Efficiency Nova Scotia: Bright Business 2015

Demystifying “Smart Grids”

Benjamin Grunfeld
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Four major trends impacting the electricity sector globally:

- Climate Change and Carbon Regulation
- Customer Choice
- Distributed Energy Resources
- Digitalisation

$1.5 to $2.0 trillion in new infrastructure investments by 2030

Edison Electric Institute
The electricity sector is poised for transformation

**TODAY: ONE-WAY POWER SYSTEM**

- Large, centrally located generation facilities
- Designed for one-way energy flow
- Controlled by incumbents
- Technologically inflexible
- Simple market structures and transactions

**EMERGING: THE ENERGY CLOUD**

- Widespread adoption of distributed energy resources
- Supporting two-way energy flows; plug-and-play emphasis
- Digitalisation of the grid and advanced planning and monitoring
- Flexible, dynamic, and resilient
- Advanced business models and new products and services
- Complex market structures and transactions
Many in the sector are already adapting

**Utilities**
Downstream diversification in solar, wind, cogeneration, energy efficiency, demand response, operations and maintenance services, sustainability and big data (billing)

**Regulators**
Modifying power market structures to open up to a wave of new entrants to the energy market, many of which using non-traditional business models (e.g., New York State, United Kingdom)

**Customers**
Rise of prosumer, moving from managing energy efficiency to managing energy cloud—making complex decisions on energy resource purchases or contracts, increased interest in home energy management, desire of options

This transformation depends on a “modern” or “smart” grid
Demystifying “Smart Grids”

01

What is “smart grid”
What is it not
Definitions
Attributes

02

What are the implications?
Benefits to customers
Benefits to utilities
Timelines
Trends

03

Case studies
Ontario
US Jurisdictions
What is “smart grid”? What is it not

Smart grid is not...

Smart meters

Metering is just one possible application constituting the smart grid

A smart meter is a good example of an enabling technology that makes it possible to extract value from two-way communication and support distributed energy resources and customer participation

Distributed Energy Resources

A smart grid encompasses the technology that enables the integration and intelligent control of distributed energy resources

The success of smart grid depends in part on the effectiveness and uptake of these devices
What is “smart grid”?  
Definitions

Smart grid refers to a class of technology people are using to bring utility electricity delivery systems into the 21st century, using computer-based remote control and automation.
- US Department of Energy

A smart grid is an evolved grid system that manages electricity demand in a sustainable, reliable and economic manner, built on advanced infrastructure and tuned to facilitate the integration of all involved.
- ABB

A smart electric grid allows homes and businesses to use, as well as produce and sell, electricity in a more technologically advanced way.
- Environmental Defense Fund

Smart grid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.
- International Electrotechnical Commission
What is “smart grid”?
Attributes

Advanced
Intelligent
Sustainable
Reliable
Automated
Efficient
Secure
What is “smart grid”?  
Attributes

A smart grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to:

1. Facilitate the connection and operation of supply resources of all sizes and technologies
2. Enable consumers to play a part in optimising the operation of the system
3. Provide consumers with greater information and choice
4. Reduce the environmental impact of the whole electricity system significantly
5. Deliver enhanced levels of reliability and security
What is “smart grid”?

The smart grid is an enabler...

Source: Ontario’s Independent Electricity System Operator
Efficiency, flexibility, resiliency, quality, and reliability

**01** Enable more active and effective participation

**02** Accommodate all generation and storage options

**03** Enable new products, services, and markets

**04** Optimise asset utilisation and efficient operation

**05** Provide power quality for the digital economy

**06** Anticipate and responding to system disturbances

**07** Operate resiliently against attack and natural disaster

**08** Improve environmental footprint / reduced emissions

What are the implications?

Benefits to consumers
The utility benefits are not that different

01. Improve economics and provide cost mitigation
02. Improve public and worker safety
03. Enable new products, services, and markets
04. Optimise asset utilisation and efficient operation
05. Provide power quality for the digital economy
06. Anticipate and responding to system disturbances
07. Operate resiliently against attack and natural disaster
08. Improve environmental footprint / reduced emissions
“not much is new, and yet everything has changed”
- Industry executive interviewed by Navigant Research in 2014

Technological breakthroughs and innovations emerge almost daily and yet, the pace of change is relatively slow

The industry is not dragging its feet; the harsh truth is that it is saddled with 100 years of embedded regulatory schemes, infrastructure designs, and culture that does not change overnight

<table>
<thead>
<tr>
<th>Today</th>
<th>10+ Years</th>
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<tbody>
<tr>
<td><strong>The smarter grid</strong></td>
<td><strong>The smart grid</strong></td>
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<tr>
<td>Valuable technologies that can be deployed within the very near future or are already deployed today</td>
<td>The longer-term promise of a grid remarkable in its intelligence and impressive in its scope</td>
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Source: US Department of Energy
What are the implications?
Recent trends

The smarter grid

1. Prosumers Prod the Traditional Model
2. Smart Metering 2.0: Maximising the Bang for the Advanced Metering Infrastructure Buck
3. Smart Edge: More Utility Solutions Leverage Distributed Intelligence and Automation
4. “Your Power Is Out; We Are Working on It.”: Utilities Get Jiggy with Social Media and Mobile Communications for Customer Engagement
5. Smart Grid as a Service: Moving from Hype Cycle to Real World Product
6. The Push and Pull of DR
7. Just the FACTS, Ma’am: Flexible Alternating Current Transmission System Deployments Rise in Step with Power Plant Decommissioning
8. High-Voltage Transmission Getting in Synch
9. A More Worldly Smart Grid Industry: Europe and Asia Pacific Especially Poised for Growth
10. Holistic Health for Utilities: Regulators Tweaking the Utility Recipe

Source: Navigant Research. “Smart Grid: 10 Trends to Watch in 2015 and Beyond”. 2015
Ontario is at the forefront of smart grid investments in Canada

Substantial investments to date, which when combined with the additional deployment of smart grid technologies over the next 20 years, are expected to transform the grid and deliver substantial benefits to the province, utilities, and customers.

**Smart Grid Investment Deployment through 2035**

Source: Navigant. "Smart Grid Assessment and Roadmap". 2015
Smart grid investment in Ontario estimated to provide a net benefit of $6.3 billion

**Net present value of smart grid investments (2014 $B)**

Smart grid investments, if continue to be made through 2035, have the potential to deliver a net benefit of $6.3 billion.

**Uncertainty analysis for net present value (2014 $B)**

The uncertainty surrounding the benefits and cost of smart grid investments does not undermine the positive business case.

**Distribution of costs and benefits across industry segments (2014 $B)**

The distribution segment incurs the majority of the costs, whereas benefits accrue across the various segments of the industry.

**Annual benefits and costs of smart grid investments (nominal $B)**

Source: Navigant. “Smart Grid Assessment and Roadmap”. 2015
Three US jurisdictions to watch

New York REV Proceeding

» **Industry Structure Elements**: Regulatory changes to promote efficient use of energy, deeper penetration of renewables and increased distributed energy resource deployment

» **Key Questions**: What are the roles and responsibilities of the regulated utilities and retail markets? What changes are necessary to align utility interests with these objectives?

California Initiatives (AB327 – DRP filing, AB2514, DR, Rule 21)

» **Industry Structure Elements**: Enable retail entities to receive appropriate locational value for distributed energy resources through integration into local system planning, established procurement targets for storage, movement of demand response into wholesale markets

» **Key Questions**: How will system planning evolve to optimise distributed energy resources? How will locational based benefits and costs be quantified? Will energy storage add value to system operations? How fast can new devices enter the marketplace?

Massachusetts Grid Modernisation

» **Industry Structure Elements**: Enable grid design that “maximises integration of renewable power, much of which is intermittent.”

» **Key Questions**: How will the utility incentive structure and utility cost recovery mechanism change to enable achievement of this policy?
There are a number of trends impacting the electricity sector globally, and driving a transition from centralised to distributed, of which, smart grid is an important component.

Smart grid means a lot of different things to different people, but it is more than smart meters and solar panels.

Smart grid is an enabler.

The transformation to a smart grid will come in stages and it will take time.

Over the longer term, it has the potential to provide significant value to customers and utilities.
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- Regulatory Compliance
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- Policy Development and Code & Standards

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- Customer Analytics

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