Distributed Energy Resources - The New Internet?

Written by Jeff Tolnar, Chief Technology Officer, BPL Global

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Most everyone in the utility industry has heard the terms smart grid or modern grid. The definitions of these terms vary depending upon which standards body, manufacturer, utility or software provider that you speak with. But the fundamentals are the same. The modern grid includes integrated two way communications, expanded sensing and measurement capability, advanced components, superior control methods, and improved systems. Most everyone agrees that the transformation of the electrical infrastructure will dramatically change the way that energy is delivered and used in the coming years.

A Modern Grid is required to address the profound changes that are occurring in the world today. The global energy industry is seeing astounding increases in energy required for growing nations like China and India, a worldwide and growing imbalance of energy supply and demand, increasing costs of fossil fuels, aging energy assets, customer pressures for improved system performance, the continued expansion of our digital society, environmental factors, and the ever present shareholder expectations.

These issues are truly global in nature with responses required immediately in order to position the industry for the future. In the past couple of years many nations and states have launched oversight bodies to set the framework for strategy and standardization. The U.S. Department of Energy has commissioned the Modern Grid initiative. The European Parliament continues to release directives and specific targets for renewables and energy efficiency. Individual states have stepped up efforts to publish strategic plans and goals for energy efficiency.

The U.S. Department of Energy's Strategic Plan for Distributed Energy Resources (DER) set a mid-term goal which stated that, by 2010, distributed generation would represent 20 percent of new electric capacity additions in the United States. The draft version of this strategic plan contained the following, similar goal for the year 2020 that 20 percent of all incremental generation will be distributed.

The European Parliament Rule 116 of its Rules of Procedure called upon the EU Institutions to:

- Pursue a 20% increase in energy efficiency by 2020,
- Reduce greenhouse gas emissions by 30% by 2020 (compared to 1990 levels),
- Produce 33% of electricity and 25% of overall energy from renewable energy sources by 2020,
- Make power grids smart and independent by 2025 so that regions, cities, SMEs and citizens can produce and share energy in accordance with the same open-access principles as apply to the Internet now.

These changes are dramatic and require new ways of thinking and operating, creating a paradigm shift for utilities. The EU comparison of the future energy system to the Internet is profound. Think of that world changing evolution of communications and information exchange. Information was transformed from central locations on main frames or system libraries into a distributed infrastructure with open access for users and information providers. Let's take this analogy a step further.

The present electrical infrastructure is established around centralized supply with widely understood power flows and electrical models. The growth of distributed energy resources (distributed generation, renewables, etc.) as a larger percentage of overall energy supply will significantly change existing power flow models, system planning, engineering design, operations, IT support requirements, and ultimately payment and reconciliation models.

An Internet Parallel

In the same way that the Internet changed the way that people exchange information, the emergence of distributed energy resources and continued expansion of demand management programs will significantly change the energy delivery model. The combination of these two emerging applications, if properly integrated, can positively affect the price of energy, result in a drastically improved electric energy load factor, enable operational enhancements and improve system reliability.

The key difference today and the indicated direction for the future is that distributed generation, storage and load management systems are getting much more pervasive and pushed more to the edges of the distribution grid. In fact there is a present view that hybrid vehicles could become a potential source of energy in the future during peak periods. This adds elements of granularity and mobility to the equation that have never existed previously. In the Modern Grid, distributed generation can be added easily and often times without the awareness of the electric utility. Just consider homes with solar panels and commercial buildings with diesel generators. In addition, load management programs are becoming much more pervasive and often times are directly implemented with energy users and not dependent upon the electric utility. This sounds a bit like new computers and servers that are added daily to the Internet.

In order to anticipate this change, the energy management system of the future must take a page out of the Internet management guide book. Systems must be able to self discover devices, dynamically monitor and manage energy delivery and usage with the grid from multiple distributed assets at the most granular levels. Those assets could be distributed generation, various types of renewable energy sources, stored energy or traditional electrical load. This system must be able to function as a localized monitoring and control mechanism. It must then be capable of feeding a centralized system that manages those individual assets in order to respond to real time changes in energy markets, operational factors and system reliability.

These needs are obvious when we consider the many reasons why distributed energy resources are deployed. The reasons for deployment could range from a need to service peak loads in a high growth market to a customer desire to insure availability of energy for critical processes to geographic access to renewable sources. The DER could be put in place to improve system reliability by providing localized energy in the event of a primary outage that feeds the DER service area. DER is also broadly implemented to supplement primary generation in order to improve energy delivery efficiency, reduce carbon emissions or as redundant power for large commercial facilities.

Regardless of the reason for placement, localized management of the distributed energy resource environment is required to control the energy delivery from the asset itself and the utilization of that energy within the asset area. This localized system needs to be self contained in the event that the DER is operating in an island mode (separated from primary power) and it must have adequate communications within the DER area in order to respond quickly enough to energy delivery changes within that area. The DER area must also contain adequate sensing capabilities in order for the system and operator to understand real time conditions within the area. A system that properly balances energy delivery and load management at the localized level will yield the most efficient and effective energy delivery paradigm. This DER area sounds exactly like a localized version of the Modern Grid vision.

If taken to a higher level, the aggregation of multiple DER assets can be centrally managed to most optimally balance supply and demand factors on a system wide basis. In addition, aggregated information within the centralized system can be utilized for market energy exchange (generation and load), to feed operational support systems for enhanced reliability, and contain consistent management parameters for a broad scale energy management and control scenario.

The parallels between the evolution of the energy market and the creation and evolution of the Internet are astounding. As an industry we must learn from the Internet creation experiences and utilize whatever analogous tools we can in order to facilitate a smooth transition into the modern grid.