SMART GRIDS: ARE THEY THE SMART CHOICE?

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Case Study: Gapa Island Smart Grid

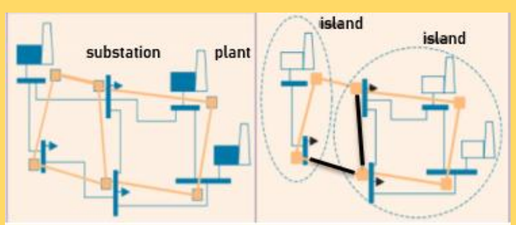
A case study performed on the remote island of Gapa in South Korea exhibits the cost saving abilities of a smart grid. The 8.5 km^2 island, home to 281 residents, relies on diesel generators for power. As fuel costs soar, so do their costs of living. Implementing a smart grid infrastructure with 100% compatibility with renewable energy sources reduced their reliance on diesel fuel from the mainland and saved them over $400,000, not to mention 750 tons less carbon dioxide released into the atmosphere.

Fuel Cost & Island Demand

Year	2008	2009	2010	2011
Fuel Cost ($)	226,824	208,337	264,520	270,444
Demand (kWh)	814,051	871,373	1,044,602	915,281

Smart Grid Self Healing

The threat of brownouts and blackouts has always plagued the grid and power distributions , but with an internal computing network, smart grids aim to take immense strides in remedying this. With the smart grid's implementation of sensors and processors, the grid can in a sense "self heal," halting the costly and time-consuming process related to blackouts early on, and mitigate damages and risk of blackout overall.



In the diagram above, a grid is broken into separate islands when two transmission connections (black lines) have failed. The internal processors analyze the situation by measuring frequencies, detecting load changes resulting from the split, and transmit data over the computer network. Since this is an independent system/network, emergency action can be rapidly and autonomously taken to maintain grid functionality in each island.

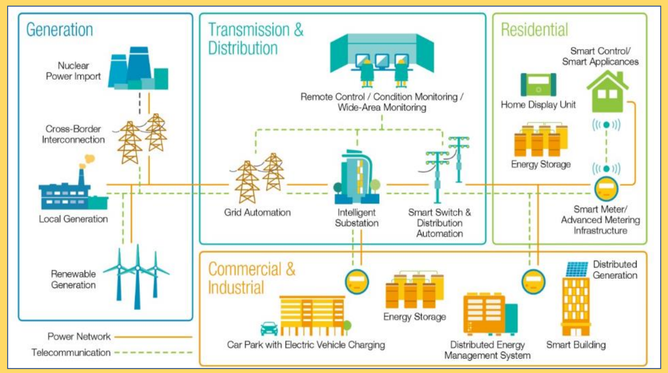
What is Smart Grid?

Rather than the traditional electromechanically rooted grid, the smart grid sees a digital overhaul with the incorporation and application of multi path data and power transmissions, smart metering, and networking technology.

Key components of the smart grid include...

- Two way dialogue of power and information
  Information is autonomously exchanged between the consumer and distributor with the use of smart meters. This allows for better management of power generation and distributions and better informs consumers of their usage.
- Smart metering
  Smart meters collect data regarding power consumption and relay this information directly to the distributor, therefore allowing for autonomous adjustments to be made relative to power distribution.
- Intelligent computing and control network
  Processors and sensors integrated within each of the grid's components and substations can act individually, are aware of their current state, and can communicate with other processors. This forms a grid-wide internal computing network. This system allows the grid to better cater to the incorporation of variable and renewable power sources and also provides "self healing" capabilities.

Smart Grid System



Traditional to Smart: Grid Comparison

Traditional Power Grid	Smart Grid
Uses technology from the 20th century: Current equipment are slightly updated models of their 20th century counterparts	New 21st century technology: Incorporates technology from the digital age; sensors and computing systems
Has difficulty incorporating variable power sources: Current grid is not 100% compatible with renewable energy sources. Difficulty variable energy sources	Can easily accommodate renewable sources: The smart grid can easily adjust to a different power source
Unimodal functionality: Unidirectional in terms of transmitting information or electricity	Supports transfer of information both ways: Allows for transfer of information between the end user and electricity provider
Utilizes SCADA (Supervisory Control and Data Acquisition): Programmable logic controllers (PLCs) or remote terminal units (RTUs) to manage the grid	Uses an intelligent computing and controlling network: Incorporates sensors and logic controllers to control the system over the wide area network (WAN)
Limited efficiency: The current grid cannot easily adapt to different situations	Increased efficiency: "plug and play" feature allows the renewable energy sources to easily connect to the main grid to transmit electricity
Less prone to attack: One advantage of using old-school technology is its isolated nature; it does not connect to other devices, which mitigates the risk of being hacked into	More prone to cyberattacks: The increased connectivity increases the chance of being hacked

Traditional Grid System