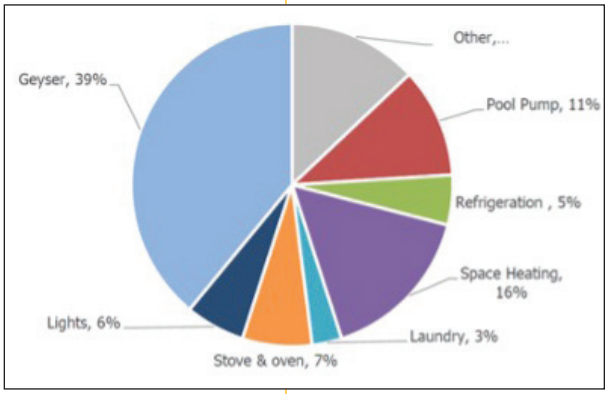
PV2heat in South Africa — Almost 12,000 Systems Installed

Through the SOLTRAIN project, coordinated by AEE INTEC and funded by the Austrian Development Agency, the Center for Renewable and Sustainable Energy Studies (CRSES) at Stellenbosch University in South Africa has been collecting data on PV2heat installations in South Africa since 2018.

PV2heat systems are a technology entering the market with little fanfare but great potential. One country where this technology is gaining in popularity is South Africa. Solar thermal collectors (both flat plates and evacuated tube technologies) and heat pumps historically dominated the market for sustainable hot water preparation, but now there is a trend towards heating water directly with electricity from solar photovoltaic (PV) technologies. These systems, referred to as PV2heat, consist of PV modules directly connected to an electrical element that heats the water with DC power without the need for inverters. The system also usually includes an AC element connected to the electricity grid to heat the water when the sun is not shining.



▲ **Figure 1. Residential electricity load in South Africa.** (South Africa Geyser: Cost-Efficiency Technical Study, 2014.)

The falling cost of solar technologies, increasing cost of electricity, abundant sunshine, and regulations mandating more sustainable hot water heating are steadily moving the South African hot water market away from traditional water heating methods to electrical elements using electricity from the grid.

As recent as 2014, the residential sector in South Africa accounted for 17% of the country's electricity load, increasing to 35% during peak consumption periods. Considering that 39% of the electricity use of middle- and high-income households is used to heat water, switching to non-fossil fuel alternatives for hot water could significantly reduce the country's carbon emissions.

The growth in the installation of PV2heat technologies is in some ways fueled by their simpler installation, only requiring wiring from the panels to the tank instead of insulated pipes, as is the case with traditional solar water heaters. The hot water tank also can be installed much closer to the taps, resulting in a shorter wait time for the flow of hot water. However, the greatest incentive for installing these systems is the mandated regulation that stipulates that not more than 50% of the annual hot water volume consumed in households be heated by fossil fuel-derived energy. This 50% requirement is deemed to be 100 liters of hot water tank size per bedroom per residence. There is no "deemed to be" interpretation for a PV2heat system yet, allowing for the installation of systems with a lower solar energy yield at an obviously reduced cost.

PV2heat systems do have some disadvantages compared to conventional solar thermal collectors—PV panels require approximately 3–4 times the roof area to install the same thermal capacity as conventional solar thermal collectors and present a higher risk of theft.

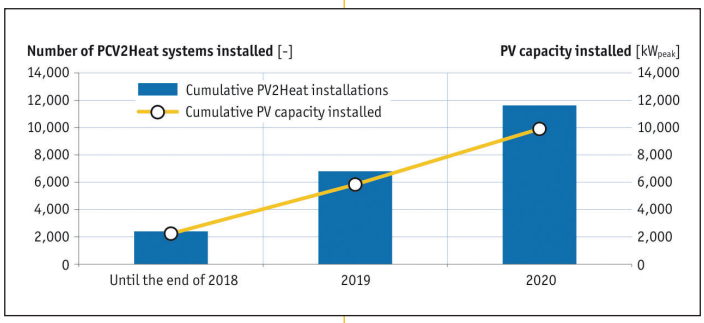
Although the country currently has no testing standards for PV2heat technologies, most municipalities allow for the installation of locally supplied PV2heat technologies. There is, however, some resistance towards this technology and its ability to comply with national building regulations.

At the end of 2018, there were an estimated 2,400 PV2heat systems installed in the country, and by December 2020, approximately 11,700 systems with an estimated total PV capacity of 9,869 kWp, with an average PV capacity of roughly 850 Wp of PV per system (see Figure 2).

continued on page 19

The technical capabilities of locally available PV2heat products indicate that most, if not all, are installed within the residential sector for domestic hot water. And it is assumed that most of these installations are in new buildings, but it is impossible to say this with certainty with the available data. However, through observation, it can be confirmed that PV2heat systems are being installed in multi-story housing developments (apartment complexes), semi-detached houses, terraced houses, and single-family houses, mostly for middle- to high-income households.

The degree to which PV2heat technologies are being used to retrofit existing geysers would be interesting to quantify since these technologies provide a unique degree of simplicity for integration into existing hot water tanks compared to solar water heating systems. However, it is expected that a larger percentage of PV2heat installations are in new building developments since their uptake is primarily driven by the previously mentioned regulations.



▲ **Figure 2. PV2heat installations and capacity in South Africa.** (Solar Heat Worldwide, 2021 edition)

In South Africa, there are several local suppliers and distributors of PV2heat technologies and "off-the-shelf" PV2heat solutions. All of these suppliers have contributed to the understanding of the local market and installation numbers presented in this article. Another contributing factor to the noticeable rise of PV2heat installations over recent years is that companies supplying and distributing these products have all been involved in the South African hot water market for many years, so they know the market very well.

The electrical elements for PV2heat systems in South Africa are rated anywhere between 900 W to 4 kW (DC) and are integrated with storage volumes ranging from 100–300 liters. Local distributors recommend using PV capacities ranging between 0.5–4 kWp, depending on the element size and type, geyser volume, annual solar radiation in the area, as well as the specific daily hot water demand of the respective household. In essence, sizing of PV capacities can vary depending on the installer, hot water storage volume, solar radiation in the region, element size, and the desired percentage contribution of solar energy throughout the year. On average, 900W DC/2kW AC PTC elements made up more than half of the PV2heat installations in South Africa at the end of 2020.

Although the number of PV2heat systems is showing rapid growth in South Africa, it has yet to take off in other markets. Nevertheless, this emerging technology shows significant promise for sustainable hot water preparation in the residential sector, despite not receiving the same amount of attention as solar thermal heating and heat pumps. With the appropriate standards in place, correct exposure, capacity building, and other initiatives, PV2heat technologies could provide a cost-competitive, sustainable hot water solution for South Africa and the world.

Article contributed by the SOLTRAIN partners Angelo Buckley and Karin Kritzinger of CRES, and Werner Weiss of AEE INTEC and the Austrian IEA SHC Executive Committee representative.

References

South Africa Geyser: Cost -Efficiency Technical Study, 2014. Lawrence Berkeley National Laboratory, Unlimited Energy and Stellenbosch University.

SANS 10400-XA Energy usage in buildings: A homeowner's guide to compliance in home design. Sustainability Institute.