Author: Steve Pullins – Horizon Energy Group

Energy Central series on the Seven Principal Characteristics of the Modern Grid

[Article 3 of 7]: ***Research on the Characteristics of a Smart Grid by the NETL Modern Grid Strategy Team***

Enables Markets

Last month we presented the second Principal Characteristic of a Smart Grid, "Accommodates All Generation and Storage Options." This month we present the third characteristic, "Enables Markets." This characteristic will fundamentally enable competitive and regulated markets to the benefit of the consumer. Along with the other six, this characteristic, defines a Smart Grid that will power the 21st Century economy. For a more detailed discussion on "Enables Markets", please see: http://www.netl.doe.gov/moderngrid/docs/Enables%20Markets_Final_v2_0.pdf

Summary

There are three main elements of market functionality that the smart grid must enable:

1. A properly designed and operated market efficiently reveals benefit-cost tradeoffs to consumers by creating an opportunity for competing services to bid.
2. A smart grid allows regulators, owners and operators, and consumers to orderly modify the market rules to suit local or regional operating and market conditions.
3. Market infrastructure and support systems are critical factors in successfully enabling markets with a smart grid.

An electric market must simultaneously exhibit rigor, discipline, and flexibility. Greater intelligence in the grid allows more rigor and discipline through application of rules and transparency, while also enabling the flexibility to design and operate new services or old services in a new way. According to Vernon Smith, 2002 Nobel laureate in economics, (Wall Street Journal, 2003), "…better and cheaper technologies will be invented once retail energy is subject to free entry and exit. No one knows what combination of technology, cost, and consumer preferences will be selected. And that is why the process must be exposed to the trial-and-error experiment called free entry, exit, and pricing."

As shown in Figure 1, there are different timeframes, or elements, of market operations from the long-term preparatory phase (Planning) to the operating phases (Day Ahead and Real Time) to the settlement phase (Post Real Time).

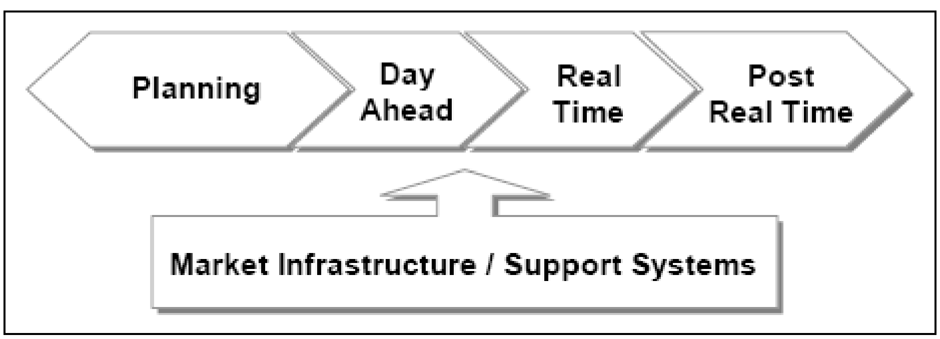

Figure 1: Market Operating Timeframes

Current State

The majority of the nation's electric power system operates in accordance with rate structures established by state utility regulators. These rates are based on the cost to build out the service, other directly passed costs like fuel costs and line losses, plus a reasonable rate of return on the investment.

Where retail markets operate today, the rates typically separate production costs and wire costs. But, the consumer is served by the same wires, and often the same generation, thus the "savings" in a retail market are just not there. This minimal cost savings for consumers could explain the low participation in state retail choice programs.

A quick assessment of the wholesale market shows that 60% - 70% of the nation's electric system participates in competitive markets (see Figure 2). The participation in these markets seems limited to generators and transmission operators, however, there is a steadily increasing number of new market participants as prices increase.

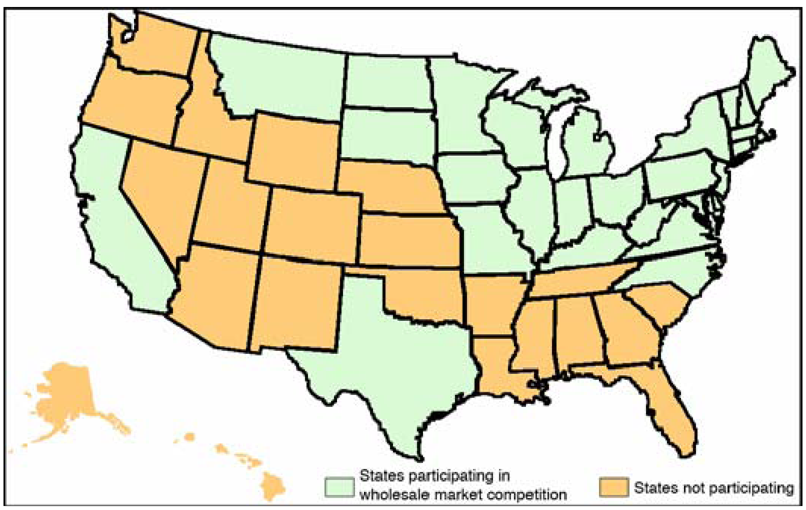

Figure 2: States Participating in Wholesale Markets (DOE EIA 2005)

Nationally, electricity markets today can be described as:

- Bilateral and long-term wholesale transactions are the majority,
- Wholesale markets, where operating, are mostly day-ahead markets and zonal in nature,
- Real time, locational, and ancillary services markets are in the minority, but RTO/ISO's are transitioning to these, and
- Active participation in retail choice markets is small.

The competitive wholesale market has steadily made more services available to participants and has increased the number of participants.

Some industry professionals claim that the higher average wholesale price in regions served by regional transmission organizations (RTO) and independent system operators (ISO) is due to deregulation of the markets. The wholesale price in RTO/ISO regions is higher than those in vertically integrated regions and large public power regions. However, this is not a real or fair comparison because the average wholesale prices were already higher in those regions before the introduction of the RTO/ISO. To effectively evaluate the market performance in RTO/ISO regions, it is important to compare what the average wholesale price is to what it would have been without the introduction of the RTO/ISO. Most RTO/ISO's have conducted detailed studies of the effects of market transition in their regions. The results show that without the transition, the average wholesale price of electricity would have been higher in an already high priced region.

Complaints with national interest electric transmission corridors (NIETC) and FERC Backstop Authority are publicly being tied to RTO/ISO markets as the cause, but this may be misleading. Such actions to build transmission in one state to sell power in another pre-dates RTO/ISO introduction and continues in regions that do not have an ISO. These situations are far less transparent than the transmission expansion plans in RTO/ISO markets.

Future State

The nation will always have regions of competitive markets and regions of vertically regulated markets (non RTO/ISO), and the future will see full commoditization of electric supply and deliver. This will best be served by open-access (wholesale and retail) markets across the country.

Wholesale markets will be regional since regional differences affect the ability of transmission networks to serve markets. Figure 3 represents compilation of vast stakeholder feedback from the Smart Grid Summits conducted in 2005 – 2007.

Energy Central series on the Seven Principal Characteristics of the Modern Grid

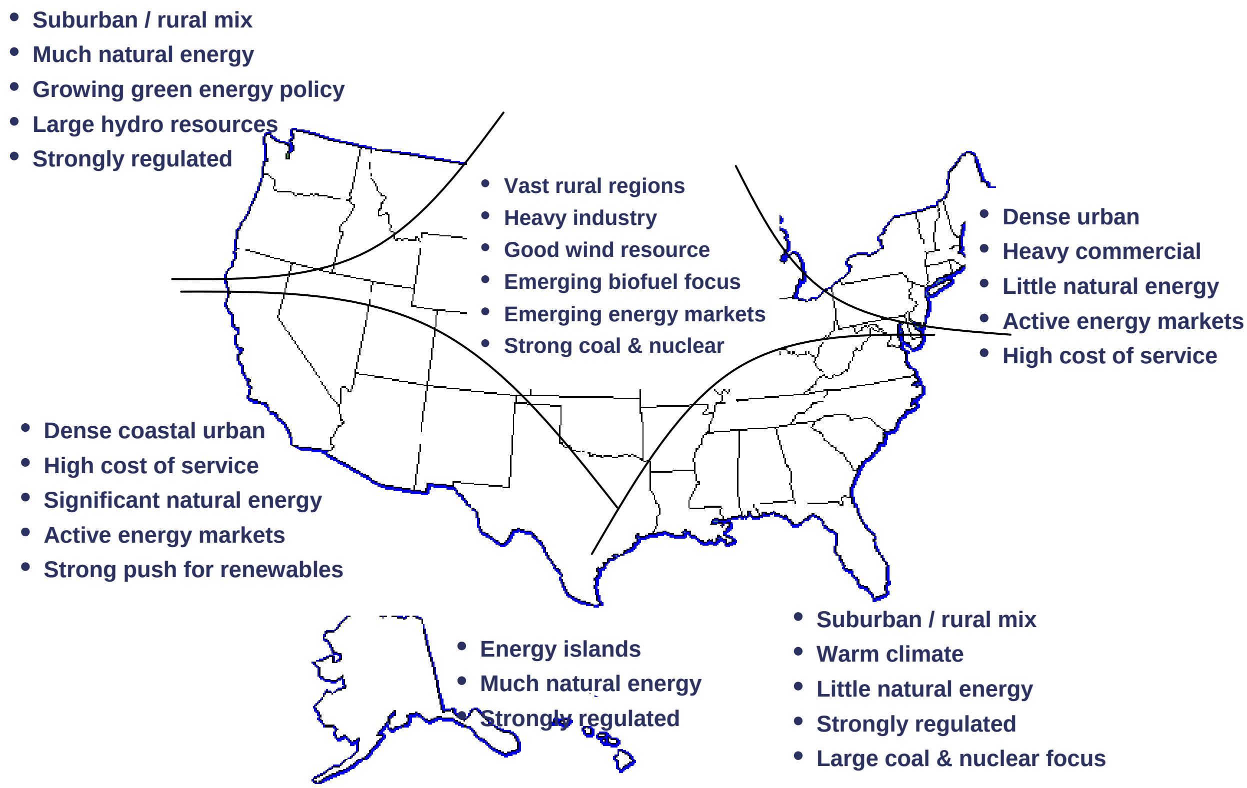

Figure 3: Regional Differences

If the present generation trends hold, the future will see a larger number of smaller generating units distributed throughout the load areas. This will increase the need for intelligence in the grid to manage a larger number of generating units. Today, there are roughly 25,000 generating units connected to the grid. In 20 years, that number could top 150,000 with an average unit size under 20 MW.

In addition, new market elements will emerge in the future:

- New ancillary service offerings at the wholesale level,
- Renewables, carbon, and other specialty markets will blossom at the wholesale level, and
- Distributed energy resource (DER) and other consumer-rich markets will be introduced at the wholesale and retail market levels.

Clearly, the market offerings (and complexities) will expand over time. It is only natural.

Requirements

To function properly, wholesale and retail electricity markets require adequate physical and information infrastructure, sound market rules, vigilant oversight, and fair, equitable access. This requires new tariffs, systems, information flows, and training of a growing number of market participants. This demands logical and controlled deployments to assure smooth transitions to new markets.

As the industry needs grow, the distribution level resources will be treated as market resources at the wholesale and retail levels. Participation in demand response (DR) and DER programs (distribution level) will be considered transmission resources at the wholesale level. Therefore, the design concept must include:

- Fully effective wholesale markets
- Selective expansion into retail markets
- New, presently unidentified markets that may not fit the traditional wholesale / retail model, such as those needed to engage DR and DER.

The design of the smart grid must be consistent with a fully enabled electricity market across the country capable of delivering economic benefits in many ways. Figure 4 shows the complexity of this coming challenge.

Planning Power systems coordination and planning Load forecasting Facility and operational data Long-start resource commitment Congestion management Reliability planning and coordination Generation and transmission outage coordination Financial transmission rights	**Day Ahead** Generation supply offers Demand bids Physical bilateral transactions Financial transactions Ancillary services offers and bids Market results (clear day ahead) Re-offer period
Post Real Time Metering / meter data management agent Settlement calculations Accounting and billing Settlement dispute resolution Market auditing	**Real Time** Supply offer instructions Security constrained economic dispatch Physical bilateral transactions Prices Re-dispatch Emergency ancillary services

Figure 4: Electricity Market Design – Multiple Markets

The market infrastructure and support systems for the smart grid must be complete, robust, and of high quality (Figure 5). This must include an architecture that encourages scalability, information flow, quality control, and reliable operations.

Infrastructure Systems functions Business processes Market participant readiness functions	**Architecture** Common information model Communications (dispersed, reliable, and multi-variant)

Independent market monitor functions Financial transmission rights functions LMP and state estimation functions Contingency functions and processes Control area functions and processes Joint operating agreement functions (seams)	Policy and regulation (investment, transparency, structure) Codes and standards Quality (embedded) User interface (easier to socialize)

Figure 5: Electricity Market Infrastructure and Architecture

It is easy to see why competitive wholesale and retail markets take a lot of time and money to establish.

Barriers

When considering whether or not to enable markets in a certain region, federal and state decision makers must determine if the results will benefit society, consumers, and the utility industry. The transition will be disruptive. Costs and problems in the first few years can make it seem as if the decision was a poor one. Likewise, poor execution of the transition can be misunderstood as "markets are bad". These risks provide reasons to resist markets, but maybe these risks should increase industry vigilance to plan and communicate well, thus managing the risk.

Some regional policy and utility decision makers often point to the struggles of other regions who have transitioned to markets and claim their own rates are lower as a result of remaining as regulated markets. As stated before (Current State) this comparison is somewhat unfair, however, it remains a barrier to enabling new markets.

Regulations – rules and incentives for markets will influence new supply in high cost regions, yet this competition to in-region supply will meet resistance as it challenges profits. Opening a market will have an initially disruptive effect as it uncovers winners and losers in the energy supply.

Market Participant Skills – a competitive market requires new skills for the participants which takes time and money to acquire.

Information Infrastructure – a competitive market requires much more data, that must be available to a much broader range of users, and the value of the information necessitates third-party control to assure fair and equal access. These three factors dictate new information systems that are extensive.

Capital Investment – aside from the large capital investment to set up a competitive market, this new system greatly influences how future infrastructure investment will be made. This change is disruptive.

Benefits

Some in the industry argue that consumers only care about price, others only care that the electricity is always available. Others argue that consumers do not want to be bothered with a variable energy service that requires their attention. However, actual retail markets and demonstration projects show that if the industry supports an integrated information model (Figure 6), the consumer modifies behavior to suit their own situation. Some more focused on price, others on performance.

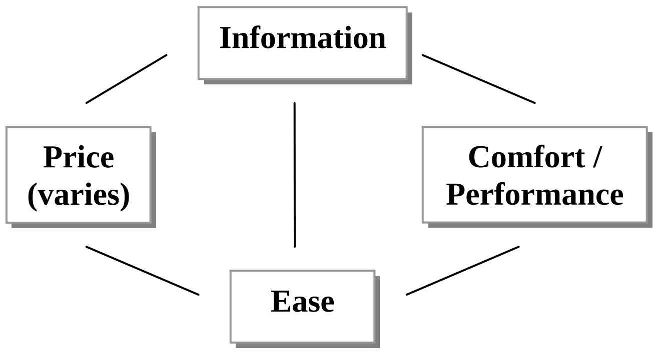

Figure 6: Consumer Information and Ease of Use

Enabling markets drives this customer service to a higher level, which should be the industry's chief goal.

Market opponents often cite the enormous cost of deploying a day-ahead and real-time market (~ $250M) as an indicator of a possible bad outcome of market transition. However, as many RTO/ ISO's have shown, the market can mitigate needs to build several new transmission lines. In today's environment, a single transmission project can easily exceed $250M. This avoidance is a benefit.

Markets will benefit the industry, consumers, and society by mitigating demand through consumer response, finding alternate lower cost solutions, driving smarter decisions on locating grid resources, and expanding the participant base providing more solutions.

Recommendations

As the nation builds the smart grid, there are a few key actions to assure its ability to enable markets where needed and desired:

- Modify policies and regulations to remove barriers to integrated markets.
- Provide widespread electricity market education.
- Standardize communication of market information throughout the design of the smart grid.
- Incentivize capital investment that open markets for wider participation and show societal benefit.

Author: Steve Pullins – Horizon Energy Group

Energy Central series on the Seven Principal Characteristics of the Modern Grid

More Information Available

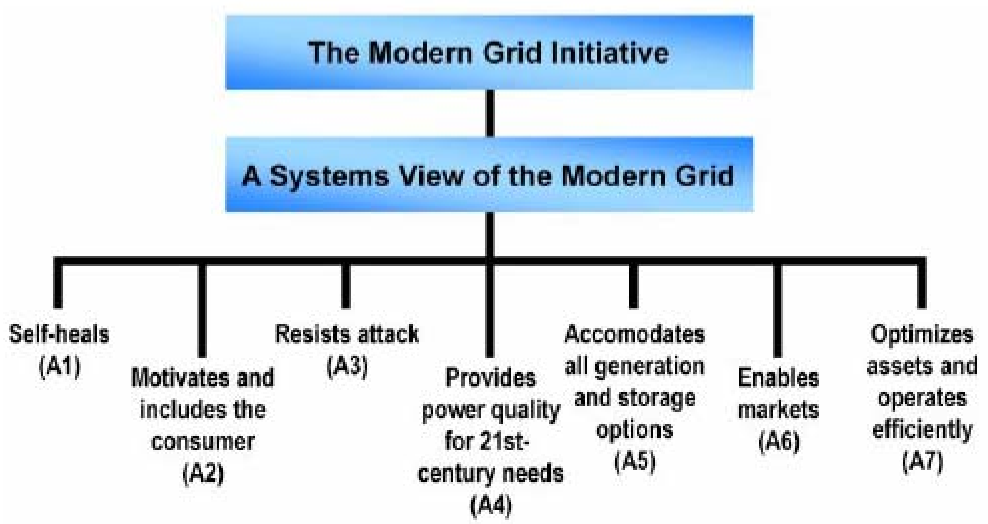

Figure 7: Principal Characteristics of a Smart Grid

Documents are available for free download from the Modern Grid Strategy website:

http://www.netl.doe.gov/moderngrid/

Email: moderngrid@netl.doe.gov

(304) 599-4273 x101