Teaching the Smart Grid
Why Data Management is Essential to the Future of Electricity

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Outline

- What is the Electric Grid?
- What is the Smart Grid?
- The Importance of Data Management
- Current Data Policy
- Policy Options
- Recommendations
What is the Grid?

Source: US-Canada Power System Outage Task Force
What is the Grid?

- Mostly privately owned
- New stresses:
  - New types of generation
  - Long distance transmission, increased power on lines
What is the Grid?

Number of minutes without power has increased...

97  94  201  109  104  104  104  105  111  112

...and so has the spending per customer

$250

$163

$232

NOTE: Does not include blackouts from major storms or other events.

SOURCE: Ventyx, PA Consulting Group
What is the Smart Grid?

- 2007 Energy Independence and Security Act: “Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid”
- Adding more sensors and controllable devices to the grid
- Example: Updated meter communications
What is the Smart Grid?

![Diagram of NIST Smart Grid Framework]

Secure Communication Flows
- Electrical Flows
- Domain

Markets
- Operations
- Service Provider
- Bulk Generation
- Transmission
- Distribution
- Customer

NIST Smart Grid Framework
The Importance of Data Management

- 2009 American Reinvestment and Recovery Act: $11 billion
- 15.5 million smart meters by 2014
- 1,000 new synchrophasors by 2014
  - Transmit data on phase, frequency, and voltage/current levels 30 times a second
- 10,780 terabytes (TB) of new data created in 2010
- 75,200 TB predicted in 2015
- All of the info in Library of Congress = 15 TB!
- Ideal use of data is to have real time response
The Importance of Data Management

- **Efficiency**
  - 2012 survey of utilities found that vast majority are not using this data in real time

- **Privacy**
  - Electricity usage contains personal information

- **Security**
  - Consumer data needs to be secure
  - Grid itself needs to be secure from potential attacks
Current Data Policy

- 2007 Energy Independence and Security Act
- National Institute of Standards and Technology (NIST)
- Smart Grid Interoperability Panel
  - Public-private partnership
  - Identification of voluntary, consensus-based standards
- Who makes/enforces the rules?
Jurisdiction

- Federal Energy Regulatory Commission (FERC)
  - Interstate electricity sales/transmission
- North American Electric Reliability Corporation (NERC)
  - Can enforce standards using financial penalties
- Independent System Operators (ISO) & Regional Transmission Organizations (RTO)
Policy Options: Voluntary Standards

- Encourage and coordinate voluntary, consensus-based standards
- Example: Smart Meter Updatability
  - Hardware installed with stimulus money, without coherent data analysis plan
  - Need to be able to upgrade firmware remotely
- Varying levels of success
  - Differences between vendors
  - Conformity assessment
Policy Options: Enforceable Standards

- FERC/NERC can use standards vetted by the SGIP
- Example: Common Information Model
  - IEC Standard, endorsed by SGIP
  - Specifies how information should be represented
  - Essential for communication, yet rarely used
  - Corporate inertia, costs of updating IT infrastructure
Policy Options: Infrastructure Funding

- The American Recovery and Reinvestment Act of 2009 (ARRA) provided funding for 15.5M new meters
- Technology needs to reach “critical mass”
- Lots of ways to implement, some already being used
  - Grants
  - Tax credits
  - Research funding
- Most difficult option to implement politically
Policy Recommendations

- Efficiency of Data Management
  - A CIM needs to be mandatory - use SGIP recommendations
  - More standards, conformity assessment needed
- Privacy
  - Strip as much identifying info as possible
  - Persistence of data
  - Give people access/control over own data
- Security
  - Condition of grid is a national security issue
  - Defense funding, expertise should be used
Questions?