The Benefits of Demand Response for Utilities

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Executive summary

The European utility industry is changing in substantial ways with respect to electricity system needs, customer requirements, and regulatory policy. Network operators and managers face the inevitable adoption of Demand Response (DR) technology and practice. This paper details the unique ways in which each department within a utility can benefit from DR.

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Introduction

As network design and operation models change in response to new technology and regulation, the European utility industry clearly faces Demand Response (DR) adoption on a large scale. Many European utilities' development strategies feature numerous smart grid initiatives, of which DR is one key component.

Naturally, there are many stakeholders within any utility. In order to sufficiently cope with new network design and operational challenges, it's important for each of these stakeholders to understand the unique ways they can benefit from DR technologies and practices.

What is Demand Response?

Demand Response is any reaction to a stimulus that changes electricity demand in a market. The response to that stimulus seeks to achieve a variety of correlated and beneficial results. Those include bolstering electrical grid reliability, ensuring that demand doesn't exceed supply, and flattening demand curves by redistributing consumption from peak periods to off-peak times. DR also addresses operational and emergency reserves, capacity, and real-time balancing.

Any electricity market participant can initiate these DR actions. That includes consumers, retailers, Distribution System Operators (DSOs), Transmission System Operators (TSOs), suppliers, and aggregators. The following describes just some of the ways these stakeholders benefit from DR endeavors:

- Consumers can unlock and monetize their DR potential with their existing assets.
- Retailers can offer new services to their end users and improve customer loyalty and satisfaction.
- DSOs and TSOs have an additional, reliable market player that provides fast and dependable operating reserves (ancillary services) and capacity to meet imbalance and congestion issues, and to balance intermittent renewable generation.
- Electricity suppliers can employ alternative solutions to source their power and avoid investing in peaking plants that operate for only a few hours per year, as well as globally improve the load factor of their assets.

Most often, DR aims to reduce electricity demand. In some cases, however, DR seeks to increase that demand. It's sometimes beneficial to all stakeholders when consumers balance the grid by consuming more energy when capacity is overly plentiful.

Consider the history and future of DR. Even a brief glance at the following map of Europe (see **Figure 1**) clearly underscores the obvious DR benefits recognized by energy industry stakeholders, and their constant progression toward further adoption of DR technology and practice.

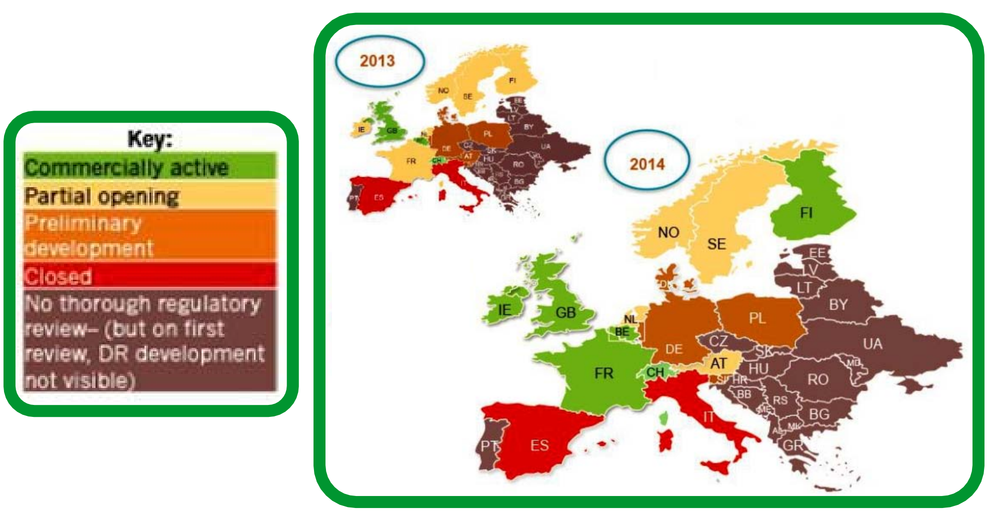

Figure 1
"Mapping Demand Response in Europe Today: Tracking Compliance with Article 15.8 of the Energy Efficiency Directive" – Source: Smart Energy Demand Coalition, April 2014

What's driving the transition to DR?

Several factors are driving this growing deployment of, and investment in, DR mechanisms.

Electricity system needs

The first consideration is the needs of electricity systems as well as the increase of Distributed Generation (DG), which particularly includes backup generation, biofuel, CHPs (Combined Heat and Power) and renewable resources.

Figure 2 illustrates current and projected growth in renewable energy capacity.

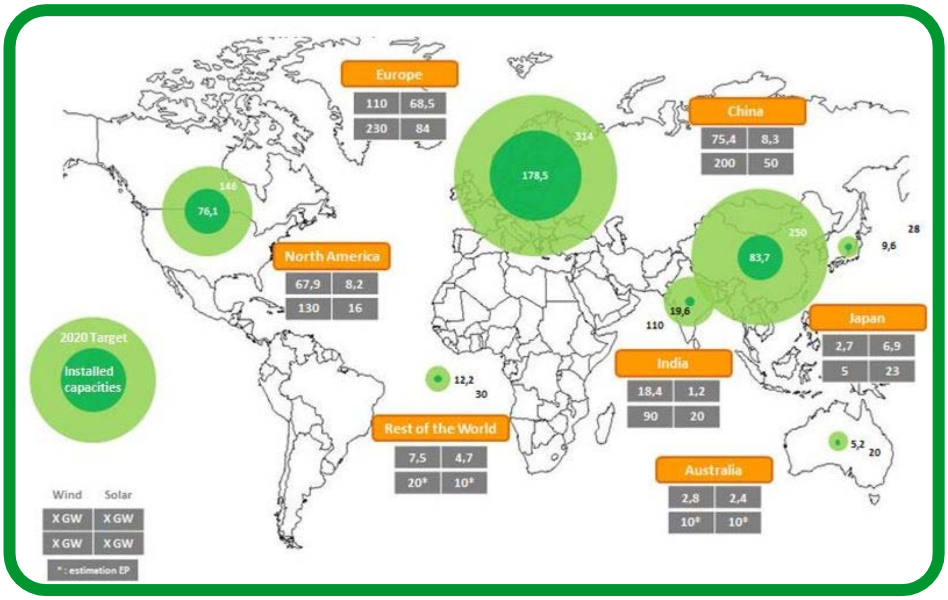

Figure 2
Installed capacities and development targets – Source: BP Statistical Review of World Energy 2013

When integrated into a grid, renewable energy sources such as wind and solar introduce significant challenges for grid operators. For example, there's the startling fact that in France during 2012, hour-to-hour wind generation varied between 3-4% of installed capacity, as shown in **Figure 3**. Statistics for neighboring countries are similar.

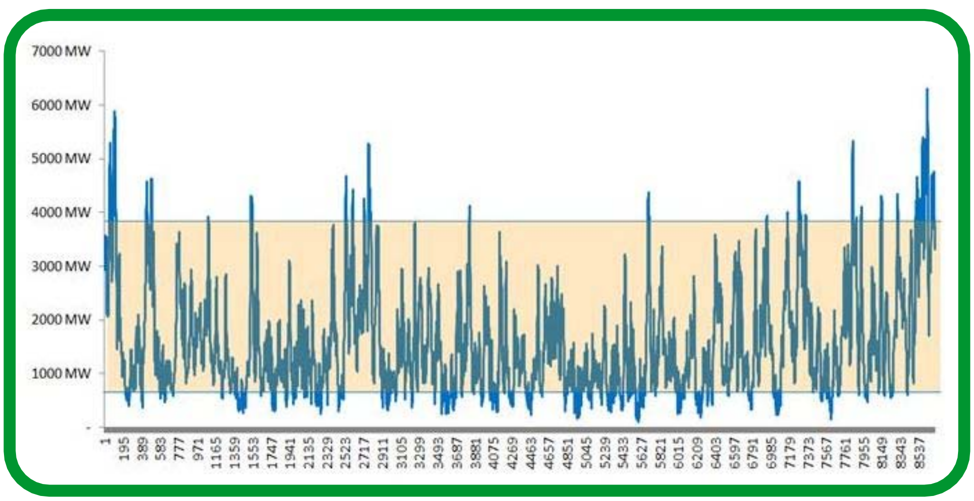

Figure 3
Wind production in France (2012) – Source: 2012 annual eCO2mix data, RTE Réseau de Transport d'Electricité

Also consider the significant and very rapid variations during the production day of certain photovoltaics as shown in **Figure 4**.

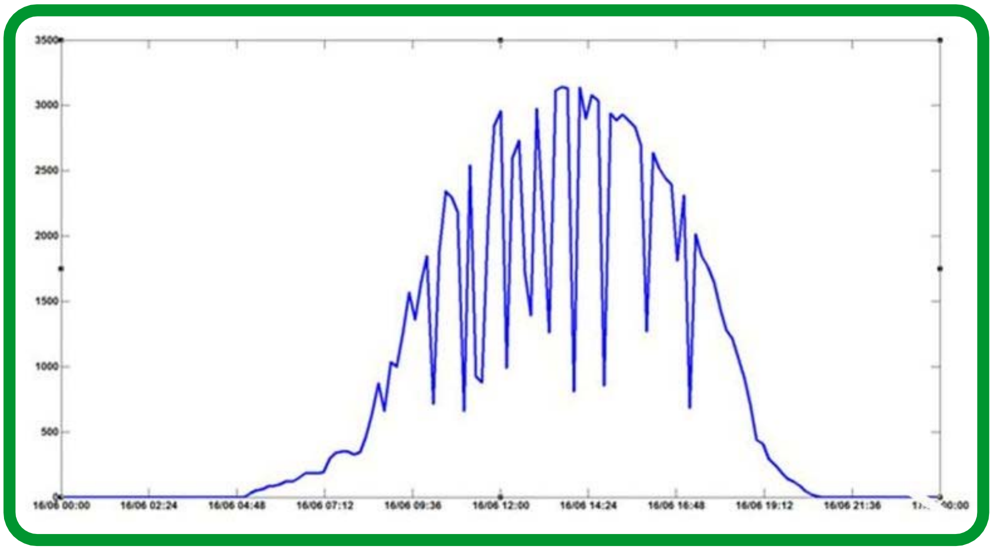

Figure 4
Production analysis: Pmean (W) while sunny with clouds, 16/6/2009 to 17/06/2009 – Source: RTE Réseau de Transport d'Electricité

The intermittent nature of these sources, as well as their growing contribution, practically necessitates the adoption of DR management mechanisms. Utilities need flexible tools that can respond very quickly to substantial and unpredictable variation. DR is often the most economical tool utilities can use to balance their portfolios.

In addition to variability, some perimeters face the problem of renewable overproduction, subjecting a grid to more energy than it's designed to handle. Excess energy leads to grid constraints and may also disturb markets.

There are also potential economic consequences of overproduction. Too much energy available on markets leads to price reductions—sometimes to the point of negative prices.

It can then become crucial to identify the location of a grid's excess energy. That's often a problem addressed at a local level, whereby some customers must be incentivized to over-consume. Depending on the nature of the excess energy issue, however, this problem may also be dealt with on a regional or national level.

Renewable sources also introduce forecasting problems. Unlike the output of base generation, e.g., nuclear, coal, etc., which one can predict in advance by days or weeks, renewable output is far more variable and difficult to anticipate. This results in larger forecasting error margins than those associated with non-DG sources. Although ratios vary from country to country, even a 3% percent day-ahead forecasting error ratio, such as that experienced by France in 2012, is meaningful and problematic because operating margins are tight at certain times.

Another consequence of burgeoning DG technology is a growing need for better ways to inform utilities' asset planning and management processes. In order to make the best possible decisions and optimize grid investment, utilities need new strategies that also account for DG. The top-down design of electricity grids must adapt to the rise of DG.

Additional capacity is another common electricity system need. There's often a requirement for constant growth in network coverage and supply, and not only in developing countries and emerging economies. Some European countries are shifting away from nuclear generation, or shutting down plants that can't financially sustain themselves, which can introduce new capacity issues.

Customer demands

This is a straightforward but important point: Electricity customers naturally seek providers who offer the lowest prices for a fully reliable supply.

Strong and growing competition between electricity suppliers, however, drives the need for utilities to deliver more services at even lower costs. DR schemes deliver such price reductions, as end users receive significant new incomes through the monetization of their load flexibility, either for curtailment or for consumption stimulation.

Offering DR services is becoming a necessary and unavoidable argument for utilities toward existing customers and prospects, who generally expect to benefit from these services.

Regulatory changes

Last, and by no means should it be considered a minor contributor, there's a major policy and regulatory push toward the adoption and utilization of DR technology and operation. The European Commission described in Article 15 of its Energy Efficiency Directive that national regulatory bodies should encourage demand-side resources, including DR, alongside supply in retail and wholesale markets.

Article 15 also promotes the equal treatment of DR and generation. This essentially means that policy structures should allow demand-side resources access to the same markets and mechanisms that generation-side organizations enjoy. Article 15 also encourages policy makers to review existing rules that limit and restrict the participation of DR in the marketplace.

Across Europe, there's also a trend toward the adoption of low-CO_2 technologies and initiatives that benefit electricity customers. Consider, for example, the ambitious "20-20-20" targets, which set three objectives for the year 2020:

- Reduce EU greenhouse gas emissions by 20% (compared to 1990 levels)
- Raise the portion of EU energy consumption produced by renewables to 20%
- Increase the EU's energy efficiency by 20%

It's also important to consider future regulatory requirements. The European Commission's Guidelines on state aid for environmental protection and energy 2014-2020, for example, calls for equal consideration for public subsidies to supply- and demand-side resources under certain circumstances. This will particularly impact capacity markets.

The 2030 policy framework for climate and energy proposed by the European Commission would set new targets for CO_2, renewable energy, and energy efficiency by 2030. EU leaders agreed to decide on this framework in October 2014.

How can utilities benefit from DR?

Utilities can benefit in numerous ways from the adoption of DR technology and techniques. Each component of an organization can benefit in unique ways.

Sales

The sales part of the business can use DR to expand its energy services offer to customers. This can help them gain an edge over competitors in an increasingly cutthroat market. Ensuring customer satisfaction via innovative programs and tools, some of which may lead to significant net reductions in electricity bills (from 3% to 15% in some cases), results in better customer retention and more reliably solid revenue streams. Today, DR is a major argument and strong commercial lever for the sales activities of a utility.

Trading and optimization

The trading and optimization portion of the business can benefit from new and competitive products that hedge risk and optimize the position of their portfolio. Consider trading strategies. Some players play with a set of volatility and price strategies. When this is coupled with DR, it provides more benefits for utilities.

For example, imbalance between supply and consumption within a utility's perimeter can be very costly; market operators can impose significant charges. Before a utility faces the prospect of such penalties, a common solution is to turn to the balancing market, which is the market of last resort and carries high costs. DR, however, can help utilities avoid those circumstances by offering reactive and flexible technologies to balance consumption and supply. Under certain circumstances, such as times of very high grid constraints, DR can be a superior alternative to traditional balancing mechanisms.

Another benefit of DR for trading and optimization is that it can help this arm of an organization manage its capacity charges and reserve obligations. This can lead to large gains through optimization – using DR for reserves and ancillary services frees productive assets to focus on energy sales.

Generation

DR can help improve overall power plant utilization rates by stimulating energy consumption during off-peak hours and flattening the demand curve. Also, as a type of stand-by generation tool, DR allows a generation portfolio (all things equal) to commit increased amounts of energy or capacity without taking on any additional contractual risk.

On the other hand, it might be beneficial for generators to raise demand at certain times of the day, e.g., to ensure profitability. DR can also be used to satisfy this need via consumption stimulation or displacement.

Distribution

For DSOs, DR can provide an alternative to heavy investment in HV/MV grid reinforcement. That's due to a lower need for transmission infrastructure. Distributors can also benefit from congestion management support, as well as avoid high penalties during peaks when exceeding contracted levels of power.

Obligations

A final benefit of DR relates to reserve obligations. Where each stakeholder must use part of its generation assets to supply reserves, we can expect DR to greatly support the delivery of these ancillary services – not because they're generating energy, but because DR allows utilities to free other sources of generation and direct their supplies elsewhere, where they are most valuable.

Conclusion

Following the example of the U.S., DR's most mature market, the utility industry in Europe is clearly on the verge of massive DR adoption. A great number of European utilities have placed smart grid initiatives at the center of their development strategy, and DR is a key component of smart grid technology. One way or another – be it at the demand of customers, markets, or changing regulatory policy – DR is coming.

While there may be conflicting interests among these stakeholders, it's important to recognize that each stakeholder can benefit from DR implementation. While all utility segments do not benefit in the same way from DR, each segment will experience its own improvements. Utilities are at the heart of the value creation of demand response, which is generated and shared among all energy stakeholders (grid operators, balancing responsible parties, consumers, aggregators, and retailers). Although it can be challenging to integrate and implement DR into strategies and operations, doing so maximizes benefits and addresses the complexity of identifying and managing the load flexibility of consumers. Experienced partners can support utilities in order to save significant time and effort in the design, implementation, and operation of DR solutions adapted to their needs and customers' expectations.

About the authors

Jean-Yves Blanc is Vice President Demand Response, Energy Business Unit of Schneider Electric. He joined the company in 1981 and holds a diploma in Electrical Engineering from Supelec and an MBA from Institut Français de Gestion – ICG (France). Jean-Yves has a vast international business background including project management, marketing, and R&D in M/V switchgear and electrical distribution equipment. In 2000, he was appointed to Schneider Electric's Building Automation business followed by an appointment in 2011 as Vice President Energy Management Solutions of the Buildings Business of Schneider Electric. In 2013, Jean-Yves accepted the role of Vice President Demand Response for Schneider Electric and became the President of the supervisory board of Energy Pool. Since 2009, he has also served as President of eu.bac, the association of European manufacturers of Building Automation and Controls.

Benoit Duretz, Business Development Manager for Energy Pool, is involved in the group's international activities and is a graduate of ESIEE, Electrical System Engineering. Benoit has strong knowledge and international experience in energy products and services. He helps utilities design and implement customized Demand Response solutions adapted to their electrical systems worldwide, from consulting services to the supply of full Demand Response operational systems. Before joining Energy Pool in 2012, he worked at Alstom Grid as Sales Manager to develop HV/MV turnkey substations business in Southeast Asia and Central America and as SDCEM International Sales Director in HV/MV products and services business.

Alban de la Selle, International Development Director for Energy Pool, is a graduate of EM Lyon and holds a Master's in Economics from Paris University (obtained with the highest distinction). Alban has focused his expertise on the field of infrastructure finance, mostly in the power sector. He began his career at Hill Samuel Bank in London, where he advised governments on financing major infrastructure projects and privatizations in Western, Central, and Eastern Europe. In 1997, he headed the Energy Department at Dexia in Paris, and then the Americas Project Finance department in New York; and he founded the Dexia branch in Canada.