Energy Storage Resources in Canada: Game-Changer Technology




Engineering Insurance Conference

Power Advisory LLC

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Outline

- Outline of Presentation
  - Overview of services offered by Energy Storage Resources (ESR)
  - ESR Technology Types and Characteristics
  - ESR Deployment in Canada
  - Priority ESR Applications in Canada
  - Risks for ESR Deployment
    - Regulatory
    - Financial
    - Technological
- Power Advisory LLC is a leading North American management consulting firm that specializes in electricity sector matters and solutions
  - We offer a highly qualified and focused team that provides market-tested and value-driven consulting support

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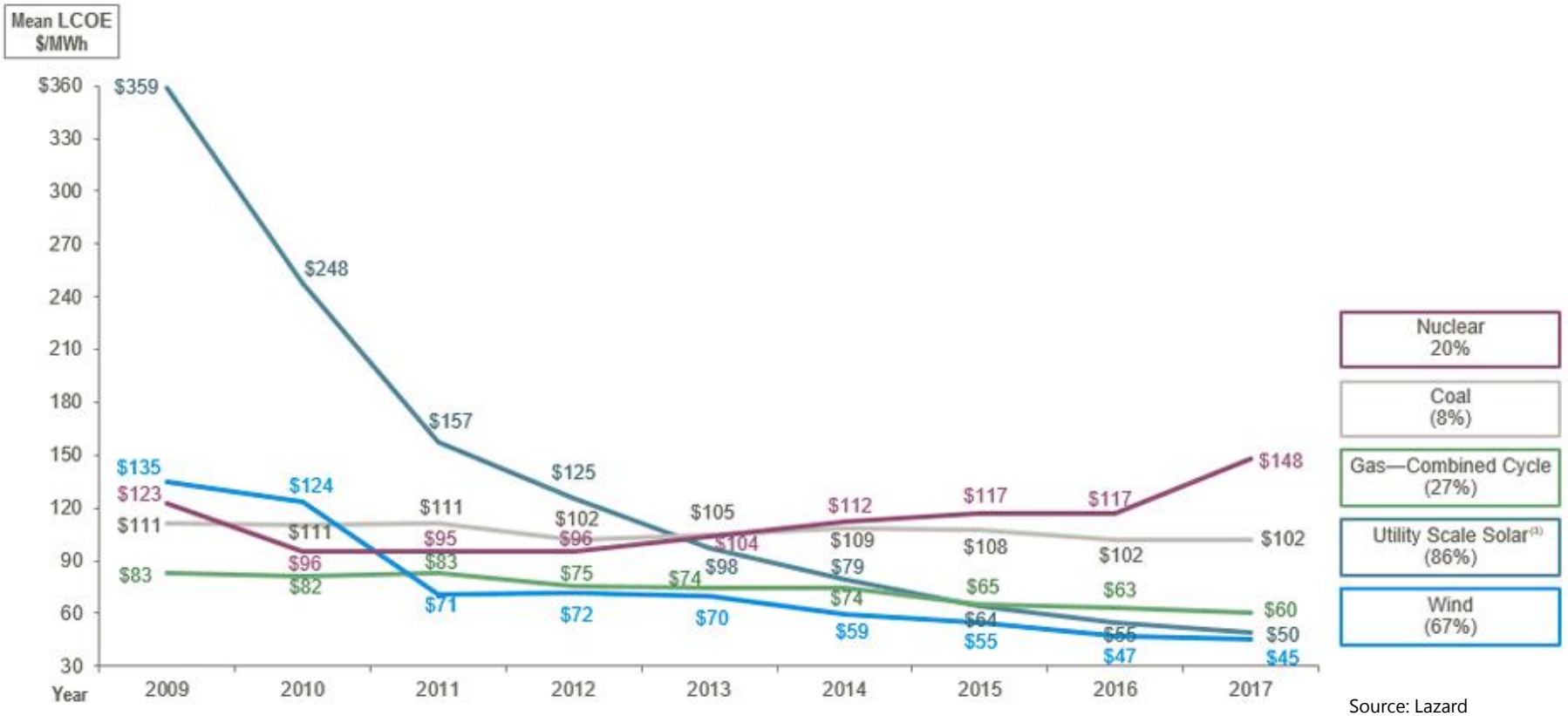
Why ESRs? Renewable energy costs have fallen rapidly over past decade

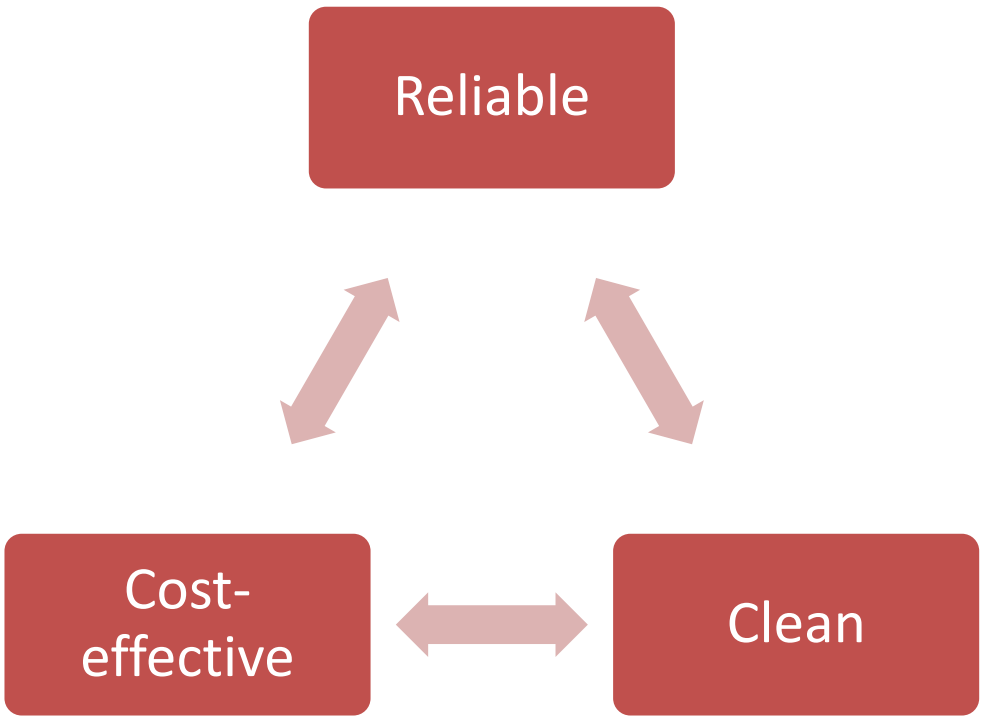
Continued technological advances and declining costs of renewable generation means these resources are increasingly becoming cost-effective relative to other 'conventional' generation sources (e.g., gas-fired fired generation, etc.)



Source: Lazard

Why ESRs? Evolving policy, supply mix and system needs

- There is broad consensus across Canada (and globally) that electricity systems should be reliable, cost-effective, and clean
- Climate change policies that support reducing GHG emissions within the electricity sector has been the primary policy driver for development of renewable generation



- Whereas recent policies (i.e., GHG reduction) have prompted renewable generation at the potential sacrifice of cost-effectiveness, falling renewable generation costs suggests that it is fast becoming the low-cost resource
- As a result, maintaining reliability standards with a supply mix composed of large amounts of variable renewable generation is becoming an important concern in electricity market design

FERC Order 841: Energy Storage Participation in Markets

- In February 2018 the Federal Energy Regulatory Commission (FERC) issued Order 841
  - Order 841 intended to remove barriers to the participation of ESRs in the capacity, energy and ancillary services operated by Regional Transmission System Operators and Independent System Operators (RTO/ISO markets)
- FERC expects Order 841 to profoundly support the increased participation of ESR in future electricity market design

*"It is something of a cliché to refer to **electric storage as a game changer**, but it is also true. Given the ongoing changes in our nation's resource mix, and the changing capabilities needed to serve customers, electric storage is poised to provide a critically important role"*

FERC Commissioner LaFleur

*"As the cost of energy storage continues to decline, these resources are poised to play an even more important role in the generation mix, **leading to the development of a more robust grid** that can, among other things, help to accommodate the ever-increasing demand for clean, renewable resources from states, corporations, and residential consumers"*

FERC Commissioner Glick

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FERC Order 841: RTO/ISOs required to adjust their market design for ESRs

1) Eligible to provide all capacity, energy, and ancillary services that ESR is technically capable of providing

- Market rule design must accommodate ESR registration in wholesale electricity markets
- All electricity products markets available for ESR participation

2) ESR can be dispatched and can set wholesale clearing price as both buyer and seller

- Recognize ability of ESR to both inject energy and withdrawal energy from electricity markets
- Allows ESRs to set clearing price allowing ability to capture highest value dispatch intervals as either a load or generator

3) Account for physical and operational characteristics of ESR

- Account for physical and operational characteristics such as: State of Charge, Min/Max State of Charge, Min/Max Charge/Discharge Limit, Charge/Discharge ramp rate, etc.
- The accounting of ESR characteristics are expected through bidding parameters or other means (e.g., telemetry)

4) Minimum ESR size requirement does not exceed 100 kW

- Ensure different technologies are not disadvantaged by size minimums

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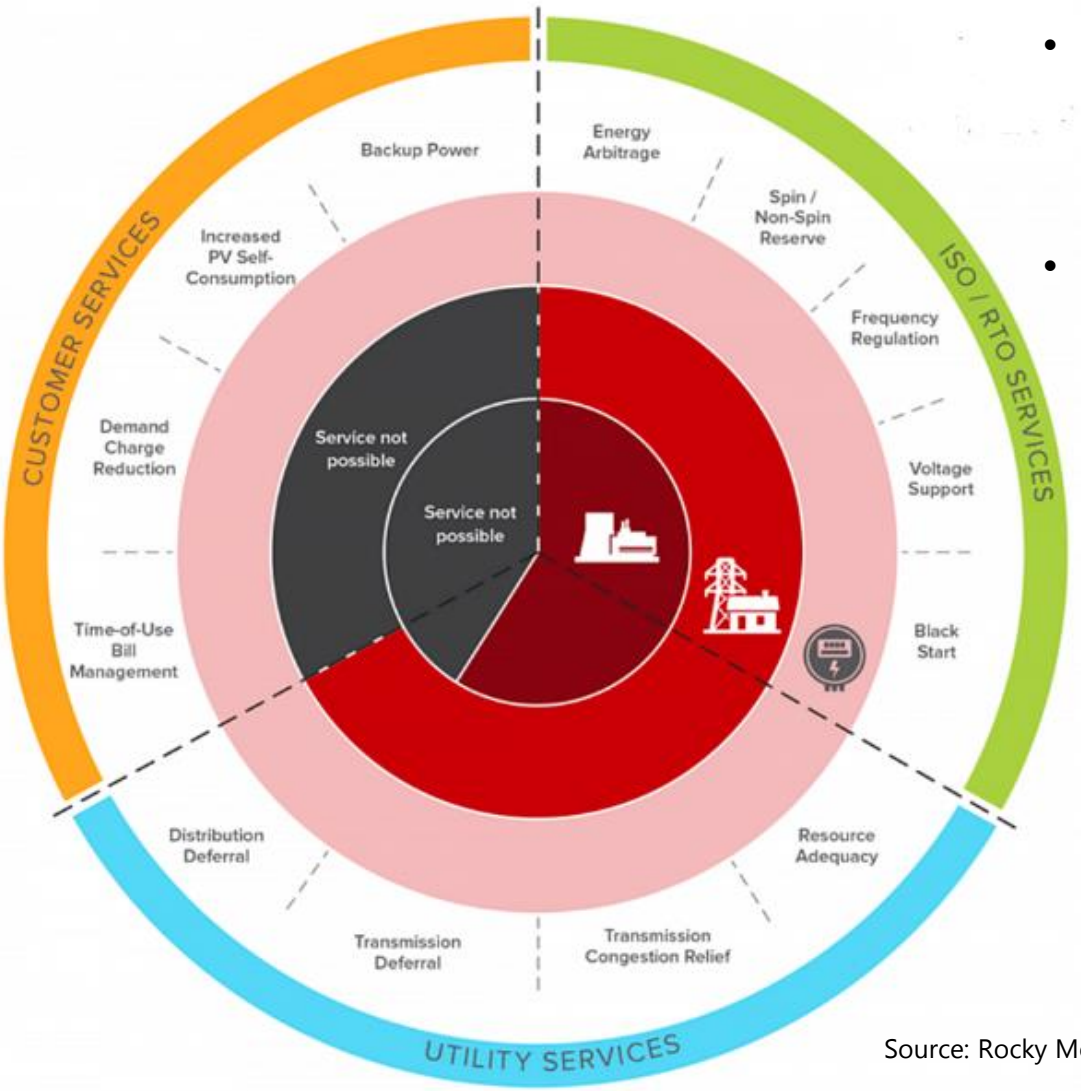
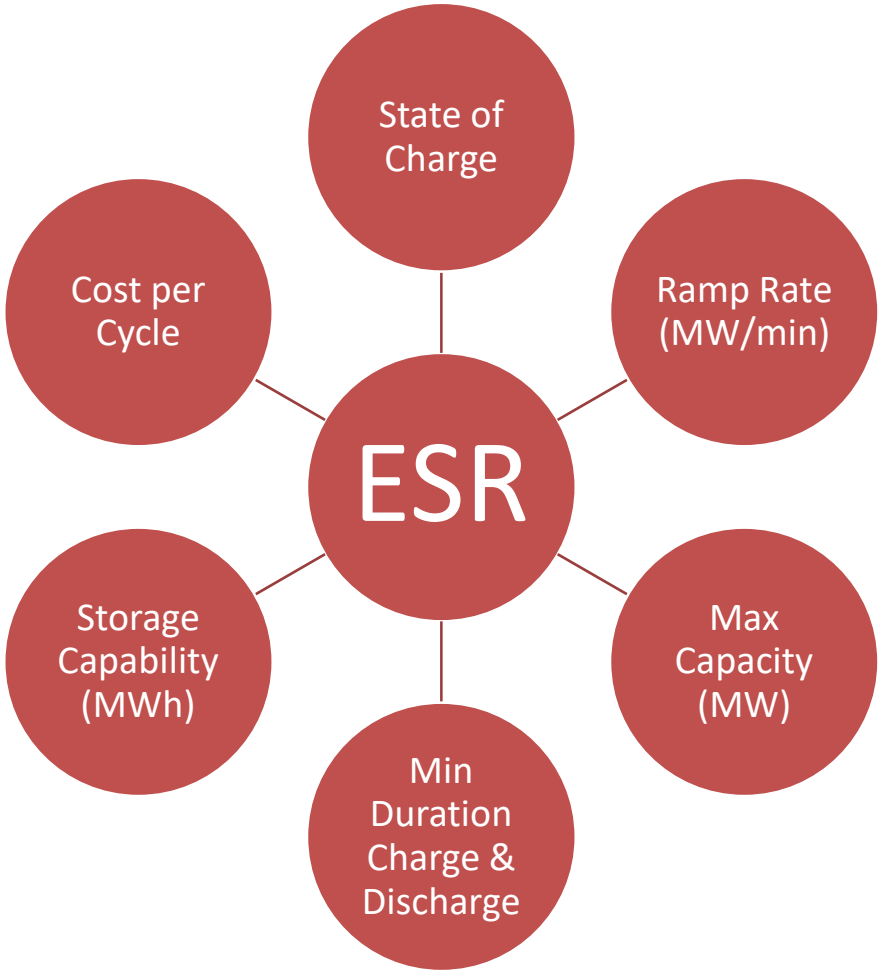
Energy Storage Resource Service Offerings



- A key benefit of ESRs is the versatility to offer variety of services to wholesale markets, grid operators (e.g., Distributors), and customers
- Scheduling and coordination of providing services an important hurdle to maximize the opportunity for ESRs

Source: Rocky Mountain Institute

ESR Characteristics and Attributes



Energy Storage Resource Characteristics and Attributes

- **Ramp Rate**: how quickly an ESR can charge or discharge
- **Max Capacity**: the maximum injection or withdrawal
- **Min Duration**: Shortest duration of charging or discharge from full charge to no charge (and vice versa)
- **Storage Capability**: how much energy can be stored
- **Cost per Cycle**: how much does it cost on average to cycle
- **State of Charge**: monitoring of current charge for injection or withdrawal

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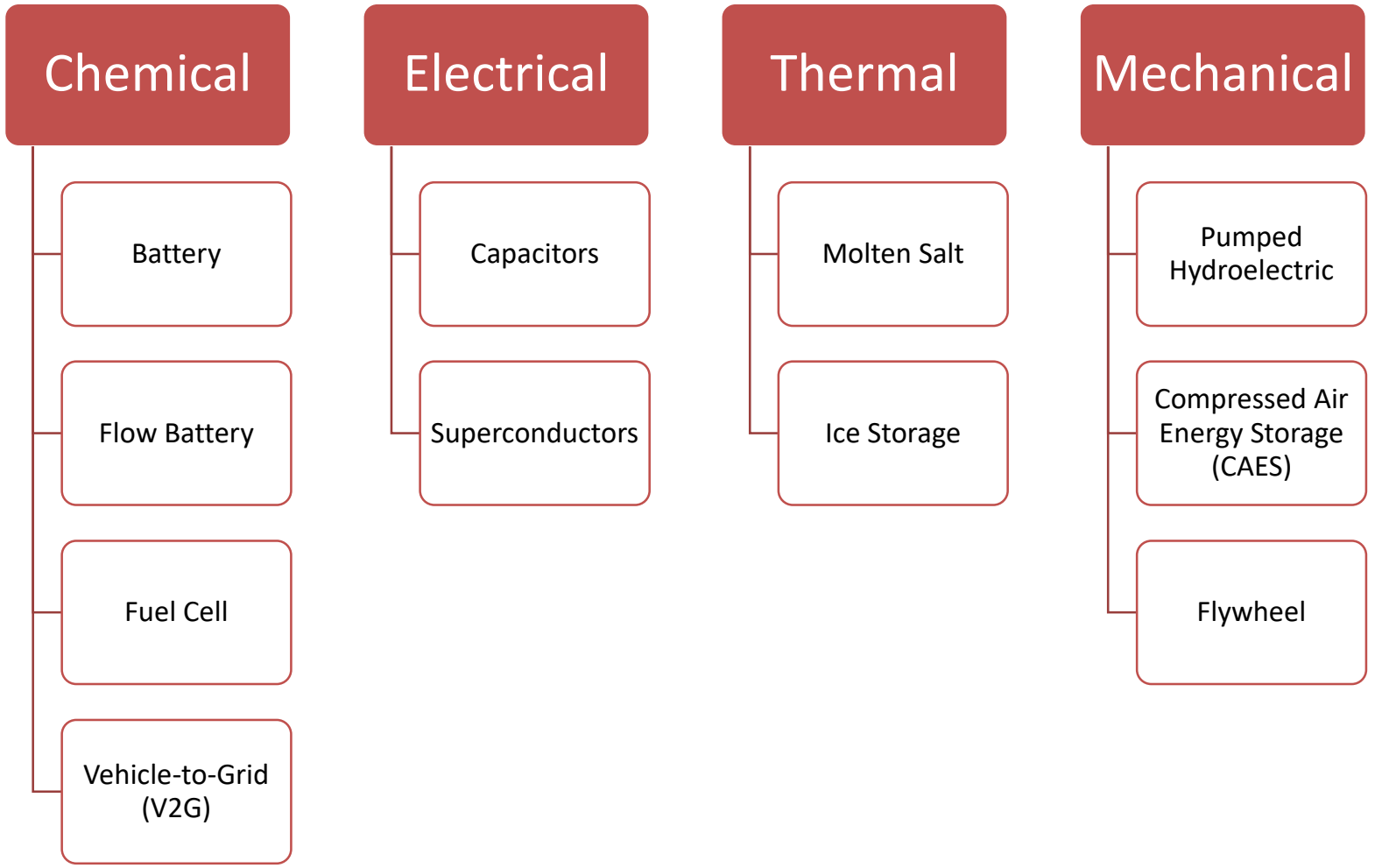
Energy Storage Resources are diverse and offer different capabilities to meet various reliability needs



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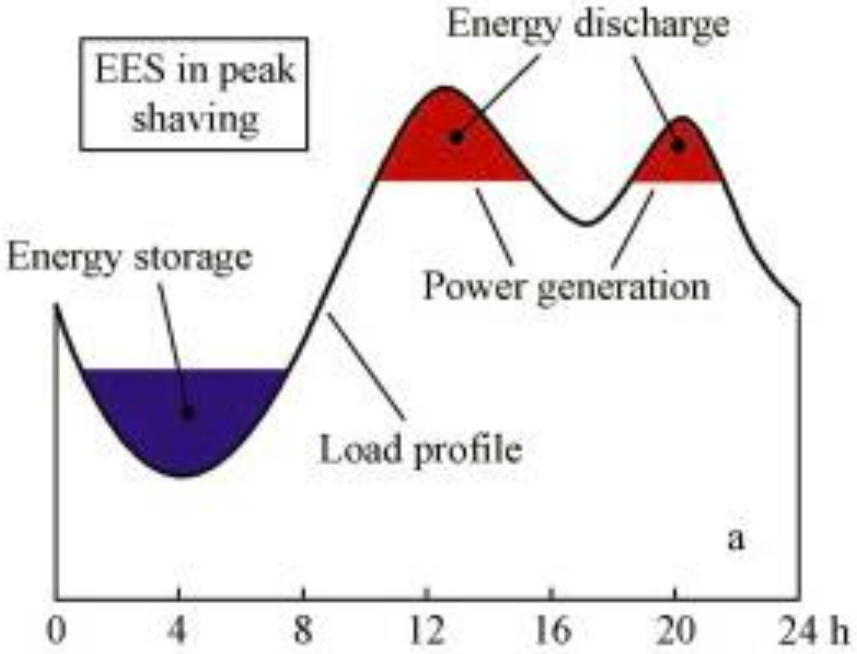
Examples of Energy Storage Resource Applications

Capacity (Seasonal)

- Energy storage can charge in low demand periods to discharge to meet peak demand needs

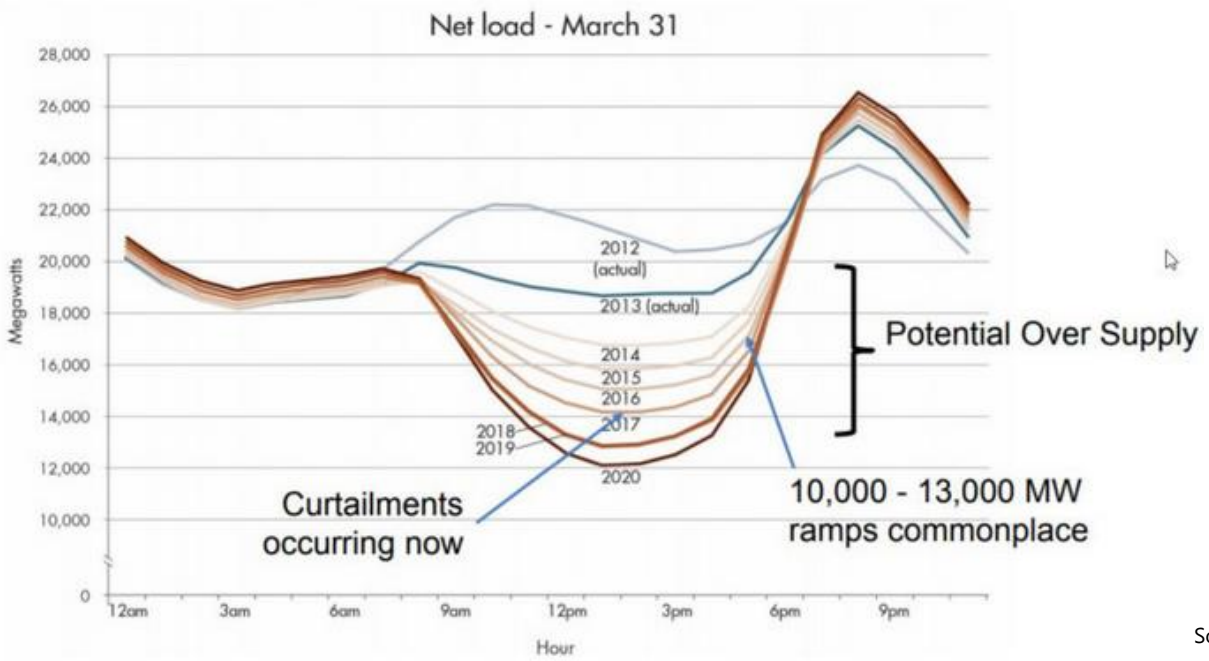


Source: ESA

Examples of Energy Storage Resource Applications

Ramping (Daily)

- The California 'Duck Curve' has formed due to excessive solar generation installations, leading to significant ramping requirements
- California expects energy storage to be a cornerstone of meeting ramping system needs

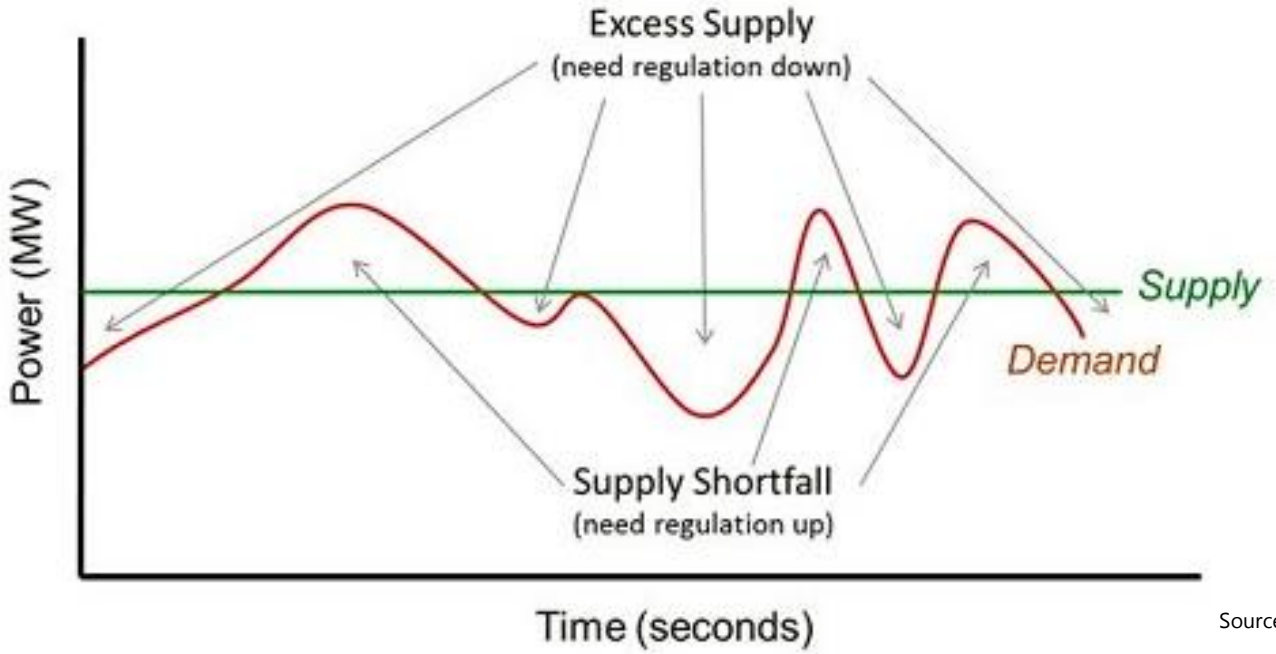


Source: CAISO

Examples of Energy Storage Resource Applications

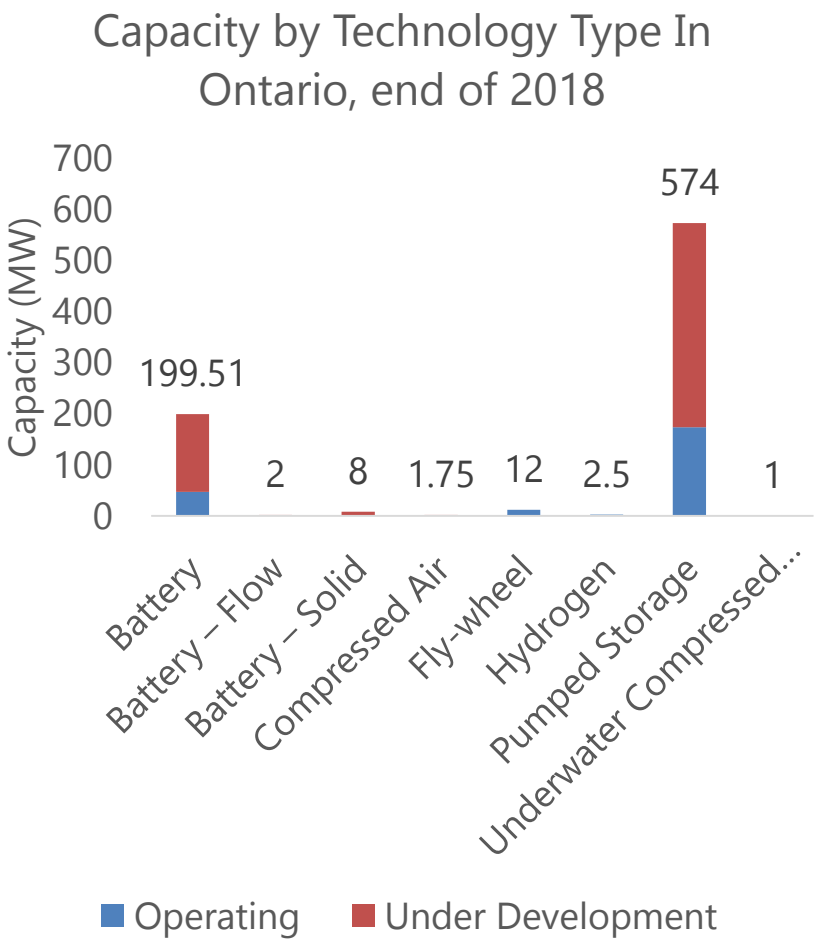
Regulation Service (Hourly)

- Regulation service maintains electricity system stability in normal or abnormal operating conditions (i.e., maintain consistent frequency)
- Involves adjusting supply & demand in 2 to 4 second increments



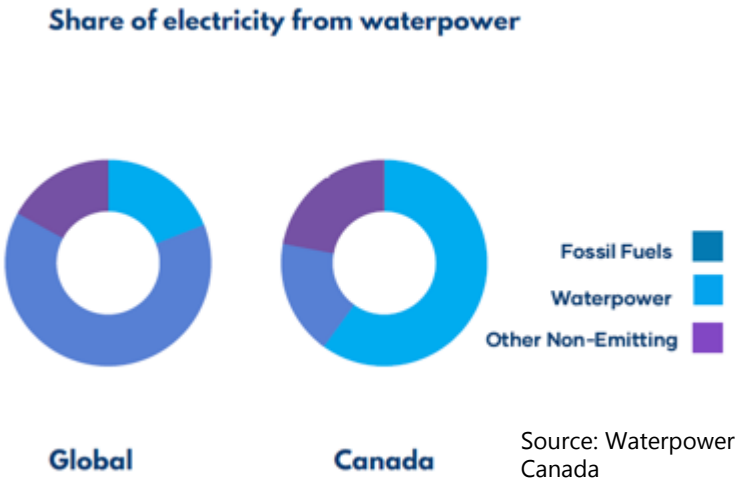
Source: ESA

Energy Storage Resources in Canada



Emission Reductions Alberta's Biotechnology, Electricity, and Sustainable Transportation (BEST) Challenge Awards

- 7 storage projects awarded
- Storage projects include:
  - Hybrid (solar + storage)
  - Transmission & Distribution deferment
  - Electric transportation (battery-based bus charging routes)



Source: Waterpower Canada

Priority Energy Storage Applications in Electricity

ON: Large Commercial & Industrial Customers

- Through the Industrial Conservation Initiative (ICI), large customers are charged their portion of Global Adjustment (GA) based on their consumption during the 5 coincidental peak (5CP) hours of the year
- GA costs represent 80%-90% of wholesale electricity costs, therefore significant savings potential
- ESRs located behind-the-meter can reduce GA costs by reducing consumption during 5CP

AB & ON: Regulation Service

- Fast-ramping ESRs can offer regulation service at costs below existing market values
- The AB market open access virtues likely early first mover; however ON did award contracts to ESRs for regulation service last year, none built yet

CDN: Transmission & Distribution Utilization

- ESRs as Non-Wires Alternatives (NWAs) can meet power system needs and increase the utilization of existing T&D assets (e.g., poles and wires)

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Broad Priority Energy Storage Applications

Electric Vehicles

- Electric Vehicles (EVs) are a fast growing segment of the automotive sector, with applications in commercial and industrial fleet management service
- Part of the reasoning around long-term battery storage price drops is multi-sector applications of same technology (i.e., electricity utilities and EVs)
- Managing EV storage capabilities and interaction with electricity grid will be a significant opportunity and challenge

Renewable Natural Gas

- With renewable natural gas (RNG) standards, carbon intensity of pipeline networks could be significantly reduced
- Interest growing for RNG applications and production methods; for energy storage, using the extensive pipeline network for a system-to-system storage application has many benefits for the rate-regulated assets that have been developed over the past decades

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Barriers for Energy Storage Resources

Participation model in wholesale markets

- As described in FERC Order 841, ESRs need unique treatment to properly reflect their characteristics and attributes
- Market rules designed for traditional resources can create barriers to entry for ESRs, even ESRs providing services today often use participation models designed for traditional resources

Roles and responsibility for energy storage resources in the regulatory framework

- Regulated utilities responsibilities to ESRs (e.g., connection, operation, protection & control) lacks clarity and lead to inconsistent treatment
- Inconsistent treatment leads to higher costs, complex application processes and limits on capabilities

Coordination for value stacking revenue streams

- A key value of ESRs is the ability to value stack (i.e., offer multiple services to different entities); however, coordination between different system operators is required to maximize the value stack
- Coordination increases confidence in services provided by ESRs and should increase their competitiveness

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Risks to Energy Storage Resource Deployments

Regulatory

- Delaying the establishment of unique treatment for ESRs in the regulatory framework (i.e., codes, standards, market design) increases uncertainty and therefore costs
- Regulated asset owners need clear cost recovery mechanisms for adoption of NWAs to resolve power system needs
- Ownership restrictions can reduce opportunities for third-party owned ESRs, namely requirements that service purchaser must own and/or operate the ESR

Risks to Energy Storage Resource Deployments

Financial

- Expectation of long-term falling costs can undermine future revenue opportunities (i.e., cost of providing service falls as storage costs drop); in other words, it is a 'Prisoner Dilemma'
- Due diligence on multiple value streams with multiple contract counterparties is difficult; this is especially true if the credit-worthiness of different parties contrast significantly

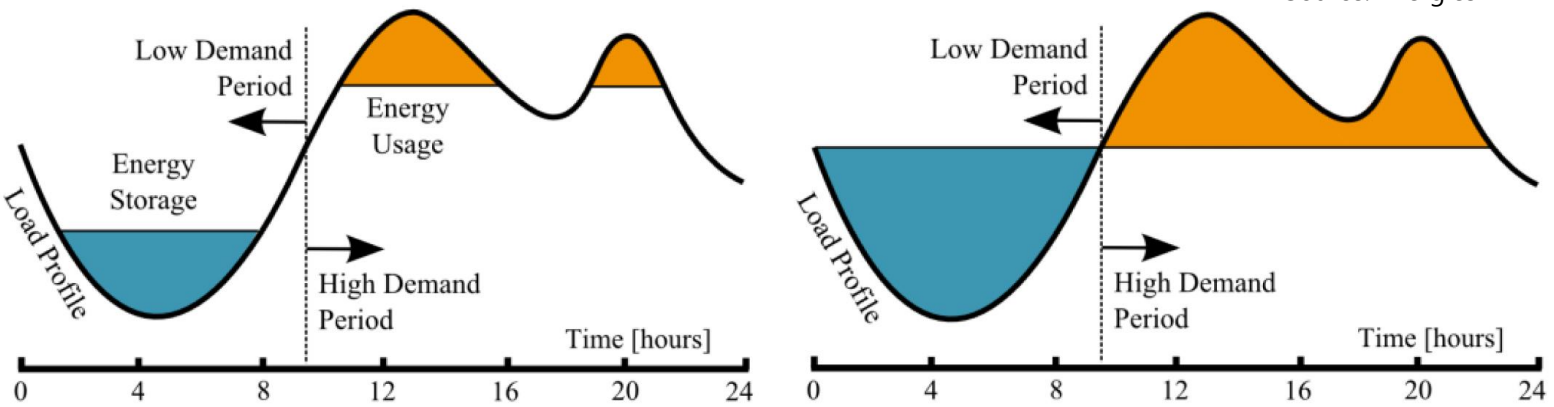
Risks to Energy Storage Resource Deployments

Technological

- Significant technological advances can be difficult to commercialize
- Long-term resilience and cost of operation are difficult to predict (e.g., solar inverter replacements)
- Many ESR technologies, each have different value offerings; risk that new or evolving ESR technology has better characteristics for certain service and therefore capture market share quickly

Parting Thoughts

Source: Energies



- ESRs provide the ability customers to manage their grid consumption independent of their unique energy needs
  - In other words, inflexible customer demand profiles can become flexible with ESRs
- Important to recognize that ESRs are utilization resources first and foremost
  - That is, ESRs do not inject new energy into the electricity system but instead optimize the usage of existing resources and power systems
- ESRs can be a true physical hedge for electricity markets and are part of a broader overhaul of electricity sector regulatory frameworks
  - Deep decarbonization is expected to lead to significant electrification, ESRs will be an important component in meeting growing electricity demand

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