Recent economic studies for Wind-Diesel in the Northwest Territories

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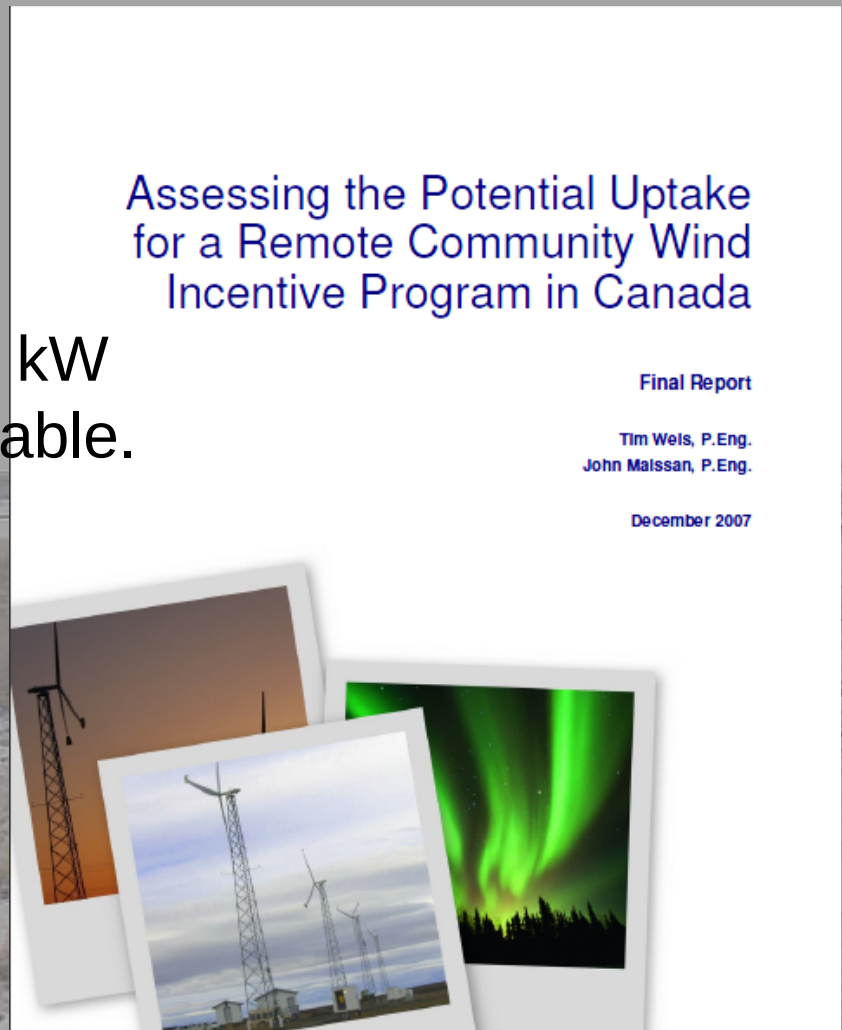
Outline

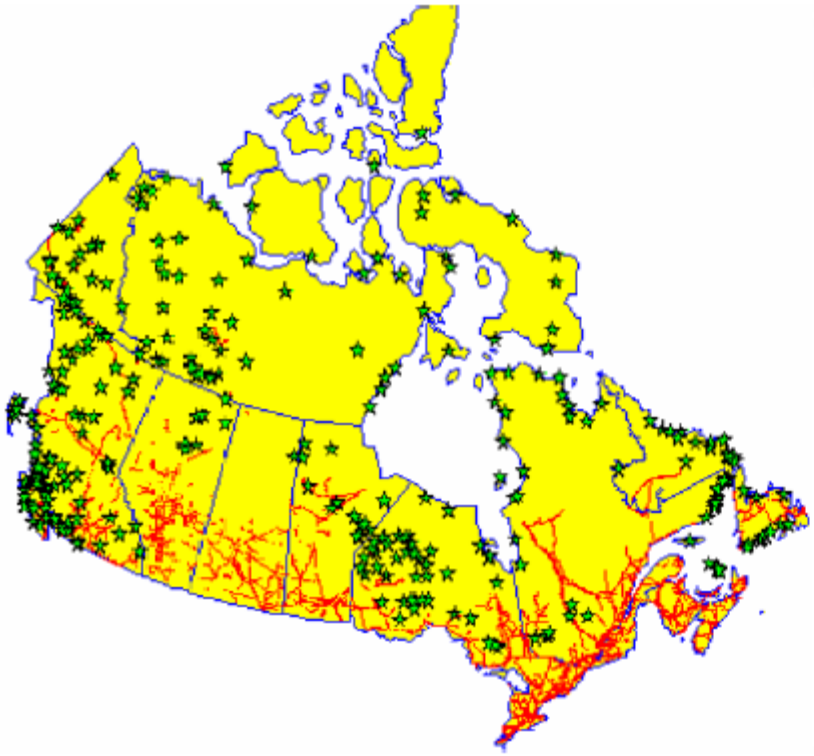
- Recent Canada-wide studies
- Beaufort Sea region wind economic studies.
- Note on climate change

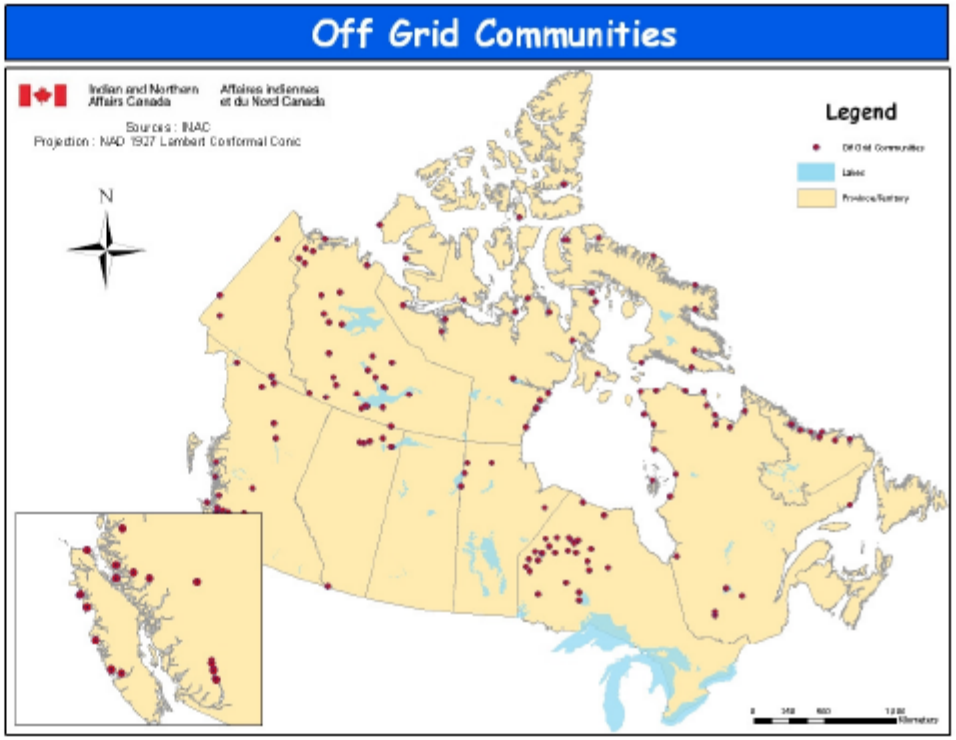
Recent Canada-Wide Study

- December 2007 study for CanWEA, by Tim Weis and John Maissan.
- Found that a target of 40 MW could be developed for mines and large communities.
- 24 projects average size of 500 kW totalling 12 MW are also achievable.



Recent Canada-Wide Study (cont'd)





There are about 80 remote communities in Canada that may have the potential for wind development.

Beaufort Sea Studies, NWT

- Recent studies were completed for Ulukhaktok, Paulatuk, Sachs Harbour, and Tuktoyaktuk.
- The following are a summary of the results of these studies.


Estimate annual mean wind speed at 30 m AGL.
Based on Canadian Wind atlas (windatlas.ca),
except for Tuktoyaktuk, Sachs Harbour,
Ulukhaktok, and Paulatuk, which have been
measured.
Sachs Harbour(272kW,6.6 m/s)
Tuktoyaktuk(1057kW,5.1 m/s)
Ulukhaktok(499kW,6.2 m/s)
Aklavik(721kW,5.3? m/s)
Paulatuk(264kW,5.6 m/s)
Colville Lake(81kW,4.8 m/s)
Ft Good Hope(700kW,5.4? m/s)
Tulita(498kW,5.3? m/s)
Deline(633kW,5.9? m/s)
Gameti(342kW,4.5 m/s)
Norman Wells(1650kW,6.5? m/s)
Wekweti(0kW,6.1? m/s)
Wha Ti(466kW,6? m/s)
Lutsel` Ke(358kW,5.2? m/s)
Trout Lake(0kW,5.5? m/s)

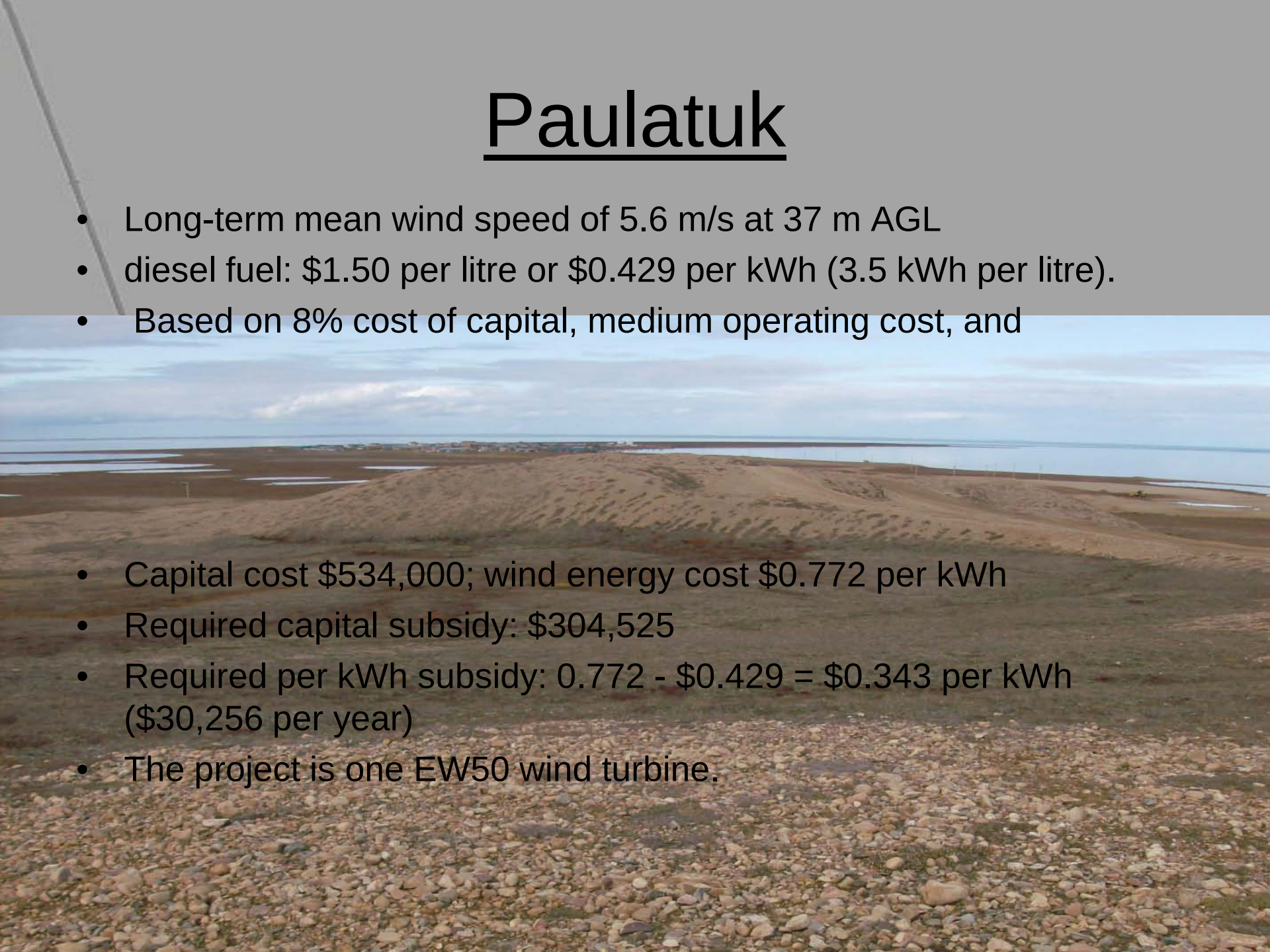
Tuktoyaktuk

- Long-term mean wind speed of 5.3 m/s at 37 m AGL
- Diesel fuel: $0.40 per kWh or $1.48 per litre (3.7 kWh per litre)
- Cost of capital 8.4%
-
- Capital cost: $1,607,000; wind energy cost $0.64 to $0.66 per kWh
- Required capital subsidy: $755,173 (equivalent to about $2,905 per kW of capacity)
- Required per kWh subsidy: $0.24 to $0.26 per kWh ($76,560 to $82,940 per year)
- Based on the Tuktoyaktuk draft technical business plan (4 EW50 wind turbines).

Tuktoyaktuk(cont'd)

Paulatuk

- Long-term mean wind speed of 5.6 m/s at 37 m AGL
- diesel fuel: $1.50 per litre or $0.429 per kWh (3.5 kWh per litre).
- Based on 8% cost of capital, medium operating cost, and



- Capital cost $534,000; wind energy cost $0.772 per kWh
- Required capital subsidy: $304,525
- Required per kWh subsidy: 0.772 - $0.429 = $0.343 per kWh ($30,256 per year)
- The project is one EW50 wind turbine.

Paulatuk (cont'd)

Sachs Harbour

- Long-term mean wind speed of 6.6 m/s at 37 m AGL
- fuel costing $1.50 per litre or $0.469 per kWh (3.2 kWh per litre).
- The project is a one EW50 wind turbine.
- Based on 8% cost of capital, medium operating cost, and diesel
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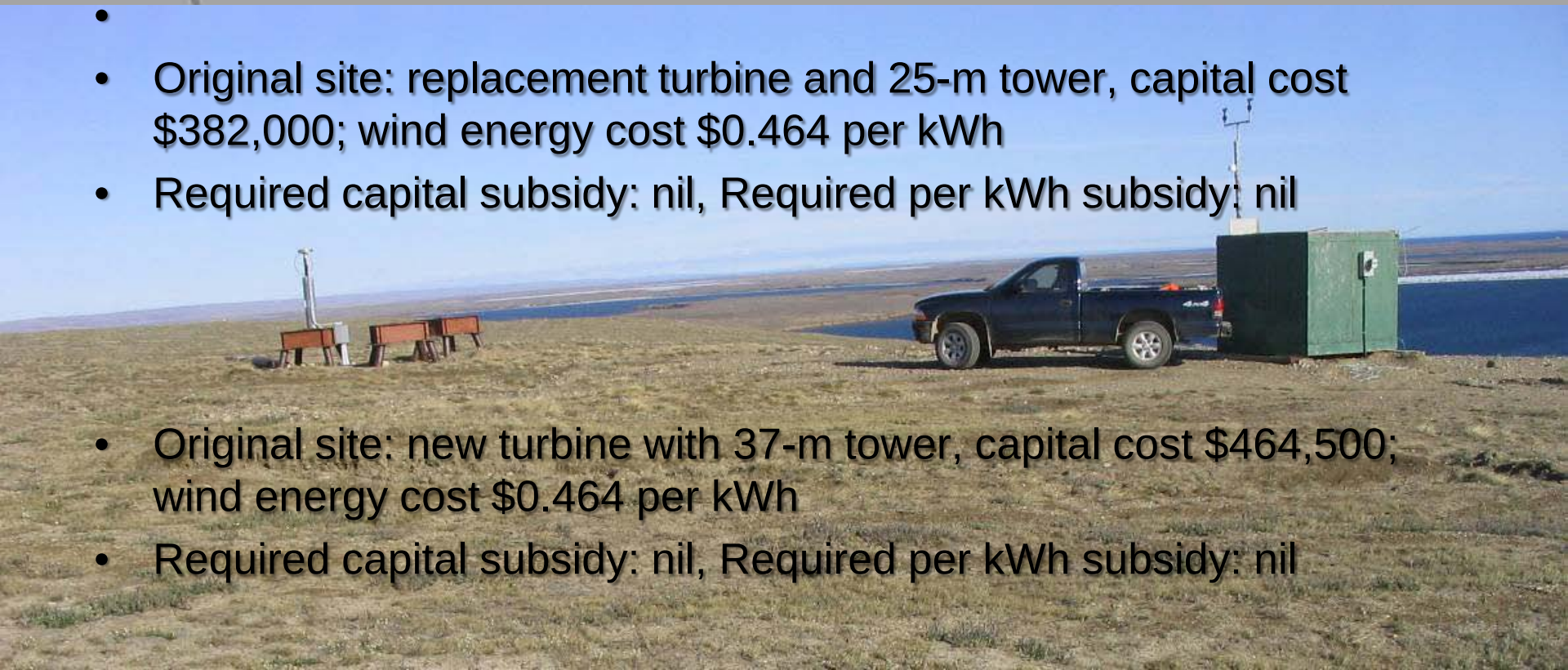
- Original site: replacement turbine and 25-m tower, capital cost $382,000; wind energy cost $0.464 per kWh
- Required capital subsidy: nil, Required per kWh subsidy: nil



- Original site: new turbine with 37-m tower, capital cost $464,500; wind energy cost $0.464 per kWh
- Required capital subsidy: nil, Required per kWh subsidy: nil

Sachs Harbour (cont'd)

- Long-term mean wind speed of 6.6 m/s at 37 m AGL
- fuel costing $1.50 per litre or $0.469 per kWh (3.2 kWh per litre).
- The project is a one EW50 wind turbine.
- Based on 8% cost of capital, medium operating cost, and diesel

  Proposed alternate site, on east loop road, capital cost $704,500; wind energy cost $0.645 per kWh
- Required capital subsidy: $232,960
- Required per kWh subsidy; $0.645 - $0.469 = $0.176 per kWh ($23,209 per year)

Sachs Harbour (cont'd)

Ulukhaktok

Ulukhaktok (cont'd)

Ulukhaktok (cont'd)

- Diesel fuel: $1.50 per litre or $0.417 per kWh (3.6 kWh per litre).
- The project is two EW50 wind turbines.
- Based on 8% cost of capital, medium operating cost, and

- East Ridge: capital cost $2,339,000; wind energy cost $0.995 / kWh
- Required capital subsidy: $1,534,260
- Required per kWh subsidy: $0.995 - $0.417 = $0.578 per kWh ($152,439 per year)

- Limestone Ridge: capital cost $1.4M; wind energy cost $0.903 / kWh
- Required capital subsidy: = $907,270
- Required per kWh subsidy: $0.903 - $0.417 = $0.486 per kWh ($90,069 per year)

Ulukhaktok (cont'd)

- Based on 8% cost of capital, medium operating cost, and diesel fuel costing $1.50 per litre or $0.417 per kWh (3.6 kWh per litre). The project is two EW50 wind turbines.

- Three Hills: capital cost $1.25M; wind energy cost $0.678 / kWh
- Required capital subsidy: $575,900
- Required per kWh subsidy: $0.678 - $0.417 = $0.261 per kWh ($59,533 per year)

- Power Plant Hill: capital cost $1.1M; wind energy cost $0.781 / kWh
- Required capital subsidy: $647,400
- Required per kWh subsidy: $0.781 - $0.417 = $0.364 ($64,216 per year)

Summary of Wind Energy Studies in NWT

Northwest Territories

Wind monitoring and completed wind prefeasibility studies to date

	Pop.	Annual mean wind speed m/s @30m	Peak load kW	Proposed size kW	Installed cost $/kW	Operating cost $/kWh	Avoided diesel cost	Subsidy needed
Norman Wells (2008)	849	6.5*	1640	300	$ 8,800	$ 0.47	$ 0.28	$ 0.19
				500	$ 7,000	$ 0.40	$ 0.28	$ 0.12
Tuktoyaktuk (2008)	967	5.2	851	260	$ 5,300	$ 0.55	$ 0.29	$ 0.26
				300	$ 5,600	$ 0.49	$ 0.29	$ 0.20
				500	$ 5,000	$ 0.47	$ 0.29	$ 0.18
Yellowknife (2008)	18,695	4.8 (37m)	Hydro	300	$ 5,200	$ 0.62	$ 0.28	$ 0.34
		5.5 (80m)	(diesel)	1500	$ 3,300	$ 0.28	$ 0.28	$ -
Colville Lake (2008)	125	4.8*	103	30	$ 9,400	$ 1.28	$ 0.43	$ 0.85
Gameti (2008)	301	4.5*	214	120	$15,000	>1.30	$ 0.31	> $ 1.00
Ulukhaktok (2009)	416	6.5	469	130	$ 9,600	$ 0.68	$ 0.42	$ 0.26
Paulatuk (2009)	321	5.6	254	65	$ 8,200	$ 0.77	$ 0.43	$ 0.34
Sachs Harbour (2009)	123	6.6	209	65	$ 5,900	0.46	$ 0.46	0
		6.6		65	$10,800	0.65	$ 0.46	0.18

* Estimates based on Enivirоment Canada weather data.

A note about Climate change affecting Wind Energy Climate

As the climate changes there are indications that the winds are increasing too.

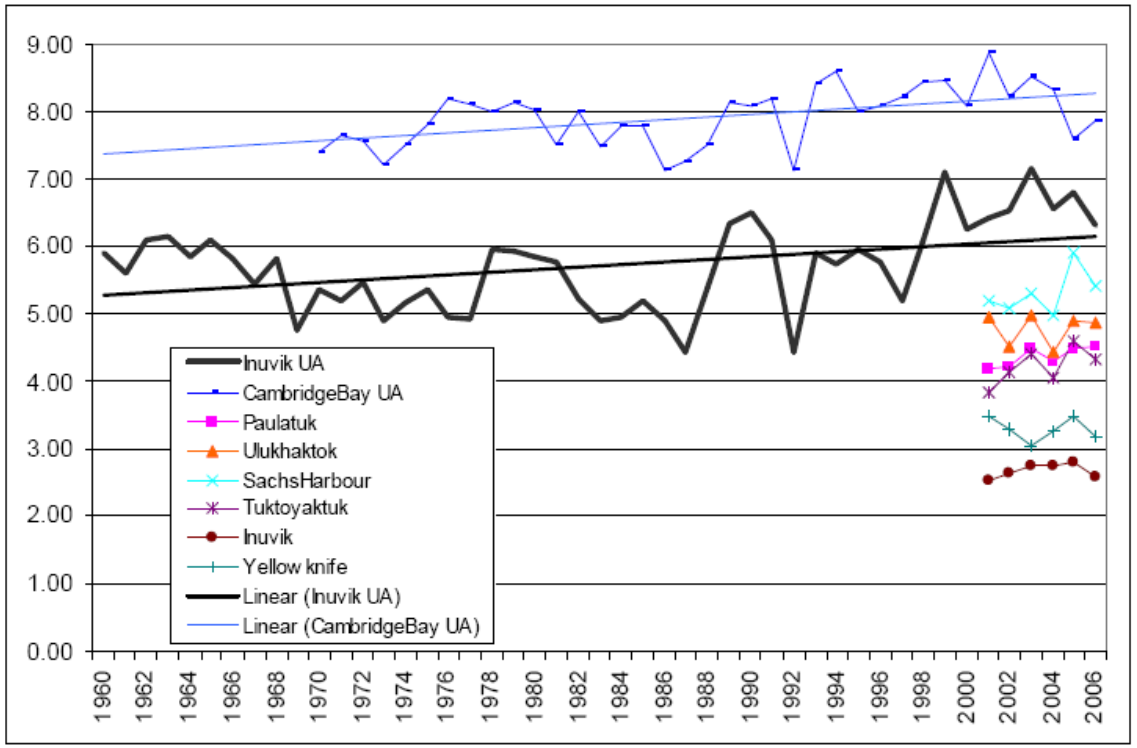


Figure 2: Time series of annual mean wind speed at 500 m above sea level (ASL) over Inuvik (58 m ASL) and Cambridge Bay (25 m ASL) and the airport stations in six communities. The mean wind speed at 500 m ASL for the period is 5.7 and 7.8 m/s in Inuvik and Cambridge Bay respectively. The rate of wind speed increase is about 0.2 m/s per decade. The acronym UA is short for upper-air or weather balloon measurements.

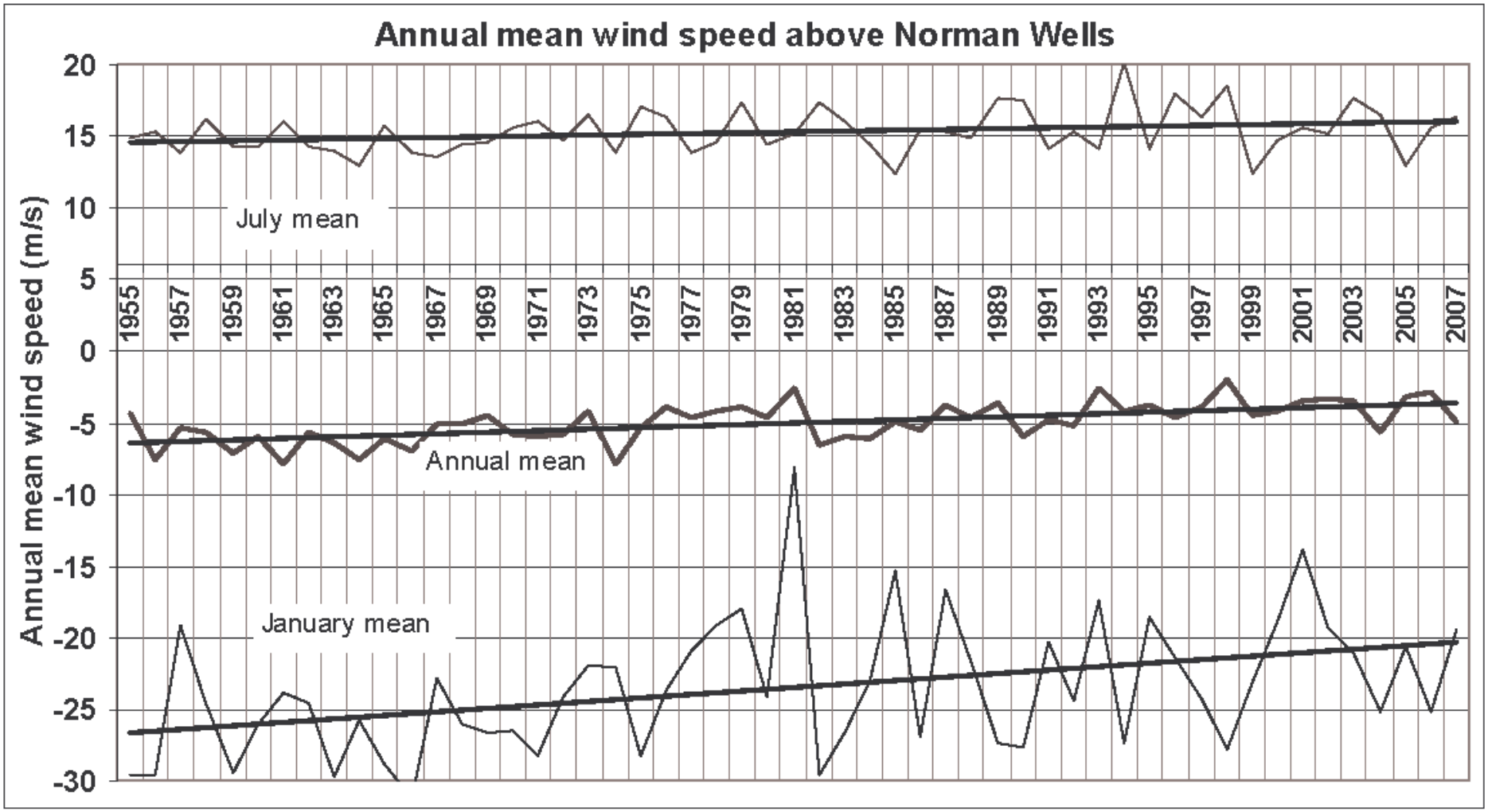


Figure 11: Time series of annual mean air temperature above the Norman Wells upper-air station at comparable heights (400 m ASL) to Kee Scarp.

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