Challenges and Success Factors for Demand Response

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Meet the Author:

An IEEE Fellow, electricity industry visionary, and leader, Dr. Mani Vadari delivers strategic services to a global set of utilities, vendors, and service providers seeking deep subject matter expertise in setting the business and technical direction to develop the next-generation electric/energy system. As a Business Architect, Dr. Vadari has been delivering solutions focusing on Transmission/ Distribution/ generation operations, Energy markets, and Smart Grid for over 35 years. In addition, he is an Adjunct Professor at Washington State University and an Affiliate Professor at the University of Washington. He has published two popular books, "Smart Grid Redefined: Transformation of the Electric Utility" and "Electric System Operations – Evolving to the Modern Grid, 2nd Edition", in addition to over a hundred industry papers, articles, and blogs. His books are serving as textbooks at several universities in the US and around the world

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Demand Response is a process by which electrical providers, distributors, transmitters, and customers (residential, commercial, and industrial) manage their electrical needs, particularly at times of peak usage or in response to market costs, thereby limiting, growing, or eliminating demand for short or extended periods of time.

As industrialized societies continue to grow, worldwide electricity demand is estimated to double by the year 2030. The notion of expanding power capacity simply by building new power generators cannot be offered as a reasonable alternative, as obtaining building permits for these new facilities is increasingly difficult. In addition, consumers and stakeholders are pressing for productivity increases to accommodate demand growth and rising capital costs. Users are expecting quality, reliability, and power production increases on the one hand, while at the same time demanding that the electrical power industry reduce or mitigate its carbon emissions and increase energy efficiency. With all of these discussions, the term Demand Response keeps cropping up. When discussing the concepts of managing Demand-side consumption – two terms surface and sometimes they are used synonymously by many people. They are Demand Response (DR) and Energy Efficiency (EE).

In general terms, DR is all about reducing the peak but not necessarily reducing the overall consumption of energy. However, EE is all about reducing energy consumption. DR shaves the peak but EE will bring the overall consumption profile down.

Importance of Demand Response (DR):

Demand Response has always been identified as the low-hanging fruit of Smart Grid. What we have had until now is a load-following system. This means that the load changes at will and the generation follows the load. The idea of load also being controlled is a significant paradigm shift that has significant benefits – especially when it influences the generation mix that needs to stay online to support the vagaries of consumption.

- Its value becomes apparent when we can retire inefficient generation used for just a few hours per year with more efficient and cheaper generation.
- Its value has the potential to be enhanced when it can be coupled with distributed renewables by providing some level of local optimization between supply and demand.

The last point is extremely important given the changes anticipated by the happenings in NY and CA and their potential to influence the rest of the country and possibly the world – by creating mechanisms to incentivize the introduction of distributed renewables into the distribution grid through a combination of market mechanisms both in real-time and for investment.
However, despite all of its potential benefits that appear to be so obvious, DR has not exactly captured the utility customer mindset.

Most successes are still attributed to the older technology-based implementations of Direct-Load-Control implemented by many of the Co-ops that were looking to reduce their peaking costs as they purchased their supply from the G&Ts.

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Key Success Factors:

Demand management is a complex endeavor with many coordinated and cooperative components. For demand management to function properly, individual components need to function collectively. These components include valuation and rate design; customer outreach, registration, and management; billing engine additions; deliver controllers for premises (if appropriate); and modeling, simulation, and the customer portal. Once the program and systems are in place – we need to keep the customer engaged; use a dispatch engine to decide when the load needs to be decreased, and control the premise (residential, commercial, and industrial) load.

As the implementation process appears to be complex, a few success factors have stood out when one looks at programs that can be considered successful.

- *Keep the customer front and center – bring them with you as the program is developed. What works in California may not work in Ohio. Get their feedback on program design ahead of time and decide which options may apply to which class of customers.*

- *Keep the regulator front and center – bring them with you as the program is developed. This is the final approver of the program and the rate case. Everything from program design to "opt-in" versus "opt-out" all need to be decided in conjunction with the regulator. Working with them ahead of time and getting their feedback as the programs are designed is critical*

The most important success factor to keep the technology simple and easy to use. If you make the customer jump through the hoops and get inconvenienced as they participate in the process, then participation will drop and the objectives of the program(s) will not be met.

There are several lessons from the Pacific Northwest Oly-Penn pilot in which specific aspects of "keep it simple" and "set it and forget it" principles were used allowing the benefits of both DR and EE to be achieved.

Key Challenges and Risks:

As we analyzed several existing implementations, DR has several challenges as well. Some of them are listed below:

- *Ineffective program design – voluntary nature with many DR programs and inaccurate price signals leading to lack of predictability of demand reduction.*
- *Customer awareness and education lead to potential for backlash or non-response.*
- *Difficulty in measuring and validating reductions*
- *Financial disincentives for utilities – asking the customer to use less of its product.*
- *Lack of predictable electronic connectivity into the home. Customers/utilities with AMI connectivity have an advantage here.*

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A Critical Challenge:

Energy Storage may probably emerge as one of the biggest challenges to DR.Storage, once it reaches critical scale in terms of price/performance, has the same characteristics as DR. It can flatten the load profile but has the potential for several other benefits. More importantly can achieve these objectives without any significant customer involvement – which has been the key impediment to the acceptability of DR as a strong alternative to peak shaving.

"The lowest carbon Kilowatt is the one that is not yet used."

Conclusions – So What!!!

Viable availability of rice-competitive Storage or not, DR remains a powerful tool in the utility arsenal and must be taken advantage of. Most storage devices are still chemical-based and have associated issues similar to how we dispose off of batteries. DR on the other hand is reducing load when needed thereby bringing in the maximum benefit. However, unencumbered access to electricity has been available for over 100 years at least in the Western world and so any reduction in the quality of life may be difficult for the customer to accept. DR needs to be able to deliver what customers are looking for – be able to consume less energy when the utility needs it without inconveniencing themselves of their lifestyles.