AURORA RESEARCH INSTITUTE
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Norman Wells Wind Energy Pre-feasibility Analysis Summary

Summary of Wind Study

- Since 2005, the Aurora Research Institute (ARI) has researched the wind energy potential for communities in the NWT served by diesel.
- In September 2008, ARI installed a wind monitoring station on Kee Scarp, 5 km northeast of Norman Wells and measured wind speed and direction there for two years.
- Results of the wind monitoring program revealed a long-term wind speed of 5.0 m/s at 40 m above ground level. The long term average wind speed was also estimated to be 5.5 m/s at 50 m above ground level and 6.3 m/s at 80 m above ground level.
- The average electrical power load in Norman Wells is about 1,142 kilowatts (kW), and electrical energy consumption in the town is about 10,000,000 kilowatt hours (kWh) per year.
- Norman Wells' electricity is currently generated from natural gas, but it is expected that sometime in the near future it will be replaced by diesel.
- A wind project in Norman Wells could produce up to 1,315,000 kWh of wind energy annually at a cost of about $0.57 per kWh. This would displace about 13% of the diesel electricity used in an average year.
- Subsidies would be needed to make wind energy competitive with present diesel fuel prices; however, diesel rises to $1.60/L, the cost of wind energy generated electricity will become competitive with diesel generated electricity.
- If the community would like to pursue a wind project, then the next step would be to assess the future plans for the gas plant, and to seek project feasibility funding from Indian and Northern Affairs Canada. Funding may also be available from the GNWT.

Assessment of Wind Speed

- The Kee Scarp ridge northeast of Norman Wells was identified as a suitable site for evaluating wind energy (Figure 1).

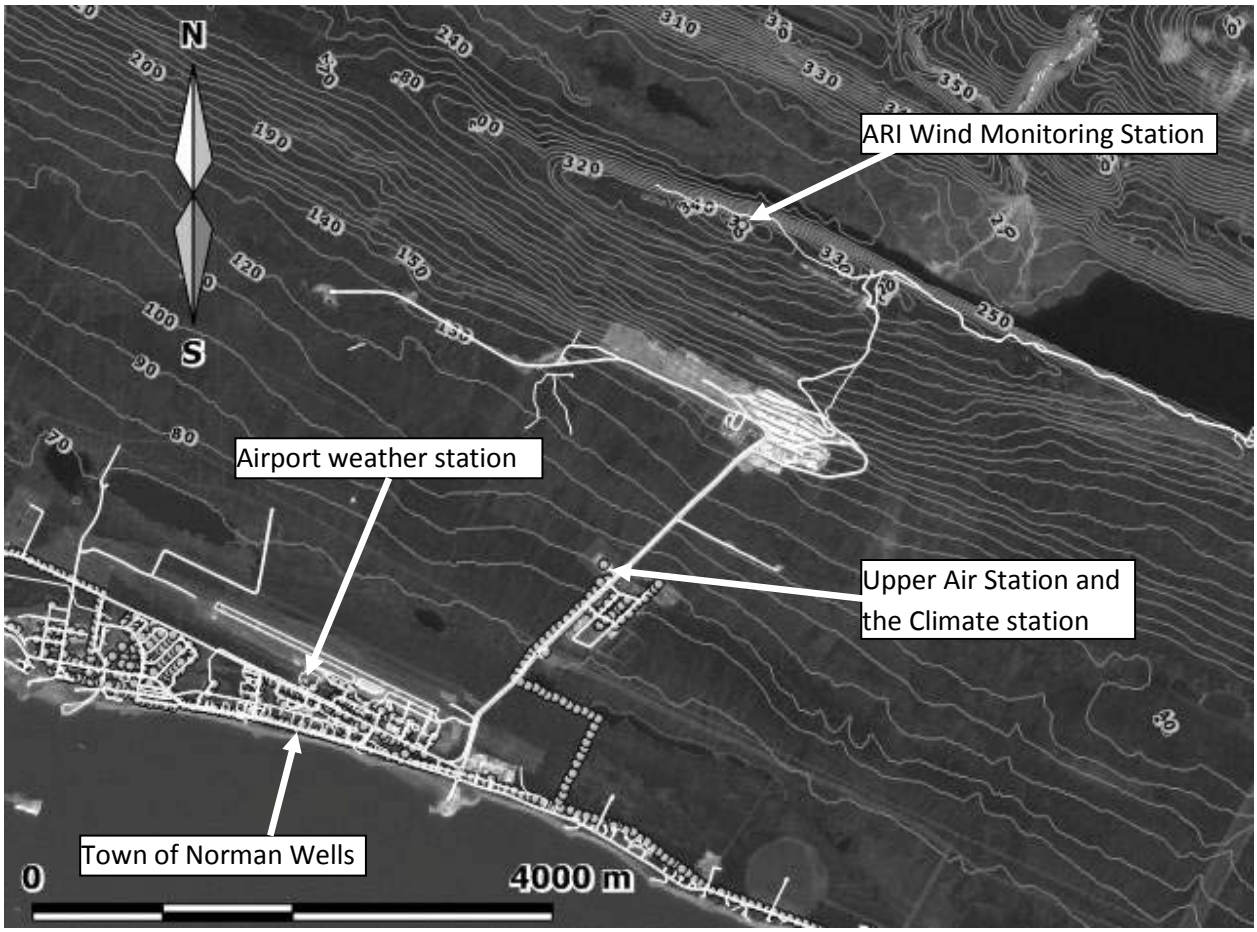

Figure 1: Map of the Norman Wells area. Contour interval is 10 m.

- In September 2008, the Aurora Research Institute installed a wind monitoring tower on Kee Scarp and measured wind speed and direction for two years. For this period the station measured a mean wind speed of 4.2 m/s (or 15.1 km/h) at 25m above ground level, and 4.9 m/s (17.6 km/h) at 40 metres above ground level.

- Using the nearby upper air measurements taken by weather balloons, the long term annual average wind speed at the Kee Scarp wind site was estimated to be 5 m/s (18 km/h) at 40 metres above ground level. These speeds are considered moderate for a wind energy project.

- Using computer analysis, the long term mean wind speeds were also estimated at 5.5 and 6.3 m/s at 50 and 80 m above ground level, respectively.
- The result of a computer wind flow model indicates that an area of about 120 m by 700 m across the top of Kee Scarp has wind speeds faster than 5 m/s at 40 m above ground level. This area, shown in Figure 2, is large enough to fit at least ten wind turbines of the size of the Aeronautica A225.

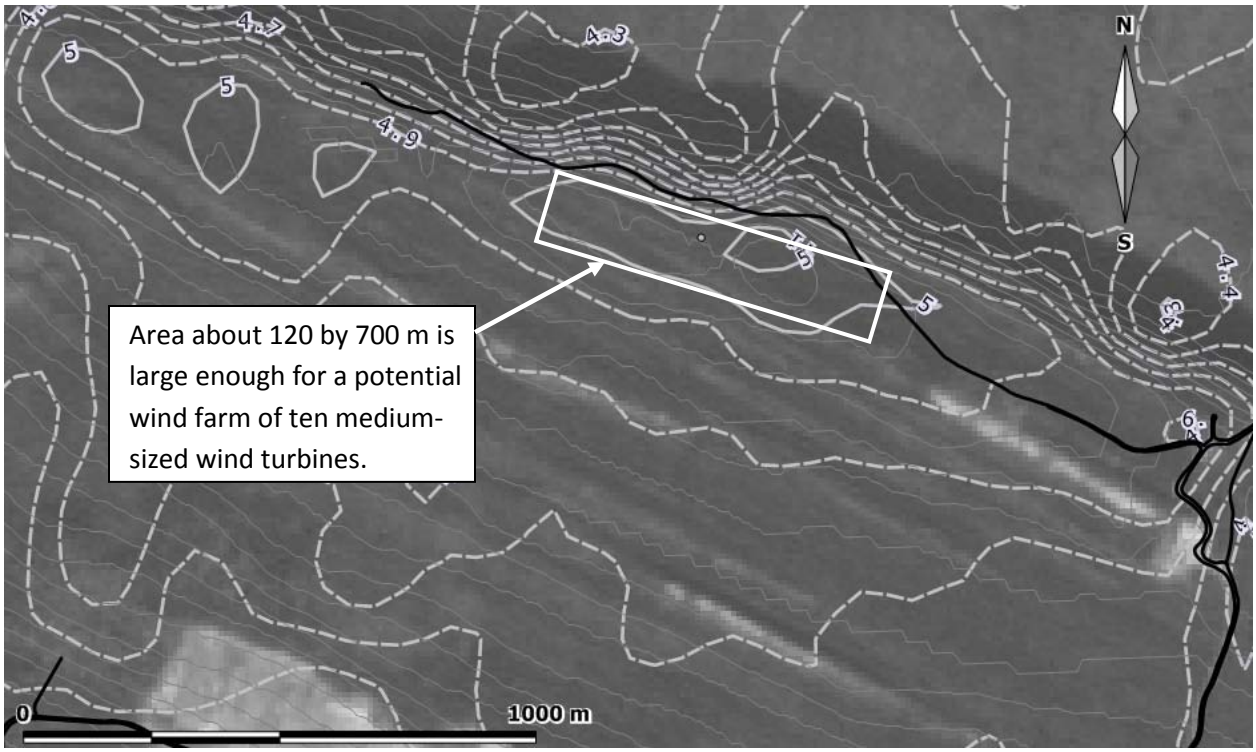

Figure 2: Aerial image of Norman Wells overlaid with wind speed contours. The wind speeds are modelled at 40 m above the ground. The wind speed contour interval is 0.1m/s.

How Wind Power Costs are Calculated

- Two different wind turbines were used to calculate the cost of a wind project for Norman Wells (Figure 3).
- The cost of installing a wind turbine in Norman Wells includes the following:
    - building a road to the site,
    - building a new powerline to the site,

- constructing the tower foundation(s),
- shipping the equipment, and
- many other expenses.

- The wind energy costs per kWh are an average annual cost (or "levelized" cost of energy) based on a typical 20-year life-span for a wind project. The energy costs include: paying the capital borrowed over 20 years at 7.5% interest; accounting for general inflation rate of 2%; and wind project operation and maintenance.

Figure 3: The two wind turbines considered in the economic study for Norman Wells. On the left is the Aeronautica A225 (225 kW) and on the right is the NorthWind 100 (100 kW).

How Much the Proposed Wind Project will Cost

The table below shows costs and production subsidies that would be required to build a wind farm at the selected site. This table shows the two types of wind turbine models used for this study: the Northern Power Systems' NorthWind 100kW (NW100) which has a 21 m rotor and a 37 m tower, and the Aeronautica's 225kW (A225) which has a 29 m rotor and a 50 m tower. The Aeronautica A225 with its taller tower would produce the lowest cost energy.

Table 1: A summary of suitable wind energy development options for Norman Wells using two different models of wind turbines. Also listed are the subsidies required to produce wind energy at a rate competitive with current diesel prices of $1.00 per L, which translates into an electricity cost of $0.38 per kWh.

Wind Turbine Model	Maximum Power Output	Total Project Cost	Energy Produced in kWh/year	Energy Cost per kWh	Subsidy Required per kWh
Four NW100	400 kW	$4,751,000	525,129	$0.97	$0.59
Two A225	450 kW	$4,240,000	666,537	$0.78	$0.40
Nine NW100	900 kW	$8,099,000	1,181,539	$0.77	$0.39
Four A225	900 kW	$6,686,000	1,315,409	$0.57	$0.19

- The Aeronautica 225kW provides the most energy per dollar spent. This results in the lowest cost per kWh of electricity produced.
- At the proposed wind site, a 900 kW wind project with four Aeronautica 225kW will produce 1,315,409 kWh of electricity and displace 355,500 litres of diesel per year. This is about 13% of the diesel-generated electricity the community uses each year.
- The current cost of diesel-generated electricity in Norman Wells is $0.38/KWh (excluding operation and maintenance), based on diesel purchased at $1.00/L. A wind farm must then be able to produce power at a cost that is lower than that cost of diesel-generated electricity to make a profit.
- A wind project with the four Aeronautica 225kW turbines would have an average energy cost of $0.57/kWh and would require a production incentive of $0.19/kWh in order for the project to be cost-effective.
- In 2008, the cost of diesel reached $1.70/L. When the cost of diesel climbs to $1.60/L, a wind energy project in Norman Wells will become competitive with diesel-generated electricity, which will cost $0.58/kWh (but this does not include operation and maintenance costs). A wind project will require very low subsidies when diesel prices reach $1.60/L.

- Funding may be available from Indian and North Affairs Canada to carry out more detailed studies, and to seek the required permits for this potential wind project. The EcoEnergy for Northern and Aboriginal Communities Program may provide capital funding. Funding may also be available from the GNWT.

Conclusions

- Kee Scarp has potential as a wind development site. It is within 5 km of the community and is accessible by road and ATV/4x4 trails.
- Capital costs for a wind project of 400 kW using four NorthWind 100 turbines will cost $4.7 million whereas a 900 kW project using four Aeronautica 225 kW turbines will cost $6.7 million.
- With forecasted wind speeds of 5.5 m/s at 50 m above ground level, the four A225 wind project would produce power at a cost of $0.572 per kWh.
- At a wind speed of 5.5 m/s at 50 m above ground, a 900 kW project with four A225 turbines would displace 355,500 litres of diesel fuel per year and reduce greenhouse gas emissions by 1 million kg of carbon dioxide (CO_2) equivalent per year.
- Some subsidies will be required but are available to develop a wind project in Norman Wells.

The full Norman Wells Wind Energy Pre-Feasibility Update report is available to download at http://www.nwtresearch.com

For more information on this or other wind energy studies in the NWT, contact the Aurora Research Institute at:

191 Mackenzie Road
P.O. Box 1450
Inuvik, NT CANADA
X0E 0T0
Phone: (867) 777-3298
Fax: (867) 777-4264

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