

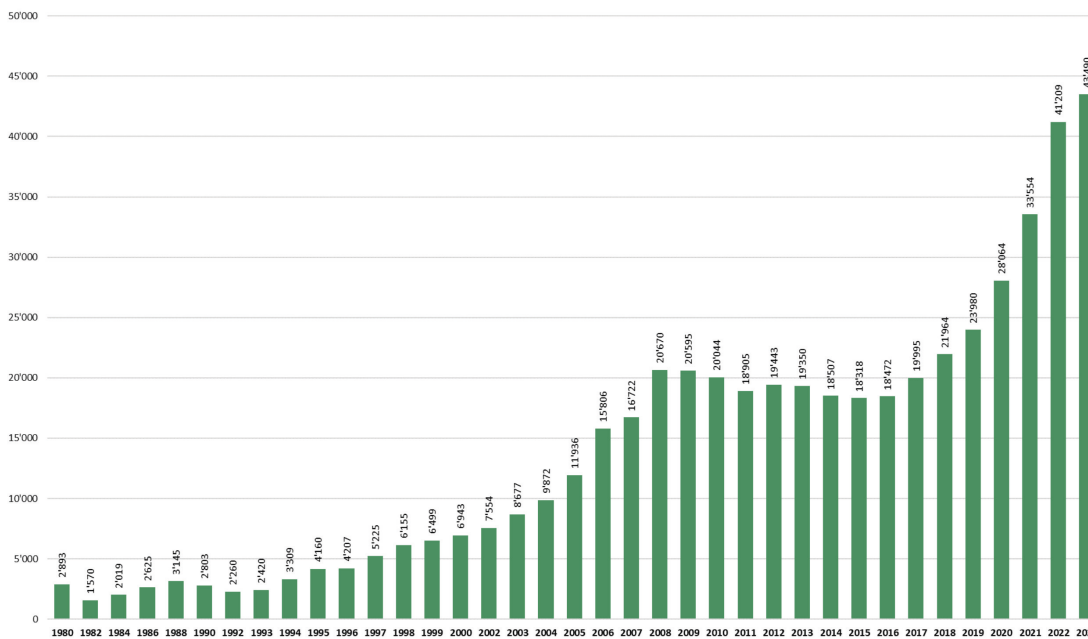
# HEAT PUMPS SHOW THEIR MUSCLE

Of the 43,000 heat pumps sold in Switzerland last year, almost 90% have an output of less than 20 kW, which is typically required for a detached or semi-detached house. In addition, already in use are high-performance heat pumps that supply apartment buildings with heat and industrial plants with process heat. This was made clear at the annual heat pump conference of the Swiss Federal Office of Energy in Bern at the end of June 2024.



Case study "Daru" from the University of Geneva: Six 31 kW air-to-water heat pumps were installed on the roof of an unrenovated residential building built in 1992. They cover about 70% of the building's heating requirements. Photo: UNIGE

## Sales of heat pumps in Switzerland per year



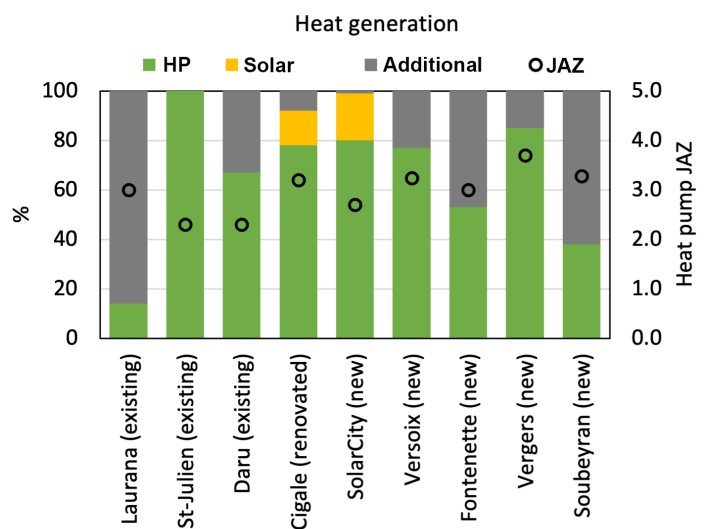
Although the number of heat pumps sold in Switzerland increased in 2023, sales figures have been declining since Q4 2023. Graphic: FWS

Last year, more heat pumps were sold in Switzerland than ever before. More than 43,000 units for generating heat and hot water from environmental heat were sold in 2023, 7% more than in the previous year. Despite this success story, Alexandra Märki, Managing Director of the Switzerland Heat Pumps Association (FWS), is not entirely satisfied. The strong growth in sales in recent years seems to have slowed since the 4th quarter of 2023. Märki noted a "slump in sales figures," which is partly due to high mortgage interest rates, she explained at the SFOE conference on heat pump research, which took place for the first time in Bern at the end of June 2024 for the 30th edition (not in Burgdorf as in previous years).

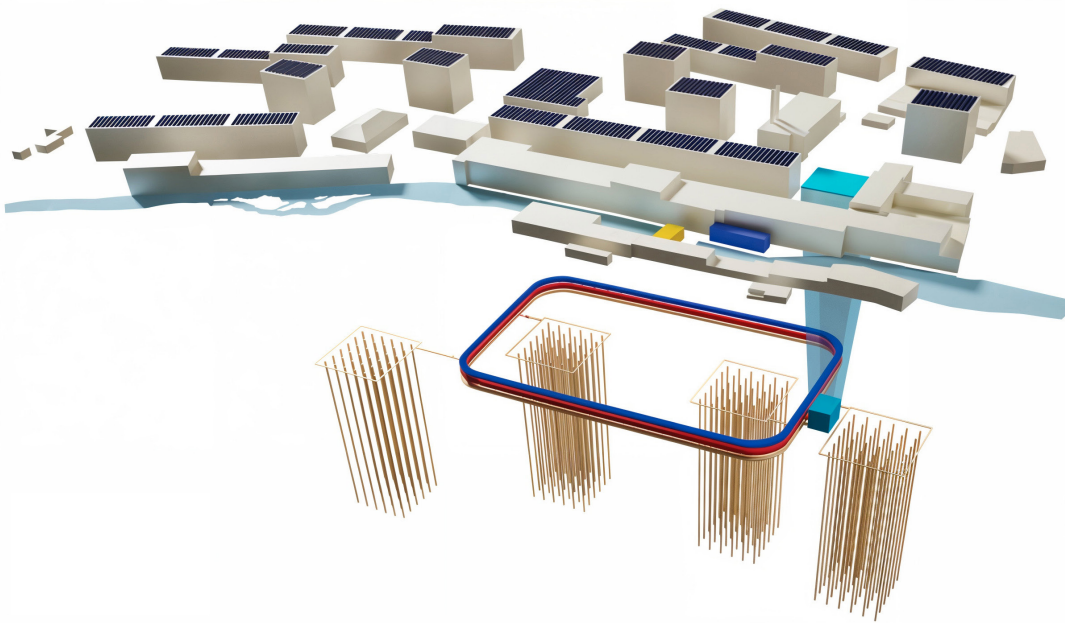
Despite this downturn, the boom in heat pumps is likely to continue in the medium term. One could also say that it must continue, because heat pumps are a "key technology for the decarbonization of the building sector," as SFOE Deputy Director Pascal Previdoli says. If Switzerland is to become climate-neutral by 2050, the number of heat pumps must increase fivefold to 1.5 million over the next 25 years. It is important to note that heat pumps should not only become the dominant heating technology in the residential sector, but should also become increasingly widespread in the service and industrial sectors. They are also of great importance in the production of heat for district heating networks.

### Geneva supplies apartment buildings

Today, the majority of small heat pumps sold are those with an output of less than 20 kW, which are tailored to the needs of detached and semi-detached houses. However, environmental heat (outside air, soil, rivers and lakes, groundwater) can also be captured on a much larger scale, to heat apart-



Heat production in nine apartment buildings studied by the University of Geneva is largely provided by heat pumps (highlighted in green in the graphic). The heat pumps operate with a measured annual performance factor of between 2.3 (for existing, non-renovated buildings) and 3.7 (for a new residential development). Graphic: UNIGE



Visualization of the Papieri site in Cham. Here, 1,000 apartments and 1,000 jobs are to be built on a 170,000 m<sup>2</sup> site by 2035. The buildings are heated by heat pumps that use the ground (geothermal probes) and river water as heat sources. Graphic: AWIAG

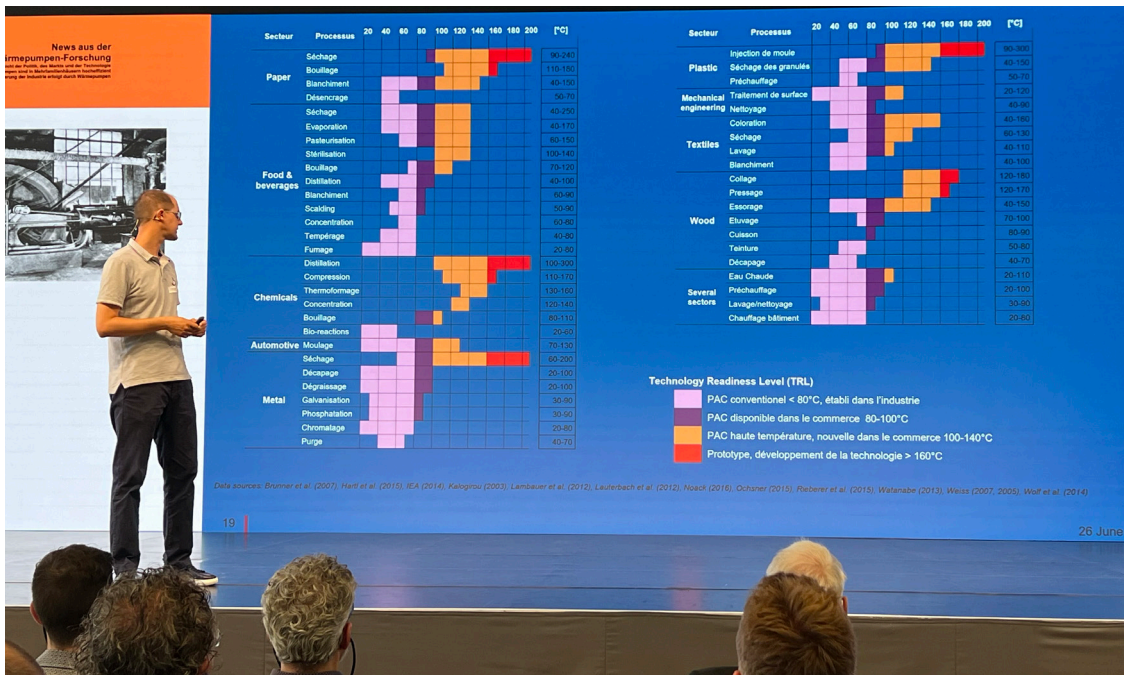
ment buildings, for example. At the heat pump conference, a team of researchers from the University of Geneva presented results of a study of nine Geneva buildings that are supplied by heat pumps. These heat pumps have outputs of 30 to 5,000 kW and cover 50 to 100% of the heat requirements of existing and new buildings in most cases. Gas boilers and sometimes solar heat are used for the remaining heat requirements, Simon Callegari, a scientist at the University of Geneva, said in Bern. With this study, Simon Callegari is contributing to Annex 62 “Heat Pumps for Multi-Family Residential Buildings in Cities” of the IEA Technology Collaboration Programme on Heat Pumping Technologies (IEA HPT TCP).

Heat pumps are also powerful enough to supply heat to office buildings and high-rise buildings. On the Papieri site in Cham, a new development with 1,000 apartments and 1,000 jobs will be built in stages by 2035 – heating requirements will be covered solely by heat pumps. When complete, it will be supplied with heat from a field containing 192 geothermal probes, which will be drilled 320 meters deep, and environmental heat from a river. “With the addition of photovoltaic roof areas, the development will be able to meet 75% of its own energy needs and the energy required for heating and cooling will be completely renewable. A plus-energy balance for the large buildings, or even the entire district, is challenging, but is an ambitious goal,” says Carsten Wemhöner from the Eastern Switzerland University of Applied Sciences, which is providing scientific support for the project. The project is part of Annex 62 «Heat Pumps in Positive Energy Dist-

riets» of the IEA HPT TCP, which is led by Carsten Wemhöner. Beat Wellig from the Lucerne University of Applied Sciences reported in Bern on an office and commercial building in St. Gallen that is heated by a heat pump with a COP of over 10 and cooled by a COP of 50. This exceptional efficiency is achieved by a specially designed low temperature-lift heat pump that operates with high source temperatures (11 to 13 °C) and a low heating flow temperature (26 °C). This low



This office and commercial building in St. Gallen, built in 1981 and renovated in 2013, was equipped with a low-stroke heat pump in 2023 that provides hot water with a temperature of 26 °C. Eight geothermal probes with a depth of 280 m are used as a heat source or for cooling the building. The heat pump works with a COP of 10 and more. The heating of 100 m<sup>2</sup> of building area only consumes as much electricity as a 40-watt light bulb, explained Beat Wellig from the Lucerne University of Applied Sciences in a vivid comparison. Graphic: Mettiss AG



Frédéric Bless from the Institute of Energy Systems at the University of Applied Sciences in Eastern Switzerland showed in Bern for which heat pumps are available today for various industrial processes and process temperatures. Photo: B. Vogel

flow temperature is sufficient because the heat in the rooms is transferred to the air using convectors.

### Funds to decarbonize industry

Cordin Arpagaus, an expert in high-temperature heat pumps at the Eastern Switzerland University of Applied Sciences (OST), has investigated the spread of large heat pumps (>100 kW output) utilized in industry and district heating networks. Cordin Arpagaus is also involved in Annex 58 High-Temperature Heat Pumps, of the IEA HPT TCP, where

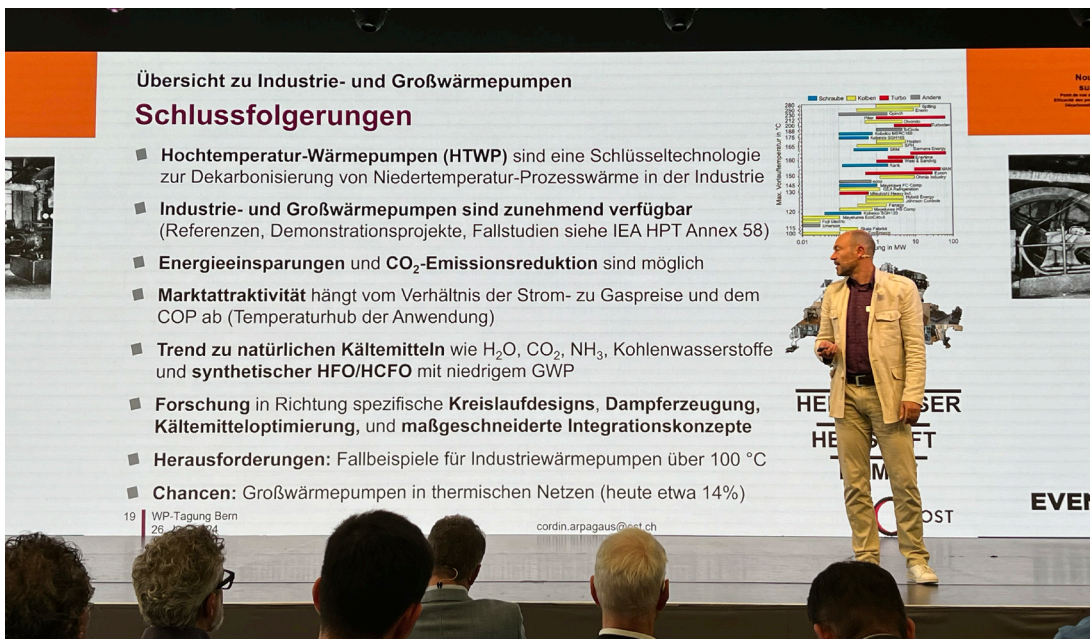
he heads task 2 "Integration Concepts". In Switzerland, 150 to 300 units have been sold in recent years – a low number considering that this performance range has great decarbonization potential. However, the range of high-temperature heat pumps on the market has doubled in the last six years. The devices usually use waste heat as a heat source and provide process heat. There is particularly high demand for this in the chemical/pharmaceutical, food and paper industries, as well as for the supply of district heating networks. According to a survey conducted in spring 2024, only 14% of thermal



At the Institute of Energy Systems (IES) at the Eastern Switzerland University of Applied Sciences (Buchs/SG site), a steam-generating heat pump (100 kW) is currently being developed as part of an Innosuisse project, which is intended to provide up to 148 degrees of steam for industrial processes (180 kg/h). Butane is used as a refrigerant; the turbo compressor compresses water vapor and is based on an oil-free gas bearing. Photo: OST IES

## PINCH ANALYSIS

If heat pumps are to be used in industrial plants, the heating and cooling requirements, including the actual process temperatures required, should be carefully examined beforehand by means of pinch analysis. Otherwise, there is a risk that heat pumps will be used as "electric heating" in the worst case or with unnecessary energy losses or low Coefficient of performance (COP), emphasized Beat Wellig from the Lucerne University of Applied Sciences at the heat pump conference in Bern. Using the example of a dairy, Wellig showed that 75% of the energy requirements in such a facility can be covered by heat below 100 °C, which means that only relatively little process steam must be provided. In the case studied, this can reduce exergy losses by up to 46% and CO<sub>2</sub> emissions by up to 66%.



In a study, Cordin Arpagaus presents an overview of the stock of industrial and large heat pumps in Switzerland. Photo: B. Vogel

networks in Switzerland currently obtain their heat from large heat pumps.

Heat pumps can save up to 80% of energy used in industry and reduce CO<sub>2</sub> emissions by up to 90%, as OST researchers have shown with examples. For Cordin Arpagaus, there is still huge potential for large-scale heat pumps: “In order to exploit this, cheaper electricity must become available. We also need engineers who can integrate such devices into existing processes. And funding measures are needed to bring this technology into widespread application, such as subsidies for heat pumps with more than 70 kW, which is planned for 2025.” The majority of large heat pumps already use natural refrigerants. They are thus leading the way in a trend that is still barely noticeable for smaller heat pumps.

### Best practice example from industry

At the Bern conference, a number heat pump research projects were presented that have been carried out with the support of the SFOE, some are still ongoing. Among other things, they involve exemplary applications of high-performance heat pumps, for example in a meat factory, a beer brewery, a milk processing plant or a factory that produces vegan cheese. In his introductory keynote speech, Reinhard Radermacher, Professor at the University of Maryland in the U.S. encouraged the researchers present at the conference not to rest on their laurels. He advocated for new inventive spirit to make heat pumps even more compact, efficient and user-friendly.

In addition to technical issues, regulatory aspects are also important for the spread of large heat pumps in the building sector. In this context, Pierre Christe, heat pump expert at the SFOE, announced that discussions are currently underway to extend the performance guarantee, – it currently only applies to the installation of small heat pumps (up to 15 kW of power)– to large systems. He also informed about the current work on the revision of the Water Protection Ordinance with the aim of creating adequate framework conditions for seasonal heat storage in the ground and especially in groundwater. This development is particularly important for heating networks in order to promote the use of heat pumps and long-term storage systems in the planning of district heating networks.

- The printed **documentation** of the 30th conference of the Swiss Federal Office of Energy's “Heat Pumps and Refrigeration Technology research program” can be purchased at [info@fws.ch](mailto:info@fws.ch).
- **Information** can be obtained from Stephan Renz ([info@renzconsulting.ch](mailto:info@renzconsulting.ch)), external head of the SFOE's Heat Pumps and Refrigeration research program.
- Further **technical articles** on research, pilot, demonstration and flagship projects in the field of heat pumps and cooling at: [www.bfe.admin.ch/ec-wp-kaelte](http://www.bfe.admin.ch/ec-wp-kaelte)