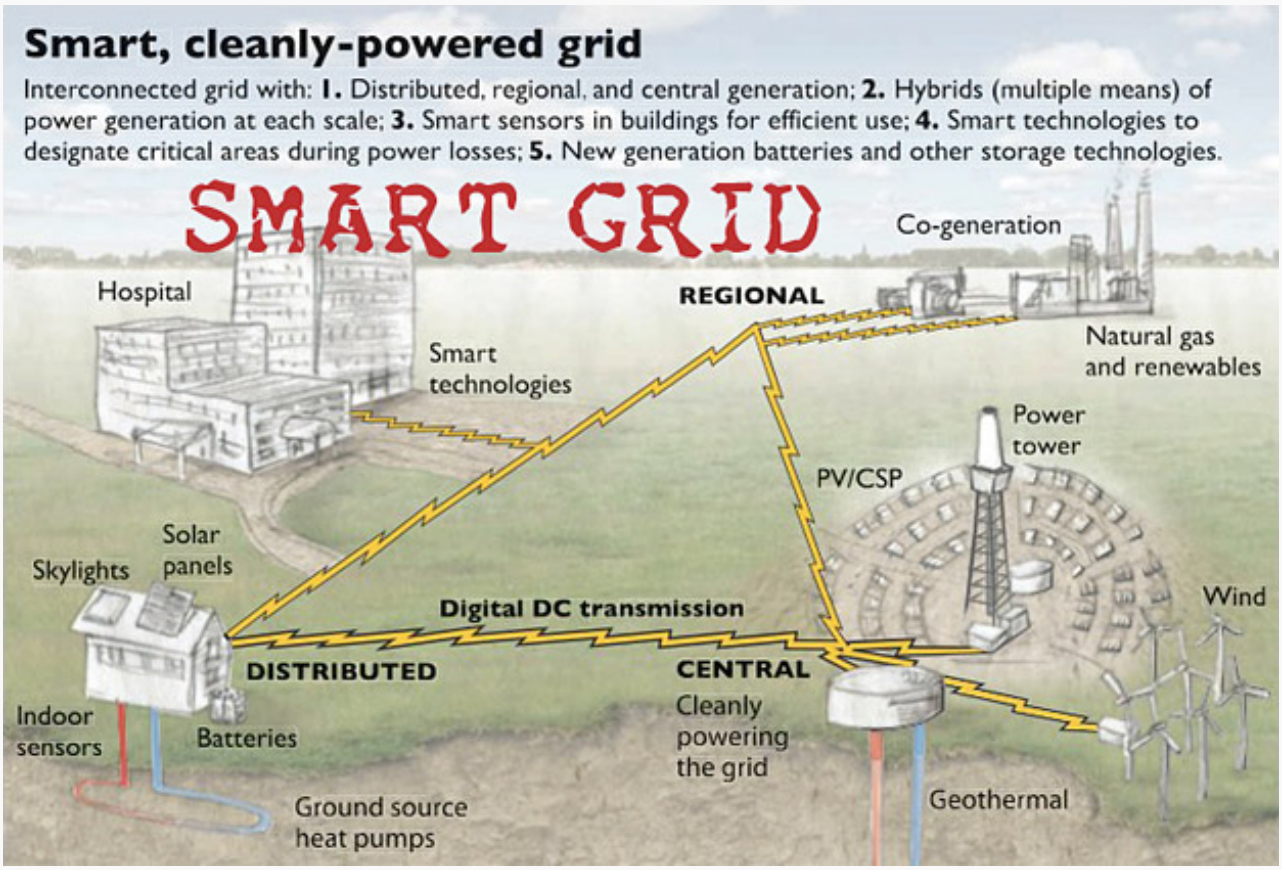
An Overview Of Smart Power Grid

vinod
ramireddy



An Overview Of Smart Power Grid

Abstract

The present electric grids use the technology of ***1970's***. But with the advancement in various concepts of power generation, problems associated with power outages and thefts, and also due to increase in demand, we require a modernized grid to avail all the needs of customers even in the situations of hype, which can be called a "***smart grid***".

The smart grid performs various functions such that it increases grid stability, reliability, efficiency and ultimately reduces line losses.

Also the smart grids are designed to allow the two-way processing of electricity from consumers that have distributed generation. Various technologies like sensing and measurement, usage of advanced components are to be used for successful functioning of the grid. In this paper, smart grid, its functions, technologies used in smart grids are discussed.

Figure 1 - Tree limbs create a short circuit during a storm, typically resulting in a power outage

Introduction to Electric Grid

The electric grid generally refers to all or the smart grid, in a nutshell, is a way to ***transmit and distribute electricity*** by electronic means. The electric grid delivers electricity from points of generation to consumers. The electricity delivery network functions via two primary networks: the transmission system and the distribution system. The transmission systems deliver electricity from power plants to distribution substations, while distribution systems deliver electricity from distribution substations to consumers.

The grid also encompasses myriads of local area networks that use distributed energy resources to several loads and/or to meet specific application requirements for remote power, municipal or district power, premium power, and critical loads protection.

Introduction to Smart Grid

Smart grid lacks a standard definition, but enters on the use of advanced of technology to increase the reliability and efficiency of the grid, from transmission to distribution. The Smart Grid is a vision of a better electricity delivery infrastructure.

Smart Grid implementation ***dramatically increases*** the quantity, quality, connectivity, automation and Coordination between the suppliers, consumers and networks, and use of data available from advanced sensing, computing, and communications hardware and software.

In addition to being outdated, power plants and transmission lines are aging, meaning they have difficulty handling current electricity needs, while demand may not be reduced any time, but it can still be increasing continuously. One solution could be to ***add more power lines***, but the aging system would still be ***overwhelmed***.

So instead of a quick fix, a more reliable, permanent solution is needed. Perhaps the most fundamental aspect of transitioning to a smarter electricity system is the smart meter.

Top

Why Modernization of Electric Grid is required?

The major driving forces to modernize current power grids can be divided in four, general categories:

- Increasing reliability, efficiency and safety of the power grid.
- Enabling decentralized power generation so homes can be both an energy client and supplier (provide consumers with interactive tool to manage energy usage).
- Flexibility of power consumption at the client's side to allow supplier selection (enables distributed generation, solar, wind, and biomass).
- Increase GDP by creating more new, green collar energy jobs related to renewable energy industry manufacturing, plug-in electric vehicles, solar panel, and wind turbine generation, energy conservation and construction.

Smart Grid Functions

The integrated system of the smart grid has two scopes.

One scope is transmission monitoring and reliability and includes the following capabilities:

- Real time monitoring of grid conditions.
- Improved automated diagnosis of grid disturbances, and better aids for the operators who must respond to grid problems.

- Automated responses to grid failure that will isolate disturbed zones and prevent or limit cascading blackouts that can spread over a wide area.
- “Plug and play” ability to connect new generating plants to the grid, reducing the need for the time consuming interconnection studies and physical upgrades.
- The automatic restoration of power would be accomplished by a combination of sensors, computer analysis and advanced substation components, as well as by the ability to reroute power to outage locations.
- Enhancing ability to manage large amounts of solar and wind power.

The

Smart grid delivery

second scope is consumer energy management:

- At a minimum, the ability to signal homeowners and businesses that power is expensive and/or tight in supply. This can be done, via special indicators or through web browsers or personal computer software. The expectation is that the customer will respond by reducing its power demand.
- The next level of implementation would allow the utility to automatically reduce the consumer’s electricity consumption when power is expensive or scarce. This would be managed through the link between the smart meters and customer’s equipment or appliances.
- The smart grid system would automatically detect distribution line failures, identify the specific failed equipment, and help determine the optimal plans for dispatching crews to restore service. The smart grid would automatically attempt to isolate failures to prevent local blackouts to spread over that area.
- The smart grid would make it easier to install distributed generation such as rooftop solar panels, and to allow “net metering”, a rate making approach that allows operators of distributed generators to sell surplus power to utilities. The smart grid would also manage the connection of millions of plug-in hybrid electric vehicles into the power system.

Hence the functions of smart grid can be summarized into the following terms as selfhealing, consumer participation, resist attack, high quality power accommodate generation options, enable electricity markets, optimize assets, enable high penetration of intermittent generation options.

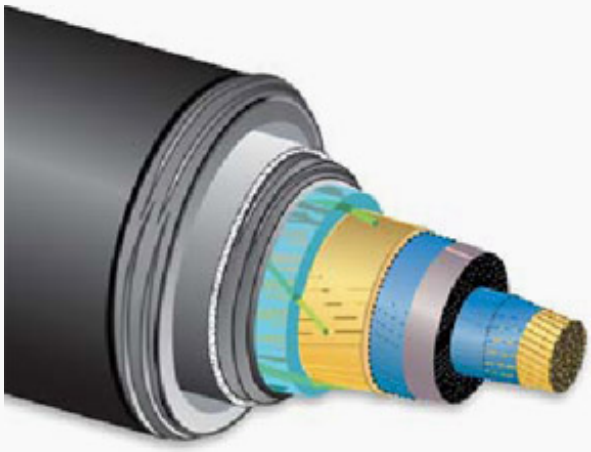
Technology- Initial Focus

Smart Grids rely on information technology advancements across telecommunications and operations. Utilities apply these technologies both to grid operations – transmission and distribution wires and associated equipment and to the customer site-meters, customer owned energy technology equipment and appliances, and ***home area networks (HANs)***.

Wires

Wires-focused Smart Grid projects commonly involve:

- One of the components to smart grid would be the replacement of the ***aging power lines*** with ***high-temperature superconducting lines***.
- The new wires could be installed underground to avoid cluttering up the already congested cityscapes.
- New telecommunications and operational (sense and control) technologies: These improve delivery performance and resilience.
- New sensor and control technologies. These, when combined with distributed intelligence, make it possible to report and resolve grid issues in real time (self healing).
- Transmission and distribution intelligent electronic devices. These alert operators, automatically respond to problems, and integrate generation from renewable resources.



High temperature superconductor (HTS) wire enables power transmission and distribution cables with three to five times the capacity of conventional underground AC cables and up to ten times the capacity of DC cables. Fault current management capability when using Fault Blocker cable systems.

Sensing and Measurement

Core

Smart Grid - Advanced Metering Infrastructure (AMI)

duties are evaluating congestion and grid stability, monitoring equipment health, energy theft prevention, and control strategies support. Technologies include smart meters, sensing systems, advanced switches and cables, digital protective relays etc… In all these, smart meters play a vital role.

In Smart Metering, an ***Advanced Metering Infrastructure (AMI)*** of interval meters and two-way communications systems serves as a gateway for utility/customer interaction. Smart Metering has the potential to reduce both customer and utility costs.

If you take a look at your current electricity meter, you will see that it is very mechanical, humming along blindly, waiting to be read by a technician, to determine the amount of electricity used in a given month, at the end of which you receive a bill. A smart meter utilizes what is known as real-time monitoring (RTM). A display lets the consumer know how much electricity is used and even when it is less expensive to use it.

“Studies have shown that when people are made aware of how much power they are using, they reduce their use by about 7%.” A smart grid also prevents the entire system from becoming overloaded, lessening the chance for a power outage.

Advanced Components

Innovations in superconductivity, fault tolerance, storage, power electronics, and diagnostics components are changing fundamental abilities and characteristics of grids.

Technologies within these broad R&D categories include: flexible alternating current transmission system devices, high voltage direct current, first and second generation superconducting wire, high temperature superconducting cable, distributed energy generation and storage devices, composite conductors, and “intelligent” appliances.

Top

Renewable Energy and the Smart Grid

The smart grid can be seen as an alternative energy source, certainly a change from the current way of doing things. In addition to rerouting electricity, the smart grid would be able to fill in the gaps of these alternative energy power sources. One way this could be accomplished, surprisingly enough, is with another alternative energy technology – the electric car, specifically, the plug-in electric hybrid (PHEV).

This would work through the concept of energy storage, in the case of the PHEV, specifically referred to as V2G or vehicle to grid. This use of alternative energy sources, like wind and solar reduces the nation’s dependence on foreign oil and helps keep pollution from car exhaust and power plants to a minimum.

Renewable Energy and the Smart Grid

Other Technologies

Integrated communications will allow for real-time control, information and data exchange to optimize system reliability, asset utilization, and security.

Conclusion

The major source of energy for human beings is electricity. Without electricity, no technology or science could have been possibly developed. But there are many problems associated with effective functioning of the electric grids which cause a serious loss of power and may even create severe scarcity in future. Also, the latest advancements in generation of electricity from renewable sources also require a means for effective utilization.

So, keeping in view of these, for better performance of the grid, smart grids should be developed all over the world So that we have a more transparent, reliable system that allows consumers to save money and utility companies to more accurately control electricity.

Thus Smart Grid technology paves way for increased utilization of green power.

Source: http://electrical-engineering-portal.com/an-overview-of-smart-power-grid