Using summer to keep winter warm

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Nothing works without electricity. In order to ensure that enough electricity is available, the capacities for wind and solar energy must be massively increased. But as long as surplus electricity cannot be stored in the long term, this will not be of much use - Franziska Vonaesch

One kilowatt hour supplies energy that can be used to operate all kinds of household appliances. It can be used to toast 150 slices of bread, prepare a meal for four people, vacuum clean for an hour, iron 15 shirts or keep an LED light bulb burning for 90 hours.

The demand for energy is constantly increasing – by no means a simple necessity. Currently, Switzerland derives 35 percent of its electrical energy from nuclear power and fossil fuels. If these sources disappear, renewables will have to fill the gap. Since wind power and solar energy fluctuate greatly in their production output, we will need long-term storage in the future. This is the only way to ensure year-round supply.

Let’s try a comparison

A simple car battery stores one kilowatt hour of electricity – not much, but it is still enough. The disadvantage of such a lead accumulator is its weight: 27 kilograms for 150 slices of toast. Cost: 250 francs for a kilowatt-hour. The situation is different with lithium-ion batteries. These weigh less than half the weight of lead-acid batteries, but cost seven times more.

Let us assume that a solar system on the roof delivers 3000 kilowatt hours of electricity per year – the same amount as a three-person household consumes on average. In theory, the family could now disconnect from the grid and produce its own electricity. But in practice this does not work. This is because the solar system produces high amounts of electricity in summer, but little in winter. By comparison, demand remains constant. In order to be self-sufficient, the family would have to be able to store a quarter of the annual production in summer for the long winter months. Converted into the weight and price of lead batteries, that would mean 20,000 kilograms of storage capacity and costs of 187,000 Swiss francs. For lithium-ion batteries, one would even have to invest half a million Swiss francs. Batteries cannot therefore be used to store the summer surpluses from photovoltaic systems in the long term. The surplus electricity goes back into the grid and is exported.

Far below target

The strategies for energy system transformation envisage that in 2050 electricity will be generated exclusively from renewable energies. Coal, oil, natural gas and uranium are to be replaced by hydropower, solar energy, wind power and biomass. However, electricity production from water and biomass has already almost reached its maximum output. Dams and run-of-river power plants will remain very important for the system. But large-scale expansion is unlikely. Any expansion of electricity generation must therefore be

based on the purchase of more solar and more wind energy – in other words, additional solar modules and wind turbines.
Let's take a look into the future – into the year 2050. In Germany, for example, the national consumption of electricity is on average 80 gigawatts. In summer and at night it is less, during the day and in winter it is more. Let's assume that dispatchable renewables, those that are not dependent on the climate, such as biomass, waste incineration or geothermal energy, produce 20 gigawatts. Then solar energy and wind power would each have to contribute half of the 60 gigawatts that are actually missing. Effective means that as much electricity is generated during the year as if it were flowing permanently. In reality, however, the feed-in fluctuates considerably. The peak power of a generator or photoelectric cell must therefore be many times higher to reach this average value.

In sunny as in cloudy days

Let us further assume that there is no wind or sun for a fortnight in winter and that only the 20 gigawatts from the dispatchable renewables are available. In order to bridge this wind and dark lull with electricity, energy storage facilities with a capacity of 20,000 gigawatt hours (60 gigawatts over 24 hours on 14 days) are needed.
However, if we want to shift electricity from summer to winter for several months, we have to put energy reserves in the piggy bank for 90 days. For photovoltaics alone, that would be 65,000 gigawatt hours of storage capacity (30 gigawatts over 24 hours for 90 days).
The world's largest battery storage facility is located in Australia: a lithium-ion battery with a capacity of 0.129 gigawatt hours. So batteries will never be able to compensate for the electricity demand, that much is certain. All pumped storage power stations in Germany together have a capacity of 37.7 gigawatt. But here too, the capacity is hopelessly too small to achieve the energy turnaround.

The power shortage is predefined

Switzerland urgently needs to consider how to secure energy production for the winter. Without nuclear power plants, the seasonal imbalance will increase. And relying on electricity imports from Germany is negligent. «Load shedding» would be the very last consequence – electrical energy would be cut off in order to forestall the imminent collapse of an interconnected grid. Good advice is urgent. Where should the band energy, which the nuclear power plants currently supply, come from in future? The following approaches are being actively discussed.

Electricity Imports

It is still uncertain whether our neighbouring countries will be able to export enough «clean» electricity at all, as they themselves are switching to sun and wind.

Building gas-fired power stations to bridge the gap

This option is also meeting with resistance. Natural gas is of fossil origin and contradicts the ambitious climate goals.

Increasing the storage capacity of reservoirs with higher walls

The storage volume of all reservoirs will never be able to meet demand over several months. This would require a 30 percent increase in storage volume. The federal government, on the other hand, expects a potential increase of 5.56 percent.

The only alternative

The only alternative to compensate for the strongly fluctuating feed-in is liquid energy storage – for example alcohols such as methanol. The only alternative to compensate for the strongly fluctuating feed-in is liquid energy storage – for example alcohols such as methanol. If electricity from renewables is used to produce methanol, the green electricity can be stored and thus used sensibly. This makes sense because methanol provides the energy not only for electricity generation, but also for heating and cooling buildings, mobility and industry.

The solution seems within reach. Methanol production could start next year if policymakers kept pace with the technology. As the negotiations progress, the summer is drawing to a close. The days are getting shorter and the production of electricity less and less. Winter is just around the corner and the next one is sure to come.