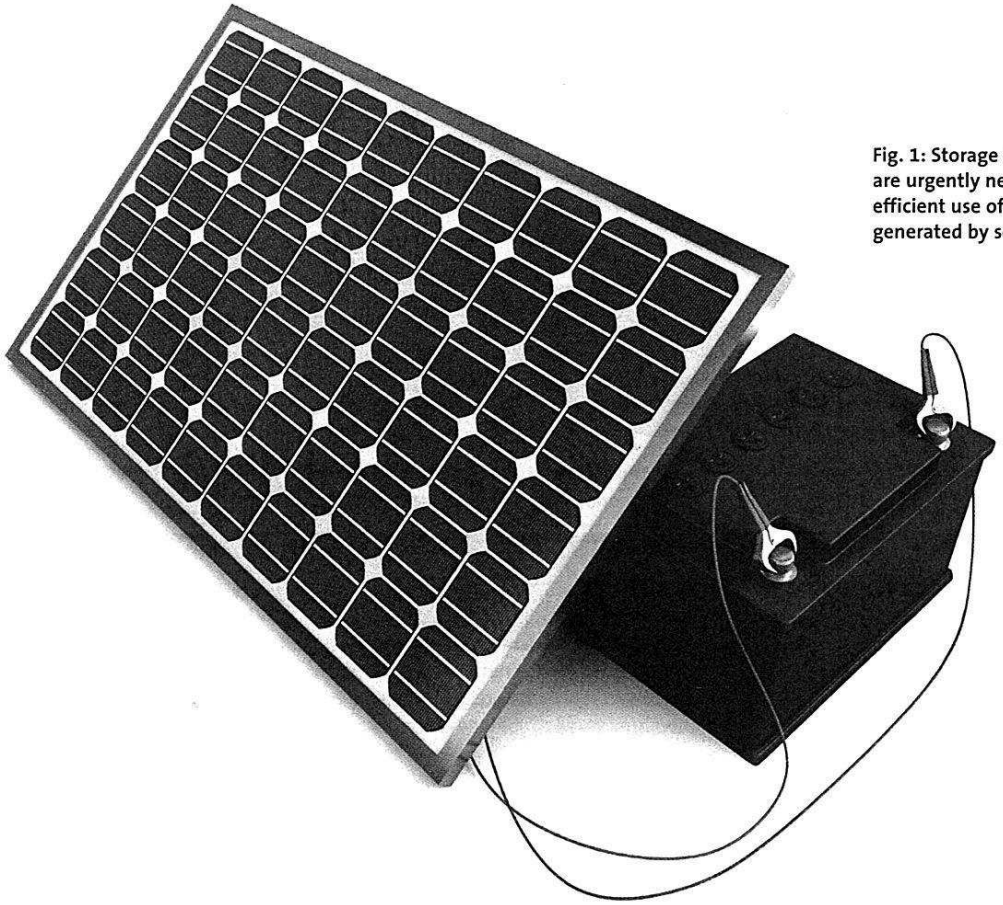

Fig. 1: Storage technologies are urgently needed for efficient use of the power generated by solar panels

Picture: 3desc – Fotolia.com

ROUND-THE-CLOCK SUNSHINE POWER

New Technologies Must be Implemented for Energy Storage Energy storage facilities will prove indispensable for a turnaround in energy production, as they add predictability to counter the fluctuations of eco-power. The German government has therefore started to sponsor the development and launch of storage technologies. The expertise of solar equipment manufacturers could prove extremely valuable in setting up manufacturing facilities.

Any conversion to renewables is hard work. The primary requirement of eco-power is new networks, but it also needs storage facilities 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; it uses electric power to produce 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 m3 of methane per day. The gas is to be fed into the existing gas grid which supplies heating facilities, power plants, and vehicle filling 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 annual energy consumption.

Without long-term energy storage it will be difficult to make the most of renewable sources in the future: Both solar and wind energy depend on the weather, on the seasons, and on the time of day. The bigger their share in the electric power generation, the greater the fluctuations of the available electricity. Storage facilities can accommodate the surplus and make it available again as needed.

However, so-called power-to-gas facilities are only one option of storing eco-power. In July the German government launched an energy storage offensive with the emphasis on four major spheres. Over the next few years 60 projects will receive state sponsorship in the areas of wind-hydrogen systems – which includes power-to-gas facilities – as well as batteries in distribution grids, energy system analysis, and ther-

Author

Sascha Renzing, Freelance Journalist, Solarpeq

Solar Power and Storage in the Future

- Batteries are required to make energy supplies predictable in spite of fluctuations in solar power generation.
- Electrolysis is the key process for storing eco-power. Researchers are searching for more efficient methods of converting electricity into gas.
- Lithium-ion batteries can store surplus solar power and increase in-house consumption in domestic use.
- In 10 years' time half of all newly registered vehicles are predicted to run on electric power. This is a good way to ease the burden on power grids.

mal storage. 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.

Eco-power to Gas

However, the energy 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 electrolysers 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 "methanised", i.e. used to produce methane by reaction 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 marketing such systems as small units with an output of 10 to 20 MW. "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 electrolysers which are said to harmonise 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 electrolysers 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 2 MW systems and in 2020 it may well be able to deliver 250 MW 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 storage facilities by themselves are not enough. To ease the burden on local grids, it is equally important to have smaller storage units, so that more eco-power can be used directly at the generation site. Eisenhuth, a company which specialises in fuel cells, and the Technical University of Clausthal have therefore developed new materials for so-called redox flow batteries. This kind of battery transforms electrical into chemical energy and then stores it in tanks. "Its major benefit is that its energy density is similar to that in a proven lead battery but its service life is 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 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. In many European countries one kilowatt hour of solar power can currently be generated for less than 20 eurocents. However, private end customers are often paying more than 20 cents for domestic power, and the price appears to be rising. In-house consumers thus not only ease the burden on the grid, but they are also in a position to save several cents per kilowatt hour.

Yet so far savings have only been possible if the battery is not included in the calculations. 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 which is accounted for by the storage unit. 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. "If the price of domestic electricity continues to rise by

Picture: DLR

Fig. 2: Electricity into gas: Electrolysis is seen as the key process in the storage of eco-power. Researchers are looking for more efficient methods

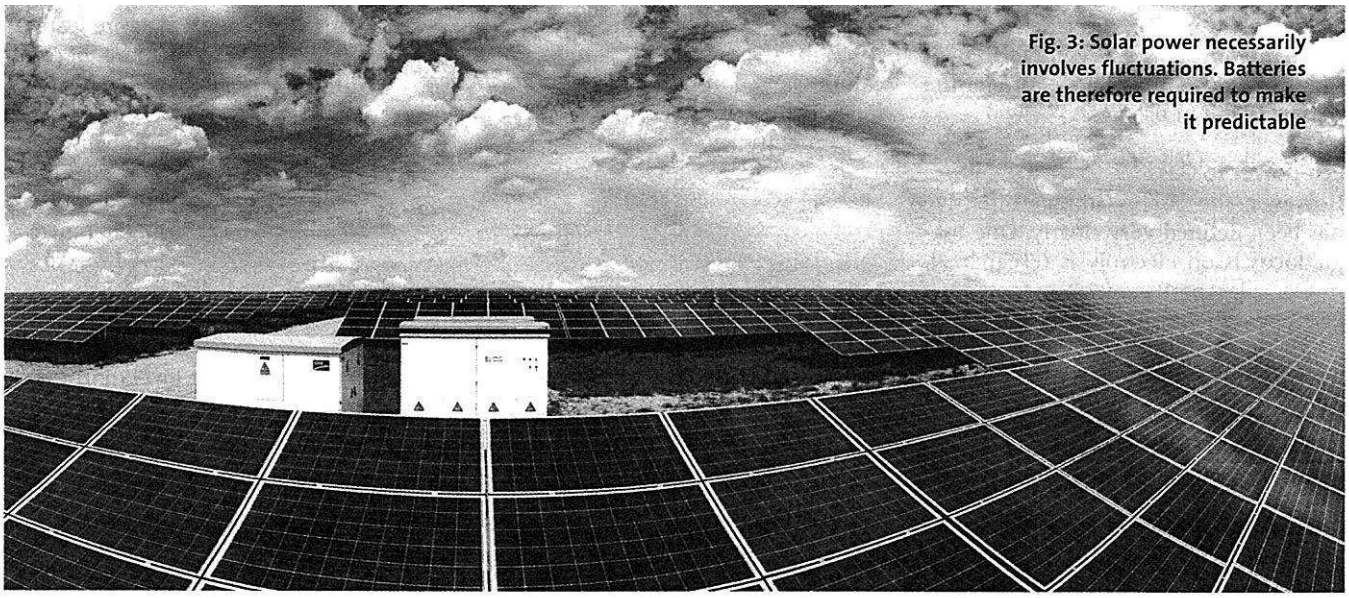

Fig. 3: Solar power necessarily involves fluctuations. Batteries are therefore required to make it predictable

Picture: SMA

5 % per year, as it has been so far, then lithium-ion storage will be worthwhile from 2015 onwards," says the battery researcher. A good overview of the current situation and options in storage technology will be provided at the International Summit for the Storage of Renewable Energies from 18 to 19 March 2013. It is the second time that this two-day event will bring together researchers, industry, energy utilities, and government at Düsseldorf.

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. They include Leclanché (Switzerland), Panasonic (Japan), and Varta (Hanover, Germany). This autumn, for example, Leclanché wants to start manufacturing an annual total of 1 million lithium-titanate cells at Willstätt in the Baden region of Germany, using a refurbished magnetic tape factory. This is the equivalent of 20,000 storage units for home use.

It is also an opportunity for solar equipment manufacturers to apply their expertise in making cells and modules to the production of batteries. "At the moment only small batteries are produced 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 entirely 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. "We now need innovative forms of production, so that we can reduce our costs."

New Business for Solar Suppliers

Brodtmann believes that there are plenty of areas for innovation. For instance, initial modification will be required for each of the process stages: rolling of the metal sheets, mixing of chemicals, coating of electrodes, and forming of the cells. Moreover, the relevant processes are still too slow. "There is still too much manual work. We need to get to a point where large batteries, too, can be made in a roll-to-roll process," says Brodtmann. Moreover, there is room for improvement in quality management. Modern metrology already allows the detection of faults and damage during the manufacturing process, but this is not yet standard.

Major automation specialists such as ABB, Bosch Rexroth, Manz, and Reis Robotics have understood that there is a demand and are already targeting the emerging battery segment of the market. "We believe that our expertise in photovoltaic production will help us to establish ourselves very well in the promising area of high-performance storage units," says Axel Bartmann, speaking for Manz. But niches in the battery business can also be found by smaller players. For instance, Isra (a company based in the German federal state of Hesse) offers optical processes for the production of batteries whereby each manufacturing process can be mapped with precision. Any defects or uneven sections of the coat and any tiny pinholes that might damage the battery separators can be detected via cameras. "Our engineering allows us to reach zero tolerance in production," says Isra Manager Martin Lehmköster. The technologies offered by equipment suppliers and the systems on the roadmaps of the energy storage industry will be at the focus of two trade fairs from 23 to 26 October 2012: solarpeq, the international trade fair for solar production equipment, and a parallel exhibition called glasstec, a leading trade fair for the glass industry.

Numerous further suppliers are likely to join the battery bandwagon, as there is a growing demand in other areas too. According to a recent study entitled "Electric Mobility in the Future – Opportunities and Challenges for Mechanical Engineering", published by VDMA and Roland Berger Consultants, about 40% of all newly registered vehicles in 2020 will run on electric power. The authors say that new manufacturing facilities for mobile batteries will lead to major new business potential for new machinery, with a volume of €4.8b by 2020. The turnaround in energy production is creating new opportunities. ■

CONTACT

www.solarpeq.com