ABB ABILITY™ ENERGY MANAGEMENT AND OPTIMIZATION

OPTIMAX® for Virtual Power Plants (VPP)

Efficient, reliable and sustainable

- Bundled technical units
- Participation in the energy balancing market
- Participation in demand-response calls/ ancillary calls/redispatch
- Increased data transparency and flexibility indication
- Reduced operating costs
- One-click reporting

ABB Ability™ Energy Management and Optimization OPTIMAX® for Virtual Power Plants aggregates, integrates and coordinates decentralized energy generation, flexible loads and storage systems to enable cost-efficient participation in the energy markets.

OPTIMAX® for Virtual Power Plants
Requirements and influence on energy efficiency

Market requirements
The energy market is currently in a transitional phase brought on by increasing generation of energy from renewable and increasingly decentralized sources. These conditions require intelligent system structures which are supported by the most modern information technologies. The ever-increasing number of regenerative production units mean that flexible power generation, consumption and storage technologies are becoming enormously important. Energy companies are making their power plants more flexible in order to take advantage of the lucrative trading opportunities on the various energy markets.

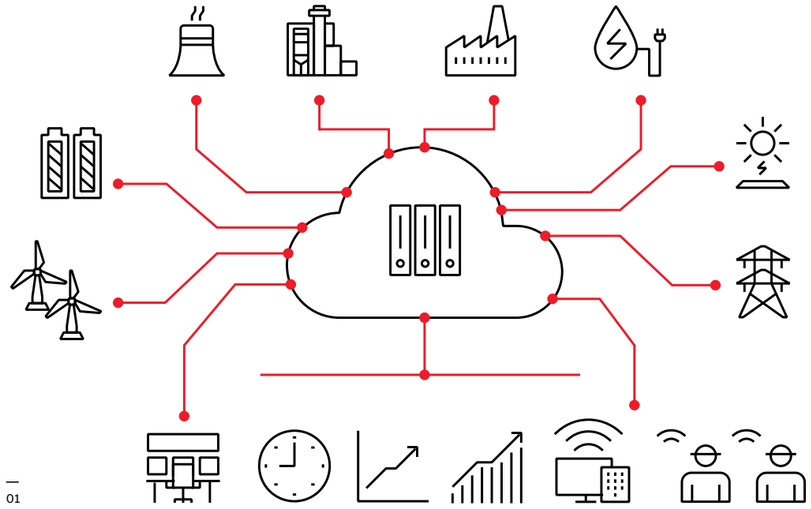
By pooling many different decentralized energy resources (DERs), this pool should be marketed as optimally as possible. It is possible to further increase the flexibility and profitability of the pool by incorporating power-to-heat, for example. ABB's optimization solution allows for the efficient and lucrative operation of controllable or steerable technical units as a whole.

History
OPTIMAX® is a unique software solution that has been developed by ABB for many years to unlock the value of industrial optimization through modern digital technologies with modular solutions for a wide range of applications.

Optimization of energy, emissions and processes

ABB OPTIMAX® for Energy Management and Optimization has evolved over the last 15 years from optimizing the operation of power plants to managing and optimizing energy, emissions and processes in the energy, utility and industrial sectors.

Starting with the first installation version at the Jänschwalde power plant in 2009, ABB now has more than 200 installations on 5 continents. They administer and optimizes all energy vectors, from electricity, steam, hydrogen, and district heating and cooling to water and combinations thereof, which covers several physical areas.



01 Overview of a Virtual Power Plant

The ABB solution
Virtual Power Plants – Unit Commitment – Pooling

— 02 Step-by-step approach to energy efficiency

OPTIMAX® for Virtual Power Plants is ABB's new solution for an energy market that is currently in transition.

OPTIMAX® employs a mathematical model in order to optimally distribute the power specifications to the technical units in real time. System limitations, disruptions and deviations from schedules are registered online and directly incorporated into controlling the use of the system, making it possible to flexibly adjust the optimization goals to changing framework requirements.

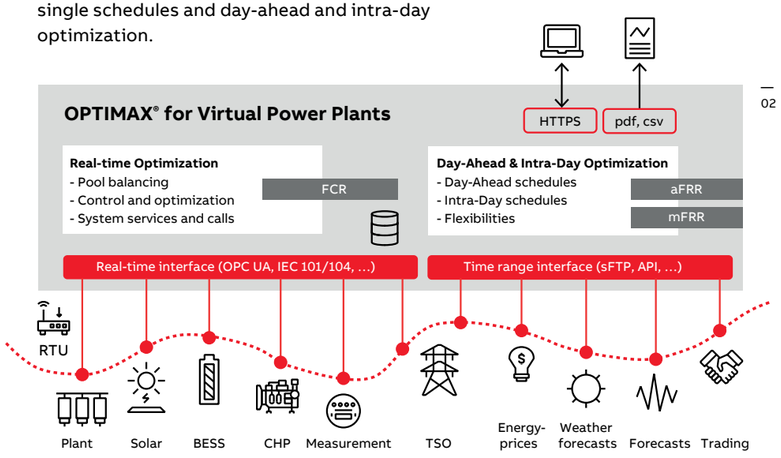
One possible optimization goal is to minimize the generation costs using the merit order method. Alternatively, OPTIMAX® allows the division into priority levels and thus ensures that all systems in a level are called up correctly.

OPTIMAX® is suited for providing secondary control and minute reserves as well as reactive power for both direct power trading and for schedule management functions such as balancing group optimization, division of overall schedules into single schedules and day-ahead and intra-day optimization.

OPTIMAX® automates communication between energy management and the technical units via standardized interfaces. Information regarding forecasts, trading, scheduling and invoicing are exchanged with the energy management system. Balancing power calls are exchanged with the transmission grid operators, and real time and system information is exchanged with the technical units. This information is available for diagnosis, analysis and statistics through OPTIMAX® archiving.

OPTIMAX® informs the user in a configurable manner regarding alarms and notifications in cases of disruptions and changes in the statuses of technical units.

Operation and monitoring are simple and easy via OPTIMAX®'s intuitive user interface or an already existing control system. The planned and current power values as well as the balancing power calls are indicated directly. The virtual power plant's current power and status are always available at a glance with the simple display.



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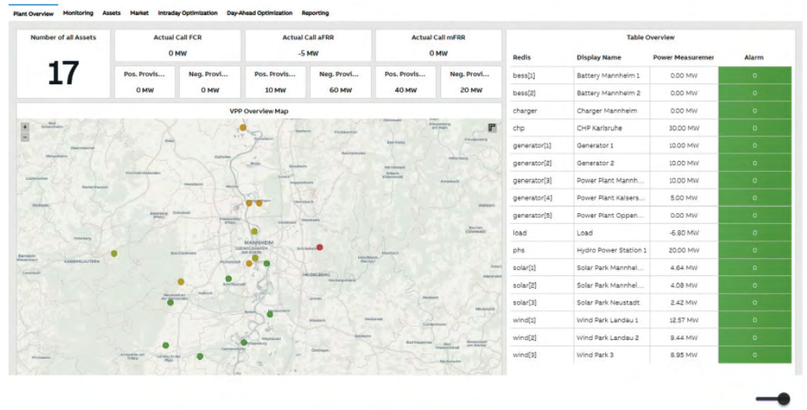
RTU - Remote Terminal Unit
BESS - Battery Energy Storage System
CHP - Combined Heat and Power system
TSO - Transmission System Operator
FCR - Frequency Containment Reserve (also known as primary control reserve)
aFRR - automatic Frequency Restoration Reserve (also known as secondary control reserve)
mFRR - manual Frequency Restoration Reserve (also R3 or tertiary control reserve or minute reserve)



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— 03 Overview of a Virtual Power Plant

OPTIMAX® provides an overview of the actual call FCRs, aFRRs and mFRRs, as shown in Figure 3. The pool's reserve calls and the corresponding reactions of the individual systems are also shown here.
If the transmission grid operator sends a balancing power call, the minute reserve and real-time optimization will take this call into account and optimize new set points.

Transparency for your Virtual Power Plant

The positive and negative reserves per system are also displayed. A positive reserve means that available energy is fed into the grid, while a negative reserve means energy is being consumed.

Table 04 shows the current values of the trading obligations for 15-minute time windows.
- The Day-Ahead tab shows the electricity traded on the Day-Ahead trading with the corresponding energy price (optimized with OPTIMAX®)
- The Intra-Day tab shows the power traded on the Intra-Day trading with the corresponding energy price (optimized with OPTIMAX®).
- Positive and negative reserve performance

The positive reserve should be fed into the power grid, while the negative reserve should be taken from the grid in the event of a reserve call.
- **Total** – indicates all of the reserves and the optimized schedule
- **Committed** – shows the already committed reserves for auxiliary services
- **Available for trading** – indicates the remaining reserves that can be traded on the market for ancillary services

OPTIMAX for Virtual Power Plants – Standard Modules

Monitoring & Reporting
- Enhanced user experience and visibility of your energy utilization
- Easily create reports (pdf, excel, csv) and send production data to billing
- Per asset, per market, per customer, per type,...

Real Time Control & Optimization
- Optimal schedule disaggregation
- Optimal Allocation of Ancillary Service Calls & Demand Response Calls

Predictive Optimization
- Optimally planning your product portfolio with Intra-Day and Day-Ahead Optimization
- Optimal schedules based on forecasts, loads and prices + updated during day
- Automatic rescheduling
- Flexibility indication for more informed trading decisions & bidding support

Forecasting & Simulation
- ML or AutoML AI Forecasting for energy generation, load demand and prices
- Digital Twin

Effective Engineering
- One-click installation
- Add and remove assets with few clicks
- White box model to develop your own models

Multi-Site Operation
- Benchmarking sites
- Enterprise-wide energy optimization

OPTIMAX® for Virtual Power Plants
Investments in the future that are worthwhile

Real-time and predictive optimization OPTIMAX® for Virtual Power Plants offers a four-stage optimization approach that enables grid operators to participate in the control markets and operate their power plants in the most cost-efficient manner.

- The optimized set points can be distributed directly to the performance set points of the controllable systems in real time. In this way, the system works in either an open or closed loop.
- Optimal schedules for the controllable system parts are generated in Intra-Day and Day-Ahead Optimization based on forecasts, loads and prices. They are then updated throughout the day and in real time.
- Weather forecasts are integrated in order to better predict the generation of renewable energies.
- The minute reserve re-optimizes the set points every minute based on the current measurements, the operating status and the tertiary reserve calls.

Integration of weather forecast services

The aim is to bundle the marketing of power plants, decentralized generation units, energy storage systems and controllable consumers.

Fig. 05 "Day-Ahead Optimization" charts the optimized use for the next day.

Reporting
- Energy generation
- Energy consumption
- Trading results
- Balancing power calls

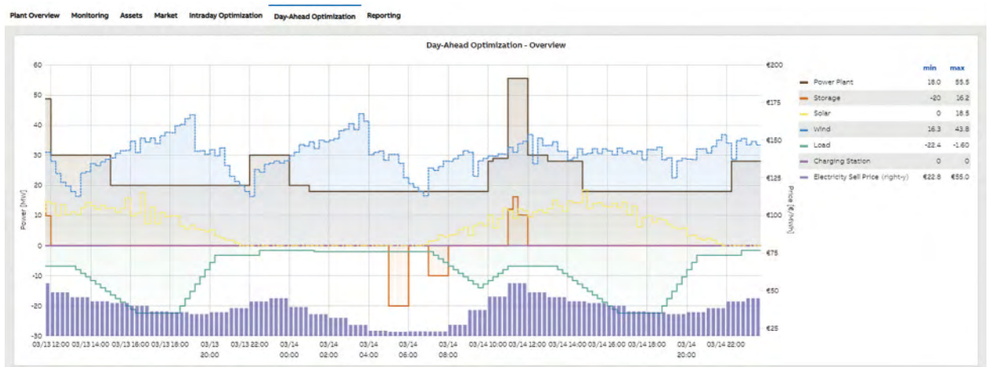
The historical data is recorded by the internal OPTIMAX database and displayed on the “VPP Reporting" tab. The recorded data includes energy generation and supply, trading and control calls and/or demand responses.

Distribution of energy balancing calls

Creating transparency
Making available flexibilities visible

Energy management

Integrated forecasts



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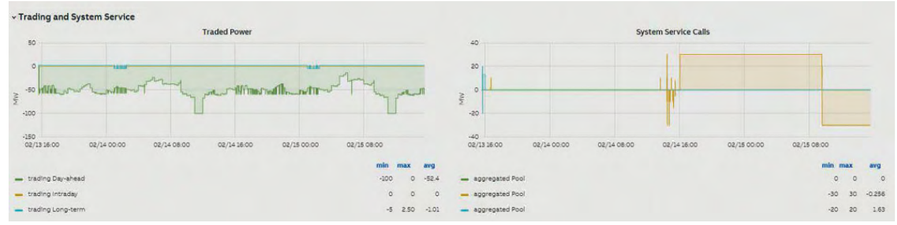
05 Forecast diagram for day-ahead optimization

OPTIMAX® Energy Monitoring and Reporting platform
Easy and uncomplicated



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06 Trading results and ancillary service calls

Automated communication
- Automated communication between energy management and technical units via standardized interfaces
- Seamless recording of operations for archiving, diagnosis and continuous improvement of the database
- Comprehensive information basis for fast decisions

Flexibility and availability
- Scalable system architecture, from a few to many thousands of technical units
- Simple integration into virtual server architectures in data processing centers
- Continuously redundant system architecture for 24/7 operation

Standardized open interfaces
- Open interfaces to the connected IT systems, such as forecasting, trading and accounting
- IEC 60870-5-104 and -101 interface to distribution system operators and transmission grid operators
- sFTP client for exchanging numerical sequences

Proven solutions
- Many years of experience in power plant automation, substation automation, and telecontrol
- References in multi-unit plants as well as in virtual power plants/pools with > 5,000 assets

Tailor-made service packages
- Expert team for basic design, engineering, supply and training related to OPTIMAX® in line with the project-specific customer requirements
- Integration into the existing IT landscape and linking of technical units
- Service contracts from software maintenance to user supported interfaces

- **Optimized control reserve calls**
- **Unit commitment**
- **Balancing group optimization**
- **Combined heat and power optimization**
- **Multi-energy site optimization**
- **Optimal schedules**
- **Demand response and load management**
- **Autonomous operation of distribution grids**
- **Steam & power optimization**
- **Minimization of forecast errors and penalty payments**

AI forecasting

OPTIMAX® 6.4 features an AutoML module that provides an efficient and seamless way to generate forecasts that can later be used for energy optimization. The module significantly reduces day-ahead and intra-day nomination errors when feeding energy to the grid. It automatically forecasts load demand, energy generation and energy pricing without manual interaction.

Optimal energy with a virtual pool
ABB Energy Management System for CKW

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07 The Rathausen power plant is a run-of-river power station on the Reuss River in Switzerland. Centralschweizerische Kraftwerke AG (CKW) incorporated it into a VPP with a pool of other diverse resources, allowing the company to optimize operation of their energy portfolio. Courtesy: CKW

Centralschweizerische Kraftwerke AG (CKW) is a service provider for energy, data, infrastructure and construction technologies in Central Switzerland. The Virtual Power Plant is marketed both on the spot market and market for balancing services.

Virtual energy pool:
- Company's own pumped storage power plants
- Many decentralized hydropower generating units
- Combined heat and power (CHP) units
- Waste incineration plants
- Industrial sites with controllable loads
- Wind and solar power plants
- > 110 technical units
- 1,400 MW installed capacity

Using ABB OPTIMAX for Virtual Power Plants, CKW was able to model the assets and their physical interdependencies. This allowed the company to optimize any given general schedule and optimally allocate dispatch power from all three Ancillary Service Markets in Switzerland (FCR, aFRR, mFRR). CKW was able to increase revenue by providing market access for small- and medium-sized assets as well as delivering significant time and cost savings when adding new assets. The ability to make fast decisions through accurate and easy-to-understand visualizations enabled new business models and revenue streams.

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Industry use case study
Infraserv GmbH & Co Höchst KG

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08

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08 Infraserv Höchst

Infraserv GmbH & Co Höchst KG supplies Industriepark Höchst with energy and steam heat.

The Virtual Power Plant aggregates the different power generation units and automates communication between the energy management system and the control system.

Customer requirement
- Control and optimization system to make the power plant fleet more flexible
- Power generation units: 3 gas turbines,
- 2 electric boilers, 1 megavolt-amperes (MVA), other external technical units (~255 MW output)

ABB solution
- Optimization system for aggregating the technical units
- Real-time optimization of ancillary service call allocation
- Automated communication

Customer benefit
- Increase in the offered control reserves
- Power-2-Heat: use of industrial heating powered by electricity
- Flexible allocation of aFRR/mFRR (control reserves)

Source: https://destination-zukunft.abb.com/sonstiges/hoechst-regelbar/

Additional information
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