



ENERGY PROFILE: INUVIK

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INUVIK



Figure 1 Inuvik, NWT from the air (Northwest Territories Tourism, 2019)

March 2020 Energy Profile

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ENERGY PROFILE

REGULATION AND GOVERNANCE

Ownership Structure

This section describes the current energy ownership structure for generation and distribution, including any private, public, cooperative, players, roles, responsibilities, and authorities.

The eight communities of the Beaufort Delta region have no existing or nearby transmission infrastructure to connect to. This includes the community of Inuvik (Figure 2). The nearest transmission infrastructure is the Snare and Taltson grids to the distant south. As a result, the comparatively small community loads and large distances between communities preclude interconnecting any transmission infrastructure between communities or to neighboring regions.



Figure 2 Map of Canada with Inuvik, NWT location

From 1999 to 2012, Inuvik was benefited from a supply of local natural gas from the Ikhil well (Millier Dickinson Blais and Pealow Consulting, 2015). Given the depletion of Ikhil well in 2012, Inuvik Gas began supplying the town with synthetic natural gas trucked up from the south. Inuvik Gas, a public energy utility (Northwest Territories Public Utilities Board), owned and operated the Inuvik gas distribution system until 2018 when terminated the Gas Franchise Agreement with the Town of Inuvik (Hood, 2018). Private corporations are currently supplying and delivering Liquefied Natural Gas (LNG) and Diesel Fuel for Inuvik (Supply and Delivery of LNG for Inuvik, 2019) (Supply, Transport and Delivery of Diesel Fuel, 2018).

The current Inuvik energy generation structure is owned by the Northwest Territories Power Corporation (NTPC) and the Government of Northwest Territories (GNWT). Non-renewable electricity generation is NTPC responsibility. The corporation owns three natural gas-fired generators with a total capacity of 7.7 MW and three diesel generators with a total capacity of 5.72 MW (Millier Dickinson Blais and Pealow Consulting, 2015). Community's renewable generation are owned by the GNWT. The Government controls the solar generation in three community buildings (Aurora Research Institute; 17-unit apartment complex; and the Department of Infrastructure) and one biomass boiler that heats the East Three School (Government of Northwest Territories, 2018). NTPC along with Northwest Territories Energy (NTEnergy) are owned by NT Hydro (Figure 3), which in turn is 100 percent owned by the GNWT. (Northwest Territories Power Corporation, n.d.).



Figure 3 Energy Ownership Structure in NWT

Institutional Arrangements

This section will describe the current rules, regulations, or standards that enable or constrain energy transition. This includes options or restrictions on community ownership of generation and/or distribution; targets or restrictions on renewables integration; rate structures; etc.

Territorial Level

The GNWT publicly lists all its Acts and Regulations on its official website (Legislation of the Northwest Territories). The Acts are the laws approved by the Legislative Assembly, and the Regulations are laws that are authorized by an act and issued by the administering departments or public bodies. The Regulations are the rules used to carry out the Acts, providing the implementation details. Details on how Northwest Territories (NWT) legislation provides or fails to provide support for renewable energy in Inuvik are listed below.

Petroleum Products and Carbon Tax Act and Regulations

In August 2019, the GNWT introduced changes to the Petroleum Products Tax Act to implement the NWT Carbon Tax (Northwest Territories Gazette, 2019). The Act, which is now called Petroleum Products and Carbon Tax Act and Regulations, charges a carbon tax on all fuel sold in the NWT (Petroleum Products and Carbon Tax Act, 2019). The objective of this law is to discourage the use of fossil fuels in order to reduce greenhouse gas emissions.

The NWT Carbon Tax will charge \$20/tonne of greenhouse gas emissions (GHG) for gasoline, motive diesel, non-motive diesel, railway, heating fuel, propane, natural gas and naphtha. The initial rate will increase annually until 2022 when it will reach \$50/tonne. Carbon taxes start at a minimum of \$0,035/litre, considering the tax for each litre of Butane in 2020, and can reach up to \$0,137/litre, considering the litre of Diesel in 2022 (Figure 4). In Inuvik, considering data from November 2019, the carbon tax represents 2.76% of the price paid for a litre of gasoline.

	Type of Fuel <i>Type de carburant</i>	September 1, 2019 – June 30, 2020	July 1, 2020 and ending June 30, 2021	July 1, 2021 and ending June 30, 2022	July 1, 2022 and thereafter
Item N		Le 1 ^{er} septembre 2019 et se terminant le 30 juin 2020	le 1 ^{er} juillet 2020 et se terminant le 30 juin 2021	le 1 ^{er} juillet 2021 et se terminant le 30 juin 2022	le 1 ^{er} juillet 2022 et continuant
1	Aviation gasoline Essence d'aviation	exempt exempté	exempt exempté	exempt exempté	exempt exempté
2	Aviation jet fuel Carburant pour turbo-	exempt exempté	exempt exempté	exempt exempté	exempt exempté
3	Butane (L)	\$0.035	\$0.053	\$0.071	\$0.089
4	Diesel (L)	\$0.055	\$0.082	\$0.109	\$0.137
5	Gasoline Essence (L)	\$0.047	\$0.070	\$0.094	\$0.117
6	Naphtha Naphthe (L)	\$0.051	\$0.077	\$0.102	\$0.128
7	Natural gas Gaz naturel (m ³)	\$0.038	\$0.058	\$0.077	\$0.096
8	Propane (L)	\$0.031	\$0.046	\$0.062	\$0.077

Figure 4 Northwest Territories Carbon Tax Rate Schedule (2019)

The act also offers **tax rebates and tax-free benefits** to help offset the cost of the territorial carbon. Consumers will receive a full rebate on the carbon tax paid for heating fuel and utility companies will receive a full rebate on the carbon tax paid for fuel used for electrical generation. The NWT Cost of Living Offset (COLO) is the tax-free benefit paid to individuals and families living in the NWT to help offset the cost of the territorial carbon. In 2020, an Inuvik family will receive \$104 per adult and \$120 per child under the ag e of 18.

The Carbon Tax Regulations also provide a **Grant for Emissions Reduction Projects**, a grant focused in large emitters which are developing projects that will contribute to the reduction of greenhouse gas emissions in the NWT. The Regulations consider as large emitters the companies: Diavik Diamond Mines Inc., De Beers Canada Inc., Dominion Diamond Ekati Corporation, and Imperial Oil Resources NWT Limited. In the current

regulations there is no grant that is not focused on these large emitters, independent producers do not have direct support from the regulations for the development of renewable energy projects. According to GNWT, the NWT Carbon Tax will generate an estimated \$16.3 million in 2019 and 2020, which \$3.8 million will be invested in initiatives that will reduce GHG emissions (Implementing the NWT Carbon Tax, 2019).

Natural Resources Conservation Trust Act

The Natural Resources Conservation Trust Act establishes **The Natural Resources Conservation Trust Fund**. The purpose of this fund is to promote through education, research and demonstration, the wise use of renewable resources; awareness, enhancement and protection of the environment; and use of the most efficient and most effective methods of trapping wildlife (Government of Northwest Territories, 2016). As defined under section 13, the Natural Resources Conservation Trust Fund Board of Trustees shall provide an annual report to the Legislative Assembly. That includes (c) the recipient and amount of each payment made from the Fund; (d) a description of the purpose for which each payment was made from the Fund. However, little information is made available as to which projects are receiving resources from this fund.

Community Planning and Development Act and Regulations

This Act defines the guidelines to community planning, and by extension, may provide a framework to support energy planning within a community. However, the act does not define as mandatory the description of future use, practices and possible areas of development related to energy (Government of Northwest Territories, 2013). As the Act does not provide specifications for the community energy sector, the Regulations, therefore, do not support the development of community energy planning (Government of Northwest Territories, 2013). The government of the Town of Inuvik, however, has a Community energy plan that specifies the energy use in the community (Town of Inuvik, 2010).

Federal Level

Details on how federal legislation provides or fails to provide support for renewable energy in Inuvik are listed below.

Northwest Territories Devolution Act

This agreement transferred responsibility for public land, water and resource management in the NWT from the federal department of Aboriginal Affairs and Northern Development Canada (AANDC) to the GNWT on April 1, 2014 (Parliament of Canada, 2014). This Act provides the territorial government more control over public lands and resource development. This is important as it provides GNWT with the authority to create their own energy future (Heerema & Lovekin, 2019).

Canadian Energy Regulator Act

This Act regulates certain energy matters within Parliament's jurisdiction and defines rules for the development of pipelines, power lines, and oil and gas exploration, regulates trade in energy products, and ensures transparent and efficient public participation (Government of Canada, 2019). In particular, this Act reinforces Indigenous participation in the evaluation of energy projects, ensuring funding to build capacity and enhance Indigenous participation (Government of Canada, 2019).

Energy Efficiency Act and Regulations

The Energy Efficiency Act provides for the making and enforcement of regulations concerning minimum energy performance levels for energy-using products, as well as the labelling of energy-using products and the collection of data on energy use. The Energy Efficiency Regulations establish energy efficiency standards for a wide range of energy-using products, with the objective of eliminating the least energy-efficient products from the Canadian market (Government of Canada, 2017). Unlike provinces such as, British Columbia, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia, the GNWT does not have an Acts or Regulations supporting energy efficiency at a territorial level. However, it does have alternative programs that support energy efficiency locally. These programmes are known as "Efficiency Rebates" and are developed in partnership with the Artic Energy Alliance.

Gaps in Institutional Arrangements

This section describes the gaps in the current rules, regulations, or standards that enable or constrain energy transition.

Independent Power Producer (IPP) Regulations

Independent Power Production allows communities to generate renewable energy and feed the local electrical grid. According to data from the Government of Yukon, one of the Canadian territories that has IPP regulations, IPP regulations provide support for utilities and independent power producer, while ensuring that rates remain stable for consumers. IPP supports affordable, reliable, flexible and clean electrical energy (Government of Yukon, 2019). Nevertheless, there is no documented IPP policy, and consequently, no IPP regulation in place in the NWT. Heerema and Lovekin (2019), states that IPP project proposals are subject to a negotiation with the government and utility. The author also states that while the 2030 Energy Strategy provides some direction for IPP projects, it does not provide adequate support for community-led energy projects. The lack of IPP regulations, therefore, limits the development of community owned renewable energy projects.

Policy Environment

This section describes overarching policies and plans (e.g. climate policies, energy policies, existing energy plans) that provide specific direction, encouragement (or lack thereof) for energy transition, security, or sovereignty. Key conflicts or synergies between energy transition needs/goals and other sectors or land uses that enable or constrain transition are presented.

2030 Energy Strategy

The Northwest Territories 2030 Energy Strategy (Government of Northwest Territories, 2019) is a long-term strategy focused on the development of the energy future in NWT. The strategic objectives include community engagement, targets for the reduction of GHG emission, an increase in the share of renewable energies and an increase in buildings' energy efficiency. The policy aims to "guide the development of affordable, and sustainable energy for transportation, heat, and electricity, support energy efficiency and conservation, and promote renewable and alternative energy solutions for the NWT". **The Energy Action Plan 2018 – 2021** (Government of Northwest Territories) sets the ongoing and yearly new Actions and

Initiatives needed for the GNWT and its partners to achieve the Strategic Objectives set out in the 2030 Strategy.

The 2030 Energy Strategy introduces two participation models for Indigenous communities that includes midscale and larger-scale projects, not only considering developments up to 15 kilowatts. The 2030 Energy Strategy design funding for the mid-scale and larger projects. This strategy provides two types of grants for projects that aim to reduce GHG emissions: **The GHG Grant Program for Buildings and Industry Program and the GHG Grant Program for Government** (Government of Northwest Territories, 2019). The Government focused program is designed to support greenhouse gas (GHG) emissions reduction projects and initiatives for NWT community governments, municipalities, GNWT departments, and Indigenous governments. This grant program may support renewable energy projects in Inuvik, as the focus of this grant is on reducing GHG emissions, and it has a strong focus on Indigenous communities.

This strategy also provides an alternative to the gap of IPP policies. The mid-scale participation model considers developments of more than 15 kilowatts, which are community owned and have the potential to receive government grants. As stated in the Strategy, the proposed approach is not the conventional independent power producer model, but it is a solution made specifically for the NWT scenario, where the community receives payments based on the value of diesel fuel displaced by the renewable energy.

2030 NWT Climate Change Strategic Framework

The 2030 NWT Climate Change Strategic Framework outlines how the territory plans to respond to challenges and opportunities associated with a changing climate. The three goals of this framework are related to the reduction of fossil fuel consumption, and consequent reduction of GHG emissions, the dissemination of climate change impacts and the process of building resilience and adapting to this change (Government of Northwest Territories, 2019). The first goal, related to the annual decrease of GHG emissions, is directly related to the energy transition objectives of the **2030 Energy Strategy.** The GNWT (2018) states that the main path to achieve the first goal is through the reduction of fossil fuel use, in particular by reducing diesel consumption for electricity generation. **The 2030 NWT Climate Change Strategic Framework 2019-2023 Action Plan** is also connected and supports the Energy Action Plan 2018 – 2021. This action plan design actions to support the NWT's transition to a lower carbon economy (Government of Northwest Territories, 2018).

NWT Petroleum Resources Strategy

"Alongside the Northwest Territories 2030 Energy Strategy and the NWT Climate Change Strategic Framework, it sets the foundation for how the GNWT will improve energy security, stabilize the cost of living and address the impacts of climate change with clear and positive actions." (Government of Northwest Territories, 2018). The NWT Petroleum Resources Strategy, opposed to the energy transition proposed by 2030 Energy Strategy, aims to improve the petroleum infrastructure and regulatory framework in NWT, along with greater investment in NWT petroleum resources. The purpose is to invest in natural gas, as it is a source that emits less GHG than diesel fuel. This strategy can slow down the energy transition in communities such as Inuvik, in view of the economic feasibility of using natural gas in the region.

NWT Economic Opportunities Strategy

The last economic strategy was launched by the GNWT in 2013, and it considers both renewable and nonrenewable resources as an economic opportunity (Government of Northwest Territories, 2013). One of the objectives of this Strategy is attract major projects and investment to the NWT, it argues that obtaining an oil and gas strategy is crucial to achieve this goal. Despite mentioning renewable energy as an economic opportunity, the strategy fails to provide details on economic strategies for the energy transition

Town of Inuvik Facilities Strategic Energy Conservation Policy

The Town of Inuvik has an energy conservation policy for all facilities and buildings that are owned by the Town. The purpose of the policy is to establish and implement procedures to promote energy conservation and to outline energy conservation measures to be taken by all Town employees in the operation of Town facilities and equipment; to work towards ensuring that lighting within all Town facilities is turned off by staff when not otherwise required; and to ensure that minimum lighting is utilized in Town facilities whenever possible to conserve power (Town of Inuvik, 2016)

Historic Shifts and Embeddedness

Establishment of Northwest Territories Power Commission, a federal crown corporation				
The federal corporation is renamed to Northern Canada Power Commission (NCPC)				
Ikhil gas field discovered near Inuvik				
Government of the Northwest Territories acquires NCPC from federal government				
The Commission is renamed the Northwest Territories Power Corporation (NTPC)				
NWT Public Utilities Board commences partial regulation of the Corporation.				
Full regulation of the Corporation by the NWT Public Utilities Board.				
Community-based rates established.				
NTPC signs 15-year agreement to become the cornerstone customer for gas in the Town of				
Inuvik, bringing gas services to the rest of the community and commencing a multi-year				
transition of the plant from diesel to natural gas.				
Ikhil pipeline begins to supply natural gas to Inuvik				
The Government of Northwest Territories creates the Northwest Territories Hydro Corporation				
(NT Hydro). The new corporate structure includes NTPC as one of three NT Hydro subsidiaries.				
Freeze for the Eutrine on Energy Dien for the NIM/T				
Energy for the Future, an Energy Plan for the NW I				
Establishment of the Energy Priorities Framework for NWT				
Creating a brighter future: a review of electricity regulation, rates and subsidy programs in the				
NWT				
One of the Ikhil wells runs dry. The second continues to be a back-up or supplementary supply				
for power generation in Inuvik				
NTPC received notice that gas supply is ending in Inuvik and begins planning to convert plant				
back to diesel generation.				
Ikhil well depletion				
Liquefied natural gas (LNG) is identified as a potential source of fuel for Inuvik and plans to				
convert back to diesel are altered in favour of a partial conversion and implementation of an				
LNG solution.				

	Inuvik Gas start providing liquefied natural gas (LNG)			
2013	NWT Energy Action Plan 2013 - 2016			
2014	New Inuvik Liquid Gas Facility is commissioned.			
2014	Devolution occurs; NWT gains more powers over its land, waters and natural resources			
	End of Inuvik Gas Contract			
2018	2030 Energy Strategy			
	2018 - 2021 Energy Action Plan			

Relationships

Grassroots information on communications between energy utilities and community leadership in energy planning, policy setting and decision making could not be found in the Government documents and papers. It is recommended that this information be acquired in interviews with members of the community and local utility, i.e. NTPC.

LOCAL CAPACITY AND INNOVATION

Local capacity and innovation are vital to a successful long-term approach to support secure, affordable and sustainable energy supply and use in the NWT. The GNWT and its partners—including utilities, governments, communities, residents, business, industry and nongovernment organizations—must work together, be innovative, and develop strategies while building capacity to achieve set goals and objectives. The components of local capacity and innovation discussed are the community energy plan, energy champion, human capital, community investments, energy programs and incentives, community energy source potential, and priorities.

Community Energy Plan

This section describes the nature and scope of Inuvik's community energy plan, including community energy goals or objectives, key gaps, date established and most recent update.



Figure 5 Inuvik, NWT Community Energy Plan (2010)

Community Energy Goals

The Town of Inuvik has developed a Community Energy Plan (CEP) through a community-based process to reduce energy consumption and greenhouse gas (GHG) emissions throughout the community. Inuvik strives to efficiently manage and reduce the consumption of energy whenever possible. The CEP defines Inuvik's five long-term goals for energy use and GHG emissions and outlines twelve associated strategies for meeting those goals and recommends actions to move the strategies forward (CITE CEP).

The first energy goal is regarding land use. Inuvik plans to increase spatial efficiency of the community. Land use planning is an important tool available to local governments to reduce energy and GHG emissions in the community. The development of mixed-use areas and preservation of natural areas are achieved through land use designations (e.g. zoning). Land use policies can influence the viability of local energy systems, impact the energy efficiency of the built environment (e.g., buildings and infrastructure), and affect the energy we use to get around our community (e.g. transportation).

There are two strategies to achieve this:

Strategy 1: Encourage mixed use development

Mixed use development combines residential, commercial, institutional and sometimes light industrial in the same land use area, which can potentially reduce the trip length required to access daily goods and services and lessen travel time to school and work.

Strategy 2: Maintain a compact Town Centre

Reduces the amount of infrastructure required to service an area. Streets, wiring, pipes and road length can be reduced in more carefully planned, compact development, which in turn reduces costs to the community. Compact communities also create more opportunities for non- motorized transportation alternatives as desired destinations tend to be much closer.

The second goal is to improve the health, safety, and energy efficiency of buildings. The Community Energy Plan identified technical issues such as energy efficiency, moisture management and industry capacity as key challenges affecting the sustainability of housing in the north (Town of Inuvik, 2010). These older homes may have deterioration of air sealing, inefficient furnaces and water heating appliances, all of which contribute to increased energy consumption. Existing buildings represent a significant opportunity to improve energy efficiency and reduce GHG emissions in the community. New construction in Inuvik faces similar challenges in terms of energy efficiency. The Town of Inuvik plans to create opportunities through outreach, incentives and regulation to increase energy standards for new construction (Town of Inuvik, 2010).

Industry capacity is an important consideration with regards to improving building energy performance. Working in partnership with the territorial government, Aurora College, and local trades, the Town may be able to increase this capacity over time to ensure local trades persons are equipped to support more energy efficient development.

This goal will be achieved with the 3 strategies below:

Strategy 3: Set energy efficiency standards for new buildings

The Town will explore opportunities to encourage higher Fort St. John Winter City Design standards of energy efficiency in all new development through activities such as a building bylaw, sustainable development guidelines and a civic green building policy.

Strategy 4: Encourage energy retrofits of existing buildings

The Town will consider ways to encourage residents to undertake energy audits and retrofits, and to adopt habits that promote energy conservation in order to improve the energy efficiency of existing buildings.

Strategy 5: Increase local capacity around building energy efficiency

Working with local partners, the Town will seek to increase capacity around energy efficiency and conservation to increase the energy performance of buildings.

The third goal is to promote alternative modes of transportation in the Town of Inuvik. The challenge for a small, isolated community such as Inuvik is that the size of the population makes it difficult to justify implementing an extensive public transit system. The number of taxis with fixed rate fares in Inuvik means that taxis are essentially public transit (Town of Inuvik, 2010).



Figure 6 Inuvik Residents Transportation Method to/from Work

This goal will be achieved through Strategies 6 through 9:

Strategy 6: Increase active transportation opportunities

This strategy encourages the Town of Inuvik to support more walking and cycling through improved amenities and accessibility. Currently, the number of sidewalks in Inuvik is limited, making potential walkers uneasy about their safety with no designated barrier between themselves and vehicles. In the winter, roads tend to become narrower as snow piles up. If there is no existing sidewalk to clear, snow is cleared to the side, making walking difficult. There is also a limited number of benches available for walkers to rest or wait for a ride. Street lighting is also limited, adding to a perception that walkers cannot be seen, and could more easily come into conflict with motorized users. Finally, the Town of Inuvik believes that providing information to residents on existing walking and cycling amenities could increase participation (Town of Inuvik, 2010).

Strategy 7: Encourage use of alternative fuel vehicles

One of the major contributors to fossil fuel combustion is the use of motor vehicles. One type of vehicle that is becoming more popular is the hybrid, which emits lower amounts of GHGs. There was a taxi driver in Inuvik who has purchased a 2009 Honda hybrid (Rankin, 2009).

Strategy 8: Promote idling reduction

The Town of Inuvik has passed an anti-idling bylaw that is enforced within the town that restricts the amount of idling for a vehicle to less than 30 minutes. According to Natural Resources Canada if every driver of a light duty vehicle avoided idling by three minutes a day, collectively over the year, 630 million litres of fuel, over 1.4 million tonnes of GHG emissions would be saved (Town of Inuvik, 2010).

Strategy 9: Encourage best practices for vehicle energy efficiency

Enhancing the energy efficiency of vehicles can result in a range of positive outcomes such as emission reductions and saving money. There are a range of resources and systems available through several organizations and governments that are interested in assisting private and public vehicle users in utilizing vehicles in the most cost-effective and energy conscious manner. Inuvik could use one of these opportunities to publicize the application of new energy-efficient techniques.

The fourth goal is to increase opportunities for renewable energy supply. Alternative technologies exist for providing electricity, space and water heating requirements to buildings. The major barrier in Inuvik is that there exists a real or perceived financial cost associated with incorporating these technologies which may not be recovered by the developer in the sale of the units. Financial barriers may be exacerbated by the limited availability of these technologies and the freight costs for transporting them to Inuvik.

This goal will be achieved by the two strategies below:

Strategy 10: Develop local energy supply

Prior to moving forward in this area, the Town must investigate the feasibility of different types of alternative energy systems for implementation in Inuvik.

Strategy 11: Increase knowledge and awareness of alternative energy options

In partnership with the GNWT and the Arctic Energy Alliance, the Town needs to implement activities aimed at increasing local knowledge and awareness of alternative and renewable energy supply options.

The fifth goal is to pursue energy efficiency and conservation within the broader context of sustainability. While having less of an impact on energy and GHG reductions in the community, this will help to address local and global sustainability. These actions will contribute to broader objectives aimed at sustaining the natural environment, and social well-being, while supporting local economic development.

This goal is supported by:

Strategy 12: Create a culture around energy conservation

The Town of Inuvik will foster a supportive culture around energy conservation, promoting energy culture in a positive and rewarding way that presents energy conservation ideas that will realize multiple benefits.

Key Gaps

Community Energy and Emissions Baseline Data Inventory: Typically, when developing an energy plan, a community will first compile an inventory of the energy consumption and resulting GHG emissions in the community. An inventory assists a community in understanding where and how energy is being consumed and the quantity of GHGs being emitted as a result, which may serve to highlight opportunities for reduction. The inventory provides a baseline from which the community can develop informed strategies and actions to reduce energy consumption and GHG emissions. That said, consumption data is not always readily available or easily accessible. In the case of Inuvik, the Arctic Energy Alliance is in the process of compiling a baseline energy and emissions inventory and is experiencing challenges with respect to data availability.

Economy Structured around Oil & Gas Industry: For years Inuvik's economy has been dependent on gains from oil and gas resources located in the nearby Beaufort Sea. These projects, however, have not materialized to their full capacity and remain uncertain for the future. In the meantime, Inuvik's economy has been struggling with extremely high utility and heating prices, a rising unemployment rate, decreasing population, and a shrinking business sector.

Recent Updates

Several new resource projects are planned across the territory over the coming decade. These projects are forecasted to bring in more than \$4.5 billion (GNWT, 2013) in new investments. A new devolution agreement

signed between GNWT and the Federal Government of Canada (YEAR?) will also contribute new revenues from mining and resource development.

Energy Champions

Clean Energy Advisor, Inuvialuit Regional Corporation

Leigh Ann Williams-Jones, Clean Energy Coordinator

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Address:

Inuvialuit Regional Corporation

Attn: Innovation, Science & Climate Change

Bag Service #21

Inuvik, NT XOE OTO

• Responsible for supporting community energy priorities and establishing an inclusive approach to clean growth and energy implementation efforts within the Inuvialuit Settlement Region (ISR). The Clean Energy Coordinator works closely with local communities, and the Inuvialuit Corporate Group to ensure a coordinated approach to energy development and management in the ISR.

Regional Energy Project Coordinator, Arctic Energy Alliance

Elye Clarkson, Regional Energy Project Coordinator for all of Beaufort-Delta

Tel: 867-777-3589, Email: beaufortdelta@aea.nt.ca

Address:

Beaufort-Delta Regional Office

#205–125 Mackenzie Road

PO Box 3342

Inuvik, NT XOE OTO

• This role of the full-time regional community energy project coordinator is based out of Inuvik but supports all communities in the Beaufort- Delta region and includes regular travel to Aklavik, Fort McPherson, and Tsiigehtchic.

Project Coordinator, Arctic Energy Alliance

Sheena Adams, Project Coordinator for Inuvik

Tel: 867-678-2339, Email: sheena.adams@aea.nt.ca

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#205–125 Mackenzie Road

PO Box 3342

Inuvik, NT XOE OTO

- Planned events such as the Inuvik Solar Information Session: topics covered included solar panels, types of installation, inverters, battery storage, net-metering, cost, and system design.
- Sheena displayed a Solar Pathfinder and gave a short video of how this unique tool is used to calculate the solar available in a selected location, allowing installers to maximize their position and be aware of objects (such as fencing, trees, or wires) that may shade the panels. Sheena is available to use the Solar Pathfinder to calculate solar energy potential in Inuvik locations.
- AEA delivers the Alternative Energy Technologies Program and rebates available to businesses and homeowners.

Regional Director, Government of Northwest Territories

Peter Clarkson, Regional Director for all of Beaufort Delta

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Address:

Government of the Northwest Territories

Department of Executive

Regional Director

Bag 1

Inuvik, NT XOE OTO

• In a photo essay by Eilis Quinn on how the natural gas crisis is affecting Inuvik, NWT Peter Clarkson was quoted saying "We almost need an Arctic community energy policy or plan because it really is a driver on the cost of living in these communities".

Energy Planning Committee

The Committee developed the Town of Inuvik's Community Energy Plan and consists of members representing the Town of Inuvik. TBD: Member names/contacts. These can be found once communication with the Town of Inuvik begins.

Human Capital

This section describes the current technical skill sets in the community in the energy sector (e.g. energy stems design, planning, generation and maintenance). Also, it explains the availability of/access to/support for community training and education in the energy sector (e.g. energy systems design, planning, generation and maintenance).

Current Technical Skills

Solar Photovoltaic Installation

Solvest, Whitehorse, YT

Tel: (867) 457-5690

Kuby Solar, Edmonton, AB

• Installed 10.97kW on an Inuvik residential home

Tel: (780) 340 - 5829

Green Sun Rising, Windsor, ON

• Installed 17 panels on Children First Daycare, Inuvik

Tel: (519) 946-0408

Bullfrog Power, Calgary, AB

- Installed 5kW on Inuvik Ski Club, Inuvik
- Tel: (877) 360- 3464

Gas Furnace and Boiler Installation and Maintenance

Plumb Crazy Mechanical Ltd., Inuvik:

Tel: 867-777-3210, Email: plumbcrazy@northwestel.net

Rocky's Plumbing and Heating, Inuvik:

Tel: 867-777-2579, Email: truman@rockysplumbing.com

Weitzel Construction, Inuvik:

Tel: 867-777-3954, Email: rweitzel@weitzels.ca

Arctic Rim Distributors, Inuvik

Tel: 867-777-2566

Community Training and Education

Open House for Non-profit Organizations (2020-02-13): AEA invited NWT-based non-profit organizations to learn about rebates for projects that save energy and money.

Electronically Commutated Motors (ECMs) for Circulator Pumps (2020-01-15): AEA offered a two-day product and technology training session on the technical aspects of these energy-efficient pumps. Training facilitated by the Grundfos Training Institute of Canada and the Arctic Energy Alliance.

Indigenous Mapping Workshop (2019-10-8): The workshop in Inuvik explored the NWT Geomatics Portal, Inuvialuit Settlement Region Online Platform, Google, Esri Canada, QGIS and OpenStreetMap, and other geospatial tools. Participants learned how to use these tools to collect, host, visualize, share, and publish community generated data and better understand how to apply these skills to issues impacting Canada's northern communities. The technical training will be co-led by The Firelight Group, Google Earth Outreach, Google's Trainer Network, Esri Canada, Mapbox, and a global network of Indigenous mapping experts.

Tekmar Boiler Control Systems Course (2019-01-14): Arctic Energy Alliance coordinated a one-day Tekmar control systems course, covering theoretical and practical applications of boiler control systems in Yellowknife.

Energy Workshops through the City of Yellowknife (2018-02-28): At the end of February, the AEA wrapped up a series of evening energy workshops offered through the City of Yellowknife's recreation programs.

Inuvik Solar Information Session (2015-06-16): A dozen Inuvik residents joined Arctic Energy Alliance staff at the Inuvik Centennial Library to learn about solar installation in the NWT.

Inuvik's Science Rendezvous (2015-05-26): Inuvik's Science Rendezvous was coordinated by The Aurora Research Institute. AEA's Inuvik Regional Energy Project Coordinator, Sheena Adams, used a Lego model to demonstrate solar power and wind power. The solar panel fed by a lamp taught visitors how light energy (solar) can be converted then stored in a battery. The wind turbine was powered by a fan and the kinetic energy collected in the same battery.

Solar PV Design Workshop in Whitehorse (2015-05-08): Arctic Energy Alliance staff members attended a 5day Solar PV Design and Installation Workshop hosted by the Energy Solution Center in Yukon. The training was delivered by Canadian Solar Institute and Soleil Power Canada Inc., featuring theoretical knowledge and hands-on practices for solar PV design and install.

Residential Mechanical Ventilation Installation Course- Level 1 (2015-04-28): The Arctic Energy Alliance sponsored and hosted the Residential Mechanical Ventilation Installation Level 1 training course, delivered by the HRAI SkillTech Academy. The three-day course was held in both Yellowknife and Hay River with a total of 22 participants, 8 attended in Yellowknife and 14 in Hay River, most of which were mechanical tradespeople. Tradespeople from the communities of Fort Smith and Fort Simpson also attended.

Safe Wood Stoves in the Sahtu (2015-04-24): Arctic Energy Alliance conducted three Wood Energy Technology Transfer (WETT) courses over a six-day period in Norman Wells to help train local and regional residents to become WETT Certified. The WETT training teaches how to safely install wood stoves and greatly reduce the risk of house fires, and to use the wood appliance efficiently in order to get the most heat possible. In anticipation of their wood stove program, Fort Good Hope sent three students to participate so that their community was prepared and certified to install thirty wood stoves.

Creative Energy Communication Session (2015-04-10): Arctic Energy Alliance (AEA) met with Ecology North's Regional Office Manager, Kim Rapati, for a hands-on workshop sharing creative communication techniques for energy conservation and renewable energy education. Sheena Adams from the Inuvik office also attended and explored a variety of innovative ways to plan and deliver engaging, hands-on, information sessions for students & community members.

Inuvik Energy Fair (2015-03-30): Inuvik's Regional Energy Coordinator hosted the Inuvik Energy Fair at the ARI building.

Energy Courses in Yellowknife (2015-02-24): Arctic Energy Alliance has been doing courses in Yellowknife in 2015 with great turnout for the first four courses and good discussions all around.

- 'Heating with Biomass' Course Description: Learn about the benefits and incentives of using wood or pellets to heat your home, including choosing a system, installation and maintenance.
- 'Learn About District Heating' Course Description: Learn about district heating basics and see if this option might be right for your situation, including information on incentives and technical support.

Elders Council Update on Energy Issues (2015-02-06): Arctic Energy Alliance's Dehcho Regional Energy Project Coordinator, met with the Dehcho First Nations Elders' Council. Investigate whether Beaufort-Delta's Energy Project Coordinator also did a similar Elder update in their jurisdiction.

Inuvik School Presentation (2014-12-1): Inuvik's Regional Energy Project Coordinator attended Inuvik's East Three School and presented about Renewable Energy. It would be useful to know if this workshop has been repeated and to obtain the curriculum.

Aurora College Programs:

- Apprenticeship Electrician
- Apprenticeship Housing Maintainer
- Apprenticeship Oil Heat Systems Technician
- Apprenticeship Plumber/Gasfitter Program
- Environment and Natural Resources Technology Diploma

Aurora Research Institute:

Creating Heat from Waste: Landfill Destined Cardboard as a Raw Material for Heating Pellets (2017-2019): Contact: Matthew Dares, Overview: The purpose of this project is to investigate the use of locally diverted waste cardboard to produce fuel pellets in Inuvik, NT.

Solar Energy Potential (2007-ongoing): Contact: Matthew Dares, Overview: In order to assess the feasibility of using solar energy in communities across the NWT, the Department of Environment and Natural Resources (ENR) and the Aurora Research Institute (ARI) have been conducting solar energy studies in the NWT for nearly ten years. Solar energy modeling programs have been established in several locations in order to provide communities with a clear picture of their local solar resources. Completed as interest arises.

Wind Energy Potential (2007-ongoing): Contact: Matthew Dares, Overview: In order to assess the feasibility of using wind energy in communities across the NWT, the Department of Environment and Natural Resources (ENR) and the Aurora Research Institute (ARI) have been conducting wind energy studies in the NWT for nearly ten years. Wind energy modeling programs have been established in several locations in order to provide communities with a clear picture of their local wind resources. Completed as interest arises.

WARC Solar Panel Data (2011-2013): The Western Arctic Research Centre (WARC) in Inuvik has 10 solar panels installed on its south-facing wall. Five were installed when WARC was built in 2011, while the other 5 were installed in partnership with Environment and Natural Resources and Arctic Energy Alliance during the summer of 2013. All 10 panels are continuously monitored to measure energy production - all energy is fed into WARC and used to offset the facility's energy demands. You can also check out how much energy the entire array has produced during its lifetime on the project's monitoring website: https://enlighten.enphaseenergy.com/pv/public systems/XXhz36611/overview. The instantaneous energy produced by the WARC solar panels can be seen over a period of time (the orange line, in kW), as well as the total cumulative energy produced during that same time period (the blue-filled area, in kWh).

Community Investments

This section describes recent community investments in energy technology, renewable energy projects, energy efficiency initiatives, or local energy literacy programs over the last 5 years.

Solar Inuvik Freezer

Using a rebate from the Arctic Energy Alliance's (AEA) Community Renewable Energy Program, a 2.5kW gridtied solar PV system was installed at the Inuvialuit Community Freezer in Inuvik, where residents can store country foods.

Western Arctic Research Centre

The INF is collaborating with the ARI and Education Culture and Employment (ECE) to build a 25-kilowatt gridconnected solar PV system on the roof of the Western Arctic Research Center in Inuvik. ECE received \$100,000 from the federal Post-Secondary Institution Strategic Investment Fund while INF is providing the balance of funding and project management. When complete, the solar array will produce an estimated 22,500kWh per year, offsetting 6,800 litres of diesel and saving the equivalent of 19.4 tonnes of CO2 annually.

Infrastructure Records Building

A 25-kilowatt solar PV array is being installed on the roof of the INF Records Building in Inuvik. The system will provide power to the building, with any excess power going onto the electrical grid. The solar array will produce an estimated 22,500kWh per year, offsetting 6,800 litres of diesel, and saving the equivalent of 19.4 tonnes of CO2 annually. The budget for the project is \$200,000.

17 Unit Singles Complex (NWTHC)

A 20kW Solar PV array was installed in Inuvik on the newly constructed 17-unit singles complex in Inuvik. The solar PV installation is wall mounted and cost \$154,000. INF worked with Northwest Territories Housing Corporation to secure funding from Indigenous and Northern Affairs Canada for the solar installation.

Exhaust Heat Recovery Unit

NTPC is designing an exhaust gas heat recovery unit (EGRU) for one of the power plant's natural gas-fired generators. An older system currently provides heat to NTPC's power plant and Inuvik's water treatment plant (WTP) but is supplemented by gas-fired boilers in the winter.

The new EGRU will:

- Reduce the need to run the plant's backup natural gas-fired boilers—which generate heat to vaporize the natural gas that powers the generators and boilers.
- Reduce operating costs and natural gas consumption, while increasing overall efficiency.
- Maximize waste heat recovered with an improved control system.
- Meet growing heating needs of the recently upgraded WTP.
- Feed new loads, including two nearby GNWT buildings that only require funding to design and install energy transfer stations and piping

Energy Programs and Incentives

This section describes the availability of energy programs (e.g. loans, grants, incentives, etc.) for renewable energy projects, energy efficiency, training or capacity building.

GNWT

The GNWT funds programs—delivered by the Arctic Energy Alliance (AEA)—that provide incentives for residents and businesses to use energy-efficient appliances as well as alternative energy sources and technologies.

Capital Asset Retrofit Fund (CARF)

CARF allows for the upgrading of existing GNWT buildings to improve overall energy efficiency. The program helps to reduce energy consumption, operating costs, and greenhouse gas emissions from the operation of GNWT buildings. The CARF program has been in existence since 2007.

Alternative Energy Technologies Program (AETP)

AETP provides funding for communities, commercial businesses and NWT residents to use renewable energy sources such as solar, wind, wood pellet heating, biofuel/synthetic gas and ground source heat pumps.

Energy Efficiency Incentive Program (EEIP)

The EEIP helps homeowners, businesses and nonprofit organizations purchase new, more energy efficient models of everyday products and appliances.

Commercial Energy Conservation and Efficiency Program (CECEP)

CECEP provides up to \$10,000 for eligible projects to help NWT businesses conserve energy and improve their energy efficiency.



Figure 7 Distribution of Energy Efficiency Projects in Inuvik (Arctic Energy Alliance, 2015)



Figure 8 Distribution of Renewable Energy Rebates in Inuvik (Arctic Energy Alliance, 2015)

Community Energy Source Potential

This section describes the physical potential based on solar radiation; hydro resource; geothermal; wind resource; sustainable biomass harvest; coal reserve, etc.

Wind Monitoring Studies

As the NWT's largest thermal community, Inuvik could benefit substantially from wind power that could be used to displace millions of litres of diesel fuel each year. A 2-5MW wind farm is being proposed in Inuvik to tie in with the NTPC power. In 2016/17, INF funded wind-monitoring studies in Inuvik, including continued data-gathering at the Inuvik High Point and Snare Rapids wind monitoring sites.

The Inuvik High Point site shows good wind potential and is only five kilometres from the highway and ten kilometres from a tie-in to the existing transmission line. Proximity to the highway and transmission line facilitates access and reduces project costs. In December 2015, a 50-metre wind tower was installed at the site and measured average wind speeds of 6.42 metres per second.

However, two years of data is needed to confirm wind resource quality, and unfortunately the first tower was lost during extremely high winds. Baseline information for a wind project was collected in 2016/17 including road and transmission line alignment, wind modeling and a review of wind turbines suitable for arctic applications. More detailed work including geo-technical testing will continue in 2017/18. A new 50-meter tower was installed in 2017 (GNWT, 2019).

Priorities

This section describes key energy priorities over the near-term and long-term (e.g. build service capacity, reduce cost of service, reduce GHGs, renewables transition, induce economic development, energy sovereignty, etc.).

Long-term Priorities

In making decisions, the GNWT has attempted to balance many competing interests, values and priorities. Energy must be secure, affordable and sustainable in the NWT, and these can be conflicting goals at times. For instance, using renewables is often not the most reliable way to generate electricity, yet GHG reductions from electricity is a priority of the GNWT and many stakeholders in the NWT. During the public engagement, it was determined that affordability of electricity is one of the biggest concerns.

Decisions about what projects and initiatives will be undertaken in GNWT's 2030 Energy Strategy are based on an approach that considers the following priorities:

- Community and Indigenous government engagement, participation, involvement and approval
- Energy security and reliability
- Affordability
- Sustainability
- Optimization of resources, including GHG reduction per dollar invested
- Project complexity and likelihood of success
- Stakeholder interests and needs
- Capacity within a sector to achieve a successful result

VULNERABILITIES AND SECURITY

The off-grid nature of Inuvik combined with the cold climate and geographic remoteness presents unique energy security issues that impact the community. This section outlines what energy security means to the community and describes the vulnerabilities of the community's energy system. The areas of vulnerability discussed are power disruptions, fuel supply, infrastructure, renewables integration and economic vulnerability.

Energy Security

The document review did not uncover any definition of energy security for the community of Inuvik. Neither was any definition of energy security found for the Beaufort Delta region. Academic literature contains definitions of energy security for arctic regions including rural Alaska and northern Russia that experience energy situations similar to the Beaufort Delta region that could be applied to Inuvik (Hossain et al., 2016; Kiushkina & Antonenkov, 2019), but it is still necessary to obtain a community-specific definition to have a

complete understanding of the vulnerabilities that need to be addressed in building a community energy plan. The definitions applied in rural Alaska and northern Russia respectively are, "A situation in which people have reliable access to socially acceptable energy generation or provisioning services, at a level sufficient to conducting a sustainable life," (Hossain et al., 2016) and, "This is the state of protection of service areas against external and internal threats caused by territory isolation and remoteness from centralized power supply sources, which enables ensuring fuel-and-energy sector diversification and favourable conditions for operation and energy self-sustainability of local power industry facilities meeting modern requirements to power quality with account for harsh climatic conditions and preventing emergencies in case of power supply interruptions" (Kiushkina & Antonenkov, 2019).

A community-specific definition for Inuvik can be developed through interviews with community residents, community leaders, the GNWT Fuel Services Division who provide fuel to the community and NTPC staff.

Power Disruptions

This section describes the timing, duration, frequency of, and reasons for power outages, changes in power disruptions trends over the past 10 years and outage implications for the community of Inuvik.

Outages and Power Disruption Trends

The sole electrical utility for the Beaufort Delta region is the crown corporation NTPC. NTPC classifies outages into eight categories by their cause (Northwest Territories Power Corporation, 2010):

- Loss of production caused by equipment failures or breakdowns,
- Loss of supply due to problems with the transmission or distribution system,
- Scheduled outages due to disconnection for construction, maintenance or repair,
- Lightning strikes to transmission or distribution systems,
- Adverse weather such as rain, ice storms, snow, winds, extreme temperatures, freezing fog or frost,
- Human elements such as incorrect use of equipment, settings or installation maintenance; switching errors or sabotage,
- External interference such as birds, animals or foreign objects, and
- Unknown where there is no apparent cause.

In its annual reports, NTPC provides leading causes of outages for the year along with reliability indices such as the System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) for its entire customer base, but the information is not available on a community level (Northwest Territories Power Corporation, 2019a). While the majority of North American utilities are required to report reliability information - including electrical outages - to the North American Electric Reliability Corporation (NERC), because NWT is not connected to the rest of the North American electrical grid, NTPC does not have this requirement. Instead, reliability performance is regulated by the NWT Public Utilities Board (PUB) (Natural Resources Canada, 2016). However, reliability performance information collected by the NWT PUB is not publicly available.

Another possible source of reliability performance data is the Canadian Electricity Association (CEA). The CEA collects reliability performance data from participating member organizations across the country including NTPC, and provides pooled data to the public in an annual report available for a fee (Canadian Electricity Association, n.d.). However, it is unknown if the data NTPC provides to the CEA is detailed at the community level and even if it is, the unpooled data for NTPC is not publicly available.

Outage Implications for Inuvik

Little information is available regarding how power outages affect Inuvik residents. The town's emergency response plan explains the protocol to follow in the event of a winter natural gas or power outage, but the details are labelled as confidential and are not publicly available (Town of Inuvik, 2014). It is unknown whether the community relies upon electricity for heat, but heating oil (diesel fuel used for heating) is available to the community that can be used in the event of a power outage.

Gaps in Data Availability

Data that still needs to be collected surrounding power disruptions are:

- 1. Current power outage data for Inuvik,
- 2. Trends of power outages in Inuvik over the past 10 years, and
- 3. Outage implications for the community.

Current and historic power outage data can be obtained from NTPC through a formal request. In the event NTPC denies the request, the information may also be obtained from the NWT PUB, though they may not have access to the same wealth of data. Additionally, the CEA could be contacted to determine if they have community-specific data and are willing to share it. Information on outage implications for Inuvik can be obtained via a formal request to INF to review Inuvik's emergency response plan and through interviews with community leaders and residents.

Fuel Supply

This section describes the access to and reliability of fuel supply for power generation and heating, as well as the reasons for any disruptions in the fuel supply chains.

Fuel Services Division

Under the Fuel Management Services Agreement, the GNWT Fuel Services Division (FSD) manages the purchase, transport and storage of fuel in 20 off-grid communities on behalf of NTPC until the contract expires on March 31, 2021 (Gwich'in Council International, 2017; Northwest Territories Power Corporation, 2019a). Furthermore, under this agreement, FSD also handles the maintenance of bulk fuel storage tank farms owned by NTPC. Though the actual Fuel Management Services Agreement document could not be located, it is highly likely that Inuvik is one of the 20 communities named for servicing. The price of fuel under this agreement depends on the market price, the cost of transport, the GNWT fuel tax rate and the amount of fuel purchased by NTPC in a given year.

In a separate agreement, FSD manages the supply of liquid natural gas (LNG) for Inuvik. Like the Fuel Management Services Agreement, the price of LNG under this agreement varies with the market price, the

cost of freight and an administrative fee. The LNG contract is set to expire on March 31, 2020 (Northwest Territories Power Corporation, 2019a).

While the agreements mentioned above explain who manages the fuel supply logistics for electricity generation, it is unknown whether FSD handles the delivery of fuel to the community that is used for other purposes such as heating.

Delivery Route

According to the 2010 Report of the NTPC Review Panel, FSD supplies Inuvik with fuel through a combination of marine and winter-road transport (Northwest Territories Power Corporation, 2010). The exact shipping route varies by fuel type. Some products are shipped by rail from Alberta to Hay River, NWT, and then transported by barge along the Beaufort Sea from Hay River to individual communities (Government of Canada, 2019). The GNWT Marine Transportation Services delivers to Inuvik twice per year during the sailing season. The estimated arrival dates for the 2020 year are June 27 and July 20 (Government of the Northwest Territories, 2020).

LNG Source and Delivery

LNG is purchased from companies in southern Canada and is transported by truck to Inuvik via the Dempster Highway (Northwest Territories Power Corporation, n.d.). Sources of LNG for Inuvik include FortisBC's Tilbury Island facility near Vancouver, BC, and Ferus Natural Gas Fuels Inc.'s production plant in Grande Prairie, AB (Government of Canada, 2019; Thomson, 2018). There is discussion about building a local production facility in the Beaufort Delta region to reduce LNG transportation costs (Scott, 2017).

Biomass Source

Wood pellets fueling biomass boilers in Inuvik's hospital and East Three School are shipped from various locations in southern Canada (Government of the Northwest Territories, 2017).

Fuel Supply Disruptions

Little information is available regarding fuel supply disruptions. One major disruption occurred in 2012, when the two natural gas wells supplying Inuvik's natural gas power plant ran dry (Northwest Territories Power Corporation, n.d.). This prompted the shift to LNG in late 2013. In its 2018-19 annual report, NTPC says it faced LNG supply issues in the early part of the year (Northwest Territories Power Corporation, 2019a). During both disruptions, Inuvik relied on its diesel generators to power the town.

Gaps in Data Availability

- 1. It needs to be verified whether Inuvik is one of the 20 communities serviced by FSD under the Fuel Management Services Agreement,
- 2. The supply chain for fuels used for purposes other than electricity need to be identified,
- 3. The exact shipping routes for fuels other than LNG need to be determined, and
- 4. Information about fuel supply disruptions needs to be collected.

Item 1 can be confirmed through discussions with FSD staff or NTPC staff. Information on the fuel supply chain, delivery routes and fuel supply disruptions can be obtained through interviews with FSD, local community leaders and local fuel distributors. The local fuel distributors will be identified through interviews with community leaders.

Infrastructure

This section discusses the condition of energy infrastructure, its current and future capacity, maintenance requirements and major threats to energy infrastructure.

Age and Condition of Existing Energy Infrastructure

Little information is given on the age and condition of energy infrastructure in Inuvik. The information available pertains to recent developments, where new energy assets have been installed or old ones have been renovated that was gleaned from NTPC's website and recent energy initiatives reports from the GNWT (2018, 2019):

- 1999
 - The natural gas power plant was built and commissioned in Inuvik
- 2013
 - The natural gas plant started using LNG imported from southern Canada
- 2017
 - GNWT installed 20 kW of solar the housing corporation's 17-unit apartment complex (see 17 Unit Singles Complex (NWTHC)
- 2018
 - o A 950-kW biomass boiler was installed in East Three School
 - An EGHU was installed on the second natural gas-fired generator (for more details see Exhaust Heat Recovery Unit section of this report)
 - Control system upgrades were performed on two gas engines
- 2019
 - o A 1250 kW KOB Viessman wood pellet biomass boiler was installed at Inuvik Regional Hospital

Capacity of Existing Infrastructure to meet Current and Future Energy Needs

NTPC keeps "a reserve margin large enough to compensate for the loss of the largest generating unit during the system peak" (Natural Resources Canada, 2016). These criteria - commonly known as N-1 criteria - means that capacity of backup generation is sized such that the electrical system can sustain the loss of its largest generating unit without disrupting the electrical supply. More specifically, NTPC backup units are 110% the size of the corresponding primary unit (Northwest Territories Power Corporation, 2010). In the 2018-19 year, the backup diesel units were able to sustain the town's load when the LNG plant was non-operational, suggesting that the existing energy infrastructure is sufficient to meet Inuvik's energy needs. However, because the peak annual electrical load for the community and the reverse margin maintained when the LNG generating units were down are unknown, one cannot conclusively say that existing infrastructure is

sufficiently satisfying the community's energy needs. Information around the existing capacity of distribution infrastructure and the capacity of infrastructure to satisfy future energy needs could not be located.

Access to Maintenance

NTPC operates the generator in Inuvik once a month to ensure it is in good working order (Northwest Territories Power Corporation, 2010). Furthermore, NTPC conducts preventative maintenance (PM) of generation assets and distribution lines periodically, although the frequency of PM in Inuvik is unknown. NTPC also states they do not have technical staff based in every community due to prohibitive costs and that there may be some delays reaching communities in the event of equipment failure (Northwest Territories Power Corporation, 2010). As mentioned in the Fuel Services Division section, if Inuvik is one of the 20 communities named in the Fuel Management Services Agreement, then FSD manages the maintenance of the fuel tank farms.

Major Threats to Infrastructure

According to NTPC's 2018-19 annual report, adverse weather and foreign interference (external objects such as tree branches, trucks, or animals) are the leading external causes of outages across the territory, but no information is available on the major threats experienced by Inuvik's infrastructure specifically (2019a).

Gaps in Data Availability

The gaps surrounding Inuvik's energy infrastructure are:

- 1. The age and condition of infrastructure that was not installed or renovated recently are unknown,
- 2. Little information is available on the capacity of existing infrastructure generation and distribution infrastructure to meet current and future energy needs,
- 3. Minimal information is known regarding maintenance routines and access to spare parts, and
- 4. Little information has been found on major threats to Inuvik's energy infrastructure.

Most of this information can be gained from NTPC through formal data requests and interviews with staff. Fuel tank farm maintenance procedures can be determined through interviews with FSD staff. Additionally, interviews with community leaders could provide some information on when major energy assets were installed and how well the infrastructure is serving existing energy needs.

Renewables Integration

This section addresses the ability to integrate renewable energy technologies (RET) into the existing energy system and discusses technical limitations and capital commitments that constrain the ability to transition to or invest in renewables.

Utility and Community Attitude Toward RET

As demonstrated through some of the recent RET installations in Inuvik, the community and NTPC are both open to incorporating RETs. Two goals of Inuvik's Community Energy Plan are to

- 1. "Develop [a] local energy supply," and
- 2. "Increase awareness of alternative Energy Options" (Kavik-AXYS & Stantec Consulting Ltd., 2010).

NTPC also supports RET, stating that utility owned renewable generation is considered when a diesel power plant is due for replacement, and has introduced a net metering program allowing customer owned solar installations less than 15 kW to be connected to the electrical grid (2017). Furthermore, a wind monitoring study is being conducted near Inuvik to assess the potential of introducing 2-5 MW of wind power into Inuvik's grid (see Wind Monitoring Studies section).

Technical Limitations

RET installations connected to the grid are limited by NTPC to 20% of a community's average annual electrical load. This is done to "protect customers from higher electricity rates and an increased number of outages" that could result from grid instability and inefficient generator cycling associated with high levels of RET penetration (Northwest Territories Power Corporation, 2018). For Inuvik, the allowable RET capacity is 670 kW and between current and planned net metering, government and utility owned installations, all 670 kW have been accounted for (Northwest Territories Power Corporation, 2019b). Therefore, no additional RET installations can be connected to the electrical grid. While a reason for the renewables penetration cap is given, little explanation is provided regarding why 20% was selected as the maximum rather than a higher or lower value.

Gaps in Data Availability

No information is available regarding ongoing capital commitments of the community and NTPC that constrain the ability to transition to or invest in RETs. This information can be obtained from interviews with community leaders and NTPC staff.

Economic Vulnerability

This section discusses the state of key industries and economic sectors in the community and how it is opening or closing opportunities for energy choices.

While little information could be located on this topic, relevant information can be divided into three main points All information presented here comes from Inuvik's Strategy for Economic Growth (Millier Dickinson Blais & Pealow Consulting, 2015):

- 1. Potential natural resource projects,
- 2. The link between economics and the high cost of energy, and
- 3. The state of the forestry sector.

There are many potential projects within the natural resource sector including oil and gas, and gas to liquids. In fact, it was the Ikhil gas project many years ago that prompted the shift to natural gas furnaces from diesel. Local resource availability in the area will influence energy system choices for the future. Regarding the link between economics and energy, Inuvik's 2015 Strategy for Economic Growth states the high cost of living - high food and energy costs - has driven local businesses out of town. Furthermore, some residents have argued that the structure of Inuvik's income and housing support programs provide an incentive to be unemployed. Energy options that decrease the cost of living will not only encourage residents and local businesses to remain in the community, but may also have a positive impact on the unemployment rate by reducing the incentives of receiving income and housing support. Lastly, the Strategy for Economic Growth notes that slow biomass growth rates in the area around Inuvik discourages large-scale forestry operations in the region. Faster-growing biomass sources would need to be available to make such operations viable. Willow is being tested to see if it can be used for biomass pellet production.

Detailed information about the relationship between Inuvik's economic sectors energy choices could not be found. This information can be obtained through interviews with community leaders to identify Inuvik's key economic sectors, and interviews with employers and employees who work in those sectors.

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