Federal Ministry for Economic Affairs and Energy

Energiewende direkt

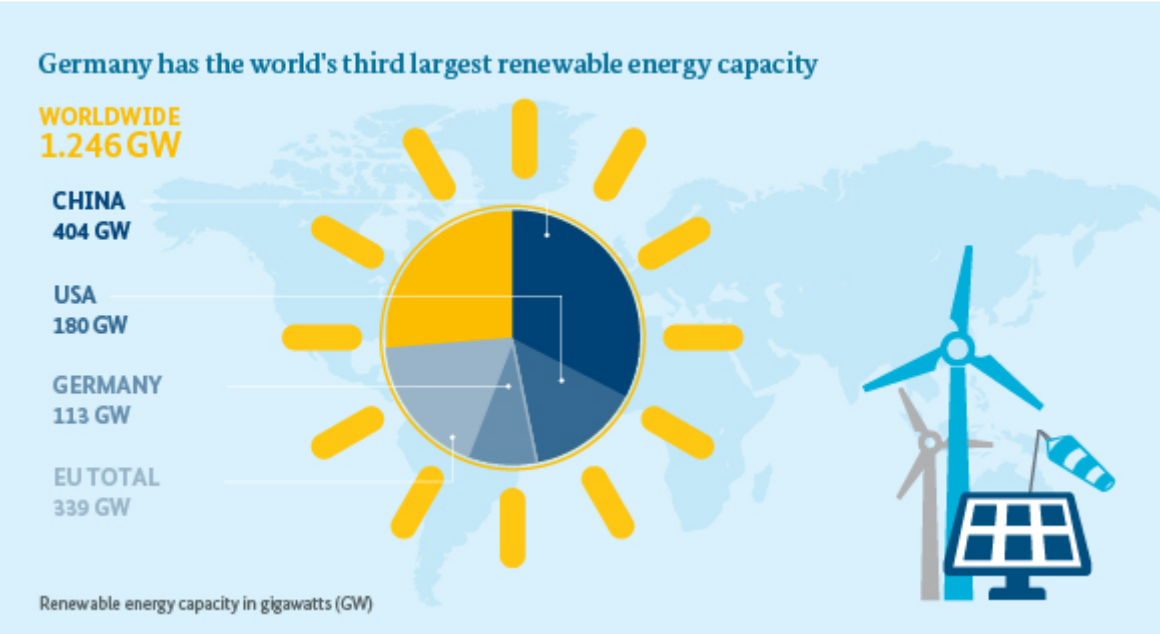
05 Sep 2019

Regulatory sandboxes: experimental areas for new energy technologies

Testing out new research findings in real life: an exciting opportunity for 20 winners of the “regulatory sandboxes for the energy transition” competition. **Find out more**

Renewables in a global comparison: Germany ranks very high

The Renewables 2019 Global Status Report published in June offers the most comprehensive overview of renewable energy around the world. Germany ranks very high - twice over - in the international comparison.



The Renewables 2019 Global Status Report published by REN21 (Renewable Energy Policy Network for the 21st Century) provides the most comprehensive overview currently available of the new world of energy. The latest report shows Germany at or near the top of two rankings: Germany is ranked third behind China and the U.S. in terms of renewable energy capacity, with 113 gigawatts (GW) in 2018. The breakdown of these is as follows: 59 GW takes the form of wind energy, 45 GW solar energy and 8.4 GW biomass.

Germany tops the rankings in terms of per-capita renewables

The United States - with a vastly larger land area - has more than 180 GW of renewable capacity, with much of this also being provided by wind (96 GW) and solar (62 GW). China, again with so much more land area, can draw on a total of 404 GW of renewable capacity. All 28 EU countries together have 339 GW of renewable capacity, and the global figure is 1,246 GW. (Hydropower was not included in the calculations.)

Germany also tops the rankings in terms of per-capita renewables. In per-capita terms, each person in Germany can use 1.4 kilowatts (kW) of renewable energy - by far the highest figure worldwide. The per-capital comparison shows a global average of just 0.2 kW, with 0.3 kW in China and 0.6 kW in the U.S. The EU average stands at 0.7 kW.

Renewables generate more than a quarter of the world’s electricity.

Other findings of the report: renewables are covering an increasing amount of global electricity generation. The status report shows that more than a quarter (26%) of global electricity generation is already produced using renewables. For the fourth year in succession, more renewable generation capacity was installed in the electricity sector in 2018 than fossil and nuclear combined. Last year alone saw the addition of 100 GW of solar capacity. That is roughly equivalent to one quarter of France’s annual electricity demand.

The report demonstrates that solar and wind are now mainstream options in the power sector. At least nine countries produced more than 20% of their electricity from intermittent wind and solar energy (photovoltaics), including Denmark (51%), Uruguay (36%), Ireland (29%), Germany (26%) and Portugal (24 %).

Cities are leading the way in the use of renewable energy

Global renewable energy uptake no longer depends on just a few countries. The use of renewable energy sources continued to rise worldwide in 2018. The report finds that cities are increasingly heading the field in the roll-out of renewables. In numerous cases, voluntary commitments and actions by cities far exceed national and regional initiatives. At least 70% of the electricity consumed is generated from renewable energy in more than 100 cities around the world. These include African conurbations like Kenya’s capital, Nairobi, and Dar es Salaam (Tanzania), as well as Stockholm (Sweden), Auckland (New Zealand) and Seattle (USA). At least 50 cities have set themselves wide-ranging targets for renewable energy. Ambitious climate targets have also been adopted by German

cities, such as Frankfurt am Main and Osnabrück, which are participating in the 100% RE Cities and Regions Network.

A clear recommendation: extend the energy transition to other fields

The authors of the Renewables 2019 Global Status Report also believe that a great deal of potential lies in extending the energy transition to the fields of heating, cooling and transport. Only 10% of the energy consumed in these sectors is renewable at present. "With the countries needing to come back with more ambitious climate targets in 2020, this report shows there are an array of opportunities to scale up action and improve people's lives by extending the benefits of the energy transition throughout the economy," says REN21 Chair Arthouros Zervos.

FURTHER INFORMATION

[→ Renewables 2019 Global Status Report

What exactly is "security of supply"?

"Security of supply" sounds great - it seems obvious that everyone needs it. Read on to find out what it means, and which aspects of this multifaceted topic are the crucial ones.

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The idea is that the electricity supply should be maintained at all times, even as the energy transition advances.

This aspect of the energy transition is highly complex and much debated: ensuring a reliable electricity supply in the face of Germany's phase-out of electricity generation based on nuclear and

coal. How can this security of supply be guaranteed in the long term? To achieve this, policy makers, planners and experts need to give consideration to many different points and predict the future as precisely as possible. We will explain the three central aspects of security of supply here:

Aspect 1: Security of supply at the generation stage

Security of supply at the generation stage means that the amount of electricity generated always matches the amount demanded by the consumers. In the 2016 Electricity Market Act, the Federal Government set out a clear framework for the electricity market. This act states that it must be possible to form prices for electricity freely and without state intervention. Also, electricity suppliers are obliged to have at their disposal the electricity they are trading. Only if this is the case can they actually meet their commitments to supply the electricity consumers. One way in which they do this is to conclude long-term supply contracts with power plant operators. This means that an important role is played by the prices on the electricity market: they show how much electricity is being generated and is needed, and whether it is worth generating more electricity or adjusting consumption at any given time.

Germany's electricity market is located at the heart of Europe, and is fully integrated into Europe's electricity supply. Cross-border trade in electricity thus results in efficient and low-cost use of Europe's power plants, as generation and consumption can be balanced over long distances and across borders.

Nevertheless, in order to ensure that security of supply can be maintained even in the case of unlikely and unpredictable events, Germany also has a unique security standby reserve totalling more than 10 Gigawatts (GW).

Aspect 2: Security of supply in the grid

In addition to adequate electricity generation capacities, supply security also crucially depends on an efficient electricity grid. This is where the biggest challenges currently facing the energy transition are to be found. Germany has a very reliable electricity grid today. It always ranks very highly in international comparisons, with only very small local downtimes. The intention is that this should remain the case as the radical transformation of the electricity supply to renewable energy takes place. It is therefore necessary to optimise the electricity grid and rapidly expand it using new technologies. More and more electricity generated from wind power in the north of Germany needs to be transported to the many consumers in the south. The Network Development Plan sets out the necessary work to be done on the grid in the forthcoming five to fifteen years. Thought is always given to ensuring that, when individual powerlines fail, the grid can continue to be operated reliably without major interventions.

Also, the grid operators use system analyses to think through particularly challenging grid situations and to prepare for these. Congestion can be tackled, for example, by curtailing electricity generation in the north and increasing it in the south - behind the temporary bottleneck. Where necessary, the grid operator can intervene in each renewable energy installation and each power station to achieve this. Also, the grid operators can deploy power stations in the security standby reserve (grid reserve power stations) in order to maintain grid security.

Aspect 3: The fuel supply

If there isn't enough fuel, even the best power station will be unable to function. For this reason, the sufficient supply of fuel to our power stations is the third decisive aspect of security of supply. The supply of fuel is mainly ensured by long-term supply contracts and a range of different suppliers. This is due to the fact that, apart from Germany's own lignite, almost all the fuel used by power stations here comes from abroad. It mainly takes the form of hard coal and natural gas. The formula is a simple one: the more countries supplying the fuel via different transport routes, the greater the security of supply and the higher the level of competition. And this also tends to reduce prices. In the case of gas, maritime transport can result in new suppliers and transport routes. For this reason, Germany welcomes private-sector initiatives to build new import pipelines and to construct import terminals to receive liquefied natural gas (LNG) transported to Germany by ship.

Current monitoring report confirms continuing security of supply

So how good is the security of supply in Germany? On the basis of the Electricity Market Act of 2016, the Federal Minister for Economic Affairs and Energy continuously monitors the security of the electricity supply. This means that risks to supply security can be identified as early as possible. At regular intervals (at least every two years), the findings are summarised in a monitoring report on the security of the electricity supply.

The latest issue of the monitoring report, which was published in July, confirms that Germany continues to have a very high level of security of supply in the international comparison. "The report shows that the electricity supply to consumers in Germany will continue to be secure as the transformation of our energy system continues," said Peter Altmaier, Federal Minister for Economic Affairs and Energy, when it was published.

One of the sources for the monitoring report is an expert study. It examines in detail how the electricity market and the available power plants will develop in the coming years until 2030. The study also considers various scenarios which can arise, e.g. due to different weather conditions or the effects of unscheduled power station failures. It finds that the electricity supply to consumers in Germany is secure at all times.

Beyond the latest report, the Federal Government continuously reviews all aspects of security of supply in order to identify risks to this at an early stage and in good time.

FURTHER INFORMATION

[→ The monitoring report on security of supply of the Federal Ministry for Economic Affairs and Energy (in German only)
[→ Study: Definition and monitoring of security of supply on the European electricity markets

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Volcanic rock stores wind energy

Researchers in Hamburg have developed a heat storage facility which can already supply some 3,000 households for one day with electricity generated from wind power – and this is just the beginning. The secret: volcanic rock from the depths of the Earth.

"Welcome to the new stone age" say the large letters on the sign at the world's first electro-thermal energy storage facility. It uses a very special technology and came on stream in Hamburg in June. The concrete building is 22 metres long, 11 metres wide and 11 metres high - roughly the size of an Olympic swimming pool - and is located on the site of the Hamburg-Altenwerder aluminium smelter in the port of Hamburg. It is filled with close to a thousand tonnes of volcanic rock. The idea is that if the wind in and around Hamburg is so strong that the electricity grid cannot transport all the wind power generated, the lava rocks will absorb the energy from the surrounding wind turbines and give it back to the grid when it is needed. When they are fully charged, the rocks can store enough energy to cover one day's electricity needs of up to 3,000 households.

The electro-thermal energy storage (ETES) facility is being run for research purposes by Siemens Gamesa, a wind turbine manufacturer, together with the energy utility Hamburg Energie and Hamburg University of Technology. In future, the partners want to make more use of renewable electricity from wind turbines by decoupling electricity generation from electricity consumption. To this end, they are combining technologies from the fields of heat storage and thermal power plants in an innovative manner. The project is entitled "Future Energy Solution – FES" and is receiving funding of approximately €10.7 million from the Federal Ministry for Economic Affairs and Energy.

Lava instead of coal

With the help of resistive heating and a fan, the electrical energy can be converted into a hot air stream and thus into thermal energy. The hot air is then fed into the insulated concrete structure,

which is filled with lava rocks. Something rather like a very hot hairdryer is used to heat the rocks to up to 800°C. After around 24 hours, the rocks are "charged" and can store up to 130 megawatt-hours of thermal energy over a period of a week or more. The ability of the lava to store heat for a long time is not the only advantage. The rock is also comparatively cheap and readily available.

When the electricity is eventually needed, ETES uses a turbine to convert the stored heat back into electricity. The principle is similar to that of a conventional thermal power station, the difference being that lava is used in place of fossil fuels like coal or gas. The heat stored in it is used to heat up air and then water in a steam generator until water vapour is produced. Under pressure, the water vapour then drives a turbine, which generates electricity with a capacity of 1.5 megawatts. If the storage facility is fully charged, the turbine can generate electricity for 24 hours. In the current trial version, ETES produces about 30 megawatt hours. That is enough to supply an average of 3,000 households with electricity for one day or to charge up around 750 electric vehicles.

Zero-emission electricity

The net efficiency of the trial ETES facility in Hamburg currently stands at roughly 22%. To put this figure into perspective: a conventional coal-fired power plant has an average efficiency of 30-40% - but across its entire life-cycle, it releases up to 1,230 grams of global-warming carbon dioxide per kilowatt of electricity. In contrast, the electro-thermal storage facility would be virtually emission-free when used in combination with wind turbines.

The facility in Hamburg is just the beginning for Siemens Gamesa. "The facility in Hamburg-Altenwerder is only a relatively small-scale demonstration and test facility," says Hasan Oezdem, Head of Research and Development and Director of the energy storage programme at Siemens Gamesa Renewable Energy. "The collaborative project aims to show how the storage facility behaves within the overall facility and how it can best be operated in line with the electricity prices." The facility can be scaled up to several gigawatt-hours if there is demand for this. All that is required is some more lava, a bit more space and a larger turbine. Once it is ready for market, the ETES technology is to achieve efficiency rates of up to 45%.

However, this efficiency rating is only one of many factors to be considered when considering how viable the storage facility is. It is also necessary to consider costs for purchase, operation, repair and safety, as well as life-time, cycle stability and environmental aspects. The volcanic rock storage technology is thus competing with other storage technologies, flexible generation and flexible demand.

Will power stations become storage facilities?

Coal-fired power stations closed down in the course of the energy transition could be converted into low-emission long-term storage facilities if components like grid connections, turbines and generators can remain in use. Whether the conversion is technically feasible and makes economic sense in any given case still requires further investigation.

FURTHER INFORMATION

[→ Information about ETES technology from Siemens Gamesa Renewable Energy

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