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Ulukhaktok Wind Energy Study

Figure 1: Alan Pogatok and William Hurst are shown installing the wind monitoring station on the East Ridge. Joseph Kuptana is in the background.

Overview of Wind Study

- In 2006 the Aurora Research Institute established a wind monitoring station on the East Ridge (Figure 1) and the equipment was taken up there by snow machine (Figure 2).
- This station measured wind speeds from 10 to 30 metres above the ground using wind speed sensors called anemometers (see Figure 3 and Figure 4).
- This site was monitored with the help of Joseph Kuptana who collected wind speed data every month during the study.
- After several years of measurements the wind data collected at the site was analysed with a computer wind model to estimate the long term wind speed for several sites in the area around Ulukhaktok.
- An economic analysis was also made to determine the cost of developing a wind project for several sites in the area of Ulukhaktok.

Figure 2: Transporting the wind monitoring equipment to the East Ridge.

Figure 3: An anemometer is a piece of scientific equipment that measures wind speed. These are placed on the wind monitoring tower shown in Figure 4.

Wind Monitoring Results

- The wind data analysis estimates that the East Ridge site has a long-term annual average wind speed of 6.6 meters per second (m/s; or 24 km/h) at a height of 37-metres above ground level (AGL).
- The dominant wind direction in the area is from the east-southeast.
- Seasonally, the wind speeds are highest in October and lowest during the spring and summer.
- The measurements reveal that there is an excellent wind resource at the East Ridge site. However it will be shown later that this site is too difficult to access for a wind project and that there are better locations in Ulukhaktok.
- The winds may be strong enough year-round to consider a wind development for a source of energy for the community.

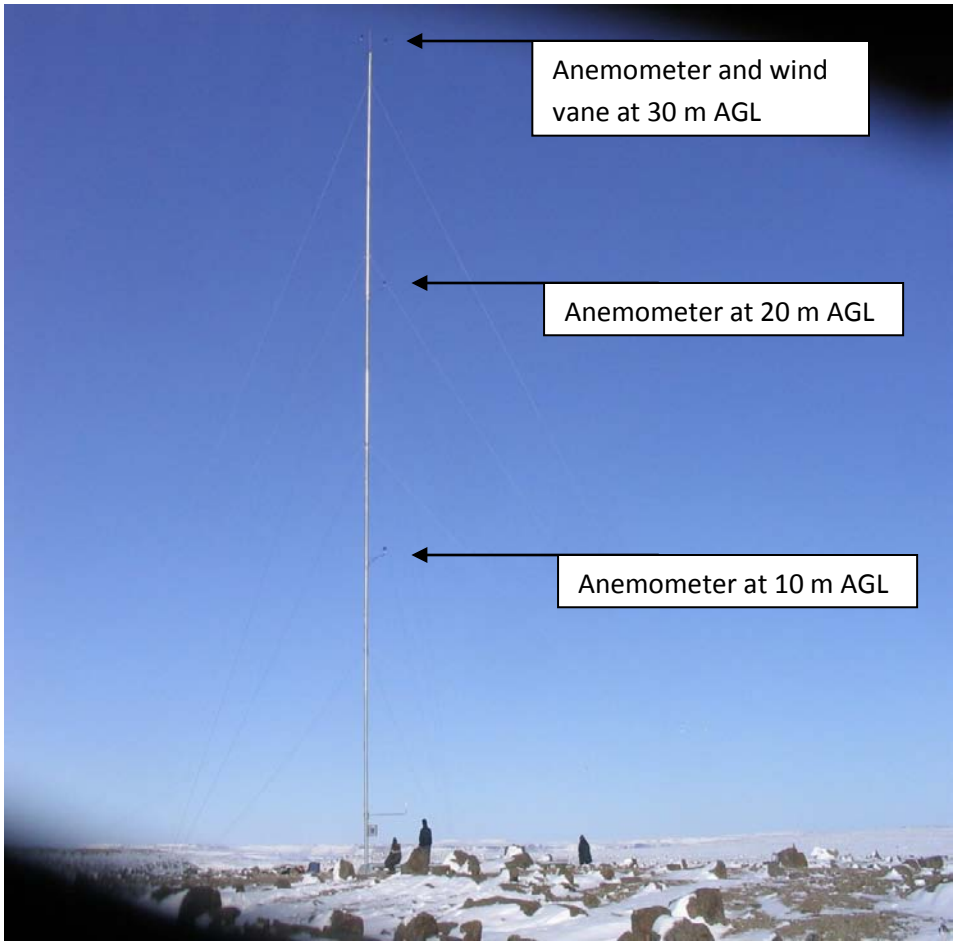

Figure 4: The wind monitoring tower is on the East Ridge, east of Ulukhaktok. It has three anemometers at 10, 20, and 30 m above ground level (marked as AGL on image) to measure wind speeds.

Sites that could be Considered for a Wind Development

- To determine the wind speeds at several other locations in the area a computer wind flow model was used.
- The images below show three sites that could be considered for a wind development. The three proposed sites are:
    - Limestone Hill by the hamlet dump (Figure 5),
    - Three Hills southwest of the hamlet (Figure 6), and
    - Diesel Plant Hill just north of the hamlet power plant (Figure 7).

Figure 5: Limestone Hill proposed wind turbine location. The long-term annual average wind at this site is 5.7 metres per second (20.5 km/h) at 37 metres above ground. The red line is the power line which runs to about 400 metres from the site. The image is from Google Earth.

Figure 6: Three Hills proposed wind turbine location. The long-term annual average wind at this site is 6.2 metres per second (22.3 km/h) at 37 metres above ground. The red line is the power line which runs to about 400 metres from the site. The image is from Google Earth.

Figure 7: Hill behind the Diesel Plant. The long-term annual average wind at this site is 5.6 metres per second (20.2 km/h) at 37 metres above ground. The red line is the power line which runs to about 160 metres from the site. The site is also 325 metres from the diesel plant. The image is from Google Earth.

How the Costs of Wind Power are Calculated

- The tallest tower available for a small scale wind development suitable for this community is 37 meters tall designed for the EW50 wind turbine made by Entegrity (see Figure 8).
- It was found that two of these 50 kW wind turbines provided the best economy; that is, they reduce overall cost of energy by 20% compared to just one turbine.
- When calculating the costs of installing wind

Figure 8: A EW50 wind turbine installed at Nome Alaska. This model is recommended for Ulukhaktok.

turbines you need to consider the following costs:

  - costs to upgrade the road to the site,
  - costs to build a new powerline to the site,
  - costs to construct tower foundation,
  - shipping costs for the equipment and many other costs.

- We estimate that the cost to borrow money is at 8% interest rate (repaid over 20 years) and the annual operating cost is $15,000 per turbine.

What the Utility will Pay for the Wind Power

- A utility company will purchase wind energy at the cost of displaced diesel. The current cost of displaced diesel in Ulukhaktok is $0.42/KWh when diesel is purchased at $1.50 per litre.
- A wind development must then be able to produce power at a cost that is lower than the avoided cost of diesel to make a profit.
- A wind development in Ulukhaktok will require subsidies to compensate for the extra costs.

How much each Proposed Location will Cost

The table below shows all of the costs and subsidies that will be required to build a wind project at each site. We should keep in mind that although a wind project might cost more to build at a particular site, the subsidy it needs may be less if the site is very windy. Sites with more wind produce more energy.

Site	Wind Speed (m/s)	Total Project Cost	Per kWh Energy Cost	Subsidy Required	Subsidy if Paid per kWh
East Ridge	6.6	$2,339,000	$1.00	$1,534,000	$0.58
Three Hills	6.2	$1,254,000	$0.68	$575,900	$0.26
Diesel Plant Hill	5.6	$1,085,000	$0.78	$647,400	$0.36
Limestone Hill	5.7	$1,382,000	$0.90	$907,270	$0.49

- The East Ridge site is too expensive mainly because of the high cost to develop a road to the site.
- Limestone Hill is a convenient site to access but has low winds and the existing power line that runs to the airport will require an upgrade.
- The Diesel Plant Hill is the second best site even though its wind condition is poor.
- The Three Hills site is the best site, it will cost more to develop than the hill behind the diesel plant but it needs a lower subsidy because its higher wind speed will produce more energy.
- At the Three Hills site a wind project will produce 228,000 kWh of electricity and displace 63,000 litres of diesel per year.

Conclusions

- Of the locations studied the Three Hills site has the best economy with its high winds, close proximity to power line, and easy access.
- A wind project at this site will cost $1,254,000 and require $576,000 in subsidies in order for it to happen.
- Costs will be reduced if this project is carried out simultaneously with other wind projects in the Beaufort region, such as those being proposed in Paulatuk, Tuktoyaktuk, and Sachs Harbour.
- Results of a wind monitoring program reveals that Ulukhaktok will save 63,000 litres of fuel annually from installing two wind turbines near the hamlet, making Ulukhaktok one of the few Arctic communities to use sustainable energy.

The full report is at:

http://www.nwtresearch.com/resources/publications/wind.aspx

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