Natural Resources Canada | Ressources naturelles Canada

Overview of the Federal Government's Demand Flexibility R&D Activities

Véronique Delisle

EBC Annex 67 Energy Flexible Buildings Public Seminar

Polytechnique Montréal

October 12, 2018

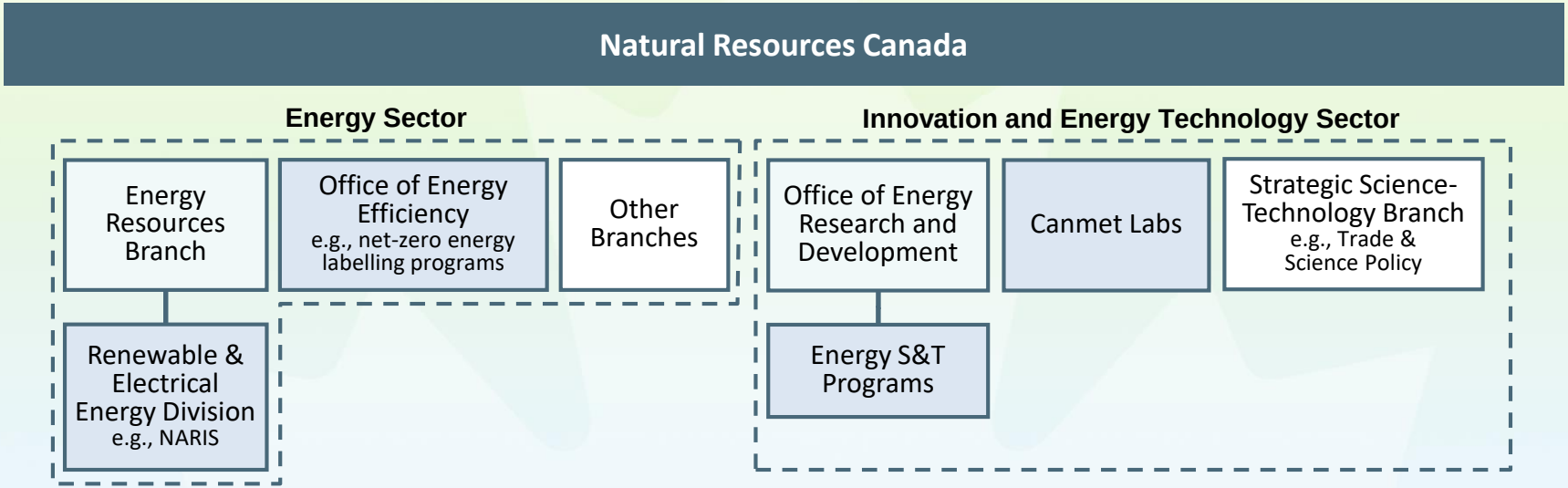
Canada

Outline

- CanmetENERGY Overview
- Role of Load Flexibility in the Smart Grid
- Peak Shaving Case Study
- Renewable Energy Integration Project

CanmetENERGY Overview

Federal Government and the Smart Grid

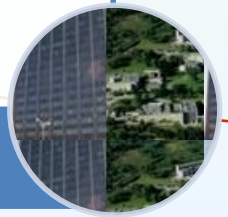


Canmet Laboratories Across Canada

- Oil sands & heavy oil

Devon

- Buildings & communities
- Industrial processes
- Clean electricity
- Bioenergy
- Renewables
- Transportation



Ottawa

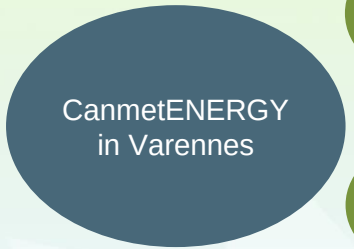
- Buildings
- Industrial processes
- Renewable energy integration
- RETScreen International

Varennes

- Transportation (materials)
- Pipelines
- Manufacturing

Hamilton

Partnerships & Collaboration



Government

- NRC
- Institut de recherche d'Hydro-Québec
- Canadian Smart Grid Action Network (CSGAN)

International

- International Smart Grid Action Networks (ISGAN)
- Smart Grid International Research Facility Network (SIRFN)
- International Electrotechnical Commission (IEC)
- Mission Innovation
- SunSpec Alliance
- Sandia National Laboratory
- Ricerca sul Sistema Energetico (RSE)
- Korea Electrotechnology Research Institute (KERI)
- Austria Institute of Technology (AIT)

Universities & Utilities

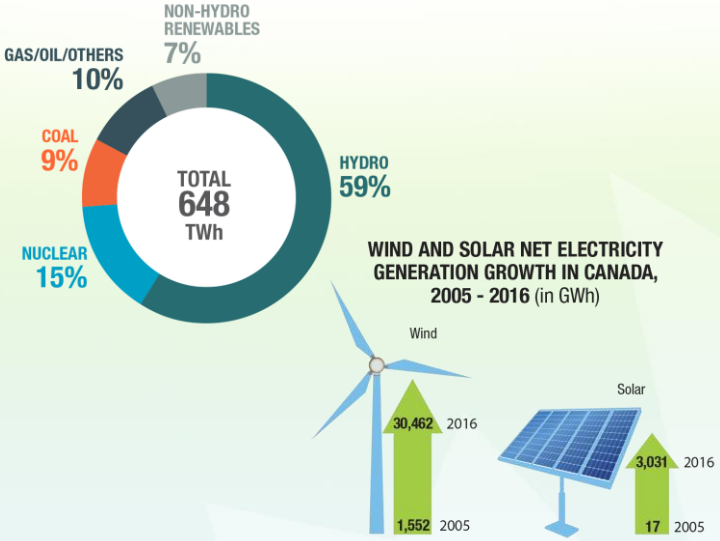
- Smart Net-Zero Energy Building Strategic Research Network – Concordia University
- NSERC Energy Storage Technology Network (NEST)
- University of Waterloo
- Polytechnique Montréal
- Hydro-Sherbrooke
- Hydro One
- BC Hydro
- Hydro Ottawa
- Summerside

Industry

- CaSA Connect
- Giant
- S2E Technologies
- CYME
- Alderville First Nation Solar Park
- Smart Grid Canada

Smart Grid Deployment Metrics in Canada 2018

GENERATION BY SOURCE, 2016



In 2016, **81%** of electricity in Canada came from **non-GHG emitting sources**

SOLAR PV
2.10 GW_{AC} distributed out of
2.48 GW_{AC} installed grid-connected capacity
Data as of December 31, 2017

EV
72.8 k BEVs and PHEVs on road
>5.8 k Level 2 charging outlets
>850 Level 3 charging outlets
Data as of July 31, 2018

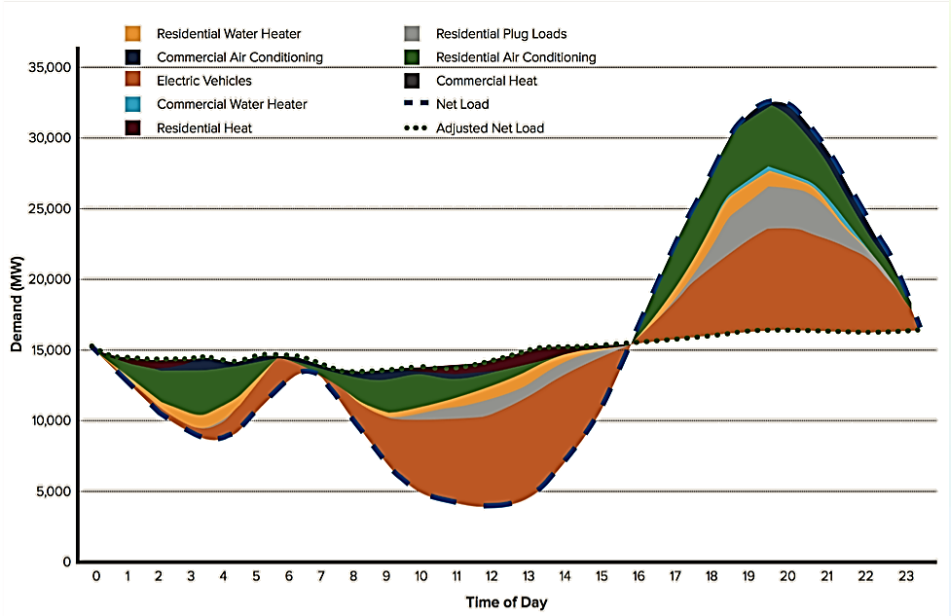
SMART METER
>81% of meters are smart
Data as of August 17, 2018

WIND
0.96 GW_{AC} distributed* out of
12.70 GW_{AC} installed capacity
*assuming all wind capacity below 20 MW is distribution connected
Data as of July 1, 2018

Role of Load Flexibility in the Smart Grid

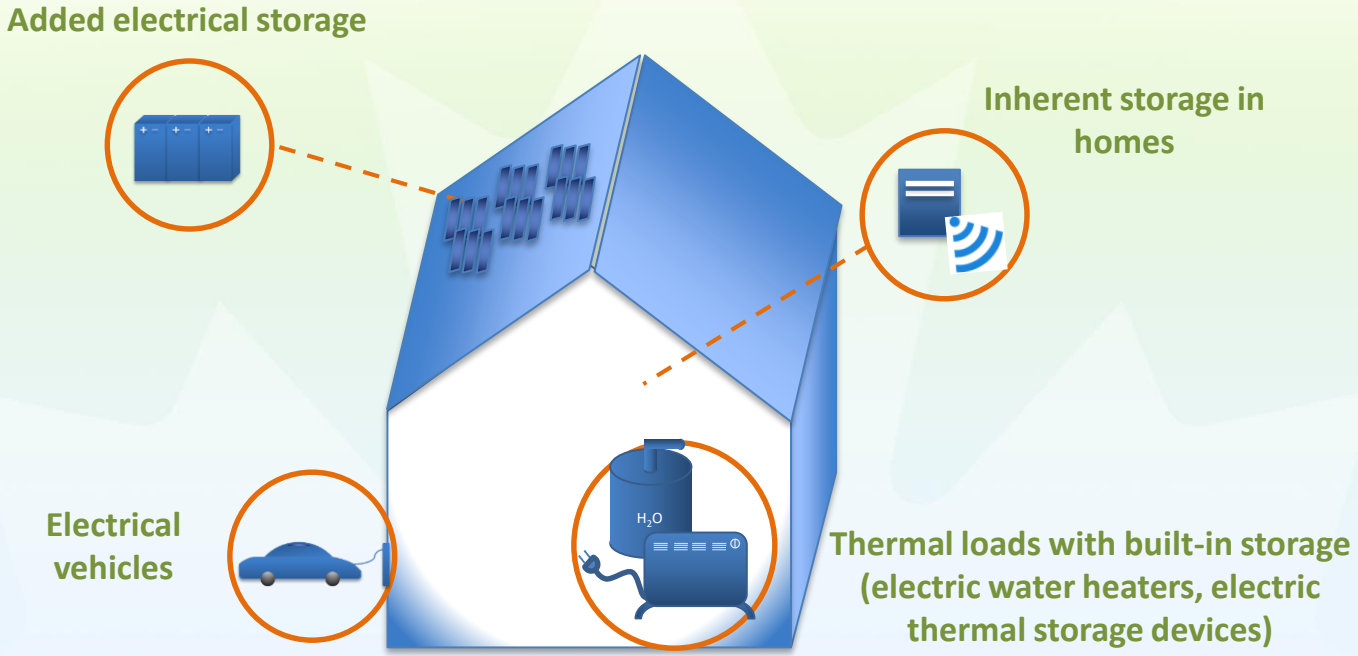
Role of Load Flexibility

- Traditionally, approaches to balance supply and demand consist of
  - Dispatching generators
  - Buying energy on the electricity market
- Now, demand - enabled by the smart grid - can be a new source of flexibility
- Flexible loads can shift their demand (ideally with little or no effect on user comfort)



Rocky Mountain Institute: https://rmi.org/news/demand-flexibility-can-grow-market-renewable-energy/

Flexible Loads in the Residential Sector



Peak Shaving Case Study

Smart Thermostats Pilot Program

Objective: Assess the potential of smart thermostats controlling electric baseboard heaters for peak shaving, while exploring impacts on

- utility demand
- energy consumption
- participant comfort

Ville de Sherbrooke

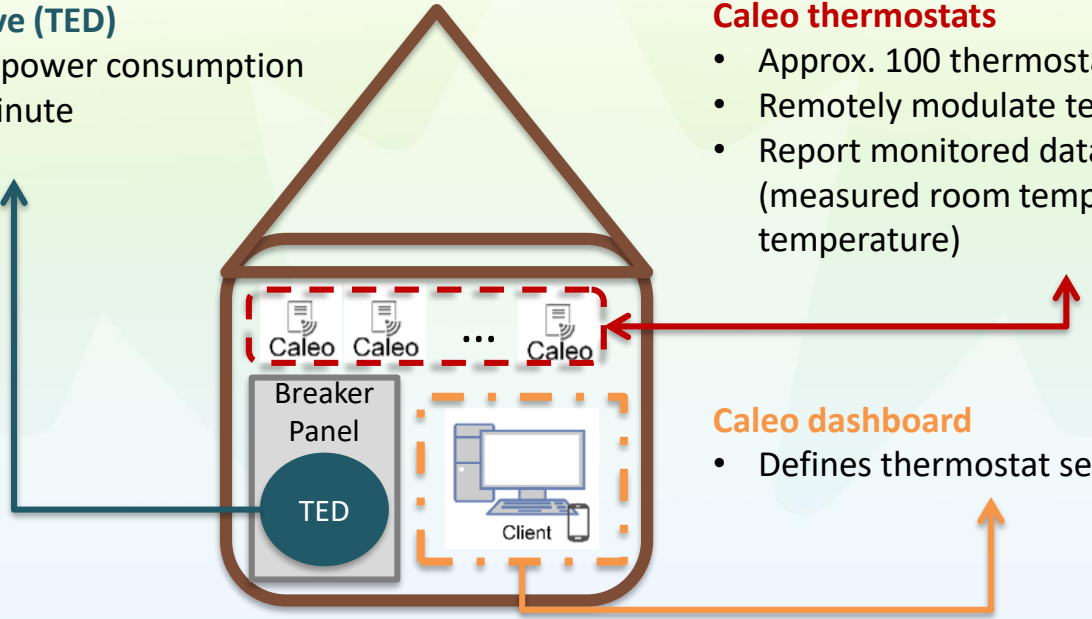
Hydro-Sherbrooke

CASA

Thermostat Pilot: Setup

The energy detective (TED)

- Measures home power consumption
- Reports every minute



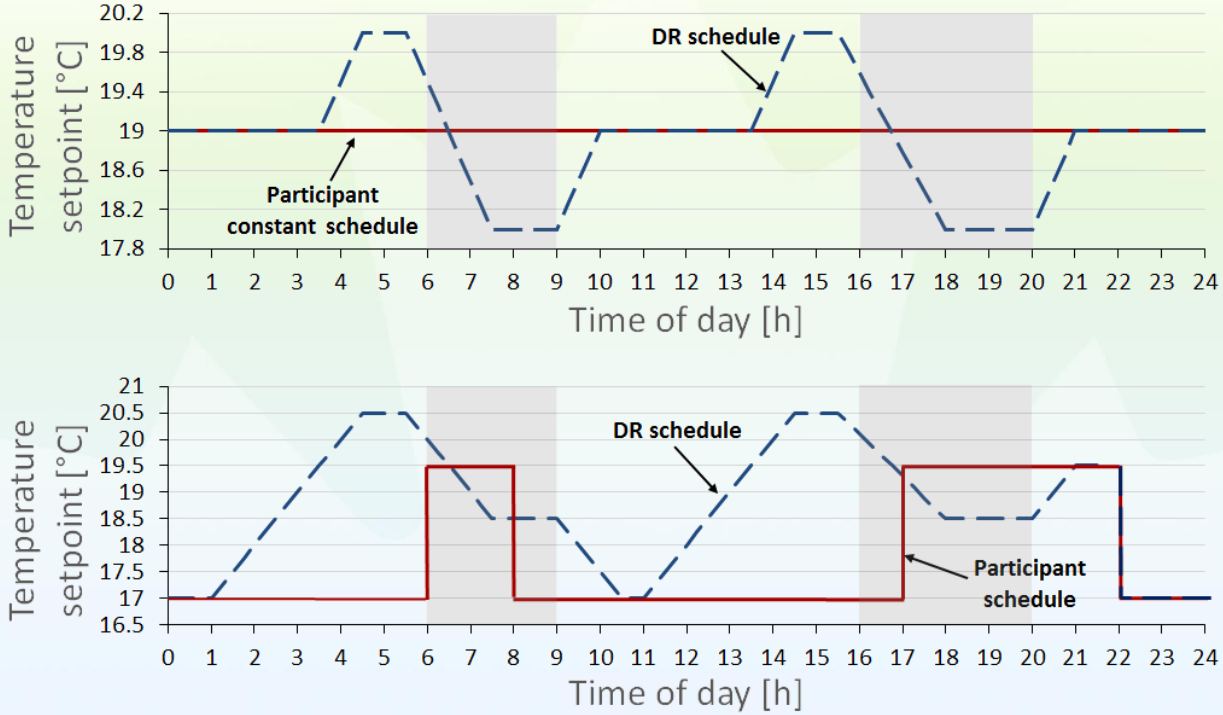
Caleo thermostats

- Approx. 100 thermostats in 11 homes
- Remotely modulate temperature setpoint
- Report monitored data every 5 minutes (measured room temperature, setpoint temperature)

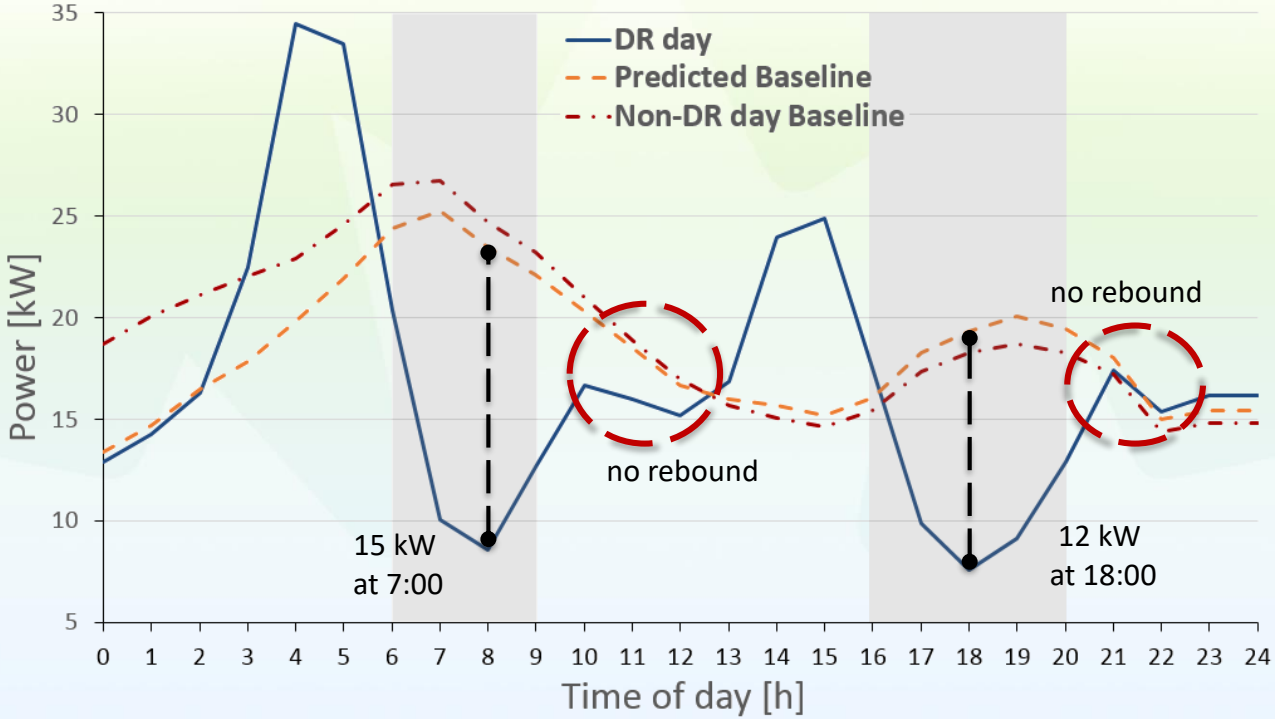
Caleo dashboard

- Defines thermostat setpoints

Scheduling



Utility DR Benefits – All Thermostats

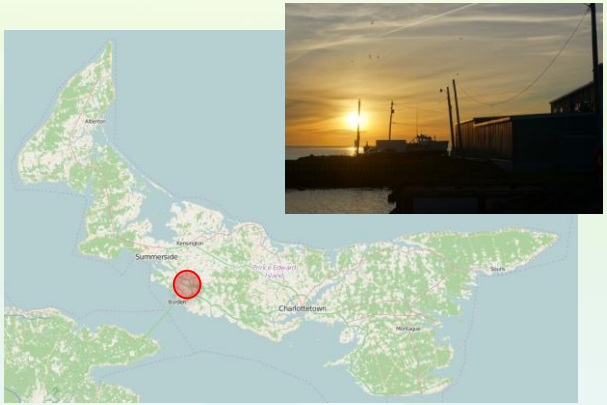


Renewable Energy Integration Project

Summerside Smart Grid Project for Wind Integration

Summerside, PEI

- 15,000 inhabitants
- 27 MW peak
- 130 GWh annual energy consumption



Electric utility

- Municipally-owned
- 21 MW wind generation
- Wind represents 46% of the electricity production
- Interconnected with NBPower

City of Summerside
Prince Edward Island

S. Wong, G. Gaudet and L. P. Proulx, "Capturing Wind with Thermal Energy Storage – Summerside's Smart Grid Approach," in *IEEE Power and Energy Technology Systems Journal*, In Press. doi: 10.1109/JPETS.2017.2754139

Wind Integration Challenge

- Mismatch between wind and load means that energy must often be exported to bulk grid
- Consequences:
  - Lost GHG reduction potential with clean energy not being used locally
  - Missed economic gains by exporting the wind energy at less than value

Solution

Solution:

- A *smart grid* program increasing local utilization of wind generation

Since wind cannot be controlled (without losing energy), solution must be on the load side

Approach:

- Increase electric heat load
- Enable flexibility in heat load through utility managed heat energy storage
- Use wind energy to heat or to charge energy storage appliances for space/water heating

High temperature electric water heater with thermostatic valve

Program

Consumer-side Program:

- Encourage replacement of oil-fired equipment with
  - Electric thermal storage (ETS) space heating units
  - High capacity/temperature electric water heaters

  by offering discounted rates
  - Offsetting customer-borne capital costs
  - Bucket at 8¢ vs 12¢ per kWh for appliance energy demand
- Appliance load management options
  - Smart (dynamically)
  - Time-of-use

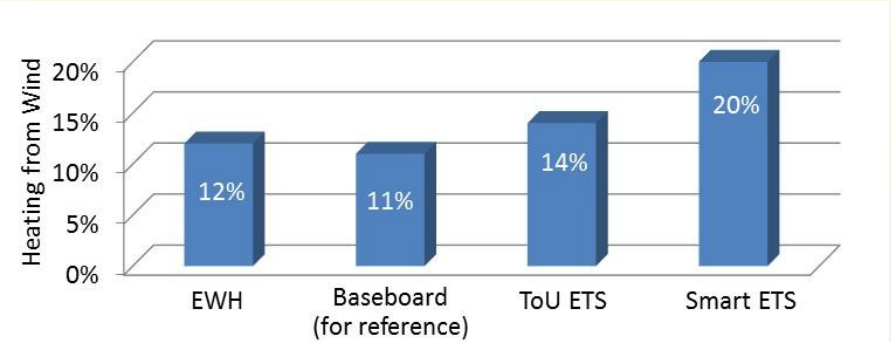
Total device uptake, to 2015

Device	No.	Total Charging Capacity (kW)	Total Storage Capacity (kWh)	Estimated Energy Use (MWh)
Room ETS	120	642	3240	1436
House ETS	45	1244	6618	2153
ThermElect Large ETS	6	480	2280	2997
Water Heater	140	630	849	n/a

Total of 3 MW and 13.5 MWh of available storage

Results

- Additional 621 MWh (24% of surplus) of wind locally consumed



Portion of energy use supplied by wind, per device

- 400 t CO_2eq GHG avoidance

ToU ETS (small home)	Smart ETS (small home)	ToU EWH
2.4 t CO_2eq/y/appliance	2.9 t CO_2eq/y/appliance	0.3 t CO_2eq/y/appliance

Conclusion

- The transition to a smarter grid has already begun
- Challenges remains to seamlessly integrate all smart grid components (renewable energy, flexibles loads, microgrids, demand response)

Questions

Véronique Delisle, Eng., Ph.D.
Project Manager
Renewable Energy Integration Program
Natural Resources Canada
veronique.delisle@canada.ca