Smart Grid Fundamentals and Benefits

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World Alliance for Decentralized Energy (WADE)

Edinburgh, Washington, Canada, China, India, Thailand
DE - Share of National Power Generation

World Average is 9% - Where are you?

## Why Smart Grid - Cogeneration/Trigeneration

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tr>
<td><strong>Energy Cost</strong></td>
<td>Energy costs can be a high proportion of the product cost in many industries. Cogeneration/trigeneration can reduce the energy costs by up to 40%.</td>
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<td><strong>Security of Supply</strong></td>
<td>Cogeneration/trigeneration can increase the reliability of power supply. Production processes need to avoid unscheduled shutdown.</td>
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<td><strong>Environmental Protection</strong></td>
<td>The high overall thermal efficiency of cogeneration/ trigeneration minimizes the production of carbon dioxide. Other exhaust emissions can be controlled by the use of low emission combustion technology.</td>
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<td><strong>Flexiability of Operations</strong></td>
<td>Optimize your operation, dependent on fuel, electricity prices, factory power and heat load.</td>
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Trigeneration System

Overall Plant Efficiency >80%

Natural Gas

Gas Turbine

Steam 10 Tonnes/hr

Absorption Chiller

Chilled Water for Process (15 C)

Heat Recovery Boiler

Electricity for Captive use 3,500 kW

Heat Exchanger

Hot water for Process
Increased Efficiency Results in Reduced Carbon Emissions

Conventional Generation:
- Power Station Fuel (U.S. Fossil Mix)
  - Power Plant: Efficiency 31%
  - Emissions: 36 kTons
- Boiler Fuel (Gas)
  - Efficiency 80%
  - Emissions: 13 kTons

Combined Heat & Power:
- 5 MW Natural Gas Combustion Turbine
- Combined Heat And Power: CHP
- Fuel (Gas)
  - Emissions: 23 kTons

...TOTAL EMISSIONS...
- 49 kTons/yr
- 23 kTons/yr

Source: ICF

WADe World Alliance for Decarbonized Energy
SMART GRID: The next big innovation
Efficient Grid

- The Electric Power Research Institute (EPRI) has estimated the cost of building a Smart Grid at over $165 billion over the next two decades - approximately $8 billion per year

- Global Electricity Sector Investment over next 3 decades i.e, 2020-30
  - US $ 10 Trillion: 60% of total energy investment
  - Three(3) times higher than investment in the electricity sector during past 30 years

- "We're sitting on an aged, old infrastructure while emerging countries like India and China are moving to the next generation of networks and generation sources." --Brad Gammons, vice president, IBM global energy and utilities industry group

- US $ 5.5 Trillion on T&D -- Approximately 30% on Transmission and rest to Distribution (smart Grid)

- Planned and proposed deployments of smart meters in United States
  - 150+ million meters by 2020
  - 45% of U.S. households
Smart Grid’s Building Blocks

- **Advanced Metering** -- Smart Meters (single phase and poly-phase meters), 2-way communications, interface to enterprise applications

- **Transmission/Distribution Automation** -- Fault Detection, Isolation, Restoration, Integrated Volt/VAR management, including switch/cap controllers, switched capacitors & voltage regulator

- **Substation Automation** -- Substation controller and transformer monitoring and diagnostics

- **Distribution Operations** -- Demand Side Management and Outage Management software & interface to existing applications, and control center optimization

- **Utility Enterprise Applications** -- Electric, Gas & Telecommunications utility geospatial based applications, Demand Side Management application, and advanced analytics & visualization

- **Customer sector** - Smart metering, Critical Peak Pricing, smart energy management customers
Smart Grid - Definitions

- Smart Grid - umbrella term - combination of technologies, approaches, and processes. Informed, involved, and active consumers - demand response and distributed energy resources.

- "Many distributed energy resources with plug-and-play convenience focus on renewable”.

- "Mature, well-integrated wholesale markets, growth of new electricity markets for consumers”. "Power quality is a priority with a variety of quality/price options - rapid resolution of issues”

- "Greatly expanded data acquisition of grid parameters - focus on prevention, minimizing impact to consumers”

- "Automatically detects and responds to problems - focus on prevention, minimizing impact to consumer”
Existing Grid

- Centralized Main Grid
- Only 1/3 of fuel energy converted to electricity
- Waste heat is not recovered (over 50-60% lost)
- Generation - Up to 20% gen capacity exists to meet peak demand only (i.e. 5% of time)
- Transmission - Up to 8% is lost along transmission lines
- Distribution – up to 45% losses in developing countries (Africa-Asia)
Today’s Grid
Future Grid
## Comparison of Existing and Future Grids

<table>
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<tr>
<th>Traits</th>
<th>Existing Transmission and Distribution System</th>
<th>Future Smart/Intelligent Grid Systems</th>
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<tbody>
<tr>
<td>Loss Reduction</td>
<td>Limited ability to address problem of high transmission and distribution losses. Limited control for distribution companies</td>
<td>Prevents disruptions, minimizes impact, more customer participation - better energy management and energy accounting, leakage can be detected quickly and prevented</td>
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<td>Peak Reduction</td>
<td>Reactive approach - Utilities tend to purchase costly power during peak hours</td>
<td>Grid technology enable utilities to reduce purchase of costly power and maintain grid discipline</td>
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<td>Integration of DG</td>
<td>Grids designed for one way flow -- Clients who have capacity to inject power into grid are limited by utilities and regulations</td>
<td>Allows individuals to generate onsite power and feed into grid without raising reverse flow reliability and safety issues. Best for DG and renewable</td>
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<td>Reliability of Supply</td>
<td>Post breakdown repair</td>
<td>Self healing. Power quality a priority</td>
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<td>Consumer Benefits</td>
<td>Little customer participation - due to price visibility and difficulty of determining price</td>
<td>Customers can optimize the monthly bill</td>
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<td>Rural Outreach</td>
<td>Still an issue -- high cost for placing transmission and distribution lines</td>
<td>Micro Grids and efficient use of available power supply will pave the way for increasing rural outreach without large investment in T&amp;D</td>
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<td>Quality of Supply</td>
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# Smart Grid benefits by Stakeholder

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<th>Government &amp; Regulators</th>
<th>Utilities</th>
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<tr>
<td>• Opportunity for GDP Uplift &amp; green-job creation</td>
<td>• Wider portfolio of investment options</td>
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<tr>
<td>• Effective carbon abatement investment option</td>
<td>• Grid efficiency, reliability &amp; Understanding of power flows increased enabling operational/maintenance savings</td>
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<td>• Creation of low-carbon regulatory frameworks accelerated</td>
<td>• Opportunity to transition from commodity provider to service provide</td>
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<td>• Spending efficiency increased by providing options to rationalize national infrastructure investments</td>
<td>• opportunity to evolve the operating model and lower operating costs</td>
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<th>Vendor</th>
<th>Consumers</th>
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<td>• opportunity to collaborate with other participants in the value chain to gain market access</td>
<td>• Greater choice between energy providers, products and services</td>
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<td>• Opportunity to create new services &amp; products to take to market</td>
<td>Greater transparency and control over energy efficiency</td>
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<td>• ability to improve understanding of consumer behaviour</td>
<td>• opportunity to see environmental benefits on a household/business benefits</td>
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<tr>
<td>• opportunity for machine-to-machine platform that can service multiple industries</td>
<td>• access to clean technologies, such as micro-generation and electric vehicles</td>
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<td></td>
<td>• provision of more reliable service with potential carbon savings</td>
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Cost & Savings

• Saving up to 15% - mostly from distribution losses. Save $500 billion in investments in the next 20 years by offsetting construction of new infrastructure that would otherwise be needed to meet load growth in Asia. NEGA WATTS

• New technology (AM) automatically lower the settings on home appliances, triggered by signals sent by utility companies over the Grid. “consumers are willing to have utilities remotely dial down the appliances to lessen the load on the grid and reduce consumption.

• Remote gateway device use - powered by systems integration software- enable energy companies and customer homes to communicate with one another. The device relies on broadband Internet connection to receive pricing information from the utility, which is transmitted wirelessly to a smart meter.

• One impediment to widespread Smart Grid usage is cost. To implement the technology in a single home can cost a utility company between $500 and $1,000 in USA. Will Customers Pay???

• Clean power sources such as wind and solar still technical challenges -- can be better incorporated with upgraded equipment.
Barriers & Challenges

- Regulatory restrictions in the implementation of energy plants in commercial complexes and buildings based on zoning
- Tariff setting does not reflect the cost of fuel, No standardization of DE, Net metering and Connection charges
- Difficulties in funding (investors and lenders) the projects
- Difficulties in getting public acceptance
- Lack of centralised organisation providing coordination, information, training or services
- Lack of awareness and knowledge on climate change issues
SUMMARY - Strategies to make a smarter grids an attainable goal

- Smart Grid/DE is a win-win for the power sector;
- DE combined with Smart Grid has great potential to reduce CO₂ emissions and reduce overall costs of supplying power;
- DE/Smart Grid can provide energy access for those in rural areas and developing countries;
- New fuels like Hydrogen will play a major role;
- Develop New Regional Transmission Plans to Bring Renewable Power to Market;
- Create New Incentives for Investments in Smart Grid Technologies;
Smart/Intelligent Grid is the Local/Global Solution!

THANK YOU &

NAMASKAR

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