

The Netherlands' Solar Heat Roadmap Looks Towards 2050



Being a northwestern European country with a temperate maritime climate, the Netherlands spends a considerable share of its energy to heat buildings. Of the 6,000 PJ consumed overall on a yearly basis, 500 PJ is used as heat for the built environment, most of which is produced using natural gas. As part of the commitments made in the Paris Climate Agreement, the Dutch government plans to phase out the use of natural gas in the built environment by 2050.

This ambitious target creates ample opportunities for other, cleaner energy sources, one of which may be solar heat. Solar heat production in the Netherlands currently amounts to just over 1 PJ, or just 0.2% of total heat demand in the built environment. Still, there seems to be an enormous potential to increase its use and develop it into a competitive technology, particularly for low-temperature applications such as hot water heating and space heating in the building sector.

To determine this potential, as well as the obstacles facing solar thermal energy, the Dutch Ministry of Economic Affairs and Climate and the Netherlands Enterprise Energy (RVO) in the summer of 2020 commissioned the Initiative for a Solar Heat Roadmap. Researchers at TNO, the Netherlands Organization for Applied Scientific Research, carried out the study and concluded that in 2050, solar heat would be a competitive standard technology for hot water and space heating in the built environment. This preliminary study was carried out in close cooperation with the solar trade association, Holland Solar, which plans to produce a solar heat roadmap together with the government and the business community at the beginning of 2021. This roadmap will include a comprehensive strategy for realizing the full potential of solar heat.

According to TNO, solar heat's potential is considerable across all sectors – buildings (residential and non-residential), agriculture and industry. The potential solar heat contribution for 2050 is projected to be 80 PJs, or 80% of the estimated total Dutch heat demand in that year.

To reach this target will take significant effort and change in focus. In the Netherlands, solar thermal hasn't seen the rapid growth of PV, biomass and offshore wind over recent years. In the Regional Energy Strategies defined by 30 regions in the Netherlands, solar heat is only mentioned in the margin.

Based on the preliminary study, the researchers make a series of recommendations:

- It is expected that solar heat can become a cost-effective part of the heat transition.
- Entrepreneurs should take responsibility for preparing and implementing the roadmap.
- A unified strategy for the development of solar is needed, including a timeline with clear milestones.
- Solar heat will need to contribute cost-effectively to sustainable energy production and natural gas-free neighborhoods.
- The roadmap should look closely at costs compared to other sustainable technologies.

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▲ **The largest solar thermal system in the Netherlands is for heating the Tesselaar Freesia Heerhugowaard greenhouse. The system has 9,300 m² of collectors with two storages, a 30 m³ basement return vessel and a 1,400 m³ storage tank. The overproduction of heat during summer is stored in the soil.** (Source: G2 Energy)

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Potential for solar thermal in 2050, with and without heat storage		Potential (PJ) in 2050	
		without heat storage	with heat storage
Dwellings	Individual systems	25.1	34.3
	In existing heat networks	0.4	0.9
	In new heat networks	9.5	18.8
	Subtotal dwellings	35	54
	<i>Share solar thermal in total heat demand</i>	17%	26%
Services	Swimming pools, nursing homes, hotels	10	10
Agriculture	Horticulture, cattle breeding	3	3
Industry	Food industry	12	12
All Sectors	Total (rounded figures)	60	80
	<i>Share solar thermal in total heat demand</i>	8%	10%

According to TNO, a strong commitment is required from industry in the solar heating sector, but also the government. Long-term cooperation between these two parties, complemented by research institutes and civil society organizations, is necessary to initiate change and achieve the targets.

The TNO researchers also identified various bottlenecks to the further development of solar heat.

- **Communication strategies.** Solar heat is often unknown to the public and absent in communication about the energy transition.
- **R&D at the producer level.** Technological innovation is necessary for price reduction and new concept development.
- **R&D at the scientific level.** Technical challenges with seasonal heat storage, integration into heat networks and building integration at the system level.
- **Strategies at the economic, political and market level.** Cost reduction to make competitive with natural gas. Comparison with other energy concepts for fossil-free neighborhoods should take place within comparable system boundaries. Solar heat is supported by subsidy schemes, but the overall effectiveness is insufficient. Integration of solar heat into heat networks requires the right regulation and policy.

According to the TNO researchers, three product-market combinations have the greatest potential in the built environment:



▲ The 7,000 m2 solar thermal collector field on Zoneiland Almere (Almere Solar Island) is one of the largest of its kind in the world. (Source is Nuon Vattenfall)

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- Solar heat for domestic hot water,
- Solar heat from uncovered collectors (solar thermal or PVT) as a source for heat pumps, ground-coupled heat exchangers, or low-temperature heat networks, and
- Solar heat for medium temperature district heating.

Most present-day heat networks in the Netherlands operate at temperatures too high for a suitable solar heat application. In the framework of the phase-out of natural gas, current and future heat networks are being designed more and more for medium and low-temperature heat. This provides ample opportunity for direct application of solar heat. Combinations with heat pumps or storage may prove useful for higher temperature district heating.

The TNO researchers provide a preliminary outlook for 2025, 2030 and 2050, regarding solar thermal's possible status in those years and the developments required for that purpose:

'By implementing multi-megawatt systems, growth can increase significantly in the short term. Meanwhile, the industry needs to focus on improving domestic systems. By 2025, the industry will have to ensure that solar heat is a serious option for natural gas free neighborhoods, both for individual homes and apartment buildings. After 2025, further cost reductions need to be achieved through targeted innovation, increased efficiency and economies of scale. This will pave the way for the roll-out after 2030, for which integral solar thermal system concepts must become standard. The sector needs to continue to focus on cost reduction and innovation for seasonal heat storage and needs to be active in both the new-build and renovation markets. The image of solar heat will then improve rapidly, and by 2050 solar heat will be a competitive standard technology for domestic hot water and space heating. Other sectors, such as industry, agriculture and horticulture, will also make widespread use of solar thermal'.

Overall, the report provides an optimistic message for solar heat in the Netherlands, as well as in general. The energy transition as a whole needs innovation and new concepts, and so does solar thermal. If the industry manages to decrease solar thermal system prices, then the competitive position of solar heat will continue to improve towards 2050, possibly helped by increasing prices for conventional energy and CO₂ pricing. In the long term, solar heat can thus become a standard and subsidy-free technology. This will require a shared vision on solar heating, in which all parties involved, nationally and preferably also internationally, are serious about achieving its potential.

This article was contributed by Tomas Olejniczak of RVO and the new Dutch Executive Committee member.