The integration of demand response (DR) and distributed generation (DG) into a virtual power plant (VPP) concept was made possible by recent advancements in the ICT field and modern power system issues. Together they bring important synergies and in the form of a VPP represent serious competition to traditional peaking power plants. There are several factors that define the success of VPP programmes.

VPP management means that electricity suppliers can offer their “prosumers” the opportunity to save money if the overall power production and distributed generation capacities are intelligently meeting the instant demand. This can only happen if the energy value chain is fully optimized by allowing remote management of the distributed generation and loads for brief periods of time. Power suppliers can use aggregated capacity to optimize the electricity schedule and minimize imbalance costs or to trade on ancillary services market.

An efficient ICT solution, developed for “prosumer” aggregation, enables the power producers to integrate with the suppliers that are able to communicate with the customer, activate, control, monitor and evaluate the aggregated capacity, and report back for better power generation. Furthermore, it should bring synergies by integrating with existing power product, network and supply systems across the value chain including power production management, energy portfolio management, forecasting, CRM, GIS, metering and billing.

The VPP is one of the major building blocks of the smart electricity networks of the future and can be deployed on a gigawatt scale at utility level. Advanced IT systems allow electricity suppliers to manage their growing share of unpredictable renewable sources, energy storage and flexible consumption efficiently. Aggregation of different distributed resources (including consumption) can efficiently replace or complement traditional peaking power plants.

VPP principles of operation can be diverse, from the simplest management of energy production units, through market or subsidy driven demand response, distributed generation and energy storage management, to heating networks, microgrids, or any combination of all of these.

DEMAND SIDE MANAGEMENT AND DG MANAGEMENT
Currently the most widely used and best established principle of the VPP is the management of commercial and industrial loads and distributed generation. Several factors define business models under which VPPs operate:

- Method of financing (market or incentivized)
- Target market (system services, imbalance management, day ahead, intraday, balancing market, etc.)
- Motivation factor (price structure, environmental aspect, system aspect, etc.)
- Customer type (household, commercial, industrial, public)
- Consumption characteristics (responsiveness, capacity, reliability, frequency, duration, etc.)
- Distributed generation characteristics (primary resource, responsiveness, capacity, reliability, frequency, duration, etc.)
- Activation type (response time, duration, changes, capacity, etc.)
- Mode of communication or activation (manual, semi-automatic, automatic).

Normally the right combination of the factors mentioned above will set the success for a relevant demand response programme.

Advanced VPP IT systems collect network data, communicate with customers and manage associated distributed control equipment. They also control the distributed base of “resources” (distributed generation and consumption), create activations, implement the energy optimization process, monitor the implementation, and evaluate the quantitative and financial performance of operations.

CUSTOM ENVIRONMENT TO TEST VPP MODELS
In March 2011 the European Demand Response Centre (EDRC), based in Vienna, started its operations. The mission of the EDRC is the promotion, development and testing of new business models and new technologies used by VPP systems and the spread of knowledge and experiences. It offers electricity suppliers, system operators, aggregators, telecom operators and anyone else interested in demand response and distributed generation issues the possibility of renting, installing and managing a custom designed VPP. The Centre was financially backed by the Austrian government (Klima- und Energiefonds) and European Union.

The operations of the EDRC are being supported by advanced cyberGRID® technology. This is designed according to latest open source Java EE specifications and IEC 62541 (OPC Unified Architecture) communications standard. Advanced computer algorithms to predict, classify, manage and optimize VPP infrastructure are run by the GlassFish application server.
PRACTICAL EXPERIENCES OF VPPs

The team started working on the development of VPPs in 2007, and has partnered with the regional utility, Elektro Ljubljana, in Ljubljana, Republic of Slovenia, since the start. cyberGRID’s VPP system is based on the SAP® software platform and is designed to match the European deregulated market specifics.

Some of the experiences in developing successful VPP programmes in Europe follow.

Where is the market for VPPs and DR?

Currently the biggest potential for making the business case from demand response programmes in Europe is the tertiary reserve market. There are many differences across the markets of the different European countries regarding their openness towards demand response programmes. Currently the most open markets are the UK and France. However, several new players (aggregators) have emerged in the last few years in countries such as Austria, Germany or Slovenia, which are targeting this market, despite the many obstacles that still exist when compared with the French or UK, not to mention the US, markets.

Other specific issues that contribute to development of demand response programmes are grid bottlenecks, larger shares of wind generation, capacity shortages and similar.

What are the barriers for VPPs?

There are no technology barriers to implement a fully functional VPP. Most of the barriers come from local regulation of the tertiary reserve market or the fact that in most EU countries capacity markets are very limited or inaccessible. The other major barrier is the conflict of interest between growing sales and energy efficiency.

Who will take on the role of VPP in the EU – new independent aggregators or existing utilities?

There are two groups of utilities. The dynamic group constantly seeks new opportunities on how to serve their customer base better and one of the possibilities to do so is VPP and active demand side management. On the other hand, the traditional group is more or less defending its position in the market. They don’t go much beyond billing, and most are already losing ground in the market.

In three to five years, all dynamic utilities will enable their customers to take an active role in VPPs and reduce their cost or generate new revenue through widely accepted demand response programmes. The traditional group, on the other hand, will face serious challenges, especially from independent aggregators who will “attack” much of their customer base – especially large customers. When these customers are assigned to independent aggregator programmes, this will become a good opportunity for them to take away much of the old utilities’ retail business.

Which DR programmes have more potential – C&I or household?

In most European households consumption is relatively small. Therefore it is very hard to achieve reasonable payback periods. Commercial and industrial (C&I) programmes on the other hand are already commercially viable and can offer good ROIs.

How big are the problems with gathering capacity?

Many studies show that there is significant available dynamic or adaptable capacity. In most cases clients are able to reduce between 10 and 60% of their overall consumption for one or two hours without any major implications to their existing business. This, of course, depends on the type of loads being controlled and the willingness of the customer.

Currently there are two approaches on what kind of loads to aggregate. First – the extensive approach – is to gather and manage as many simple loads (HVAC, boilers, fridges, etc.) as possible. The second – the focused approach – is to go deeper into the management of process related loads. Each approach has its own set of characteristics and therefore its own set of results. In most of the European countries, the focused approach has been found to be more suitable.

Should the VPP be fully automated?

Experience shows that the level of load management automation varies inversely with the complexity. Simple and non-process related loads with a certain energy reserve, a relatively small capacity and small risk of significant damage due to incorrect adjustment (boilers, air conditioners, water pumps, refrigerators, freezers, etc.) are normally fully automatically controlled. In more complex and process related loads, automation usually helps the operator to make a final decision. Full automation is usually not desirable due to the high potential damage that could be caused by possible improper completion of the consumption adjustments. Normally these type of loads offer larger manageable capacities.

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ABOUT THE COMPANY:

cyberGRID is a leading European company in the field of development and deployment of VPP. An advanced ICT solution matches up a variety of distributed generation resources with demand response capabilities (industrial and commercial) and aggregates these resources into a clean energy asset that acts like a conventional peaking power plant.

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