NAVIGANT

ENERGY

Efficiency Nova Scotia: Bright Business 2015

Demystifying “Smart Grids”

Benjamin Grunfeld

October 20, 2015

Four major trends impacting the electricity sector globally

Climate Change and Carbon Regulation

Customer Choice

Distributed Energy Resources

Digitalisation

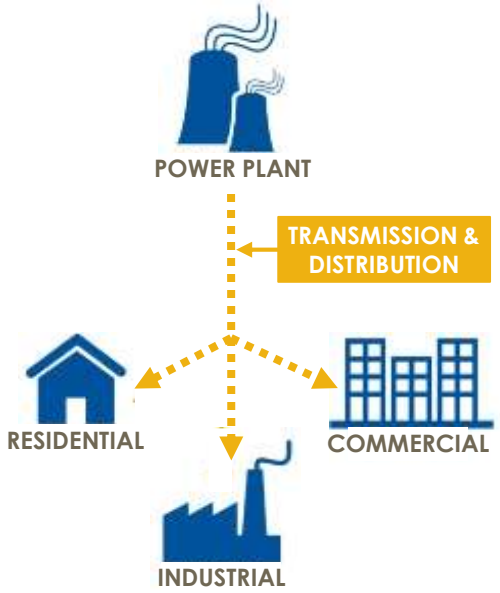
$1.5 to $2.0 trillion in new infrastructure investments by 2030

Edison Electric Institute

NAVIGANT

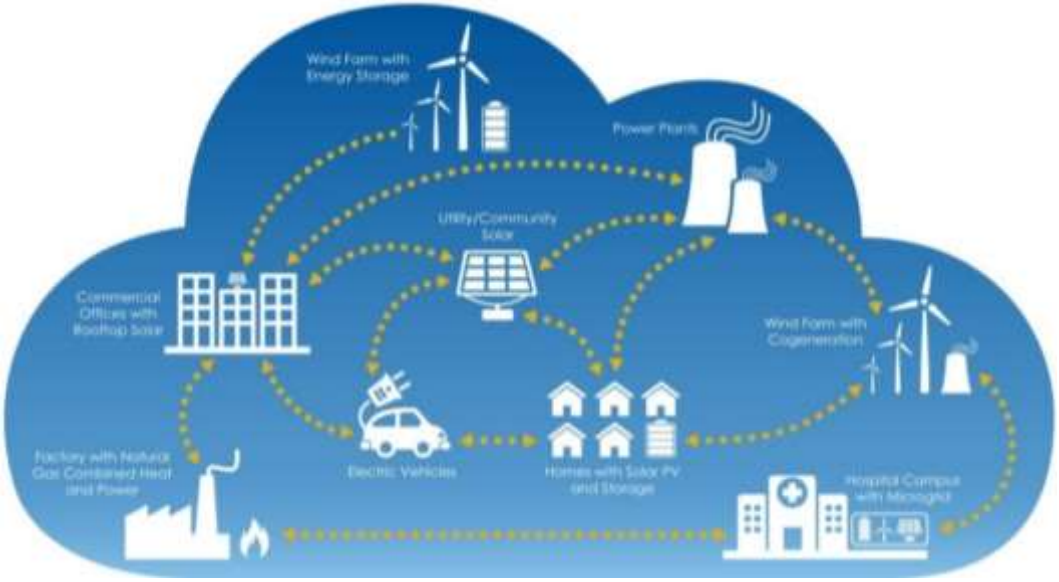
The electricity sector is poised for transformation

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

NAVIGANT

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 it not

Smart grid is not…

Source: ITron

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

Source: Vestas

Source: Car2Go

Source: Canadian Solar

Source: SAFT

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

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 electric grid allows homes and businesses to use, as well as produce and sell, electricity in a more technologically advanced way.

- Environmental Defense Fund

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

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

Attributes

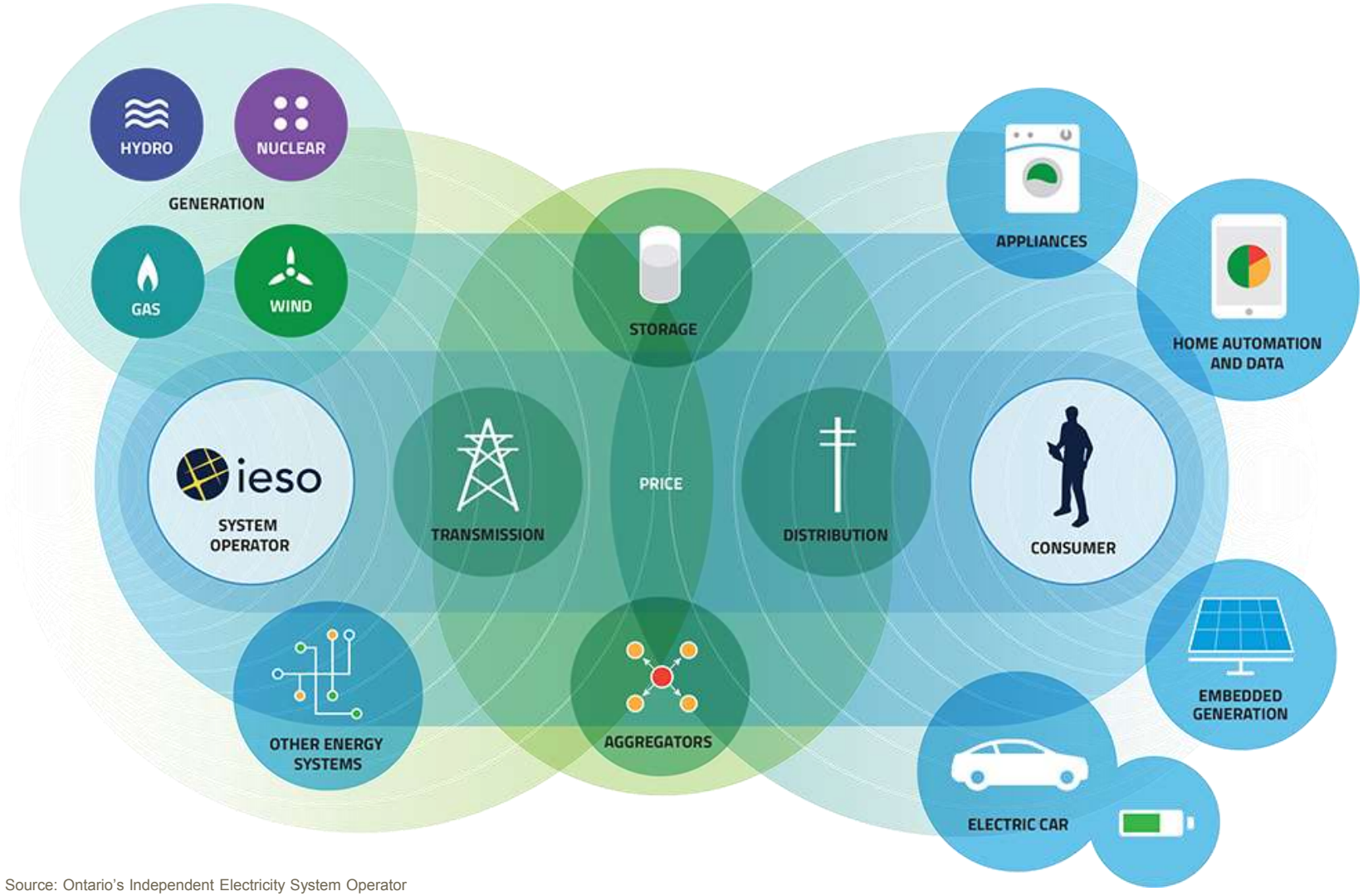

Advanced
Intelligent
Sustainable
Reliable
Efficient
Automated
Secure

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

The smart grid is an enabler…



Source: Ontario’s Independent Electricity System Operator

NAVIGANT

Benefits to consumers

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

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*

Timeline

"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

Today → **10+ Years**

The smarter grid

Valuable technologies that can be deployed within the very near future or are already deployed today

The smart grid

The longer-term promise of a grid remarkable in its intelligence and impressive in its scope

Source: US Department of Energy

Recent trends

The smarter grid

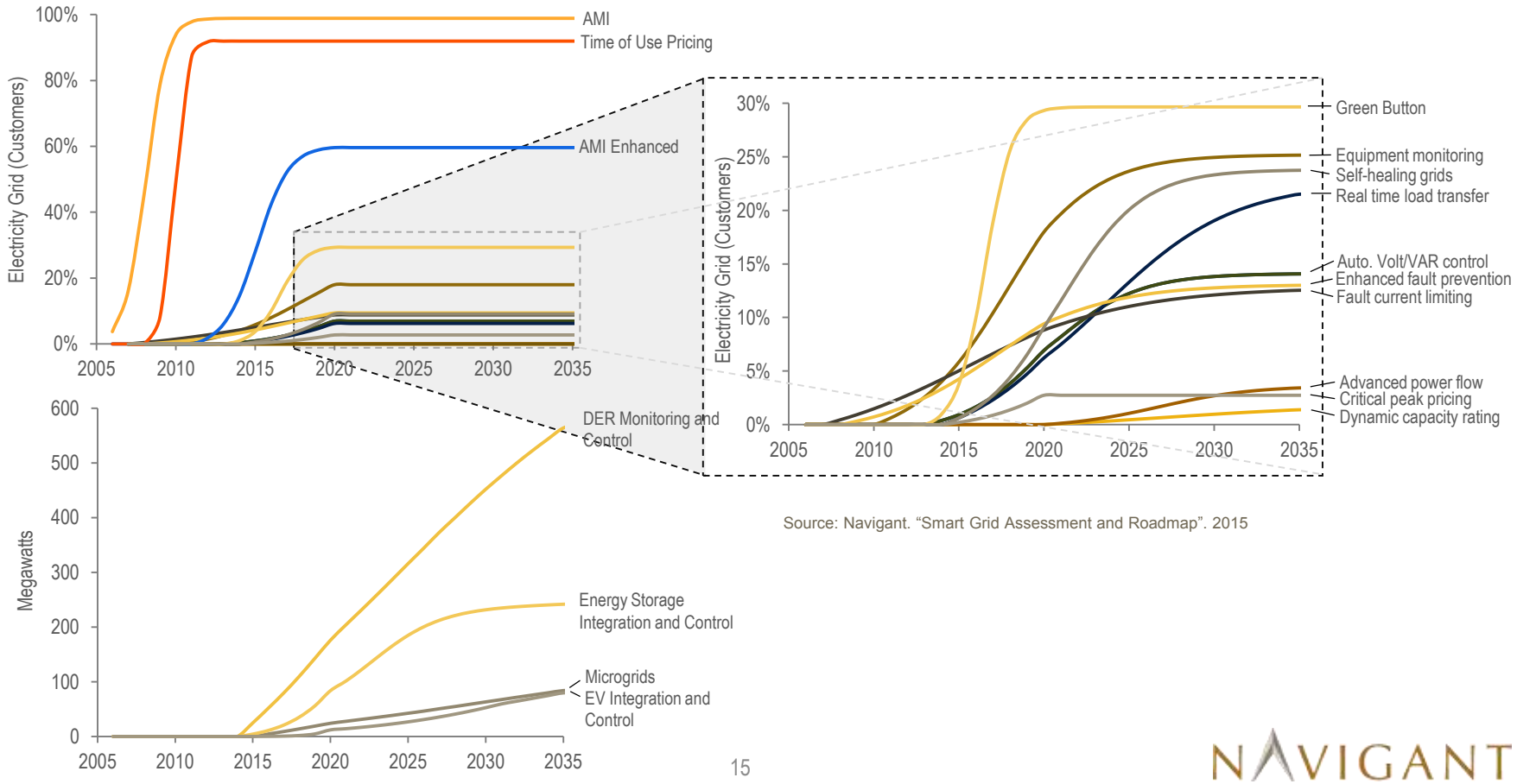
1. Prosumers Prod the Traditional Model
2. Smart Metering 2.0: Maximising the Bang for the Advanced Metering Infrastructure Buck
3. Smart Edge: More Utility Solutions Leverage Distributed Intelligence and Automation
4. “Your Power Is Out; We Are Working on It.”: Utilities Get Jiggy with Social Media 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

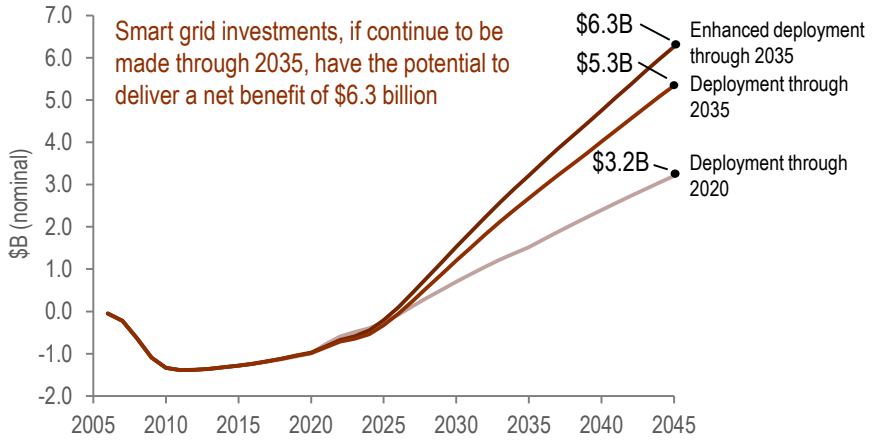


Source: Navigant. "Smart Grid Assessment and Roadmap". 2015

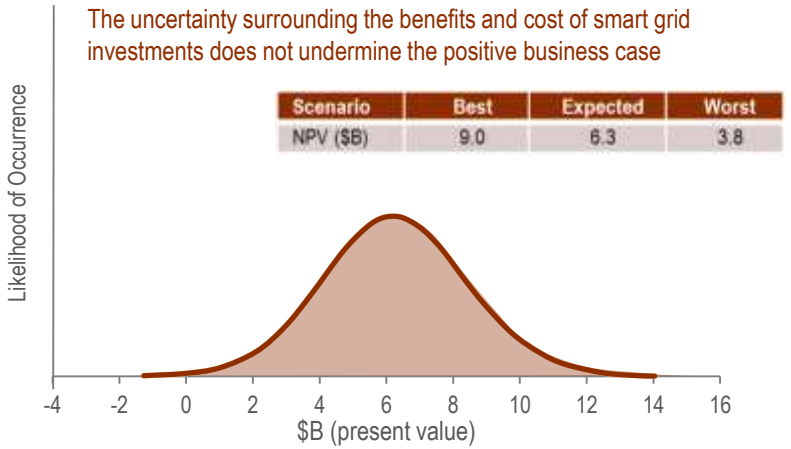
NAVIGANT

Smart grid investment in Ontario estimated to provide a net benefit of $6.3 billion

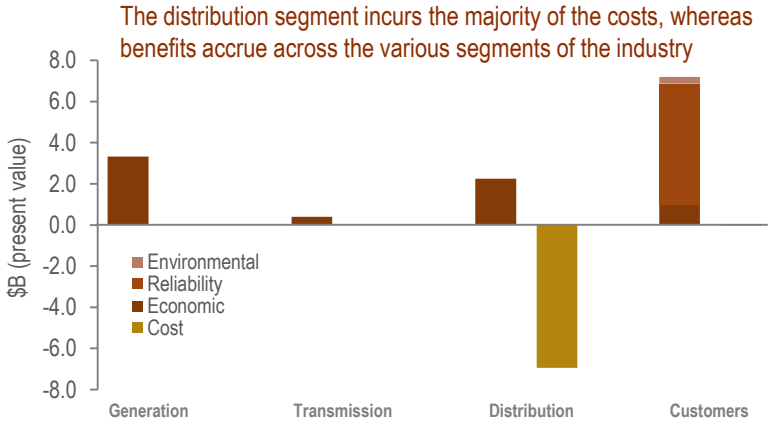
Net present value of smart grid investments (2014 $B)



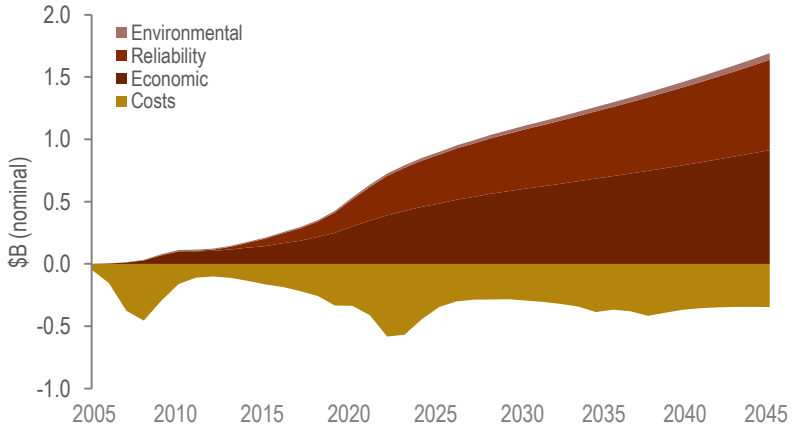
Uncertainty analysis for net present value (2014 $B)



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



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



Source: Navigant. "Smart Grid Assessment and Roadmap". 2015

NAVIGANT

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?

Summary Observations

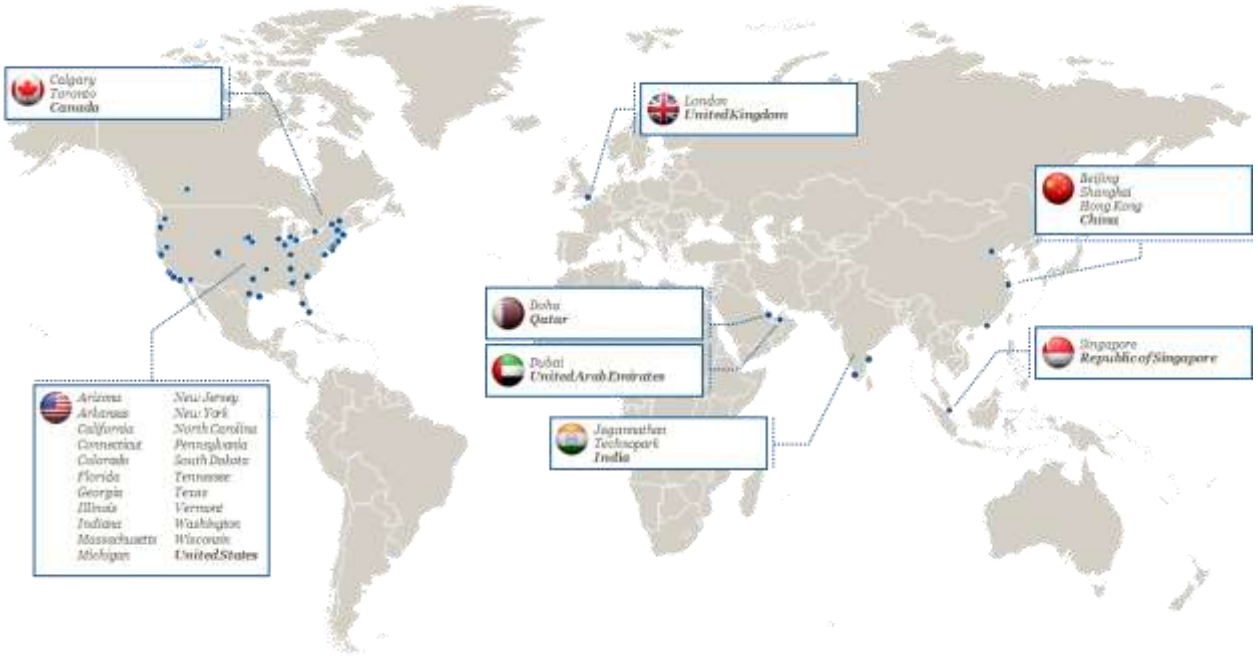
- There are a number of trends impacting the electricity sector globally, and driving a transition from centralised to distributed, of which, smart grid is an important component
- Smart grid means a lot of different things to different people, but it is more than smart meters and solar panels
- Smart 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

Key Contacts

Benjamin Grunfeld

Director, Energy
+1.416.777.2444
benjamin.grunfeld@navigant.com

Navigant Geographic Footprint



NAVIGANT

Navigant Advantage

WHY CLIENTS CHOOSE NAVIGANT…

- We focus on shareholder value and develop and implement sustainable solutions
- We collaborate with clients to craft solutions that meet their specific needs
- We deliver objective, independent, and data-driven analysis

WHAT DIFFERENTIATES US…

- Experienced industry leaders with a strong reputation for delivering on highly strategic, innovative, and complex initiatives
- Domain expertise with unmatched depth and breadth on relevant industry topics that our clients are faced with today
- Use of data analytics and technology to find answers efficiently, often leaving behind tools for our clients to manage going forward

Our Team

EXPERIENCED TEAM

- More than 400 consultants with an average of 15 years' experience
- A complete team of strategy, technology, regulatory, and domain experts, as well as project managers and research analysts
- Economics and engineering backgrounds combine to provide analytical horsepower unmatched in the industry

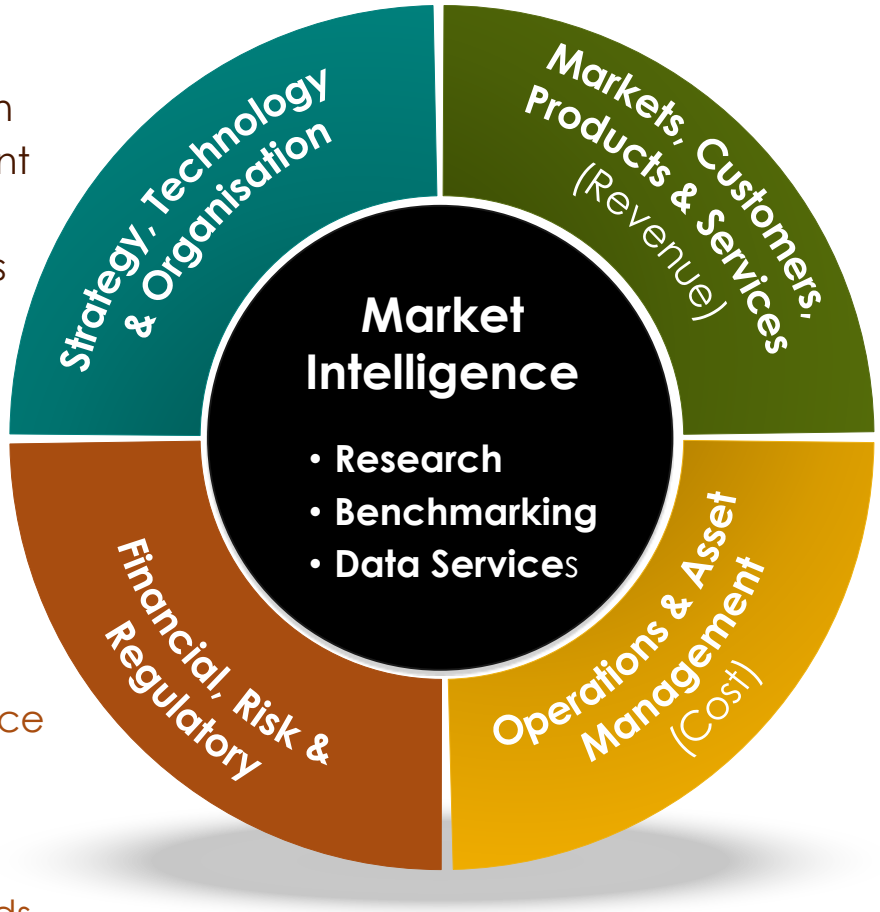
THOUGHT LEADERS

- Recognised for market insights and business strategy knowledge
- Active on industry boards and leadership committees, regular conference presenters, and frequently cited as industry experts

Our Solution Offerings and Capabilities

- Business Strategy and Implementation
- Innovation and R&D Management
- Organisational Design
- Change Management
- Technology Advisory
- Merger & Acquisitions
- Integrated Resource Planning

- Market Strategy and Pricing
- Customer Engagement
- Emerging Technologies (renewables, distributed generation, storage, micro grids and others)
- Energy Efficiency
- Demand Response
- Customer Analytics



- Business Case Development
- Risk Management
- Physical and Cybersecurity
- Regulatory Compliance
- Federal and State Regulatory Support
- Policy Development and Code & Standards

- Operational Excellence
- Asset Management
- Grid Operations
- Distributed Resource Management
- Restoration and Outage Management
- Manufacturing Impact Analysis
- Equipment / Appliance Testing