
# Case Study: Cowessess First Nation, Saskatchewan

*High Wind and Storage Systems*

## The Challenge

In 2006, SRC was approached by Cowessess First Nation (CFN) to install a 50-m anemometer tower 4 km east of Regina, Sask. to investigate the wind resource. Based on one year of data from the site's wind velocity, which was supported by 30 years of 10-m data from the Regina airport, it was shown that the wind resource could support a wind turbine. The challenge was to develop, design and arrange financing for one of the first utility-scale wind projects with battery storage in North America.

## The Need

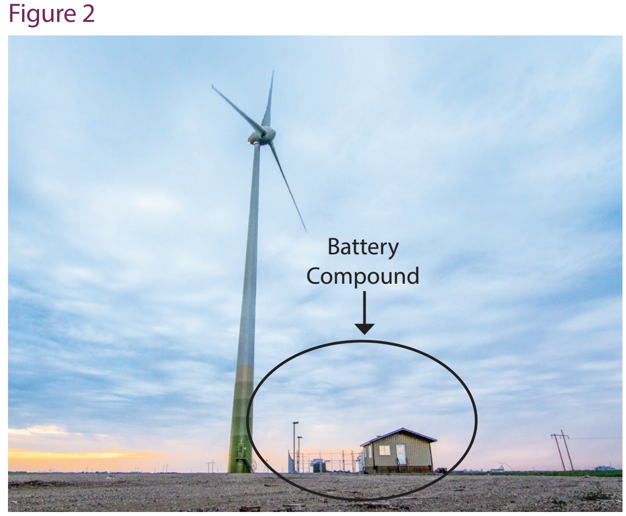
The client needed a wind turbine connected to the grid that could produce revenue, as well as provide training and knowledge on wind power development.

## The Solution

In 2009, Natural Resources Canada issued a request for proposals under the Clean Energy Fund to support SMART grid initiatives, which would pay one-half the cost of novel projects that could involve energy storage. A proposal was written to install an 800 kW Enercon E53 wind turbine and a 400 kW lithium-ion battery from Saft America with 744 kWh of storage capacity. With 25 per cent of the funding provided by Saskatchewan's Go Green fund, another 25 per cent from CFN and startup funding from Aboriginal Affairs and Northern Development Canada, the wind-battery system was operational in April 2013 (see Figures 1 and 2).

Figure 1

Figure 2



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The net electrical energy production from the turbine-battery system was 2,158 MWh between 2014-15, which provided $215,800 of revenue to CFN at a rate based on the power purchase agreement of about $100/MWh. The overall capacity factor was 30.8 per cent, and greenhouse gas emissions were reduced by 969 tonnes of $CO_2$ equivalent, assuming the displacement of natural gas power generation. The wind turbine generates sufficient electricity to meet the annual energy requirements of approximately 300 homes.

The wind-battery system is capable of firming the output when the wind is light, and time-shifting electricity from off-peak to on-peak hours when it has the highest value, or when the wind is not blowing. In addition, lithium-ion battery systems can respond to changes in wind power in less than one second. They are capable of smoothing the variable output of the wind by 65 to 78 per cent. The reduced volatility is highlighted in (Figure 3) at 8:00 when the power from the turbine drops from 800 kW (100 per cent power) to zero over about 15 minutes. The overall power output to the grid remains relatively steady at about 500 kW.

This reduction in volatility is important for increasing the level of wind and solar penetration of the electrical grid.  Note that batteries are also being evaluated for load following, providing voltage support and reducing "hot spots" on transmission and distribution lines. The performance of the turbine-battery system over one year of operation is summarized in Table 1.

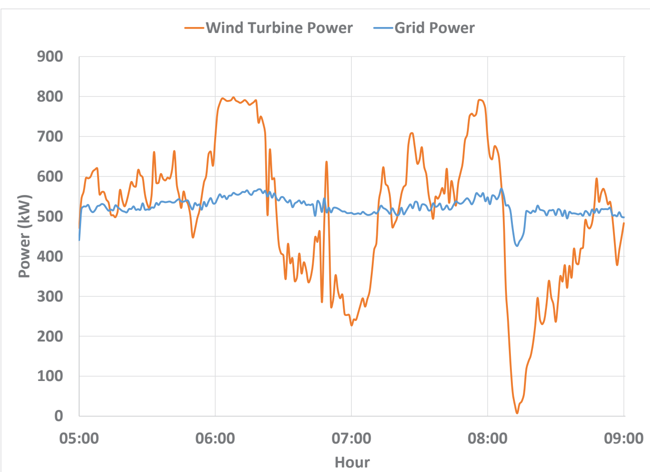


Table 1: Smoothing wind power output and performance

| Performance Summary | Actual (%) |
|---|---|
| Turbine Availability | 95.6 |
| Battery Availability | 85.0 |
| Turbine Capacity Factor | 31.8 |
| Turbine-Battery Capacity Factor | 30.8 |
| Overall Turbine-Battery Efficiency | 94.0 |
| Battery Round-trip Efficiency | 82.9 |
| Battery Round-trip Efficiency including heating, ventilating and air conditioning | 76.5 |

## Associated Services

- Proposal Development
- Project Management
- Wind Resource Assessment
- Mechanical, Electrical and Civil Engineering Design and Development
- Project Integration:
  - SaskPower – Power purchase agreement, 25 kV, 3-phase distribution line, 14.4 kV single-phase distribution line and electrical approvals
  - Willms Engineering – electrical engineering
  - Clifton Associates – environmental and geotechnical assessments and civil engineering
  - McNair Business Development – management, financing, invoicing and auditing support
- Commissioning and Regulatory Approvals
- Monitoring and Testing Wind-battery Output
- Results Analysis
- Reporting