National Grid: an international electricity and gas company

- 50% US, 50% UK
- 27,000 employees
- Distributes electricity to 3.3 million customers
- Provides natural gas to 3.5 million customers
- Services 1.1 million customers of Long Island Power Authority (LIPA)
- Currently owns over 4,000MW of generation
Energy Market is evolving - Smart Grid is an essential enabler

Traditional Energy Market - supply driven

- Large centralised generation
- Small range of conventional technologies
- Static infrastructure

- Nuclear power station
- Hydro-electric power
- Coal/gas fired power station
- Gas production

- Energy flows to users

- Industrial and commercial

Price and reliability are main determinants of customer choice

Today’s Evolving Market - customer driven

- Customers focus on economic and environmental value, using a wider range of products and services

- Electricity flows to users, and surplus from distributed generation flows back to grid

- Smart network technology rolled out

- Intermittency management

- Technology choice proliferates

- CO₂ emission reduction and wider energy services drives energy company revenue

- CO₂ transport and storage

- CCS plant (coal/gas)

- Large scale CHP and biomass

- Natural Gas

- Hydrogen

- CO₂

- Biogas

- Heat

- Industrial and commercial

- Domestic

- Micro wind

- Micro CHP

- Solar water heating

- Heat pumps

- Efficient Boilers

- Micro Biomass

- Gas production

- Storage
Smart Grid Drivers

Climate Change
• Societal awareness.
• Period of denial is over.
• Policymakers are reacting with incentives and mandates.
• Energy industry position in society is changing.

Customer Service
• Requirements increasing.
• Data revolution.
• Innovation enabler.
• Business development.

Efficiency
• Operating cost.
• Reliability through automation.
• New Generation model.

Strategy and Execution

The DOE (stimulus) and support by state regulators is a huge accelerator…
Smart technology means different things to different people – a common language and vision are essential for company alignment.

**Smart Technology Definition**

*Technology that provides advanced information, automation and control capabilities to help us to distribute, measure and use energy more efficiently, enable Renewable's reliably, safely and sustainably – all the way from the point of generation to consumer appliances.*

### What is Smart Technology?

<table>
<thead>
<tr>
<th>Meter</th>
<th>Grid</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Meter that records interval data</td>
<td>• Sensors &amp; measuring devices</td>
<td>• Customer portal &amp; Home Area Network</td>
</tr>
<tr>
<td>• 2-way communications, remote configuration</td>
<td>• Analytical programs e.g. pattern recognition</td>
<td>• Automated thermostats, switches, plugs &amp; appliances</td>
</tr>
<tr>
<td>• Informative display</td>
<td>• Automatic switches &amp; controls</td>
<td>• Load controllers e.g. PHEV controller</td>
</tr>
<tr>
<td>• Meter Data Management System</td>
<td>• Decision support tools &amp; graphical interfaces</td>
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### What does it allow you to do?

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<tbody>
<tr>
<td>• Automatic meter reading</td>
<td>• Enable Distributed generation</td>
<td>• Automatically optimize selected home appliances</td>
</tr>
<tr>
<td>• Enable customer choice and control</td>
<td>• Remotely detect, diagnose, predict and correct network problems &amp; faults</td>
<td>• Demand response programs</td>
</tr>
<tr>
<td>• Choice of tariffs e.g. time of use – peak shifting</td>
<td>• Condition-based, preventative maintenance</td>
<td>• Improve satisfaction levels</td>
</tr>
<tr>
<td>• Catalyst and validation of Energy Efficiency programs</td>
<td>• Automatic fault prevention, isolation &amp; restoration</td>
<td></td>
</tr>
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</table>
We defined 22 smart technology enabling capabilities that address the business drivers:

### Communications

- Underlying communications to support the Smart technologies

### Smart Meter

- Ability to remotely read the data contained in a smart meter
- Metering devices which provide TOU pricing information
- Digital meters capable of sending signal when they go out/identifying themselves when power/gas is restored
- Digital meters capable of being remotely connected and disconnected
- Digital meters capable of being remotely configured for functionality changes, firmware and software updates
- Ability for a retail energy service provider to manage its revenues through more effective cash collection and debt management

### Electric Gas

- 1. Two way communications
- 2. Automated meter reading
- 3. Remote consumer price signals
- 4. Providing granular energy use information
- 5. Identify outage location, extent remotely
- 6. Remote connection/disconnection
- 7. Remote meter configuration
- 8. Optimize retailer cash flow

### Electric Grid

- 9. Remote network monitoring
- 10. Remote network control
- 11. Automatic network control
- 12. Optimize power flow/pressure mgmt & losses
- 13. Optimize power quality
- 14. Fault analysis
- 15. Real-time network planning
- 16. Network re-enforcement planning
- 17. Predictive monitoring
- 18. Optimize crew management
- 19. Perform dispatch & reg services for all DG
- 20. Self-configuring grid
- 21. Aggregated DSM
- 22. Control in-home demand

### Home Automation

- Ability to aggregate and dispatch distributed generation sources
- Ability for the Grid identify the problem area and take independent actions to minimize the problem either on localized or centralized manner
- Aggregation of demand to reduce peak load and help balance the system more efficiently
- Ability to control in-home appliances to switch off high-load components during periods of high demand
Technology Aspects

1. Spine

2. Clean Technology Modules

3. Integration
Our Smart Grid “Spine” would be ubiquitous within the pilot footprint (i.e., every customer is served)

- At the core of the Smart Grid Spine is a common two-way communication system that enables advanced metering, new customer service offerings and distribution grid monitoring and control;
  - Smart metering;
  - In-Home energy management;
  - Distribution grid monitoring and control.

- Ubiquitous covers the entire footprint of Smart Grid pilots
- Supports all the potential functions of the Smart Grid
Why did we choose the modules we did?

<table>
<thead>
<tr>
<th>Rationale for Selecting the Clean Energy Modules</th>
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<tbody>
<tr>
<td><strong>Rationale</strong></td>
</tr>
<tr>
<td>Leverages ongoing National Grid activities</td>
</tr>
<tr>
<td>Provides Climate change benefits</td>
</tr>
<tr>
<td>Potentially disruptive to network operations</td>
</tr>
<tr>
<td>Enables network optimization and increases efficiency of the network</td>
</tr>
<tr>
<td>Creates new business opportunities</td>
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<tr>
<td>Demonstrates “blue sky” (e.g., customer of the future)</td>
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</table>
Communications technology choices are huge – we need to take a balanced holistic, long term view

- **IP based communications** (Fiber optics, VPN, WiMax) (Gb/s - Tb/s)
- **BPL** (10 - 200 mbs)
- **SMS, GPRS, Mesh Radio, DLC** (1 – 170 kbs)
- **Narrowband PLC** (100bps - 5kbs)

**Latency/Speed**
- Not Real-Time/Near Real-Time
- Real-Time
- Sub-Second

**Bandwidth**
- Low
- Medium
- High

**Cost**

- Optimize power quality
- Fault analysis
- Automatic network control
- Self-configuring grid
- Remote network control
- Remote network monitoring
- Identify outage location, extent remotely
- Predictive monitoring
- Perform dispatch & reg services for all DG
- Control in-home demand
- Remote meter configuration
- Remote connection, dis-/re-connection
- Remote consumer price signals
- Network re-enforcement planning
- Real-time network planning
- Optimize crew management
- Optimize power flow/pressure mgmt and losses
- Aggregated DSM
- Resource planning (p)
- Providing granular energy usage information
- Automated meter reading
- Optimize retailer cash flow
- Optimize retailer cash flow
National Grids Approach to Smart Grid is designed to allow leadership to continuously assess risks and adjust course.
Pilot Areas summary – what we are planning:

- Albany Capital District, NY (42,000 customers)
- Worcester, MA (15,000 customers)
- North Metro Boston, MA (95,000 customers)
- Syracuse, NY (40,000 customers)
- Newport, Jamestown & Portsmouth, RI (10,000 customers)
National Grid’s bid has key differentiation areas

<table>
<thead>
<tr>
<th>State Differentiation</th>
<th>Green Communities Act, (MA) leadership in renewable’s and energy efficiency, home to clean energy technology companies. NY Political muscle and aggression.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment to Climate Change</td>
<td>National Grid has a corporate commitment to address climate change. Smart Grid is an enabling technology for customer involvement and enabling low carbon resources.</td>
</tr>
<tr>
<td>End to End solution</td>
<td>National Grid’s technology solution would allow us to leverage same infrastructure for grid devices, smart meters, and modules. Many utilities are focusing only on AMI.</td>
</tr>
<tr>
<td>Clean Energy Modules</td>
<td>National Grid is deploying a Smart Grid that will be specifically designed to accommodate emerging clean energy technologies.</td>
</tr>
<tr>
<td>Proof of Concept</td>
<td>We have begun a robust proof of concept that will test interoperability and cyber security. Other utilities are taking larger risks by not taking this critical step.</td>
</tr>
<tr>
<td>Smart Tech Center</td>
<td>Center will support the near-term deployment, but will also look over the horizon at emerging technologies. Will work with local colleges and universities to develop qualified workforce.</td>
</tr>
<tr>
<td>Regional Deployment</td>
<td>National Grid is the only truly Northeast Regional Smart Grid deployment. Other utilities don’t have our breadth in the Northeast. Allows us to leverage investment across the region.</td>
</tr>
<tr>
<td>World Class Team</td>
<td>We have pulled together a world class team of established vendors, start-ups, universities with the support of federal, state and local stakeholders</td>
</tr>
</tbody>
</table>
Conclusion

• National Grid believe we are on the verge of a fundamental shift in the Energy Industry driven by market evolution and emerging customer requirements to meet environmental and service aspirations.

• This creates threats and opportunities.

• A review of the core Energy Industry infrastructure indicates a significant upgrade and radical redesign is necessary to meet current and future needs of customers and society in general.

Thank You and Check Out Our Website

http://www.nationalgridus.com/energy/