EASAC study on solar thermal power

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Solar thermal power stations are a dependable solution for the energy turnaround – EASAC study submitted to German Science Minister Schavan

As a dependable technology, solar thermal power stations can play an important role in transitioning the power grid to renewable energy sources. In contrast to other renewable sources, they supply electricity on demand and can stabilise the grid. This fact was emphasised in the study produced by EASAC (the European Academies Science Advisory Council), a body set up by leading European scientists and lead by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). On 7 November 2011, this study was handed over to the German Federal Minister for Education and Research, Annette Schavan, in Brussels.

Stabilisation of the power grid

This study was produced to commemorate the tenth anniversary of EASAC and was presented to the public in the presence of Minister Schavan and the former President of the Royal Society, Lord May of Oxford. It describes the potential for solar power stations to contribute towards a sustainable energy future. "These power stations are able to provide energy at any time, so they are able to compensate for fluctuations in the supply of renewable energies, which helps to stabilise the power grid. The value of the electricity generated by these power stations therefore goes beyond just the kilowatt-hours they feed into the system," stressed Robert Pitz-Paal, director of the study and co-director of the DLR Institute of Solar Research.

"It is vital for the market launch of numerous innovations to progress smoothly, thereby enabling the price for the provision of electrical power to drop rapidly," stated Robert Pitz-Paal in his summary. At present, generating electricity from solar power stations has the same cost as generating power from offshore wind farms, making it two to three times more expensive than electricity generated by fossil fuel plants. The authors of the study believe that, with the progressive introduction of solar power stations, backed up by appropriate levels of research and development, these generating costs will be reduced between 50 and 60 percent within the next 10 to 15 years. Given the strides currently being made in technology and the rising price trend for fossil fuels, the researchers make the further assumption that electricity from solar power stations will become competitive with their fossil fuel counterparts somewhere between 2020 and 2030.

How a solar thermal power station works

In solar power stations, mirrors are used to concentrate sunlight and convert it into thermal energy, a technique known as Concentrating Solar Power (CSP). This process enables temperatures of 400 to 1200 degrees Celsius to be achieved. This thermal energy can be used to generate power in the same way as in a conventional steam-operated power station, or through the use of a Stirling engine. The solar rays can be concentrated using four different shapes of mirror, chosen to suit the type of power station involved: parabolic troughs, flat mirrors that focus sunlight near the top of a tower, parabolic mirrors or linear Fresnel collectors.

Base-load capable power plants provide security

The researchers focused mainly on the comparison between solar-thermal power stations and photovoltaic plants, in which solar power is converted directly into electrical energy. As competition intensifies, substantial reductions in the price of photovoltaics have been causing quite a sensation over the last few months. "Unless solar thermal power stations are capable of generating a base load, it will prove difficult to convert worldwide energy systems," explained Robert Pitz-Paal with conviction. In solar thermal power stations, the energy is stored in the form of heat before it is used to drive the turbines that generate electrical power. This means that electricity can be provided on demand, without the need to have fossil fuel power stations on standby. The researchers who produced this study believe this to be a value-added feature that will become even more significant in the medium-term because, they maintain, photovoltaic plants and wind farms alone are not capable of guaranteeing a secure supply. To ensure future security of supply, the authors recommend adapting the price for power generation to reflect the times of day that have the greatest demand.

Cost-effective development involving the construction of solar power stations

The study also stresses that solar thermal power stations, unlike photovoltaic plants, can be of high local value in under-developed regions. Most especially in countries in the Middle East and North Africa, the authors expect their economies to grow through the construction of solar thermal power stations, which will also help to generate local employment. For this reason, they suggest a policy to assist the introduction of these technologies to those regions. In the medium-term, the expansion of transmission capacities can give rise to exports into Europe of an easily managed supply of solar power coupled with secure and carbon dioxide-free power generation at its point of origin.

EASAC report: Concentrating solar power: its potentialcontribution to a sustainable energy future

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Solar tower power plant

As a dependable technology, solar thermal power stations can play an important role in transitioning the power grid to renewable energy sources. In contrast to other renewable sources, they supply electricity on demand and can stabilise the grid. This fact was emphasised in the study produced by EASAC (the European Academies Science Advisory Council), a body set up by leading European scientists and lead by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). On 7 November 2011, this study was handed over to the German Federal Minister for Education and Research, Annette Schavan, in Brussels. In solar power stations, mirrors are used to concentrate sunlight and convert it into thermal energy). This process enables temperatures of more than 1000 degrees Celsius to be achieved, which can be used to generate electricity, among other things.

Credit: DLR (CC-BY 3.0).

Parabolic trough solar power plants

In parabolic trough solar power plants, sunlight is concentrated onto a receiver tube located at the focus of the parabolic mirrors. The sunlight is then converted into heat. The heated oil heats water, producing steam that drives a turbine to generate electricity.

Credit: DLR.

Fresnel collectors

Fresnel collectors consist of numerous slightly curved mirrors, which focus solar radiation onto a central absorber pipe. In this pipe, water can be evaporated and superheated and the thermal energy is then converted into electricity by a steam turbine. The Puerto Errado Fresnel collector solar thermal power plant is located in Murcia, southern Spain.

Credit: Novatec Solar.

Dish-Sterling system

In Dish-Stirling systems, a parabolic mirror concentrates solar radiation into a focal point, where the Stirling motor is placed. Heat energy is transformed into mechanical energy by the Stirling motor. As a general rule, a generator then uses the mechanical energy to generate electricity.

Credit: DLR.

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