IEA Roadmap targets

2012 2015 2020 2025 2030 2035 2040 2045 2050

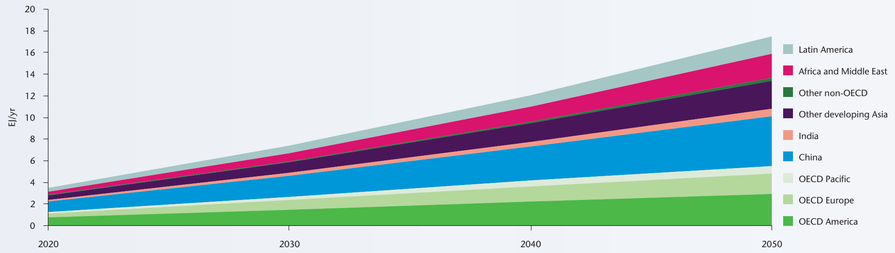
International Energy Agency

Key findings

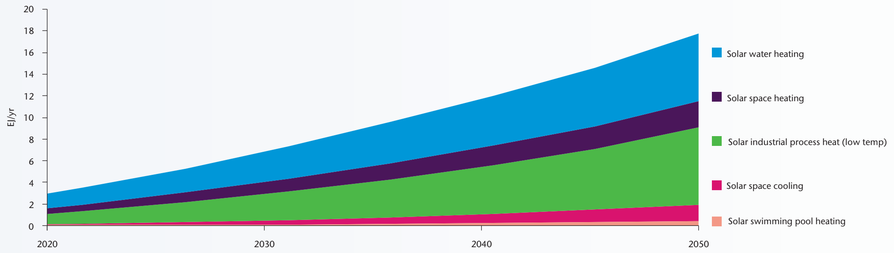
Solar heating and cooling (SHC) can provide low-carbon emission energy from solar resources that are widespread throughout the world. SHC describes a wide range of technologies, from mature domestic hot water heaters to those just entering the demonstration phase, such as solar thermally driven cooling. This roadmap envisages development and deployment of solar heating and cooling by 2050 to produce 16.5 EJ (4583 TWh_{th}; 394 Mtoe) solar heating annually, more than 16% of total final energy use for low temperature heat, and 1.5 EJ solar cooling, nearly 17% of total energy use for cooling by that time. It would include the following contributions:

- Solar collectors for hot water and space heating could reach an installed capacity of nearly 3 500 GW_{th}, satisfying annually around 8.9 EJ of energy demand for hot water and space heating in the building sector by 2050. Solar hot water and space heating accounts for 14% of space and water heating energy use by that time.
- Solar collectors for low-temperature process heat in industry (< 120°C) could reach an installed capacity of 3 200 GW_{th}, producing around 7.2 EJ solar heat per year by 2050. Solar process heat accounts for 20% of energy use for low temperature industrial heat by that time.
- Solar heat for cooling could reach a contribution of 1.5 EJ per year from an installed capacity of more than 1 000 GW_{th} for cooling, accounting for nearly 17% of energy use for cooling in 2050.
- Swimming pool heating could reach an installed capacity of 200 GW_{th}, producing annually around 400 PJ solar heat by 2050.
- By achieving the above mentioned deployment levels, solar heating and cooling can avoid some 800 megatonnes (Mt) of CO_2 emissions per year by 2050.
- Achieving this roadmap's vision requires a rapid expansion of solar hot water heating in the building sector, including in solar supported district heating, as well as in industrial applications. Dedicated policy support should overcome barriers related to information failures, split incentives and high up-front investments.
- While a number of industrial and agricultural processes can use low-temperature flat-plate collectors, advanced flat-plate collectors and concentrating technology should be further developed to produce medium-temperature heat. Industrial process heat offers enormous potential in sectors that use low- and medium-temperature heat for processes such as washing, leaching (mining industry), drying of agricultural products, pre-heating of boiler feed water, pasteurisation and cooking.
- The development of compact storage will allow heat to be transferred so that it can be used when the load is required, aiding the deployment of solar space heating in individual buildings. Dedicated research, development and demonstration (RD&D) resources could make compact storage commercially viable between 2020 and 2030.
- Solar cooling could avoid the need for additional electricity transmission capacity caused by higher average peak loads from the rapidly increasing cooling demand in many parts of the world. With substantially higher RD&D resources, standardised, cost competitive and reliable solar cooling systems could enter the market between 2015 and 2020.

Roadmap vision solar heating and cooling generation by region (building sector and industry)

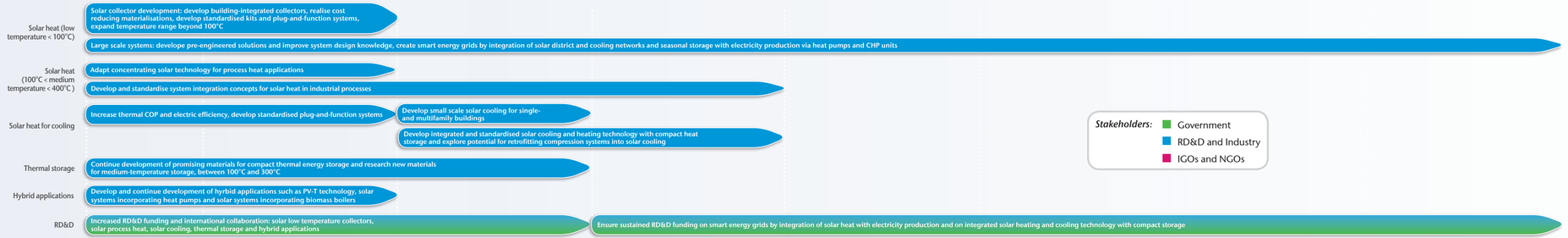


Roadmap vision of total solar heating and cooling generation per sector

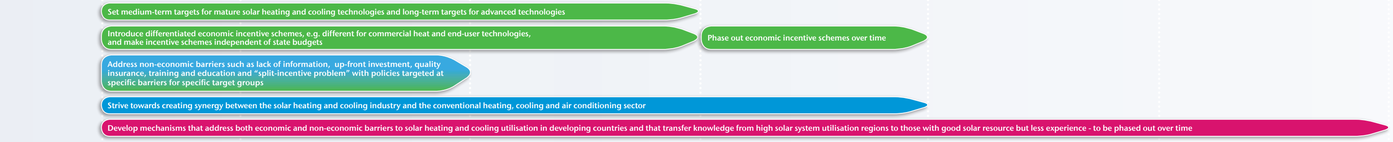


Policy actions and milestones

Technology and RD&D



Regulatory framework, support schemes and market facilitation



Key actions over the next ten years

Concerted action by all stakeholders is critical to realise the vision laid out in this roadmap. In order to stimulate investment, governments must take the lead role in creating a favourable investment climate for widespread use of solar heating and cooling. In particular, governments should:

- Create a stable, long-term policy framework for solar heating and cooling; establish medium-term targets to maximise the effective use of mature and nearly mature technologies, and long-term targets for advanced technologies that have yet to reach the market.
- Introduce differentiated economic incentives on the basis of competitiveness per technology by means of transparent and predictable frameworks to bridge competitive gaps. Incentives could for example be based on feed-in tariffs or renewable portfolio standards for commercial heat and subsidies or tax incentives for end-user technologies. Economic incentive schemes should be independent of state budget procedures to avoid "stop-and-go" policies where, for example, sudden withdrawal of incentives can destabilise the market.
- Address barriers such as information failures, up-front investment of technologies and the 'split-incentive' problem (where the investor in SHC technology does not reap the benefits of reduced energy costs). This can be done through awareness raising campaigns, industry training and education, support for new business models and modified regulations.
- Provide RD&D funding and support mechanisms to enable promising pre-commercial solar heating and cooling technologies to reach high volume commercial production within the next 10 years.
- In developing countries, expand the efforts of multilateral and bilateral aid organisations to accelerate the deployment of mature and competitive solar heating and cooling technologies, addressing both economic and non-economic barriers.

Solar water heating capacities (GW_{th})

	OECD America	OECD Europe	OECD Pacific	China	India	Other developing Asia	Economies in transition	Africa and Middle East	Latin America	World
2020	60	51	27	245	5	98	1	66	37	**590**
2030	134	121	60	422	15	270	3	190	81	**1 297**
2050	242	235	100	601	30	611	6	535	133	**2 492**

Solar space heating capacities (GW_{th})

	OECD America	OECD Europe	OECD Pacific	China	India	Other developing Asia	Economies in transition	Africa and Middle East	Latin America	World
2020	96	75	7	17	0	13	18	5	3	**233**
2030	193	156	16	48	0	34	40	13	7	**507**
2050	350	269	32	99	1	89	80	34	17	**971**

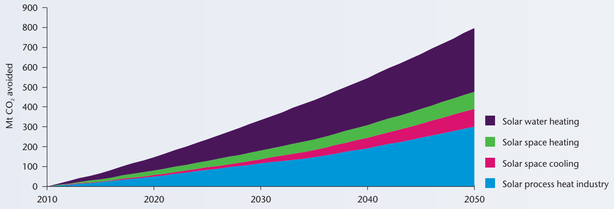
Solar process heat (industry) capacities (GW_{th})

	OECD America	OECD Europe	OECD Pacific	China	India	Other developing Asia	Economies in transition	Africa and Middle East	Latin America	World
2020	93	41	23	179	37	35	3	30	93	**534**
2030	225	118	65	435	73	80	5	63	198	**1 262**
2050	437	344	175	1125	198	248	31	160	510	**3 228**

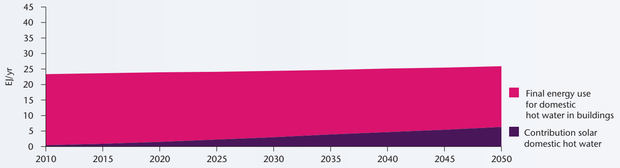
Solar space cooling capacities ($GW_{cooling}$)

	OECD America	OECD Europe	OECD Pacific	China	India	Other developing Asia	Economies in transition	Africa and Middle East	Latin America	World
2020	15	5	3	13	0	3	1	4	3	**47**
2030	36	13	6	55	2	10	3	15	9	**150**
2050	79	28	12	341	42	38	8	56	28	**631**

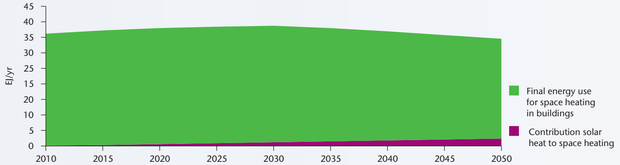
CO_2 emission savings from solar heating and cooling compared to a business as usual scenario (6 DS Scenario)



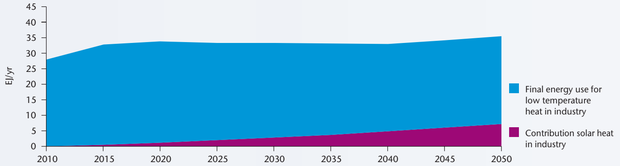
Roadmap vision for solar hot water in buildings in relation to total final energy use for domestic hot water (*ETP 2012* 2DS)



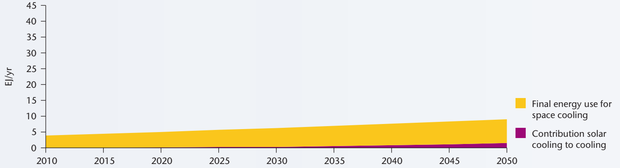
Roadmap vision for solar space heating in buildings in relation to total final energy use for space heating (*ETP 2012* 2DS)



Roadmap vision for solar process heat in low temperature heat industry in relation to total final energy use for heat (*ETP 2012* 2DS)



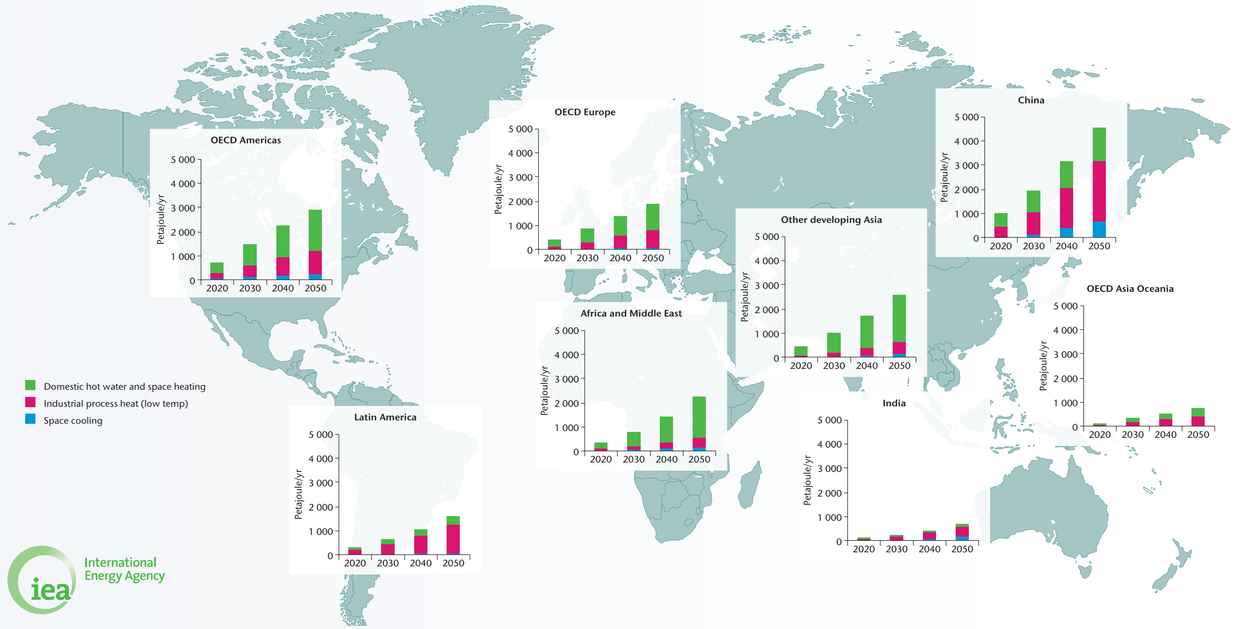
Roadmap vision for solar space cooling in total final energy use for space cooling (*ETP 2012* 2DS)



ROADMAP INSIGHTS

Solar Heating and Cooling

Regional solar heating and cooling generation in the buildings sector and industry



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