How to run a city on renewable energy

A wind farm, several biogas plants, solar panels, a hydropower pump storage facility and electric cars are part of a unique virtual power plant project in the Harz region in eastern Germany. The project could change the way municipalities in Germany and across Europe think about producing and using energy.

by Stefan Nicola

Ralf Voigt's voice is battling the roaring wind. 'That's our big one,' he shouts while pointing to a giant windmill whose blades are turning silently. It is sitting on a hill near the city of Dardesheim, home to a 60 MW wind farm with over 30 different turbines, ranging from an 80kW Lagerwey set up in 1994 to the 'big one,' a 125m-tall Enercon E-112. The world's most powerful onshore serial unit, the E-112 has a capacity of 6 MW – enough to power 4,000 homes.

The wind farm may look like many across Germany, but it is special in that it's the key asset of the Renewable Model Region Harz (RegModHarz), a project that could revolutionize the way municipalities think about energy generation.

RegModHarz is designed to supply some 250,000 people in the Harz region with locally generated energy from wind, solar, water and biomass sources. This may sound easier than it is. Wind and solar plants produce energy only when the weather is favourable. This fluctuations put strains on grids and the balancing of supplies. The experts behind RegModHarz are convinced that they can solve these problems with a virtual power plant that intelligently combines green power with energy storage capacities and modified user behaviour.
'It is about trying to ensure the stability and reliability of the energy supply system despite the fluctuation of renewable energy sources,' German Chancellor Angela Merkel said of the project, shortly after she decided to fund it with €10 million.

Although its populations is only 1,000, Dardesheim has an impressive green track record. Renewables produce an estimated 150 million kWh per year – 40 times the power the city needs. Many municipal buildings and private homes are decked with solar panels, and a biogas plant provides heat when the sun doesn't shine. Two electric cars, one with a roof made from solar panels, cruise the city's roads. Drivers can recharge their vehicles at a plug-in station near the town hall. 'It's incredible what has been achieved here,' says Rolf-Dieter Künne, the mayor of Dardesheim. 'Without renewable energy, this city would look very different.'

Iron Curtain

Dardesheim's green future started behind the Iron Curtain, some twenty years ago. Atop the Druiberg sat a Soviet radar station designed to spy into the neighbouring flat lands of West Germany. Living on a nearby hill was Karl Radach, a local engineer. Using his binoculars, he peeked into the West – but not to spy. He saw the blades of a wind power unit turning, and they were turning fast. 'My dad thought: If this machine turns so well down there, it will work even better up here, where winds are much stronger', remembers Radach's son Thomas, who works for the wind farm consortium. After the Iron Curtain came down and Germany reunified, Karl Radach took a trip westward to visit the "Wessi" with the windmill. Soon enough, Radach purchased Dardesheim's first wind turbine – the 84 kW Lagerwey that is still turning today.

This first purchase laid the basis for today's wind farm. The man who sold the Lagerwey, Heinrich Bartelt, realized that the Druiberg had excellent winds. After consultation with city

Dardesheim. Photo: Stefan Nicola

officials, Bartelt in the mid-1990s got the green light to build his first turbines. 'It's a decision we have never regretted, much to the contrary,' Künne says. The wind farm grew quickly, and the city prospered. The city gets €50,000 a year out of the wind farm, which is used to fund sports clubs or infrastructure.

Bartelt, a charismatic entrepreneur who radiates a positive energy that seems hard to resist, convinced officials to continue expanding the city's renewable portfolio. After wind came solar, then biomass, then the government-certified title of "Renewable Energy City Dardesheim". 'Mr. Bartelt is the motor behind everything. Sometimes he calls at 11 p.m. and asks, Hey, shouldn't we do this or that?' Künne says, laughing.

From the start officials involved the local people. Citizens of Dardesheim and neighbouring towns can invest in the wind farm, at returns of between 8% and 10% per year. Information panels displaying the actual power generation are attached to the turbines and solar panels. On the grounds of a former radar station, the city built an information park visited by thousands of people each year. In the summer, the wind farm is the venue for a large rock festival that has acquired cult status in the region. When the E-112 was constructed, the entire city hiked up the hill to watch. 'We are proud of what is happening here,' Künne says. 'Our citizens don't say the wind farm, they say our wind farm.'

The development has benefited the entire region. Saxony-Anhalt today is famous for its wind and solar industries. Politicians from all over the world, including India's renewable energy minister, have visited Dardesheim to see if they can emulate this success.

Electric cars

The RegModHarz organisation has now set up a virtual power plant to manage the region's energy production and consumption. Run by the Institute for Solar Energy Technology (ISET) at the University of Kassel, it will electronically balance supply and demand, while trying to use as much renewable energy as possible.
When more energy is generated than the region needs, surplus power is used to pump water into a storage basin. When demand is high and power production low, the stored water can be released through two 40 MW turbines, generating the additional energy needed.

Over the next two years, experts will also test how electric cars can help RegModHarz in the form of small renewable energy storage systems. A communication infrastructure will be built to link electric cars with charging stations, grid operators and renewable energy providers. Cars will be able to feed power stored in their batteries back into the grid. 'Special tariffs will reward drivers when they feed power back in times of peak demand,' says project coordinator Ulrich Narup. In June, the German government decided to fund this special project, called "Harz.EE-mobility", with an additional €7 million.

Bartelt and his colleagues are optimistic they can revolutionize decentralized power generation. 'If RegModHarz can work, then the model can be used in other regions,' Narup says. ■