Engaging Customers in Smart Grid Technology

www.powershiftatlantic.com

Michel Losier, Program Director, New Brunswick Power
Praveen Rosario, Systems Integration Lead
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PowerShift Atlantic
Wind Integration via Load Shifting
Canada’s current installed capacity: 8,119 MW

(as of May 2014)

Across Canada, electricity generated from wind is already powering over 1.5 million homes and businesses in a clean, reliable and efficient manner. With Canada’s unparalleled wind resource, there are still opportunities to do more to maximize the economic, industrial development, and environmental benefits associated with wind energy for Canada.

- The wind energy industry installed 936 MW in 2012 with new projects commissioned in British Columbia, Alberta, Ontario, Manitoba, the Northwest Territories, Quebec and Nova Scotia.
- Canada will see an average of 1,500 MW of new projects commissioned annually over the next four years.
- Creating 68,000 additional person-years of employment and attracting $15 billion in new investment.

www.canwea.ca
Determine if shifting patterns in energy consumption through load shifting can enable utilities to more effectively integrate renewable energy such as wind

• Is load shifting cost effective and reliable?
• How load shifting performs in sync with system balancing & forecasted wind power
• Understand the customer’s role with new smart grid technology
PSA Participants

- Canada
- Énergie NB Power
- New Brunswick Energy
- UNB

PM and Integration

- Stantec
- Accreon
- Leidos

Aggregators

- Steffes Corporation
- Integral Analytics
- UNB
- Enbala Power Networks

End-Use Connectivity

- Sequentric
- Dimplex
- Tantalus
- Bell Aliant
- Steffes Corporation
- Enbala Power Networks
Reduce and Shift Demand

Connected to Atlantic Canada, Quebec and New England

Wind Generation

- NB – 294 MW
- NS – 335 MW
- PEI – 173 MW
- Total – 822 MW

Total generation in Canada – 8119 MW

NB Power and Atlantic Canada

(Peak - 200MW)

Wind Generation

- NB – 294 MW
- NS – 335 MW
- PEI – 173 MW
- Total – 822 MW

Canada – 8119 MW
Typical Household Energy Usage – New Brunswick

- Space Heating & Cooling: 61%
- Water Heating: 22%
- Appliances: 13%
- Lighting: 4%

Énergie NB Power
Virtual Power Plant – Intelligent Load Management
Currently, generation controlled and managed to meet customer demand

Power Generated = Power Consumed (Customer Demand)

Integration of Wind Energy to Supply

Conventional Generation + Wind Generation = Customer Demand

**Initial Concept:**

- Perform a “Wind Following” service using load shifting

**Research Outcomes:**

- This could cause additional system demand peaks, stressing the electrical grid further
Implemented VPP Design Concept

Conventional Generation = Customer Load Demand - Wind Generation

**Actual Requirement:**
- Optimize to net system forecasted load minus net wind generation forecast

*VPP will reduce strain on conventional generation and the grid as wind generation is integrated*

- Controllable
- Partially Controllable using Load shifting
- Weather dependent
The Proposed Solution

• Shift consumer load demand to reduce effects of the variability of wind generation (intelligent load management)

• Provide a new tool to allow the SO to more easily and efficiently balance the power grid
“SHIFTING” = INTELLIGENT LOAD MANAGEMENT

SHIFTING EVEN OUT ENERGY USE WHICH MAKES USING RENEWABLES EASIER
EQUAL ENERGY USE
We are forming a partnership between customers and utilities to collaborate and align demand and supply enabling renewable energy sources onto the grid more cost effectively.

VIRTUAL POWER PLANT

Intelligent Load Management – engaged customers and new technology solutions
System Architecture

Virtual Power Plant

Executive Control Module
Dispatch Optimization & Control Subsystem
Data Management Subsystem
Logging & Alerts Subsystem

Graphical User Interface
(Partformance Monitoring, Load Control Plan, System Status, RTGD Control)

Head End
- DDI
- DSU
- Residential Aggregator
  - GDI
  - FLC
  - PSU

EMS
- DDI
- DSU
- Commercial Aggregator
  - GDI
  - FLC
  - PSU

LOAD
- GDI
- DSU
- Direct Load Control
  - GDI
  - FLC
  - PSU

System Operator Interface Module

System Operator
- RTGD
- ASU
- LCP
- FS

Interface Modules

Functional Modules

RTGD = Real-time Generation Dispatch
GDI = Gross Dispatch Instruction
DDI = Device Dispatch Instruction
DSU = Device Status Update
PSU = Performance Status Update
FLC = Forecast Load Capability
LCP = Load Control Plan
FS = Forecast Shape
ASU = Aggregate Status Update
VPP Functions

• Primary Function: Assist the system operator’s job of balancing the grid (Load Shape Management)
  – Reduce the effects of wind generation variability on the system

• Secondary Function: Provide the equivalent of a 10 minute spinning reserve ancillary service (RTGD)
Load Shape Management Effects (Simulated)

System Level Optimization Results

- Original Forecast Shape
- Optimal Shape

Power (MW) vs. Time (ADT)
Real Time Generation Dispatch (Example)

- RTGD Up Operation shown below (Load Shed)
- Same operation in opposite direction for an RTGD Down (Load Restore)

**RTGD Load Control Plan**

- RTGD LCP
- Original LCP

- Capacity dispatched within 10 mins (2:45am)
- RTGD Up: Consistent Load Shed
- Capacity sustained for 60 mins (till 3:45am)

RTGD Initiated @ 2:35am
## End-Uses Implemented

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End-Uses – Implemented Cont’d

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What did I just say?

• 1270 Customers across Maritimes 18MW (residential and commercial)
• Open architecture – common interface (inter-operability)
• Variety of end-use providers
• Variety of Aggregators
• All year round and seasonal loads
Electric Thermal Storage

In the home

Existing Baseboard

(60% of New Brunswick homes)

Electric Thermal Storage

(Potential solution for the future)
Electric Thermal Storage – In the Home
Hampton Middle School

Electric thermal storage in public buildings
Reduce and Shift Demand

NB Power’s Woodstock Office

Electric thermal storage in public buildings
Electric Thermal Storage
Storing Heat in Ceramic Bricks “off peak”
A new Partnership with new solutions
Energy Efficiency (Reduce) and Load Shifting (Shift)

Customer Issue:
Investment (Efficiency programs)

Customer Issue:
Behaviour

Customer Issue:
Trust

Reduce and Shift Demand
Co-branding and “Thank You” Program

Corporate Social Responsibility
PowerShift Atlantic Recognized

“Recipient of Three major awards”

Canadian Electricity Association - Sustainability Award for Economic Excellence for 2012

Canadian Wind Energy Association – RJ Templin Award for 2012

Peak Load Management Alliance (U.S. based - Denver, Colorado) 2014 award for “Innovation in Demand Response”
The Future
Bulk generation meets Distributed Energy Resources

Bulk Generation
Traditional Large Generation
Hydro, Nuclear, Fossil, Wind,

“meets”

Distributed Energy Resources
Engaged Customers with new technologies
EE, DR, DG, EV’s, HAN, WAN

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