

R&D needs and opportunities in the Smart Grid

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Agenda

- What is a Smart Grid?
- Smart Grid: BC Hydro's Framework
- Opportunities and Needs for Innovation

What is a Smart Grid?

In Summary:

- Smart Grid is the accumulation of intelligent devices on the power delivery system.
 - *In reality, “Smart Grid” is just a term.*
 - *In reality, there is no beginning nor end to the advancement of a smarter grid.*
- The importance of smart grid at this point in time is the speed of technological advancement combined with the significant opportunity for business transformation.

What is a Smart Grid?

20th Century Grid

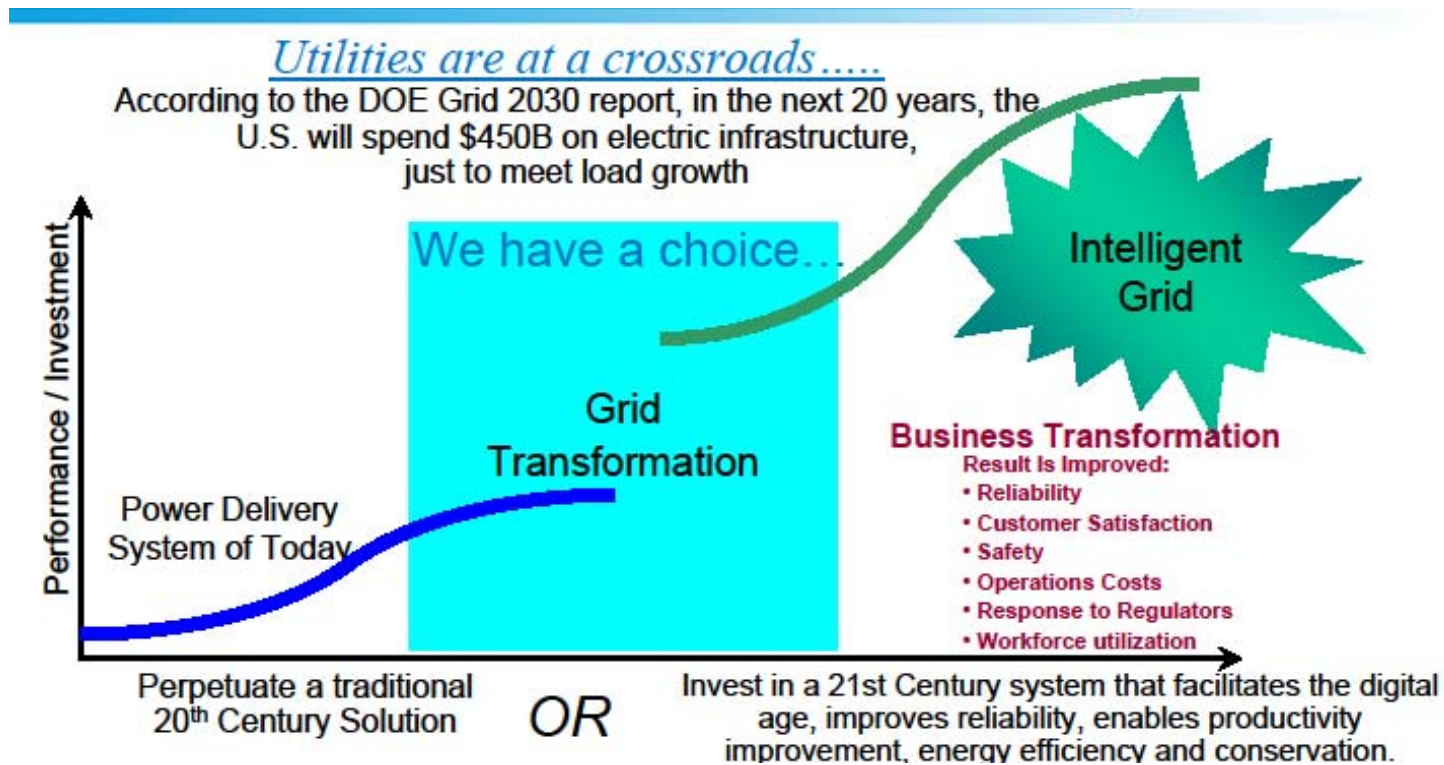
- Electromechanical/Analog
- One-way communications (if any)
- Built for centralized generation
- Radial topology
- Few sensors
- “Blind”
- Manual restoration
- Prone to failures and blackouts
- Check equipment manually
- Emergency decisions by committee and phone
- Limited control over power flows
- Limited price information
- Few consumer choices

21st Century Grid

- Digital
- Two-way communications
- Accommodates distributed generations
- Network topology
- Monitors and sensors throughout
- Self-monitoring
- Semi-automated restoration and, eventually, self-healing
- Adaptive protection and islanding
- Check equipment remotely
- Decision support systems, predictive reliability
- Pervasive control systems
- Full price information
- Many consumer choices

Source: Global Environment Fund, Center for Smart Energy, “The Emerging Smart Grid: Investment and Entrepreneurial Potential in the Electric Power Grid of the Future (October 2005); and PJM Interconnection 2007

What is a Smart Grid?



Smart Grid Drivers

Internal

Declining reliability
Safety (public and worker)
Green energy requirements
Refresh aging infrastructure
Ageing assets
Customer Satisfaction



BChydro 
FOR GENERATIONS

External

Increased customer expectations

- More interactive energy use
- High degree of reliability
- Higher quality power needs
- Potential use of electric vehicles

Demographics

Better technology now available

Regulatory mandates

- Smart meters
- Carbon-neutral operations
- Carbon-free generation
- Increase in distributed generation

What is a Smart Grid? - The opportunity

Over 60% of our GDP now comes from industries and services that run on electricity; in 1950, the figure was only 20%. Since 1980, over 85% of energy growth has been supplied by electricity.

Manhattan Institute: The Million-Volt Answer to Oil

Power outages and interruptions cost Americans at least \$150 billion each year – about \$500 for every man, woman and child.

DOE, The Smart Grid: an Introduction

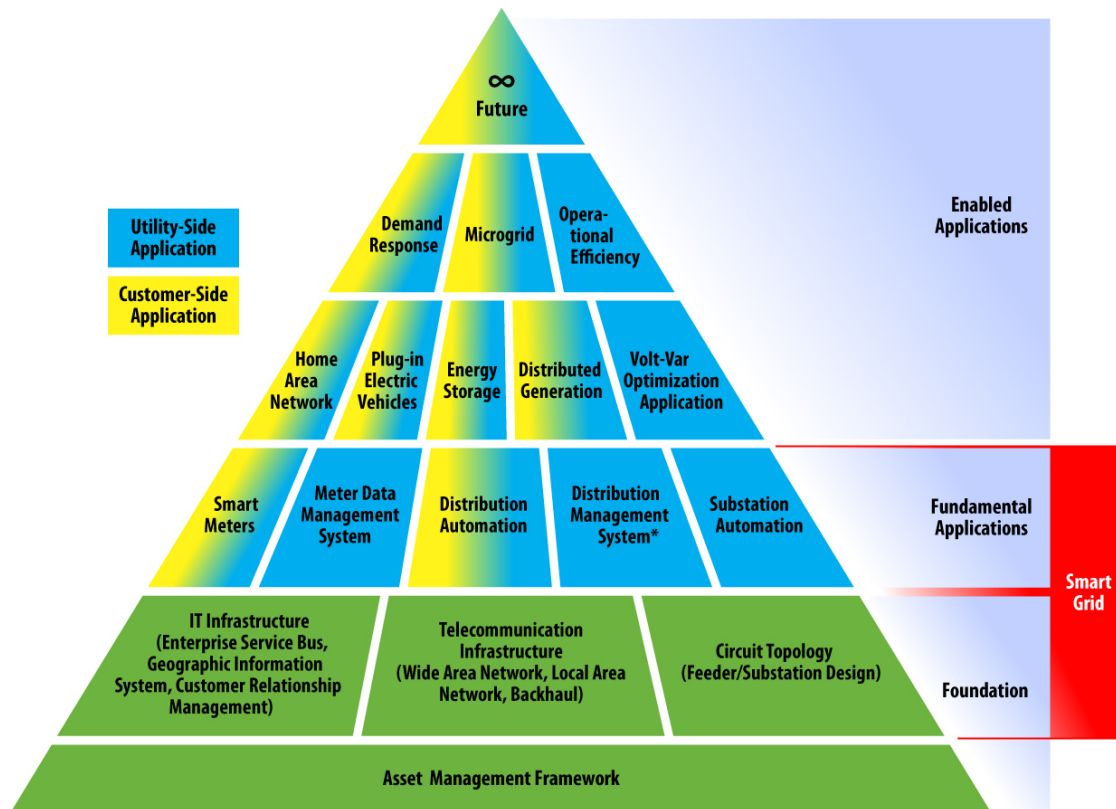
A substantially more efficient and reliable grid will provide \$1.8 trillion in annual additive revenue by 2020.

EPRI, Electricity Sector Framework for the Future

The deployment of Smart Grid technologies will add an estimated 280,000 direct jobs in the US.

GridWise Alliance, Smart Grid Jobs Report

BC Hydro's Smart Grid Framework



*includes Energy Management System

How BC Hydro Drives Innovation

- Awareness and promotion
- Structured decision making
- Life cycle assessment
- Joint solution design
- R&D
- Pilots
- Test labs
- Collaboration with academia
- Industry participation



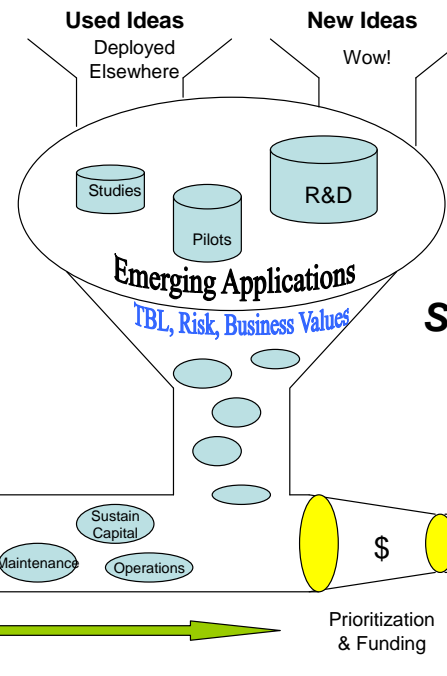
Achieving Innovation

- Recognize the drivers for change
- Search out the opportunities
- Assess new technologies and methods
- Embed solutions

Create

Innovate

**Develop
Business
Solutions**



**Smart Grid
Will Become Our
System of the Future**

Risks

Organizational

- New processes don't work
- Sponsorship disappears
- Can't attract or train resources fast enough
- Lack of support for change
- Other businesses not onboard

Technology

- Standards don't solidify
- Problems with first releases
- Becomes obsolete sooner
- No best practices for integration

Customer

- Needs are not understood
- Impact is not identified early
- Participation not great enough to realize benefits
- Inadvertently create barriers through poor ease of use
- Misconceptions arise over privacy concerns

Other

- Economy doesn't recover
- Rate cases rejected
- Lack of detail or poor implementation of regulations

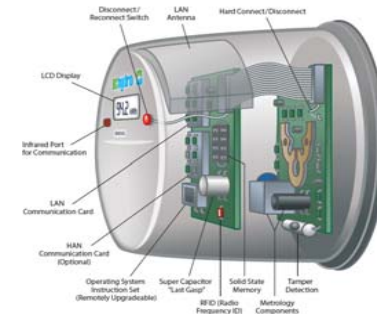


Smart Grid Projects Underway

Olympic Venues
Smart Metering Program
Distribution Management System (DMS)
Downtown Vancouver Supply
Volt Var Optimization (VVO)



Smart Neighborhoods
Microgrids
Distributed Generation
Theft Detection
Electric Vehicles
Energy Storage



Looking Forward

“We must increase our use of innovative solutions to advance our Asset Management Practices and Processes”

The Clean Energy Act provides us a mandate: “The authority must establish a program to install and put into operation a smart grid...”

Next Steps:

- Drive Innovation into programs to reduce risk; e.g. R&D, pilots
- Develop Roadmap to ensure alignment