# Heat Pump Market Development in Switzerland

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**Switzerland has been a pioneer in the development and commercialization of heat pumps. Until the 1980s, mainly large heat pumps were sold. Since the 1990s, the availability of reliable and efficient small devices as well as environmental aspects have been driving forces. In a ten-year period from 2007 onwards, almost 20,000 units were sold year after year. Since 2018, sales have risen again, reaching 23,980 units in 2019. Of these, 85% are small systems up to 20 kW heating capacity for single-family homes. Future challenges lie in the retrofitting of heat pumps in existing multi-family buildings and in office buildings in urban environments.**

## Introduction

Renewable energy sources and energy efficiency are pillars of the Energy Strategy 2050, which guides the way towards a sustainable transformation of the Swiss energy supply. Heat pumps play an important role in this process. The sales figures for heat pumps in Switzerland were constant for a long time, but have now been rising for two years in a row. This article provides background to this development.

## History

Swiss technology pioneers were the first to construct vapour recompression plants [1]. Probably stimulated by the experiments of Peter von Rittinger at Ebensee, the first truly functioning vapor recompression salt plant was developed in Switzerland and put in operation in 1878 at the salt works at Bex. It was the first heat pump in Switzerland (Figure 1).

Until the 1930s, industrial chillers in sizes up to several megawatts were the primary applications of heat pumping technology in Switzerland. Before and during the Second World War, Switzerland experienced a severe coal supply shortage. This stimulated the construction of more hydroelectric power plants and a rational use of hydroelectricity, the so called "Swiss White Coal".

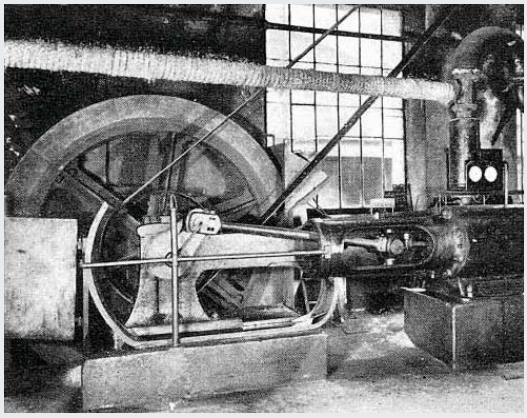

*Fig. 1: Compressor installed at the Saline Bex in 1878 [1]*

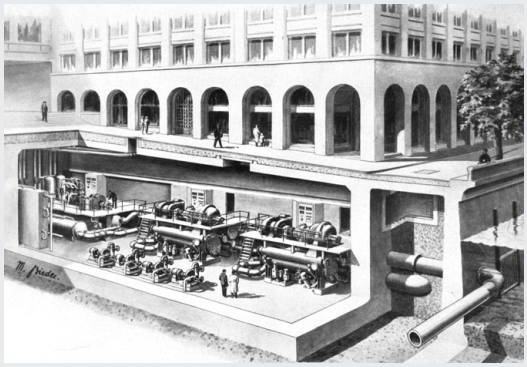

*Fig. 2: 5.86 MW heat pump plant at Walche, 1942 [1]*

Advanced mechanical and thermal engineering skills allowed Switzerland to become a heat pump pioneering country. Between 1938 and 1945, 35 large heat pumps were manufactured and installed in Switzerland, by companies such as Sulzer in Winterthur, Escher Wyss in Zurich and Brown Boveri in Baden. These heat pumps were used for space heating, but also for other low temperature heating purposes (e.g. domestic hot water, water in a public swimming pools). The main heat sources were lake water, river water, ground water and waste heat. Exploiting waste heat from cooling at skating rinks and breweries was practiced already in the 1930s. After the Second World War heat pumps remained important. In 1955, there were about 60 large heat pumps in Switzerland, the biggest of them reaching 5.86 MW (Figure 2).

To date, Switzerland remains a heat pump champion. The country's pioneering work in the development of borehole heat exchangers, sewage heat recovery, oil free piston compressors and turbo compressors is well known. Some of the biggest heat pumps ever built comes from Switzerland. Although there is a rather large natural gas distribution grid, 90% of new single-family homes in Switzerland in 2019 were equipped with heat pumps. Recent developments in the Swiss heat pump market are discussed in the Market Overview further below.

## Policy and drivers

*Federal policy and laws*
Swiss energy policy is characterized by two fundamental drivers: phasing out of nuclear energy and reducing greenhouse gas emissions. The challenge is to achieve these objectives while maintaining security of supply at affordable costs. The core measures of the revised Energy Act [2], in force since 2017, are therefore to withdraw step by step from the use of nuclear energy, to reduce electricity consumption, and an expansion of hydropower and new renewable energy sources.

Climate change discussions worldwide and local youth movements such as "Fridays for Future" had tangible impacts on the Swiss parliamentary elections in autumn 2019 when Green party candidates won numerous seats. Several cities and cantons declared state of climate emergency. Furthermore, the Federal Council decided in August 2019 to reduce Switzerland's net carbon emissions to zero by 2050. The new parliament is expected to pass a revised $CO_2$ Act soon, in which the $CO_2$ tax could be massively increased from today's CHF 96/tonne $CO_2$ to CHF 210/tonne $CO_2$ (1 CHF = 0.97 USD). And after 2030, the installation of new boilers with fossil fuels could be largely banned if $CO_2$-emissions of the building sector will not have been cut in half compared to 1990.

One way to achieve these objectives is to replace outdated heating systems within the scope of building renovations. As forecast in 2019, around 900,000 fossil-fuelled heating systems will need to be overhauled or replaced by 2050, which presents a huge opportunity for heat pump technologies [3].

*Energy-legislation at cantonal level*
Legislation for buildings is the responsibility of the cantons. In order to standardize energy legislation in the 26 cantons in Switzerland, their energy ministers have drawn up a model template [4]. In this act, heat pumps are a preferred solution for heat generation. As cantonal parliaments are in charge of updates to the existing building regulations, they decide whether to deviate from the model template and, for example, demand lower or higher energy efficiency. After the parliamentary decision, citizens are free to demand a popular vote on the new bill. Figure 3 shows where a revised energy law was rejected (red) and where it is in force (dark green). Clearly, the status of implementation varies greatly between the cantons.

*Incentives*
Each canton also decides on their own subsidies for energy efficiency measures. The amount of subsidies varies widely. Some cantons make a minimum amount of CHF 2000 available for heat pumps, whereas the canton of Basel-Stadt offers maximum contributions per installed heating capacity of 10 kW: CHF 10,500 towards expenses for air-to-water heat pumps or CHF 30,000 for brine-to-water heat pumps.

## Market overview

After two decades of stagnation, the heat pump market was reinvigorated during the oil crises in 1973 and 1979. The development of smaller heat pumps for central water heating systems in single-family homes and larger residential buildings began. Between the 1980s and the mid-1990s, around 2000 - 3000 heat pumps were sold in Switzerland each year. Establishing the Swiss Association for the Promotion of Heat Pumps (FWS) in 1993 contributed to the success. Its tasks include the provision of information and advice, education and training, advocacy and quality assurance [3]. Sales rose rapidly in the mid-1990s and reached a first peak in 2007 with 20,670 units. In 2018 sales numbers rose again and in 2019 a new record of 23,980 units sold was reached (Figure 4). Please note that these and the following statistics do not include hot water heat pumps (6071 units sold in 2018), large heat pumps, e.g. in district heating applications or custom-made products for the industry.

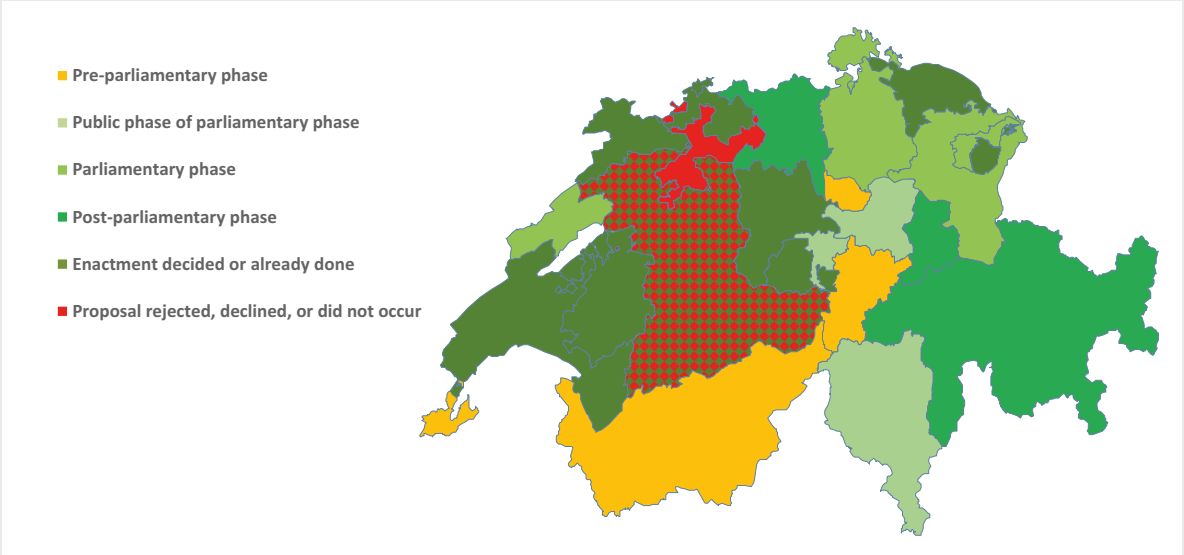


*Fig. 3: Status of revisions to energy legislation in the 26 cantons in Switzerland [4]*

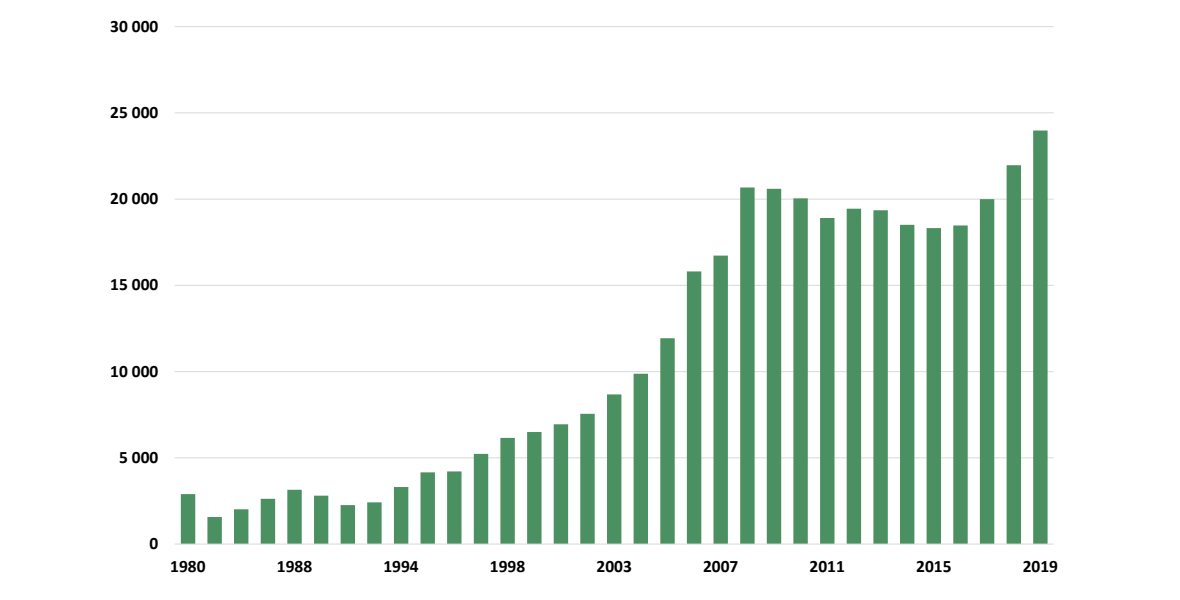


*Fig. 4: Sales figures for heat pumps per year in the Swiss market [5]*

71% of the heat pumps sold rely on air as a heat source and 28% on brine (figure 5). Ten years ago, the share of air-to-water heat pumps was only 59%. Heat pumps account for a very high proportion in the number of heating systems sold annually in Switzerland. In 2019, the figure was 40% (Figure 6).

Further analysis of sales figures shows that a large number of small heat pumps were sold. 85% of the units has an output of less than 20 kW (Figure 7). In the future, larger heat pump systems will need to be installed to effectively displace heating systems that rely on fossil fuels.

When multiplying the number of newly installed heating systems with the capacity of the units sold, it becomes clear that gas and oil dominate in the larger output categories (Figure 8). Cumulated numbers show that fossil fuel-based heating systems still cover a much larger share (1390 MW) of the heat supply than heat pumps (400 MW). The data points to the major challenge of introducing heat pumps in new and existing multi-family buildings and office buildings, especially in urban environments. [6, 7]

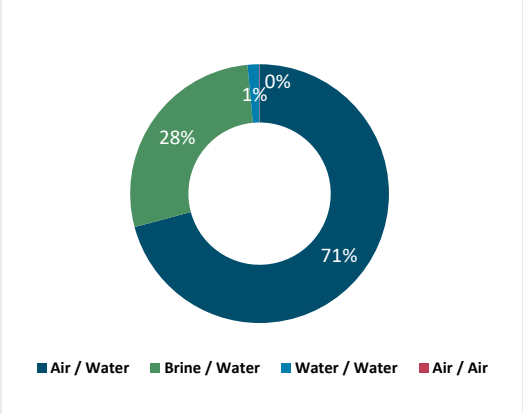


*Fig. 5: Percentage distribution of heat pump sales by energy source in the Swiss market for 2019, [5]*

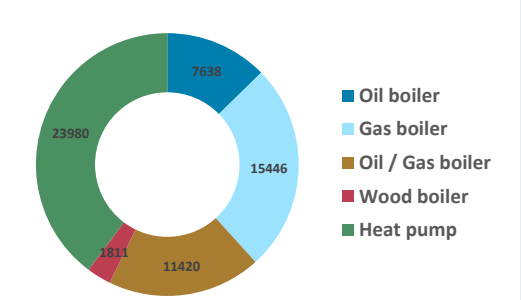


*Fig. 6: Sales figures for heat generation units and oil/ gas burners in the Swiss market for 2019 [5]*

## Conclusions

Fossil fuels have been a driver for the development and sales of heat pumps in Switzerland, although in different ways: In the past, there were supply bottlenecks, and today it is the demand for decarbonisation of the energy system. In order to further promote heat pump sales, appropriate energy and environmental laws as well as incentives are needed.

Recent developments in energy policy had a favourable impact on heat pump sales figures. Compared to the previous year, sales increased by about 10% in 2019. To replace all fossil-fuelled heating systems by 2050, around 40,000 heat pumps would have to be installed each year, a two-fold increase compared to the last decade.

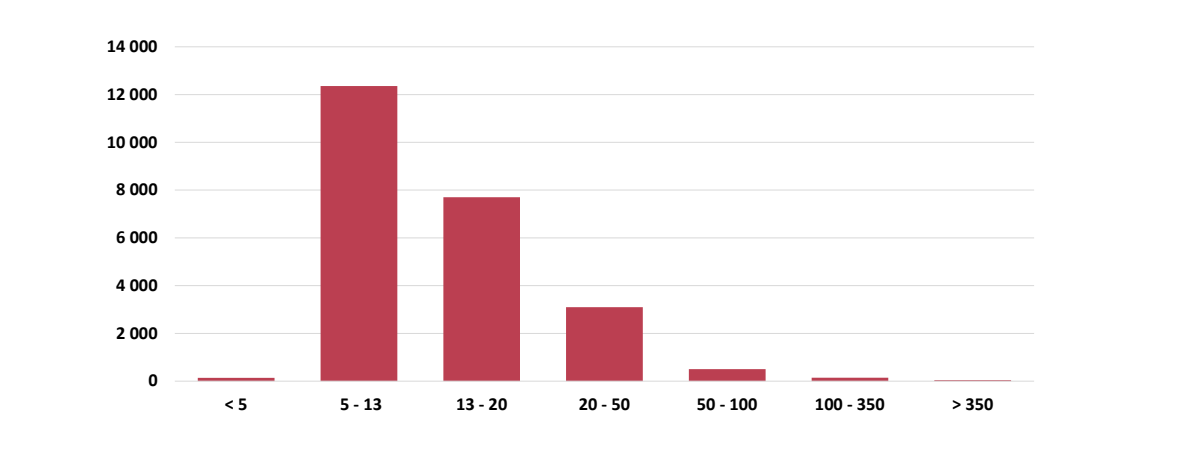


*Fig. 7: Heat pump sales by power in kW in the Swiss market for 2019 [5]*

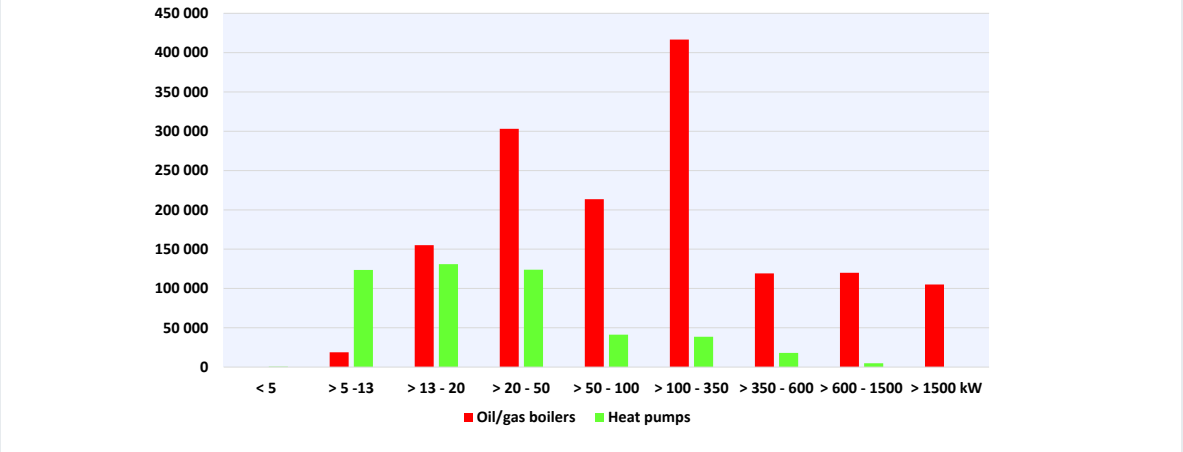


*Fig. 8: Distribution of sales figures by power range for 2019 [5]*

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