GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

SECTION 11.3

SUBJECT OF NOTE: ALTERNATIVE ENERGY SOURCES

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11.3 SUBJECT OF NOTE: ALTERNATIVE ENERGY SOURCES

11.3.1 Introduction

11.3.1.1 Context

This section of the environmental impact statement (EIS) for the Gahcho Kué Project (Project) consists solely of the Subject of Note: Alternative Energy Sources. In the Terms of Reference for the Gahcho Kué Environmental Impact Statement (Terms of Reference) issued on October 5, 2007, the Gahcho Kué Panel (2007) provided the following rationale for defining this subject of note:

> *"This development would be the fifth diamond mine in the region generating its power from diesel generators, resulting in air quality issues, transportation issues, climate change issues, renewable resource use issues and others."*

The selection of energy sources can have a direct or indirect effect on other aspects of this EIS, particularly the following subjects of note:

- Air Quality (Section 11.4);
- Traffic and Road Issues (Section 11.8);
- Climate Change Impacts (Section 11.13); and
- Tourism Potential and Wilderness Character (Section 12.7.3).

The EIS has a separate section on Project Alternatives (Section 2). However, in accordance with the Terms of Reference, alternative energy sources have been assessed here as a subject of note, instead of being assessed in EIS Section 2.

11.3.1.2 Purpose and Scope

The purpose of the Subject of Note: Alternative Energy Sources is to meet the Terms of Reference. The table of concordance for the Terms of Reference for this subject of note are shown in Table 11.3-1. The entire Terms of Reference document is included in Appendix 1.I of Section 1, Introduction, of this EIS. A complete table of concordance for the entire EIS and Terms of Reference is in Appendix 1.II of Section 1, Introduction.

Table 11.3-1 Terms of Reference Pertaining to Alternative Energy Sources

Final Terms of Reference Requirements		Applicable EIS Sub-section
Section	**Description**	
3.2.6 Assessment Methods and Presentation: Alternatives	the EIS must provide a reasonably detailed analysis of alternatives to individual development components or activities, including but not limited to: - energy sources and energy conservation measures	11.3.2, 11.3.3.1, 11.3.4
5.2.8 Biophysical Subjects of Note: Alternative Energy Sources	the EIS must provide a thorough analysis of alternative means of carrying out the development; this is especially true for energy sources in addition to discussing the feasibility of alternatives and how they could be incorporated into the development, the EIS must compare the environmental impacts of transporting and burning diesel fuel to the environmental impacts of renewable energy sources (e.g. hydroelectric power or wind power) the EIS must also provide details regarding any relevant current negotiations and commitments relating to alternative energy sources	11.3.3.1, 11.3.3.2, 11.3.4

Source: Terms of Reference for the Gahcho Kué Environmental Impact Statement (Gahcho Kué Panel 2007).

EIS = environmental impact statement.

One of the guiding principles of the review process provided by the *Mackenzie Valley Resource Management Act* (MVRMA) is conservation:

> *"c) the importance of conservation to the well-being and way of life of the aboriginal peoples of Canada[..]"* (MVRMA Section 115).

In keeping with this principle, the Terms of Reference for this EIS includes an analysis of alternative energy sources and energy conservation measures. This analysis examines the feasibility of alternative energy sources, compares environmental impacts of feasible alternative energy sources, and outlines relevant current negotiations and commitments related to the use of alternative energy sources.

11.3.1.3 Study Areas

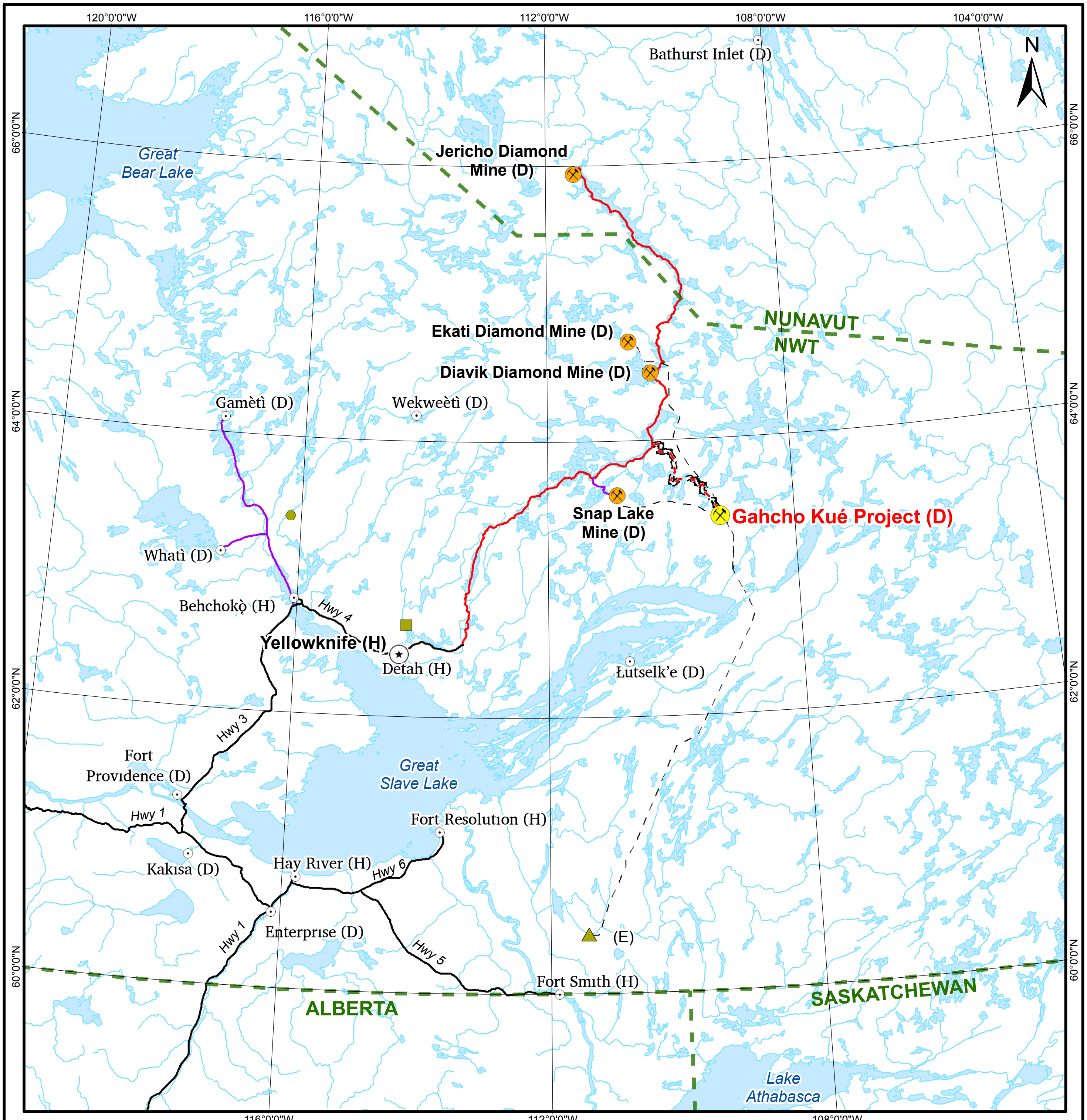
11.3.1.3.1 General Location

The Project is situated north of the East Arm of Great Slave Lake in the Northwest Territories (NWT) at Longitude 63° 26' North and Latitude 109° 12' West. The Project site is about 140 kilometres (km) northeast of the nearest community, Łutselk'e, and 280 km northeast of Yellowknife (Figure 11.1-1).

11.3.1.3.2 Study Area Selection

The existing and proposed energy sources in the NWT (Figure 11.3-1) are as follows:

- diesel generators in the communities of Łutselk'e, Wekweètì, Whatì, Behchokǫ̀, Fort Providence, Kakisa, and Enterprise;
- diesel generators at the Snap Lake Project, the Ekati Diamond Mine, the Jericho Diamond Mine, and the Diavik Diamond Mine;
- hydroelectric power generation stations on Prosperous Lake and the Snare River;
- Taltson hydroelectric generating station (Twin Gorges) at Fort Smith;
- potential expansion of the Taltson station and a linear transmission corridor from Fort Smith to the diamond mines; and
- diesel generators at the proposed Project site.



LEGEND

- Gahcho Kué Project
- Existing Mine
- Territorial Capital
- Populated Place
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Baseline Winter Access Road
- Proposed Winter Access Road
- Watercourse
- Waterbody
- Territorial/Provincial Boundary
- Proposed Taltson Transmission Line

Major Power Sources and Proposals

- Prosperous Lake Hydroelectric Station
- Snare River Hydroelectric Station
- Taltson Hydroelectric Station

(D) Existing or Proposed Diesel Power Use
(E) Proposed Hydroelectric Expansion
(H) Hydroelectric Power Use

NOTES
Base data source: The Atlas of Canada, Hydroelectric sites provided by MVLWB and Proposed Taltson Transmission Line provided by Northwest Territories Energy Corporation.

GAHCHO KUÉ PROJECT

Location of Existing and Proposed Energy Sources in the Northwest Territories

PROJECTION:	DATUM:
Canadian Lambert Conf. Conic	NAD83

Scale: 1:4,500,000
50 25 0 50
Kilometres

DE BEERS CANADA

FILE No:			DATE:
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JOB NO:	REVISION NO:		
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GOLD-CAL	CW	JP	**Figure 11.3-1**

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The information in Subject of Note: Alternative Energy Sources is based on an evaluation of feasible options. Figure 11.3-1 shows the locations of existing and proposed energy sources, but identification of a defined area is not needed to understand this topic. Therefore, a specific study area has not been established for this subject of note.

11.3.1.4 Content

The following briefly describes the content under each heading of this subject of note:

- **Existing Energy Sources for the Gahcho Kué Project** summarizes baseline data on existing energy sources, and energy uses in the NWT (Section 11.3.2).
- **Feasibility of Energy Alternatives** describes the alternative energy sources that were considered for the Project and discusses the suitability of each (Section 11.3.3.1).
- **Environmental Effects of Feasible Alternatives** presents the results of the analysis of environmental effects that may occur as a result of the use of feasible energy alternatives, if available (Section 11.3.3.2).
- **Energy Conservation Measures** identifies ways to save energy at the Project site (Section 11.3.4).
- **Monitoring and Follow-up** describes monitoring and follow-up plans proposed to reduce uncertainty related to availability of feasible energy alternatives (Section 11.3.5).
- **References** lists all documents and other material used in the preparation of this section (Section 11.3.6).
- **Glossary, Acronyms, and Units** explains the meaning of scientific, technical, or other uncommon terms used in this section. In addition, acronyms and abbreviated units are defined (Section 11.3.7).

11.3.2 Existing Energy Sources for the Gahcho Kué Project

The main power sources in the NWT at present are hydroelectric power and diesel power generation. The overall electricity mix for the NWT is 43 percent (%) hydroelectric, 38% diesel, and 19% natural gas. Hydroelectric power, through three major developments (Snare, Taltson, and Yellowknife), serves major communities like Yellowknife and Hay River. Diesel powered electrical generation serves many smaller towns and facilities that are off this grid, including the Diavik, Ekati, and Snap Lake diamond mines:

- Diavik Diamond Mine relies on three, 4.4 megawatt (MW) diesel power generators, for a total of 13.2 MW;
- Ekati Diamond Mine also uses diesel generators, which produce 22 MW; and
- Snap Lake Mine has four, 4.4 MW diesel power generators, three of which run during normal operations, for a total of 17.6 MW.

In Nunavut, the Jericho Diamond Mine was also developed to operate with diesel power, but the mine stopped production in the first quarter of 2008. Generally, the mine projects in the past have expressed a willingness to use hydroelectric power as an alternative to their diesel plants, but this power is not yet available nearby.

The power generation requirements of these diamond mines are comparable to the Project, which has an estimated maximum demand of 7.0 MW and a total installed power capacity of 12.5 MW.

11.3.3 Energy Alternatives for the Gahcho Kué Project

11.3.3.1 Feasibility of Energy Alternatives

The energy alternatives considered for the Project include hydroelectric power, diesel power, wind power, and solar power.

11.3.3.1.1 Hydroelectric Power/Grid

Presently, no local electrical grid or power plant external to the Project exists to supply power economically to the Project.

Dezé Energy Corporation is proposing to provide hydroelectric power to the region’s remote mines by increasing power generation from the existing Taltson Twin Gorges plant and constructing transmission lines (Dezé Energy Corporation 2010). Dezé Energy Corporation is owned by the Akaitcho Energy Corporation, the Métis Energy Company Ltd., and the NWT Energy Corporation Ltd. A total of 56 MW of power generation capacity is associated with the proposed expansion at Taltson. The environmental assessment of the Taltson Hydroelectric Expansion Project is complete and the Mackenzie Valley Environmental Impact Review Board is waiting for ministerial decision (MVEIRB 2010).

Discussions have been held with the Dezé Energy Corporation regarding the potential supply of hydroelectric power for both the Snap Lake Mine and Gahcho

Kué Project from the Taltson Hydroelectric Expansion Project. However, an agreement for supply of electricity has not been reached prior to submission of this EIS and there is currently no certainty that a hydroelectric power project will be realized in time to meet Project requirements.

The Taltson Hydroelectric Expansion Project requires several users, including government, to commit to funding their project. Government approvals for the project would also be required. However, should it be realized, the use of hydroelectric power provides the advantage of lower greenhouse gas emissions. This power could also come at a stable, and potentially lower, cost. The disadvantages include additional environmental impacts associated with dam and power line construction and operation.

11.3.3.1.2 Diesel Power

Diesel power has the advantages of proven technology, reliability, economics, and suitability for a remote location with a relatively short life (i.e., 11 years of operation for this Project). For these reasons, in an application such as the Gahcho Kué Project, diesel power generation is typically the first consideration, if transmission lines from a central grid are not available. The other nearby diamond mines have all independently chosen diesel power generation.

The operating cost associated with the use of diesel fuel for power generation is significant, but the cost is justified by having a highly reliable power source. Potential energy conservation measures for the Project associated with combustion of diesel fuel are described in Section 11.3.4.

The main negative aspect of diesel power generation is the potential environmental impacts of emissions of oxides of carbon, sulphur, and nitrogen, which include potential acidification of waterbodies and contribution to greenhouse gas emissions. In addition, to facilitate the delivery of this fuel, transport from fuel sources is required, using the Tibbitt-to-Contwoyto Winter Road and the Winter Access Road leading to the Project. Concerns related to this added use of the winter roads include increasing the already high traffic volumes, shortening of the length of time the roads are open due to global warming (which will further increase traffic volume), increasing effects on wildlife, and public access to a wilderness area. Noise will be generated at both the generation site and along transport routes, which is another potential negative impact.

11.3.3.1.3 Wind Power

Wind turbines are increasingly being used to supplement diesel-powered electricity in the NWT. Sole reliance on wind power is not possible because of the lack of reliability of the power source; therefore, wind energy users have adopted hybrid generation systems (Natural Resources Canada 2003). Communities with such hybrid diesel-wind electrical generation use power from the wind turbines in conjunction with diesel-generated electricity when the wind is blowing, and diesel-powered electricity only when wind is not available. This system has proven useful in reducing the consumption of diesel fuel in locations where there is sufficient wind.

In addition to lack of reliability, other potential negative effects relating to wind energy include space required for a large installation, impacts on visual aesthetics, noise effects, and effects on birds (i.e., collisions with turbines).

The average wind speed at the Project site is 5.2 metres per second (m/s) at 10 metres (m) above ground. This is lower than in most other areas in Canada where wind energy is in operation. Consequently, supplying wind-generated power to the Project is not currently feasible.

11.3.3.1.4 Solar Power

Photovoltaic cells were evaluated as a source of power generation near the Project. Elsewhere in the NWT, photovoltaic cells are primarily used to supply small amounts of power for local lighting and for electronic instruments. However, this power source would be neither cost effective nor reliable on a continuous basis, based on the low levels of solar energy available in the area year-round. Further, the size of the cell banks required to produce appreciable power would require vast areas and therefore significantly expand the terrestrial footprint of the Project (an example is provided below).

To evaluate the size of a potential solar installation and availability of power, the solar radiation available for power generation at the Gahcho Kué Project location was assessed. The National Aeronautics and Space Administration (NASA 2008) satellite weather data for 63°24’ North, 109°12’ West indicated the following monthly average solar radiation as summarized in Table 11.3-2.

Table 11.3-2 Monthly Average Solar Radiation at the Project Site

	Averaged on Horizontal Surface [kWh/m²/day]											
	January	February	March	April	May	June	July	August	September	October	November	December
10-year average	0.13	0.77	2.04	3.93	5.09	5.56	5.51	4.01	2.37	1.03	0.35	0.06

Source: NASA 2008.
$kWh/m^2/day$ = kilowatt hour per square metre per day.

Current solar technology is reported to be 7 to 17% efficient in converting solar into electrical energy. Using the above historical solar energy data and 12% efficiency, the electrical energy that could be produced at the Gahcho Kué Project by a one square metre photovoltaic cell is estimated in Table 11.3-3.

Table 11.3-3 Average Daily Electrical Energy Production for Photovoltaic Cells

Average Daily Electrical Energy Production [kWh/m²/day]											
January	February	March	April	May	June	July	August	September	October	November	December
0.02	0.09	0.24	0.47	0.61	0.67	0.66	0.48	0.28	0.12	0.04	0.01

$kWh/m^2/day$ = kilowatt hour per square metre per day.

To put this in perspective, in June, the sunniest month of the year, a 100 kilowatt (kW) load would require a photovoltaic cell bank of over 3,500 square metres (m^2) or 0.885 of an acre. The low voltage load in the process plant that may be suitable for receiving energy from photovoltaic cells is in the order of 4.5 MW. This would require a photovoltaic cell bank of 161,200 m^2 or nearly 40 acres. Clearly, even in June, solar energy is impractical given the size of the solar arrays required. Additionally, a large storage (batteries) facility would be required, itself a potential environmental concern. A full-size power plant would still be required to provide power in the winter months, which is the time of year when electrical power consumption is at a maximum due to heating requirements.

Solar air heating appears to offer some potential, but requires further investigation to determine if is feasible for use on site buildings. Solar air heating using SolarWall® or a similar technology will be investigated further for use in one or more buildings at the Project site. The investigation can be completed before construction, once building sizes and airflows have been determined. However, waste heat from the proposed diesel generator sets will be captured and is expected to provide most of the space heating requirements on-site and solar air heating may not be required.

11.3.3.1.5 Conclusions

The Project's critical power requirements include steady, non-fluctuating and reliable power, at a competitive cost, without large environmental or social impacts. At present, diesel-powered electric generators is the only technically and economically feasible alternative for meeting these needs. It is not feasible to implement either wind or solar power as a primary power source, due to their low reliability under the conditions that the Project must operate. It is not yet feasible to rely on hydroelectric power, as the power source and grid have not been approved for development. Therefore, diesel power is the only feasible power source available to the Project as it initiates construction and operations.

De Beers Canada Inc. (De Beers) will continue to evaluate alternative energy sources that will reduce the Project's dependency on fossil fuel as part of adaptive management and De Beers' sustainable development policy.

11.3.3.2 Environmental Effects of Feasible Alternatives

At present, no one feasible alternative exists to the use of diesel power plants to provide the energy required for the Project. Therefore, environmental effects of feasible alternatives technically and economically could not be assessed. The effects of diesel power generation, which is the only feasible energy source, were assessed in Section 11.4 (Subject of Note: Air Quality). Effects of air emissions on environmental receptors were assessed in many sections of the EIS.

11.3.4 Energy Conservation Measures

Potential sources of energy conservation, which would lower emissions and operating costs associated with combustion of diesel fuel, were investigated, and several opportunities were identified and will be implemented in project design, as described below. De Beers is committed to continuously evaluate ways to improve energy efficiency that are both technically and economically feasible.

The principal source of energy conservation will be that of recovering exhaust and other sources of heat from the diesel generator sets. At various loads and times of year it will be possible to meet space heating requirements for the process plant, camp, warehouse, and maintenance facilities from this source.

To minimize electrical requirements, use of the highest efficiency available equipment will be made. Major items include transformers, motors, and lighting systems. As part of the selection of equipment, efficiency will be one of the criteria.

Variable speed drives will also be used to minimize power consumption. These can be used to provide process control and to "slow down" drives while maintaining much of their electrical efficiency when full output from the driven machine is not required.

The power plant will also be optimized by way of generator sizing to most efficiently match the anticipated loads. The power plant management system selection will be made for minimal fuel usage.

11.3.5 Monitoring and Follow-up

De Beers will continue to evaluate opportunities to reduce fossil fuel use and greenhouse gas emissions at the Project. The possible use of solar, wind, and hydroelectric power will continue to be explored and may be incorporated into Project design at some later date if it proves to be both technically and economically feasible. Evaluation criteria would include energy efficiency, proven performance in a northern setting, environmental cost or benefit, and cost effectiveness.

11.3.6 References

Dezé Energy Corporation. 2010. Taltson Project. http://www.dezeenergy.com/taltson_project/index.html. Website accessed: April 2010.

Gahcho Kué Panel. 2007. Terms of Reference for the Gahcho Kué Environmental Impact Statement. Mackenzie Valley Environmental Impact Review Board. Yellowknife, NWT.

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NASA (National Aeronautics and Space Administration). 2008. Surface Meteorology and Solar Energy. http://eosweb.larc.nasa.gov/cgi-bin/sse/sse.cgi?+s01#s01.

Natural Resources Canada. 2003. Stand-Alone Wind Energy Systems: A Buyer's Guide. Electricity Resources Branch - Renewable and Electrical Energy Division - Natural Resources Canada. Ottawa, ON. http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier.php/codectec/En/ISBN%200-662-37706-0/WindEnergy_buyersguide_ENG.pdf.

11.3.7 Acronyms and Glossary

11.3.7.1 Acronyms and Abbreviations

De Beers	De Beers Canada Inc.
EIS	environmental impact statement
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVRMA	*Mackenzie Valley Resource Management Act*
NASA	National Aeronautics and Space Administration
NWT	Northwest Territories
Project	Gahcho Kué Project
Terms of Reference	Terms of Reference for the Gahcho Kué Environmental Impact Statement

11.3.7.2 Units of Measure

%	percent
km	kilometre
kW	kilowatt
kWh/m^2/day	kilowatt hour per square metre per day
m	metre
m/s	meters per second
m^2	square metres
MW	megawatt

11.3.7.3 Glossary

Hydroelectric power	Using the power of water currents to generate electric power.
Megawatt	One million watts. A watt is a derived unit of power in the International System of Units (SI).
Photovoltaic cells	Manufactured cells that convert solar radiation into direct current electricity.
Solar radiation	The visible and near-visible (ultraviolet and near-infrared) radiation from the sun.
Wind turbines	Mechanisms that convert wind energy into electricity.