Europe turns a blind eye to big battery

Substantial use of sustainable energy can only be realised if electricity can be stored on a large scale. In batteries for instance. Japan has already successfully built a combined mega-battery and wind turbine park installation. The US is experimenting with new flow batteries. Not much is going on in Europe.

Photo: ChiselVision/Corbis

by Hans Verwijs

Electricity is a beautiful form of energy but it has one disadvantage: it is difficult to store. Supply and demand of electricity on the grid must be in balance at all times. That is especially difficult with solar and wind energy whose output varies with the weather. For the world to be able use of these types of energy on a large scale, new ways of storing electricity must be found.

Electricity may be stored in reservoirs (lakes), but not all landscapes are suitable for this. One obvious alternative is to build big batteries. Leading in this field is Japan, which has a total of 250 MW of big batteries installed, roughly the capacity of one small gas turbine. The most recent development in Japan is the installation of a 34 MW battery close to a wind park. Christoph Kuhrt, a former F16 pilot in Germany and co-founder of the Japan Wind Development company, was closely involved in this project. In his office in Salzbergen, he says that his company has built 120 wind turbines of 1.5 MW in Japan. The Japanese utility companies demand a guaranteed supply of power at all times. Consequently, Japan Wind Development had to go in search of storage solutions. It found them at NGK Insulators, a company that manufactures 0.5 MW, 1 MW and 2 MW batteries for hospitals and industrial facilities who need a secure power supply in earthquake-prone Japan.

NGK uses the sodium sulphur battery. This type of battery needs to be kept at a constant temperature of 300˚C. In June 2008, 17 of these batteries of 2 MW each were built near the wind power park of Futumata, which has 34 wind turbines of 1.5 MW each. With this combined installation of storage batteries and wind turbines, Japan Wind Development felt confident enough to turn the facility into an autonomous electricity supplier delivering directly to the market rather than through the utility companies. Although the project is successful, being a supplier is a headache, says Kuhrt. ‘When you deliver to the market you have to report 48 hours in advance how much electricity you will deliver. You can still change your commitment if you cannot meet it, but no later than approximately 12 hours in advance and at considerably reduced prices. The fines are hefty if you don’t deliver. We are now trying to improve our delivery forecasts, so that we can make less conservative supply estimates.’

Green energy yields a guaranteed 0.15 eurocents per kWh in Japan. On top of that there is the market price. With the additional support of an investment subsidy the project is not only technically but also economically healthy. Kuhrt does not divulge how much the installation cost, but it ran into hundreds of millions of euros.

According to Cian McLeavey-Reville, a consultant at Delta Energy and Environment in Edinburgh, the sodium sulphur battery is the most reliable and safe technology of the moment as the system contains no fluids. But it is relatively expensive and this is not expected to improve. Also, the capacity can only be delivered in modules of 0.5 MW.

Outdated

In the US, says McLeavey-Reville, the poor quality of the grid makes investments in storage batteries interesting. The grid is so outdated that batteries often have to bridge the time between power failure and when the backup generators kick in. Storage batteries are not used on a large scale yet, but considerable growth is expected. This is also what Bic Stevens believes. He is Senior Vice President of the Premium Power Corporation, supplier of zinc bromine batteries.

According to Stevens, the zinc bromine battery is the best option for the foreseeable future. These batteries work at room temperature, last for 30 years and can be charged and discharged endlessly. The zinc bromine battery is a flow battery with a separate tank containing a zinc bromide salt solution that places the zinc onto the electrode during charging. The zinc is dissolved again during discharging. Stevens is glad that the sodium sulphur batteries in Japan have put large-scale storage of electricity on the map, but he believes that this type of battery will always be more expensive. McLeavey-Reville shares that opinion. He believes the cost of zinc bromine batteries will drop, largely compensating for their slightly lower efficiency of approximately 70%.

Stevens says that Power Premium is ready to build a 100 MW battery – all it takes is

34 MW Sodium Sulphur Battery in Futumata, Japan. Photo: NGK

What is the best battery?

'Two things are very important when it comes to storage batteries', explains senior consultant Raadschelders of KEMA. On the one hand, the capacity (amount of MW) and on the other hand, how long that power can be provided (MWh). Lithium ion batteries can provide a lot of power in a limited period of time and are therefore most suitable for laptops, mobile phones, cars and, if set up as a series of cells, for frequency support on the grid as well. Balancing the grid by means of large-scale electricity storage requires capacity over a longer period of time, for which lithium ion is unsuitable. Today, the most reliable technology for longer-lasting batteries is the NaS (sodium sulphur) battery. It is a closed system that needs to be kept at a constant temperature of 300° C and is available in modules of 0.5 MW. This system releases its capacity in 7.6 hours after which it needs to be recharged. Another type of battery uses fluids which are pumped through a reactor during charging or discharging. The size of the reactor determines the capacity and the stored amount of fluid determines how long the battery can provide energy. The size of the tanks and of the reactor can therefore be determined to meet the requirements. So this so-called flow battery has a promising future, thanks to its flexibility. Several types of fluids are used. The vanadium redox flow battery uses vanadium in the fluid and the zinc bromine battery creates zinc bromide salt while discharging. There is also a supplier who uses organic acid. No specific technology can as yet be declared the winner, but it is justified to expect that flow batteries will come out on top.

for a purchaser to come forward. With its modular construction it can be expanded to a 300 MW battery. Stevens believes that every renewable energy plant will eventually have a storage battery. 'We are going to be a major company and the market is immense.'

Another supplier of flow batteries, VRB Power Systems in Richmond, Canada, went bankrupt in November 2008 due to lack of funding. Chinese company JD Holdings will take over all the assets. According to McLeavey-Reville, the VRB technology, based on the principle of vanadium redox flow, is reliable and its efficiency of 75% can be considered as high. However, according to Stevens, the battery's life span is too short and the technology will remain too expensive for it to become a player of any real significance.

> *'We are going to be a major company and the market is immense'*

Risk

Europe is lagging quite a ways behind Japan and the US, says McLeavey-Reville. The fact that Plurion, the Scottish flow battery developer, is struggling to raise capital to finance their 2-year development plan and their holding company, AIC, recently sold off 5% of the company for £50,000 to incentivise staff, are not good signs, says McLeavey-Reville. He does not expect any storage project to be implemented in Europe before 2015. The good quality of the high-voltage interconnections on the European continent is an impediment to the development of electricity storage. At present, electricity storage seems unnecessary. Yet with its ambitious renewable energy goals, Europe runs the risk of several countries at once having to cope with surpluses or shortages due to the varying amounts of wind or sun power, says storage technology specialist Jilles Raadschelders, senior consultant at Kema, a globally operating Dutch firm of consulting engineers. The existing network will not be able to guarantee reliability in the future, he says.

McLeavey-Reville notes that quantitative studies on the storage of electricity are lacking. The unbundling of the energy companies does not make things easier, either, since parties may have differing interests. 'Who is prepared to write the check?' McLeavey-Reville wonders.

The Dutch energy companies have commissioned Kema to make an in-depth study on the requirements for large-scale electricity storage. This study should be ready before the summer. 'Then at least we will know what benefits (in the broadest sense of the word) storage has to offer for the Netherlands', says Raadschelders. The research is done through powerful simulations of the electricity system in all of western Europe. It also involves various scenarios for fuel prices, the use of electric transport and the expansion of the grid or of production units.

Where in Europe would one expect to find the first big battery? Perhaps where the large wind parks are located. But Norway and Denmark, for example, already make a very effective use of the storage reservoirs in Norway and do not need batteries. Kuhrt expects that Spain will be the first to need a big battery because of its enormous amount of solar power and the limited capacity of its network. McLeavey-Reville thinks it will be Ireland with its high ambition for wind parks and its old high-voltage network, which is linked only to the Scottish grid with a 500 MW line. But all the experts agree that too little experimentation is going on in Europe. The fact that there are virtually no European battery suppliers in this field does not afford much hope of that changing in the foreseeable future. ■