Smart/Intelligent Grid Development and Deployment in Thailand (Smart Thai)

Smart/Intelligent Grid: Principles and Benefits

Sridhar Samudrala
Smart-Grid Specialist

Project Launching Seminar
1st March 2011
Pullman Bangkok King Power, Room Infinity I
Smart/Intelligent Grid – Definitions

• Smart/Intelligent Grid - umbrella term - combination of technologies (central and Decentralised Energy 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, minimising impact to consumers”
• "Automatically detects and responds to problems - focus on prevention, minimising impact to consumer”
Existing Grid

- Centralised Grid
- Only 1/3 of fuel energy converted to electricity
- Waste heat is not recovered (over 30% lost)
- Up to 8% is lost along transmission lines
- US, 20% gen capacity exists to meet peak demand only (i.e. 5% of time)
- Distribution – up to 45% losses in developing countries
Today’s Grid
Energy’s Future Vision

- Bio fuels
- Plug-in H2
- Distributed Utility
- Fossil Fuels
- Nuclear
- Solar
- Wind
- Zero Energy Home
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
## Existing and Future Grids

<table>
<thead>
<tr>
<th>Traits</th>
<th>Existing Transmission and Distribution System</th>
<th>Future Smart/Intelligent Grid Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loss Reduction</strong></td>
<td>Limited ability to address problem of high transmission and distribution losses. Limited control for distribution companies</td>
<td>Prevents disruptions, minimises impact, more customer participation - better energy management and energy accounting, leakage can be detected quickly and prevented</td>
</tr>
<tr>
<td><strong>Peak Reduction</strong></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>
</tr>
<tr>
<td><strong>Integration of DG</strong></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>
</tr>
<tr>
<td><strong>Reliability of Supply</strong></td>
<td>Post breakdown repair</td>
<td>Self healing. Power quality a priority</td>
</tr>
<tr>
<td><strong>Consumer Benefits</strong></td>
<td>Little customer participation - due to price visibility and difficulty of determining price</td>
<td>Customers can optimise the monthly bill</td>
</tr>
<tr>
<td><strong>Rural Outreach</strong></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>
</tr>
<tr>
<td><strong>Quality of Supply</strong></td>
<td>Quality is limited due to losses in T&amp;D systems</td>
<td>Quality parameter can be monitored and changed as load varies</td>
</tr>
</tbody>
</table>
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 optimisation
- **Utility Enterprise Applications** -- Electric, Gas & Telecommunications utility geospatial based applications, Demand Side Management application, and advanced analytics & visualisation
- **Customer sector** - Smart metering, Critical Peak Pricing, smart energy management customers
Smart Grid Cities

• **Rotterdam, Neatherlands:** Rotterdam is working with IBM to become the world’s first “Smart Delta City” by collecting and analysing real-time data on the rivers, ocean, weather and more. Committed to reducing carbon dioxide by 50 per cent and reaching a climate adaptive situation while strengthening our region’s economic condition by 2025.

• **Boulder, CO:** Boulder is aiming to become the world's first smart grid city. Energy on the $100 million effort and customers can use the Internet to lower their thermostats or home or change the temperature on their furnace.

• **Chicago, IL:** With the help of the Galvin Electricity Initiative the Illinois Institute of Technology (IIT) is adopting the electric grid. Use digital technology to collect, communicate and react to data, making the system more efficient and reliable. For example, sensors would help utilities locate problems and fix them quickly.
Local, Mini- and Micro-Grids

- Distributed Generation can offset some of the losses and eventually costs – can save up to 8-12% per year that equals to about $26 per month Avg. bill. This is not much but adds to the whole.
- Renewable (solar, wind and micro hydro play a vital role)
- Local distribution systems are connected to the regional networks, and through that to the national electric backbone. Power from distributed energy facilities flows to and from customers and into the regional network, depending on supply and demand conditions.
- Real-time monitoring and information exchange still not available - this will enable markets to process transactions instantaneously and on a national basis.
- Customers do not have the ability to tailor electricity supplies to suit their individual needs for power, including costs, environmental impacts
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 and no standardisation of DE
- Net metering and Connection charges vary
- Difficulties in funding (investors and lenders) the projects and getting public acceptance
- Lack of centralised organisation providing coordination, information, training or services
- Lack of awareness and knowledge on climate change issues
Cost & Savings

- Savings of 10-15% - 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. NEG A WATTS

- New technology 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.
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

ssamudrala@localpower.org