

Wind, Solar, Storage and Electric Cars – Our high tech renewable future!

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An article in the current issue of *MIT Technology Review* presents a picture of how renewable energy for power plants is making a greater impact and how it may look not many decades out as wind and solar power are intelligently integrated into a power grid. Readers know that I have traditionally been skeptical about the extent that we may soon rely on huge amounts of renewable energy, but I am certainly interested in developments (including the rapid drop in the cost of solar cells) that will bring us closer to have a more significant percentage of our electricity generation come from wind and power. A number of approaches are already able to optimize the mix of sources a utility relies upon to generate the electricity demand load at any given time. A few decades ahead, the situation could improve more dramatically as daily supply and demand from different energy generation sources are optimally managed, together with electricity “storage”.

In Colorado, Xcel Energy, its largest utility, generates electricity at a number of large wind farms: every few seconds each turbine sends information about how much power it is generating to high speed computers a hundred miles away. These data are crunched with data from weather satellites and from other wind farms, providing wind power forecasts with surprising accuracy. These help the company deal with the big challenge of “intermittency” (Loss of wind, cloudy weather), which requires Xcel and other utilities to operate backup plants burning fossil fuels. The greatly improved forecasts allow the company to operate much less backup power, thus greatly reducing carbon emission from idling units and saving money. Good forecasts, such as when there is a chance ice could form on wind turbines, slowing or stopping them, can give early warning to start fossil fuel based generators. On nice days, however, all backup plants may be shut down. On such days, wind power becomes the prime variable power source at Xcel and turbine power production can be varied to meet demand. The much better

forecasts allow Xcel to project how much wind power it can expect in 15-minute increments for seven days ahead.

Forecasting solar power is more tricky. It makes sense, however, to see how wind and solar can complement each, given the fact that solar power is generated during the day while wind power is or may be generated at night. But the most interesting approach involves electric and hybrid cars. Cars store enough energy to power a house for a day or more, depending on battery size. With some modifications, car batteries can be reversed to deliver stored power to homes and the power grid. The concept is that when a substantial percent of new cars are electric or hybrid, cars not being driven could store solar power from solar panels during the day and use it to power neighborhoods when electricity peaks in the evening, recharging the batteries with electricity from wind power at night(!) This will obviously require complex forecasts on the number of cars on the road versus charging/discharging at home, weather forecasts, etc. And drivers will worry whether they will be fully charged in the morning – though hybrids would be ok. It could make sense.

In Colorado, wind power is already a major contributor. Similar to what was the case on a summer day in Germany that I wrote in my October 14, 2013 post, Xcel in Colorado on a windy day during a weekend last year supplied 60 percent of its electricity from wind power over a period of one hour(!).

Let's keep our eyes on battery technology. In *Atlantic* magazine, ex Energy Secretary Chu projects that battery storage costs will drop radically over the next decade or two. Combined with very cheap solar power, houses away from electricity grids will become independent of utilities as storage batteries supplant external power supply and generators(!). This is already envisioned for parts of Alaska not served by utilities and for parts of Asia and Africa that do not have power grids

Electricity "storage" is also involved in the solar process that heats a circulating fluid which then generates steam – and can be stored for periods of hours or more to generate power when the sun had gone down.(See my post dated December 22nd, 2013). Electricity storage, already being created by pumping water up to reservoirs and then using the downflow to drive turbines, will become a much more important than it is now.

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