BEHIND-THE-FENCE ENERGY STORAGE SYSTEMS TO FACILITATE THE PARTICIPATION OF EXISTING WIND FARMS IN ANCILLARY SERVICES

CANWEA O&M SUMMIT, JANUARY 29-30, 2019, TORONTO

Presented by Martin Rheault
Authors: Payam Zamani, Shila Karimi and Martin Rheault
BBA AT A GLANCE

- Private consulting engineering firm established in 1979
- Over 800 employees
  - Locations across Canada | Vancouver, Calgary, Timmins, Sudbury, Toronto, Abitibi, Montréal, Boucherville, Mont-St-Hilaire, Labelle, Québec City, Labrador City
- Practice-Centered Engineering Firm
- Leading expertise in the following sectors:
  - Power
  - Mining
  - Environmental Services
  - Biofuels, Oil & Gas
THE CONTEXT

- LCOE of Wind is now the lowest*
- Change of policy and electricity market design
- Shorter electricity contract terms in the future
- Transition from subsidized to unsubsidized
- IPPs have to bear more risks

*REF.: LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS—VERSION 12.0, 2018
What if all the wind capacity would have participated in **Ontario** spot market in 2018?
What if all the wind capacity would have participated in Alberta spot market in 2018?
What if all the wind capacity would have participated in Ontario spot market in 2018 and had a 2-hour storage, 10% of wind capacity? ~$1.3/MWh increase, 6% reduction of discount.
WHAT IF… WE HAD STORAGE

What if all the wind capacity would have participated in Alberta spot market in 2018 and had a 2-hour storage, 10% of wind capacity? ~$1.9/MWh increase, 3% reduction of discount
Energy arbitrage improves revenues, but it’s not enough. Let’s take advantage of ancillary services.
Ancillary Services is a **closed** market, so early adopters will win

- AESO procures:
  - ~240MW in Regulating Reserve (Act and Stby)
  - ~330MW in Spinning Reserve (Act and Stby)
  - ~255MW in non-Spinning Reserve (Act and Stby)
- AS needs will increase with renewable growth
FINANCIAL MODELING OF THE ESS

**Basic Parameters of ESS**
- Round-Trip Efficiency
- Life Cycle
- Nominal Energy & Power
- Opex & Capex
- Capacity Maintenance Agreement

**Market Parameters**
- Perfect Knowledge
- Market Forecast
- Probability of Dispatch

**Energy Storage System**

**Electricity Market**

**ESS Revenue Optimizer**

**Output**
- Day-Ahead Bid Schedule
Revenue: $464.90
REVENUE STREAM OPTIMIZER – TYPICAL DAY #1

Revenue: $3,267.69

*hourly offering enabled
Revenue: $8,321.49
Revenue: $28,873.74

*block offering enabled
ANNUAL AVERAGE PRICES FOR ANCILLARY SERVICES

AESO's Annual Average Prices for Energy & Active Reserves from 2012 to 2018
Estimated annual revenue from 2012 to 2018 for a typical 10MW / 20MWh ESS operating in Alberta

- **Perfect Knowledge**
- **Market Forecast**
Estimated annual average revenue from 2012 to 2018 for a typical 10MW / 20MWh ESS operating in Alberta

- **Arbitrage**
- **ESS Revenue Optimizer**

### Perfect Knowledge vs Market Forecast

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<th>Revenue Level</th>
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<th>ESS Revenue Optimizer</th>
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BENEFITS OF BEHIND-THE-FENCE PROJECTS

- Lower capital cost
- Minimal impact on existing supply/demand contracts
- Avoid ever-increasing demand tariffs
- Simpler Behind-the-fence interconnection with utilities
- Easier permitting and social licensing
- Cost effective integration to central control system
TECHNO-FUTURE KEY TAKEAWAYS

- Storage is an effective technological solution to generate more revenues
- Simple arbitrage strategies will not succeed
- Deep market knowledge will be an asset
- Advanced data analytics knowledge will be required (Development & Operation)
- Procurement of highly flexible technology and control system is a must
- Artificial intelligence functions (neural networks) will unlock further profitability
  - Improved forecasting accuracy
  - Enhanced decision making (adaptive bidding strategy)
  - Possibility to out-bid competitors
  - ...

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