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Comprehensive distribution planning expertise to address the grid challenges of tomorrow, today

Siemens PTI Consulting

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Answers for infrastructure and cities.

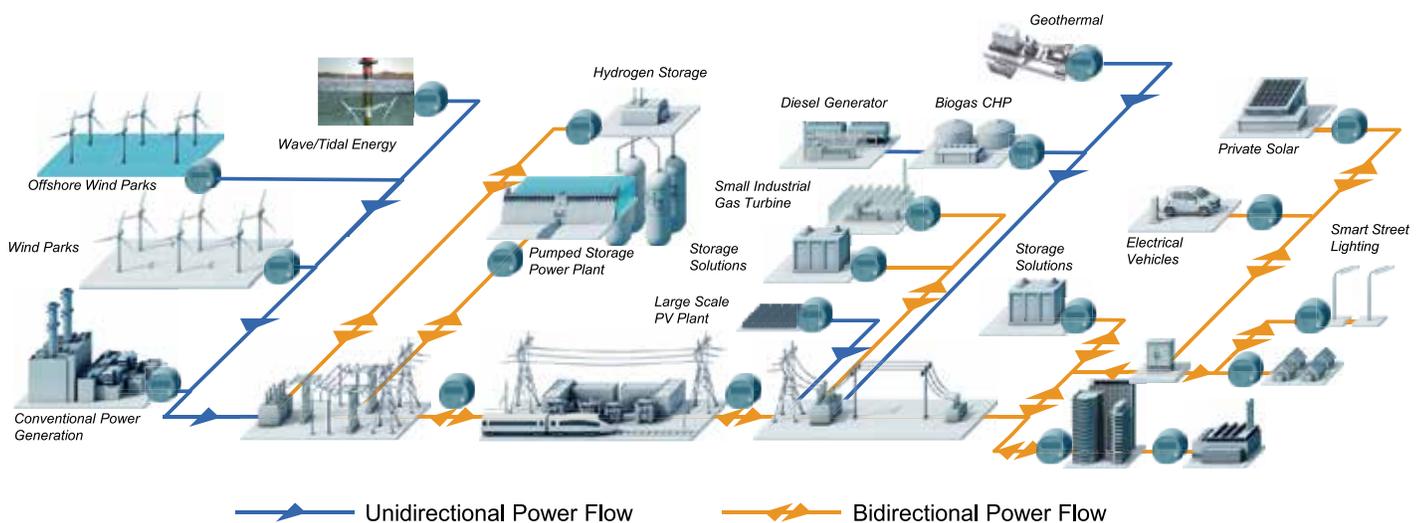
# Bringing a world of knowledge to your business

Economic and environmental concerns are driving government policy and distribution utility executives to support the use of new generation technologies and load management schemes. The impact of these policies and technologies are far reaching and touch on all aspects of the network from equipment ratings, to protection and control schemes, tariff structures and business processes.

Understanding these new technologies and demand response schemes, how they may be deployed and the scenarios under which they may be deployed requires a deliberate and methodology-driven approach with the insight, experience and tools to ensure optimal business decisions.

Smart Grid technologies include:

- Microgrid
- Distributed Generation
- Distribution Automation
- Telecommunications
- Energy Storage
- Electric Vehicles



# Microgrid

A microgrid is a combination of onsite generation, load and a monitoring and control system that is capable of operating in both grid dependent mode and grid independent mode to achieve specific needs. The key drivers of microgrid networks include: need for improved reliability and security, need for meeting renewable generation targets, ability to interconnect onsite generation including intermittent resources along with storage technologies, and emerging new monitoring and control technologies.

Microgrid design is driven by various objectives, including meeting the required renewable portfolio target, achieving loss reduction, and improving economic benefits by participation in utility programs such as demand response. It is important to get an overview of existing load, existing onsite generation technologies, network topology and existing level of automation in the given distribution network to design, model and analyze the microgrid.

Siemens PTI has expertise in designing microgrid networks to achieve predefined objectives by performing various studies, which include the following activities:

- Design the microgrid encompassing predefined objectives such as renewable portfolio, loss reduction, economic benefits, demand response and any other as required
- Modeling of the microgrid network and components using PSS®SINCAL or any third party software
- Analyze the impact of onsite generation on the distribution grid while the microgrid is operating in grid-dependent mode

- Test the ability of the microgrid for seamless grid-independent mode of operation from technical stand point
- Estimate and compare the cost of energy by various generation portfolios and provide recommendations on optimal generation mix
- Estimate the energy cost savings due to participation in utility demand response programs
- Revise existing protection schemes and provide necessary recommendations
- Demonstrate the improved reliability

## Did you know?

Siemens PTI offers its own advanced network simulation tool – PSS®SINCAL. Using an open commercial database structure, PSS®SINCAL provides the ability to connect with a meter data management system (MDMS) and use near real-time data to perform distribution planning and analysis. The data derived from smart meter communication can be automatically updated allowing utilities to make more refined decisions in response to energy consumption and generation.

Building on the ability to interface with smart meter systems, PSS®SINCAL offers the unique ability to assign and learn individual consumer load profiles, which can be analyzed individually or in aggregate to optimize system performance.



# Distributed generation

Successful integration of distributed and renewable generation into a distribution network relies heavily on effective planning and operation. The output of renewable generation (such as wind turbines or photovoltaic units) is highly intermittent with comparably few full-load hours, and it is difficult to predict. This renders a traditional, deterministic network analysis approach inaccurate or even ineffective and also drastically complicates energy-balancing tasks.

With unique insight and experience, Siemens PTI stands apart in the ability to provide the depth and breadth of consulting services, covering both decentralized energy management and active network analysis, for optimized interconnection and operation. Specific areas of expertise include:

## Network analysis

Probabilistic steady-state and dynamic calculation of distributed energy resources system performance within the network, which explores loading of network and equipment, transmission constraints, voltage control, power quality, fault ride through behavior and short circuit power.

Optimize siting and sizing of the units to minimize losses, improve reliability, assess impacts on reliability and ensure protection of units and network.

## Energy management

Optimized configuration of thermal and electrical generation units (power range, technology) considering economics, environmental impacts and energy aspects, which includes

the calculation of optimum supply scenarios (minimum energy costs, optimum generation portfolio, power trading, calculation of required reserve capacities, recommendations for operation) and optimized operation strategies based on daily schedules.

## Stochastic network analysis

Since the majority of renewable energy resources are intermittent and non-dispatchable, they cannot be modeled as conventional generators with full controllability. Since the output of renewable generators mainly depends on meteorological conditions, different stochastic models have to be applied to simulate annual profiles of different energy resources.

Using commercially available third party software tools (or our own PSS®SINCAL) and heuristic data mining, Siemens PTI can provide site-specific annual models for wind, solar or heat-controlled co-generation systems. The stochastic models of renewable generators are then applied to standard network analysis routines, such as load flow and reliability evaluation. Calculation results of these routines can be used for important decision-making procedures, e.g. quantification of the potential benefits of active operation of distribution network.

Intelligent control of both distributed generators and network devices in the distribution grid could bring about various benefits, such as improvement of voltage quality, supply reliability, reduction in energy losses and improved overall safety.



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# Distribution automation

Distribution automation enables real-time adjustment to changing loads, generation and distribution system failures with or without operator intervention. It requires control of field devices and communications to allow automated decision making in the field and relaying of critical information to the utility control center. Distribution and substation automation helps to improve reliability and increase operations efficiency by using real-time monitoring of switching devices and intelligent control. Fault location, isolation and system restoration (FLISR) capability enables distribution utilities to meet reliability targets while optimizing operations and minimizing safety concerns. The challenge is to identify and unlock the values which provide the best return on investment in ways that can be measured by utilities.

Siemens PTI expertise in advanced distribution analysis and simulation tools provides incomparable advantage to utilities planning for deployment of distribution automation

technologies. The services offered by Siemens PTI range from planning studies, technology assessment and system integration.

Studies may include:

- Economic evaluation and cost-benefit analysis
- Feeder sectionalization and automation
- Switching location and optimization
- Optimal topology assessment: radial, closed- and open-loop
- Reliability performance assessment
- Operation and control strategy: distributed versus centralized
- FLISR assessment and self-healing grids
- Protection, control and monitoring

# Telecommunications

The utility industry is changing at an accelerating rate, and virtually all utilities will need to upgrade or deploy new telecommunications networks in order to keep up with industry practice, stay above the curve, or become leaders. Grid modernization is being facilitated via the deployment of smart grid applications such as smart metering, distribution/feeder automation, and countless other operations. As a result, the success of any grid modernization initiative hinges on making correct telecommunications planning. The choice of telecommunications infrastructure is complicated by the vast and complex ecosystem of technologies and vendors. An optimal telecommunications design must address several questions such as:

- Which technologies can be leveraged to handle multiple operations?
- How does the design behave under different conditions (e.g. steady state/exception, low/high speed, etc)?
- What are the data traffic requirements for grid-specific operations?
- What are the CAPEX and OPEX for each design?
- What are the optimal locations for Basestations?
- What is the potential of the design for future expansion?

Siemens PTI Consulting offers technology unbiased and vendor agnostic services to help utilities assess their current telecom situation, and develop an overall telecommunications strategy to propel them into the future. Siemens telecom engineers and consultant have the cross-domain expertise to understand power systems, the utility environment's operational needs, and how those needs map to telecom requirements.

Siemens minimizes the assumptions, guesswork, risk, and subjectivity in analysis and recommendations with the use of our proven advanced simulation and modeling software SG-CAT (Smart Grid Communications Assessment Tool). SG-CAT is telecom planning software for grid-specific applications that goes beyond the capabilities of RF planning tools by adding the dimensions of performance prediction (e.g. congestion, capacity, response time, reliability) and cost modeling. SG-CAT allows Siemens engineers to model different telecommunication technologies/designs and evaluate how each solution will perform in real-life scenarios by simulating the utility's own topography and geography, over a period of time, and under various "what if" system operating and loading conditions. SG-CAT allows a detailed technical evaluation of the specific/unique requirements of the utility based on their actual service area and future deployment strategies.

# Energy storage

Energy storage technologies have garnered strong attention for their ability to support power grids at all levels from generation-transmission (large-scale bulk-storage) to distribution and customer facilities (community energy storage).

The unique characteristics of current energy storage technologies such as energy efficiency, fast response, number of cycles to charge/discharge, and transportability have transformed the concept of storage into a tool that is generally accepted as an important component of a modern electrical grid.

The real value of energy storage resides in understanding the state of existing and developing storage technologies and their potential applications. Siemens PTI offers the opportunity to leverage its knowledge and experience on energy storage technologies to conduct technical and economical feasibility analyses as well as grid impact studies using advanced simulation tools.

Some energy storage applications and benefits include:

- Reduced cost of new capacity and capital deferral by peak-load shaving
- Frequency regulation, spin reserve and other ancillary services
- Integration of intermittent renewable generation
- Management of transmission congestion
- Voltage support and power factor correction
- Reliability improvement and planned islanding
- Load management at customer facilities and time-of-use (TOU) rate avoidance
- Enabling integration of EVs
- Energy management for microgrids

# Electric vehicles

The emerging trend to substitute combustion engine cars with electric vehicles (EV) for personal and commercial transport will have a large impact on the existing medium-voltage and low-voltage networks.

Currently these networks are designed to supply, on average, a typical household load of around 2 kW. If EVs are integrated, this household load might – depending on simultaneity of charging process and charging power – increase to more than 10 kW causing potential overloading of network components. Additionally, these new types of load may be operated as energy storage affecting the normal power flow in the network, which might at times cause a reversal of the power flow.

Siemens PTI network consultants can help you identify directions to enhance network performance, such as:

- Identification of the optimal location for chargers or fast charging stations
- Determination of necessary extensions of the network

- Assessment of investment costs for derived variants
- Evaluation of charging strategies
- Optimized network operation using communication and intelligent controls

Possibilities such as using EVs to participate in ancillary grid services and advanced distribution management systems can be evaluated. Control applications might include:

- Reactive power or voltage control
- Reduction of load peaks or equipment loading
- Operation as energy storage for vehicle-to-grid (V2G) functionality and primary control
- Balancing of renewable energy sources in networks with a high distributed generation
- Integration into demand side management (DSM) systems or virtual power plants

# Expertise at your fingertips – wherever you are

Siemens Power Technologies International (Siemens PTI) provides network consulting services, network planning software, and professional training on all aspects of power transmission and distribution as well as on Smart Grid technology.



## ▶ PTI General

Siemens PTI's internationally renowned experts provide the knowledge and expertise required to combine individual equipment components to a complete power supply system that meets even the highest technical and economical demands. The comprehensive software and training portfolio, long-standing expertise in advanced power system technologies, and Siemens' financial strength are a sound basis for the development of state-of-the-art solutions that ensure the utmost reliability and efficiency of any supply network.

With regional offices around the globe, Siemens PTI is present on all continents. Wherever you are, Siemens PTI's unique supply network expertise is always in close reach.



## ▶ Software Solutions

Siemens PTI offers a suite of powerful software tools that support network planning and operations engineers in their development of highly accurate and efficient power system analyses. The Power System Simulator (PSS®) Product Suite provides a complete set of integrated, conventional, and specialized tools for the simulation and analysis of transmission, distribution, and industrial power networks, as well as gas, water, heating, and cooling infrastructures. Easily integrated into any existing IT environment, these powerful and user-friendly tools feature an intuitive graphical user interface, customizable visualization options, automation capabilities, and efficient data management.



## ▶ Power Academy TD

As specialists in training and continuing education, Siemens Power Academy TD offers professional training in the fields of power transmission and distribution, the industrial and commercial use of electrical energy, and Smart Grid technology. In more than 25 state-of-the-art training centers worldwide, Siemens Power Academy TD provides access to Siemens' expert knowledge and capabilities. Employing the latest teaching methods and highest-quality content, Siemens' certified trainers provide a superior quality educational experience, so participants acquire practical skills with a focus on retaining these skills long term.

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Smart Grid Division

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