Flexibilities – a necessity for an affordable future energy system

Introducing the innovative Virtual Power Plant by Altran

17 December 2014

Content

Executive Summary

Big challenges – big opportunities: In times of rising energy prices and the threat of blackouts, one often forgets the opportunities presented by the new energy system and its increased reliance on renewables. Flexibilities are in demand throughout Europe, and there will be rewards for market participants who can promptly deliver capacity.

More renewables mean higher demand for short fill-ins. System operators are starting to build storage capacities into their physical grids.

Industrial companies are looking at production methods which can be switched on and off in a flexible way – this will allow them to reduce the cost of energy intensive processes.

And the combination of renewables and charging stations for e-mobility promises even higher revenues than the fixed premia on offer through government subsidies.

All these examples demand an intelligent energy system and intelligent market, as these are the cornerstone of flexibility. As a global consulting company for technology and innovation, Altran has researched the market thoroughly and developed a Virtual Power Plant (VPP) concept.

1. Background/Changes in the European Energy Industry

Across Europe countries are faced with several but different challenges, which all have one source in common – the increasingly volatile supply of energy due to the growth of decentralized renewables. The effects vary as questions arise concerning real-time congestion solving, frequency regulation, reactive power regulation, energy float in neighbouring countries and real-time balancing. Today, these problems can be solved by trading products on an "energy-only market". Additional generation capacity could lead to problems in some regions, requiring additional storage capacity and more flexible demand – e.g. Demand Side Management (DSM) and Combined Cycle Gas Turbines (CCGT). As a result, the ability to flexibly shift load or production in time is getting a high market value.

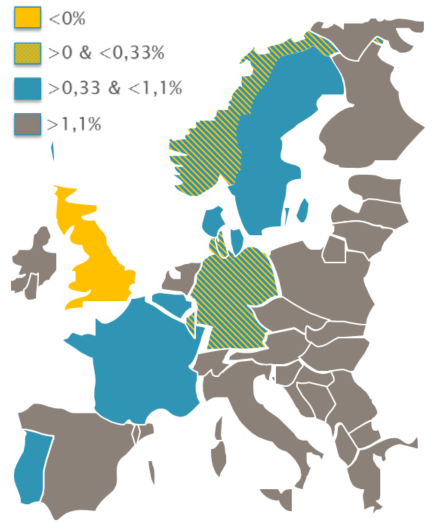


Exhibit 1: Entso-e average annual load growth per country between 2013 and 2020 ('Best Estimate' Scenario)

The current solutions for solving the problems differ from country to country as the European energy market is not harmonized. The main differences are in the subsidies and integration of renewables and in the future composition of the energy trading market. While Belgium and the UK use quota agreements for renewables and direct capacity market mechanisms, Germany pays fixed premia for renewable energies and is counting on a rearrangement of the energy-only market. One of Belgium's neighbours, France, follows a mix of premia and capacity mechanisms.
While Germany is still discussing the right to a secure and affordable supply, Italy has rolled-out over 30 million smart meters.

Exhibit 2: Models for supporting renewable energy in Europe (own diagram based on 2012_RE-Shaping)

Although the solutions may vary, the changes and challenges in the European energy industry can be summed up as follows:

- Decreasing reliability and grid balance
- Decreasing profitability of conventional plants (especially in countries with a priority feed-in of renewables)
- Increasing gaps between generation and consumption
- Increasing demand for flexibility

All in all, studies predict total investment of up to €500 billion for energy networks in Europe until 2020. Alone in Germany €40 billion are needed for grid investment, especially for north-south-connections to deliver power from offshore wind parks to the industrial areas in southern Germany [DENA_2012].

Apart from the rearrangement of the grids, the revision of role definitions is being discussed. Should system operators be enabled to switch own storages on or off to guarantee the grid balance more independently this would turn-around the unbundling made a few years ago. Beside new roles for the classic players, new players are entering the market, especially aggregators. Germany is discussing giving aggregator's legal status, as they can have a positive influence on the grid balance if they operate as an independent market player [2013_IASS]. The role of an aggregator can be covered by nearly any player: rail operators might combine their administrative buildings with overhead cable provision (rail track) and the charging stations for e-mobility in a station's car park, car manufacturers might connect their production demands with buffer storages of the batteries in e-cars waiting for shipment, etc.

Despite different developments in several European countries, the conclusion is the same: the more renewables in the mix, the more flexibility is demanded.

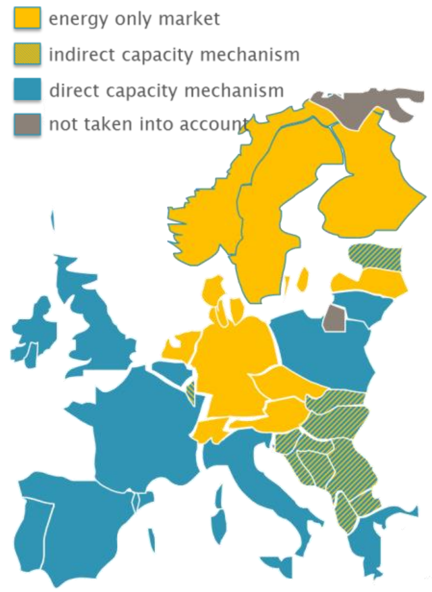


Exhibit 3: Overview of different European models for capacity markets (own diagram based on Eurelectric_2013)

The following facts and studies underline these developments:

- It can be expected that by 2050, the fluent production out of DER in combination with flexibilities in production and consumption can ensure the coverage of nearly 40 % of the demanded electricity *(VDE_2012_Positions papier)*
- Coverage of positive reserves by DSM with a share of 60% in Germany in 2020 can be forecasted for the secondary reserve market. *(dena 2010 – Netzstudie_II)*

"The energy system of the future has to be more flexible."

One of the main questions regarding the future energy system concerns the optimal point in time for investments in smart grids. Scenarios show that it is economic to invest in grid intelligence as soon as possible since it will lead to lower investment needs in the long-term

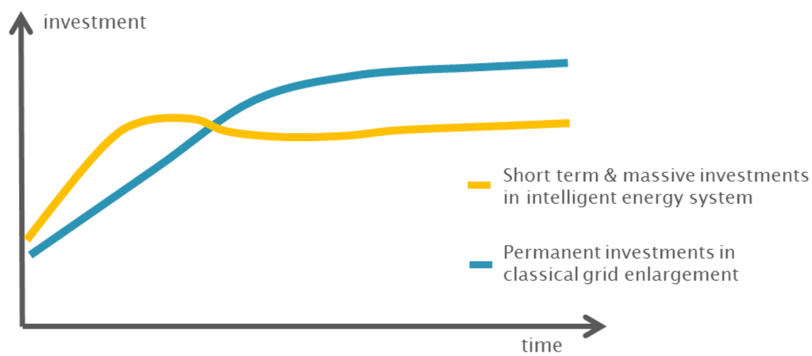


Exhibit 4: Short and long-term investment scenario (BMWi_2014_E_Energy_Abschlussbroch_Mai_2014)

The European energy efficiency market is expected to achieve double-digit annual growth, reaching a total investment volume of almost €30 billion per year in 2020 [BCG]. Several studies prove that investment in smart grids will deliver both growth and savings.

- German government proposed a binding European-wide goal of 30% less emissions *(2014_BMWI_10-punkte-energie-agenda).*

- Since June 2014, in Germany, the most important energy carriers for production are renewables, with a 31% share. This development has two side issues which underline the need for a new system: gas plants are running only half the time compared to 2010 and in times of high production output of wind and sun energy, the grids of German neighbouring countries are flooded with green energy. *(2014_Fraunhofer_EEX_Stromerzeugung_2014)*

Gains due to efficiency	Billion €	Growths impulses	Billion €
Less energy consumption through more efficient power management	5,57	Private households: new services for utility management & smart home	0,6
Energy savings through smart buildings	1,4	B2B: new services due to Virtual Power Plants, grid automation and IT for energy procurement/trading	1,1
Savings of grid investment due to intelligent grids instead of conventional grids	2,06		
Saving effects per year	**9,03**	**Growths shares per year**	**1,7**

Exhibit 5: Estimation of growth and saving effects for Germany in Fraunhofer ISI_2012_Intelligente Netze

As renewables expand both in output and acceptance, and as the chances of an intelligent energy system become more clear and immediate, a quick delivery mechanism for flexibility is vital. This is the basis for Virtual Power Plants.

2. VPP as optimal provider of flexibility

Virtual Power Plants (VPPs) are regarded as the most cost efficient producers of dynamic flexibility in innovative electricity systems. VPP's combine different types of assets

- conventional generation
- renewables
- load shifting (Demand Side Management)
- different types of energy storages
- financial contracts

Each element has its own strengths and limitations. A VPP works more efficiently than the sum of its assets – it collects energy assets of small players and opens the energy markets for them, by expanding their possibilities for trading due to increased strength as part of a common pool. Thanks to a Virtual Power Plant, both conventional (coal, nuclear, etc.) and renewables will enjoy higher planning reliability, the barrier for trading will decrease and cause less costs while a higher rate of return will be achieved.

The provided flexibility has an increasing market value and can be sold on different markets:

"Intelligent energy systems and intelligent markets are the cornerstones of flexibility. Combining these elements is the task of a VPP."

1. Delivering capacity on a (random) call from the secondary reserve market.

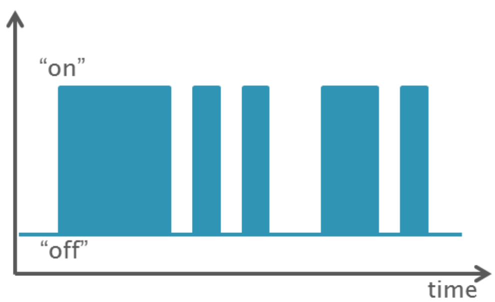


Exhibit 6: Scheme of binary call signal (positive capacity)

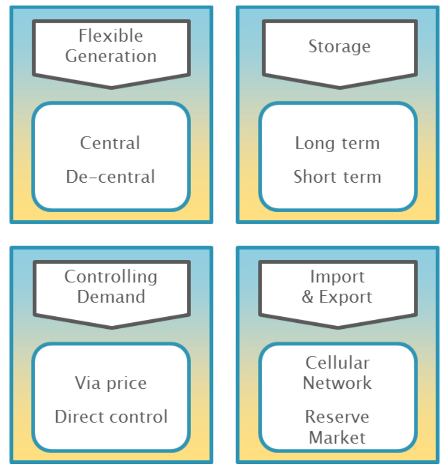


Exhibit 8: Examples for flexibilities

2. “Filling up” the load difference between a short forward delivery obligation and the current production of a wind or solar farm, thus making renewables more reliable and increasing the applications for storage systems.

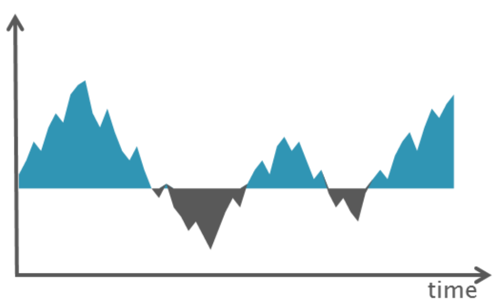


Exhibit 7: Scheme of continuous call signal (pos/neg capacity)

So the overall purpose of the VPP is to make use of the change in electricity markets and earn a stochastically-maximized rate of return by:

1. Dynamically reproducing a given **stochastic capacity signal**
2. Achieving goal (1.) with **a minimum of costs**
3. Achieving goals (1. and 2.) with a maximum of **robustness under stochastic boundary conditions**

4. Achieving goals (1., 2. and 3.) not only once, but for an unlimited period of time (**sustainability**)

The goal is to maximize the following rate of return:

$$rate\ of\ return = \frac{expected\ pay\ off - expected\ cost}{investment\ cost * uncertainty\ factor}$$

A fully-working VPP is an analytical decision system, which has interfaces to markets, generation, storage and further relevant information via telecontrol and operating systems.

The VPP Ecosystem and its players

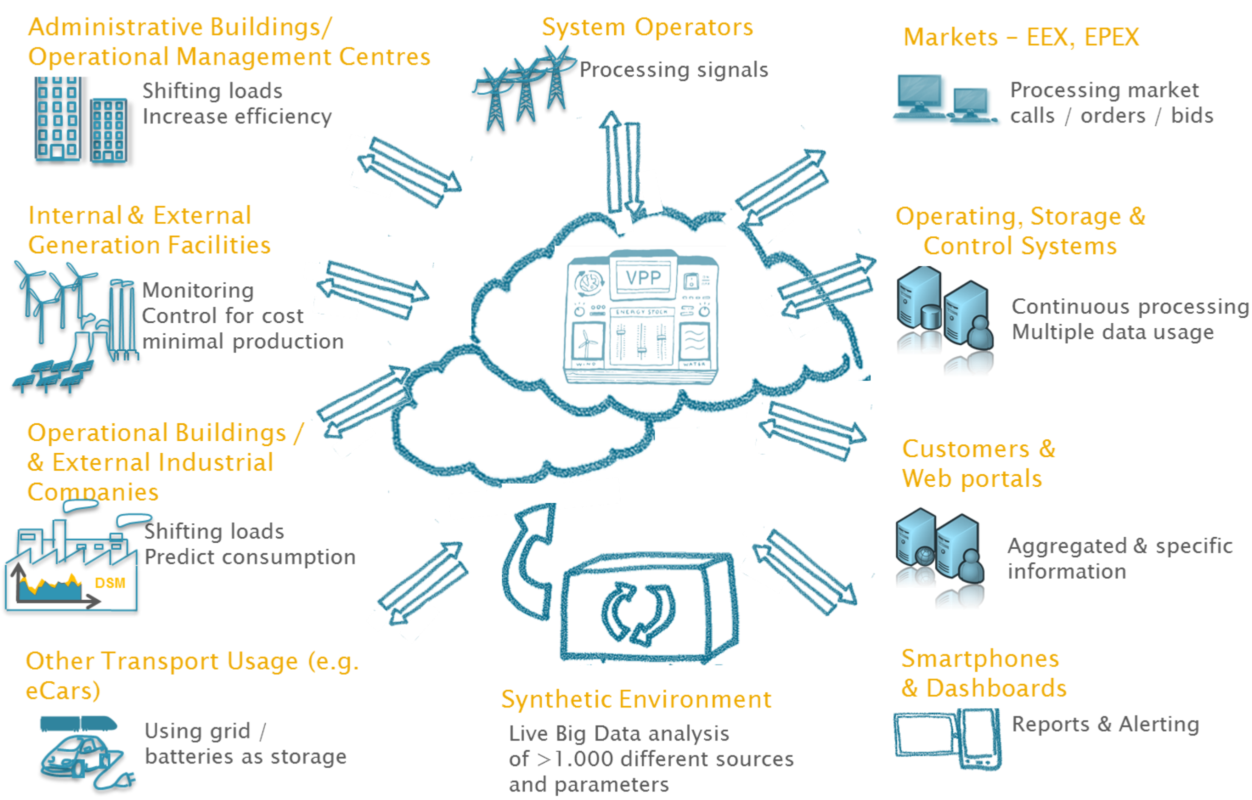


Exhibit 9: Overview VPP Ecosystem

2.1. Business Case: Balancing Group Deviation & Optimization

Depending on the client, the supplier, their imbalance position, a balancing revenue is received from – or a balancing cost is paid to– the transmission system operator (TSO). The VPP can help the balance responsible party (BRP) to correct deviations from the forecast and prevent the incurred costs if the balance is not maintained.

Balancing energy ensures the business balance between power producers, electricity customers and transmission system operators. In other words, activating energy reserves in a controlled way, regulating the flow of electricity. The TSO has to take care that it activates enough energy reserves. The costs are forwarded to the Balance Responsible Parties (BRP).

Business Case: Balancing Group Deviation & Optimization
+ increased energy efficieny/transparency in companies
+ decreased grid fees
+ optimized grid balance

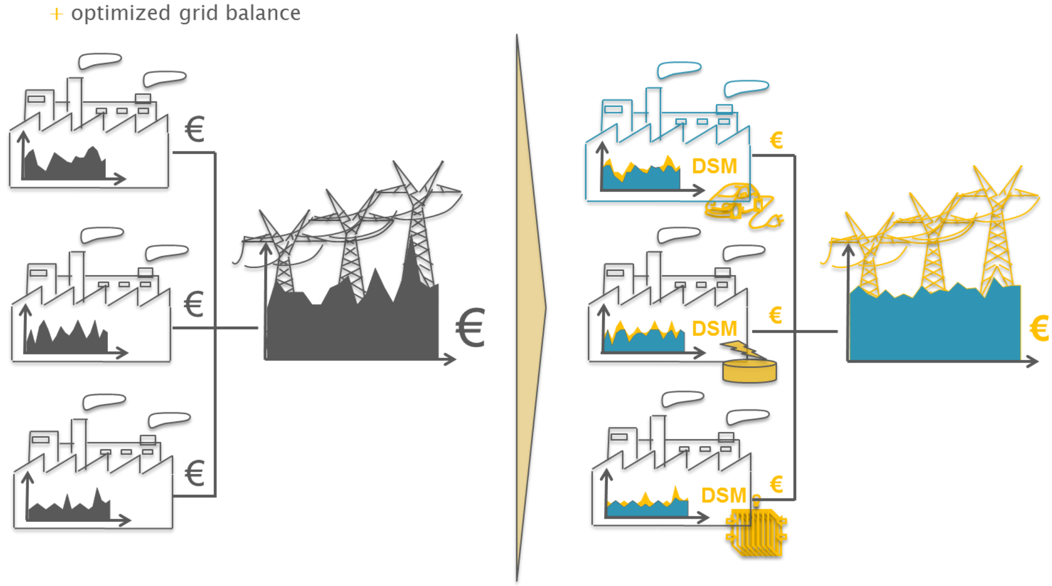


Exhibit 10: Business Case Balancing Group Deviation & Optimization

2.2. Business Case: Optimized Power Trading, Optimized Reserve Trading, Cross Commodity Energy Management

The VPP simplifies energy purchasing on the future/forward and intraday day market as it offer clearer boundaries of base, middle and peak load. Also, the VPP simplifies reserve trading as it optimizes the choice of reserve assets. In terms of cross commodity optimization, the benefit mainly relies in the use of "natural" storages like the heating/cooling network in buildings, production facilities and additional storages or DSM. The VPP calculates the energy management in the assigned owner company and optimizes its trading opportunities.

This concept increases efficient energy management as it covers electricity consumption, forecasting of electricity use and the usage and storage of gas and heat. Storage businesses could be influenced by uncertainties around European funding guidelines on Renewable Energies, as well as by changes in the hurdles for market participation, potential strengthening of aggregators' positions, relaxing Smart Meter Regulation, which could lead to new VPP Businesses and finally by regulatory relaxing around nuclear modulation.

Business Case: Optimized Trading and Cross-Commodity Management
+ expending market possibilities of all players
+ holistic increase of energy efficiency
+ optimized purchase through clearer base, middle and peak load bonds

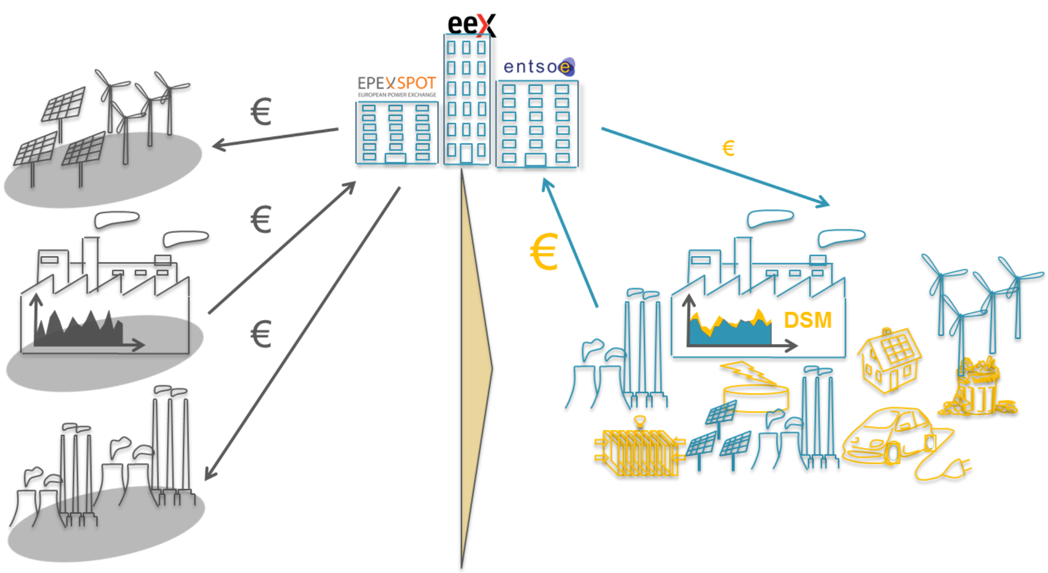


Exhibit 11: Business Case Optimized Power Trading, Optimized Reserve Trading, Cross Commodity Energy Management

2.3. Business Case: Integration of Renewable Energy Production

The VPP can help analyse when which renewables are/will be delivered. This helps calculate the needed investments in the grid extension or the integration of storages into the grid. In Germany, DSO's are also responsible for the integration of renewables production.

Regulation changes are needed in order to allow DSO's to take part in the power market. Currently in Germany and Belgium, DSO's can only use storage systems to integrate renewable fluctuation. As the DSO is not allowed to have its own energy generation, it is important to look at possible regulation changes, e.g. the option for intervention of DSO's (or TSO's) in the renewable production as well as in the timing of consumption.

Business Case: Integration of Renewables production
+ higher reliability of renewables – even on future markets
+ increased usages/incentives for storage systems
+ optimized grid balance

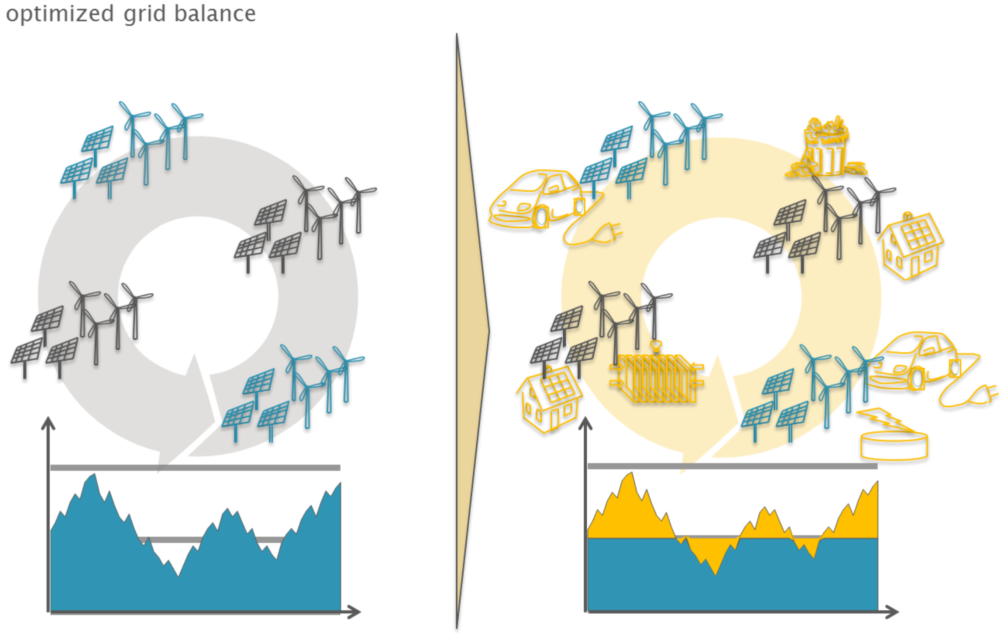


Exhibit 12: Business Case Integration of Renewable Energy Production

2.4. Business Case: Reactive Power & Storage Management

TSO's and DSO's need a certain amount of local grid stations to control grid voltage. There is the possibility for a huge benefit if the generation of reactive power can be controlled flexibly as this influences the need for physical grid investment. A possible solution is the utilization of the inverter modules in PV's controlled by a VPP. So the VPP could help balance reactive power in order to avoid installation of new local grid stations.

Reactive power on the one side is an additional load on the grid which has to be reduced. On the other side, providing reactive power through solar inverters is an important step for integrating photovoltaic into the grid control.

Business Case: Reactive Power & Storage Management
+ decreased demand for physical grid enlargement
+ extra revenue for photovoltaic systems
+ increased usages/incentives for storage systems
+ + increased value in celluar grid parts

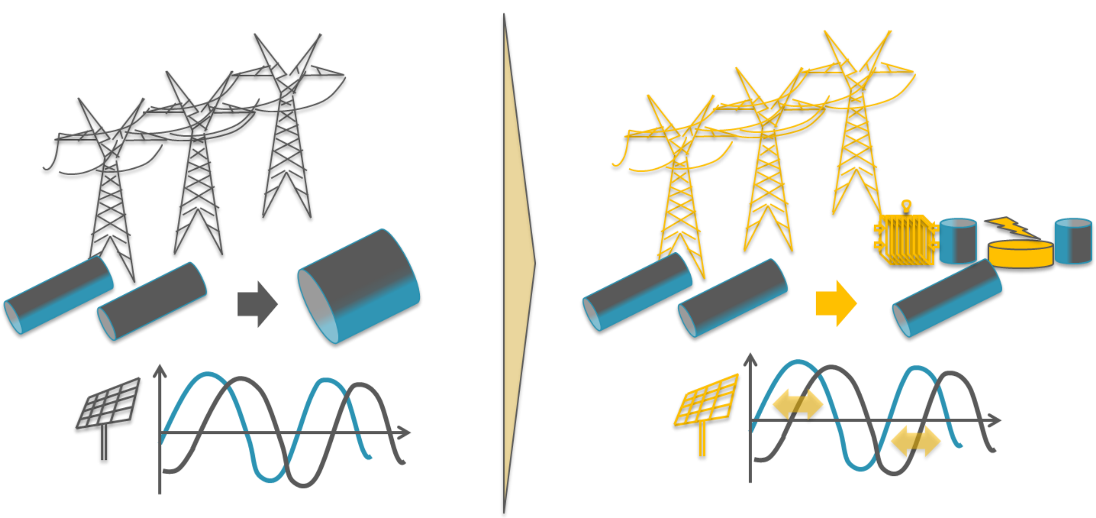


Exhibit 13: Business Case Reactive Power & Storage Management

Change in Emissions Certifications (higher price) could also make the VPP an attractive tool in the CO2 trade certificates. The VPP can help answer to the question of a carbon footprint oriented company, whether it is the best option to take capacity out of a cheap asset with high emissions or a

Currently being discussed: proposed EU greenhouse gas reduction target of at least 40% by 2030. In addition, a binding EU renewable target of 27% by 2030.

It was also suggested to introduce a

more expensive asset but with lower emissions.

The combination of a Virtual Power Plant with operating & controlling systems also allows co-benefits regarding data validation and prediction.

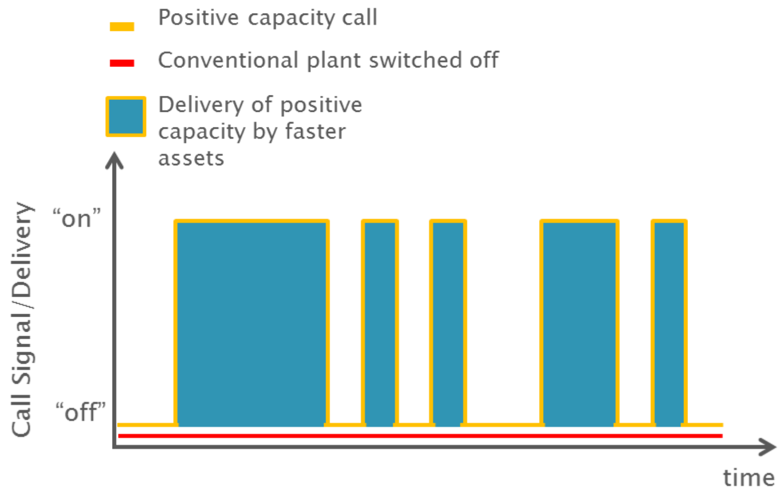
market stability fund for rapid and sustainable reform of the EU Emissions Trading Scheme, which will help stabilize the CO2 prices and avoids excessive fluctuations. The mechanism could start from 2017. Further discussed is a scheme to avoid carbon leakage, which ensures that the plant relocation will not take place due to environmental reasons.

3. The Altran VPP as an innovative approach

Altran's Virtual Power Plant optimizes energy portfolios in a more efficient way due to real option theory approach. The underlying algorithm is based on a mathematical model which allows fast calculations even with a huge number of assets. This leads to a maximized ROI thanks to a perfect mixture of technical simulation, risk consideration and calculation time.

Most operating VPP's are concentrating on only one or a few different assets or only one business case. So existing VPP approaches may connect either thousands of private households CHP's and balance the provided energy with the demand through a smart meter. They may also live-connect the production of several conventional power plants, renewable generators and storage facilities in one region and act like one plant. Another option is to live-connect the production of several conventional power plants, renewable generators and storage facilities with the demand side management in industrial companies (e.g. collecting immersion heaters) to balance production and demand and trade surplus energy.

According to Altran's definition, the Virtual Power Plant consists of a portfolio of technical (plants, storages, DSM,…) and contractual (Futures, OTC contracts,…) assets, which are able to deliver electrical capacities when needed. As there are no constraints regarding a minimum capacity, the Altran VPP will also collect energy assets from small players and categorize them as “fast” or “slow” assets.

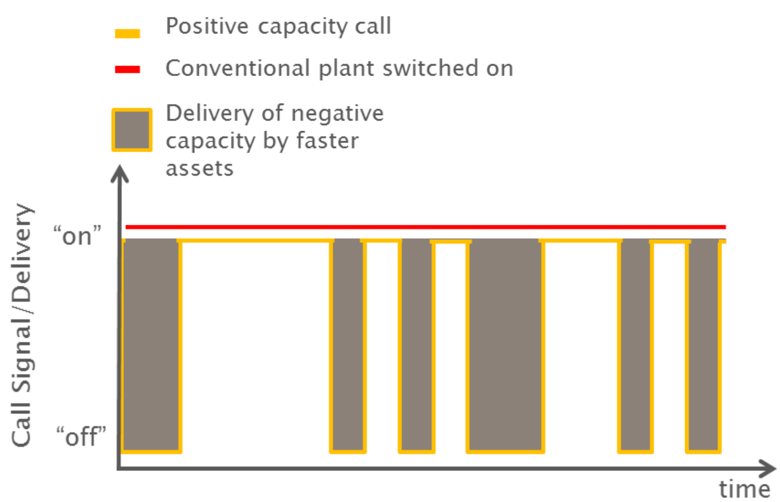


“Fast” assets fulfill a random capacity demand e.g.

- Gas turbines
- Demand Response
- Heat Storages
- Flywheel Storages
- OTC Contracts

Exhibit 14: Scheme of VPP portfolio of “fast” assets – able to respond to any signal

Most of the conventional power plants are unable to directly deliver capacity. Dependent on the state of the “faster” assets they can “invert” a demand for capacity: they will deliver the needed capacity and additionally refill the fast assets.



“Slow” assets invert the call signal and recharge the fast assets e.g.

- CHP stations
- Coal Plants
- Power-to-Gas
- Call Options

Exhibit 15: Scheme of a VPP portfolio including “slow” assets – independent capacity deliver from call with ability to recharge "fast" assets

So the most important part of the VPP is the algorithm, which optimizes the exercising of decisions of this set of assets.
The innovation of the Altran VPP is in its decision algorithm, which is based on teaming up the energy industry and the real option theory. The VPP can be used as a hedging machine against risky short positions in the electrical market. Every asset of the VPP's portfolio exhibits the value of a real option.

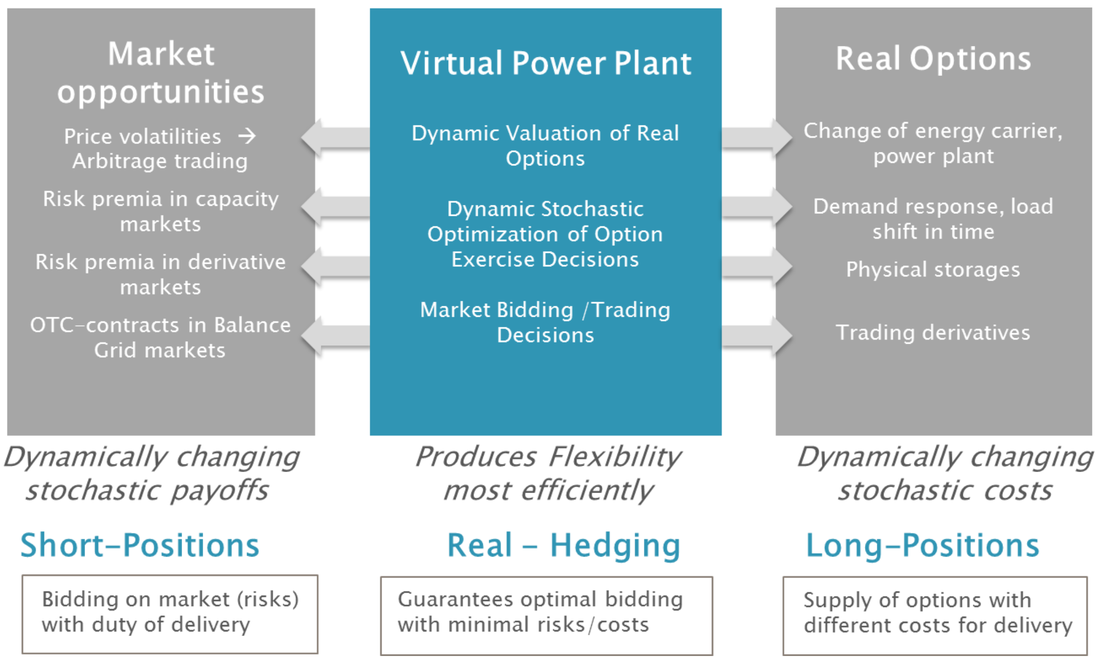


Exhibit 16: Modeling Concept - bringing together the financial option theory and the energy market

Traditional methods such as Discounted Cash Flow have the potential to undervalue generation assets as they ignore the value of flexibility. At the same time it is important to include operational characteristics of the assets valued in order to avoid overstatements of the option value. To achieve this, the real options approach is seen as a viable tool in energy research.

Altran's algorithms are based on real options theory and offer an advanced level of intelligence by:

- Calculating the value of the existing options
- Using the probability of volatile weather
- Learning from past imbalance
- Triggering actions to instantly compensate the ups and downs of production or consumption
- Storing electricity or shifting energy demand from large customers in the most cost effective way
- Calculating decision trees for future demands

The most important criteria for the decision algorithm are not only the costs of the different assets, but also a sustainable exercise ("short-term pawn offer for long-term queen catching") and the different risk-appetites of the customers.

Two decisive factors for the successful operation of the VPP are: taking risks into account – financial, economic and technical risks are considered as well as human behaviour and weather influences – and deriving outage probabilities.

Regulatory risks may change the whole landscape, but occur only in long-term.

Risk and outage consideration directly influence the decision-making in the algorithm in two ways:

1. Risk consideration on the market side:

The calculation of the market behaviour leads to a spanned tree including the most possible paths for the near future.
The branches are derived from patterns of the market, but also include risks, e.g. price dynamics, weather dynamics and consumption dynamics.
The following illustration is based on the typical behaviour of the positive Secondary Reserve Market in Germany:
The rules of the (positive) Secondary Reserve Market where a market signal is sent every 4 seconds:

- Change from "Arbitrary" to "Delivery" after 8 continuous call signals
- Change from "Arbitrary" to "No Delivery" after 8 continuous no-call signals
- Change from either "Delivery" or "No Delivery" to "Arbitrary" after at least one call and one no-call within the last 8 signals

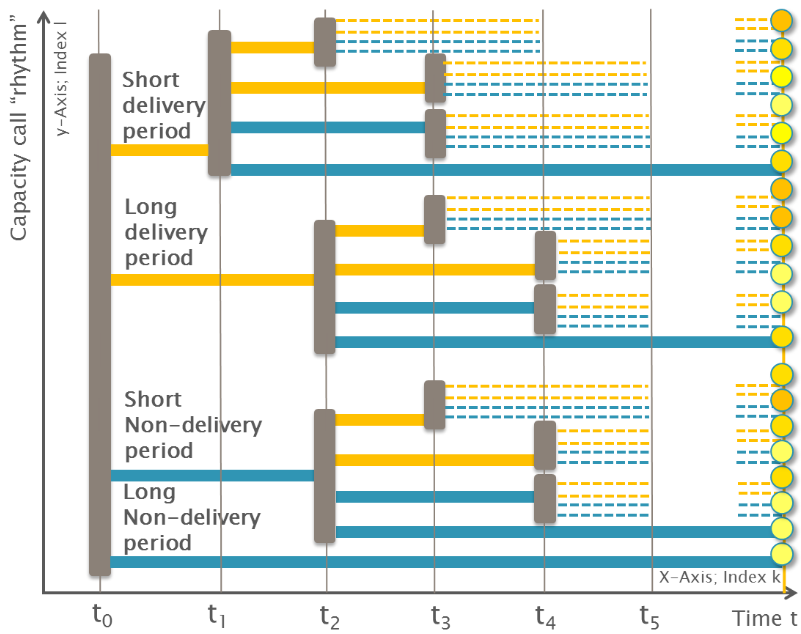


Exhibit 17: Scheme of state space

The derived typical periods of the German Secondary Reserve Market are the following:

- Short delivery period
- Long delivery period
- Short no-delivery period
- Long no-delivery period

and lead to conditional probabilities of the future market demand.

2. Risk consideration on the asset side:

Assuming the possible market behaviour as a given fact, apparently there is only one possible strategy – if the outage risks of the assets are not taken into consideration.

The best strategy does not include the outage of an asset – but there is a probability that the asset is not available (aggregated risk including technical or human failure and residual risk for a complete different market behavior) and so there is a branch to the remaining best strategy without this asset. This is calculated for every spanned path.

The best asset switching strategy is calculated based on the possible market behavior.

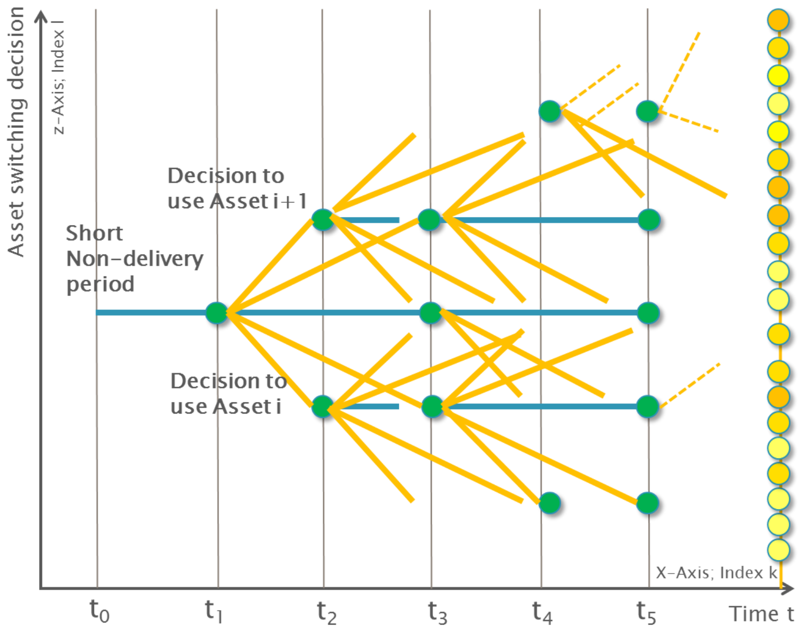


Exhibit 18: Scheme of control space and asset switching strategy

This is aggregated to a total risk and leads to two paths:

- The best strategy including the asset as available
- The remaining best strategy excluding this asset

Finally, the stochastic dynamic optimization algorithm finds the optimal decision under uncertainty for all assets.

The Altran model is not dominated by only one discipline. It is actually based on an innovative mix of heuristic models, option theory, mathematics and engineering models and offers an optimal combination of realistic technical behaviour, calculation time and risk consideration.

4. What companies can do to be at the forefront of this new technology?

Based on the Smart Grid Architecture Model framework (SGAM), Altran has developed a roadmap charting approach which links important market, product & technology trends to each other and reveals critical trigger events. SGAM is based on the ISO/OSI communication standard model and builds up on the five interoperability layers: Business, Function, Information, Communication and Component.

SGAM was developed by the CEN-CENELEC-ETSI Smart Grid Coordination Group to define a standardized roadmap to Smart Grids with modular approaches.

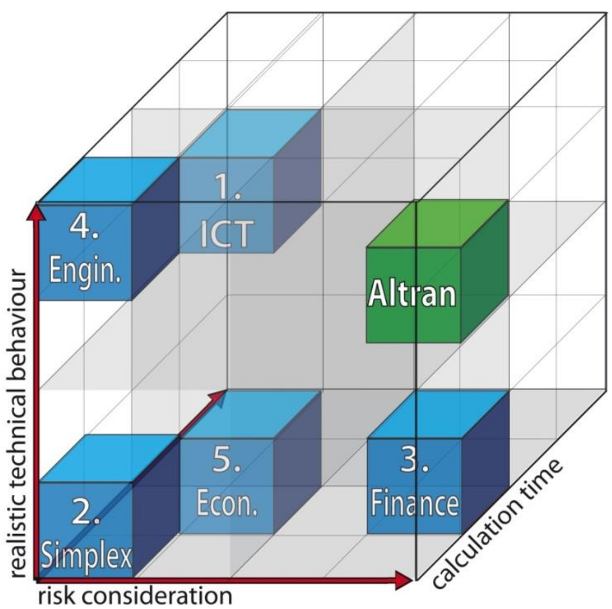


Exhibit 19: The Altran VPP model is the optimal combination regarding realistic technical behaviour, risk consideration & calculation time

Interoperability is the possibility to exchange information between two systems/layers/vendors with guarantee of optimum cooperation.

Initially, the current maturity level of a client needs to be defined. This will help identify the best fitting business models and calculating the Business Case regarding Smart Grids and Virtual Power Plants. This will form the basis for sound detailed technical development and implementation.

Layer	Description	Most Important
Market & Business	Represents the business view on the model. It is used to map regulatory and economic (market) structures and policies, business models, business portfolios (products & services) of stakeholders involved. It supports business executives in decision making related to (new) business models and specific business projects (business case).	•Customer Needs •Business Objectives •Regulatory Framework •Definition of value adding Products and Services Portfolio
Function	Describes functions and services including their relationships. The functions are represented independent from actors and physical implementations in applications, systems, and components. The functions are derived by extracting the use case functionality.	•Outline of uses cases •Translation of required functions into cost efficient Products and Services
Information	Describes the information that is being used and exchanged between functions, services, and components	Data Model
Communication	Describe protocols and mechanisms for the interoperable exchange of information between components	Data exchange protocol
Component	Describe the physical distribution of all participating components such as actors, applications, power system equipment, protection and telecontrol devices, network infrastructure (wired/wireless communication connections, routers, switches, servers), and any kind of computers.	Understanding of the technical evolution of the involved technologies
R&D and Capabilities	Assess the needed investments and capabilities for all above layers.	•Define the R&D portfolio •Secure talent with the right capabilities

Exhibit 20: VPP related layers

Example Demand Response

Demand response adoption is expected to include mass-market residential users as more sophisticated technologies are deployed in the future.

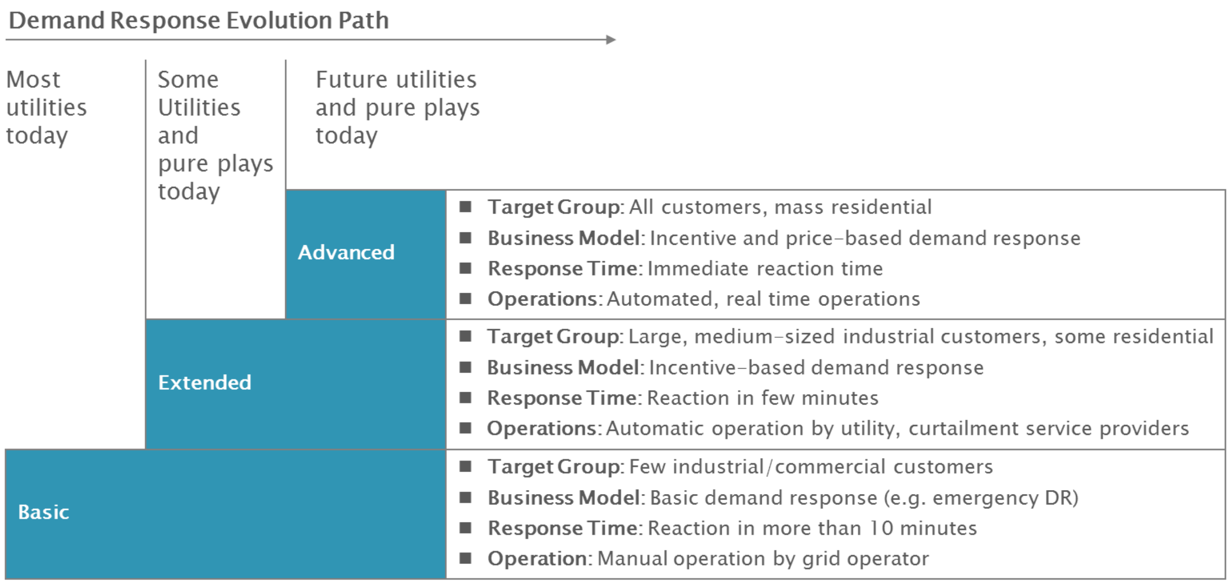


Exhibit 21: Demand Respond maturity and development

Example Energy Data Management

As a first step, it has proven successful to start with a smaller building block to generate a success story supporting the next development phases. For instance, the initial “first step” project can be automated controlling and forecasting of static assets like administrative buildings.

Energy Data Management leads to:

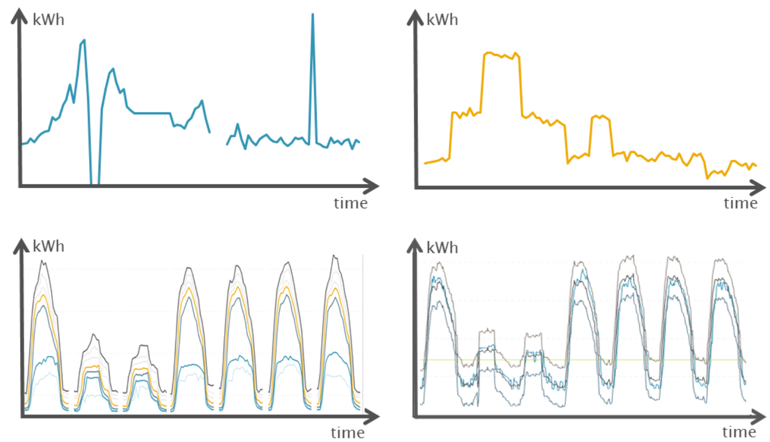
- Energy consumption transparency
- Energy Data quality increase
- Derived energy efficiency measures reliable consumption forecast and purchase optimization

Energy Data Management detects irrational data in load profiles:

1. zero values
2. constant values
3. missing values
4. “jumps”

using additional data sources

- internal
  - timetable & speed profile
  - building services (e.g. HVAC)
- external
  - Public holidays, weather conditions



Detailed explanation:
The technical and data analysis of the original load profile (top left) lead to an optimal and more calculable load profile (top right).
Additional weekly and daily profile analysis derive confidence intervals (bottom left) and lead to high quality predictions (bottom right).

Exhibit 22: Scheme of value added through automatic data validation and forecasting

The complexity rises by increasing the dynamics and the number of assets, which increase calculation time for the additional energy market opportunities.

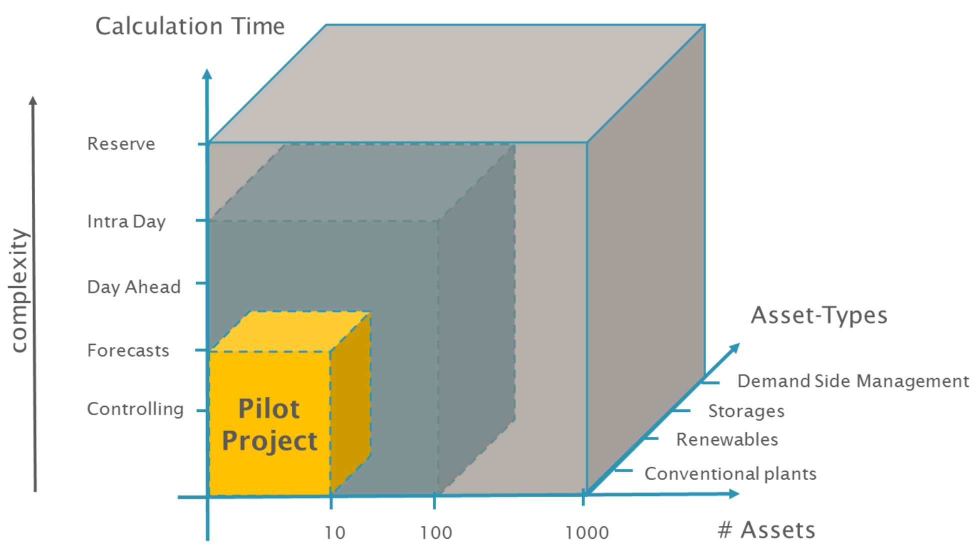


Exhibit 23: Pilot Projects ensure transparency, data access & validation and detect potentials

VPP's constitute a threat to the established player in the energy market. For instance, in the energy sector, the historical utility business model is about investing capital in power plants and capturing returns. As VPP's are viable business models supporting decentralizsed energy penetration, it involves capital shifts from areas that utilities have traditionally controlled to areas in which they are not involved.

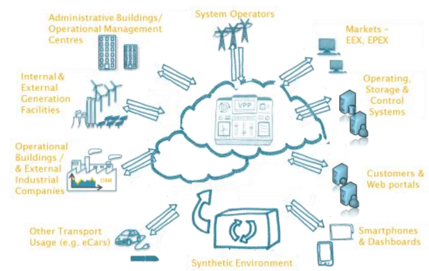
5. Altran's services

Altran, as a global technology and innovation consultancy provider, has detailed knowledge of all components to develop a solution from the first idea into a business case, detailing a business model and developing a breakthrough product with the latest technologies. Professional know-how on all layers allows Altran to guide a client from the very physical basis of an interoperable system to the top of an intelligent and totally connected environment. This leads to a service portfolio which addresses each client at his respective starting point, maturity level and specific goals.

1 Customer Needs & Objectives	2 Technology Roadmap	3 Business Case, Business Model and Assets analysis	4 Specification Development & Procurement Support	5 Im-plementation Project Management	6 Innovative Product & Process Development
▪ Market research ▪ Customer Labs ▪ Customer Needs Analysis (e.g. Synectics, I Power 5, Main Parameters of value) ▪ Apply "Lean Start Up" principals	▪ Technology Roadmap Workshop ▪ Align: ▪ Market ▪ Product ▪ Technology ▪ Resource Layer and develop the optimal path to a successful product or service ▪ Technology Radar	▪ Asset potential analysis ▪ Business Case Calculator (estimate the potential value generated) ▪ Investment need analysis and technical feasibility ▪ New Business Model Generation ▪ Business development for VPP Operators	▪ Requirements Workshop ▪ Specification writing ▪ Model based systems engineering ▪ Procurement & Tender support ▪ Supplier selection	▪ PMO Setup ▪ Project Management Support ▪ Program Management Support ▪ Owners engineering services	▪ Grid calculation ▪ Interfaces /Com-munication Box Development ▪ Logistic & Smart Meter Rollout ▪ Development and technical interconnection of customers flexibilities ▪ ICT Develop-ment ▪ Software Development

Exhibit 24: Altran service portfolio

Altran has built VueForge™, an end-to-end offer to create value from data generated by machines in all industries. VueForge™ not only addresses technology challenges such as connecting the embedded and the IT worlds, it also focuses on innovation and rapid-prototyping together with new business model setup to ensure market success.



A VPP – based on Altran's machine-driven big-data concept VueForge

The key to success in machine-driven big-data is having the ability and the experience to combine technology expertise, innovation and ecosystem setup. Altran has the expertise required to ensure this success:

- As an industrial company, Altran has a deep vertical understanding of machine technologies and regulations.
- As a global integrator, Altran incorporates key players, partners and clients at the global level to build the right ecosystem.
- As a technology company, Altran builds, integrates and delivers solutions based on cross-industries expertise, in-house accelerators and reference architecture.

6. "Flexibility is a must" – Interview with Prof. Dr. Konrad Mußenbrock

Dr. Konrad Mußenbrock is Professor for Renewable Energies and Energy Management at the Polytechnic University Aschaffenburg. For over 20 years he was in leading positions in the strategic and operating management of the energy industry and possesses extensive experience in almost all stages of the value chain of the energy business. In his former role as Senior Business Development Manager Energy within Altran, Dr. Konrad Mußenbrock played an important role in the development of the Virtual Power Plant concept. The VPP has twice received awards in Altran's global research & development innovation competition "THE I PROJECT".

VPP – the next big thing or only temporary fashion?

The rising share of renewables has the support of most people and of politicians as well. So on the one hand, you have a rising volatile energy source and on the other hand a more or less constant demand. The goal is to bring both sides together. The solution is flexibility in production and consumption. Times have changed from when the production only followed the consumption. Today's market demands an intelligent system, which permanently calculates the ideal combination of generation facilities and consumption sides: a Virtual Power Plant.

Why do you think Altran's VPP is innovative?

The benefit of a VPP depends on the calculation speed. Flexibilities are most promising traded on reserve or intraday markets. These markets permanently send signals and demand capacity immediately. Although the Altran approach considers risks in every calculation step, the decision speed is fast enough for trading on every market. Neither the real option theory is innovative nor the challenges in the energy industry. The innovation lies in the combination which guarantees realistic predictions and optimal decisions within seconds

What does a VPP need to operate successfully?

The bundling of different plant types is a must as well as the live-connection to consumers: industrial processes. One basis is transparency on all levels of production and consumption. An industrial process which is not operated efficiently cannot be traded in a portfolio – the risk of being unavailable is too high. What is even worse: this threatens the producer's value chain. Another basis are regulations, especially the requirements for the prevention of unbundling, which prohibit energy storing for system operators. And another pillar is the system's ability to analyse, validate and predict thousands of different pieces of information in real-time.

So a VPP is directly linked to big-data?

Exactly and the chances which lie in big-data analysis are not only on side of the providers. Every market player can benefit from combining production and consumption data. For example aggregators, who collect decentralized renewable sources and connect them with Demand Side Management processes.

Make a guess – what will be the situation in 2025?

We will see a lot of almost or complete autarkic cells, in which production, distribution, storage and consumption are harmonized and automatically operated – new players will have entered the market with a lot of new products, e.g. in the field of customer specific tariffs. We might even see emergency services offered by a provider: if an older client exhibits totally different usage behaviour, the provider will inform a medical service. Or while the VPP is analysing production demand, it alerts about a high probability for a shutdown and informs the maintenance service. It is exactly the type of playground essential to ensure security of supply. Before one invests billions in physical grid enlargements or pays for disused power plants, one should take a time and think about more intelligent opportunities.

Authors:

Fabrizio Rossi (Belgium)
Project Director
fabrizio.rossi@altran.com

Konstantin Graf (Germany)
Project Manager, Market & Technology Research, Business Development
konstantin.graf@altran.com

Christopher Muth (Germany)
Solution Architect, Coordination, Regulations, Business Cases
christopher.muth@altran.com

Contributors:

Belgium Team

Catalin Lupu
Senior Software Development, Asset Modelling
Olivier Terlinden
Regulations, Business Cases, Data Research
Vincent Watteyne
Regulations, Business Cases, Data Research
Sebastien Vandepoele
Regulations, Business Cases, Data Research
Jeroen De Vlam
Business Development
Jelle Meersmans
Business Development
Jef Daniels
Regulations, Business Cases, Data Research
Pierre-Henri D'Haene
Market Analysis, Business Cases

German Team

Kevin Vazquez Kiesel
Regulations, Business Cases, Data Research
Holger Bartels
Business Development
Hagen Späth
Business Development

Italian Team

Marco di Stefano
Regulations, Business Development
Nicoletta Neri
Software Development, Asset Modeling
Novella Saccenti
Software Development, Asset Modeling

General information about THE i PROJECT

"The objective of THE I PROJECT is to promote Research & Innovation internally by an important programme organized around contests, awards and value creation to reinforce our positioning as global leader in innovation". Philippe Salle, Chairman and Chief Executive of the Altran group.

What is THE i PROJECT?

Innovation is what we provide to our clients on an everyday basis. And it's also and above all an in-house value.

This is why we launched THE i PROJECT – i for innovation –, our internal innovation contest lets us identify and support innovations designed by our employees, called the Innovation Makers, to meet our clients' future needs in all industrial and service sectors worldwide.

Open to all the Innovation Makers, this programme supports all kinds of innovation: technical and services offers, business models…

Each project submitted by the Innovation Makers must be new and exciting, fit with the Altran strategy and have potential impacts on Altran: clients, reputation and attractiveness.

Up to 10 projects are granted per year.

The projects are selected by a jury of some of the most senior and experienced employees – with business and technical background – within the Altran group.

Who is it for?

THE i PROJECT is open to all Altran employees. As strength lies in numbers, teams from one or several units will be preferred to lone rangers.

What's to be gained?

Each winning team gets a significant budget to pay for the personnel required, external spending, prototype making…

Among a number of recognitions, winning team members which are successful in delivering their project will be awarded an "Altran Innovation Maker Title" by the Executive Committee. In addition, people who were not involved in the winning teams but who provided sponsoring, coaching, supports are awarded a "Best Innovation Sponsor Title".

General information about Altran

As global leader in innovation and high-tech engineering consulting, Altran accompanies its clients in the creation and development of their new products and services. Altran's Innovation Makers have been providing services for thirty years to key players in the aerospace, automotive, energy, railways, finance, healthcare and telecoms sectors. Covering every stage of project development from strategic planning to manufacturing, Altran's offers capitalize on the group's technological know-how in five key areas: Intelligent Systems, Product Development, Lifecycle Experience, Mechanical Engineering, and Information Systems.
In 2013, the Group generated revenues of €1,633m. Altran now has a staff of almost 21,000 employees in more than 20 countries.

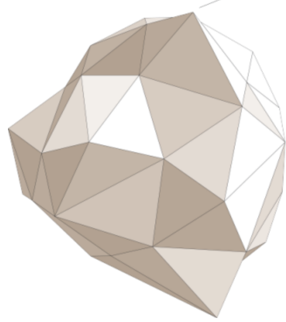
www.altran.com

List of sources

AgoraEnergiewende 2014 _ Auf dem Weg zum neuen Strommarktdesign
AgoraEnergiewende_2014 - Speicherstudie_Präsentation der Ergebnisse
BCG_2014_The_Energy_Efficiency_Opportunity
BMWI_2014_10-punkte-energie-agenda
BMWi_2014_Connect Energy Economics_Leitstudie Strommarkt
BMWi_2014_E-Energy_Abschlussbrosch_Mai_2014
Cambridge Consultants_2011_UMI - The USB for Smart Metering
CENEELEC_2012_SGAM - Smart Grid Reference Architecture
dena 2010 -Netzstudie_II_Ergebnisbericht_Integration erneuerbarer Energien in die deutsche Stromversorgung im Zeitraum 2015-2020 mit Ausblick auf 2025
ECOFYS_Fraunhofer_2012_RE-Shaping_Renewable Energy Policy Country Profiles
ENTSO-E_2014_Scenario outlook and adequacy forecast 2014-2030
Eurelectric_2013_Visions for integrated markets_EC stakeholder Forum
European Union_2011_Energy Infrastructure - Priorities for 2020 and beyond
Fraunhofer_2014_EEX_Stromerzeugung_2014
Fraunhofer ISI_2012_Intelligente Netze - Potenziale und Herausforderungen Metastudie
Germanwatch_2012_Tietjen - Kapazitätsmärkte
IASS_Töpfer_2013_Eckpunkte für die Gestaltung der Energiewende
VDE_2012_Positionspapier: Energiespeicher für die Energiewende - Speicherungsbedarf und Auswirkungen auf das Übertragungsnetz für Szenarien bis 2050

List of exhibits

INNOVATION MAKERS



Karnapp 25 – 21079 Hamburg – Germany
Tel : + 49 (0) 40 7971560 Fax : + 49 (0) 40 79715628