Energy from water

Harnessing rivers and streams

Hydroelectric power is an important part of the electricity supply for most mountainous countries, and it should be developed to the full. This does not mean only large dams. Small-scale hydro and run of river systems can also play an important role, both for mini-grids and to feed power into a national grid.

With small changes in financial incentives, our existing hydroelectric dams could be used to provide backup power for wind and solar energy. It has been calculated that there is enough water in Europe's hydro lakes to meet the entire European electricity demand for three weeks. Of course, no one would suggest running the lakes dry. Nor would there ever be a need to, as the wind never stops for three weeks, the desert sun shines every day, and solar panels produce photovoltaic energy whenever the sun is up. But this statistic shows that simply by using our existing hydro resources in a slightly different way, we could for example dramatically expand wind power and still be sure of 100% reliable supply from wind and water combined.

With regional supergrids in place, most of us could benefit from the energy storage potential of existing dams, wherever we live. Essentially, our mountain ranges can act as giant batteries for whole regions.

Energy storage

If additional energy storage is needed, there is almost unlimited potential for using water to store electricity generated by wind, waves or solar PV, in order to provide a steady supply of energy when the wind drops or the sun goes down. No river is needed; all that is required is one reservoir at the top of a valley and one at the bottom. On coastal hills, only one reservoir is needed, using seawater. When the wind is strong and the sun is high, water is pumped uphill. When more energy is needed, the same water runs downhill again through a turbine.

In this "pumped storage", some 75% of the energy put into the system can be retrieved when it is required, which makes it one of the most efficient forms of energy storage.

If sufficient incentives were created through a feed-in tariff or other instruments, any farmer or landowner in hill or mountain country could build two reservoirs to store energy on a small scale (or one at the coast), ready to be automatically fed into the grid whenever it is needed. If governments wished to, they could build large-scale reservoirs near the coast (a picture of such a reservoir in Okinawa can be found on our home page at www.e-parl.net.) For practical purposes there is no limit to how much energy could be stored in this way.

Pictured above is the Marchlyn Mawr Reservoir at Dinorwig Power Station in North Wales, which uses a two-reservoir pumped storage system.

In this pumped storage system in Okinawa, Japan, seawater is pumped up into a single reservoir, and released again when energy is needed.

This has profound implications for the more variable renewables, such as wind, PV or wave power. Provided there is sufficient storage capacity as backup, we can build as much wind or PV infrastructure as we need. We simply need to build additional generation and storage capacity to ensure that we can store enough energy to keep the supply steady during the night (in the case of PV) or when the wind drops.

Clearly, the requirement for energy storage would be very large if PV provided a large percentage of the energy mix, and relied entirely on pumped storage for night-time backup. For this reason, PV may be better used mainly to help meet peak demand during the day from factories and offices, especially in hot

countries where air conditioning creates high additional demand. But equally clearly, if only by building reservoirs near the coasts where hills come down to the sea, it would be possible to create a very large capacity for energy storage if needed to provide a 100% reliable supply of clean energy. Such a large storage capacity may or may not be needed, but if it were it would still be greatly preferable to build the necessary infrastructure than to face the dangers of uncontrolled climate change.

Pumped storage does not have to be the only back-up power source for wind and PV. It goes without saying that, as the transition to clean energy progresses, we will not be short of back-up capacity from fossil fuels. The existing coal, gas and oil power plants do not need to be dismantled. At least some of them can be available as needed to provide power if ever renewable sources are insufficient to meet demand.

Wave and tidal

Wave and tidal power are now on the brink of large-scale commercial deployment, with a Portuguese feed-in tariff for wave power putting Portugal among the leaders. Underwater turbines are already generating tidal power from the East River in New York City. According to estimates by the UK's Royal Academy of Engineering, and by the UK Government, both wave and tidal should be able to produce electricity for less than €0.10 per kilowatt hour in the short term. Many of the world's coastlines should soon be able to contribute substantial energy to the mix. Like wind and PV, they need to be combined with energy storage to provide a steady supply.