Solar Power Can Now Be Stored

Energy storage facilities are indispensable for a turnaround in energy production, as they add predictability to the fluctuations of eco-power. The German government has therefore started to sponsor the development and launch of storage technologies. To set up manufacturing facilities, it is helpful to use the expertise of solar equipment manufacturers.

Courtesy of SMA

Too much solar power? Solar power necessarily involves fluctuations. Batteries are therefore required to make it predictable

Any conversion to renewables is hard work. The primary requirement of eco-power is new networks, but it also needs gas stores which can cushion fluctuations in the production of solar and wind power. In Stuttgart the world's first methane storage system will soon be connected to the network, based on electric power that generates storable methane. The project is run by a company called **Solarfuel** together with the **Centre for Solar Energy and Hydrogen Research in Baden-Württemberg (ZSW)**. With 250 kilowatts of power, the system will generate 300 cubic meters per day. The gas is to be fed into the existing gas grid which supplies heating facilities, power plants and petrol stations. "This technology can be an important module in our future energy supply, as it allows the development of enormous storage capacities," says ZSW project engineer *Andreas Brinner*. German gas pipes and subterranean caverns can hold a gas volume with an energy content of 200 terawatt hours. This is roughly one third of Germany's total energy consumption per year.

Without long-term gas stores it will be difficult to make the most of renewable sources in the future: Both solar and wind energies depend on the weather, on the seasons and on the time of day. The bigger its share in the electric power output, the greater the fluctuations of the available electricity. Gas stores can accommodate the surplus and make it available again when there is a need. However, so-called power-to-gas facilities are only one option of storing eco-power. In July, the German government launched a gas store offensive with the emphasis on four major spheres. Over the next few years 60 projects will receive state sponsorship in the areas of wind-hydro systems – which includes power-to-gas facilities – as well as batteries in distribution grids, energy system analysis and thermal gas stores. How much money will be available has not been decided yet. The German Ministry of the Environment says that the approval procedure for the project is still in progress.

"… the German government launched a gas store offensive with the emphasis on four major spheres"

Eco-power to gas

However, the gas storage offensive has been defined very clearly. One major focus is on electrolysis research. If, say, a solar park generates too much electricity, then the surplus can be redirected into electrolyzers where the electric power splits water into oxygen and hydrogen. The latter can be used directly as fuel for hybrid or fuel cell vehicles or, as in Stuttgart, it can be synthesized into methane with carbon dioxide. Methane can then be stored very conveniently in the existing gas grid.

Within the next two or three years **Solarfuel** will be mar-

keting such systems as small units with an output of 10 to 20 megawatts. "They can be used locally near solar and wind turbine locations," says Solarfuel engineer *Stefan Rieke*. At the same time the relevant system components are continually being improved by the industry. **Siemens**, for instance, is currently developing innovative electrolyzers which are said to harmonize particularly well with renewable energies. They center around a special membrane with permeability for minute particles – the kind of membrane that is also used in fuel cell technology. "Conventional electrolyzers take minutes to respond to changes in the electric power supply, while a membrane model does so within milliseconds," says *Manfred Waidhaus*, an engineer in Siemens' Water Electrolytes Division. Two pilot plants are due to be commissioned this year. In 2015, Siemens wants to market two-megawatt systems and in 2020 it may well be able to deliver 250-megawatt systems. Eventually, the biggest units should transform the power of 100 large solar and wind power parks into hydrogen.

However, to achieve a turnaround in energy production, large long-term gas stores by themselves are not enough. To ease the burden on local grids, it is equally important to have smaller gas stores, so that more eco-power can be used directly at the place of production. **Eisenhuth**, a company which specializes in fuel cells, and the Technical University of Clausthal have therefore developed new materials for so-called redox flow batteries. It is a battery that transforms electrical into chemical energy and then stores it in tanks. "Its major benefit is its energy density which is similar to the density in a proven lead battery, although it lasts 10 times longer," says *Christopher Hebling*, Head of Energy Technology at the **Fraunhofer Institute for Solar Energy Systems (ISE)**.

The rise of lithium-ion batteries

One alternative to lead and redox-flow batteries is to use lithium-ion batteries. They can store a large amount of energy within a small amount of volume, while also having a cycle stability that enables them to last for up to 20 years. Some solar companies are therefore already combining these small power bundles with their modules, so that solar operators can have a higher level of in-house consumption. This is making in-house consumption increasingly lucrative.

Lithium-ion batteries for domestic use are still quite expensive and would therefore nullify any savings that might be made. According to ISE researcher Hebling, a stored kilowatt hour of solar power currently costs about 40 cents. Half of this goes into storage. Nevertheless, Hebling is confident that, thanks to technical progress and an increase in production, the cost of storage can be halved, to 10 cents, over the next three to four years.

Battery for the basement: Lithium-ion batteries can store surplus solar power & increase in-house consumption in domestic use

"… lithium-ion batteries […] can store a large amount of energy within a small amount of volume"

The hope that there will soon be a breakthrough for lithium-ion batteries is not unfounded, as a number of well-known battery manufacturers are currently planning to work on the development of solar power technology and to launch suitable mass products. It is also an opportunity for solar equipment manufacturers to apply their expertise in making cells and modules for the production of batteries. "At the moment only small batteries are made for use in portable electronic devices, i.e. mobile phones and laptops. However, high-performance applications – such as energy storage facilities – would require large batteries. This is opening up an almost totally new territory for newcomers," says *Thilo Brodtmann*, manager of the **VDMA division Robotics & Automation**. In particular, he believes that there is still a lot of work to do in the automation of battery plants. ■

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تعتبر مرافق تخزين الطاقة من الأمور الأساسية في أسلوب التحوّل في إنتاج الطاقة كونها تسمح بتجنّب تقلّبات الطاقة الأيكولوجية. ووفقاً لآخر التقارير سيكون من الصعب الاستفادة بشكل كامل من موارد الطاقة المتجددة من دون توفّر مخازن الغاز الطويلة الأمد إذ أنّ الطاقتين الشمسية والريحية تعتمدان على الطقس والفصول وأوقات النهار. ستمكّن مخازن الغاز من استيعاب الفائض وجعله متوفّراً عند الحاجة إليه. لذا، ستقوم الحكومة الألمانية في السنوات القليلة القادمة برعاية ٦٠ مشروعاً في مجالات الأنظمة الريحية المائية بما فيها مرافق تحويل الطاقة إلى الغاز والبطاريات في شبكات التوزيع وتحليل أنظمة الطاقة ومخازن الغاز الحراري. لم يُتّفق بعد على قيمة الأموال التي ستستثمر لكنّ إجراءات الموافقة على المشروع تجري على قدم وساق. كلّ ذلك، من دون أن ننسى أهمية الاستعانة بخبرة مصنّعي معدّات الطاقة الشمسية من أجل إنشاء مرافق التصنيع.