Emergence of Policies to Promote Smart Grid Urban Infrastructure

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“Why should I worry when the grid is better than 99% reliable?”

2009 U.S. electricity consumption: 3,741 Billion kW-h \( (EIA) \)

Estimated annual outage costs: $30 Billion - $130 Billion
\( (LBNL\ report\ to\ OE,\ 2004) \)

2003 Northeast Blackout

- 508 generators tripped
- Cleveland → Toronto → NYC
- 7 minutes \( Report\ on\ 2003\ North\ American\ Blackout,\ \)

Grid congestion

Requests for relief from power exchanges

North American Electric Reliability Council
The Grid connects and touches many parts of the energy system

We cannot accept the mantra “changing the Grid is not possible because it is too complex” – it is too important to ignore.
The Future Grid
what should it look like?

It should be capable of:
• Enabling informed participation of customers
• Accommodating all generation and storage options
• Providing the power quality for a range of needs
• Optimizing asset utilization and operating efficiency
• Providing resiliency to disturbances, attacks, and natural disasters

How do we get there?
• Planning, policy and other non-technical support (e.g., markets, regulations, environmental considerations)
• Analysis, standards and model development
• System integration and distributed technologies
• Grid energy storage and demand response
• Grid components and materials innovations
Smart Grid: A Vision for the Future

Changes to the Grid require an intricate balance of technologies, markets, and policies

U.S. Department of Energy’s Clean Energy Goals:

• By 2035, 80% of America’s electricity will come from clean energy sources
• By 2020, 20% improvement in the energy efficiency of commercial buildings relative to 2010
• Put 1 million electric vehicles on the road by 2015
• Energy-related GHG emissions will reduce 17% by 2020 and 83% by 2050

• Policies drive markets which drive technologies

Policies
state RPS, federal CES, FERC, PUC’s, environmental regulations, siting, etc.

The Grid

Markets
business models, cost allocation, wholesale power trading, utilities, vendors, etc.

Technologies
generation, infrastructure, smart grid, electric vehicles, storage, etc.
Technologies – Smart Meters & Displays

- Meter that allows frequent data collection
- Enables alternative pricing
- Can interface with in-home or in-office displays of online consumption information
- NOT just an automatic meter reader

ZigBee Rate saver

Google PowerMeter

Energy Orbs that signal expensive & inexpensive times to use energy
Markets – Complex of grid regulators and stakeholders in the U.S.

Policies – Shaping the Smart Grid

• Net Metering Policies
• Interconnection Standards and Rules
• Dynamic Pricing and Demand Response
  - Time-of-Use Pricing (TOU)
  - Critical Peak Pricing (CPP)
  - Real-Time Pricing (RTP)
• Smart Metering Targets
• Renewable Energy Subsidies & Regulation
• Smart-Grid Demonstration Projects
• International Smart-Grid Collaboration
Public-Private Partnerships (e.g., Tennessee Valley Authority & EnerNOC)

TVA Energy Efficiency and Demand Response (Cumulative Electricity Savings)
## Smart-Grid Policies: Barriers and Drivers

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<th>Smart-Grid Policies</th>
<th>Barriers</th>
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Net Metering Policies in Four US States: Capacity Limits of Qualifying Facilities

- **1,000 kW:** Solar, wind, biogas, fuel cell
- **10 - 2,000 kW:** Solar, fuel cell, micro-hydroelectric, farm waste, micro-CHP, wind
- **10/100 kW:** Residential/commercial-industrial (Solar, wind, fuel cells)
- **50 kW:** Renewable energy

(Source: revised from DSIRE’s map, http://www.dsireusa.org/summarymaps)
# Dynamic Pricing Policies in Four US States

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<tr>
<td>NY</td>
<td>Real Time Pricing</td>
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# National Targets and Policy Drivers

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<th>Country</th>
<th>Carbon Emissions</th>
<th>Renewable Energy (% of total primary energy supply)</th>
<th>Policy Drivers</th>
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</table>
| USA     | 17% below 2005 level by 2020 | Vary across states: CA — 33% by 2020, TX — 5880 MW by 2020, NY — 29% by 2015, GA — no target | - Technical and operational standards  
- Smart meters  
- Dynamic pricing and demand response |
| EU      | 20% below 1990 level by 2020 | 20% by 2020 | - Technical and operational standards  
- Smart meters |
| Japan   | 30% below 1990 level by 2030 | 13% by 2030 | - Smart community  
- Smart meters  
- Solar PV |
| Korea   | 30% below BAU by 2020 | 11% by 2030 | Smart power grid  
- Smart transportation  
- Smart renewables  
- Smart electricity services |
| China   | 17% below 2011 level by 2015 (Carbon Intensity) | 11.4% by 2015 | - Ultra High Voltage (UHV) regional transmission  
- Upgrading and modernizing urban and rural electric grid |
Smart Grid Policies: From the Local to the International

- Smart Grid Demonstration Projects
- Smart Metering Policies
- Dynamic Pricing and Demand Response Programs
- Interconnection Policies
- Mandatory Net-Metering Rules
- Net Energy Metering Tariffs
- Rural Electric Loans
- Smart City Policies
- Energy Storage Policy
- International Smart Grid Collaboration

Regulatory
Information
Financing

Town/City  State/Province  National  Regional  International
Recommended Policy Directions for the U.S. Smart Grid

- A policy framework that attracts diverse funding sources for smart-grid deployment
- Regulatory changes that promote competitive electricity markets
- Policy making that takes into account societal cost-benefit analysis and consumer behavior
Thank You!
谢谢！