



Green power

Energy efficiency and sustainability studies in power systems



At a glance

Since many years the protection of the environment has become a major topic – also in power supply systems. Driven by the scenarios of global warming the reduction of CO₂ emissions and other greenhouse gases, as well as resource efficiency in total, is a clear target.

At the same time, the standard of living and the security of electricity supply are assets to be kept. Reliable, high-quality supply of electric power is a key foundation of modern societies.

Increasing the efficiency of energy use in the actual processes such as drives, lighting or heating is a key requirement to achieve these contradicting targets. Also, the integration of renewable energy resources and the efficiency increase of power supply equipment and systems support these targets.

Siemens Power Technologies International (Siemens PTI), your provider of network consulting, network planning software and trainings on the Siemens T&D portfolio, offers green power studies for overall solutions to convert existing power generation and supply systems into sustainable and future orientated, environmental friendly systems.

The challenge

Existing power supply systems were driven by the top down electricity distribution from central power plants to the distributed consumers – and, of course, by cost optimization.

In order to reach the new targets it will be essential to integrate renewable power, to reduce transmission and distribution losses, and to increase overall efficiency (e.g. also resource usage and land use for substations) while keeping an eye on the cost structure.

A big hurdle is the balancing of generation and demand. In the past, generation was scheduled ahead to meet the expected demand – with load forecasts achieving remarkable accuracy.

However, with increasing energy production from renewable energy sources, a new and much harder predictable variable enters, and very often already dominates, the system. In consequence, load has to adapt more and more to the available generation level.

Only the detailed knowledge of possible generation profiles, storage capabilities, and load shaping options (both decreasing and also increasing demand) that will not impair the performance of the customer's processes will allow the mitigation process.

Our solution

We start to analyze the given situation based on the actual setup, location and processes. In a kick-off meeting the key performance indicators for the project will be selected and ranked with respect to the defined targets.

A site visit will reveal the local conditions with regard to age and condition of existing equipment. Based on the single line diagram for electric power supply, the different infeed scenarios and the geographic layout options will be developed.

In the frame of technical feasibility the environmental and the financial options will be investigated. This has to include CAPEX and OPEX, possible future scenarios based on load development or energy price development as well as the sequence of modification.

For industrial applications in many cases a close cooperation with further specialists having specific plant process knowledge is necessary.

For commercial building environment the overall optimization can only be achieved by an advanced energy management which has to include building technology driven issues like cooling, heating and ventilation.

After the selection of the preferred option a roadmap for the conversion will be developed and given as a rollout plan.

Siemens PTI – Network Consulting

Answers for infrastructure.

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Application examples

Microgrid simulation

Microgrids are geographically limited energy systems with distributed energy resources, loads and preferably storage capabilities. Based on the specific condition, microgrids may be capable to operate in an island mode, thus requiring load frequency control, reactive power management and the functionality to change over from interconnected to island mode. Special attention is necessary to reconnect the system by synchronizing the island system to the main grid.

The control function is achieved by a microgrid controller collecting the relevant parameters from the running system and activating the required generation, load and storage functions.

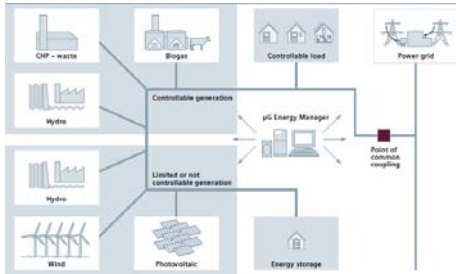


Figure 1: Elements of a microgrid

For a microgrid project we modeled the electricity supply system together with all generators, loads, storage facilities and control functions.

In addition to the standard analysis of load flow and short circuit for normal

operation and contingencies, the generation and the load have a daily profile and therefore it is possible to generate charts showing the loading of elements, the losses and emissions as a day profile.

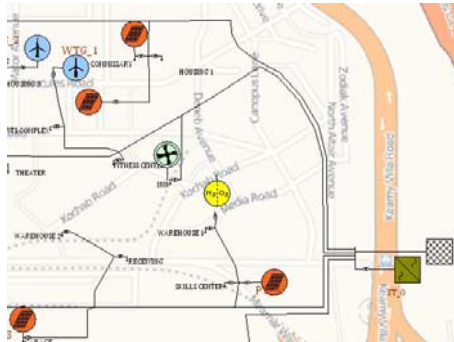


Figure 2: Microgrid system model (section)

Based on the targets, e.g. limitation of emissions, it was possible to optimize the mix of generation in a way that costs, equipment utilization and emission limits are kept at required levels over the whole day. Thus it was possible to optimize the control functions and to finally simulate and validate the dynamic behavior.

Green harbor

For a harbor development project we run a feasibility study to show the integration of battery driven container lifting vehicles in combination with a charging and swapping station. Also, crane operation was optimized with respect to energy management of the complete site by developing appropriate peak shaving strategies. In addition to the conven-

tional grid connection a remarkable contribution from wind generation along the quay was integrated, as well.

Ships in the harbor running their own engine are a big contributor to emissions and pollution. In order to supply the vessels with power from the shore we modeled a MVDC link to demonstrate the principle of cold ironing (i.e. power supply from the shore).



Figure 3: Siharbor solution for power supply from the shore

Green factory

The challenge to convert existing industrial complexes into so called green factories lies in the integration of renewables in combination with power supply security and power quality requirements – and of course highest energy efficiency in the actual industrial processes. With respect to power supply, the most valuable contribution comes from loss reduction. These analyses are conducted in cooperation with specialist knowing the technology of the production process.