OPINION

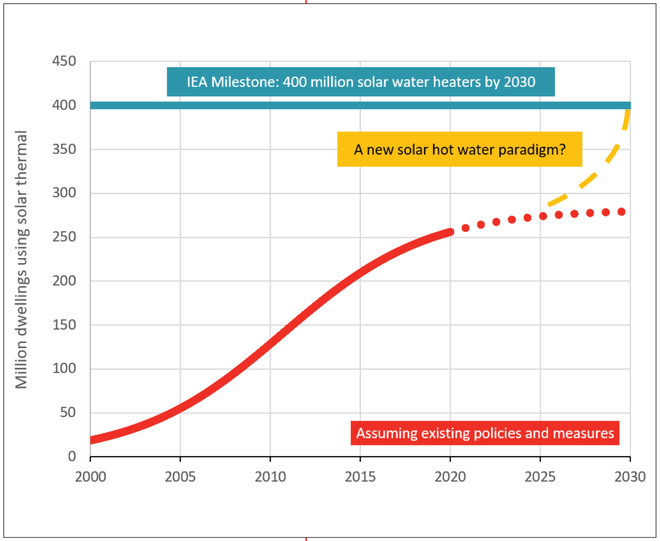
400 Million Residential Solar Water Heaters by 2030

The International Energy Agency (IEA) has provided the solar hot water sector with a clear mission to deploy at least 400 million residential solar systems by 2030. Dr. Richard Hall, a Vice Chair of the Solar Heating and Cooling Programme (SHC), discusses the implications of this new global mission on the structure of the solar thermal sector.

In their flagship Net Zero by 2050: A Roadmap for the Global Energy Sector, the IEA states that to limit the rise in global temperature to 1.5 ºC, we need a "massive deployment of all available clean … energy technologies" and "drastic and immediate technology and policy shifts" to decarbonize buildings. For the solar heating and cooling sector, this means having at least 400 million solar hot water systems in operation by 2030 and 1.2 billion in operation by 2050.

Revival, Stagnation, or the Birth of Rival?

To achieve this milestone, we need to deploy around 300 million solar hot water systems in the 2020s (see graph), although I acknowledge that the exact number is arguable. The reason this number is so high is that many of the rural low-cost thermosyphon systems installed over the past 20 years, which have an assumed operational lifetime of between 10 and 15 years, will be decommissioned by 2030.



Source: *IEA Net Zero by 2050 and SHC Solar Heat Worldwide 2022*

With such an increase in deployment, I find myself wondering how the sector will respond and whether it will be able to meet such high levels of demand. I see three possibilities ahead of us: 1) a revival of solar thermal, with it entering a new growth phase; 2) a stagnation of the sector, with it being unable to meet the demands placed upon it; or 3) the birth of a rival form of solar thermal, based on photovoltaics.

A revival of solar thermal (evacuated tube and flat plate) is certainly a possibility given the demand, but I would argue that we must seriously consider the possibility that solar thermal has already reached technological maturity. The consequence of this would be solar thermal reaching a market share in 2030 that is well below what is required to limit the rise in global temperature to 1.5 °C (the second law of energy-technology deployment) (Kramer and Haigh, 2009). This is not only a problem for the solar sector, but also for the global effort to decarbonize heat. But if a technological breakthrough occurs and a new rival form of solar thermal develops, then there would still be a way to meet these targets.

Urban Solar Hot Water Systems

To date, the rapid growth of solar thermal worldwide can largely be explained by the technological breakthroughs in all-glass evacuated tubes achieved by Tsinghua University, along with the economic, political, and cultural landscape of China in the era following the economic reforms instigated by Deng Xiaoping. Yu and Gibbs (2018) argue that the rural Chinese market between the 1990s and early 2000s provided an 'empty space' for solar thermal diffusion to take hold. But the challenge for the future growth of the market lies in the fact that the urban market is now an 'occupied space.' This

continued on page 9

means that for solar to increase its market share in hot water heating, we now need a technological breakthrough that addresses the "high-end demands of urban markets."

I think we are seeing the emergence of such new urban solar thermal systems in OECD countries like the United Kingdom, the United States, and Australia. In the broadest sense, these systems use photovoltaic power to heat devices, which can come in several forms, such as smart power diverters and smart hot water tanks. For people living in urban areas, these smart consumer devices offer benefits such as being very compact, smartphone-connected, having low capital costs, and being highly reliable. A perceived downside of these devices is that they do not necessarily promote self-sufficiency, often connecting consumers with large-scale renewable power plants. However, as was the case for the rural solar thermosyphon systems, the economic savings and convenience of these new urban solar thermal systems may outweigh concerns for the environment or personal desire to become independent from the grid. And their perceived acceptability may be an important tool in promoting their installation in situations where solar thermal is considered too difficult or disruptive. In this sense, I see the two technologies as being complementary rather than true rivals, with each appealing to slightly different markets, but with their combined efforts achieving our ultimate goal of decarbonization.

Whist these new urban solar thermal systems are seemingly only being deployed in the 10,000s, I believe that this new paradigm of solar thermal could make a significant contribution to meeting the IEA's 400 million residential solar water heaters by 2030 millstone. It must be made clear to Governments that just as the technological breakthroughs by Tsinghua University led to the growth of the evacuated tube collector market, we need strong and well-funded innovation programs to ensure that these 'urban' solar thermal systems enter their growth phases as soon as possible. Challenges such as the current structural shortage of semiconductors, device interoperability, and cyber security will become pressing issues sooner than many people expect.

A Pivotal Task: Solar Hot Water for 2030

There is little doubt that solar will play a major role in the complete decarbonization of heating, cooling, and hot water (Mercure et al., 2021). What is coming into question is which types of solar technologies will dominate the solar heat sector in the 2030 to 2050 period. Figuring out the answer to this question, which will not only be technical, but will have broader economic, political, and cultural dimensions, must be at the core of our work within the IEA Solar Heating and Cooling Programme.

This is why I think the new SHC Programme's Task 69 on Solar Hot Water for 2030 is potentially one of the most important Tasks the SHC has ever undertaken. Encompassing both solar thermosyphon systems and photovoltaic power to heat devices, the work being undertaken within the guiding framework of SHC Task 69 will provide the sector with the knowledge and skills to effortlessly pivot between the two solar worlds. If SHC Task 69 is not successful, then I fear the real possibility of the sector missing, by a significant margin, the IEA's 2030 millstone. Not meeting the milestone will not only diminish the relevance of the SHC Programme in the eyes of the IEA but will contribute to the world being on a disaster course of 3°C of global heating.

References

Mercure, J.-F. et al. (2021) 'Reframing incentives for climate policy action,' Nature Energy, 6(12), pp. 1133–1143. doi:10.1038/s41560-021-00934-2.

Yu, Z. and Gibbs, D. (2018) 'Encircling cities from rural areas? Barriers to the diffusion of solar water heaters in China's urban market', Energy Policy, 115, pp. 366–373. doi:10.1016/j.enpol. 2018.01.041.

Kramer, G.J. and Haigh, M. (2009) 'No quick switch to low-carbon energy,' Nature, 462(7273), pp. 568–569. doi:10.1038/462568a.