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Can a Smarter Grid Slow Down Climate Change While Accelerating Energy Independence?

Symposium ID 4120, Organized by Dr. Hassan Farhangi, PI NSMG-Net

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Agenda

Speaker #1:	Dr. John Macdonald – Day4 Energy (Founder and Chairman)
Title:	Future of energy systems and unsustainability of status quo
Speaker # 2:	Mr. Kip Morison – BC Hydro (Chief Technical Officer)
Title:	Utility perspectives on issues confronting the energy industry
Speaker # 3:	Dr. Hassan Farhangi – BC Institute of Technology (Director)
Title:	Smart Grid and its role in achieving energy independence
Speaker # 4:	Dr. Reza Iravani – University of Toronto (Professor)
Title:	Managing demand through a smarter distribution system
Speaker # 5:	Dr. Geza Joos – McGill University (Professor)
Title:	Expanding production capacity thru renewable sources of energy
Speaker # 6:	Dr. David G Michelson – University of British Columbia (Professor)
Title:	Role of ICT in transforming the existing grid into smart grid
Discussant:	Dr. Chris Marnay - Lawrence Berkley National Lab (Staff Scientist)

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Utility perspectives on issues confronting the energy industry

Kip Morison
Chief Technology Officer
BC Hydro

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Outline

- The electric utility situation
- The role of a smarter grid
- Developing smart grid strategy to achieve strategic objectives
- Some key smart grid technologies
- Summary

Situation

Electrical Utilities are in a transformational period

- the lack of investment in the last few decades has meant that generation, transmission, and distribution assets are aging and, due to challenging approval processes and growing rate pressures, the building of new facilities is difficult; there is a urgent need to get better utilization and efficiencies out of the existing assets
- our workforce is aging
- there are an increasing number of smaller, more distributed, and often intermittent, generation sources on the grid that may lead to operational challenges including two-way power flows in the system
- the number of customers continues to grow and the customer connected devices may now include a wide array of equipment including generation, storage, or emerging technologies such as electric vehicles.
- in some jurisdictions there are increased pressures from policy and legislation to reduce greenhouse gas emissions, attain energy independence, control rates, and provide economic development benefits

Situation

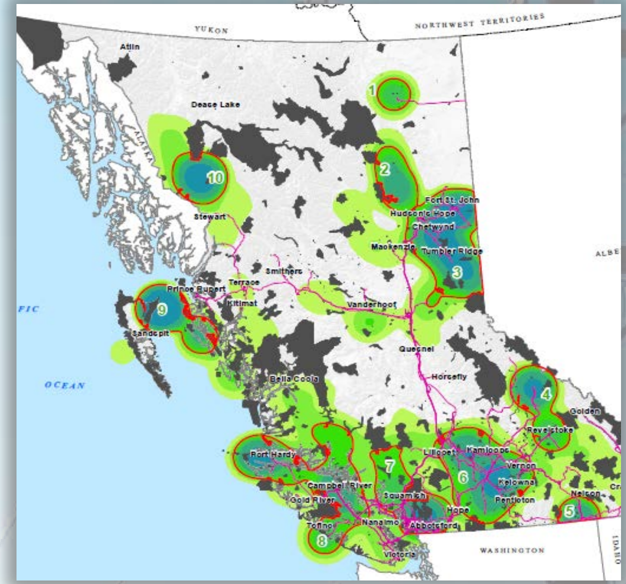
BC Energy Policy: The Clean Energy Act

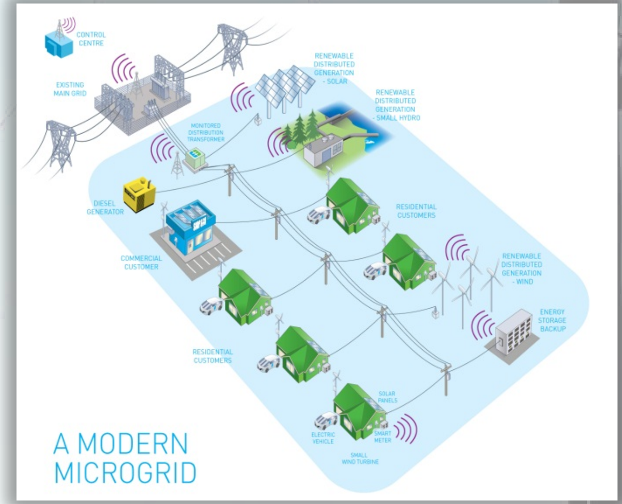
- ★ Increase renewables target from 90% to 93% of total generation
- ★ Reduce GHGs to 33% below 2007 level by 2020
- ★ Accelerate deployment of EV and NG vehicles
- Meet 66% of new resource requirements from energy efficiency
- Achieve electricity self-sufficiency by 2016
- Install smart meters to all customers by end of 2012
- Prohibit future developments of large hydro (excluding Site C)
- Complete objectives without consideration of nuclear power
- Ensure rates that are among the most competitive in North America

Situation

Clean Energy Resource Challenges

- Mix of resources with variety of technical and economic challenges: wind, hydro, biomass, geothermal, marine, etc
- Larger scale renewable resources are often remote from load → requires significant T&D
- Distributed renewables are typically small and numerous → requires management
- Renewables are often intermittent → requires shaping (storage)
- Other environmental impacts
- Cost





Moving to a Smarter Grid

- Despite the “transformational” impacts, the power system must continue to serve the load and operate safely, with a high degree of reliability, and respecting pressures to keep rates low.

- To meet this challenge, advanced technologies are being applied throughout the electric utility business…developing the “**Smart Grid**”

> *…..a power system which achieves reliability, safety, and efficiency through the use of widespread monitoring, communications, automation, and intelligent control.*

- Investments in smart grid technologies are now occurring in almost every part of our business including smart meters for customers, wide-area communication networks, advanced generation/transmission/distribution monitoring and control systems, and intelligent data management tools.

Role of a Smarter Grid

Improving energy security and reducing GHG emissions

Examples

Managing aging assets

- Real-time asset condition assessment and life extension
- Asset utilization optimization
    - o dynamic rating of asset,
    - o on-line dynamic security assessment

Integration of distributed renewable energy

- Advanced energy management systems
- Storage and control systems
- Microgrid technologies

Conservation and efficiency

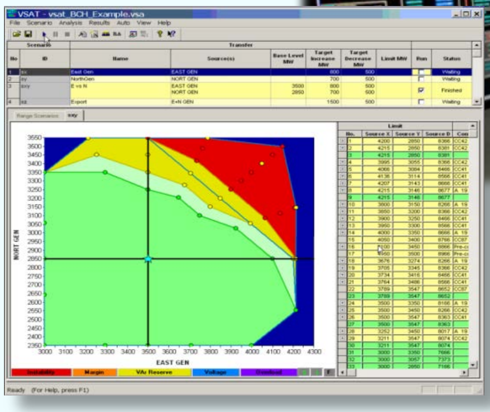
- Demand-side management
- Demand response (load control)
- Volt-VAr optimization

Reliability and safety

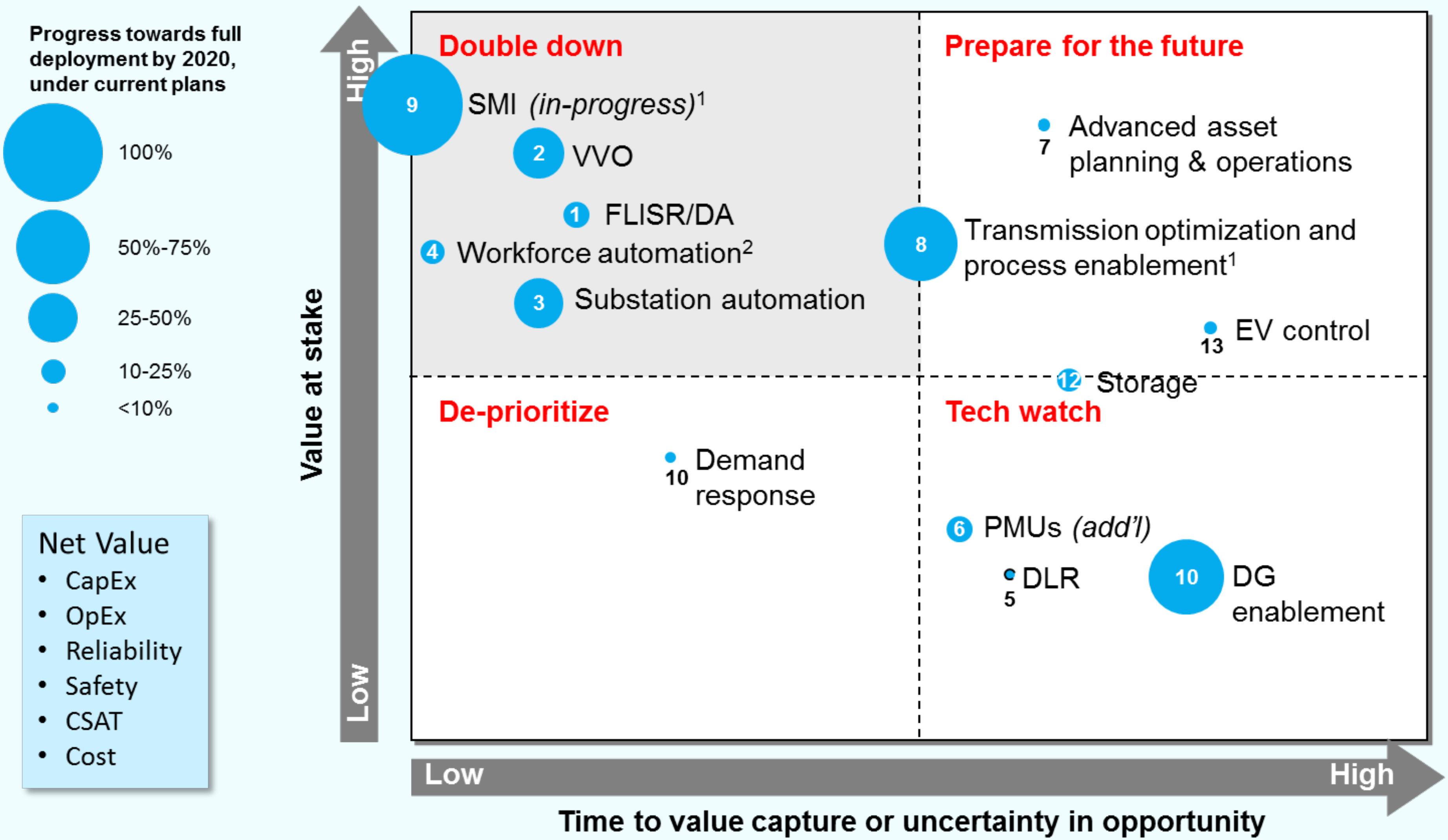
- Distribution automation (such as FLISR)
- Smart Meters

Electric vehicles (fuel switching)

- Charging control



BC Hydro strategy focuses on smart grid solutions that have significant, well-defined value and are ready to deploy



Smart Metering & Infrastructure (SMI)

…key first step in modernizing our electricity system and ensuring the safe, reliable delivery of electricity to homes and businesses throughout the province.

SMI PROGRAM SCOPE and BENEFITS

IMPROVED OPERATIONAL EFFICIENCY

- Optimize voltage regulation to reduce electricity waste and improve power quality
- Enable long-term distribution system planning
- Automate meter reading

GREATER CUSTOMER CHOICE & CONTROL

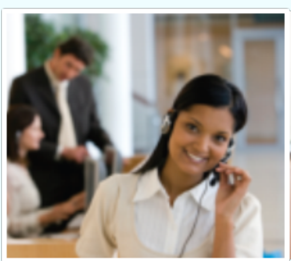
- Enable timely access to usage information
  - Web & mobile applications
  - Energy management devices
- Introduce new conservation programs
- Enable customer generation

IMPROVE WORKER & PUBLIC SAFETY

- Pinpoint outages and restore power faster
- Discourage illegal tampering with electricity wires which cause fires and live wire dangers

ENHANCE CUSTOMER SERVICE

- Better informed customer service
- Eliminate estimated billing
- Streamline moving procedures
- Faster outage restoration




REDUCE ELECTRICITY THEFT

- Locate and reduce power diversions that cost ratepayers over $100 Million per year


MODERNIZE BC'S ELECTRICITY SYSTEM

- Accommodate clean energy transportation
- Support micro-grids & distributed generation
- Enable an intelligent, self-healing grid that can accommodate two-way flow of electricity



► Micro-Grids

Localized grouping of electricity sources and loads that normally operates connected to and synchronous with the traditional centralized grid but can disconnect and function autonomously as physical and/or economic conditions dictate. Can be home, community, campus, town, etc.

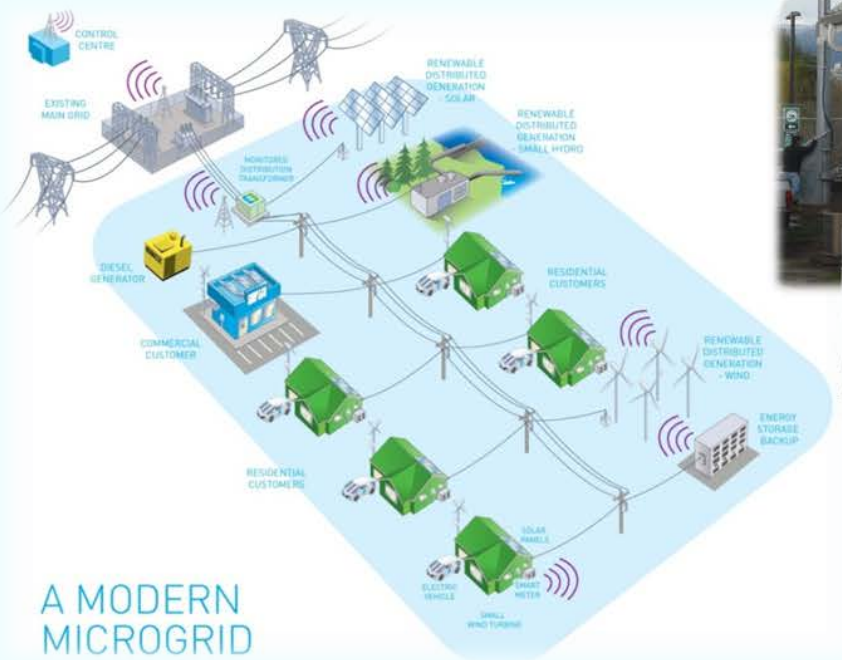
- Can defer bulk transmission and generation additions
- Can improve local reliability
- Two-way power flow
- Can be green

Vbine and EV Charger at BCIT smart house

BCIT Microgrid Project

- Renewable/efficient generation
- Smart Meters
- Loads (including electric vehicles)
- Building envelops and systems
- Storage (battery, flywheel)
- Networks (WAN / HAN)
- Software analytics
- EMS - Automation and Control

NSERC Smart Micro Grid Network



► Storage

- acquiring knowledge of storage integration for future BC Hydro initiatives including the support of intermittent generation from renewable sources
- supporting load capacity-constrained substations in other locations
- piloting the intelligent management of distributed energy resources
- providing an alternative backup energy source to diesel
- providing savings from deferring transformer upgrade costs – reliability improvements


Hydrogen Storage

Flywheel

Projects

- Demonstrate 2 x 1MW NaS Batteries from NGK at Golden and Field
- Hydrogen Assisted Renewable Power
- 25kW Flywheel at BCIT


Battery

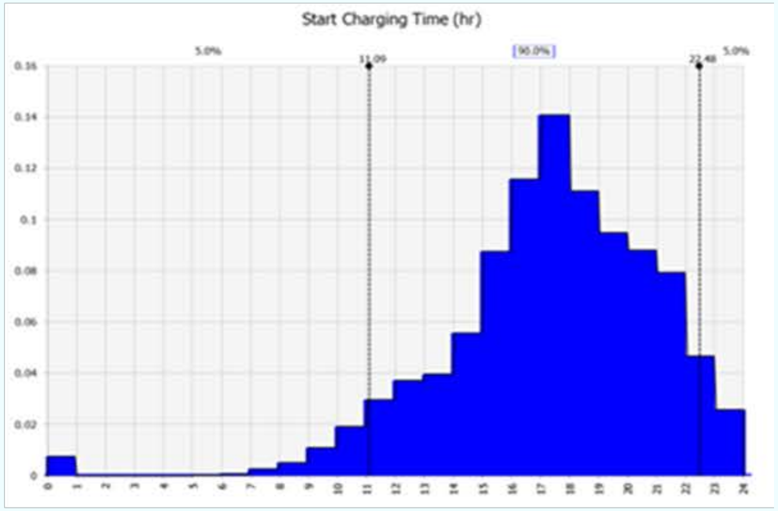
▶ Dynamic Line Rating (DLR)

- Maximum capacity of conductors is a function of many factors – ultimately limited by sag
- If maximum capacity can be known accurately it may be possible to raise loading
- Vision – wide-scale deployment
- Extends to virtually all assets (generators, transformers, switchgear, structures, etc)
- Components
  - Sensors
  - Communications – device x ground x control centre
  - Software; analysis, visualization, and archive
- Challenges
  - Device Reliability
  - Communications
  - Deployment

Installation of DLR Equipment

► Electric Vehicles Charging Control

- Electric vehicles are here
- If numbers become significant – charging pattern is critical to impact on transmission and distribution infrastructure.
- In BC, transportation sector accounts for ~ 38% of GHG production – CEA calls for electrification
- Challenges
  - Metering solutions
  - Smart charging
  - Policy
  - Modeling and planning (mobility)



Activities

- T&D Impact study
- Dunsmuir Office Tower EV Charging Pilot
- Easy Park EV Charging Demonstration—In Conjunction with the City of Vancouver
- Pilot Project with City of Terrace to test a plug-in Prius EV
- Level 2 Charger for Electric Vehicles at BCIT Microgrid

Summary

- The electric utility business in in a transformational period
- The goals of ensuring energy security and addressing climate change must be managed considering a myriad of challenges and constraints
- Modernization of power systems using smart grid technologies can play a valuable role in energy security and GHG reduction
- A number of available smart grid technologies can bring high-net-value to utility operations
- The transition to a smarter grid will be incremental and continual - building on advancements in communication, automation, and control technologies.
- Some emerging technologies, such as storage, advanced distribution automation, and asset condition assessment will play a key role in future system operation.