

A seminar on SMART GRID TECHNOLOGY



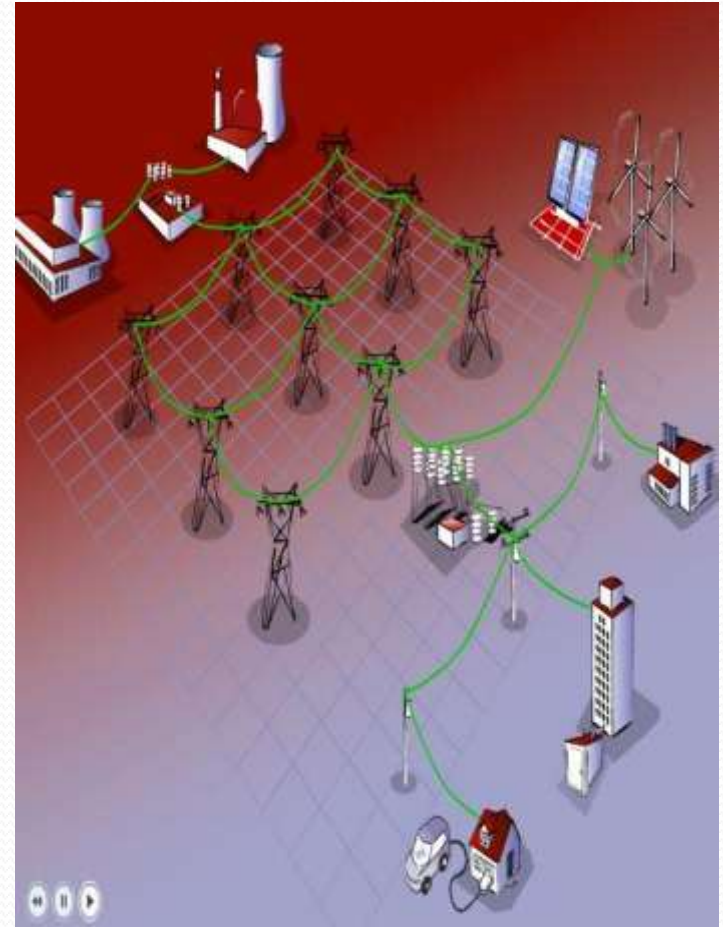
Table of contents:

- Introduction to smart grid?
- Pillars of smart grid
- Overview of smart grid
- Need of a smart grid
- Comparison between smart grid and today's grid
- Components of smart grid
- Smart meter
- Upcoming technologies
- Devices for it
- Initiatives towards smart grid
- Benefits and loopholes

WHAT IS A SMART GRID???

This electric grid **delivers electricity from points of generation to consumers, and the electricity delivery network functions** via two primary systems: the transmission system and the distribution system. The transmission system delivers electricity from power plants to distribution substations, while the distribution system delivers electricity from distribution substations to consumers.

Building the smart grid means **adding computer and communications technology to the existing electricity grid**. With an overlay of digital technology, the grid promises to operate more efficiently and reliably. It can also accommodate more **solar and wind power**, which are inconsistent sources of energy that can become more reliable with better controls. Much like computers and **routers** manage the flow of bits on the Internet, **smart-grid** technologies use information to optimize the flow of electricity.



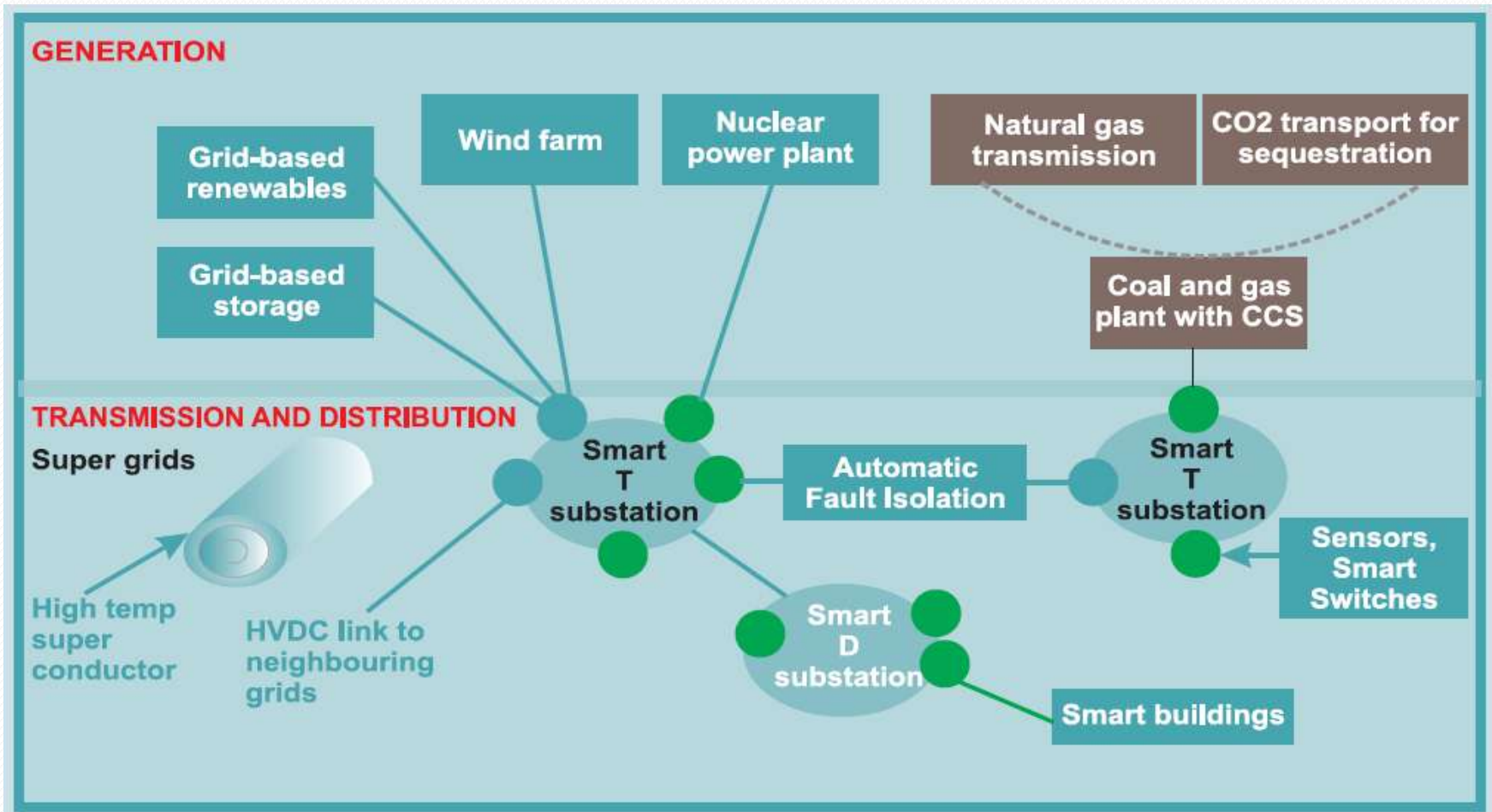
WHAT IS A SMART GRID(contd) ??

- Adding sensing, embedded processing and digital communications makes the grid:
 - Observable
 - Controllable
 - Automated
 - Fully integrated

Pillars of Smart Grid

- Transmission Optimization
- Demand Side Management
- Distribution Optimization
- Asset Optimization

Overview of Smart Grid



NEED FOR A SMART GRID

- Electromechanical electrical grids are inefficient networks highly prone to power failures. It has become a stressed grid structure.
- Energy demand is increasing at a faster rate than energy supply because of the increase in population.
- With the increase in energy costs, customer expectations are also increasing. Customers want to do more to protect the environment, use less energy and control their costs.
- Also, customers are increasingly technologically savvy and expect to receive the information to help them manage their energy usage(One of the main characteristics of the Smart Grid is enabling customers to manage energy and control their costs).
- Greenhouse gas emissions is increasing due to the increase in energy consumption..

Clearly, a new method is required.

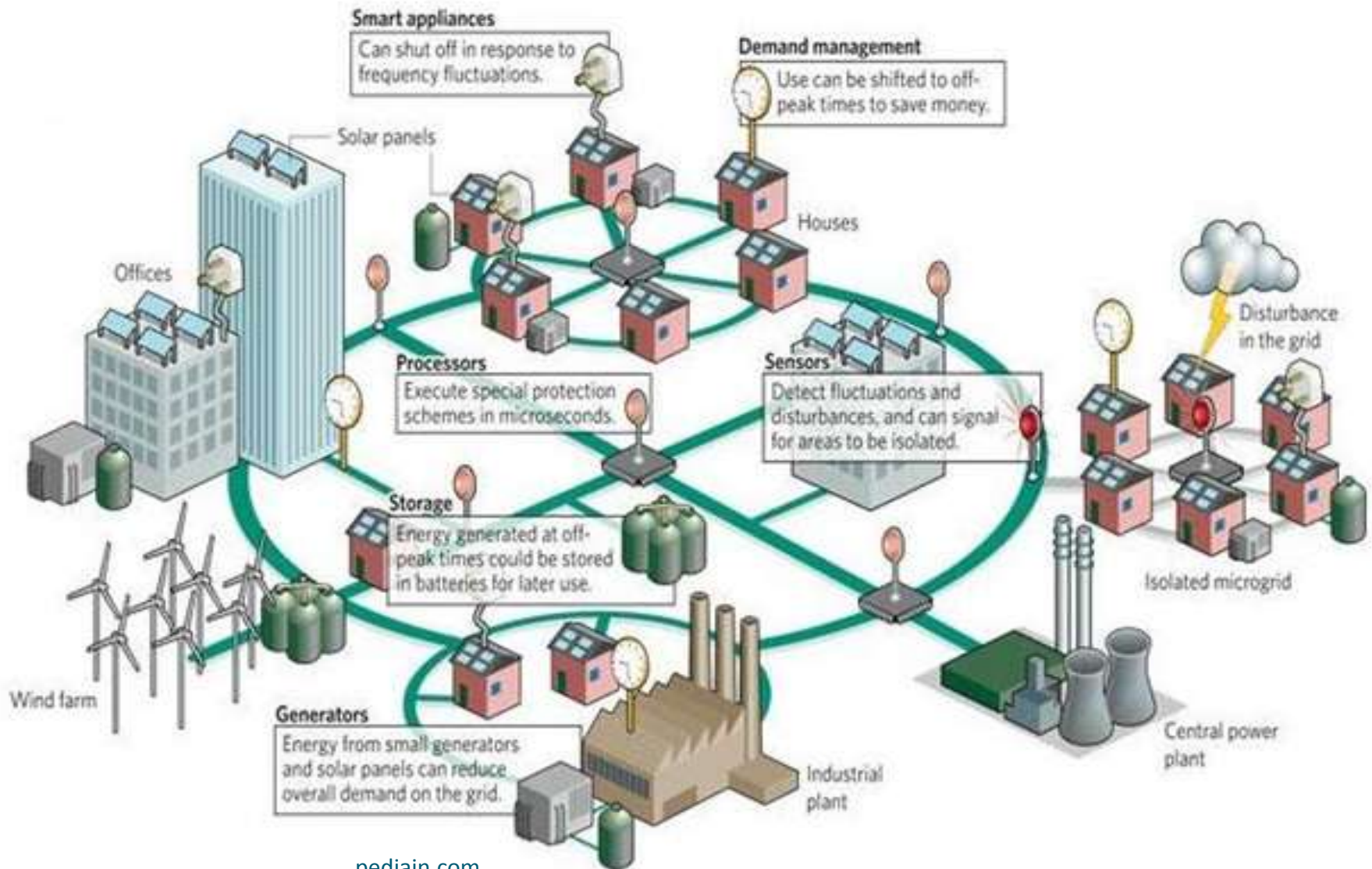
What would a smart grid be able to do that today's not-so-smart grid can't?

- Right now, if there's a breakdown at your local substation, the utility usually finds out when customers call to complain. Placing a networked sensor inside a transformer or along wires could locate and report a problem, or prevent it from happening in the first place.
- Despite living in the age of information, most of us only get a glimpse of our energy consumption when the utility bills come once a month. In people's homes, the smart grid should mean more detailed information through home energy-monitoring tools. These can be small displays or Web-based programs that give a real-time view of how much energy you're using, which appliances consume the most, and how your home compares to others.

A Smart Grid a boon....

- ❑ Transforms the way power is consumed.
- ❑ Increases reliability and power quality .
- ❑ Improves responsiveness and efficiency .
- ❑ Potentially reduces costs for the provider and consumer .
- ❑ Adds intelligence throughout the newly networked grid .
- ❑ Decrease Greenhouse gas emissions.
- ❑ Reduces client-side power consumption ,especially during peak hours.

A SMART GRID



COMPARISON

CURRENT STATE	MODERN UTILITY
❖ Analogue/electromechanical	❖ Digital/microprocessor controlled
❖ Reactive(prone to failures and blackouts)	❖ Proactive
❖ One pricing	❖ Real time pricing
❖ No/limited consumer choice.	❖ Multiple consumer products
❖ One-way communication (if any)	❖ Two-way/integrated communication
❖ Few sensors	❖ Many monitors and sensors
❖ Manual restoration	❖ Condition -performance-based maintenance
❖ Limited transparency with customers and regulators	❖ Transparency with customers and regulators
❖ Limited control over power flows	❖ Pervasive control systems
❖ Estimated reliability	❖ Predictive reliability

COMPONENTS OF A SMART GRID

A Smart grid has two main components:

- The connectivity Network
 - Core Networks
 - Distribution Networks
 - Access Networks
- Sensing and measurement

CORE NETWORK:

The Core network handles connectivity between substations and utilities' head offices. Technologies used for core network implementation include:

- Wireline technologies
- Fiber
- Wireless technologies
- WiMAX

● **DISTRIBUTION NETWORKS:**

The Distribution network handles broadband connectivity for transmitting data collected by Smart Power Grid concentrators and distribution automation devices (e.g. monitors, sensors,), which are located on the grid, to their related databases and analytics servers, which are located at headquarters.

Technologies used for distribution network implementation include:

Wireline technologies

- **Fiber**
- **BPL (broadband over power lines)**

Wireless technologies

- **WiMAX**
- **License-exempt broadband wireless**
- **GSM**

● **ACCESS NETWORKS:**

The Access network handles last-mile connectivity from smart meters located on the edge of the power grid (at homes, offices, and municipal facilities) to SPG concentrators.

Technologies used for access network implementation include:

- **Wireline technologies**
 - PLC (Power Line Communication),
- **Wireless technologies**
 - ZigBee ,
 - Wi-Fi ,
 - WiMAX
 - GSM

● **OPTIMIZED SMART POWER GRID WIRELESS CONNECTIVITY:**

- Scalability and enhanced flexibility
- Carrier-class all outdoor link reliability and availability (eg IP67)
- Secured communication (eg FIPS-140-2)
- High bandwidth with low latency
- Standard-based technologies (eg 802.16e, 802.11)

● SENSING AND MEASUREMENT:

Its easy to cut your electricity bills if you know...

- Exactly how much electricity you are using.
- How much it is costing you in rupee per hour
- How much harmful carbon dioxide your household contributes to the greenhouse effect

SMART METERING CONCEPT

- **AUTOMATED METER READING(AMR):** is a remote reading system based on an advanced technology that permits utilities to read electronic meters over long distances. Through AMR, **the energy consumption can be read on an annual, monthly, weekly, daily or on an hourly basis.** The automatic data collection enables billing based on real time consumption as opposed to an estimated consumption.
- **ADVANCED METERING INFRASTRUCTURE(AMI):** refers to systems that measure, read and analyse energy consumption. AMI systems can be defined as an extension of the simpler AMR-system. The AMI always communicates two-way and comprises **the whole range of metering devices, software, communication media, and data management systems.**
- **AUTOMATED METER MANAGEMENT(AMM):** or Smart Metering is another expansion of a remote reading system that includes the possibility of **performing technical measurements and functions and carrying out customer-orientated services via the system.**

SMART METER

**Smart meters are to mutual benefit for utility and consumer.
The smart meter makes a greener difference.**

FEATURES:

- **Communication**-able to communicate with the data management system which is placed on a server either at the utility or at the system provider.
- **Smart disconnect/reconnect**-allows the utility to switch off the power remotely and to switch the power back on.
- **Tamper Protection**- is integrated as a real time clock will stamp any breaking of the seal.
- **Voltage Quality**- are measured and recorded providing the energy distributor with valuable information to perform an efficient grid operation.
- **Load profile**- The Utility may also take advantage of the recorded load profile data and four quadrant measuring for optimization of the grid load.
- **Shunt measuring principle**-secures an accurate measuring of consumed energy.
- **Tariffing**- reduces power demand during peak hours
- **Energy Awareness**- It makes it a lot easier for the consumer to follow his energy consumption.



UPCOMING TECHNOLOGIES

PICOWATT:

These are strategically placed smart plugs which fit over existing outlets, are essentially mini Wi-Fi routers running Linux, each capable of gathering data and controlling devices.



GOOGLE POWERMETER ENERGY TRACKER:

- It works without smart meter
- In combination with Power Meter, a person can view details, such as real-time electricity use and weekly trends from a Web browser or using a smart phone running iGoogle.



DEVICES FOR SMART GRID

ENERGY HUB: Energy Hub makes a high-end energy dashboard that will offer Google Docs-style spreadsheets and graphs of resource use.



TENDRIL: Tendril sells a combo of energy management services, including a wireless in-home energy display, a smart, web-based energy portal, smart outlets and cell phone apps that can help homeowners diagnose and cut energy consumption.



ONZO: is a slick-looking energy display and wireless sensor kit that runs on energy harvested from the home electrical cable.



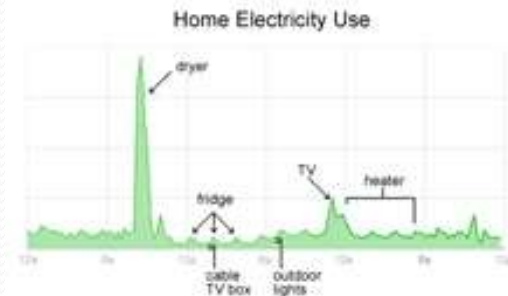
ENERGY DETECTIVE: is an energy management tool that helps consumers to save 10-20% of their monthly electricity bill.

DREAM WATTS: is a wireless energy management tool that focuses on making smart thermostats effective for cutting energy consumption.



AGILEWAVES: The system, custom-designed for larger buildings and higher-end homes, needs to be installed by an electrician and can also be used to dim lights, turn on and off heating and cooling, and adjust smart appliances.

GOOGLE POWERMETER: it is an online energy information tool



GREEN BOX: Green Box is focusing on the software side of things with its web-based energy tool.

**OK, so the smart grid is supposed to reduce wasted energy, give consumers better information, and allow the grid to use more solar and wind power.
What's the hold-up?**

- **Where to start?**

Utilities aren't known as the most fleet-of-foot businesses and the energy industry invests lower percentage of revenue in technology than most industries. This helps explain why we've been hearing about the grid for 10 years but very few of us actually have it.

- **A high cost at the beginning of implementation.**
- **Political and economic frameworks & traditions**

- Then there's the **lack of standards** for a dizzying number of tasks
- A key regulatory piece of the smart grid is time-of-day pricing, which is supposed to reflect the fluctuating cost of energy delivery in a day. Some sort of **tired pricing** would allow a consumer to take advantage of off-peak rates, but it isn't the norm in many states.
- Amid all the technical and business challenges, there's the question of **consumer acceptance**. Consumers, in general, are likely to welcome more detailed information on how much electricity, natural gas, and water they use. But even though there's the promise of energy savings, it's not clear that people are willing to pay much money for home energy-management tools.

Power grid's initiative towards smart grid:

- **Pilot Project in Northern Region**
- **Intelligent Monitoring & Control of the Interconnected Electric Power Grid Using Wide Area Measurements (WAM) for Western Region**

Benefits of smart grid:

- Integrate isolated technologies : Smart Grid enables better energy management.
- Proactive management of electrical network during emergency situations.
- Better demand supply / demand response management.
- Better power quality
- Reduce carbon emissions.
- Increasing demand for energy : requires more complex and critical solution with better energy management

Loopholes of smart grid:

- Present Infrastructure is inadequate and requires augmentation to support the growth of Smart Grids.
- Most renewable resources are intermittent and can not be relied on (in its present form) for secure energy supply
- Regulatory Policies to deal with consequences of Smart Grid; like off peak, peak tariffs and other related matters.
- Grid Operation : Monitoring & control

CONCLUSION

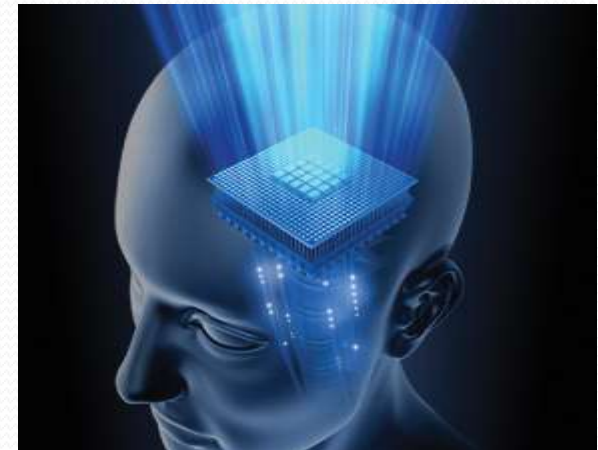
- By using smart grid technology energy can be utilized to the maximum and would not be wasted.
- This technology also helps to save earth from the global warming.
- It refers to the modernized version of the earlier traditional method of energy supply.

A Super Smart Grid



1 Saving money: uses technology to help us optimize our homes and businesses so we can buy electricity at the cheapest rates

2 Making money: a smart grid allows everyone to sell unused power back to the system. A smart grid meter spins both ways



THINK 'SMART'!!!



THANKYOU!!