

Water Power and the Energy Market: Destruction of Green Energy

By Professor Dr.-Ing. Dr. h.c.mult. Franz Nestmann



Water power to store energy - Häusern pumped-storage power plant in the southern Black Forest. (Photo: Schluchseewerk AG)

Water power is the secret star of regenerative energy sources: The mountainous south of Germany in particular provides many opportunities to use rivers and lakes for supplying households and industry with power. More than 7,000 hydropower plants of various sizes exist in Germany. Even when considering strict ecological criteria, many more locations can be found, which are suited for the use of water power to produce electricity. However, our secret star is not paid the attention it deserves. In competition with other environmentally friendly energy sources, such as wind power or photovoltaics, the percentage share of water power in the energy mix has decreased. But that's not all: Many a water power plant, and here I mean pumped-storage power plants, today even destroys energy. Hardly anybody is aware of this fact. How did this unacceptable situation develop? And what can be done against it?

For thousands of years, man has used water power. This always proved to be rather advantageous, because water mostly is available in sufficient and constant amount, in our part of the world at least. And due to its high density, it potentially is very rich in energy: A height of fall of 10 m and a flow rate of 1 m³/s results in 1000 kWh of power

within a period of twelve hours. The same potential, but associated with severe impacts on the environment, is reached by 123 kg of hard coal, 70 l of petroleum, or 0.5 m³ of firewood.

Thanks to this high efficiency, water power significantly shaped the territory of Germany and Central Europe in the past. Mill creeks and mills were characteristic elements of hydropower use in mountain valleys. In the late 19th century, water power was increasingly applied to produce electricity. Big water power plants were developed and built. Engineers constantly improved weir systems and dams of high mountain reservoirs and river power plants. Turbines were further developed and optimized. Today, the best suited high-performance paddle wheel can be designed for any purpose on the computer. Thanks to this progress, no other regenerative energy source can compete with water power in terms of efficiency.

In the past decades, water power plants and in particular pumped-storage power plants largely contributed to the stability of our energy system by producing and storing electricity. The demand for energy is known to fluctuate considerably in the course of the day. Pumped-storage power plants can compensate these fluctuations very well. In times of low demand, these power plants have the big advantage that their generators can reverse operations within about half a minute. Instead of being driven by water for electricity production, connected motors extract electric power from the grid and pump the water uphill – energy is stored in the lake or reservoir.

The advantages of this extremely rapid switchability of pumped-storage power plants from the “generator” mode into the “pump” mode are manifold: Water is an extremely efficient energy storage system – no battery could compete with a water reservoir until today. Pumped-storage power plants are ideally suited for meeting peak demands. In addition, they can reliably balance frequency fluctuations in case of blackouts in interconnected grids. This is

very important to our European integrated grid, where the grid frequency is to deviate from the 50 Hertz standard by about 0.05 Hertz only.

And still: The European electricity market and the energy market in general has reversed all these advantages of pumped-storage power plants. Due to the numerous competing suppliers on the market, it is no longer possible to plan in the long term who is to cover the peaks and where and when energy has to be stored with the help of e.g. pumped-storage power plants. Prices of electricity are extremely volatile. It may even happen that two electricity suppliers use the same pumped-storage power plant for different purposes. One utility company makes the turbines run in the generator mode, whereas the other company operating the power plant uses another downpipe to pump water uphill. In this way, green energy is destroyed efficiently.

But what can be done? I am afraid that a short-term solution is not in sight. Politics is called upon to ensure stability on the market in the long term, a market, where realistic prices for energy can be enforced. We need a policy to prevent cheapskates from increasing energy destruction, to make ecologically reasonable energy production methods profitable, to use them efficiently and jointly, and to increase attractiveness for investors. Science is required to provide design criteria for water power plants, which do not only consider technical efficiency, but also ecological and environmental requirements. If this will not be done, the environment and future generations will pay the price.