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Flexibility Solutions for High Penetration Renewables

Steven Wong

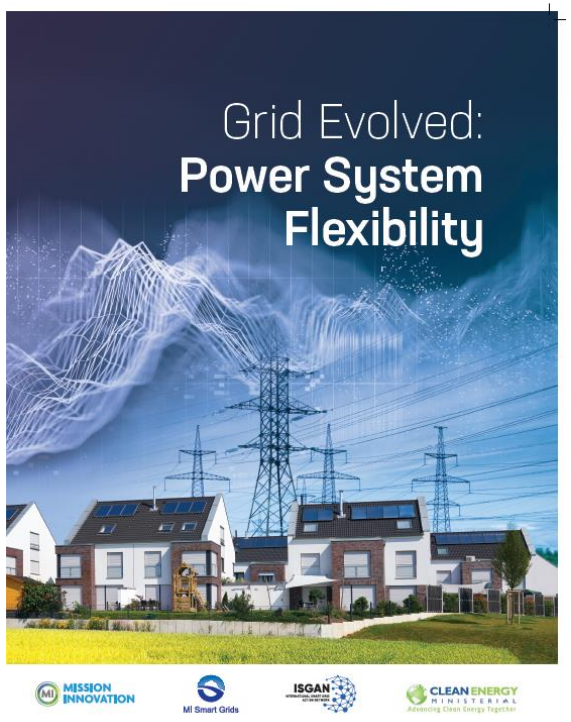
IEA REWP Workshop: The Role of Storage beyond Electricity

Sept. 29, 2020

Canada

Storage and Flexibility

- Key message: The driver for storage is flexibility, and thus, from an economic and technical standpoint, flexibility should be at the core of the discussion
- Benefits:
  - More renewables
    - Enables balancing of variable renewables (wind, PV, hydro)
    - Reduces need for new, expensive capacity
  - Better grid utilisation
    - Provides for more efficient use of grid assets
    - Increases supply options
  - Increased reliability and resilience
    - Enables configuration of systems to prevent outages
    - Increase speed of restoration post contingency



http://www.iea-isgan.org/wp-content/uploads/2019/05/ISGAN_Factsheet_Flexibility-ExCo.pdf

Emerging Sources of Grid Flexibility

Resource	Flexibility	Enabler
Generation		
Interties	(High)	Transmission capacity
Wind and solar (inverter-based gen.)	High	Technical, regulatory, market
Load		
Residential, commercial, industrial	Mid	Local energy markets (technical incl. ICT, regulatory, market), electrification
Transportation	Mid	
Storage		
Flow batteries	High	Technical
Solid batteries	High	Cost reduction
Pumped storage	High	Cost reduction

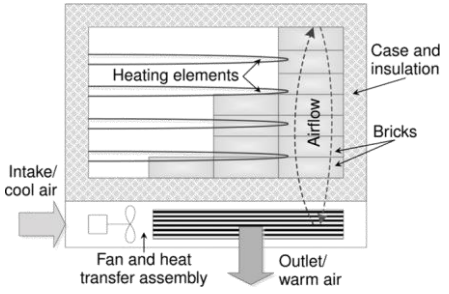
Emerging Technology Trends – Highlights

- Decarbonisation-led Electrification
  - Potential for massive increase in electricity demand, but also new flexibility resources, including
    - Residential and commercial space and water heating
    - Transportation
    - Industrial processes

Cross-sector opportunities

- Local energy markets
  - Distribution-centred markets coordinating DER
    - Enables increased participation in power system operations from numerous small resources, enabled by ICT and,
      e.g. transactive energy and deep learning (AI) algorithms

- Residential flexibility technology developments
  - Focuses on capturing ‘storage’ potential of existing elements with or without addition of thermal storage, e.g. electric thermal storage



A room-sized electric thermal storage unit

Summerside, PE: Introduction

- City of 15,000 people, with city owned electric distribution utility
- Energy demographics
  - 80% residential, 15% commercial
  - Winter space heating demand
    - Two options: oil or electricity
- Power system (2018)
  - 27 MW peak, 130 GWh annual load
  - 21 MW wind (40 to 50% energy needs)
  - Interconnected with neighbouring system

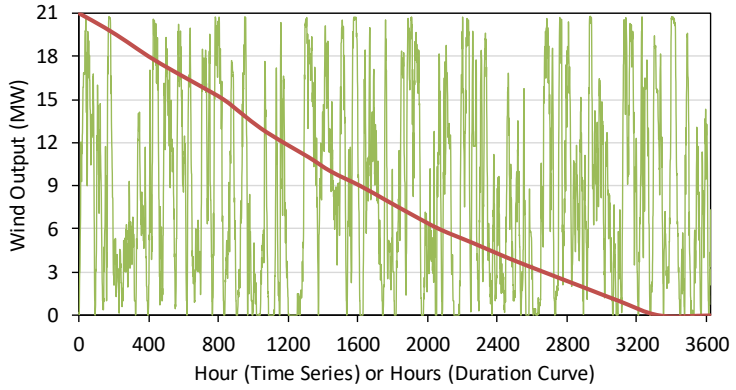


City of Summerside
Prince Edward Island

Background:
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*
doi: 10.1109/JPETS.2017.2754139

Summerside: Goals and Approach

- Goals
  - Reduce GHGs (increase renewables use)
  - Increase value of existing assets to community



- Method
  - Use storage to increase community *self-consumption* of renewables
    - Charge devices when excess of wind
  - Encourage fuel switching from oil to electric heating

Utility-side Program

- MyPowerNet
  - Communications network
    - Multipurpose fibre-optic backbone
    - Open protocol (OpenADR) for high speed control and security
  - Smart metering (AMI/R)
  - Utility SCADA system integration

Consumer-side Program

- Encourage replacement of oil-fired appliances with electric equivalent
  - 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

  with time-of-use or smart control

Thank You

References

- ISGAN Annex 6: Power Transmission and Distribution Systems
  http://www.iea-isgan.org/our-work/annex-6/
- Mission Innovation 1, Innovation Challenge 1: Smart Grids
  http://mission-innovation.net/our-work/innovation-challenges/smart-grids/
- Mission Innovation 2, [Power Challenge]



To learn more about CanmetENERGY Laboratory in Varennes visit our webpage: http://www.nrcan.gc.ca/energy/offices-labs/canmet/varennes/5761

For more information, contact:
Steven Wong & Alexandre Prieur
NRCan / CanmetENERGY
steven.wong@canada.ca; alexandre.prieur@canada.ca



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