Smart Grid
Distribution Automation System (DAS)

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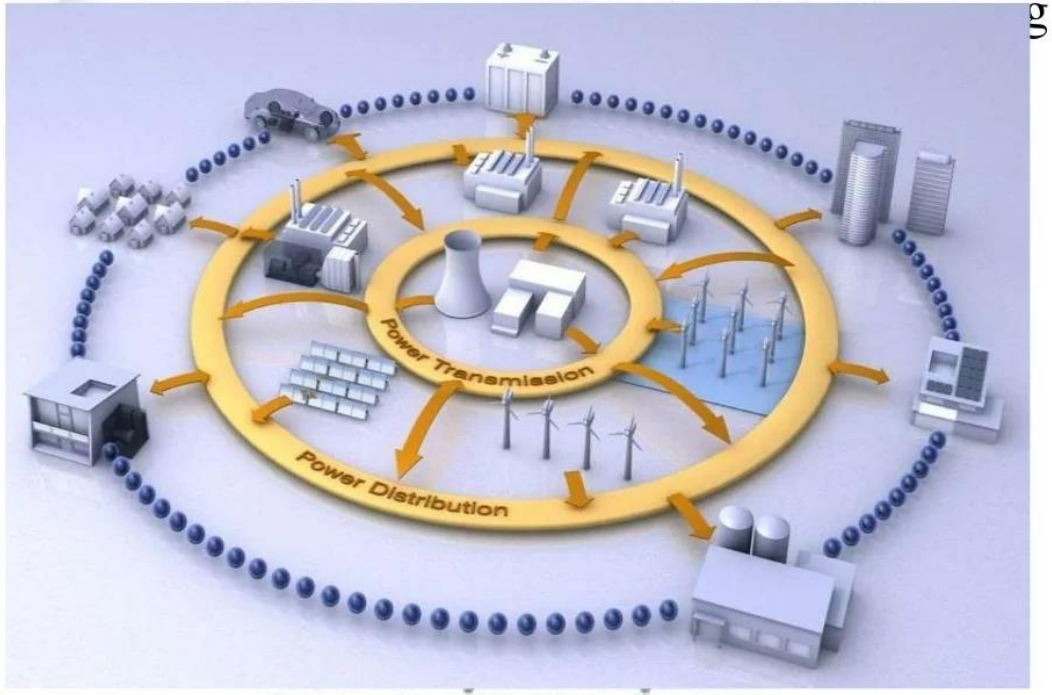
Introduction

- In recent years the term "Smart Grid" has become a widely used buzz word with respect to the operation of Electric Power Systems
- A smart grid is a modern electric system
- It is used in development countries like USA Japan China and European.
- It is used to improve reliability, efficiency, safety and reduce Co_2 by using renewable energies.

What is the Smart Grid?

- Short Answer: Smart Grid = IT + Electric Grid
- It is operated by interconnection of elements—from the central and distributed generator through the high-voltage network and distribution system, to industrial users, energy storage installations and consumers.

How does it work?

- 

Smart Metter

- To record and measure electricity.
- Provided the consumption and price data or other signals.
- To sent remotely to a central data management center.

Smart Metter

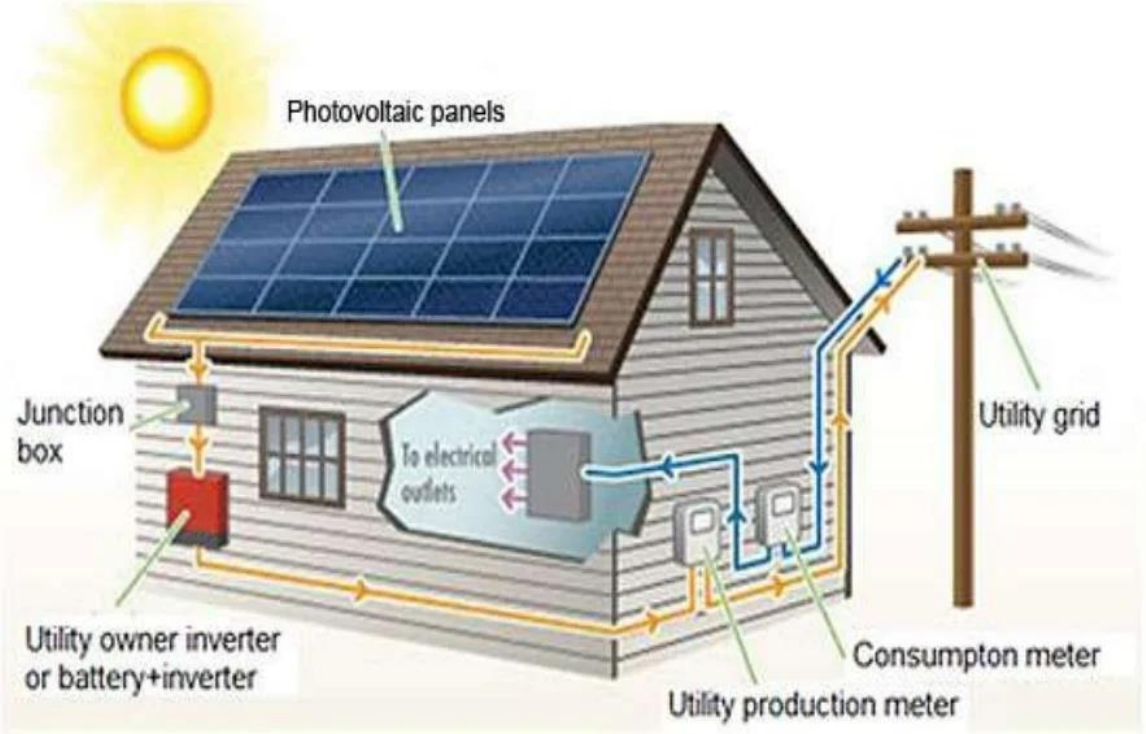
Benefits of smart meters

- Accurate bills
- Less time waiting in for the meter reader
- Could help you save money
- Reduced theft of energy
- Faster resolution of problems
- Micro-**ge**neration

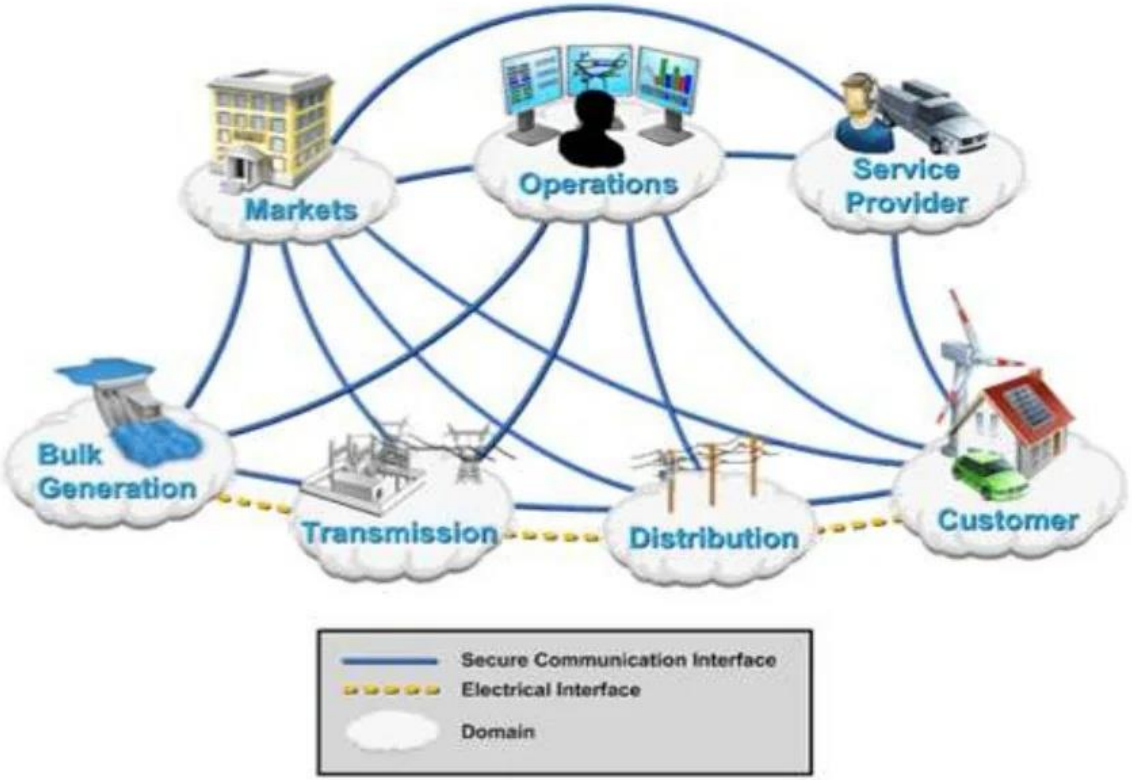
Micro-Grids

- A micro-grid is an integrated energy solution that serves a group of consumers.
- We can buy and sell electricity from the grid.

Micro-Grids

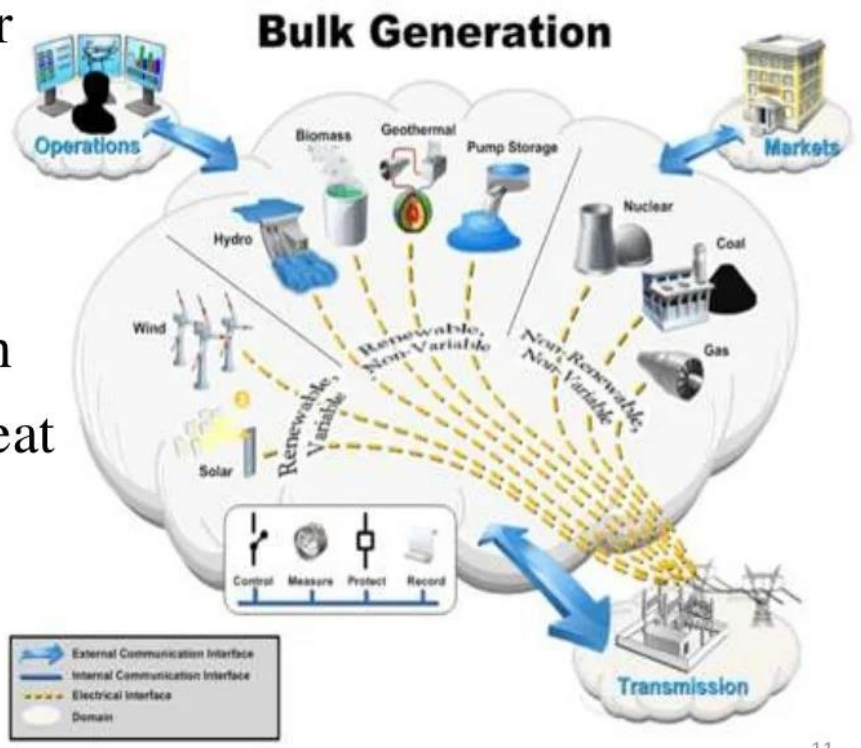

Photovoltaic panels
Junction box
To electrical outlets
Utility grid
Utility owner inverter or battery+inverter
Consumpton meter
Utility production meter

Smart Grid Unites Transmission and Distribution



Distribution Generation

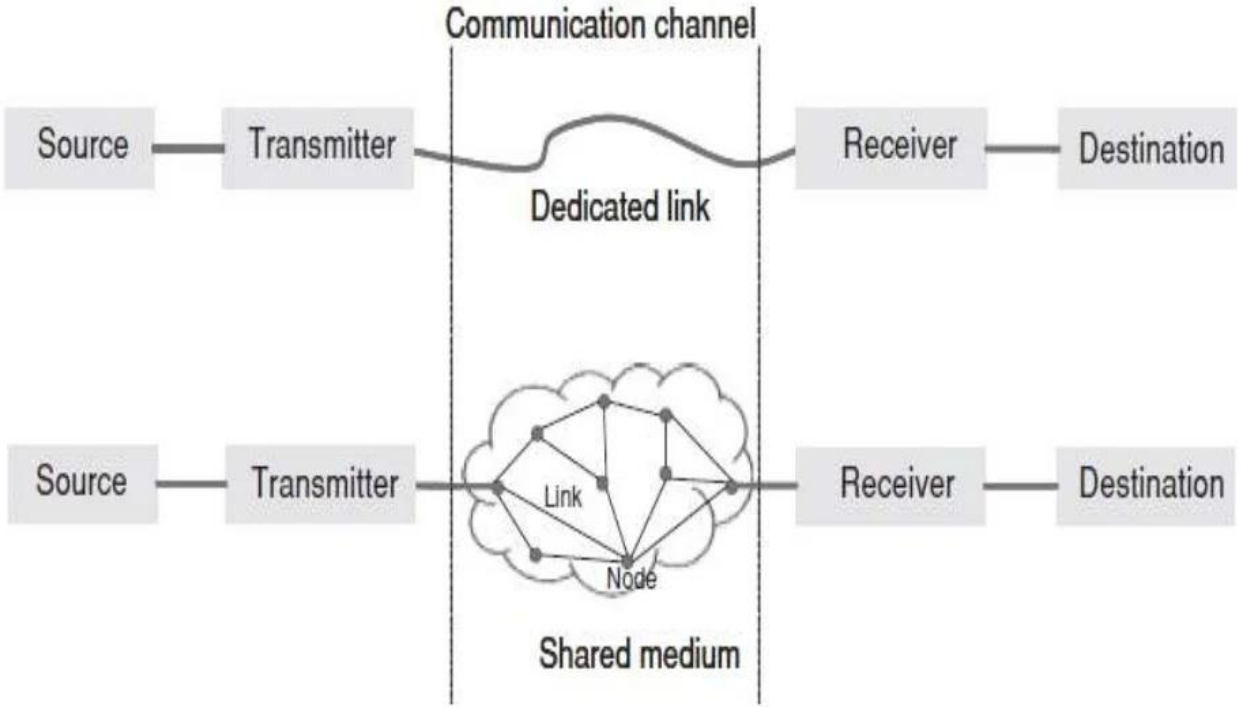
- Nuclear power plant,
- Hydro,
- Wind,
- Solar radiation
- Geothermal heat
- Natural gas
- Biomass.

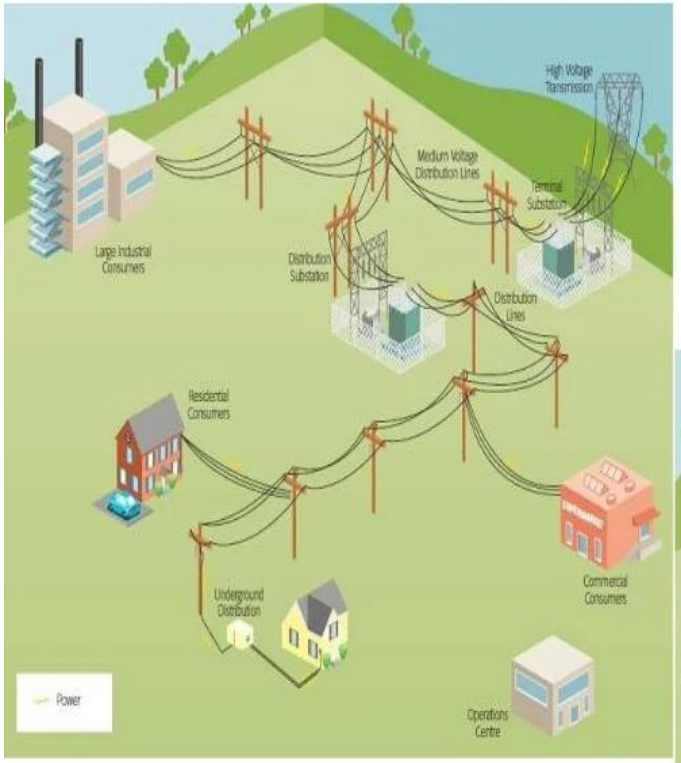


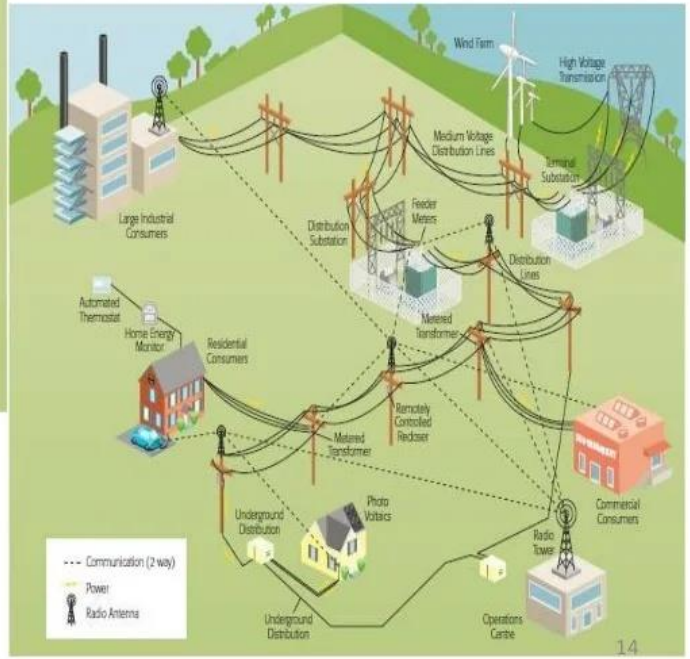
Distribution Automation

- DA is a family of technologies including sensors, processors, communication networks, and switches that can perform a number of distribution system functions depending on how they are implemented.
- utilities have been applying DA to improve reliability, service quality and operational efficiency.

Distribution Automation




High Voltage Transmission
Medium Voltage Distribution Lines
Terminal Substation
Large Industrial Consumers
Distribution Substation
Distribution Lines
Residential Consumers
Commercial Consumers
Underground Distribution
Operations Centre
Power


Wind Farm
High Voltage Transmission
Medium Voltage Distribution Lines
Terminal Substation
Large Industrial Consumers
Distribution Substation
Feeder Meters
Distribution Lines
Automated Thermostat
Home Energy Monitor
Residential Consumers
Metered Transformer
Remotely Controlled Recloser
Metered Transformer
Commercial Consumers
Underground Distribution
Photo Voltaics
Radio Tower
Communication (2 way)
Power
Radio Antenna
Underground Distribution
Operations Centre

SCADA System

***S**upervisory **C**ontrol **A**nd **D**ata* **A**cquisition used to **monitor** and **control,** used for:

- Electric utilities use SCADA system to detect current flow and line voltage
- To monitor the operation circuit breaker
- To take sections of the power grid online or offline
- Gathering and analyzing real time data
- Transfers the information back to a central site

SCADA System

There are 4 components:

(1). Field Instrumentation

(2). Remote telemetry units

(3). Communication Networks

(4). Central Monitoring Station or Master terminal units (MTU)

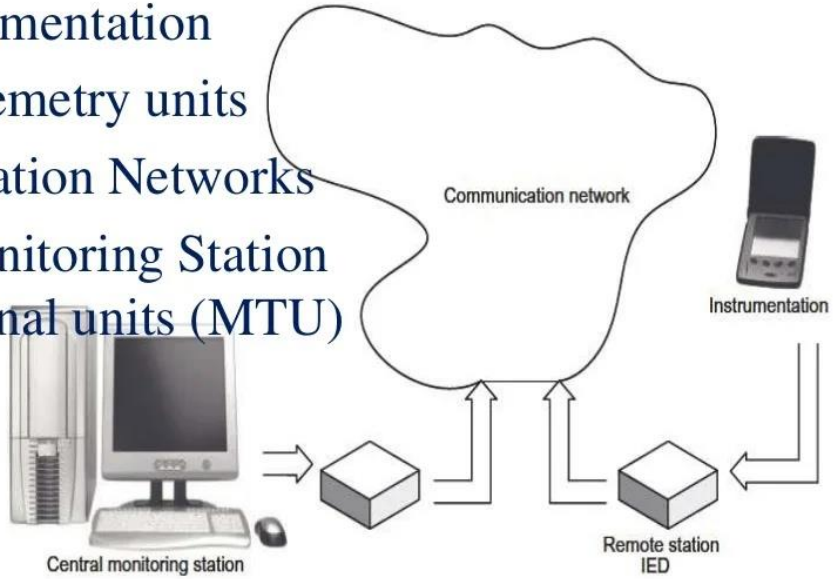
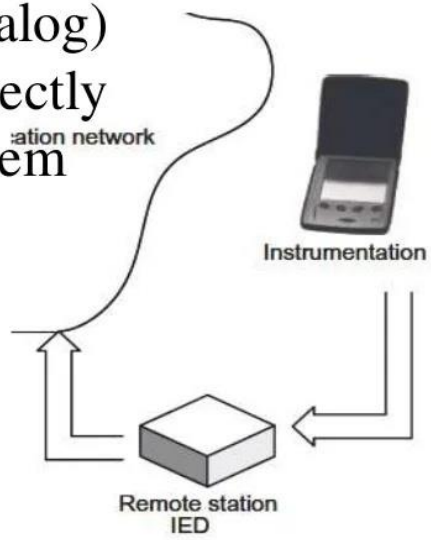


Figure 13.4 Elements of a SCADA system.

(1). Field Instrumentation

- Devices used for monitoring and controlling each parameters
- Sensors (either digital or analog) and control relays that directly interface with the managed system
- These devices are connected to Remote Stations(RTU)



DA system.

(2). Remote telemetry units

- These are small computerized units deployed in the field at specific sites and locations.
- RTUs serve at local collection points for gathering reports from sensors and delivering command to control relay
- Receiving data and control signals from MTU and transmitting the control signals to the plant devices.

(2). Remote telemetry units (cont.)

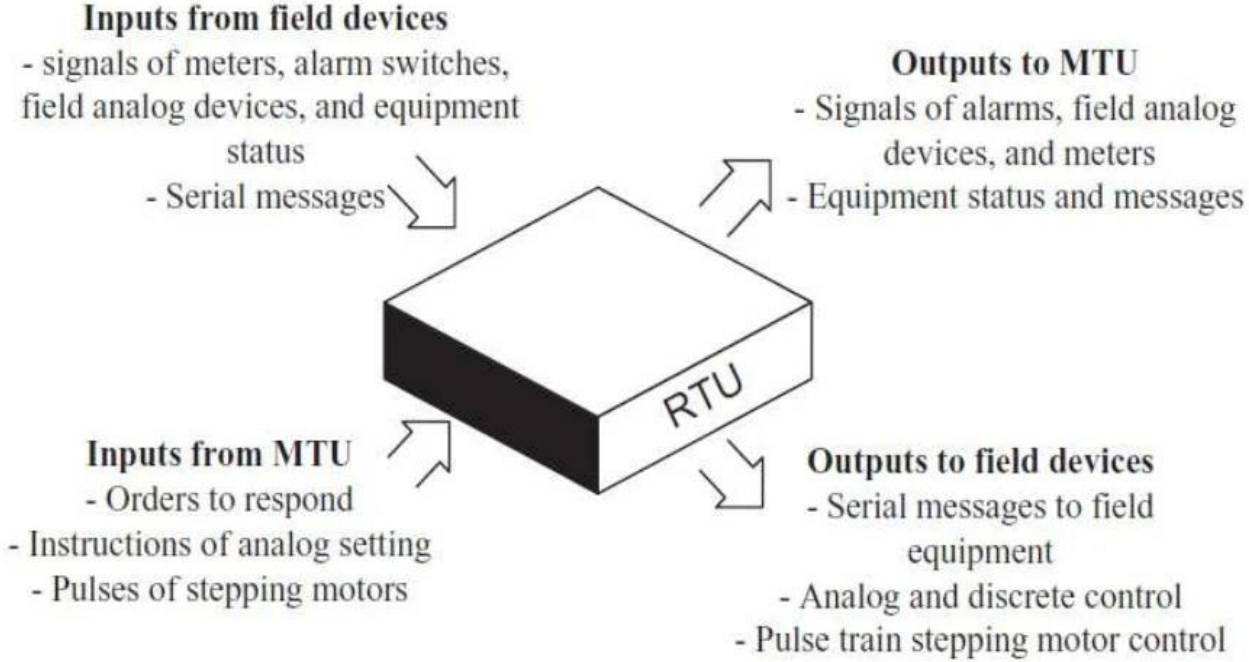


Figure 13.5 Remote terminal unit: inputs/outputs.

(3). Communications Network

- The communications Network that connect to the SCADA master terminal unit to Remote Telemetry unit (MTU to RUT).
- SCADA communication techniques include
  - Modulation
  - Multiplexing
  - Message format
  - Information transfer

(4). Central Monitoring Station

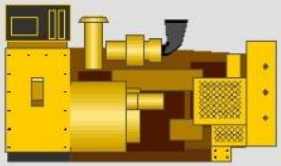
- It is considered as the **heart** of the system where its main functions are:
- Making the communication, gathering data, storing information, sending information to other systems
- Processing the data gathered by remote stations to generate the necessary actions
- Interfacing to the operators mainly via monitors and printers. The inputs and outputs of the MTU.

23: 31: 43
10/ 02/ 2020

3

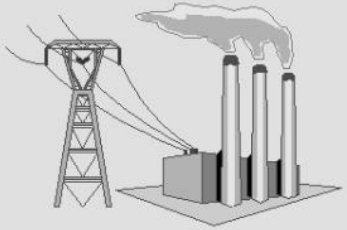
Overview | Power Area | Intake | Chemical | Flocu-Sediment | Filtration | Utility | Reservoir | User : admin | Logging | Report | Security | EXIT

POWER INTAKE



GENSET INTAKE

PJU



PLN

ATS INTAKE

Current	=	150,81	A
Voltage	=	399,6	Volts
Frequency	=	49,9	Hz
Real Power	=	96,67	kVA
React Power	=	39,42	kVAR
Apparent Power	=	104,40	kW
Total Power	=	526,53	MWh
True PF	=	1,07	Lead
Displace PF	=	1,01	Lead

MANUAL

Sistem Auto

Start

Flow Transmitter Intake
108,59

Level Transmitter Reservoir
3,14
87,8 %
Tingkat Keasaman Reservoir
6,72

STATUS SISTEM

Intake Auto

Chemical Auto

WTP Auto

SDB Auto

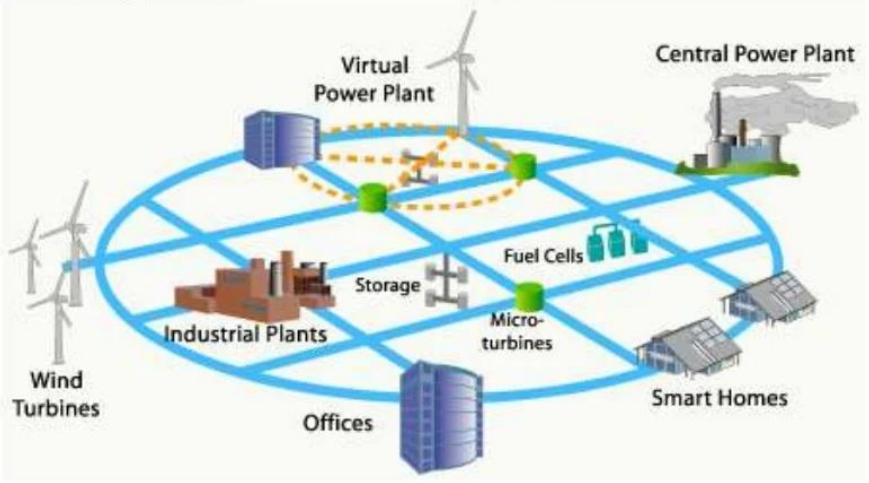
0 0 31 0

Display Side /DR

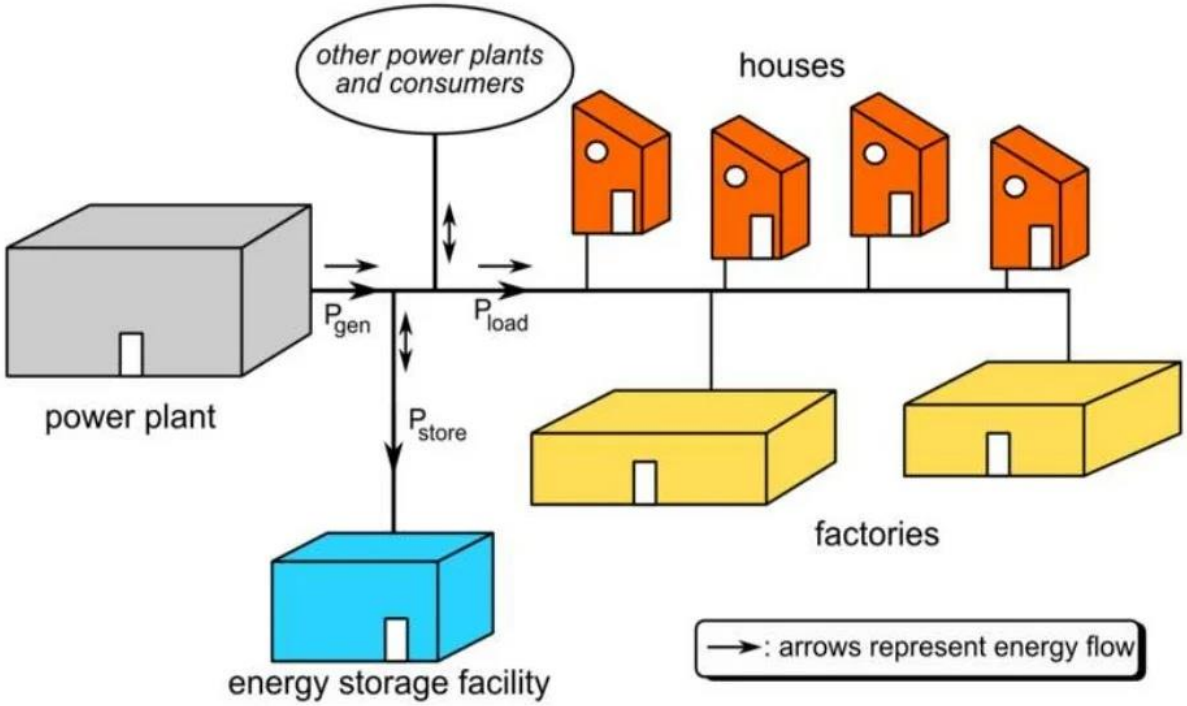
Clear | Clear All

Energy Storage

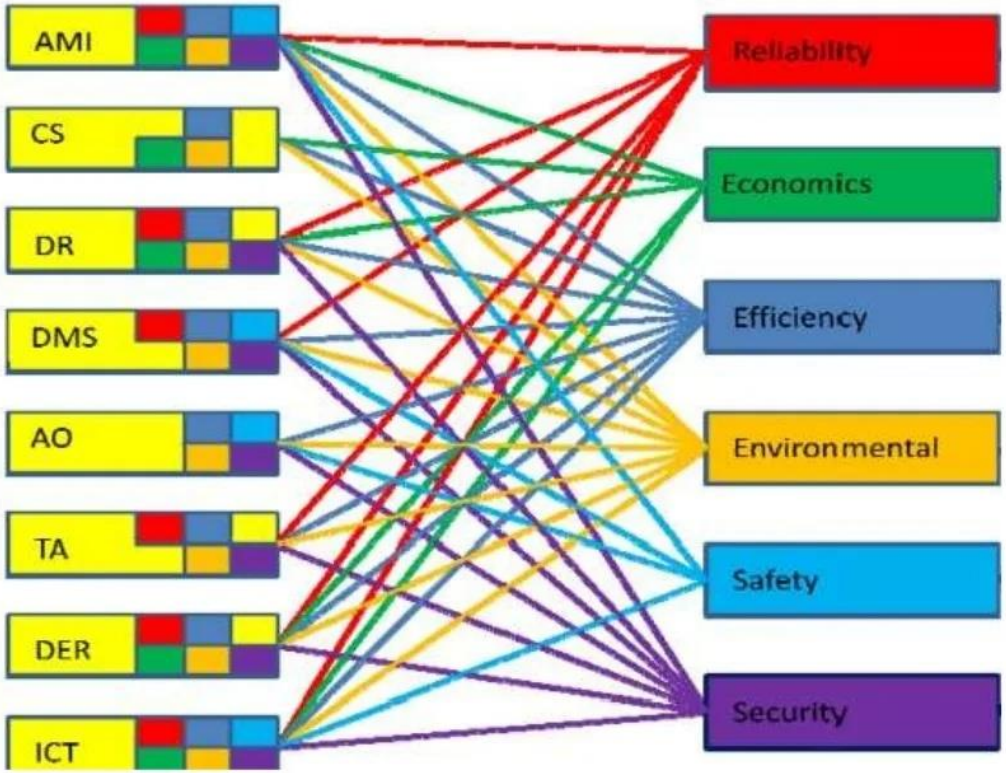
- Distributed energy storage can help the grid remain stable, with the potential to make it a more efficient and reliable system that leads to lower operating costs in the long term




BESS N° 4
03904-08B-2
LITHIUM BATTERIES
ELECTRICAL

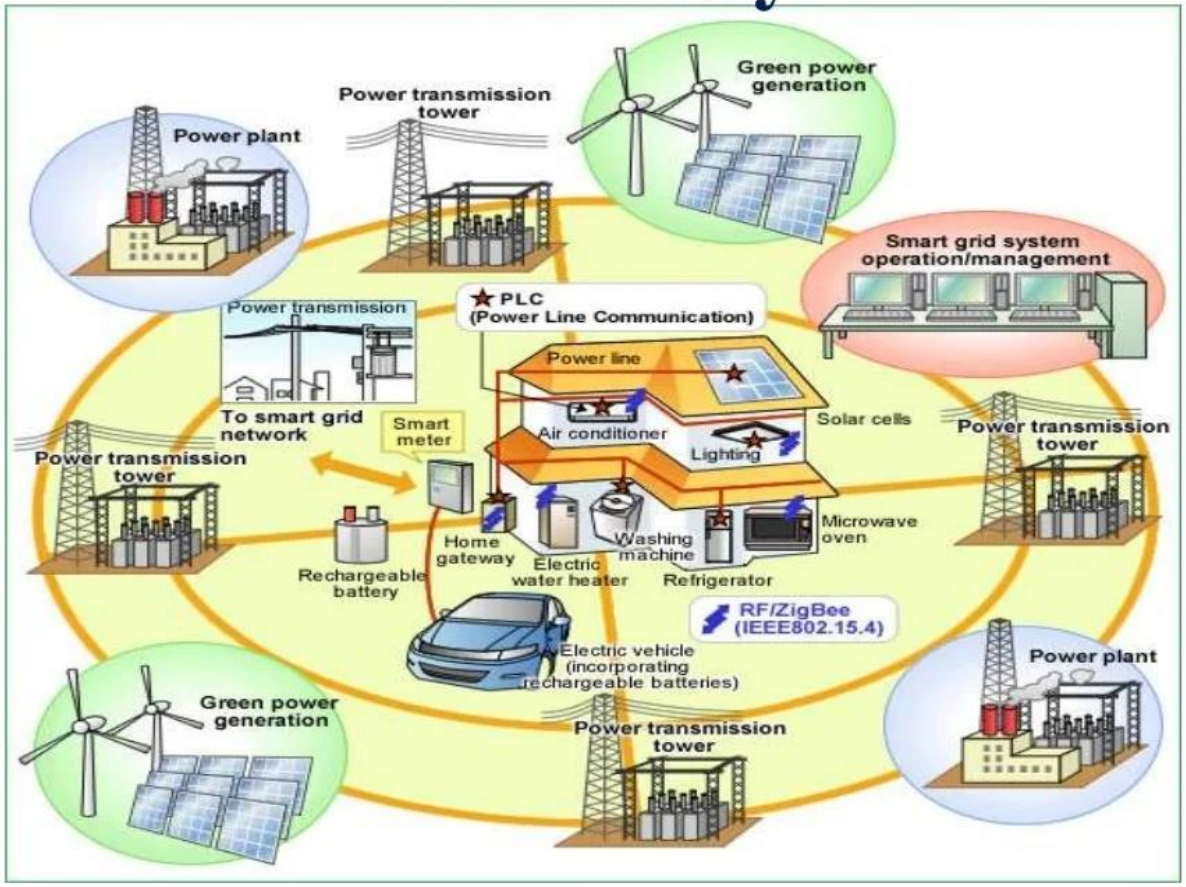

other power plants and consumers
houses
P_{gen}
P_{load}
power plant
P_{store}
factories
energy storage facility
: arrows represent energy flow

Advantages

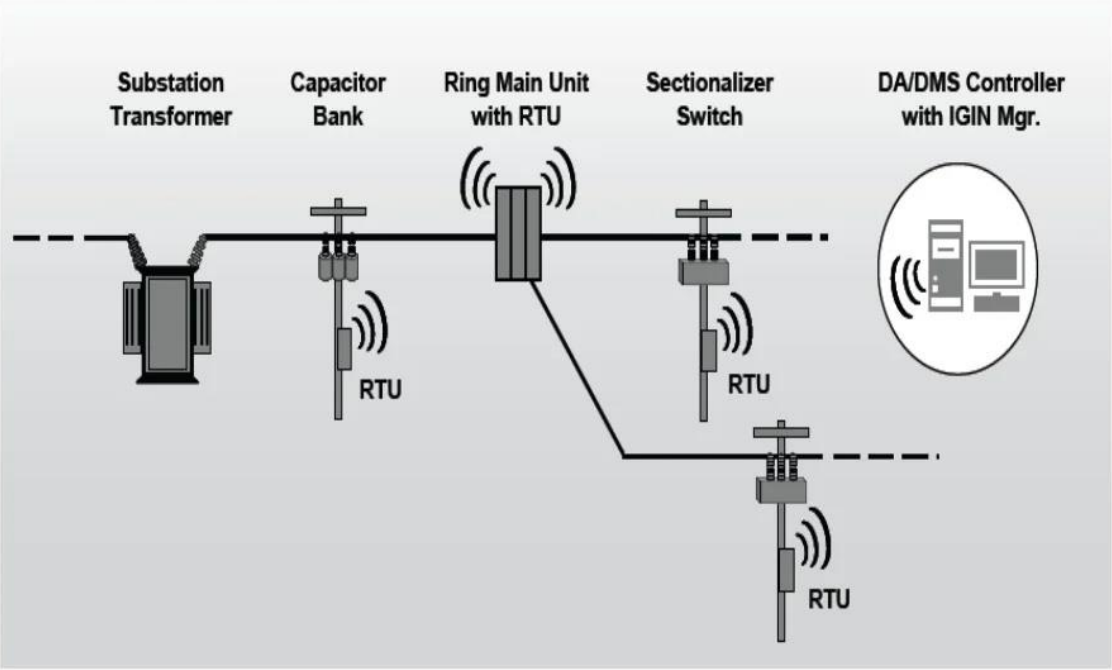

AMI
CS
DR
DMS
AO
TA
DER
ICT
Reliability
Economics
Efficiency
Environmental
Safety
Security

Reliability

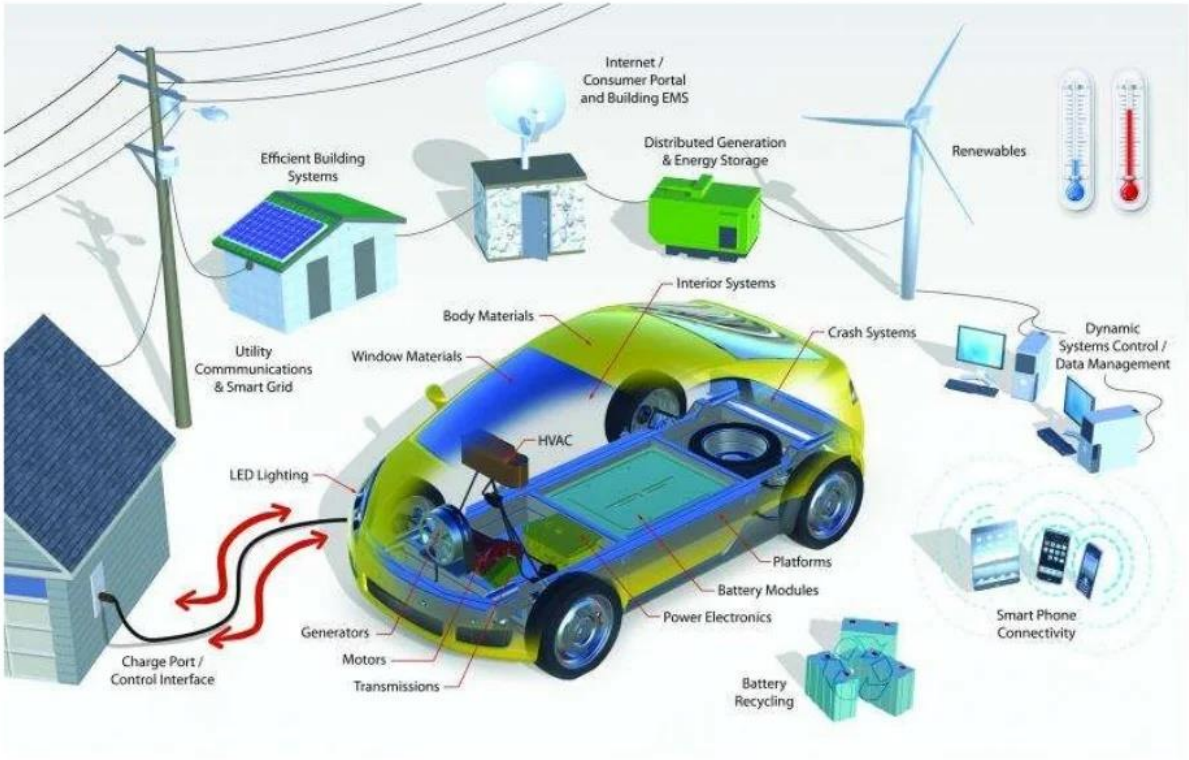
Economy


Green power generation
Power transmission tower
Power plant
Smart grid system operation/management
PLC (Power Line Communication)
Power transmission
To smart grid network
Smart meter
Power line
Solar cells
Air conditioner
Lighting
Power transmission tower
Power transmission tower
Microwave oven
Home gateway
Electric water heater
Washing machine
Refrigerator
Rechargeable battery
RF/ZigBee (IEEE802.15.4)
Electric vehicle (incorporating rechargeable batteries)
Power plant
Green power generation
Power transmission tower

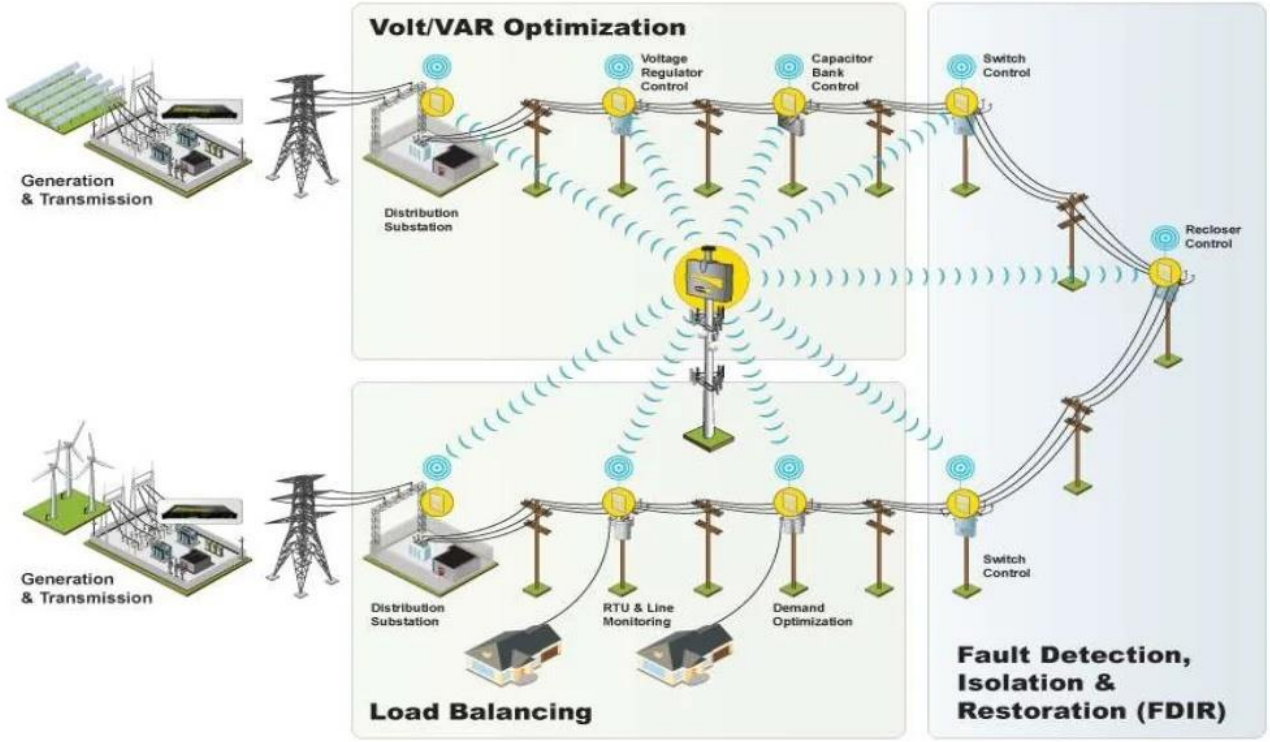
Efficiency


Substation Transformer
Capacitor Bank
Ring Main Unit with RTU
Sectionalizer Switch
DA/DMS Controller with IGIN Mgr.
RTU
RTU
RTU

Environment

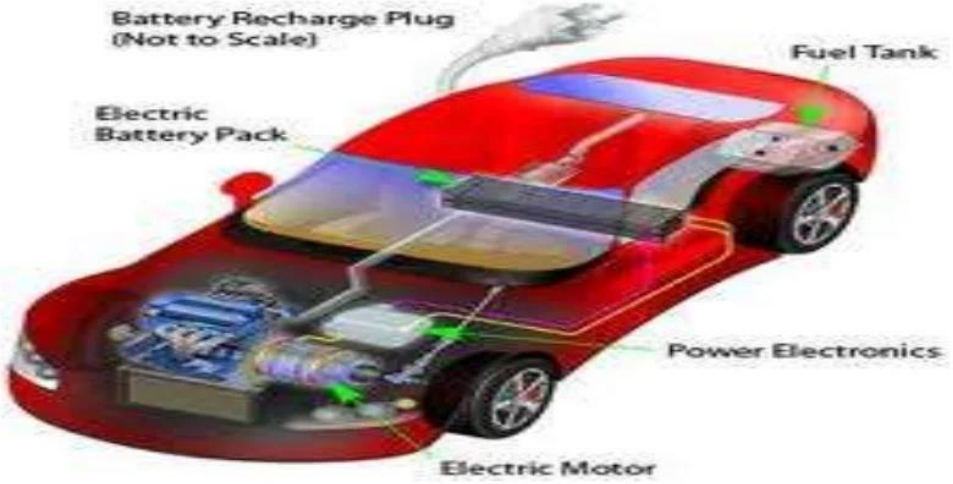


Safety and Security



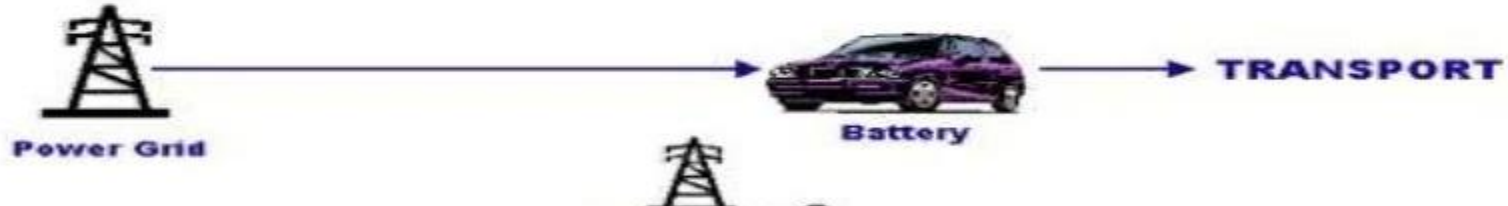
Application

- Application of mitigating impacts of Plug-in Hybrid and Battery Electric Vehicles and allowing the implementation of Vehicle-to-Grid (V2G) strategies.


Battery Recharge Plug
(Not to Scale)
Fuel Tank
Electric
Battery Pack
Power Electronics
Electric Motor


PLUG IN
120 V


V→L
V⇄G
V⇄V


Power Grid
Battery
TRANSPORT

Application

- Application for optimal operation and control of distribution systems and allowing the implementation of micro-grids.

Case Study of Smart Grid at Austin Energy, Texas, USA

- The first part of Austin Energy's programmer, called Smart Grid 1.0, to be concluded at the end of 2009, focuses on the utility side of the grid, going from the central power plant through the transmission and distribution systems and all the way to the meter and back.

- Use generation mix, including nuclear, coal, natural gas, and renewable energy for a total of 2,600 MW.
- By 2020, Austin Energy plans to obtain 700 MW of energy efficiency and a share of 30% of renewable energy in its generation portfolio, of which 100 MW coming from solar.

Case study fact sheet

• *Full name of the company:*	*Austin Energy*
• *Location (HQ / main branches):*	*Austin, TX (USA)*
• *Main business activity:*	*Electricity company*
• *Year of foundation:*	*1893*
• *Number of employees:*	*1,700*
• *Turnover in last financial year:*	*$1.3 billion (2009)*
• *Primary customers:*	*388,000 residential customers* *43,000 businesses*
• *Most significant geographic market:*	*Austin, TX and surrounding areas*
• *Main e-business applications studied:*	*Smart Grid, Smart Metering*
• *Case contact person(s):*	*Andres Carvallo* *Chief Information Officer* *Austin Energy*

Recommendations for Future

- Smart grid technologies have continued along their development and deployment paths since the completion of the 2009 SGSR. Visions of an electricity system that not only provides service but also interacts and communicates with end users.
- So, our country should toward this technology to get reliability between provider and users.

Recommendations for Future

- ❖ Future reports should consider addressing the following potential improvements:
- Further evaluation of stakeholder feedback
- Further investigation and analysis of the risks and challenges organizations
- Review progress toward resolving smart grid challenges

Conclusion

- Smart grid use communications and information technology, with the objective to improve reliability, operating efficiency and reduce impact to the environment.
- Smart Grid Technology can play a key role in Green Power Installed at the Distribution Systems.
- Technological Advances are developing Some Unique Generators, especially in the Wind Turbine Area and PV.

Questions & Answers

Review Jurnal :
Smart Grid Distribution System (Studi Kasus atau Eksperimental).

- Implentatif
- Optimasi
- Aplikasi