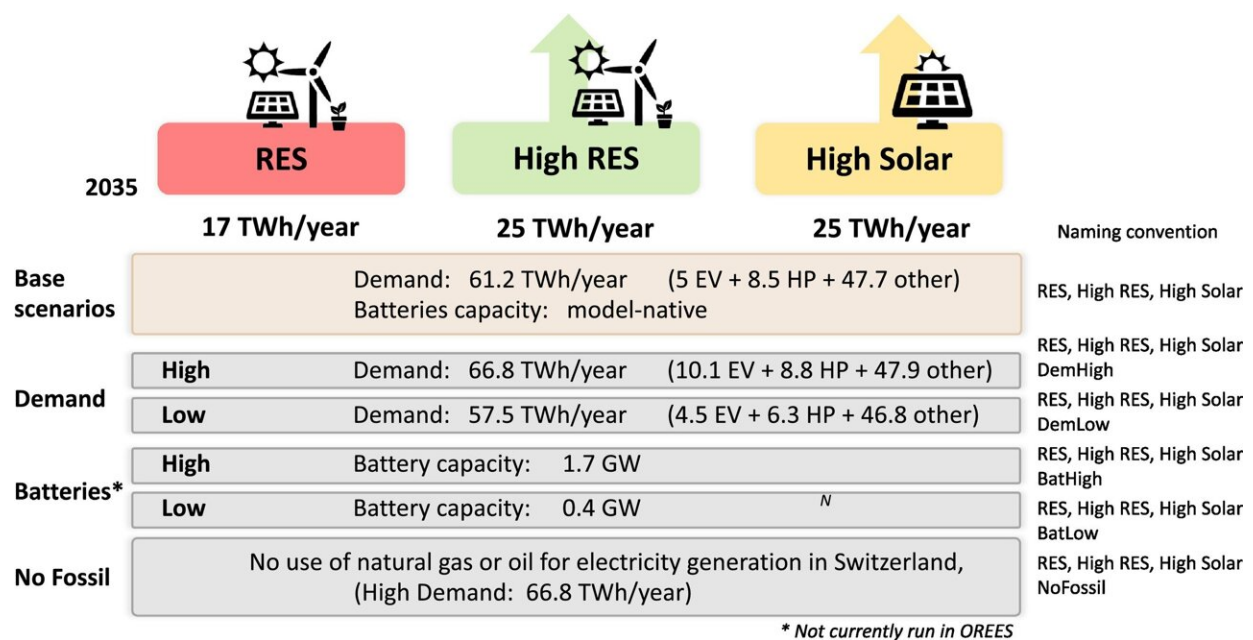


Three strategies to boost green electricity in Switzerland

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Matrix of 18 harmonized scenarios, depicting the three main groups of scenarios (RES, High Solar, and High RES) and the three dimensions of uncertainty that are investigated (the levels of electricity demands, battery system adoption, and a strict ban on fossil fuels for electricity generation in Switzerland). Credit: *Applied Energy* (2023). DOI: 10.1016/j.apenergy.2023.121700

Switzerland's ambitious green electricity targets are realistic. A new study by the SWEET EDGE consortium shows that three distinct strategies would make it possible to cover electricity needs and lead to

the employment of several thousands of people in the sector of new renewable energy. The findings are [published](#) in the journal *Applied Energy*.

Carbon neutrality and nuclear phase-out are two key objectives of Swiss energy policy. Achieving them requires a profound and rapid transformation of electricity supply. Supported by the Swiss government's SWEET program, the EDGE consortium brings together scientists from the universities of Geneva (UNIGE) and Bern (UNIBE), EPFL and ETH Zurich among other partners.

Using three different computer models, the scientists assessed the capacity to achieve four targets of national green electricity production by 2035. The results show that even the most ambitious targets are realistic. A [report](#) has been produced to provide guidance for political decision-makers.

Approved by the Swiss parliament on 29 September 2023, the Mantelerlass is a set of measures aimed at accelerating the development of renewable energies. It sets a target of 35 TWh/year from new green technologies (solar, wind, wood and biogas) by 2035, compared with the level of around 6 TWh/year in 2022. This target would represent around half of Switzerland's electricity demand that could be expected in 2035. The other half would be met by [hydroelectric power](#) and import. And all without relying on nuclear power or large fossil fuel power stations.

In this context, the EDGE consortium of the SWEET program of the Swiss Federal Office of Energy (SFOE), has worked on four targets for electricity production between now and 2035: 17 TWh/year, 25 TWh/year and 35 TWh/year using a mix of new renewable energies and 25 TWh/year using [solar energy](#) alone. Each target has been assessed by three modeling teams, to define three strategies for attaining it at minimum cost. The technical, regional, economic and social implications

of each strategy were carefully analyzed.

1. Focus on diversity

The first strategy combines new technologies as far as possible, guaranteeing diversity and security of supply. To achieve the most ambitious target (35 TWh/year), this strategy implies a mix of 25 TWh/year of photovoltaic solar, 8 TWh/year of biomass and waste, and 2 TWh/year of wind power. Here, even with the lowest target (17 TWh/year, which would imply 15 TWh/year less solar), photovoltaic remains the dominant energy source.

"This strategy involves discreet solar installations on facades and on rooftops. So, it would be well accepted. With the lower production targets, they would already be found all over the country. With the high target, they would be even more widespread in Ticino and Valais, where sunshine is abundant," explains Evelina Trutnevyte, co-coordinator of SWEET EDGE, associate professor of Renewable Energy Systems at UNIGE. Wind farms would ideally be located in the Jura mountains, in north-eastern Switzerland and in the French-speaking part of the country.

2. Focus on solar PV with batteries

The second strategy focuses on solar photovoltaic installations with storage batteries for individual consumption, located on private roofs. This option requires a more active commitment on the part of citizens but has the advantage of avoiding certain less widely accepted technologies. With a target of 35 TWh/year, solar power should supply 31 TWh/year, supplemented by 4 TWh/year from existing biomass and waste-to-energy plants.

"For the 17 TWh/year and 25 TWh/year targets, photovoltaic installations would be deployed in the cantons of Berne, Zurich and other cantons in central Switzerland, where the density of buildings capable of hosting them is high and where promotion policies are assumed to be more supportive, based on the current situation. To reach 35 TWh/year, the cantons of Graubünden and Valais would also have to build many more installations, including in open fields. Higher capacity factors in these cantons lead to a decrease of the installations in the cantons of Bern, Zurich and central Switzerland," explains Giovanni Sansavini, professor of Reliability and Risk Engineering at ETH Zurich.

3. Focus on productivity

The third strategy focuses on optimizing production for wind and photovoltaic infrastructures, including photovoltaics on rooftops and in open fields. It offers the advantage of concentrating installations on the most productive sites and avoiding investment in biomass and waste treatment plants. To reach 35 TWh/year, this option requires a mix of 30 TWh/year of photovoltaic and 5 TWh/year of wind power.

"With this option, most photovoltaic solar plants would be concentrated in Alpine municipalities, particularly in the cantons of Graubünden and Valais, assuming that some of these plants would also be built on the open field, rather than integrated into existing buildings or infrastructure, but would limit winter import most efficiently," explains Michael Lehning, co-coordinator of SWEET EDGE, full professor at EPFL and WSL, Director of the Laboratory of Cryospheric Sciences and CLIMACT.

Substantial investment required but many jobs created

Investment would be required at between CHF 0.5 billion and CHF 2.1 billion a year, from now until 2035. The third strategy ("productivity") would be the cheapest (CHF 0.5 billion per year to reach 17 TWh/year and CHF 1.4 billion per year for 35 TWh/year) as it needs to build the lowest number of plants. The first strategy ("diversity") would cost the most to achieve the high target (1.4 billion) but would rank second for the other three targets. Taking all targets and strategies together, the 25 TWh target with all-solar power would be the most expensive (1.6 billion). As photovoltaics is the dominant energy source for all models, it would absorb at least 80% of all the sums required.

Depending on the strategies and the targets, setting up the needed generation capacity would employ between 18,000 and 57,000 persons full-time every year until 2035. Manufacturing jobs would account for 33%, construction and installation 62%, operation and maintenance 4%, and plant renewal 1%. With a target of 35 TWh/year, photovoltaics with batteries would generate the largest number of jobs (50,000). By way of comparison, Swiss nuclear power plants currently employ around 1,500 people.

The largest number of jobs would concern photovoltaic installations. For the first and third strategies, they would be concentrated in the southern and south-western cantons. In the case of the second strategy, mainly in the cantons of Berne and Zurich.

High acceptance for renewables and energy independence

Along with the three strategies and their techno-economic evaluation, the report also documents, based on survey data, that the current concerns about energy supply security that have gained in importance since the Russian attack on Ukraine, go hand in hand with a strong desire to aim at

energy independence and domestic renewable energy production.

Nevertheless, as Isabelle Stadelmann-Steffen from the University of Bern states, "wind energy and ground-mounted photovoltaics—like nuclear [energy](#)—remain a controversial topic among the population." The Professor of Comparative Politics is responsible for a large population survey that was designed and conducted at the University of Bern and forms the basis for the acceptance analyses.

Realistic targets

The three models show that the four electricity production targets are technically achievable without nuclear power and without large fossil fuel plants. The higher the target, the less electricity Switzerland needs to import. With a target of 35 TWh/year, Switzerland can produce enough renewable electricity to nearly cover its consumption on a yearly basis.

Nevertheless, net electricity imports will remain an essential tool for balancing supply and demand, especially in winter. All in all, these results support the most ambitious targets, including that of 35 TWh/year recently approved by the Swiss parliament.

More information: Verena Heinisch et al, Inter-comparison of spatial models for high shares of renewable electricity in Switzerland, *Applied Energy* (2023). [DOI: 10.1016/j.apenergy.2023.121700](https://doi.org/10.1016/j.apenergy.2023.121700)

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