"We need energy storage for the energy transition"

05 March 2012

Interview with Ulrich Wagner, Executive Board Member for Energy and Transport at the German Aerospace Center (DLR)

Until now, energy storage has mainly been used in devices such as mobile phones or notebook computers. Energy experts say this is going to change. As the use of renewable energy sources expands, the electricity grid will change and energy storage facilities will be required to take on an important role in this process. The possible future design of such energy storage facilities ('Energiespeicher' in German) will be the subject of discussion for researchers on 7 March 2012 at the DLR Energiespeicher Symposium in Stuttgart. In this interview, Ulrich Wagner explains the urgent need for these storage facilities and the current status of research in this area.

Why do we need energy storage?

Wagner: We need energy storage to compensate for the fluctuating amounts of power delivered by renewable energy sources. Consumer demand almost never matches the power available from wind and solar energy sources at any given time. Until now, this problem has been limited because the energy output from fossil-fuelled power stations is quick and easy to adjust, enabling them to deliver more power at peak times. However, given that over 30 percent of our grid power will soon be deriving from renewable sources this mechanism will no longer work. We will need to be in a position to balance out troughs in power generation, or peaks in electricity consumption, with energy storage facilities. To effect this energy transition here in Germany, we are in urgent need of energy storage facilities of this kind. It is my opinion that demand for these will emerge from 2025, and will rise steadily thereafter.

How can energy be stored?

Wagner: It is no simple task to store energy in the form of electricity. In the past, pumped-storage power stations have proven to be an effective and relatively inexpensive technology, achieving efficiency rates of more than 80 percent. But pumped-storage facilities can only be constructed in mountainous or fairly hilly regions, and many such locations have long since been exploited to full advantage. In Germany and Europe, there is now relatively little scope for expansion of this technique. We therefore need to come up with new ideas. One option could be to use batteries. These also operate at efficiency ratings in excess of 80 percent, but when compared to pumped-storage power stations, they are still a very expensive proposition. We can also use electrolysis to produce hydrogen from surplus electricity. When required, this hydrogen can then be used to generate power. However, by far the best energy solution is to use this hydrogen in fuel cell vehicles. Hydrogen is an energy storage medium that offers genuine solutions for the transport sector. At this time, DLR and other research institutions are committing significant resources to researching batteries and the generation of hydrogen.

Are there easier ways to store energy?

Wagner: Especially in combination with renewable power generation in solar-thermal power stations, there is the simple but nonetheless elegant option of using thermal storage facilities, and here we are talking of a temperature range of 400 to 800 degrees Celsius. This kind of thermal storage facility is proving to be a very cost-effective form of buffer storage for energy. Essentially, this involves the use of giant tanks containing a salt that is heated throughout the day using solar energy. The stored heat is then used during the evening and night-time hours to generate steam, which in turn enables these power stations to feed electricity into the power grid around the clock.

But storage necessarily implies conversion, and that always entails the loss of a certain amount of energy. The aim of research at DLR and other institutions is to devise efficient forms of storage that are cost-effective to produce and operate.

What is the current situation with energy storage research?

Wagner: Though we are already familiar with ultra-efficient storage facilities used in the space sector, we cannot envisage these enjoying commercial success on the terrestrial market due to their high costs. We are still looking to achieve substantial improvements in terms of cost and service life to enable energy storage facilities to become competitive with systems powered by fossil fuels. In comparison to power generation from renewable energies, our work into storage technology is still lagging far behind. In Germany, we made the mistake of withdrawing from electrochemistry research in the early eighties. As a consequence, we have, broadly speaking, lost the industrial base needed to drive this forward. Over the last decade, we have been seeking to remedy this mistake by setting up research facilities in our centres and at universities. Moreover, the research departments in our big companies – and here one only needs to take a look at the automotive industry – are working flat out on this topic. Nonetheless, we have lost more than 20 years and we need to hurry if we are to have any chance of catching up with our international competition.

The German Federal Government is making 200 million Euros available for its 'Förderinitiative Energiespeicher' – an initiative to promote research into energy storage. Is that sufficient?

Wagner: At first glance, 200 million Euros is a large sum of money. But when you take a close look at the figures, that impression becomes relative. In Germany, we consume 500 billion kilowatt hours of electricity every year. If we were to seek to store just one percent of this energy in batteries, the energy sector would need to invest at least 500 million Euros. If we assume that, in the longer term, we need to store at least five percent of our electricity, the investments would need to amount to 2.5 billion Euros. If the funding initiative enables us to save just eight percent in terms of battery-related costs, then it will have been worth it.

Which storage technologies will we be using in 2050?

Wagner: My favoured approaches involve deriving the maximum possible benefit from methods with a good price-performance ratio, and here I am thinking primarily of pumped-storage power stations, to the extent that further potential may be accessible in this area. Thermal storage facilities have an important role to play in solar power stations. Furthermore, I view the conversion of surplus electricity into hydrogen as a very promising area, and also a most attractive one given the potential scope for using this hydrogen to power motor vehicles. Another possibility would be large, centrally located battery plants. Having said that, over the course of the next few decades, decentralised battery storage facilities will also start to be of interest, also in the form of electrically powered cars. The key phrase here is ‘Vehicle to Grid’, which means that, at times when the supply of electricity becomes really constrained, power stored by electric vehicles could flow back into the power grid.

What are the aims and objectives of the DLR symposium on energy storage taking place in Stuttgart on 7 March?

Wagner: The special feature of this event is the overview of the full range of energy storage technologies it will be providing. A wide spectrum of very diverse groups of researchers will be present at the symposium. Although these researchers are working to develop different kinds of storage technologies, many of the methodological problems they face are very similar; for example, integration of the storage into the overall system. The aim is for these researchers to be able to give and receive new insights from one another by looking at the same issues from different perspectives and then, to take that one step further. I am hoping that we will arrive at a consensus on new ideas relating to methodology or grid integration.

DLR has expertise on almost all aspects of energy storage, and has some completely original contributions to make. For decades, DLR researchers have been working on chemical storage facilities such as hydrogen storage, and on electrochemical storage facilities. In particular with regard to thermal storage facilities associated with research into solar power, DLR has many years of experience and is actually leading the field internationally at this time. Comparatively speaking, research into batteries is still in its early stages at DLR, but it is able to bring much to bear on this subject through its work on fuel cells.

Contacts

Dorothee Bürkle
German Aerospace Center (DLR)
Media Relations, Energy and Transport Research
Tel.: +49 2203 601-3492
Fax: +49 2203 601-3249
Dorothee.Buerkle@dlr.de

Ceramic materials being tested as a thermal storage medium

Researchers at the DLR Institute of Technical Thermodynamics are testing ceramic materials (pictured here), molten salts, concrete and natural stone for use as thermal storage media.

Credit: DLR.

Ulrich Wagner – "looking for new energy storage technologies"

Until now, energy storage has been used predominantly in devices such as mobile phones or notebook computers. That is going to change, say energy experts. As the use of renewable energy sources expands, the electricity grid will change and energy storage facilities will be required to assume an important role in this process. Ulrich Wagner, Executive Board Member for Energy and Transport at the German Aerospace Center (DLR) explains why these storage facilities are needed so urgently and the current status of research in this area.

Credit: DLR.

Production of hydrogen at DLR

Electrolysis test stand with DLR-developed electrodes for alkaline water electrolysis. DLR researchers are working on more efficient methods of producing hydrogen by electrolysis.

Credit: DLR.

Battery research at DLR Stuttgart

The Department of Electrochemical Energy Technology at the DLR Institute of Technical Thermodynamics in Stuttgart is working to develop more efficient electrochemical energy conversion, particularly batteries, fuel cells and electrolysers.

Credit: DLR (CC-BY 3.0).

Contact details for image and video enquiries as well as information regarding DLR's terms of use can be found on the DLR portal imprint.