Renewable Isolated Microgrids



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Hatch at a Glance

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Global Operations

150 countries
9,000 staff
$50+ billion in projects

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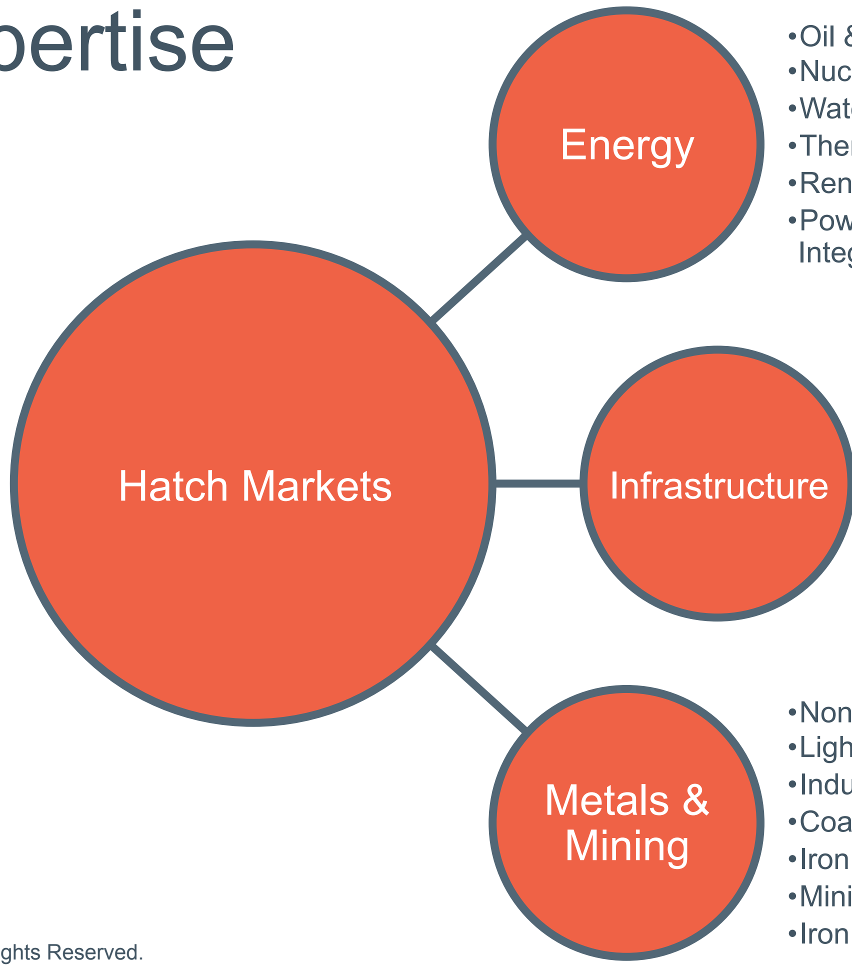
Hatch Expertise



Energy

- Oil & Gas
- Nuclear
- Water Power
- Thermal
- Renewable Power
- Power Delivery and Integration

Infrastructure

- Rail
- Roads & Transportation
- Ports and Marine Terminals
- Infrastructure Services
- Structures & Bridges
- Water & Tailings Management

Metals & Mining

- Non-Ferrous
- Light Metals
- Industrial Minerals
- Coal
- Iron Ore
- Mining & Mineral Processing
- Iron & Steel

Overview of Renewable Isolated Microgrids

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Remote Off-Grid Power Systems

- Remote communities and mines
- High cost of long High Voltage (HV) transmission lines
- Diesel generators are often the main power supply source
- Fuel has to be delivered to the sites via ice roads, on barges and airplanes
- Environmental risks transporting large amounts of fuel: spills
  - Road/Ice Road Accessible: **$0.25/kWh - $0.95/kWh**
  - Arctic Locations: **$1.5/kWh - $2.5/kWh**

Fuel Transport and Storage

Fuel tanker plunges through Deline, N.W.T., ice road

Driver escaped without injury, transportation department says

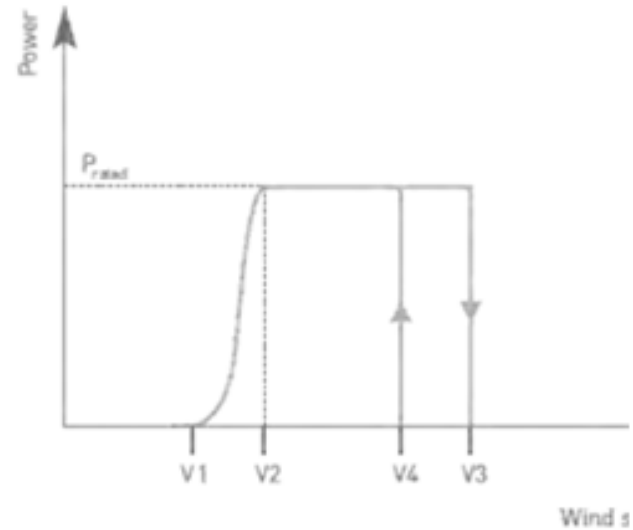
By Chris Windeyer, CBC News Posted: Mar 05, 2016 4:43 PM CT | Last Updated: Mar 06, 2016 4:53 PM CT

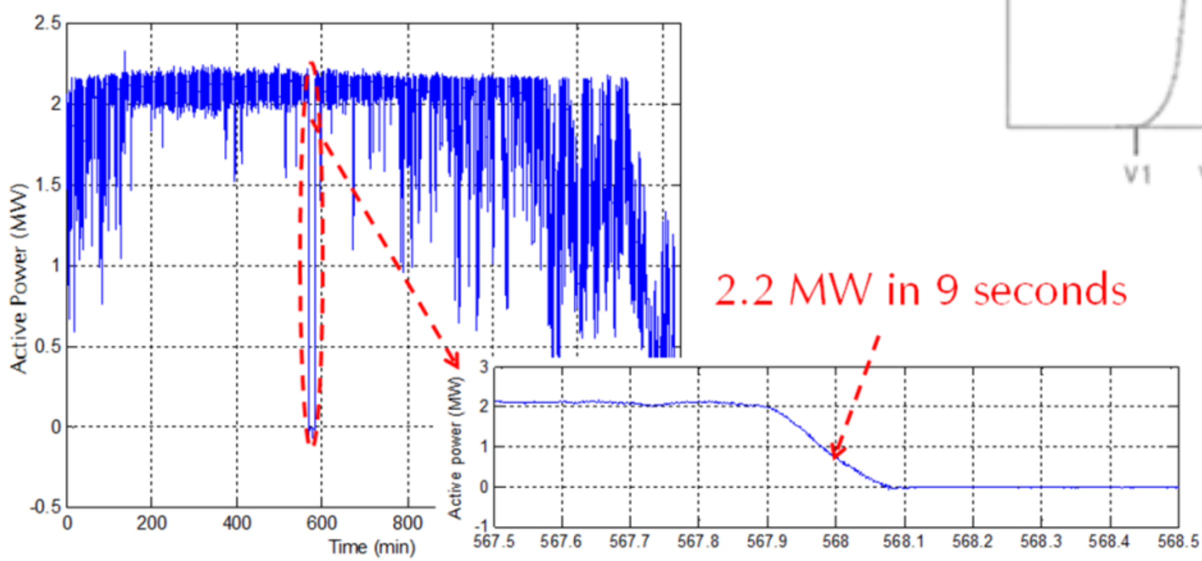
A fuel truck went through the ice on the Deline access road Saturday. (Environment and Natural Resources)

Challenges in Hybrid System Implementation with Medium and High Renewable Penetration

- Fossil power plant operating constraints
  - Low partial load efficiency
  - Min. loading
  - Start-up times
  - Load pick-up capability
- Renewable power variability and constraints
  - Resource variability
  - Not load-following: excess-deficit conditions

Wind Power variability





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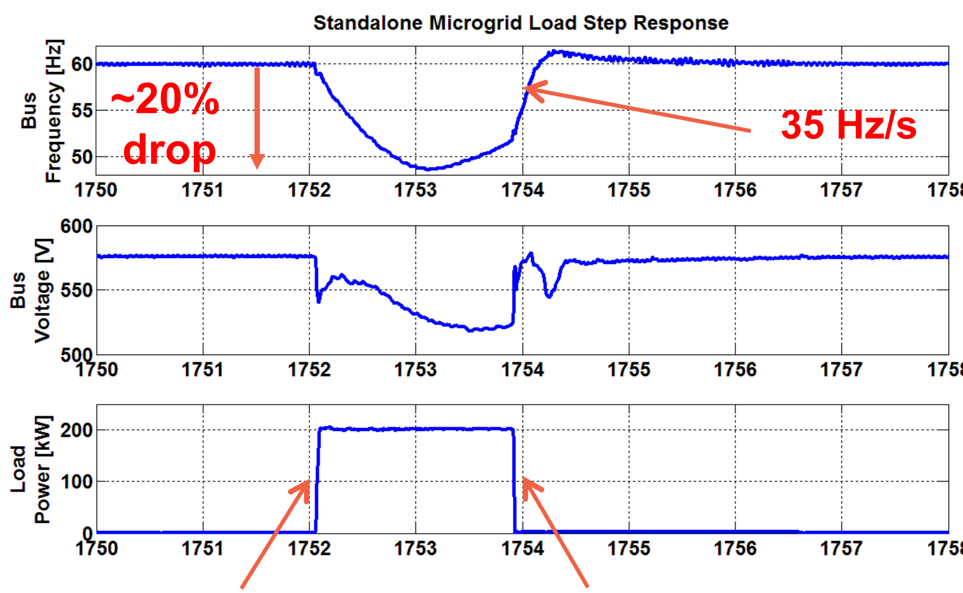
Wind Power Drop=Genset Load Pick-up an Extreme Example



Measured 67% step load increase and decrease

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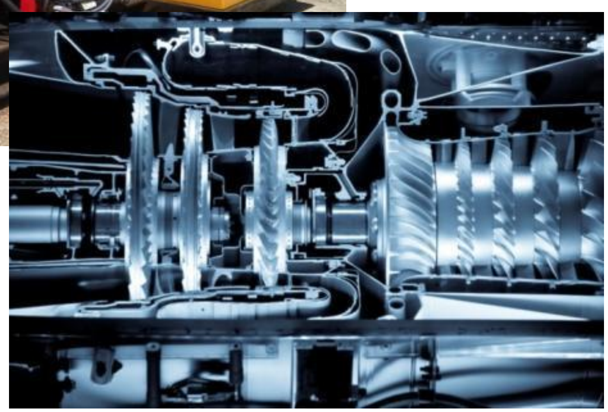
Thermal Power Plant Operating Constraints



Grid services: Start up time from 0-100%	
Diesel engines	1 - 5 min
Gas engines	4 -10 min
Aeroderivative GT	5- 10 min
Industrial GT	10 - 20 min
GT Combined Cycle (CTCC)	100-120 min
Steam turbine plants	600-720 min

With high pre-heating

Maximum step change in 5 s	
Diesel engines	10 – 30 %
Gas engines	10 – 20 %
Industrial GT	5 - 10 %
GT Combined Cycle (GTCC)	10 - 20 %
Steam turbine plants	2 - 3 %
Nuclear plant	0 %

Source: MAN

Energy Storage and Advanced Grid Controls Applications

- Reduction of spinning reserve
- Coordination of thermal plant load pick-up capability with renewable power change ramp rate
- Management of excess renewable power (no spills)

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A Sub-Arctic Renewable Isolated Microgrid For Remote Mine

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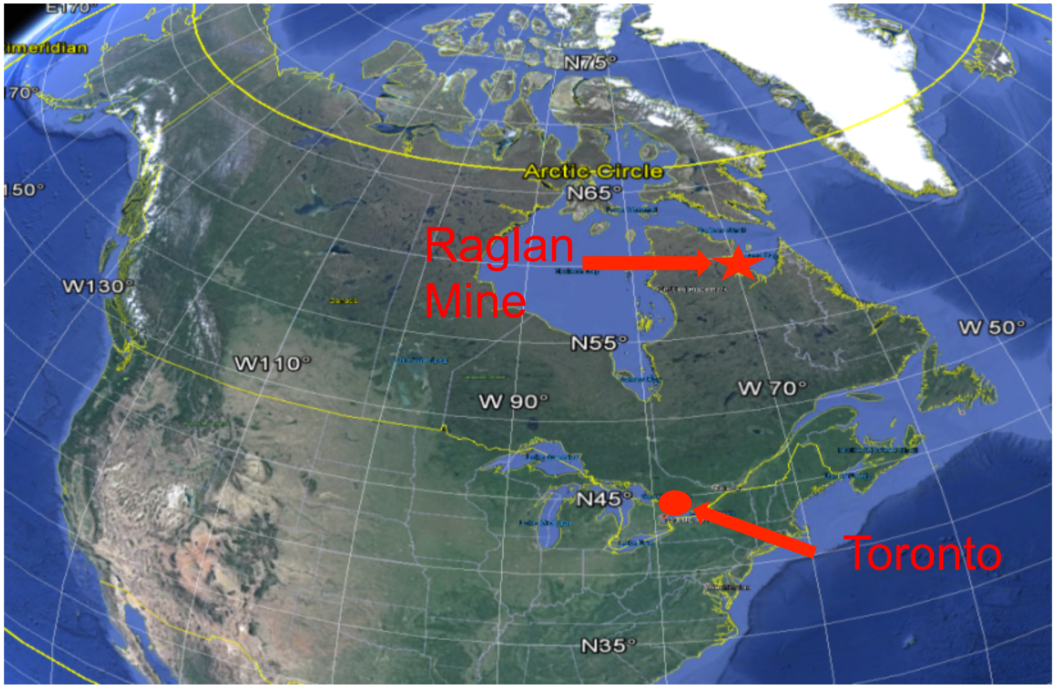
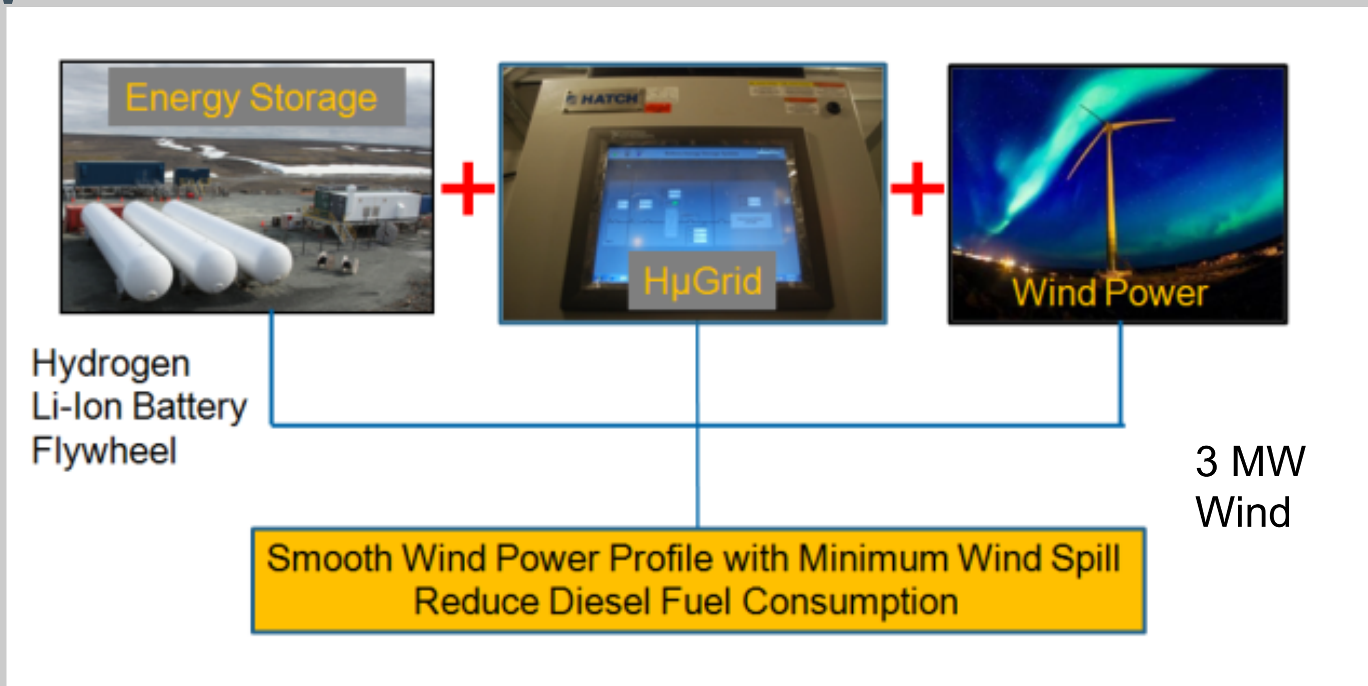
Glencore Raglan Mine

- Located ~2000 km North of Toronto
- Accessible only by sea or air
- Several mines spread of a 70 km area with legacy distributed diesel generation
- Good wind resource



Raglan Wind-Storage Pilot Project Overview



Wind Turbine Photo Courtesy of Justin Bulota (Tuglig Energy)

Energy Storage Systems

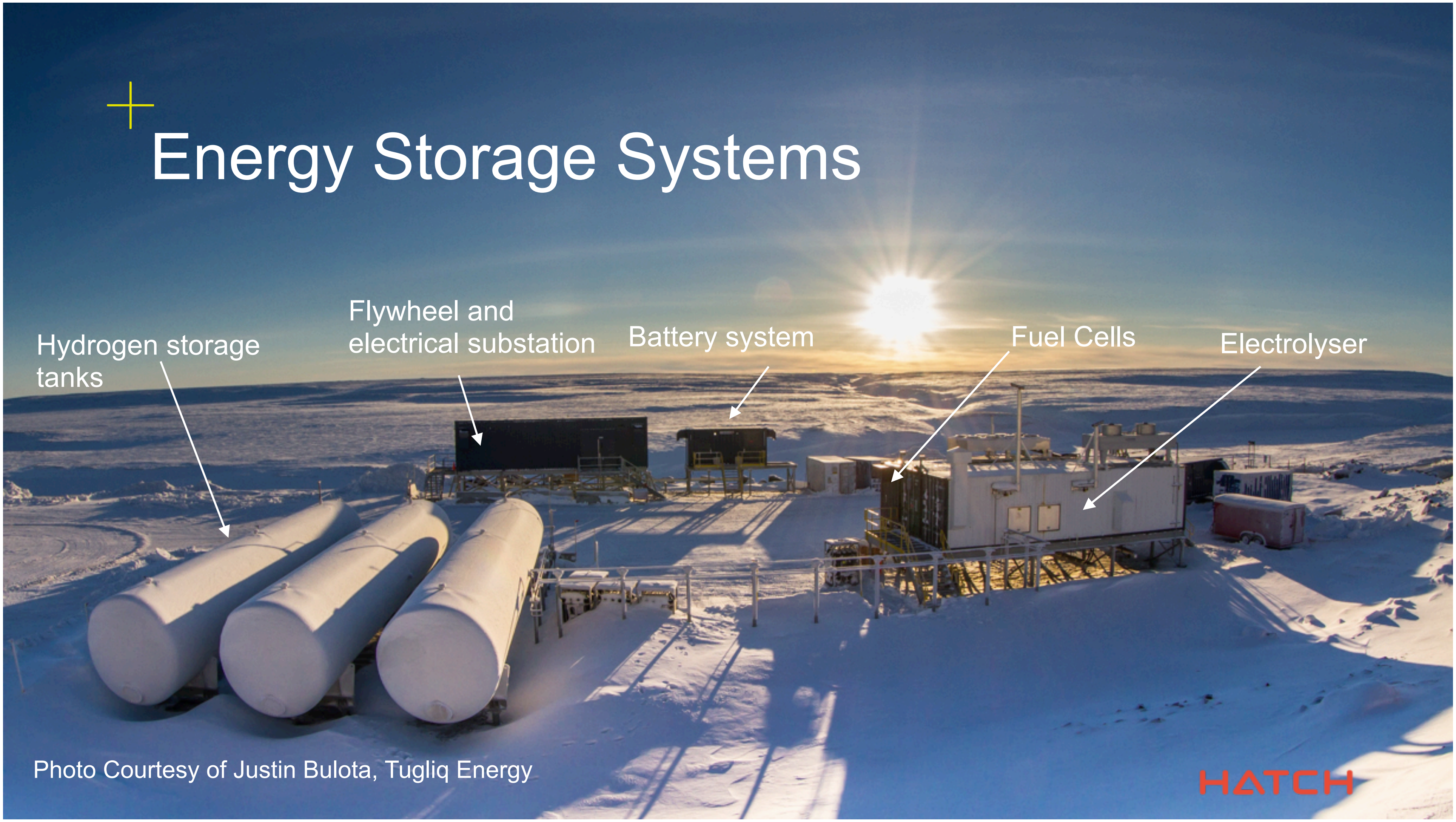
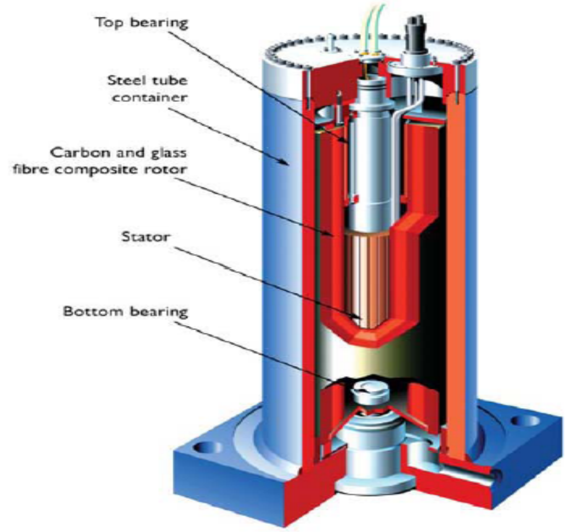


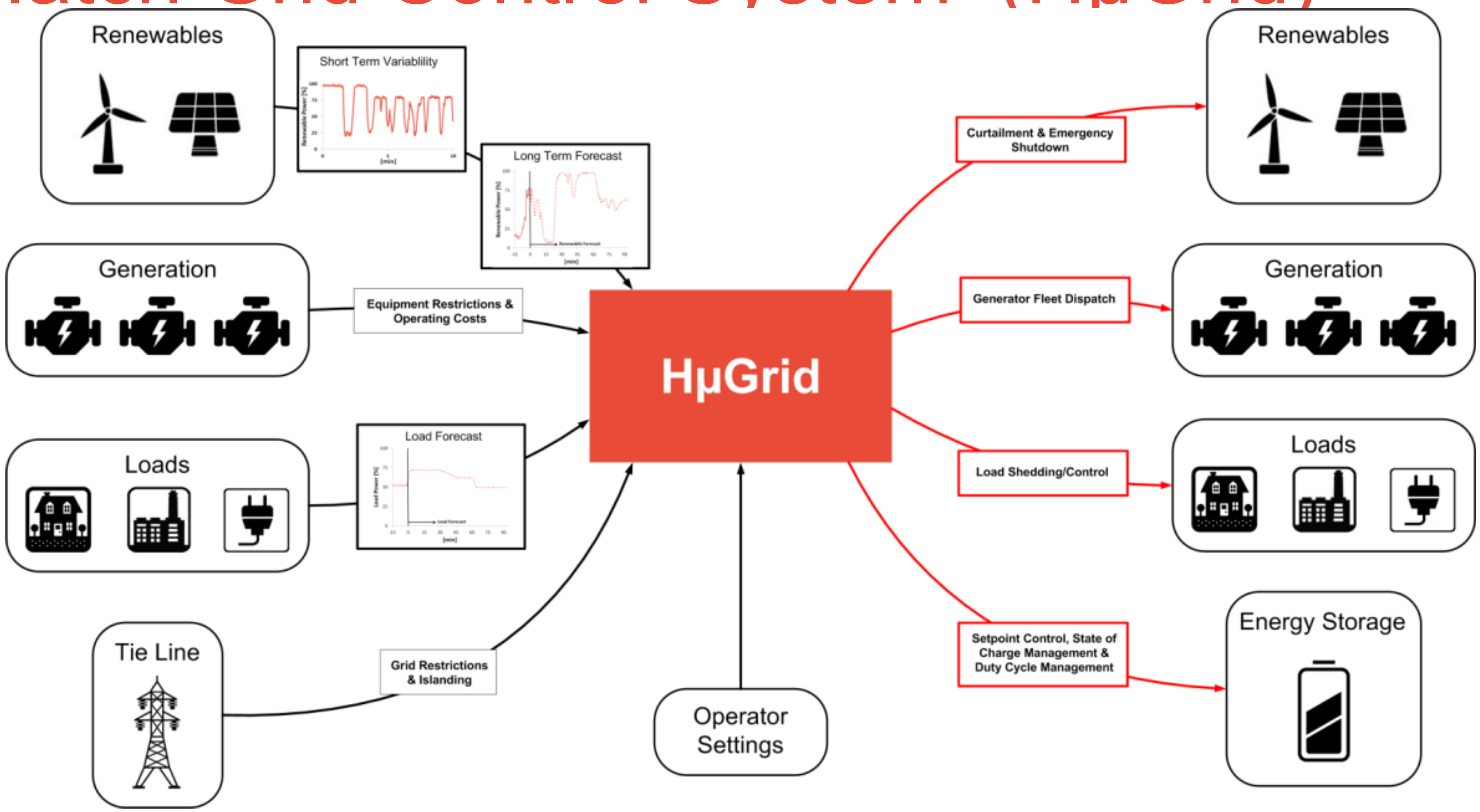
Photo Courtesy of Justin Bulota, Tugliq Energy

High-Speed Composite Flywheel

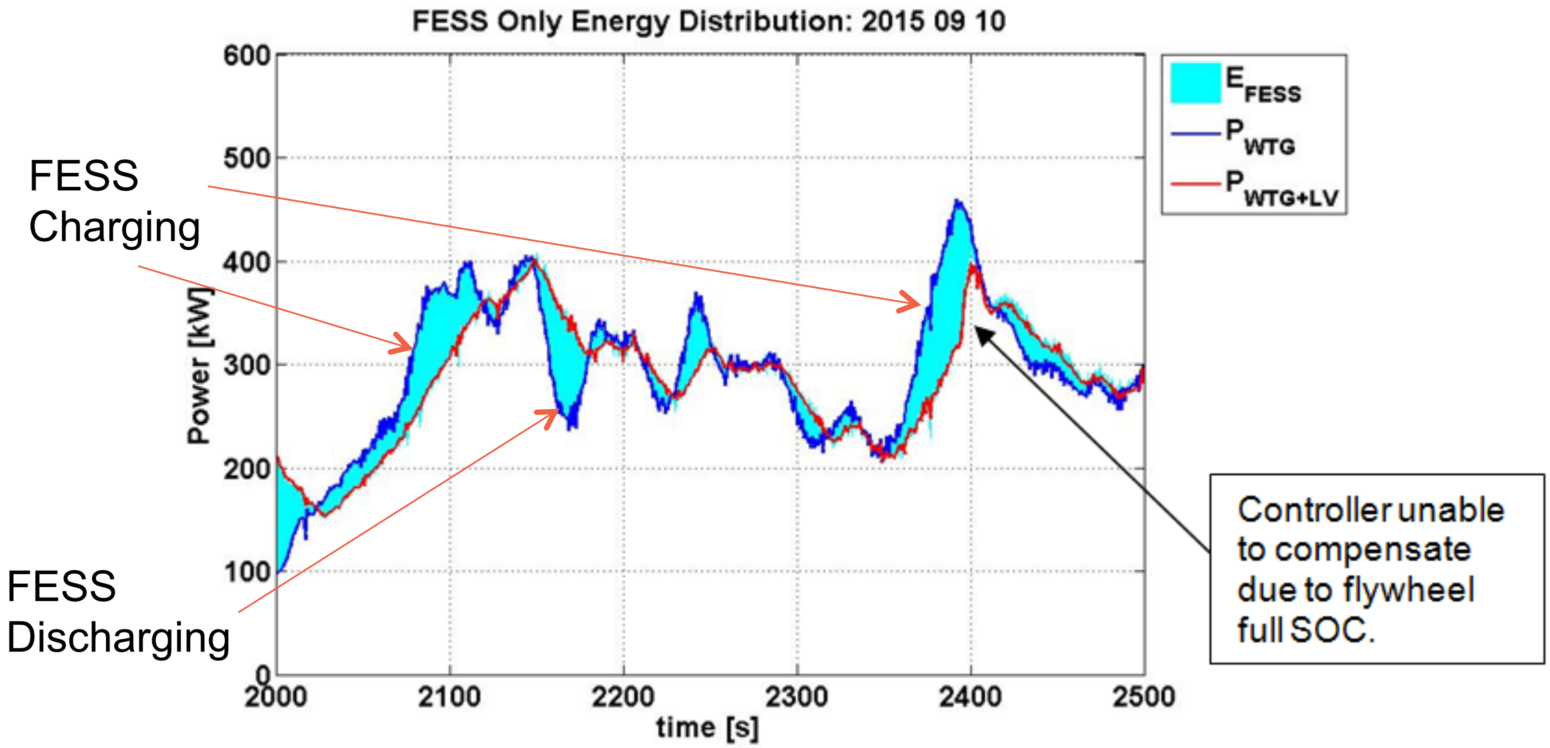


- 200 kW peak, 1.5 kWh storage
- High round trip efficiency (>96%)
- <5ms response time

Hatch Grid Control System (HμGrid)



Wind Power Ramp Control Using Flywheel (FESS)



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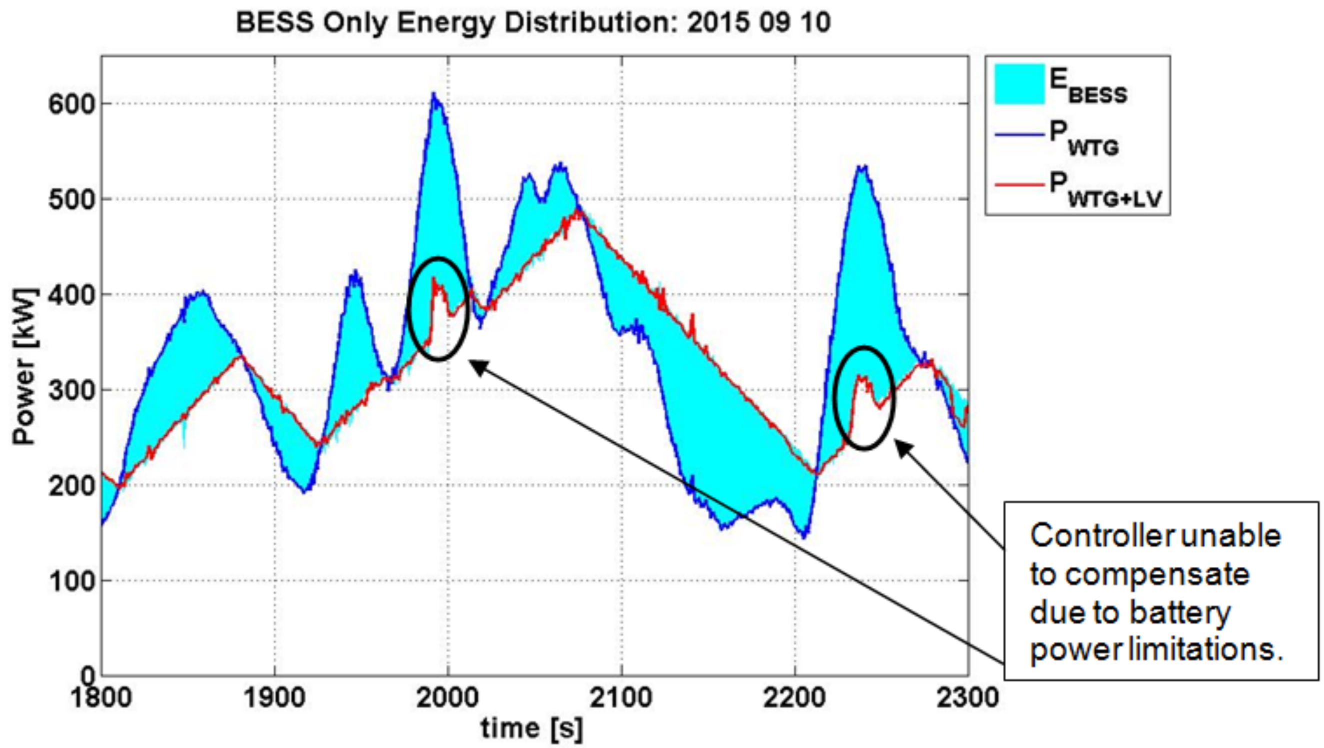
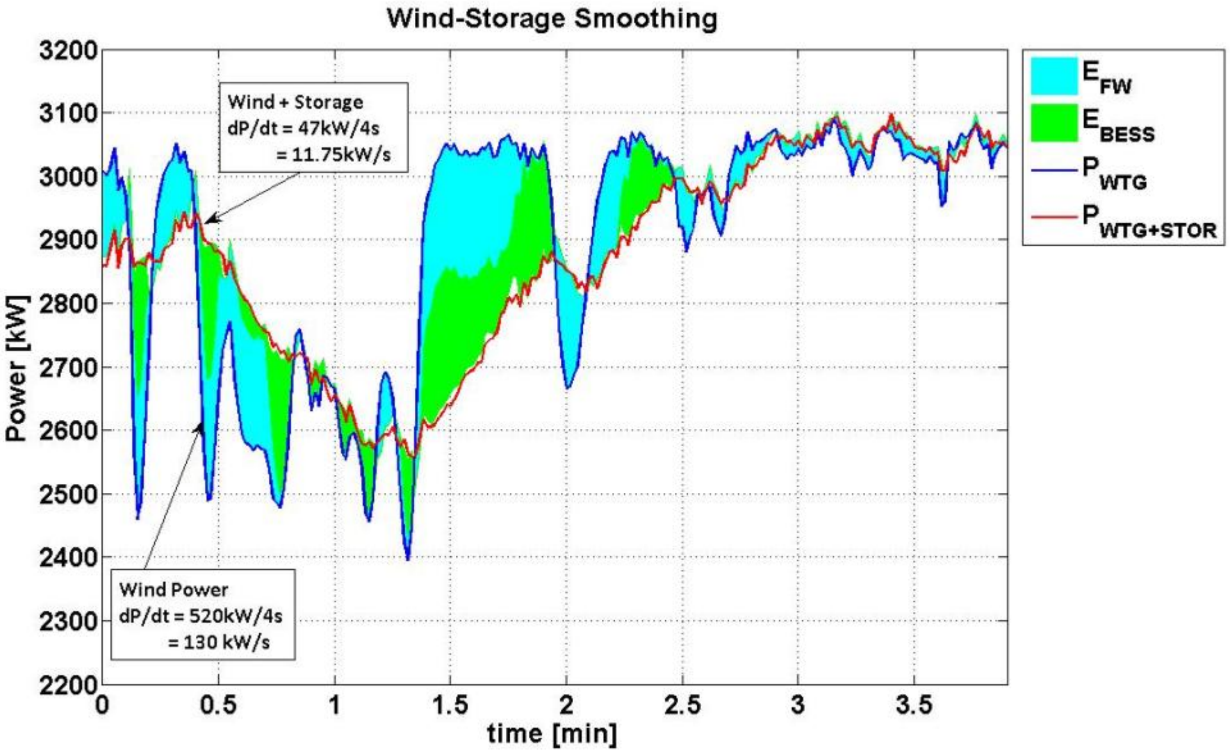
Wind Power Ramp Rate Control Using Battery (BESS)



Wind Power Ramp Rate Control using Both FESS/BESS



Project Results

- Availability in 2016: 99.4%
- Wind power maximum monthly Capacity factor: 51.76%
- Clean Energy production: 14.75 GWh
- Diesel Displaced: 3.78 million litres
- GHG reduction: 10,530 tons

Recap

- A case study of implementation of energy storage/ and advanced grid controls has been presented in the context of a remote islanded grid, with challenging load and renewable power profile.
- Energy storage and advanced grid controls allow increasing the penetration of renewable power in an island grid by:
  - Preserving system stability by operating within the thermal plant load pick-up capabilities
  - Management of excess renewable power
  - Reduction of spinning reserve

Thank you.

For more information,
please visit www.hatch.com

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