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RENEWABLE ENERGY:
A Smart Grid Is a Green Grid

By Kurt Yeager

Upgrading the network of power plants, power lines, and substations that constitute our electricity grid is decades overdue. This upgrade to a "smart grid" will be the energy equivalent to opening the information superhighway, as it ensures that information about pricing and use gets to consumers and electricity producers in real time so they can conserve energy and anticipate problems. In addition, smart technology will allow our current electricity grid to better incorporate renewable energy sources such as wind and solar power. The benefits of a smart grid include increasing the efficiency of the current electricity infrastructure, reducing greenhouse gas emissions, and reducing costs to consumers.

The importance of renewable energy has been recognized, and repeatedly rediscovered, since ancient times. Today, we are again rediscovering wind, solar, geothermal and biomass renewable energy resources because of their potential importance in limiting carbon dioxide (CO_2) emissions from electricity and establishing sustainable U.S. energy self-sufficiency.

Although the cost of renewable energy sources, which emit no CO_2, is becoming more competitive with rising coal and gas costs, these sources still provide in some cases less than one percent of a state's electricity. A major reason why coal and gas remain dominant despite rising costs is because today's electricity grid is not designed to handle renewable energy sources such as wind and solar on a large scale.

For today's electricity grid to accommodate a significantly higher percentage of wind and solar power, it would need large quantities of conventional back-up power and/or non-existent large-scale, centralized energy storage (i.e. huge industrial batteries). These would be necessary to compensate for natural variations in the amount of power generated depending on the time of day, season, and other factors such as the amount of sunlight or wind at any given time. Because today's electricity grid cannot handle this variability, the cost of adopting these renewable energy sources is much more expensive than it should be. In other words, many power companies do not pursue renewable energy simply because their grids are too old, too inefficient, and too cumbersome to adapt.

Successfully incorporating renewable electricity sources like wind and solar into states' existing power transmission and distribution grid requires state-wide deployment of what has become broadly known as the "smart grid." The smart grid can be best understood as the overlaying of a comprehensive electronic control and communication system on the current power grid, essentially providing 1950s technology with an upgrade that is 50 years overdue. In many ways, a smart grid is the energy equivalent of the information superhighway, as it ensures that the right information gets to the right people at the right time so they can take the right actions.

This much-needed upgrade would optimize power supply and delivery, minimize losses, "self-heal," enable maximum use of renewable energy resources, and substantially increase energy efficiency. A smart grid incorporates a variety of important technologies, including smart meters that enable time-

of-use electricity pricing for consumers; electronic sensors and controls that enable the grid to automatically correct for power supply variability; and distributed clean generation and storage that maintain system reliability at all times under all conditions.

One benefit of a smart grid is that it provides an instantaneously accurate flow of information, eliminating the cumbersome layers of slow—and manual—decision-making required by today's grid operators. Instead, a smart grid better automates the complex network of devices that control the flow of electricity to work together faster, more efficiently, and with a level of precision that is not possible using today's manual systems. Furthermore, a smart grid supports renewable energy because it can anticipate the intermittency of wind and solar power and keep electricity supply in absolute balance with consumer demand at all times, at literally the speed of light. As a result, far less back-up power and expensive storage capacity will be needed to keep the power system from failing to keep the lights and computers on.

Just as a smart grid can protect users when renewable sources are not operating at optimal generation, it also will enable each transmission and distribution line to carry much more electricity without the risk of overloads and blackouts when the amount of power being generated is high. The need for coupling a smart grid with renewable energy was recently demonstrated, for example, by the near collapse of the obsolete Texas power grid in February 2008 due to a sudden drop-off in wind speed. Indeed, as reported in the media, "Texas power grid operations narrowly avoided rolling blackouts."

In addition to making renewable energy more efficient and reliable, a new smart grid will also enable distributed power generation and plug-in hybrid electric vehicles to contribute to grid reliability and capacity. And a smart grid will enable consumers to better control the cost and quality of their electricity service with absolute convenience. Real-time "prices to devices" is the ultimate realization of the smart grid. Here, dynamic utility price signals are conveyed to consumers' appliances, which then automatically adjust their operation to best meet each consumer's cost and performance requirements.