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State of the Electric System in 2030

The Issue

Last month's SGN article by Joe Miller discussed how the transition to a Smart Grid might take place. Joe's article was part of a series that has discussed the seven Principal Characteristics of a Smart Grid. While those seven characteristics promise a future in which the power grid supports and enables the needs of 21st century society, such a grid does not exist today. And it will not exist tomorrow unless there is a concerted effort by all stakeholders.

The likely alternative is a grid built on a "business as usual" (BAU) basis. In that case, equipment will be replaced in kind as it wears out as design models will be the same as those employed over the past century. Little attempt will be made to move toward a new paradigm based on 21st century technologies - particularly digital communications, imbedded intelligence and computing, advanced materials, and power electronics.

Drivers

There are several major drivers/concerns that will help shape the future electric system.

Cost Concerns:

The life cycle cost, or total cost of ownership (TCO), of all baseload generation technologies is going to increase dramatically. Any carbon taxes and/or CO_2 offsets and markets will make it more costly to operate carbon-fueled baseload generation, particularly coal-fired generation. In addition, natural gas and coal prices will continue to rise, as will the cost of nuclear fuel. And the capital cost for new power plant construction will grow sharply as commodity and labor costs continue to inflate.

Efficiency Concerns:

The issue of climate change will place a major emphasis on improved power system efficiency. Nonetheless, the efficiency of our existing centralized generation fleet is going to decrease over time, as a result of both aging equipment and the retrofitting of more plant environmental control systems. Alternatively, distributed energy resources (DER) could be deployed to serve much of the peak load at the point of consumption, eliminating the electrical losses associated with the transmission and distribution of centralized generation. Distributed energy resources including generation and storage, as well as the increasing use of demand response, could be readily integrated into a Smart Grid as this is simplified to the level of "plug and play." And, distributed generators themselves can be more efficient than large central plants since they can deliver both electricity and heat to consumers. In addition, the increased penetration of clean renewable sources could be a large part of a shifting emphasis from a central generation model to a distributed generation model.

Public Concerns:

The huge societal benefit of energy independence is going to be widely recognized, as will the value of grid reliability. With SAIDI and SAIFI (outage duration and frequency indices) increasing 3-4% per year, businesses in a typical state are losing $2B per year due to power disturbances. As a result, grid divorce - the number of customers who have decided to provide their own power and not use the grid - has grown 33% per year over past decade.

While many of these concerns can be mitigated by the move to a Smart Grid, the inertia associated with a BAU strategy could still be too great to overcome.

A View of Two Futures

While none of us has a crystal ball, the following two scenarios are based on the information, trends, and research that the Modern Grid Strategy team has been doing for the last 4 years.

Scenarios for 2030	
Business As Usual Scenario	**Smart Grid Scenario**
Reliability continues to worsen; SAIFI at 1.7 and SAIDI above 200 minutes/yr.	Reliability greatly improved; SAIFI below 0.4 and SAIDI below 10 minutes/yr.
CO_2 emissions increase 35%	By employing DR, consumer DG, storage, etc, CO_2 emissions revert to 2005 levels.
Billion kwh — 2005 — 2030 Residential sales — 1,300 — 1,900 Commercial sales — 1,200 — 2,100 Industrial sales — 1,000 — 1,100 — 3,500 — 5,100	Growth as to the left; however, it comes from an expanding economy offset at the same time by decreasing per capita energy intensity.
Demand increase to 125 GW over the next 20 years, with replacement generation of 150 GW over that same period.	Half of all new generation capacity (growth and replacements) is offset by use of consumer-side resources to more effectively address peak and variable needs.
The peak to average energy ratio increases in the next 20 years by a factor of 2 or more	The national peak to average ratio stabilizes at 1.2.
Generation asset utilization drops 16% by 2030, from 47% (2007) to 31% (2030).	Generation asset utilization reaches an all time high of more than 60 %.
Continued battles over new generation and transmission elevate with court cases becoming the normal resolution path, further eroding consumer relations for the industry. The new “industry everyone loves to hate.”	Since new generation build is only for baseload as the economy expands, and new transmission build is to gain further access to renewable energy sources, there is greater public approval of new construction.
Re-regulation as federal and state authorities try to manage volatile electric and gas prices with stop-gap measures.	Because intelligence in the grid enables a better real time connection between a wider variety of assets and markets, energy volatility moves from 67% (2007) to less than 20% (2030).
Customer satisfaction continues to slip and grid divorce tops 30M customers.	Grid divorce stabilizes at 4M customers, and most utilities have for-profit programs that provide grid divorce systems and services for those who choose.

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CO_2 control / capture and tax become the largest cost factor in the capital expenditures (CAPEX) required to build a new fossil power plant.	CAPEX for generation shared between renewables and CO_2-creating baseload resources. Utilities advocate renewables and demand response equally with fossil and nuclear.

But How Do We Pay For It?

The potential benefits of moving to a Smart Grid strategy are clearly illustrated in this table. But the above question always arises. While it is a fundamental question, the answer may be deceptively simple. Take some of the money that would go into traditional generation and transmission under a BAU approach and spend it instead on Smart Grid modernization. Easy to say and probably correct, but the challenge is to make it happen, particularly given that there could be winners and losers in the business aspects of the electricity delivery system.

Yet in the final analysis, everyone is a winner when the U.S. quality of life is made better. And that is what a Smart Grid promises to do.