

## Renewables Global Status Report 2025 – Solar Thermal - Endnotes

- 1 AEE-Institute for Sustainable Technologies (AEE INTEC), “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 16, <https://www.iea-shc.org/solar-heat-worldwide>.
- 2 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 16, <https://www.iea-shc.org/solar-heat-worldwide>.
- 3 Based on preliminary data for gross additions (17.8 GWth, 25.4 million m<sup>2</sup>) in 24 countries, from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025. The global market also shrank in 2023, from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2023, Detailed Market Figures 2022, 2024 Edition”, International Energy Agency Solar Heating and Cooling Programme, 2024, <https://www.iea-shc.org/solar-heat-worldwide>, as well as in 2022, following seven years of decline and a slight increase in 2021, from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2022, Detailed Market Figures 2021, 2023 Edition”, IEA SHC, May 2023, pp. 8, 10, <https://www.iea-shc.org/solar-heat-worldwide>. Note that the conversions throughout use a factor of 0.7 kilowatts-thermal (kWth) per m<sup>2</sup>, based on the agreement of international solar thermal experts in Gleisdorf, Austria, in 2004, from Weiss and Spörk-Dür, “Solar Heat Worldwide”, 2024, op. cit. this note.
- 4 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 17, <https://www.iea-shc.org/solar-heat-worldwide>; and M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 5 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 17, <https://www.iea-shc.org/solar-heat-worldwide>; and M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025; Brazil from

Associação Brasileira de Energia Solar Térmica (ABRASOL), “Produção e Vendas de Sistemas de Aquecimento Solar 2025, Base 2024” [Production and sales of solar heating systems 2025, Base 2024], 2025, 2,

<https://abrasol.org.br/pesquisa-de-producao-e-vendas/>; and Mexico from M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>.

- 6 Based on number of countries covered by Solarthermalworld.org, which has reported on solar thermal sales activities in at least 134 countries worldwide, from B. Epp, solrico, personal communication with REN21, 6 May 2024, and on no updated number available per B. Epp, solrico, personal communication with REN21, 6 June 2025.
- 7 Figure of 443 terawatt-hours (TWh) from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 8, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025. Equivalence of 443 TWh with 260.6 million barrels of oil from Kyle’s Converter, <https://www.kylesconverter.com/energy,-work,-and-heat/terawatt-hours-to-barrels-of-oil-equivalent>.
- 8 Based on 544 GWth at the end of 2024 and on 559 GWth at the end of 2023, for a net decrease in 2024 of around 15 GWth, from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 8, <https://www.iea-shc.org/solar-heat-worldwide>; and from M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025. The difference between annual installations and net additions is due to an assumed statistical collector lifetime of 15-25 years, depending on collector type and country; in most cases, however, collector lifetime is longer than theoretical lifetime. Data for 2024 are based on detailed statistics for 24 countries and data for 2023 are based on data from 73 countries, all from idem, 9-10. **Figure STH1** based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 8, <https://www.iea-shc.org/solar-heat-worldwide>, and M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 9 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 10, <https://www.iea->

shc.org/solar-heat-worldwide. The difference between annual installations and net additions is due to assumed statistical collector lifetime of 15-25 years, depending on collector type and country; in most cases, however, collector lifetime is longer than theoretical lifetime, from idem.

- 10 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 10, <https://www.iea-shc.org/solar-heat-worldwide>.
- 11 B. Epp, solrico, personal communication with REN21, 6 June 2025. Solar thermal challenges also from, for example: Mexico’s National Solar Energy Association (ANES), cited in “Mexico Solar Water Heater Market: Top Manufacturers and Trends”, IWSolar, 4 June 2025, <https://iwsolar.com/mexico-solar-water-heater-market-top-manufacturers-and-trends/>; P. Dias, Solar Heat Europe, personal communication with REN21, 17 March 2023; F. Stier, “Producers Point to Forced Electrification and Cheap Natural Gas as Barriers for Solar Thermal in the US”, Solar Thermal World, 30 August 2023, <https://solarthermalworld.org/news/producers-point-to-forced-electrification-and-cheap-natural-gas-as-barriers-for-solar-thermal-in-the-us>.
- 12 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 18, <https://www.iea-shc.org/solar-heat-worldwide>. Competition with solar PV and heat pumps also from B. Epp, “Australia’s Strong Role in the IEA SHC Global Solar Heat Collaboration”, Solar Thermal World, 11 May 2025, <https://solarthermalworld.org/news/australias-strong-role-in-the-iea-shc-global-solar-heat-collaboration>; in India, from J. Malaviya, cited in B. Epp, “Signs of Growth in India Solar Thermal Market”, Solar Thermal World, 3 April 2024, <https://solarthermalworld.org/news/signs-of-growth-in-indian-solar-thermal-market>; in China, from Qingtai Jiao, “Current Situation of Solar Water Heater in China (Thermosyphon)”, SolarEast Holding Co., Ltd., viewed 19 May 2025, 20, <https://www.iea-shc.org/Data/Sites/1/media/events/webinars/2024-09-25/current-situation-and-development-of-solar-hot-water-heater-in-china.pdf>. In Mexico, despite positive market trends, solar thermal also faces competition from fossil gas heaters, from Mexico’s National Solar Energy Association (ANES), cited in “Mexico Solar Water Heater Market: Top Manufacturers and Trends”, IWSolar, 4 June 2025, <https://iwsolar.com/mexico-solar-water-heater-market-top-manufacturers-and-trends/>.
- 13 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 18, <https://www.iea-shc.org/solar-heat-worldwide>. Solar thermal systems (predominantly pumped

systems, which are relatively technologically complex) are facing increasing competition from PV systems and heat pumps in China and much of Europe, whereas thermosiphon systems, which dominate most other markets, have experienced less pressure from other technologies, with the exception of South Africa, from idem.

- 14 Based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>; M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025; and Brazil also from Associação Brasileira de Energia Solar Térmica (ABRASOL), “Produção e Vendas de Sistemas de Aquecimento Solar 2025, Base 2024” [Production and sales of solar heating systems 2025, Base 2024], 2025, 2, <https://abrasol.org.br/pesquisa-de-producao-e-vendas/>; and Mexico from M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>. The top 10 countries for additions in 2024 accounted for around 93.8% of estimated global additions, based on data from M. Spörk-Dür, op. cit. this note. **Figure STH2** based on idem, all sources.
- 15 Share (72.1%) of cumulative capacity in China and top countries for cumulative capacity in operation based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 9, <https://www.iea-shc.org/solar-heat-worldwide>; and country rankings from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025. Country rankings in 2023 in order from largest were China, Türkiye, United States, Brazil and Germany, from AEE INTEC, “Solar Heat Worldwide...” 2025, op. cit. this note.
- 16 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 9, <https://www.iea-shc.org/solar-heat-worldwide>. The adoption of solar thermal technology for water heating took off during the 1960s in Cyprus and, owing to this technology, the country has already exceeded the EU’s renewable energy targets for heating and cooling of buildings; an estimated 93.5% of households and most hotels in Cyprus use solar thermal for domestic hot water heating, all from H. Smith, “‘You Basically Have Free Hot Water’: How Cyprus Became a World Leader in Solar Heating”, The Guardian, 20 September 2024, <https://www.theguardian.com/environment/2024/sep/20/cyprus-solar-thermal-heating-water-rooftop-renewable-energy-climate>.

- 17 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 17, <https://www.iea-shc.org/solar-heat-worldwide>; M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 18 China added 16,254,419 m<sup>2</sup> of collector area, or 11,448 MWth (including 2,759.1 MWth of flat plate collectors and 8,689 MWth of vacuum tubes) in 2024 for a year-end total collector area of 559,756,972 m<sup>2</sup> (391,829.9 MWth), from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE – Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 19 Qingtai Jiao, “Current Situation of Solar Water Heater in China (Thermosyphon)”, SolarEast Holding Co., Ltd., viewed 19 May 2025, 20, <https://www.iea-shc.org/Data/Sites/1/media/events/webinars/2024-09-25/current-situation-and-development-of-solar-hot-water-heater-in-china.pdf>.
- 20 Passed India based on 2024 additions for Brazil and India from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>; and M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025; figure of 10.8% market growth in 2024 (and 2.8% in 2023) from Associação Brasileira de Energia Solar Térmica (ABRASOL), “Produção e Vendas de Sistemas de Aquecimento Solar 2025, Base 2024” [Production and sales of solar heating systems 2025, Base 2024], 2025, 2, <https://abrasol.org.br/pesquisa-de-producao-e-vendas/>.
- 21 Brazil’s additions, unglazed collector share and total operating capacity based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025; record based on record in 2023 and installations from D. Johann, Associação Brasileira de Energia Solar Térmica (ABRASOL), personal communication with REN21, 2 April 2024, and from ABRASOL, “Solar Heating Systems Production and Sales 2024 (Database 2023)”, May 2024, <https://abrasol.org.br/wp-content/uploads/2024/05/Solar-Heating-Systems-Production-and-Sales-2024.pdf>; figure of 8.2% from Associação Brasileira de Energia Solar Térmica (ABRASOL), “Produção e Vendas de Sistemas de Aquecimento Solar 2025, Base 2024” [Production and sales of solar heating

- systems 2025, Base 2024], 2025, 4, <https://abrasol.org.br/pesquisa-de-producao-e-vendas/> (with Google Translate).
- 22 Associação Brasileira de Energia Solar Térmica (ABRASOL), “Produção e Vendas de Sistemas de Aquecimento Solar 2025, Base 2024” [Production and sales of solar heating systems 2025, Base 2024], 2025, 2, <https://abrasol.org.br/pesquisa-de-producao-e-vendas/>, and from B. Epp, “Brazil Adds 1.4 GW of Solar Collectors, Surging to Global No. 3 in 2024”, *Solar Thermal World*, 27 May 2025, <https://solarthermalworld.org/news/brazil-adds-1-4-gw-of-solar-collectors-surging-to-global-no-3-in-2024/>. Domestic production of solar water heaters increased 11%, although economic uncertainty and the lack of financing continued to affect the supply chain, from ABRASOL, op. cit. this note.
- 23 Based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>; and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 24 Decline of 2.6% in 2023 and reasons for decline, from K. Ülke, Bural Heating, Kayseri, Türkiye, personal communication with REN21, 2-3 May 2024; expansion (10%) in 2024 from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>; M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025; new construction as source of 2024 increase from B. Epp, solrico, personal communication with REN21, 6 June 2025. Note that subsidies for fossil gas (zero-cost up to 25 cubic metres) provided to every household monthly through much of 2023 probably also affected sales during 2023, although the impact is difficult to measure, from Ülke, op. cit. this note.
- 25 B. Epp, solrico, personal communication with REN21, 6 June 2025.
- 26 Second place globally in 2023 and 27% increase based on data from J. Malaviya, Malaviya Solar Energy Consultancy, cited in B. Epp, “Signs of Growth in India Solar Thermal Market”, *Solar Thermal World*, 3 April 2024, <https://solarthermalworld.org/news/signs-of-growth-in-indian-solar-thermal-market>, from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2023, Detailed Market Figures 2022, 2024 Edition”, International Energy Agency Solar Heating and Cooling Programme, 2024, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, March–May 2024; decline of 24% in 2024 from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market

Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>.

- 27 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 28 The Indian state of Karnataka mandates the installation of solar water heating to obtain building permits, from J. Malaviya, cited in “CSH In India Is Best Suited For Heating Applications’, Jaideep Malviya”, Saur Energy International, 14 March 2024, <https://www.saurenergy.com/solar-energy-conversation/csh-in-india-is-best-suited-for-heating-applications-jaideep-malviya>; in addition, Gujarat, Karnataka, Maharashtra and Rajasthan have mandates for building completion certificates and property tax rebates for solar thermal systems, from “Solar Water Heating Warms Up For A Second Innings In India”, Saur Energy International, <https://www.saurenergy.com/solar-energy-conversation/solar-water-heating-warms-up-for-a-second-innings-in-india>.
- 29 J. Malaviya, cited in “Solar Water Heating Warms Up For A Second Innings In India”, Saur Energy International, <https://www.saurenergy.com/solar-energy-conversation/solar-water-heating-warms-up-for-a-second-innings-in-india>. The same was true in 2023, based on data from J. Malaviya, cited in B. Epp, “Signs of Growth in India Solar Thermal Market”, Solar Thermal World, 3 April 2024, <https://solarthermalworld.org/news/signs-of-growth-in-indian-solar-thermal-market>, and J. Malaviya, cited in “CSH In India Is Best Suited For Heating Applications’, Jaideep Malviya”, Saur Energy International, 14 March 2024, <https://www.saurenergy.com/solar-energy-conversation/csh-in-india-is-best-suited-for-heating-applications-jaideep-malviya>.
- 30 “MNRE Issues Quality Control Order for Solar Water Heaters”, Saur Energy International, 17 October 2024, <https://www.saurenergy.com/solar-energy-news/mnre-issues-quality-control-order-for-solar-water-heaters>; “Solar Water Heating Warms Up For A Second Innings In India”, Saur Energy International, 6 May 2025, <https://www.saurenergy.com/solar-energy-conversation/solar-water-heating-warms-up-for-a-second-innings-in-india>.
- 31 “MNRE Issues Quality Control Order for Solar Water Heaters”, Saur Energy International, 17 October 2024, <https://www.saurenergy.com/solar-energy-news/mnre-issues-quality-control-order-for-solar-water-heaters>; “Solar Water Heating Warms Up For A Second Innings In India”, Saur Energy International, <https://www.saurenergy.com/solar-energy-conversation/solar-water-heating-warms-up-for-a-second-innings-in-india>.

- 32 Mexico was eighth in 2023, based on data from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2023, Detailed Market Figures 2022, 2024 Edition”, International Energy Agency Solar Heating and Cooling Programme, 2024, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, March–May 2024; ranking and capacity numbers for 2024 based on data from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 33 Mexican Solar Energy Association (ASOLMEX), cited in “Mexico Solar Water Heater Market: Top Manufacturers and Trends”, IWSolar, 4 June 2025, <https://iwsolar.com/mexico-solar-water-heater-market-top-manufacturers-and-trends/>; M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>. Mexico City has made solar technology compulsory in new buildings and the local government has invested USD 718,570 (MXN 14.7 million) in the installation of solar water heating in public hospitals; Jalisco has introduced a State Energy Plan outlining the public policy strategy for the state’s energy transition and highlighting support for solar thermal heating solutions in the residential, commercial and industrial sectors, all from Oropeza, op. cit. this note. Currency converted using OANDA currency converter for the date 31 December 2024, <https://www.oanda.com/currency-converter>.
- 34 “Mexico Solar Water Heater Market: Top Manufacturers and Trends”, IWSolar, 4 June 2025, <https://iwsolar.com/mexico-solar-water-heater-market-top-manufacturers-and-trends/>; M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>. Barriers remain, however, including a lack of awareness of solar thermal heating; high upfront installation costs; competition from fossil gas heaters; a shortage of technicians to install and maintain solar thermal systems; and the influx of low-quality products, which has led to quality concerns, all from Mexico’s National Solar Energy Association (ANES), cited in “Mexico Solar Water Heater Market: Top Manufacturers and Trends”, IWSolar, 4 June 2025, <https://iwsolar.com/mexico-solar-water-heater-market-top-manufacturers-and-trends/>.



- 35 M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025.
- 36 B. Epp, “Australia’s Strong Role in the IEA SHC Global Solar Heat Collaboration”, Solar Thermal World, 11 May 2025, <https://solarthermalworld.org/news/australias-strong-role-in-the-iea-shc-global-solar-heat-collaboration>.
- 37 Figure of 42% from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>, and from M. Spörk-Dür, AEE Institute for Sustainable Technologies, personal communication with REN21, May 2025. J.P. Meyer, “Difficult Market Environment for Residential Solar Thermal Providers in Germany”, Solar Thermal World, 25 June 2024, <https://solarthermalworld.org/news/difficult-market-environment-for-residential-solar-thermal-providers-in-germany/>. Economic troubles led to large declines in markets for all heating technologies during 2024, from B. Epp, solrico, personal communication with REN21, 6 June 2025. Germany added approximately 26,000 new solar thermal systems in 2024, bringing the total in operation to 2.59 million. New collector area in 2024 was around 0.22 million m<sup>2</sup> (141 MWth), bringing the total to 21.82 million m<sup>2</sup> (14.20 GWth); estimated solar thermal energy produced in 2024 was 8.8 TWh thermal, from BSW Solar, “Statistical Data on the German Solar Heating (Solar Thermal) Market”, March 2025, <https://www.solarwirtschaft.de/en/press/market-data/>.
- 38 German Federal Government, “Climate-friendly Heating: New Building Energy Act to be Implemented”, 19 April 2023, <https://www.bundesregierung.de/breg-en/news/new-building-energy-act-2185010>; S. Ligewie, “Germany to Ramp Up the Decarbonisation of Buildings Heating from Jan 1st 2024. How”, Energy Post, July 11, 2023, <https://energypost.eu/germany-to-ramp-up-the-decarbonisation-of-buildings-heating-from-jan-1st-2024-how/>. Around 80% of Germany’s residential buildings are heated using fossil fuels, from Ligewie, op. cit. this note.
- 39 Figure of 87% from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 18, <https://www.iea-shc.org/solar-heat-worldwide>. Large-scale systems data from idem, 8.
- 40 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 13, <https://www.iea-shc.org/solar-heat-worldwide>. Large-scale systems are also used to heat residential, commercial and public buildings, with many installed on hospitals, hotels and sports centres. At the end of 2024, 622 large-scale solar thermal

systems (including those for district heating) were in operation worldwide, totalling 2.4 GWth (3.4 million m<sup>2</sup>). Of these, 276 systems (with a combined capacity of 396 MWth) were providing heat directly to buildings (not through district heating networks), mainly in China (128 systems) and Turkey (18), but also across Europe, Latin America, the Middle East and other countries in Asia, from idem.

- 41 Ten new systems including one in the Netherlands, four in China, three in Germany, and one each in Italy and Austria, from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 4, 22, 27, <https://www.iea-shc.org/solar-heat-worldwide>.
- 42 Fourth largest from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 19, 21, <https://www.iea-shc.org/solar-heat-worldwide>; figure of 25% from B. Epp, “37 MW Solar District Heating Plant in the Netherlands with Outstanding Features”, Solar Thermal World, 11 November 2022, <https://solarthermalworld.org/news/37-mw-solar-district-heating-plant-in-the-netherlands-with-outstanding-features/>. The Groningen system, the largest installed in Europe during 2024, combines solar thermal and waste heat with seasonal storage, from AEE INTEC, op. cit. this note. The solar thermal component is expected to meet 25% of the total heat demand in the network, from B. Epp, op. cit. this note; and from “37 MW Solar District Heating Plant in Groningen, Netherlands”, Solar Heat EU, accessed 19 May 2025, <https://solarheateurope.eu/2022/11/30/37-mw-solar-district-heating-plant-in-groningen-netherlands/>. The project was financed through a 30-year solar heat delivery contract with the local utility and via a special purpose vehicle (the entity that owns and operates the plant), which is the financing mechanism usually used for solar PV projects, from B. Epp, “37 MW Solar District Heating Plant in the Netherlands with Outstanding Features”, Solar Thermal World, 11 November 2022, <https://solarthermalworld.org/news/37-mw-solar-district-heating-plant-in-the-netherlands-with-outstanding-features/>.
- 43 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 19, <https://www.iea-shc.org/solar-heat-worldwide>. China reported four new systems; the Netherlands reported only one new system, with 48,800 m<sup>2</sup> of collector area; Germany added three systems with a combined area of 9,804 m<sup>2</sup>; and Italy (917 m<sup>2</sup>) and Austria (555 m<sup>2</sup>) installed one each, from idem.

- 44 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 19, <https://www.iea-shc.org/solar-heat-worldwide>. At year’s end, Germany had 16 systems (with a combined 204,136 m<sup>2</sup> of collector area) in advanced planning or under construction, including the country’s largest plant (65,000 m<sup>2</sup>), which began construction in the city of Leipzig, from idem.
- 45 B. Epp, “District Heating Has Never Had Such a High Significance in Germany”, Solar Thermal World, 28 April 2024, <https://solarthermalworld.org/news/district-heating-has-never-had-such-a-high-significance-in-germany/>. The funding scheme, Federal Funding for Efficient Heating Networks, is available until 2026; the Local Heat Planning Law also requires all municipalities to recommend areas for refurbishment of homes, all from idem.
- 46 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 8, 20, <https://www.iea-shc.org/solar-heat-worldwide>.
- 47 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 20-21, <https://www.iea-shc.org/solar-heat-worldwide>. At the end of 2024, Denmark had 124 solar thermal district heating systems, followed by China (76), Germany (59, some with seasonal storage), Sweden (23), Austria (21) and Poland and France (each with 8); such systems were also in operation in Canada, Japan, Kyrgyzstan, Russia, Saudi Arabia, South Africa and the United States. In terms of the number of large-scale plants not part of district heating systems, China leads with 128 systems (295 MWth), followed by Türkiye (18 systems, 14.2 MWth), and the Latin America region (16 systems, 12 MWth), mostly in hospitals, hotels and sports centres, all from idem, 20, 22.
- 48 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 22, <https://www.iea-shc.org/solar-heat-worldwide>.
- 49 Lack of awareness from F. Stier, “Feasibility Studies for Large Solar Heat Plants Totalling Almost 1 Million m<sup>2</sup> Underway”, Solar Thermal World, 6 April 2023, <https://solarthermalworld.org/news/feasibility-studies-for-large-solar-heat-plants-totalling-almost-1-million-m2-underway>, and from B. Epp, “Solar District Heating Solutions Providing Higher Temperatures”, Solar Thermal World, 4 December 2022, <https://solarthermalworld.org/news/solar-district-heating-solutions-providing-higher-temperatures>; accessing funding from B. Epp, “District Heating Has Never Had Such a High Significance in Germany”, Solar

Thermal World, 28 April 2024, <https://solarthermalworld.org/news/district-heating-has-never-had-such-a-high-significance-in-germany/>; finding suitable sites and permitting from idem, F. Stier, “Access to Land Is One of the Key Bottlenecks for Rolling Out Renewables”, Solar Thermal World, 22 November 2022, <https://solarthermalworld.org/news/access-to-land-is-one-of-the-key-bottlenecks-for-rolling-out-renewables>, and from C. Travasaros, Prime Laser Tec. and Solar Heat Europe, cited in F. Stier, “European Council Speeds Up Permission Procedures But Only for Solar Systems on Buildings”, Solar Thermal World, 2 February 2023, <https://solarthermalworld.org/news/european-council-speeds-up-permission-procedures-but-only-for-solar-systems-on-buildings>; high temperatures and seasonal storage from B. Epp, op. cit. this note. Many district heating grids operate at high temperatures (above 100 °C) and reducing temperatures to accommodate input from solar thermal systems is a complex, costly and lengthy process. Further, even in Germany, where there are beneficial policies, there are many challenges, and accessing funding to cover the enormous investments required for each project at the local level can prove difficult, from idem.

- 50 Global spread from B. Epp, “Global Expansion of Solar Industrial Heat: Key Insights from the Latest Outlook”, Solar Thermal World, 1 April 2025, <https://solarthermalworld.org/news/global-expansion-of-solar-industrial-heat-key-insights-from-the-latest-outlook/>; completed in 2024 and under construction at year’s end from B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>.
- 51 Significant share and heavy reliance on fossil fuels based on data from International Energy Agency (IEA), “World Energy Outlook 2024”, 2024, 105-106, 118-119, <https://www.iea.org/reports/world-energy-outlook-2024/>, and from E. Bellevrat and K. West, “Clean and Efficient Heat for Industry”, International Energy Agency, 23 January 2018, <https://www.iea.org/commentaries/clean-and-efficient-heat-for-industry>; growing interest in solar thermal from M. Lehnis, “Sunshine, Mirrors and Steam: Meet the Company Quickly Decarbonizing the \$444 Billion Industrial Heat Market”, Forbes, 14 December 2023, <https://www.forbes.com/sites/mariannelehnis/2023/12/14/sunshine-mirrors-and-steam-meet-the-company-quickly-decarbonizing-the-444-billion-industrial-heat-market>; heavy reliance on fossil fuels also from M. de Kempenaer et al., “Net-Zero Heat: Is It Too Hot to Handle?” McKinsey, 22 July 2022, <https://www.mckinsey.com/capabilities/sustainability/our-insights/sustainability-blog/net-zero-heat-is-it-too-hot-to-handle>. Internal decarbonisation targets have been important factors, from B. Epp, “Welcome to a New Year and Another Chance for Solar Heat to Get Big”, Solar Thermal World,

- 17 January 2023, <https://solarthermalworld.org/news/welcome-to-a-new-year-and-another-chance-for-solar-heat-to-get-big>.
- 52 Temperature ranges from Solar Payback, “Suppliers of Turnkey Solar Process Heat Systems”, accessed 31 January 2023, <https://www.solar-payback.com/suppliers>; see also Solar Heat Europe, “Decarbonising Heat with Solar Thermal – Market Outlook 2022/2023”, p. 5, 2023, <https://SolarHeateurope.eu/wp-content/uploads/2023/10/SHE-ST-MarketOutlook-2023-finalv.pdf>; solar thermal collectors and sorption chillers from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2022, Detailed Market Figures 2021, 2023 Edition”, International Energy Agency Solar Heating and Cooling Programme, May 2023, <https://www.iea-shc.org/solar-heat-worldwide>; down to -40°C from hycool, “Some Facts on SHIP”, accessed 13 March 2024, <https://hycool-project.eu/resources/resources-on-ship>.
- 53 Based on total collector area of 1,531 million m<sup>2</sup>, with data assessed from annual surveys (2017-2025) of the companies listed on the “Turnkey SHIP Supplier World Map”, cited in B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>. Also from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 9, <https://www.iea-shc.org/solar-heat-worldwide>. This was up from 1,209 projects in operation totalling 951 MWth at the end of 2023, based on data from annual surveys (2017-2024) of the companies listed in Solar Payback, “Turnkey SHIP Supplier World Map”, cited in B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>. Capacity was calculated by Epp using the factor 0.7 kW per m<sup>2</sup> for all collector types.
- 54 Based on data from the SHIP Database (SHIP-plant.info), cited in AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>. Note that the database covered by the AEE INTEC report lists only 714 systems, whereas there are at least 1,315 systems in operation worldwide. However, the food and beverage industries combined do have the largest number of systems and the mining sector is most likely the largest for operating capacity, all from B. Epp, solrico, personal communication with REN21, 6 June 2025.

- 55 B. Epp, “Global Expansion of Solar Industrial Heat: Key Insights from the Latest Outlook”, Solar Thermal World, 1 April 2025, <https://solarthermalworld.org/news/global-expansion-of-solar-industrial-heat-key-insights-from-the-latest-outlook/>. Developers have reported 73 plants, totalling 277 MWth, that are expected to be realized by 2027. These include three multi-MWth (totalling 154 MWth) mining facilities in Chile (with 112 MWth of that under construction); the largest number of plants will be built in Europe, with substantial heat capacity also to be added in Australia, the Middle East and North America, from idem.
- 56 B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>. The 116 systems completed during 2022 totalled 31 MWth of capacity, and during 2023 totalled 94 MWth, based on data from annual surveys (2017-2024) of the companies listed in Solar Payback, “Turnkey SHIP Supplier World Map”, cited in B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>. Capacity was calculated by Epp using the factor 0.7 kW per m<sup>2</sup> for all collector types.
- 57 B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>; CSTA, “The Handan Kunle Bay International Tourism Resort—The Solar Thermal+ Comprehensive Development Demonstration Project”, China Solar Thermal Alliance, May 21, 2025, <http://en.cnste.org/news/detail/1353.html>; and AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>. This is the world’s second largest SHIP plant, after a 330 MWth facility in Oman, from AEE INTEC, “Solar Heat Worldwide...”, op. cit. this note.
- 58 Data for 2024 from B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>, and from B. Epp, solrico, personal communication with REN21, 6 June 2025. Data for 2023 from B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>. The rankings for 2022 were based on a survey among the companies listed in Solar Payback, “Suppliers of Turnkey Solar Process Heat

Systems”, accessed 31 January 2023, <https://www.solar-payback.com/suppliers>, and cited in B. Epp, “High Level of Dynamism on the SHIP World Market in 2022”, Solar Thermal World, 27 March 2023, <https://solarthermalworld.org/news/high-level-of-dynamism-on-the-ship-world-market-in-2022>. The leading markets in terms of the number of systems installed in 2022 are based on data from a survey among the companies listed on the SHIP Supplier World Map in March/April 2022, from Solar Payback, “SHIP Supplier Map of Turnkey Solar Process Heat Systems”, April 2022, <https://www.solar-payback.com/suppliers>. China possibly under-reported its installations during 2022 (and 2021), from B. Epp, “High Level of Dynamism...”, op. cit. this note, and from W. Weiss and M. Spörk-Dür, “Solar Heat Worldwide, Global Market Development and Trends 2022, Detailed Market Figures 2021, 2023 Edition”, International Energy Agency Solar Heating and Cooling Programme, 2023, <https://www.iea-shc.org/solar-heat-worldwide>. The China Academy of Building Research reported that a total of 359 SHIP systems (256,000 m<sup>2</sup>) were added in 2021 alone; because detailed data are not available, the systems are not included in data from Weiss and Spörk-Dür, op. cit. this note, p. 26. The majority of new facilities in Germany were used for drying agricultural products, although this application no longer received government support as of the beginning of 2024, leading to a shift in investment decisions for future projects, as reported by a German air collector supplier to solrico, from “Emerging Trends in Industrial Solar Heat Generation Worldwide 2024”, ACETECH, 13 May 2025, <https://www.acebattery.com/blogs/emerging-trends-in-industrial-solar-heat-generation-worldwide-2024>.

- 59 B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>. Germany moved up from seventh in 2023 due to a 20 MWth plant that began operating at a biomass company; Mexico (2.6 MWth) and Austria (1.9 MWth) ranked fourth and fifth, from idem. Rankings for 2023 from B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>.
- 60 B. Epp, “Key Factors Behind SHIP Project Developers’ Business Satisfaction”, Solar Thermal World, 19 March 2025, <https://solarthermalworld.org/news/key-factors-behind-ship-project-developers-business-satisfaction/>.
- 61 B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>, and AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025

Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>. Note that these data are based on systems installed between 2017 and 2024. The world’s largest SHIP plant is in Oman, followed by the new Handan Bay facility in China and Sundrop Farms in Port Augusta, Australia (36 MWth). The Oman plant was first commissioned in 2017 and has been expanded continuously, to a capacity of 330 MWth as of early 2025, from idem, p. 33. Mexico has installed 139 SHIP systems with combined capacity of 24 MWth and leads in terms of number of projects, while Oman has 342 MWth of capacity in two projects at the Amal Oilfield (Miraah and Amal II). China ranks second for total installed capacity, with 157 MWth comprised of 70 documented systems; however, the China Academy of Building Research notes that significantly more systems have been installed since 2021. In Europe, the leading countries for total capacity are Spain (59 MWth), the Netherlands (32 MWth) and France (28 MWth). In addition, both the United States (29 MWth) and Chile (28 MWth) are among the top 10 countries for installed SHIP capacity, all from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, 28-29, <https://www.iea-shc.org/solar-heat-worldwide>. According to another source, at least 273 SHIP plants have been installed in Mexico since 2017, from M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>.

- 62 solrico, in “Solar Industrial Heat Outlook 2023-2026”, cited in B. Epp, “Promising Solar Industrial Heat Outlook 2023-2026”, Solar Thermal World, 27 September 2023, <https://solarthermalworld.org/news/promising-solar-industrial-heat-outlook-2023-2026>; AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>. Average system size has increased significantly over the past few years, tripling in 2023 relative to 2022 and increasing a further 30% in 2024, from AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>.
- 63 AEE INTEC, “Solar Heat Worldwide, Global Market Development and Trends 2024, Detailed Market Figures 2023, 2025 Edition”, International Energy Agency Solar Heating and Cooling Programme (IEA SHC), 2025, <https://www.iea-shc.org/solar-heat-worldwide>. Stationary collectors able to achieve higher



temperatures from B. Epp, solrico, personal communication with REN21, 6 May 2024.

- 64 Data for 2024 from B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>. Data for 2023 from B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>. The high share of concentrating collectors (69%) installed in 2024 was largely owing to the 80 MWth parabolic trough field completed in Handan, China; excluding this plant, the global concentrating solar collector share of newly installed capacity was only 7%, from Epp, “Global SHIP Market Reaches...” op. cit. this note.
- 65 B. Epp, “Key Factors Behind SHIP Project Developers’ Business Satisfaction”, Solar Thermal World, 19 March 2025, <https://solarthermalworld.org/news/key-factors-behind-ship-project-developers-business-satisfaction/>; B. Epp, “Structural Changes in Solar Industrial Heat Supply Industry”, Solar Thermal World, 6 July 2022, <https://solarthermalworld.org/news/structural-changes-in-solar-industrial-heat-supply-industry>. Examples of low fossil fuel prices making it difficult to close deals for SHIP projects include: Mexico from B. Epp, “Global SHIP Market Reaches Five-Year High Despite National Fluctuations”, Solar Thermal World, 17 March 2025, <https://solarthermalworld.org/news/global-ship-market-reaches-five-year-high-despite-national-fluctuations/>, and Australia, from B. Epp, “Australia’s Strong Role in the IEA SHC Global Solar Heat Collaboration”, Solar Thermal World, 11 May 2025, <https://solarthermalworld.org/news/australias-strong-role-in-the-iea-shc-global-solar-heat-collaboration>. Even where SHIP systems are highly cost-competitive with fossil fuels, such as in southern Spain, the lack of awareness of the benefits of solar heat remains a challenge. As of early 2023, one company in southern Spain offered heat for USD 15.6-20.8 (EUR 15-20) per MWh, which compared to gas at USD 83.3-93.7 (EUR 80-90) per MWh, from A.D. Rosell, “Heat Purchase Agreements on the Rise in Spain”, Solar Thermal World, 10 August 2022, <https://solarthermalworld.org/news/heat-purchase-agreements-on-the-rise-in-spain>.
- 66 Minimise risk from B. Epp, “Welcome to a New Year and Another Chance for Solar Heat to Get Big”, Solar Thermal World, 17 January 2023, <https://solarthermalworld.org/news/welcome-to-a-new-year-and-another-chance-for-solar-heat-to-get-big>; dominant business model based on capacity of systems in the project pipeline, from B. Epp, “Global Expansion of Solar Industrial Heat: Key Insights from the Latest Outlook”, Solar Thermal World, 1 April 2025, <https://solarthermalworld.org/news/global-expansion-of-solar>

industrial-heat-key-insights-from-the-latest-outlook/; moved SHIP to new markets from solrico, in “Solar Industrial Heat Outlook 2023-2026”, cited in B. Epp, “Promising Solar Industrial Heat Outlook 2023-2026”, Solar Thermal World, 27 September 2023, <https://solarthermalworld.org/news/promising-solar-industrial-heat-outlook-2023-2026>, and from B. Epp, “The Netherlands and Spain Drive SHIP Market 2023”, Solar Thermal World, 28 March 2024, <https://solarthermalworld.org/news/the-netherlands-and-spain-drive-ship-market-2023>.

- 67 A study in Australia found that low-temperature process heat is cost-effective even compared to the cheapest heat from coal and fossil gas, from B. Epp, “Australia’s Strong Role in the IEA SHC Global Solar Heat Collaboration”, Solar Thermal World, 11 May 2025, <https://solarthermalworld.org/news/australias-strong-role-in-the-iea-shc-global-solar-heat-collaboration>; and a 2024 project in Germany, undertaken by Bundesverband Solarwirtschaft e.V. and Deutsche Energie-Agentur to evaluate the economic viability of SHIP in Germany, determined that the technology is already competitive under suitable conditions and that, even without government support, many SHIP applications – particularly at low- to medium- temperatures – are economically attractive, from “SHIP – Solar Process Heat in Germany”, Fraunhofer Institute, accessed 13 May 2025, <https://www.ise.fraunhofer.de/en/research-projects/ship.html>. For Germany, also see B. Epp, “Germany: Solar Process Heat 50 to 80% Cheaper Than Gas-based Alternatives”, Solar Thermal World, 3 June 2025, <https://solarthermalworld.org/news/germany-solar-process-heat-50-to-80-cheaper-than-gas-based-alternatives/>.
- 68 M. Oropeza, “Solar Thermal – A Growing Market Spotlighted at Intersolar Mexico”, Solar Thermal World, 28 May 2025, <https://solarthermalworld.org/news/solar-thermal-a-growing-market-spotlighted-at-intersolar-mexico/>.