

Lutselk'e Wind Energy Pre-feasibility Analysis Summary

Summary of Wind Study

- Since 2005, the Aurora Research Institute (ARI) has researched the wind energy potential in NWT communities that are served by diesel.
- In 2010, ARI chose Lutselk'e for a desktop pre-feasibility study to assess the wind climate and the economics of building a wind project in the community.
- In this study, a ridge southeast of the hamlet and south of the airport was identified as an ideal location for a wind project, if one were to be proposed.
- Using the wind measurements from the nearby airport climate station, a computer wind flow model estimated that the wind speeds are about 6.2 m/s (22.3 km/h) on the ridge south of the airport.
- Lutselk'e's electrical load is currently met by a diesel-electric plant. The community's average electrical load is about 190 kilowatts (kW), and the electrical energy consumption is 1,700,000 kilowatt hours (kWh) per year.
- The economic analysis for a wind project in Lutselk'e estimates that 160,000 to 280,000 kWh of wind energy could be produced at a cost of about \$1.00 to \$1.60 per kWh. This would offset about 9 to 16% of the diesel electricity.
- The wind project will need to cost \$0.37 per kWh or less to be competitive with diesel electric generation.
- Subsidies will be needed to make a wind energy project competitive with present diesel fuel prices (\$1 per litre); however, as the cost of diesel rises to \$2.90 per litre, the cost of wind generated electricity will become competitive with diesel-electricity.

- Other renewable energy sources, like hydro and solar energy, should be examined before proceeding with a wind project in Lutselk'e.

Assessment of Wind Speed

- A ridge southeast of Lutselk'e was identified as a suitable site for evaluating wind energy (Figure 1).

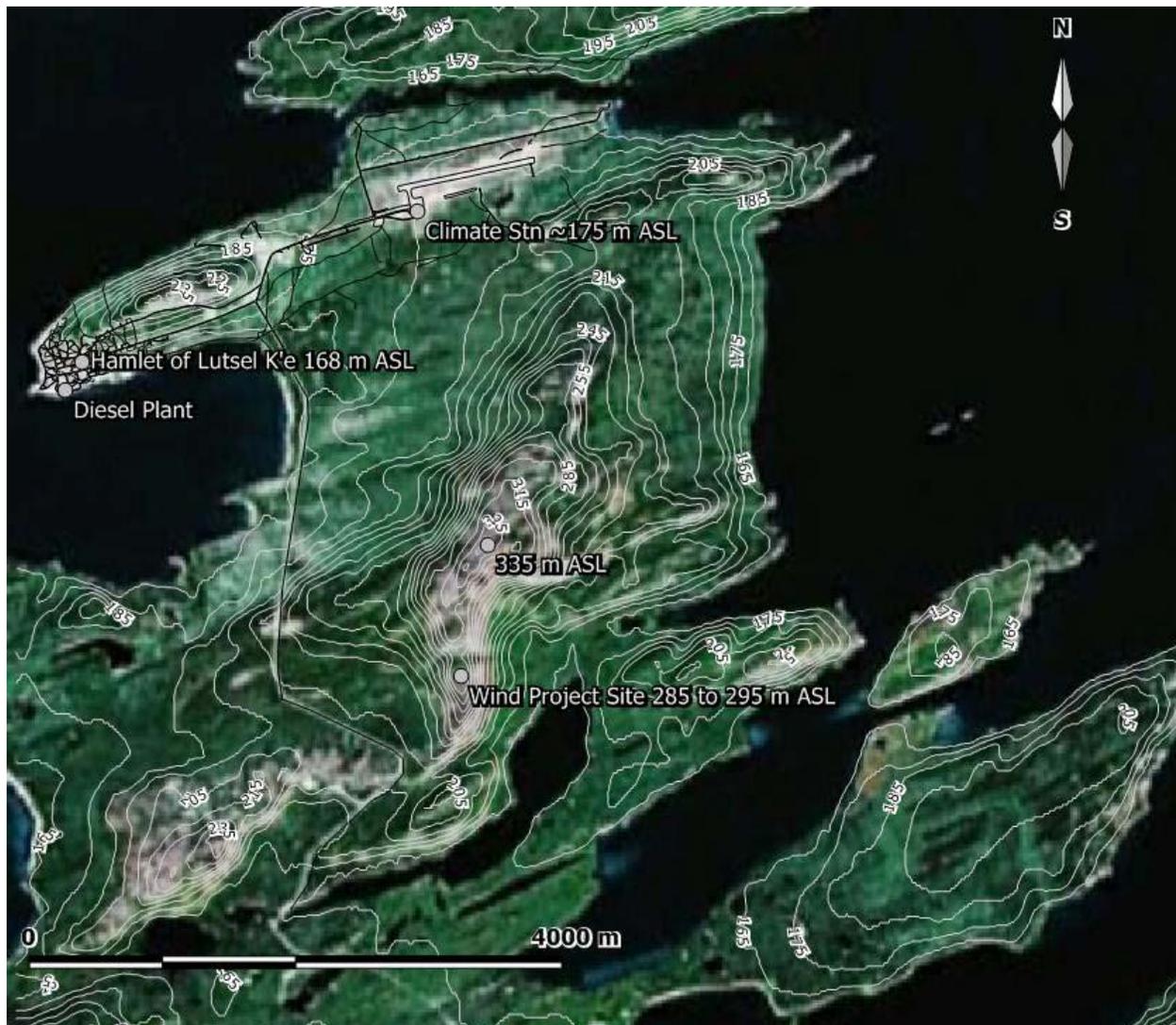


Figure 1: Map of the Lutselk'e area. Contour interval is 10 m, starting with the lowest contour at 165 m above sea level (ASL).

- The nearest weather station to Lutselk'e is at the local airfield, which is 3 km east. This station measured an average annual wind speed of 3.2 m/s (11.5 km/h) at 10 m above ground level.

- A computer wind flow model was used to estimate the wind speed to the hilltops near Lutselk'e, as shown in Figure 2.
- The average annual wind speed on the ridge top southeast of the hamlet was estimated at more than 6.2 m/s (22.3 km/h) at 30 metres above ground. These speeds are considered good for wind energy development.



Figure 2: Aerial image of Lutselk'e overlaid with wind speed contours. The wind speeds are modelled at 30 m above the ground. The contour interval is 0.5m/s.

How Wind Power Costs are Calculated

- Four different wind turbine options were used to calculate the cost of a wind project in the hamlet. Two of them are shown in Figure 3.
- The cost of installing a wind turbine 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: Two of the four wind turbines considered in the economic study for Lutselk'e. On the left is the Endurance E-3120 (55 kW) and on the right is the NorthWind 100 (100 kW).

How Much the Proposed Wind Project Will Cost

The table below shows the costs and production subsidies that would be required to build a wind farm at the selected site. This table shows the four wind turbine models used for this study: Northern Power Systems' NorthWind 100 (100 kW), Seaforth Engineering's AOC 15/50 (60 kW), the Endurance E-3120 (55 kW), and the Wenvor 30 (35 kW) turbines.

Table 1: A summary of wind energy development options for Lutselk'e using four different models of wind turbines. Also listed are the subsidies required to produce wind energy at a rate competitive with the current diesel prices of \$1.00 per litre, which translates into an electricity cost of \$0.37 per kWh.

Wind Turbine Options	Maximum Power Output	Total Project Cost	Energy Produced in kWh/year	Energy Cost per kWh	Subsidy Required per kWh
One NW100	100 kW	\$2,555,000	208,600	\$1.29	\$0.92
Two AOC 15/50s	120 kW	\$2,443,000	224,700	\$1.17	\$0.80
Two E-3120s	110 kW	\$2,592,000	278,200	\$0.998	\$0.63
Three Wenvor 30s	105 kW	\$2,391,000	161,700	\$1.60	\$1.23

- The current cost of diesel-generated electricity in Lutselk'e is \$0.37/kWh (excluding operation and maintenance), based on diesel purchased at \$1.00 per litre. A wind farm must then be able to produce power at a cost that is lower than the cost of diesel-generated electricity to make a profit.
- The Endurance E-3120 is the most expensive option to install, but it also produces the largest amount of energy and results in the lowest cost per kWh of electricity produced.
- A wind project with the two E-3120 turbines would have an energy cost of \$0.998/kWh and require a subsidy of \$0.63/kWh in order for the project to be cost-effective.
- The most expensive part of the wind project is the 5.5 km power line which would be required to bring wind energy to the community and is estimated to cost \$1 million. Without the power line, the cost for energy would range from \$0.619 (two E-3120s) to \$0.947 per kWh (three Wenvor 30s).

- At the proposed wind site, a 110 kW wind project with two Endurance E-3120 will produce 278,200 kWh of electricity and displace 73,200 litres of diesel or 220 tonnes of greenhouse gas emissions per year. This is about 16% of the diesel-generated electricity used by the community in a year.
- In 2008, the cost of diesel reached \$1.70 per litre. When the cost of diesel climbs to \$2.90 per litre, a wind energy project in Lutselk'e will be competitive with diesel-generated electricity, which will cost \$1.00 per kWh (this does not include operation and maintenance costs). At this new price for diesel, the wind project will require very low subsidies to be competitive.

Conclusions

- The ridge south of Lutselk'e is the only potential wind development site in the area, and it has an estimated wind speed of 6.2 m/s at 30 m above ground level. It is about 5.5 km from the community and has all-weather road access.
- The cost for a wind project of about 100 kW would range from \$2.4 to \$2.6 million depending on the turbine model selected.
- With a forecasted wind resource of 6.2 m/s, wind projects with a power line would produce power at a cost of \$1.00 to \$1.60 per kWh depending on the turbine selected. The wind project will need to cost \$0.37 per kWh or less to be competitive with diesel.
- The Endurance E-3120 would produce the lowest cost energy.
- At a wind speed of 6.2 m/s, a 100 kW project would displace up 73,200 litres of diesel fuel per year, and reduce greenhouse gas emissions by up 220,000 kg of carbon dioxide (CO₂) equivalent per year.
- A wind project in Lutselk'e will require significant subsidies to be cost-effective.
- Given the cost of a wind project in Lutselk'e, other renewable energy sources (such as hydro and solar power) should be examined.

- If wind energy development is still a serious consideration for Lutselk'e, a wind monitoring tower should be installed at the identified project site to confirm the computer wind flow model results by measuring wind speed and direction. See figure 4 for an example of a wind monitoring tower.

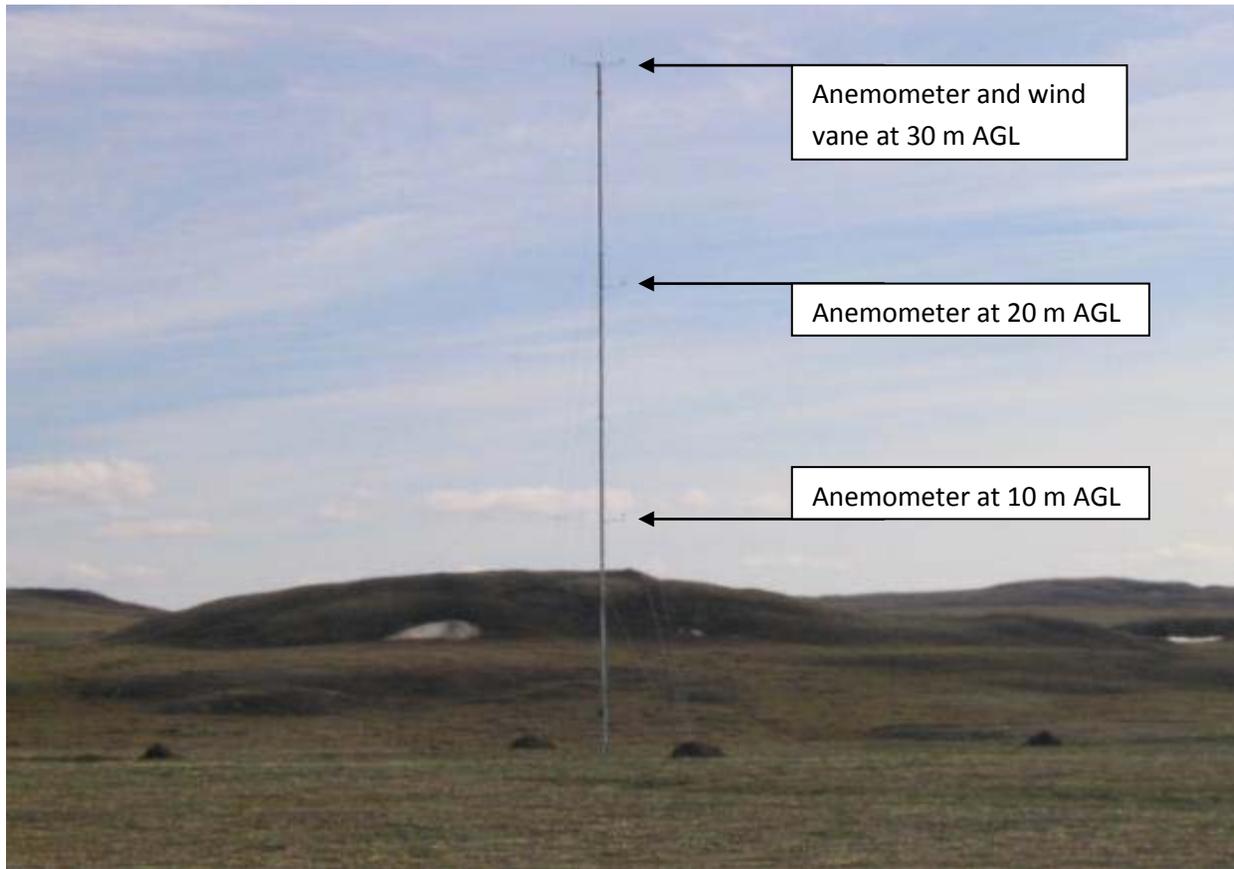


Figure 4: The wind monitoring station proposed for Lutselk'e will look like this tower that was used in Paulatuk. It has three wind speed sensors (anemometers) at 10, 20, and 30 m above ground level (AGL).

**The full Lutselk'e Wind Energy Pre-feasibility Report is available
for download at www.nwtresearch.com**

**For more information on this or other wind energy studies in the NWT,
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