Section 3: Value of a Smart Grid System

Implementing a Smart Grid is the effort to move the electric grid from a "static" to a "dynamic" state. Doing so improves the efficiency, reliability and cost-effectiveness of the electrical system's operations, planning and maintenance and creates a system that is interactive with consumers and markets, allowing better energy and dollar savings. Below we summarize the value of the Smart Grid from six perspectives:

Consumers

Environmental

Utilities and Grid Operators

Market Efficiency

Economy

Regulatory

Comment [g1]: This sentence needs to be cleaned up and strengthened when sections 1 aND

Consumer Value of a Smart Grid

Smart Grids will provide consumers many benefits, deriving mainly from the increased information and insight it brings them about their individual consumption as well as the minute-to-minute state of the grid. Consumers will benefit from knowing the price of energy at any given point in time and how it will impact their energy costs. Most importantly, they will have the opportunity to make more informed energy consumption decisions as a result of the availability of this information. In order to achieve overall consumption, consumers must change, and for that to happen, the system must provide them with the information they need to make better decisions.

An essential component of a Smart Grid system is the successful implementation of advanced metering infrastructures (AMI), which allow collection and distribution of information such as consumption to individual consumers. States like California are already well on their way to bringing AMI to their utility consumers. Beginning in 2005, the California Public Utilities Commission ("CPUC") created the pathway for all California investor-owned utility consumers to have AMI meters.[1]

Comment [g2]: Need examples beyond California.

Comment [g3]: Not sure explanation of AMI belongs here – might be more appropriate in section 2

A Smart Grid system should provide more efficient and reliable energy while providing consumers with valuable information for better decisions on when, where and how to consume energy. The California Public Utilities Commission (CPUC) on July 31, 2008 continued its commitment to empower energy consumers by setting a timetable for

[1] CPUC Decision 05-09-044. See http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/50267.htm

Pacific Gas and Electric Company (PG&E) to propose new "dynamic pricing" rate structures for all of its customers. Dynamic pricing will enable PG&E customers to take advantage of the new advanced meters that PG&E is installing throughout its service territory. With the new advanced meters, customers will no longer have to wait until the end of the month to see how much energy they have used. The new meters will tell customers how much energy they are using day-to-day and hour-to-hour. Dynamic pricing will give consumers a tool to take advantage of the new meters and reduce their electricity bills.[2]

Another expectation of the Smart Grid system is that it will allow advanced decision-making in order to make more efficient and cost effective use of electricity. A fully network-connected system will identify all aspects of the power grid and communicate its status and the impact of consumption decisions (including economic, environmental and reliability impacts) to automated decision-making systems on that network including the consumer's home network. As a result, a Smart Grid system would clear the way for more energy efficiency. Energy efficiency is the least- cost, most reliable and most environmentally-sensitive resource, and minimizes our contribution to climate change.[3]

Environmental Value of a Smart Grid

The overall value to the environment and society of a Smart Grid will be in the form of a reduced need for additional transmission lines, power plants and correspondingly less impact on the environment, including reduced greenhouse gas (GHG) emissions. For instance, the California Independent System Operator (CAISO) system peak usage in [year] was 50,085 megawatts.[4] However, usage has reached 45,000 megawatts only 0.65% of the time.[5] This means that California, like others, is building peaking plants, additional transmission lines and distribution lines to meet demand that occurs less than one percent of the time. Recovering the capital costs of these rarely used assets results in extremely high peak energy prices, which can be avoided via consumer price response and energy management.

A successful Smart Grid system will reduce usage during peak hours so that additional resources are not built. Efficient use of resources helps not only the individual consumer from having to pay for resources that are stranded 99.35% of the time, but

[2] CPUC Decision 08-07-045
[3] California Energy Action Plan II at pg 5.
[4] [add cite].
[5] [add full cite]

also helps keep our environment cleaner and our neighborhoods safer from additional transmission lines and power plants. A Smart Grid system will create the ability to optimize traditional fuel sources and decentralize power generation to allow increased distributed generation such as solar panels, wind turbines and combined heat and power systems (CHPs). Distributed power generation allows individual consumers to generate power onsite and/or close to load centers, thereby eliminating or significantly reducing the need to build costly transmission lines.

Integrating renewable resources that are customer- and utility-operated will require an open Smart Grid architecture that can manage the diverse resources for economy and reliability.

Utilities and Grid Operators

According to the Electric Power Research Institute ("EPRI") a major blackout can cost an affected region in excess of $1 billion in direct costs and socioeconomic impacts. Reducing the probability of a major cascading outage by even a fraction would result in savings in excess of millions of dollars annually.[6] Smart Grid technologies such as synchrophasors (reference the North American Synchro Phasor Initiative) will lead to new methods of grid reliability monitoring and management. Combined with technologies such as FACTS devices and Dynamically Insertable Reactance, grid operators will have new tools for managing the grid for reliability, congestion management and relief, and economics.

Smart Grid technologies also will provide more sophisticated monitoring of major transmission assets such as circuit breakers and transformers, thus enabling grid operators to better predict maintenance needs and avoid failures. A 230kV or higher power transformer is a critical multi-million dollar asset with increasingly long lead times for delivery. The nation's transformer fleet was largely installed in the 1960s and 1970s and is approaching what would otherwise be end of life and expensive replacement. Asset management methodologies enabled by the Smart Grid offer life extension and the deferral of very expensive replacement as well as avoided failures.

Just as consumer energy intelligence from the Smart Grid leads to avoided peak generation capacity needs, it can also defer transmission investments due to peak requirements. Furthermore, integrating remote renewable resources -- especially wind -- with the grid will require smart grid technology.

[6] EPRI. 2008 Research Summaries. Grid Operations – Program 39 at pg 2.

Market Efficiency

Lack of information leads to market inefficiencies in all market domains – financial, commodity and virtually anything that people trade. Energy is no exception. Better forecasting and management of demand and renewable production, as well as increased delivery assurance from better reliability, will lead to improved market efficiencies. Furthermore, energy storage technologies offer the promise of making electricity markets more like other commodities and not so volatile due to shifts in moment-by-moment production.

Economy

The United States has enjoyed a low cost and reliable electricity supply for roughly a century, which has been a key driver for economic growth, productivity, living standards and environmental compliance. That trend is at risk due to aging infrastructure, an unprecedented change in energy resource mix and the need to quickly change the carbon content of the infrastructure in response to the reality of global warming. Every other industrial and commercial sector has seen great benefits from automation, embedded intelligence and integration into a broader and broader domain of electronic commerce. Electricity will reap the same benefits from the Smart Grid, with corresponding benefits to all walks of American commerce and life. By contrast, to not pursue Smart Grid aggressively condemns the United States to dependence upon 20th century grid architecture. In response to the "end of oil" and carbon reduction, many forms of end energy consumption such as transportation and home heating will shift from oil and other fossil fuels to electricity. The Smart Grid is essential to the national preparedness for this change.

Regulatory

The grid has morphed from being the wires that utilities used to deliver power from their own generators to today's (partially) deregulated model where the wires are provided by utilities to customers so that both independents and utility generators can deliver power. Regulators have wrestled with questions of open grid access and cost recovery mechanisms as well as determination of what decisions are considered prudent and necessary investments through this transition. The explosion of new technologies for renewable and distributed generation means that the "wires" broadly speaking now must integrate new technologies, bi-directional energy flows and the information to make it all work.

Conclusion

When the United States' original power grid was built over 100 years ago, it was not necessary or even possible to think of consumer choice and distributed generation. However, today we are faced with dwindling fossil resources, higher demands for energy, a need to have dramatically reduce carbon usage, and a need to provide better energy information to consumers and businesses. Today's grid has reached the end of its useful life both physically and functionally. A Smart Grid will provide tangible and intangible benefits to all stakeholders, including consumers, utilities and regulators. It will bring environmental benefits through efficient use of energy and existing capacity, and it will give customers options and choices to change their behavior when it comes to the amount and type of power they use, and when to use those energy resources. Utility operating costs should be lower as a result of automation and better visibility into operational aspects of the grid, leading to more efficient and effective use of resources. The reality is that our outdated grid is not only a challenge, but also an opportunity to provide benefits impossible with the system of today.