



Energy Co2 : Energy Efficiency

Saving Energy: The Smart Grid

There has been much talk about renewable energy production and reduced consumption. Now, engineers are looking at the link between the two: Could smart grids and power meters start an energy revolution?



Labourers repair electrical pylons on the outskirts of Pingxiang, China (Photo: Reuters)

One of the biggest problems with renewable energy is that it is so difficult to plan. Whether the wind blows and the sun shines is hard to anticipate. What is worse, some of the best places for solar energy or wind power are far a way from consumers.

Wind and solar power exemplify the dilemma. The Sahara desert holds enough solar power potential to satisfy Europe's energy needs many times over. Wind is abundant in the German North Sea and off the Scottish coast, but there is little local demand for the electricity produced.

The super grid

So-called super grids that transport electricity hundreds or even thousands of kilometers to Europe's metropolitan power houses would be necessary. Unfortunately, existing high-voltage grids, mostly built in the 1960s to 1980s, are already at their capacity limits; and every extra kilometer of conventional grid wastes energy.

While most regional grids work with alternating currents (AC), a long-distance grid would have to be based on high voltage direct current lines (HVDC) that suffer less loss, but come at a hefty price tag. A study from the European Climate Forum estimates that producing and transporting 5 gigawatts (GW) of renewable power from North Africa to Europe would need investments of 10 to 25 billion Euros, while a 1 GW coal power plant currently costs about one billion Euros.

At peak load, Europe consumes about 400 gigawatts of power. Building the renewable power plants necessary to cover parts of this demand is less of a problem, says Johan Lilliestam, energy expert at the Potsdam Institute for Climate Impact Research.



Picture Gallery (click on the image to start)

How to harness the energy of sun, wind, water, and earth (Photo: Reuters)

“Building the power lines is the big challenge,” he adds. “Today, you have to wait 10 to 15 years for permissions to build a new power line. If you want to build a lot of power lines all over Europe then you will have a very big problem with public acceptance.”

What is more, grids are also overstretched by the erratic production patterns that are typical for many renewable energy sources. The higher the share of renewable energy, the more complex it becomes to match supply and demand.

In Denmark, wind power currently provides more than 20 percent of the electricity generated. While the country still has offshore wind potential, it has already reached a level of penetration where wind power starts becoming a challenge for its grid, says David Jones, CEO of Allianz Specialised Investments.

“In a large electricity system that’s well interconnected like Germany, this is manageable. But within a less flexible grid system, if you have unpredictable power contributing much more than 20 percent, the cost of standby capacity starts to become prohibitively expensive.”

The smart grid

This is where a smart grid would come into play. Dubbed, the internet for electricity, a smart grid would link up various energy sources like wind turbines, conventional power plants, or photovoltaic cells and combine them in an intelligent way, adapting to changing demand.

In its most advanced form, a smart grid could create a virtual power plant that draws on every possible energy source. Standby renewable sources could cover demand peaks on a calm day with little wind power. Hybrid cars, parked in a garage and plugged into the grid at night, could cover the electricity needs of an urban home during peak demand in the early morning and evening. Biogas power plants, running on farm manure, are another standby source of renewable power. The possibilities are endless, and so are the challenges.

The first thing needed is smart power meters that measure consumption of every application plugged into the grid and transfer this data back to the utility. Consumers would have to disclose private data; in exchange they could buy electricity when it is cheapest and avoid cost peaks.

“Theoretically you could have an automatic dishwasher that starts when electricity is cheap and stops when it becomes too expensive,” says Johan Lilliestam. “And you would have a more detailed electricity

bill that allows you to check when you need what amount of electricity."

A 100 million dollar project containing many smart grid features is up and running in Boulder, Colorado. Xcel, the utility behind the scheme, plans to use the data gathered to let prices fluctuate so that customers pay more during peak load and save when there is little demand.



The Super-smart grid

While the first smart grid projects are barely taking shape, energy experts like Lilliestam are already dreaming of the super-smart grid. Such a network would combine the advantages of a smart and a super grid and transmit renewable electricity from small and large sites scattered over huge distances, while constantly matching fluctuating supply and demand loads.

In such a very large system, the wind always blows somewhere. Regional lows or peaks in production could thus be flattened by renewable power from other regions or through the intelligent combination of different power sources.

But would a super-smart grid be financially viable? Many uncertainties loom above the redesign of our electricity infrastructure. A breakthrough in carbon storage and capture technologies could turn coal power plants, currently the cheapest but most carbon-intensive way of generating electricity, into a climate friendly alternative. Improved nuclear power plants could be another carbon-free source of electricity.

A super smart grid might still be decades away, but transforming antiquated electricity grids into smart grids could improve energy efficiency in the coming years. UK opposition leader David Cameron

has promised to invest one billion pounds in a smart grid and smart power meters if elected. And U.S. president Obama already earmarked 4.5 billions dollars of his stimulus package for smart grid technology.

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One of the problems with smart grids is that they are less enticing for utilities that still profit from rising energy consumption. A new system would have to base their revenues on the electricity saved, rather than on the power sold. In the end, all the shiny new technology won't work without dedicated consumers and politicians changing the rules of the game.

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