

Virtual power plants - A reliable source of energy for the future

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The amount of electricity produced using renewable energy sources is subject to fluctuations, making the network unstable. Conventional power plants can be used to balance out the situation. However, the problem with these is their negative CO₂ balance and lack of flexibility. Virtual power plants can ensure stability by automatically combining renewable energy sources based on availability.

Supplies of fossil fuels at conventional storage facilities are running out. Extraction methods which are more complex and have a higher level of risk such as fracking, for example, are increasingly being used. The unexplained problems surrounding its long-term storage and the associated financial and political uncertainties make nuclear energy a difficult option. There is an urgent need for environmentally-friendly alternatives.

Renewable sources

There are potentially numerous renewable energy sources that can be used. One possibility is solar energy although it can only be produced during the day and is dependent on the weather. Wind energy has been around for centuries - historic windmills are testament to that fact. However, the drawback with wind is that availability and intensity are neither constant nor predictable. In addition, the noise produced and shadows cast by the rotors of modern wind turbines have affected their

acceptance by society.

While hydroelectric energy can be stored and accessed quickly, availability is however limited in some European countries due to geographical conditions. For political reasons, it is sometimes practically impossible for larger barrage and pumped-storage power plants to be built. Geothermal energy has also remained rather a niche energy in some areas of Europe.

Energy from biomass can also be stored and made available quickly via combined heat and power plants. However, the associated land requirement competes with food production. The deforestation associated with the cultivation of biomass outside Europe should also be regarded extremely critically.

There is a need for conventional plants to regulate the demand for energy in order to balance out the volatility of renewable energy sources and keep the energy network stable. For example in Germany, that regulation is achieved by using hard coal- and lignite-fired power plants which have an extremely negative CO₂ balance and may be old and inflexible but have already been written off, making them very cost-effective. The alternative would be gas-fired power plants which are easy to control and more favourable in terms of the CO₂ emissions that they produce but more expensive to run. It is ultimately for the market to decide: A surplus of renewable energy has suppressed gas-fired power plants in favour of more profitable coal-fired power plants.

Virtually networked and controllable

New intelligent strategies for production, storage, distribution and consumption are required. Virtual power plants where different sources of renewable energy can be intelligently networked provide a solution. Control and information technology enables the relevant energy sources

to be combined automatically based on availability.

Instead of comparatively slow coal-fired and nuclear power plants, in a virtual power plant intelligent and centrally controlled biomass plants and hydroelectric and storage power plants balance out the volatility of solar and wind power plants, thus ensuring a stable energy supply.

Further potential for improvement lies in the intelligent integration of consumers. For example, sewage treatment plants use sewer gas itself to cover part of their energy requirement. If a sewage treatment plant is integrated in a virtual power plant and there is a surplus of energy, the own production by the sewage treatment plant can be stopped and the sewer gas can be stored in an appropriate gas storage facility or combined heat and power plant. The sewage treatment plant will then get its energy from the grid, thus helping to ensure stabilisation in the process. If the network requirement increases, the sewage treatment plant can supply additional energy from the sewer gas stored earlier. Pumped-storage power plants can also store mains energy and feed it back if required. However due to the multiple energy conversions, the level of efficiency is limited.

This intelligent networking of different energy sources means that operators will be able to join the lucrative market of control energy with minute and quarter-hour reserves and thus improve their amortisation and profitability. The higher the number and the greater the variety of energy sources there are, the better.

As soon as virtual power plants can provide the capacity required, fossil fuel "backup power plants" can finally be shut down. The result will be a sustainably improved CO₂ balance with no limitations in respect of energy availability.

Automation know-how for engineers and operators

There are no ready-made solutions for virtual power plants. Every installation is designed to meet individual requirements based on the specific type and number of participants. There are a variety of approaches that can be taken in order to formulate a suitable solution. Experienced specialists can help to configure a reliable and economical production set-up while taking into account the sustainable development of society and the environment.

Powerful automation components with optimised energy consumption form the basis of any control system. Mitsubishi Electric's portfolio ranges from complete converter substations for connecting wind and solar energy systems to the network, through PLCs for small applications or with several thousand inputs and outputs and intelligent remote terminal units - smartRTUs for short - for communicating securely and wirelessly with a master station to contactors and fuse elements for controlling and protecting valves and drives as well as HMI devices in a wide variety of designs. There are also powerful energy-saving inverters for controlling drives. Feedback capability and the possibility of temporary storage complement the design possibilities for energy-optimised control systems.

Powerful, finely scalable SCADA solutions enable individual electricity generating facilities to be linked in order to create virtual power plants, coordinated intelligently. Mitsubishi Electric offers products such as the process control system PMSX®pro and the Mitsubishi Adroit Process Suite life-cycle software tool (MAPS) for ensuring that installations respond quickly and flexibly to demand from the grid and controlling the renewable energy power plants connected to them according to their utilisation and capacity. Like MAPS, PMSXpro also offers a wide range of options for centralised and decentralised plant operation while also being certified to the VGB power plant standard.

Costs and financing

Developing a renewable energy supply – i.e. plants, networking and distribution networks – has to be financed. With the interest rate being so low at the moment and government bonds being barely trustworthy and offering little return, along with risky property and securities transactions, investing in renewable energies could offer a profitable option.

Picture caption:



Picture 1: Automation components enable the energy sources from a virtual power plant to be linked together based on availability.

[Source: Mitsubishi Electric Europe B.V.]



Picture 2: Virtual power plants automatically combine renewable energy sources, thus ensuring a stable energy network.

[Source: Mitsubishi Electric Europe B.V.]



Picture 3: Dag Hoeft, Process Industry Technical Sales Consultant,
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[Source: Mitsubishi Electric Europe B.V.]

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With around 124.000 employees the company recorded consolidated group sales of 39,3 billion US Dollar* in the fiscal year ended March 31, 2014.

Our sales offices, research & development centres and manufacturing plants are located in over 30 countries.

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