

Carnegie Mellon's Eighth Annual Conference on the Electricity Industry: What They Really Said-- A Personal Take

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First imagine the setting. The Cathedral of Learning bulks dark against the western sky with a half moon behind it, and to the east, rosy-fingered dawn extends her tendrils over Carnegie Mellon's Greek temple, as I hike through Pittsburgh darkness (they start early and go late at Carnegie Mellon) to a conference entitled "Data-Driven Sustainable Energy Systems", located around the corner, down the stairs to the basement in Giant Eagle Auditorium (named after a local grocery chain), which resembles Zankel Hall in the bottom of Carnegie Hall except for the acoustics.

Think about the conference title. Data will play a crucial role in the provision of new energy services, many of which will integrate renewables into the grid, help the utilities to run more efficiently and the consumer to consume electricity more efficiently. (We could debate about the definition of "sustainable" but we would agree that spewing out less carbon dioxide and using fewer resources to accomplish our goals makes us more sustainable than before.) Here is how.

Renewables introduce uncertainty and variability into the electricity network. They do not always run when the system needs them and, to make matters worse, they may stop running just when the system needs them. The system operator has to keep track of and find ways to integrate renewables into the system despite their unfavorable (from the system operator's standpoint) characteristics. That requires data for prediction and real time understanding of the situation. Even excluding the renewable problem, real time information about the state of the network and its equipment would enable the system operators to run it more efficiently, anticipate problems or catch them before they become serious, and clear them up faster. At the customer level, measurement and interpretation of data would permit the electricity companies to provide information that would help the customer to adjust energy consumption in an economically beneficial manner, to monitor service levels, and give the customer an easy means to make consumption choices.

You can read the papers submitted (over 50 of them) on the web. I admit that I did not hear everything and did not understand everything. These are my takeaways, ideas that I picked up at the presentations, the receptions and the hallways.

- The better the wind forecast, the lower the reserves needed. On shore wind blows out of sync with load. Off shore wind is more predictable: the regular sea breezes. The market is not designed for variable generation. The network can handle wind energy up to 20-30% of needs. Wind requires storage because too much of it blows when there is

no load. Lithium ion batteries can provide storage. So can a water heater at home. Wind is a social -- not an economic -- choice.

- Information tells system operators how close to the edge they can reliably operate the network.
- Incentives are needed to get investors in conventional generators to build new units.
- Forecast error for wind declines as the system gets closer to real time, from 20-30% to 1-2%. The system, however, still has to have fast response units available to make up for deficiencies at real time.
- The electricity industry requires a systems approach to renewables. Hurricane risk, for instance, is greatest at the best offshore wind sites. Building to protect against hurricane damage adds 20-30% to costs. Coal and gas units have to fill in quickly when wind fails.
- Renewable portfolio mandates specify the percentage of renewables in the generating mix, not the percentage reduction in carbon emissions.
- Sustainability means conserving the planet's life support systems. Which requires monitoring the environment and infrastructure, and changing behavior, too. When shooting for long term sustainability, policy makers might want to consider Jevons' paradox (improving the technology used in the consumption of a resource makes more of the resource available for consumption and consumers then use more of it).
- Users have to see data in real time.
- Operating the network with lower margins requires more controls and data.
- Adding distributed resources to the network can create instabilities, so the system operator will need more information, will have to act speedily, and will require more assets that can follow the load.
- If the customer does not want it, it does not happen.
- It's a network, a single system, and a major plant outage in Florida had an impact in Manitoba.
- The case for distributed generation: it could reduce system reserve margin to 5%, reduce line losses by 50%, lessen the need for new transmission lines.
- In a complex, coupled system, the number of links and interfaces determines reliability, not the reliability of each interface.

- What other industry calls customers "loads"? The assumption behind the name is that the customer acts in a highly inelastic fashion. Markets are about autonomous agents that interact. They need real time information.
- Planners should consider option value when making decisions, try to make more choices in the future (when more information is available) rather than locking in decisions way ahead of time.
- Twenty seven states plus DC and Puerto Rico have renewable portfolio obligations that require the electricity supplier to buy renewable resources.
- With adjustment in voltage support, transmission line could carry more wind - generated energy without building new transmission lines.
- ARPA-e, the Department of energy's venture capital agency is looking for home runs, and understands that it will suffer failures during the quest.
- More distributed generation leads to small energy users paying for a greater share of transmission and distribution. That is, those on the bottom rung of the economic ladder pay more.
- We need to see the development of a science of cyber security because of the unprecedented level of communication and coordination -- within plants, between plants, between plants and home, within the home.
- Studies of the impact of home displays (which give energy information to consumers) suffer from biases which exaggerate impact, so existing studies cannot be relied upon to measure benefits to consumers.
- Power grids waste too much energy. Grids built in the 1970s need replacement. The grid should capitalize on existing rights of way.
- The old electric world involved 10 samples per second, market data at intervals of 60, 30, 15 minutes for large customers and one month for small customers. The new world involves 30 samples per second, and market intervals of 60, 30, 15 and 5 minutes and who knows what next?

One of the speakers said, "We know that there are enormous opportunities out there" -- meaning opportunities to improve the operations of the electric network, improve its sustainability, improve its economics in a conventional sense, and even transfer some of those benefits to consumers or to society as a whole. The presenters rose to the challenge in that they unveiled a plethora of ideas, many off which could provide us with tools to grasp those opportunities, if developed and packaged properly for decision makers and investors.

One consultant said, "A lot of this stuff will go nowhere." But, having worked with venture capitalists, that observation does not disturb me. A lot of stuff goes nowhere in any line of business or inquiry. The winners should more than make up for the losers. What did discourage me was a comment by a rising star in the field who said that nobody listens. Nobody meaning all the regulators, bureaucrats, risk averse executives who operate under a perverse set of incentives that may stifle innovation and discourage both economic and sustainable improvements, and don't know or care much about technology anyway. Where are the visionary engineers or marketers that will move the process forward?

Should the presenters publish undecipherable papers and then move on to other projects or to other countries, or should they push their ideas into the world and make some noise, maybe establish an "Occupy Electricity" movement? They did not present papers about the origins of the universe or the hidden sexual relationships in America's two greatest novels or delve into the well of deep philosophical ideas. They wrote about practical matters-- how to make the electricity network more productive and sustainable. Practical ideas unimplemented don't amount to much. Maybe getting them implemented should be the topic for the Ninth Annual Carnegie Mellon Conference on the Electricity Industry. Or maybe something sooner.