de Belgique (ATTB/Belsolar); Czech Ministry of Industry and Trade; Solar Key/Danish Solar Heating Association (DSF); Syndicat des professionnels de l'énergie solaire (ENERPLAN); Bundesverband Solarwirtschaft (BSW-Solar); Greek Solar Industry Association (EBHE); Sustainable Energy Authority of Ireland (SEIA); Assotermica; Holland Solar; Polish Association of Manufacturers and Importers of Heating Appliances (SPIUG); Associação Portuguesa da Indústria Solar (APISOLAR); THERMO/SOLAR Ziar s.r.o.; University of Ljubljana; Asociación Solar de la Industria Térmica (ASIT); Svensk solenergi/Chalmers University of Technology; Swissolar; Solar Trade Association (STA).

*Figures for countries marked with an * are Solar Heat Europe/ESTIF estimations and, therefore, these are not sufficiently accurate to be used for percent change calculations in these markets. For some of the cases, the total sales or distribution between collector type combines historical data and information received regarding the market evolution.*

1) The relation between collector area and capacity is $1m^2 = 0.7kW_{th}$ (kilowatt-thermal)

2) Capacity "in operation" refers to the solar thermal capacity built in the past and deemed to be still in use. Solar Heat Europe/ESTIF assumes a 20 year product life for all systems installed since 1990. Most products today would last considerably longer, but they often cease to be used earlier, e.g. because the building was demolished, or there has been a change of building use.

3) The figures shown here relate to Metropolitan France (mainland). As a reference, in 2010 the overseas departments amounted to 49 MW_{th} (70,000 m^2).

Solar Thermal Markets in Europe

Data for 2016

Key

EU28+ — Country name
-5.6% — Annual evolution 2015/2016
34 458 MW_{th} — Cumulative installed capacity in operation (MW_{th})
68.1 kW_{th} — kW_{th} per 1000 capita

- > 250 kW_{th}
- 50-250 kW_{th}
- 25-50 kW_{th}
- 15-25 kW_{th}
- < 15 kW_{th}

Finland*
36 MW_{th}
6.5 kW_{th}

Estonia*
10 MW_{th}
7.7 kW_{th}

Latvia*
9 MW_{th}
4.3 kW_{th}

Lithuania*
10 MW_{th}
3.5 kW_{th}

Sweden
-58.3%
229 MW_{th}
23.5 kW_{th}

Denmark
83.8%
1 129 MW_{th}
199.4 kW_{th}

Ireland
-12.8%
255 MW_{th}
55.1 kW_{th}

UK
-42.7%
559 MW_{th}
8.6 kW_{th}

Netherlands
17.6%
405 MW_{th}
23.9 kW_{th}

Belgium
3.3%
408 MW_{th}
36.3 kW_{th}

Luxembourg*
42 MW_{th}
74.8 kW_{th}

Germany
-7.7%
13 143 MW_{th}
161.9 kW_{th}

Poland
-58.3%
1 497 MW_{th}
39.4 kW_{th}

Czech
0.0%
393 MW_{th}
37.3 kW_{th}

Slovakia
-81.1%
112 MW_{th}
20.7 kW_{th}

France
-35.0%
1 808 MW_{th}
27.2 kW_{th}

Switzerland
-33.5%
1 016 MW_{th}
123.3 kW_{th}

Austria
-18.7%
2 890 MW_{th}
337 kW_{th}

Hungary*
200 MW_{th}
20.3 kW_{th}

Slovenia
-3.6%
103 MW_{th}
49.8 kW_{th}

Croatia*
147 MW_{th}
34.8 kW_{th}

Romania*
122 MW_{th}
6.1 kW_{th}

Bulgaria*
96 MW_{th}
13.4 kW_{th}

Italy
-9.0%
3 056 MW_{th}
50.3 kW_{th}

Portugal*
713 MW_{th}
68.7 kW_{th}

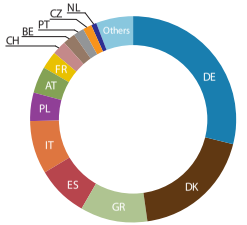
Spain
-12.0%
2 435 MW_{th}
52.4 kW_{th}

Greece
0.1%
3 133 MW_{th}
288.6 kW_{th}

Malta*
38 MW_{th}
88.6 kW_{th}

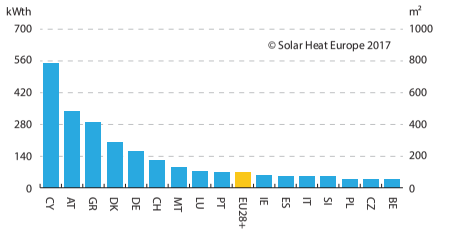
Cyprus*
466 MW_{th}
549.9 kW_{th}

Shares of the European Solar Thermal Market
(Newly Installed Capacity)

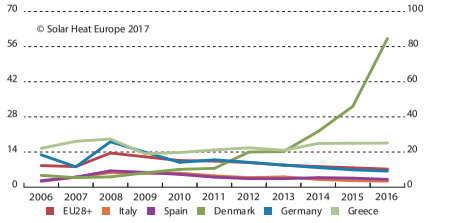


DE	29.1%
DK	18.7%
GR	10.6%
ES	8.6%
IT	8.2%
PL	4.5%
AT	4.3%
FR	2.6%
CH	2.4%
BE	1.8%
PT	1.8%
CZ	1.2%
NL	1.0%
Others	5.6%

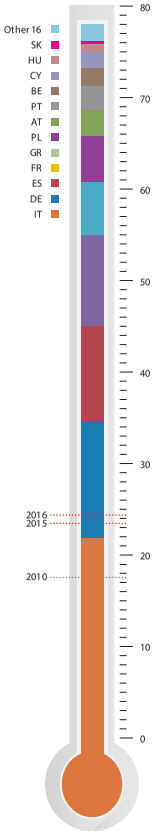
Solar Thermal Capacity in Operation
(per 1000 Capita)



Development of Main Markets
Newly Installed Capacity per 1000 Capita



NREAP Barometer



Estimated energy produced in 2016 in comparison with EU 2020 targets for annual solar thermal energy generation in TWh.

The data are usually provided by national solar thermal associations or other national sources. Countries marked with an * are Solar Heat Europe/ESTIF estimations and are therefore not sufficient to set a percentual variation in the market.

Solar Thermal Markets in EU28 and Switzerland
(Glazed Collectors)

In 2016, the European solar heat market confirmed the trend from the previous years. While the total installed capacity and the energy generation from solar heat continues to increase in Europe, the annual sales have contracted. The total capacity in operation increased to 34.4 GW_{th} (49.2 mio m^2), adding 1.2 GW_{th} (+ 3.6%) to the total installed capacity by the end of 2015. The annual sales totalled 1.8 GW_{th} (approximately 2.5 million m^2), a reduction of 6.4% in comparison with 2015.

Solar heat is at diverse stages of market penetration in different markets. While in several markets the technology faced a strong growth pace in the first decade of the millennium to decay in this second decade, several other markets, namely in Eastern Europe have never reached relevant sales per capita.

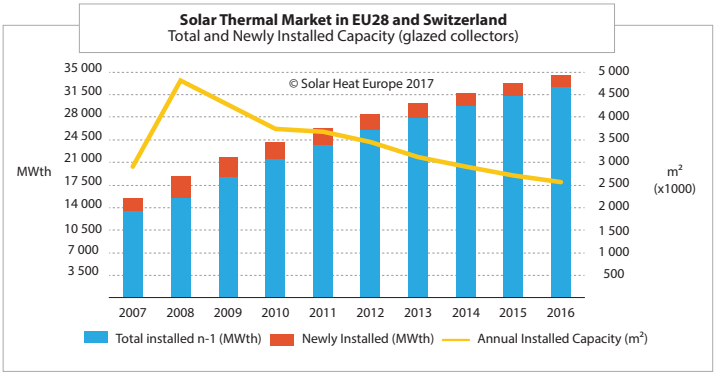
Germany remains, by far, the largest European market, with installations totalling 521 MW_{th} (744 000 m^2) in 2016. This market faced a decrease of almost 8%, confirming some earlier expectations regarding the limited impact of the MAP programme and other support schemes. In fact, it is considered that there is poor information on the existing support, which might also affect the interest of potential users. Still, the existing support schemes have helped to reduce the negative effect of other factors in the market, such as the competition coming from low fossil fuel costs, the competition from other RES, such as the use of solar PV for heating, the low modernisation rate for heating systems in general in the German market and also installation bottlenecks, as installers prefer other works considered more interesting and profitable than solar thermal systems.

The main development was observed in Denmark, where the market grew by approximately 80%, reaching a new national record of 335 MW_{th} (478k m^2), due to an increase in the number and size of solar district heating systems. As an example, a new record was attained with a new solar district heating plant of 110 MW_{th}, coming into operation at the end of the year, more than doubling the size of the previous largest plant. Consequently, Denmark was the second largest market in Europe, just behind Germany. Considering the size of the country (5.6 million), it is a remarkable fact, reaching almost 59 kW_{th} (85 m^2) of newly installed capacity per 1000 inhabitants in 2016.

Greece, Spain and Italy complete the top five of solar thermal markets in terms of newly installed capacity. Out of these the only one that remained stable was Greece. Italy and Spain have decayed approximately 9 and 12% respectively. In Spain this decrease is due to the slow uptake of new construction, where solar heat is facing also increased competition. Furthermore, there is still a lack of public support to the technology and renewable heat in general. In Italy, the support scheme put in place last year fails to produce the desired effect, in part due to the lack of information about it in the market.

With such poor developments, the achievement of the indicative targets for 2020 specified in the National Renewable Energy Actions Plans is seriously jeopardised. Most Members States fail to put in place measures that can incentivise the decarbonisation of the heating and cooling sector by promoting the fuel switch from imported fossil fuels by renewable heat solutions that can provide energy security, investment, create local jobs and promote the local economy.

Even if its role is often ignored or undervalued, there are over 10 million solar heating and cooling systems in Europe, playing an important role in the European energy strategy, allowing for decentralised solutions to meet the heating and cooling demand in Europe. The 34.5 GW_{th} in operation generate an estimated 24.4 TWh_{th} of solar thermal energy while contributing to saving an equivalent of 2.1 Mio toe and avoiding 6.49 Mt CO_2 emissions. In terms of economic significance, the solar thermal sector reached a combined turnover of 2.2 billion Euros in 2016, employing approximately 22 400 people.



Levelised Costs of Solar Heating Systems

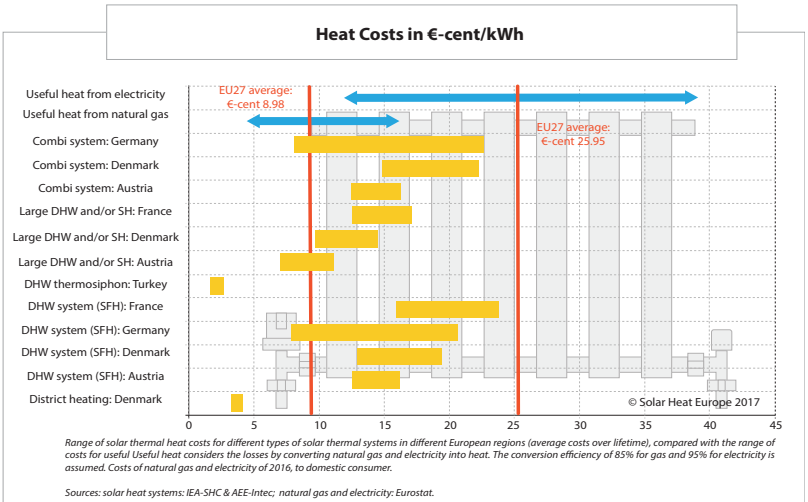
Solar heating and cooling is a well-developed technology, which can compete in the heating and cooling market with different Renewable Energy Sources (RES) and fossil fuel options. Particularly when a level playing field between technologies is ensured.

Currently, a level playing field between technologies in the heat market is still an abstraction. Negative externalities associated with the use of fossil fuels, be it in terms of emissions of CO_2 or other harmful gases, are not properly reflected in their prices. Furthermore, some incentive schemes, such as feed-in tariffs, with extremely appealing financial benefits, have strongly balanced the plate in favour of some RES technologies in the past decade, such as solar photovoltaics.

The competitiveness of solar heating and cooling depends on several technical and financial factors. For instance, the location affects the available solar radiation but also the thermal conditions, in particular the heat demand and potential thermal losses. Furthermore, the type and size of system are important factors, as it can affect the investment costs, or the proportion of useful solar heat provided by the system[1].

Based on an assessment published in "Solar Heat Worldwide"[2]; we compared the levelised costs of different solar heating systems in different locations in Europe. The results are quite diverse when the type of system and the location are considered. The lowest levelised cost of heating[3] (LCoH) is reached with systems diametrically different.

On the one hand, we have a small, low-cost thermosiphon system (2.8 kW_{th}), with diurnal thermal storage (12.7 kWh_{th}), providing domestic hot water in a Mediter



Range of solar thermal heat costs for different types of solar thermal systems in different European regions (average costs over lifetime), compared with the range of costs for useful Useful heat considers the losses by converting natural gas and electricity into heat. The conversion efficiency of 85% for gas and 95% for electricity is assumed. Costs of natural gas and electricity of 2016, to domestic consumer.

Sources: solar heat systems: IEA-SHC & AEE-Intec; natural gas and electricity: Eurostat.

[1] Information on different solar heating systems available at : http://solarheateurope.eu/publications/guides-fact-sheets/

[2] Solar Heat Worldwide, 2017 edition; Weiss, Spörk-Dür, Mauthner; AEE Intec; IEA-SHC 2017

[3] More information on the levelised cost of heating can be found at the websites of the FROnT project (www.front-rhc.eu) and of Task 54 of IEA-SHC (task54.iea-shc.org).

-ranean country, reaching below 2 €-cents per kWh. On the other hand, we have a large solar district heating system (35 MW_{th}), with seasonal thermal storage (142 MWh_{th}) in Denmark, reaching a remarkable 3.5 €-cents per kWh.

The solar heat systems with higher LCoH are domestic hot water systems (DHW) in France and combi-systems in Germany and Denmark. It should be noted that combi-systems have usually a higher LCoH, due to their lower solar fraction[4]. The case of the DHW system in France is very specific, as part of its LCoH is related to higher installation costs in this country.

As shown below, the variations in terms of LCoH are depending on the system type and the location. Hence, it becomes interesting to analyse the installation and energy costs variations in a similar location. The graph below shows such a comparison for Denmark, for different types of system using diurnal storage.

In this case, it is possible to observe the different system variations. The bars indicate the system costs per kW_{th} installed. There is a clear reduction on system costs and also a clear shrinkage of the cost's range, implying that generally the larger the system is, the lower is the cost per kW_{th} installed. This cost reduction has a direct impact on the LCoH. The graph shows a LCoH evolution very much in line with the lower installation costs[5].

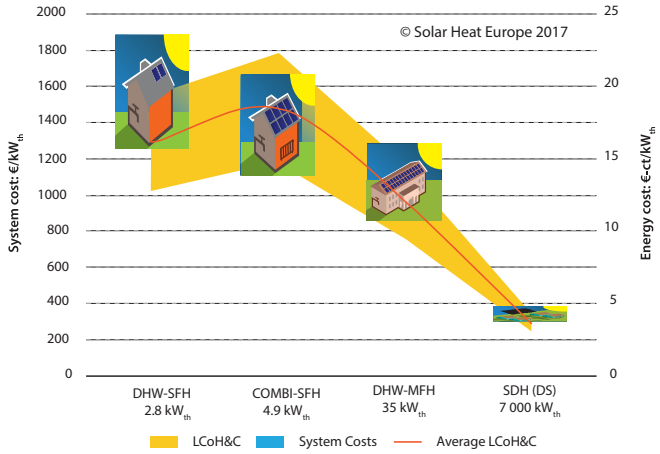
Besides the potential to reduce costs based on larger systems, it is important to understand if the technology has also the potential to reduce costs overtime. As presented in the chart above, the learning curve[6] factor of solar hot water systems is approximately 18%. This is comparable to solar photovoltaic systems, a reference in the energy sector, while having a major advantage: the costs of solar heat systems already include the thermal storage capacity.

In brief, the LCoH of solar heating systems is in a range between the average cost of gas and the average cost of electricity in Europe, with the best performing being clearly below the cost of gas. Solar heating systems have the potential to significantly reduce costs (installation and LCoH) when increasing the system size and have a strong learning curve factor of 18% for each doubling of the market.

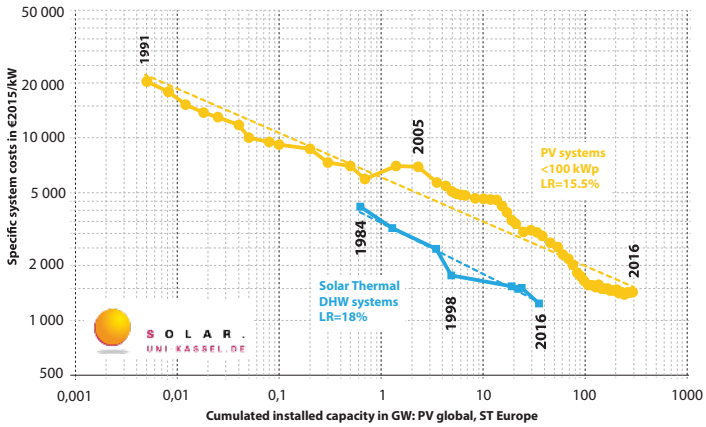
Clearly, solar heat is a clean, secure and affordable energy source, with a strong potential for cost reduction, provided market barriers are addressed in order to promote a stronger deployment of this technology in the market.

[4] Combi-systems have to cope with higher seasonal variations in heat demand, it can result in some of its capacity not being fully used during Summer.
[5] Combi-systems also tend to improve their LCoH for bigger installations. Though they are likely to have a higher LCoH than a DHW system of the same size.
[6] More information on the learning curve concept, including an assessment for solar thermal collectors, can be found in the Strategic Research and Innovation Agenda for Renewable Heating & Cooling, page 16 - http://www.rhc-platform.org/fileadmin/user_upload/members/Downloads/RHC_SRA_epo_final_lowres.pdf

Variations in system prices and energy cost based on system size



Learning curves of PV and solar thermal systems in Germany



The turnkey system costs without subsidies and VAT show similar learning rates for PV and Solar Thermal. The stronger market development of PV lead, however, to larger absolute price reductions. Credits: University of Kassel 2017

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