Above: Small date palm farm in Meca, California

Fort Pickett, VA. The project, a $2.2 million, 488 kilowatt solar array that measures 10,000 square yards and consists of nearly 2,000 individual solar panels, provides the RTI with nearly 80 percent of its daytime energy needs.

This field is estimated to produce 712,000 kilowatt hours per year and was installed adjacent to the RTI campus. The Lufft weather sensor provides wind speed, wind direction, temperature, humidity and air pressure. The weather station and pyranometer together provide weather and solar radiation data from the field that is then integrated into a Schneider Electric BAS (Building Automation System) and display on the customer's energy management dashboard. Evergreen Solar was the installer on the job with oversight from Schneider Electric. Lufft provided the weather sensor that for data collection of the solar plant.

But not only are pyranometer-equipped weather sensors useful; wind sensors are also critical for photovoltaic plants. The V200A for example is a standard wind sensor for many California solar power projects. Ultrasonic wind sensing is preferred now so this has become the standard for many projects.

Recently Lufft USA finished a small 1MW rooftop installation for the city hall building of Harlingen in Texas. It only powers the building and the surrounding area. For this a WS501 was installed at six feet above the array to provide weather data and transfer it into the Schneider Electric control system.

The weather data is compared with the project production data. It also was given to the utility as a report to measure the efficiency of the solar project based on the current solar radiation at any given time. Also a V200A is used to inform on the actual wind situation (air pressure, wind direction, wind speed and virtual temperature).

Another notable project Lufft USA worked on was on a small date palm farm in Meca, California. The farm located in this hot desert oasis was far away from the power gird and required the solar plant to greatly lower the price of electricity. The WS501 again provides weather data with solar radiation information that fed reports into the California independent systems operator (CAISO). The harsh environment is no match for the WS501. ■

www.lufft.com

About the company

Since its founding by Gotthilf Lufft in 1881, G. Lufft GmbH has been the leader in the production of climatological measuring equipment – always with the motto "tradition meets innovation". Lufft's capacity for innovation and precision has helped its products establish the solid reputation they enjoy around the world. The company's products can be found in use wherever variables such as air pressure, temperature, relative humidity and other environmental factors need to be measured. Together with its subsidiaries in the U.S. and in China, the company has 100 employees. In November 2012, G. Lufft GmbH was awarded the German Standards Brand Prize and was named a 'Brand of the Century'.

The decentralized energy revolution in Germany

Words: Professor Christoph Burger and Jens Weinmann, European School of Management and Technology in Berlin

Germany has embarked on a journey to fundamentally transform its energy supply system: the energy turnaround, or "Energiewende" as it is known. But the country that kick-started the PV movement around a decade ago has since been superseded by even more ambitious nations. So can Germany become a game-changer once more?

Between 1990 and 2014, power generation from renewable energies in Germany rose from 17 to 160 Terawatt hours. In 2014, they accounted for 26 percent of total generation. Until 2020, the German government targets to increase this share to 35 percent. Most of the power stems from small-scale and decentralized power units with biomass combustion, photovoltaic panels or wind rotors.

More than a million investors now participate in providing electricity – private residents and farmers own almost half of the installed capacity of renewable energy installations, while the share of the big four German energy utilities hovers at less than 10 percent.

It is an unparalleled success story that has unfolded over the last ten years, but it comes at a cost. On 2014, the average feed-in supplement to the regular electricity price of a private residential consumer was 6.24 €-cent per kilowatt hour. In total, German electricity consumers paid around €23.6 billion to finance existing installations of renewables in 2014 via their electricity bills.

Residential consumers paid more than a third, while industry contributed around €7.4 billion. However, many industrial and commercial consumers are exempted from paying the feed-in supplement, because the higher electricity costs would create financial disadvantages in the global marketplace.

The government tries to curtail subsidies, though. In particular, photovoltaic panels that were installed in 2014 receive only around €100 to €140 per megawatt hour, compared to an average compensation of around €370 per megawatt hour across all PV installations in 2012.

Prices for wind turbines have not decreased as drastically as in photovoltaics, hence on-shore wind that went online in 2014 receives around €90 per megawatt hour, roughly similar to the average subsidy of all wind farms in 2012. By contrast, off-shore wind turbines installed in 2014 yield feed-in revenues between €150 and €190 per megawatt hour.

The number of interventions to stabilize the grid by Germany's largest transmission grid operator TenneT rose from two interventions in 2003 to 1,009 interventions in 2013. While most of the photovoltaic panels are installed in rural areas of the South of Germany, the bulk of on-shore wind power is located in the Northern states Lower Saxony and Mecklenburg-Vorpommern.

"The German Energiewende started in the early 1990s with first incentives to promote renewable energies. Soon it became clear that it was a lucrative and ecologically sound investment opportunity for individuals, communities, and associations"

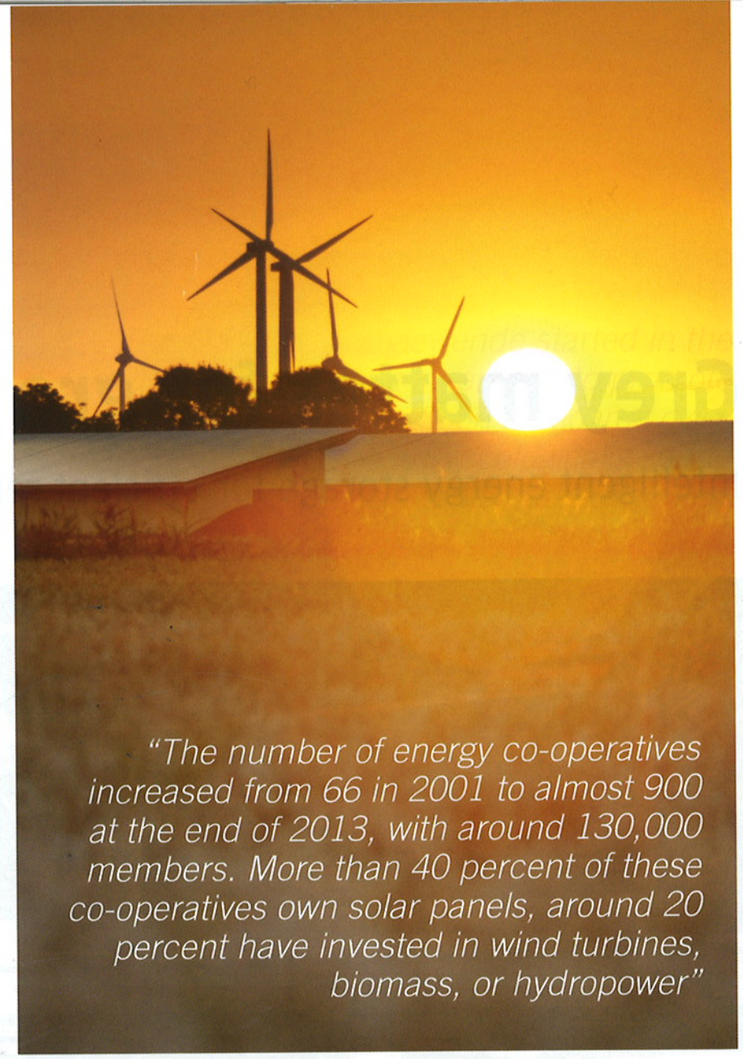
In order to transport the electricity to the load centers in the South, and to compensate for the gradual phase-out of nuclear plants in the Southern states, the German energy agency has calculated that around 2,800 km of new transmission lines and 2,650 km of reinforcement of existing transmission lines are necessary. The Federal Network Agency expects total costs of around €16 billion.

Empowerment and 'emotionalisation'

The German Energiewende started in the early 1990s with first incentives to promote renewable energies. Soon it became clear that it was a lucrative and ecologically sound investment opportunity for individuals, communities, and associations. With the liberalization of electricity markets, final customers could choose their electricity supplier. With decentralized energy, they are able to become self-producers.

But investments often exceed the budget of individuals, asking for a broader base of financing, for example via energy co-operatives. In Germany, the number of energy co-operatives increased from 66 in 2001 to almost 900 at the end of 2013, with around 130,000 members.

More than 40 percent of these co-operatives own solar panels, around 20 percent have invested in wind turbines, biomass, or hydropower. The remainder of the co-operatives owns co-generation units or has invested in grid infrastructure. The German Renewable Energies Agency estimates that German energy co-operatives have invested around €1.2bn in so-called "citizens' power plants".



"The number of energy co-operatives increased from 66 in 2001 to almost 900 at the end of 2013, with around 130,000 members. More than 40 percent of these co-operatives own solar panels, around 20 percent have invested in wind turbines, biomass, or hydropower"

On aggregate, they supplied 160,000 households with electricity in 2013. Even with donations of less than €100, citizens are often able to join these co-operatives. 40 percent of participants spend between €1,000 and €3,000 for a membership, 28 percent between €3,000 and €6,000, and only 11 percent more than €6,000. Energy co-operatives create a possibility even for urban dwellers to participate in the Energiewende.

Many municipalities have discovered that decentralized, renewable energy in their home territory increases acceptance and emotionally compensates for comparatively high tariffs, because final consumers can identify with their product offers. The municipal utilities are able to build upon geographical proximity to their clientele combine their support for the community with marketing campaigns for carbon-free, locally produced energy, for example by solar panels on top of representative public buildings like sports facilities, town halls or schools.

The amount of decentralized energy produced under these circumstances may often be small, but intelligent marketing creates a positive association with final energy consumption and transforms the indistinguishable commodity energy into a personalized and emotionalized good of self-determination.

Losers and winners

To identify the losers of the decentralized energy revolution is fairly simple: All four major electric utilities in the German market suffer from a lasting decline in wholesale electricity prices on the European Energy Exchange EEX in Leipzig. The larger municipal utilities that own generation assets are financially affected, too.

Since renewable energies have priority feed-in into the grid over conventional energies and they operate at practically zero marginal cost, they deprive utilities from both base and peak load revenues. In particular, the maximum of solar radiation coincides with the mid-day peak in electricity consumption and cuts into the formerly secure revenues of utilities.

E.ON and RWE, Germany's two largest energy utilities, posted losses of €3.2 billion in 2014 and €2.8 billion in 2013, respectively. RWE returned to profitability in 2014 with a surplus of €1.7 billion, but conventional electricity generation decreased by 30 percent from 2013 to 2014. E.ON has responded to the crisis with a bold move to split its assets and workforce into two independent entities: Renewable energies, distribution and customer solutions will remain with E.ON under the new structure, whereas conventional power generation, upstream activities and trading will be part of a new company called Uniper.

According to plans of the top management, the division shall be finalised at the beginning of 2016. Swedish electricity utility Vattenfall, which entered the German market in the early 2000s, has reacted with a massive cost-cutting program and may even withdraw from the German market in the future.

Without doubt, the winner of the Energiewende is the climate – not domestically, because currently lignite plants drive emissions up, but on a global scale: Over the last decade, prices for photovoltaic panels have fallen by 70 to 80 percent. In many countries and regions of the world, solar energy becomes economical without state aid and can compete with fossil-based sources of energy.

In each year between 2005 and 2012, Germany installed more new photovoltaic panels than any other country – except for 2008, when a short-lived Spanish incentive scheme was introduced but soon afterwards abandoned. The subsidies triggered and accelerated the emergence of Chinese PV manufacturers, which drove most of Germany's producers out of business but were able to decrease prices even further.

Since 2013, China, Japan and the USA have taken the lead in photovoltaic installations. More than 45 Gigawatts of new panels have been installed in 2014, more than any year before. The momentum that was initiated in Germany around a decade ago has become independent from the German market and will become the game-changer in global energy supply. ■

About the authors

Professor Christoph Burger is the author of 'The Decentralised Energy Revolution' and a consultant to businesses across. He and his colleague, Jens Weinmann, lecture at the Europe European School of Management and Technology in Berlin and are experts on renewable energy – with a specific focus on the clean energy revolution and how businesses can engage