

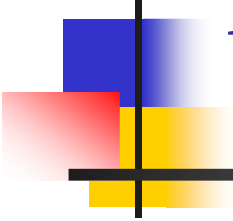


# Privacy and the Smart Grid: New Frontiers, New Challenges

---

Jules Polonetsky

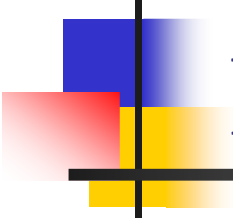
THE FUTURE OF PRIVACY FORUM  
[WWW.FUTUREOFPRIVACY.ORG](http://WWW.FUTUREOFPRIVACY.ORG)



The Smart Grid market “may be bigger than the whole internet.”

---

- John Chambers, CEO  
Cisco Systems, Inc.



“The ability to get richer data...is  
also its Achilles’ heel from a  
privacy viewpoint.”

---

- Gary Locke, Secretary  
U.S. Department of Commerce



# What is the Smart Grid?

---

- The “Grid” refers to the method by which energy is generated, transmitted, and distributed to homes and businesses.
- Companies involved in providing services along the Grid are seeking to improve their infrastructure by making the Grid “Smart” – Introducing technology with communication capabilities so that electricity can be delivered more cleanly and efficiently.



# What are the Benefits of the Smart Grid?

---

- Energy Efficiency
- Demand Management by Utilities
- End-User Control over Energy Use
- Quicker Response to Electricity Outages
- Real-Time Pricing for Electricity
- Integration of Clean Energy Technologies

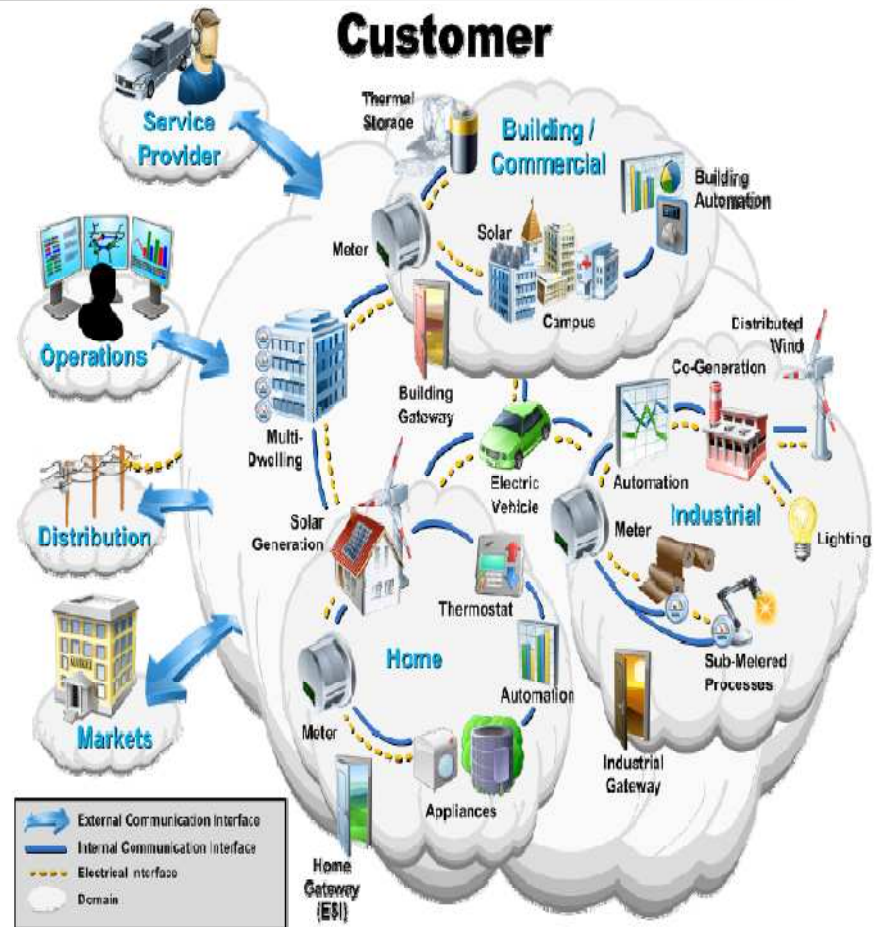
# Components of the Smart Grid

- Electricity Generation
- Electricity Transmission
- Electricity Distribution
- Communications and Operations
- End-User Applications



# End-User Applications

- Advanced Metering Infrastructure (AMI) - Tools to monitor and analyze energy usage by the consumer.
  - Smart Meters
  - Data Management Software
  - Data Storage Devices
  - Smart Appliances.
  - Home Area Networks





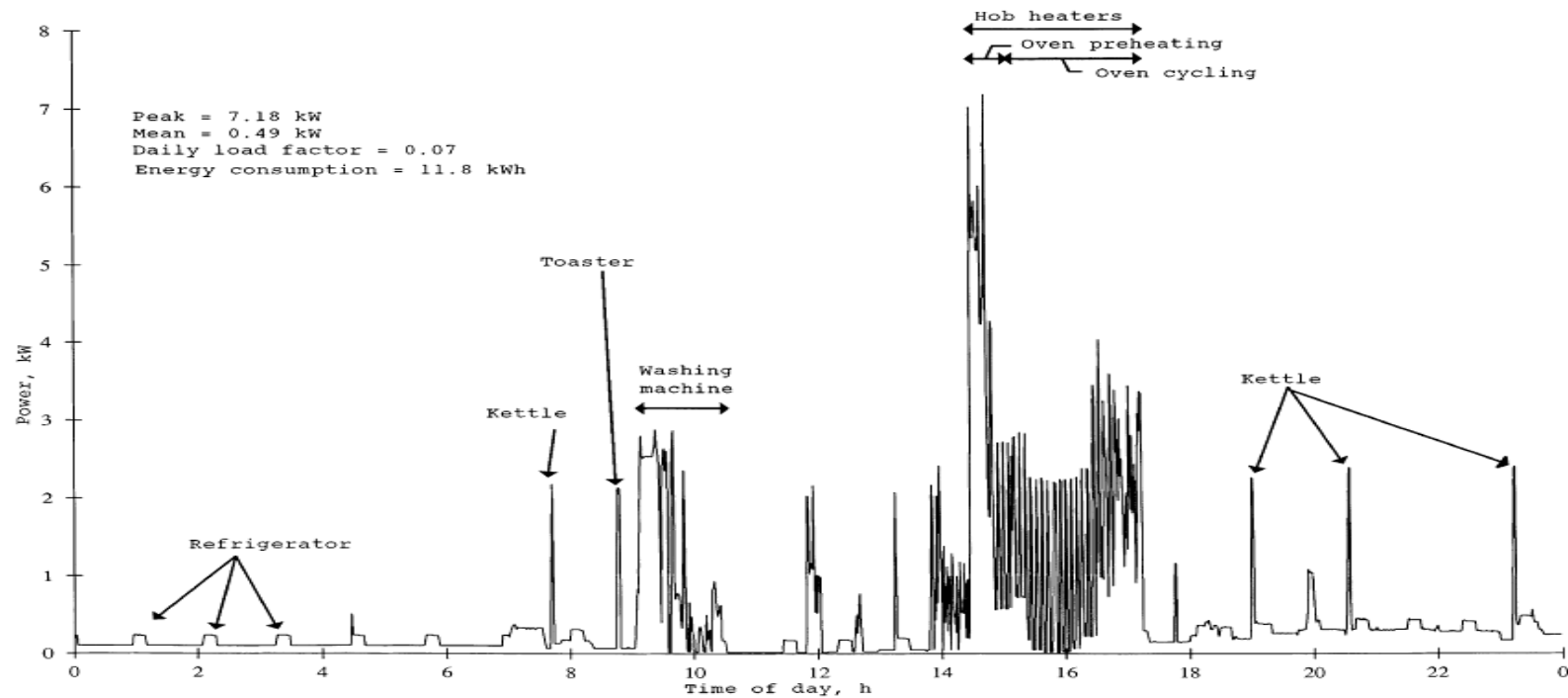
# Privacy Concerns – End-User Applications

---

- Smart Metering
  - Information regarding energy use will be collected from the home and may be able to relay information about specific types of appliances being used at specific moments in time.
    - Data will potentially be collected at very short (15 minutes or fewer) intervals.
    - Load Signatures could potentially indicate when you are home and whether you are cooking, watching television, or using other electronic devices.



# Load Signatures



- Smart meter data may be used to determine device usage in the home.



# What Could Detailed & Specific Power Usage Information Reveal?

---

- Do you have children? Do you leave them at home alone?
- What hours do you work?
- Do you come home after bars close for the night?
- Do you have an alarm system and is it armed?
- When do you usually bathe?
- Do you cook your meals in the microwave or on the stove?
- Are you a restless sleeper?
- How frequently do you wash your clothing?



# Privacy Concerns – End-User Applications

---

- Home Area Networks
  - Appliances and devices may communicate with one another to use electricity more efficiently.
  - Consumers or others may remotely control temperature gauge and other appliances.
- Remote Connect / Disconnect of Meter Demand Response and Pricing
  - Customers will respond to real-time pricing signals.
- Use of Comparable Power Usage to Encourage Energy Conservation
  - How detailed are the comparisons?
  - Risks of public sharing and bullying.
- Marketing Use of Data
- 3rd Party Application Developers
  - Device-makers may seek access to data to provide in-home tools for better monitoring of electricity use.

# Smart Appliances

- General Electric and Whirlpool plan to roll out “smart” appliances by 2010.
  - Automatic shut-off during times of peak demand.
  - Communicate with metering devices and other appliances.
  - What does consent look like?  
Will customers understand what they are signing up for?
    - Secondary uses include offering warranty renewals and replacement with newer models.



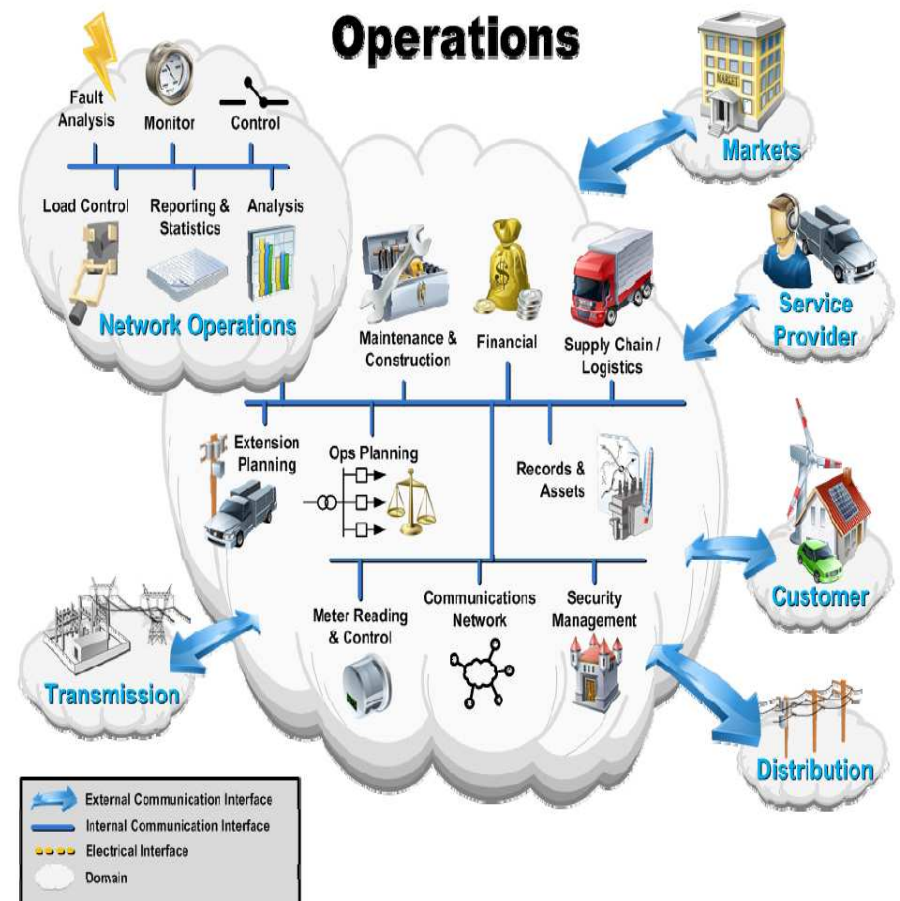
# Plug-In Electric Vehicles

- Identify each vehicle at the location it charges and bill the proper account.
- Accommodate times of peak charging demand.
- Use batteries for storage and exchange power between the Grid and your vehicle.



# Communications and Operations

- The implementation of Smart Grid technologies will require collaboration among a number of different companies, regulatory agencies, and utility operations.
- Will data flow and communications take place over public networks or dedicated private spectrum?

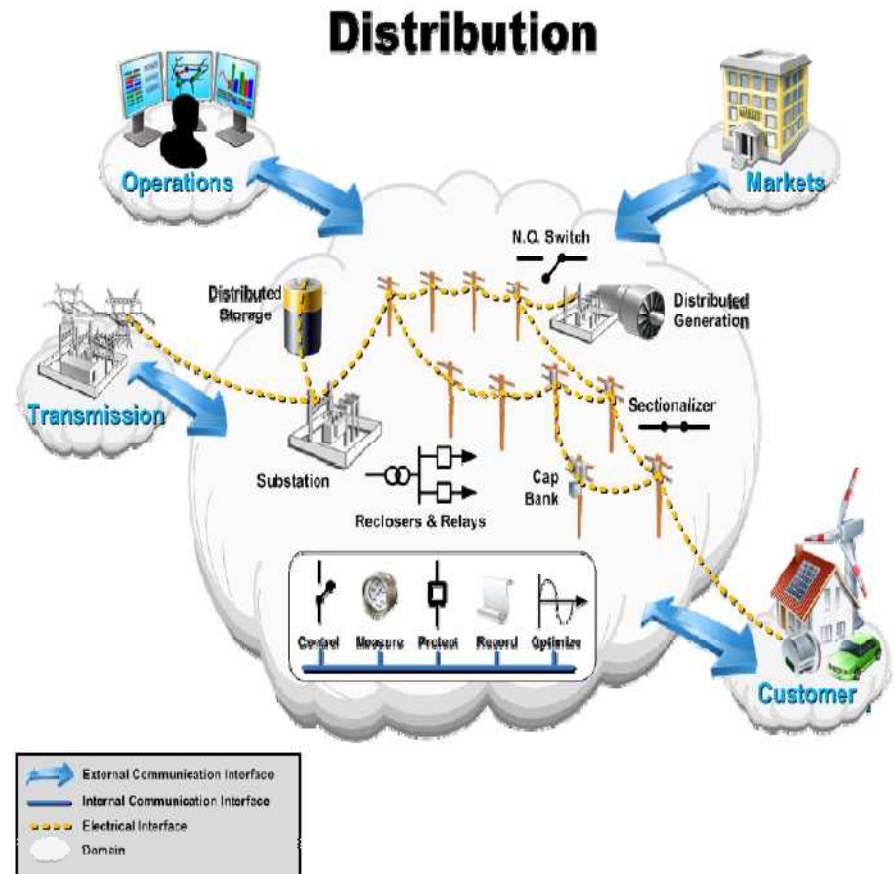


# Electricity Distribution

- The Distribution system carries electricity from the substation to the consumer's metering point.

Infrastructure includes –

- Feeders
- Power Lines
- Transformers
  - Change voltage from transmission levels to consumer use levels.







# Privacy Concerns - Distribution

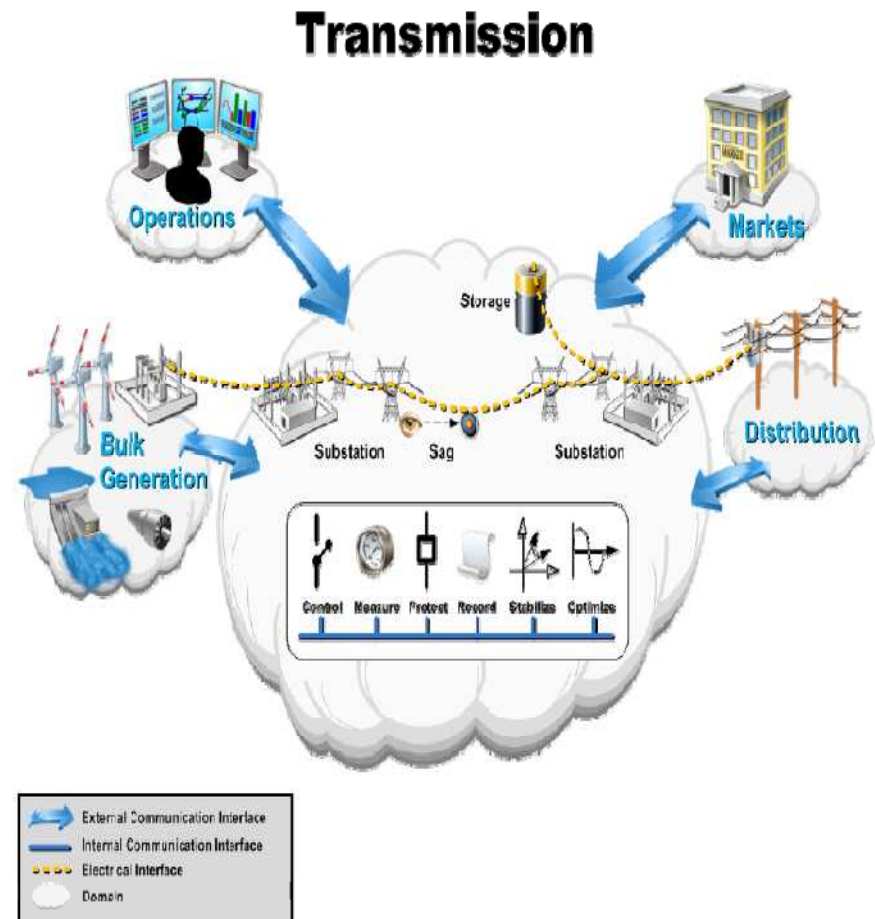
---

- Automation of Feeder Equipment
  - The automated system will communicate directly with smart meters.
- Fault Detection
  - Utility companies will access personal information regarding electricity use in real time, without direct interface with the consumer.
- Load Management
  - Utility may take control of systems within the home – i.e. air conditioner cycling off during times of peak demand.
- Data Gathering and Storage
  - Utilities will now control many times more data points than they currently collect.
  - How will utilities ensure data privacy and security?



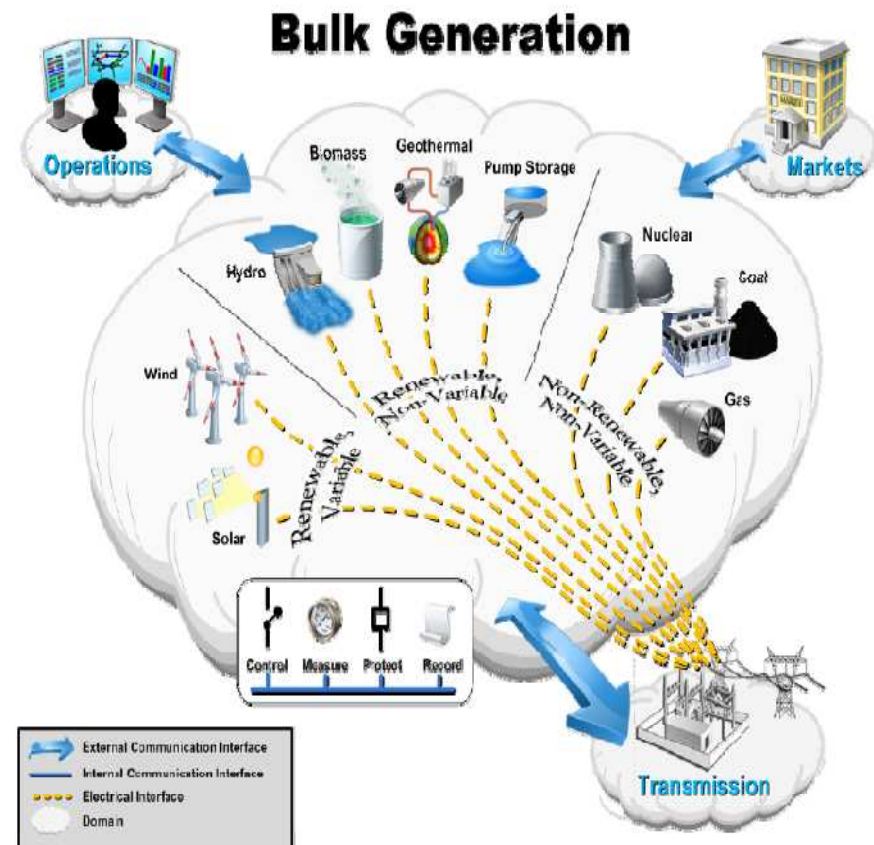
# Electricity Transmission

- Bulk transfer of electrical energy from Generators to substations via overhead power lines or underground cables. Most activity in this component takes place in substations, whose operations are controlled by the Supervisory Control and Data Acquisition (SCADA) system.



# Electricity Generation

- The process of creating electricity from other forms of energy, such as chemical combustion, nuclear fission, photovoltaics (solar), or kinetics (water and wind).





# Privacy Concerns – Back-End Databases

---

- Policies for Anonymization, Data Deletion, and Storage.
- Government / Law Enforcement Access
  - *Kyllo v. United States*
  - Law enforcement uses thermal imaging to determine Kyllo is growing marijuana in his home.
  - Scalia, J. - What time does the lady of the house take her daily sauna and bath?



# The Smart Grid is Here.

---

- United States

8.3 million smart meters have already been installed in the United States. This number is projected to increase to 52 million by 2012.

The U.S. Federal Government has allocated \$4.5 billion in federal stimulus funds for Smart Grid projects.

Xcel Energy has instituted “SmartGridCity”, a joint consortium of eight information technology companies to develop and implement Smart Grid technologies for Boulder, Colorado.

- Homes will be outfitted with smart metering devices and each ratepayer will have access to an in-home energy management website.
- Infrastructure will protect against blackouts and reroute power around electricity bottlenecks.



# The Smart Grid is Here.

---

- Canada

North American utilities are expected to spend \$10.75 billion on Smart Grid infrastructure.

The Government of Ontario is committed to installing smart meters in all homes and businesses by the end of 2010.

Toronto Hydro has instituted a program in which residential customers can sell “distributed generation” back onto the grid.



# The Smart Grid is Here.

---

- Germany

Yello Strom was the first European utility to grant consumers access to Google PowerMeter. Yello is now teaming with Cisco to install in-home energy management devices.

- Italy

85% of homes have smart meters installed. This is the highest penetration rate in Europe. France is second with only 25%.

- Netherlands

April 2009 - First Chamber declined to pass a bill which would require the installation of smart meters in residences.

Chamber cited privacy issues as the measure may violate the right to privacy in the European Convention on Human Rights.



# The Smart Grid is Here.

---

- England

The Government has announced plans to install a smart meter in every home in England by 2020.

However, the Department for Energy and Climate Change (DECC) has expressed privacy concerns about smart meters in its impact assessment. There is “scope...for monitoring of vulnerable householders by health authorities or social services.”

- European Union

The European Parliament passed the 3<sup>rd</sup> Energy Package in April 2009 which proposed that 80% of electricity customers have smart meters by 2020.



# Forward Thinking

---

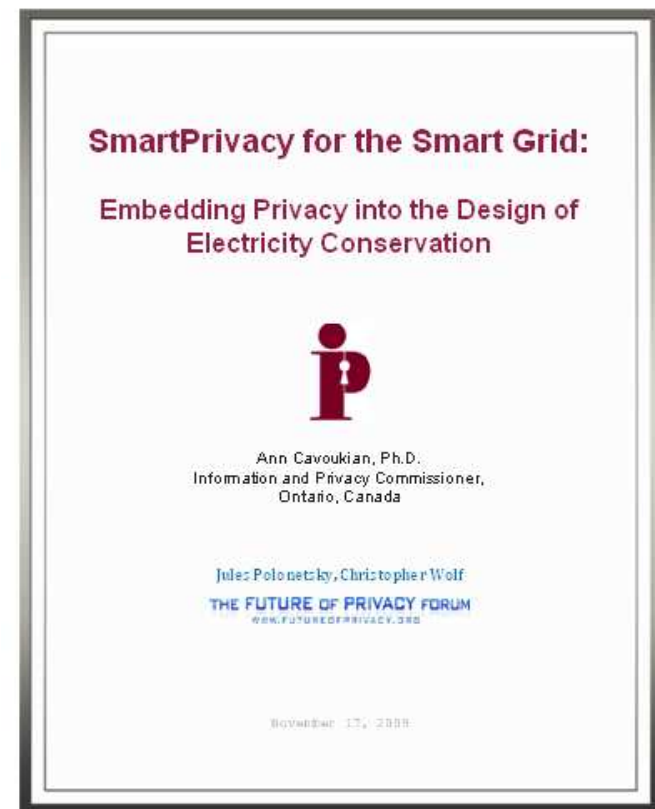
- Privacy-by-Design
  - Incorporate principles of privacy-by-design into the construction of the Smart Grid.
  - Layering privacy protections on top of an already-constructed system will be costly and ineffective.
  - Development of the Smart Grid must give end-users control of their data.
  - Policies controlling data use and information gathering by stakeholders must be transparent.
- Consumer research and innovation are needed to learn how to best communicate and inform users about new types of data use.





# SmartPrivacy for the Smart Grid

- Joint Paper by Ontario Privacy Commissioner and the Future of Privacy Forum.
- Coming Soon.





For more information, please see our Smart Grid portal  
at [www.smartgridprivacy.org](http://www.smartgridprivacy.org)

Thanks to FPF Smart Grid Privacy Fellow Matthew  
Gruenberg for collaborating on this presentation.