In my last post, I talked about how Obama's Clean Power plan was the right response to a changing grid. The grid is in the process of changing even more. Itwas designed for some relatively straightforward tasks. The main power plants, mostly burning coal (but sometimes natural gas or nuclear energy), ran day and night. They were supplemented by other power plants when needed to meet load (customer demand). All the power flowed from these central power plants and was instantly used by consumers, who were billed based on their total consumption and sometimes on their peak demand. The fundamental rule was that increasing demand for power allowed for greater economies of scale, reducing costs. Thus the goal of electric utility companies was to increase demand for electricity, thereby lowering average production costs and increasing their profits.

Power systems today have begun to deviate sharply from this model and will do so even more in the years to come. Power is increasingly coming from solar and wind, which are less predictable and more prone to fluctuations. Consumers may generate their own power from rooftop solar and sell it back to the grid. Storing electricity has become more feasible and is likely to play an increasing role in grid operations. Meanwhile, for both economic and environmental reasons, ever-expanding electricity demand is no longer appealing. Consumers are starting to play a more active role in managing their own electricity use, and energy conservation has become an independent goal.

Utilities have already spent billions of dollars revamping the grid for the 21st Century, with more yet to come. One particular focus has been installation of smart grids, which give utilities real-time information about consumption and also allow consumers to shift their demand away from peak use periods. Over 40% of consumers nationwide are now covered by smart grids, and the number is continuing to rise. Utilities are also digitizing the grid in other ways to better track possible overloads and to respond to outages more effectively. Some people are talking about blockchain as a game changer for the grid — but then, that's pretty much what they always say about blockchain.

California and Illinois are the two states where utilities have invested the most in the smart grid. In Illinois, ConEd claims a 50% reduction in the frequency and duration of outages due to its upgrades, including a 10% decrease in the past two years alone. In California, utilities reported spending $500 million on grid upgrades in the 2016 fiscal year with benefits of nearly $1 billion. Nationally, the Department of Energy has estimated that utilities invested $32.5 billion in the smart grid from 2007 to 2014.

Technological change is allowing greater digitization of the grid and more refined control. For instance, "smart inverters" can aid grid stability while providing smoother integration of solar and wind into the power system. Here's a non-technical explanation from Energy

News:

> "Traditional inverters have helped manage this change by converting solar energy into the kind of electricity used on the grid, and by shutting off when there's a potentially unsafe change in system-wide voltage or frequency. That kind of basic functionality is sufficient for low levels of solar but higher penetrations [i.e. greater usage] could pose technical problems. [But] advanced inverters have multiple ports that allow them to manage the flow not just between solar panels and the grid, but also between solar panels and an on-site battery, or between solar panels and an electric vehicle charging station, or between an on-site battery and the grid itself."

When use of smart inverters becomes more widespread, it will be easier to integrate larger amounts of renewables into the grid.

From the environmental perspective, the smart grid is important for several reasons. According to the Congressional Research Service:

> "The potential for the Smart Grid to enable change may be most visibly exemplified in the potential to further integrate variable renewable resources at a lower cost. A wider deployment of a "fully functional" Smart Grid could see the renewable generation in one state or region supporting energy needs in another state or region. It is likely that all of the drivers and technologies—from microgrids, energy efficiency, smart appliances, and zero-net energy homes to electric vehicles (EVs) and energy storage—could see more effective deployment at lower cost from an integrated Smart Grid approach."

The smart grid is also a prerequisite for any massive rollout of electric vehicles. While Trump is trying to provide temporary support for obsolete generation technologies like coal, state utility commissions and utilities are busy laying the foundations for a modern sustainable power system. Trump Administration policy is in many respects an effort to recreate the past, but utilities are looking toward the future.