



ENERGY PROFILE: TSIIGEHTCHIC

THIS RESEARCH WAS SUPPORTED BY THE SOCIAL
SCIENCES AND HUMANITIES RESEARCH COUNCIL OF
CANADA, GRANT NUMBER 895-2019-1007.

SSHRC  CRSH

Partnership Project 895-2019-1007



TSIIGEHTCHIC



Figure 1 Tsiigehtchic, NWT (Northwest Territories Tourism, 2019)

March 2020

Energy Profile

Christopher Bespflug, Renata Leonhardt, Rhys McMaster, Sara Thompson, Ali Yousry

Table of Contents

Regulation and governance	4
Ownership Structure	4
Institutional Arrangements	5
Territorial Level	5
Petroleum Products and Carbon Tax Act and Regulations	5
Natural Resources Conservation Trust Act	6
Community Planning and Development Act and Regulations	7
Federal Level	7
Northwest Territories Devolution Act.....	7
Canadian Energy Regulator Act.....	7
Energy efficiency Act and Regulations	7
Gaps in Institutional Arrangements	8
Independent Power Producer (IPP) Regulations.....	8
Policy Environment	8
2030 Energy Strategy	8
2030 NWT Climate Change Strategic Framework.....	9
NWT Petroleum Resources Strategy	9
NWT Economic Opportunities Strategy	9
Historic Shifts and Embeddedness	10
Relationships	10
Local capacity and innovation	10
Community Energy Plan	10
Vision for Tsiigehtchic in 2050	11
Community Energy Goals	11
Key Gaps.....	12
Recent Updates	12
Energy Champion	12
Clean Energy Advisor, Inuvialuit Regional Corporation	12
Regional Energy Project Coordinator, Arctic Energy Alliance	13
Project Coordinator, Arctic Energy Alliance	13

Regional Director, Government of Northwest Territories	14
Local Advisory Committee	14
Human Capital	14
Current Technical Skills	14
NT Petroleum Products Program	14
Community Training and Education	15
Community Investments	15
Wood Stoves	15
Energy Programs and Incentives	15
GNWT	15
Capital Asset Retrofit Fund (CARF)	15
Alternative Energy Technologies Program (AETP)	16
Energy Efficiency Incentive Program (EEIP)	16
Commercial Energy Conservation and Efficiency Program (CECEP)	16
NT Petroleum Products Program	16
Community Energy Source Potential	17
Climate Change Impacts and Potential Opportunities	17
Priorities	17
Replace Fuel Line Connections in Heating Oil Tanks	17
Develop Closer Ties with Arctic Energy Alliance	18
Complete a Forest Resource Assessment	18
Investigate Biomass Fuel Sources	18
Investigate Other Renewable Energy Sources	18
Vulnerabilities and security	19
Energy Security	19
Power Disruptions	19
Outages and Power Disruption Trends	19
Outage Implications for Tsiigehtchic	20
Gaps in Data Availability	20
Fuel Supply	21
Fuel Services Division	21

Delivery Route	21
Gaps in Data Availability.....	21
Infrastructure	21
Age and Condition of Existing Energy Infrastructure	21
Capacity of Existing Infrastructure to meet Current and Future Energy Needs	21
Access to Maintenance	22
Major Threats to Infrastructure	22
Gaps in Data Availability.....	22
Renewables Integration	22
Utility and Community Attitude Toward RET	23
Technical Limitations.....	23
Gaps in Data Availability.....	23
Economic Vulnerability	23
References.....	24

Tsiigehtchic

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 Tsiigehtchic. 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).



Figure 2 Map of Canada with Tsiigehtchic, NWT location

The current Tsiigehtchic non-renewable energy generation structure is owned by the Northwest Territories Power Corporation (NTPC). NTPC along with Northwest Territories Energy (NTEnergy) are owned by NT Hydro (Figure 3), which in turn is 100 percent owned by the Government of the Northwest Territories. (Northwest Territories Power Corporation, n.d.).

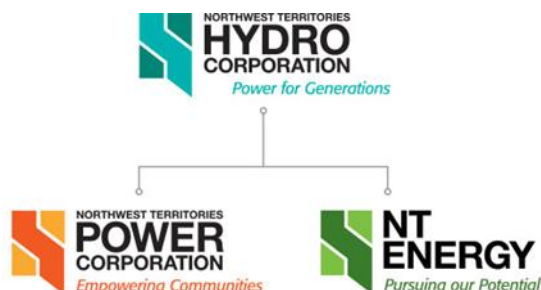


Figure 3 Energy Ownership Structure in NWT

Institutional Arrangements

This section describes 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 Government of Northwest Territories (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 Tsiigehtchic 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

Tsiigehtchic

Diesel in 2022 (Figure 4). In Tsiigehtchic, considering data from November 2019, the carbon tax represents 2.83% of the price paid for a litre of gasoline.

Item N°	Type of Fuel Type de carburant	September 1, 2019 – June 30, 2020 <i>Le 1^{er} septembre 2019 et se terminant le 30 juin 2020</i>	July 1, 2020 and ending June 30, 2021 <i>le 1^{er} juillet 2020 et se terminant le 30 juin 2021</i>	July 1, 2021 and ending June 30, 2022 <i>le 1^{er} juillet 2021 et se terminant le 30 juin 2022</i>	July 1, 2022 and thereafter <i>le 1^{er} juillet 2022 et continuant</i>
1	Aviation gasoline <i>Essence d'aviation</i>	exempt <i>exempté</i>	exempt <i>exempté</i>	exempt <i>exempté</i>	exempt <i>exempté</i>
2	Aviation jet fuel <i>Carburant pour turbo-</i>	exempt <i>exempté</i>	exempt <i>exempté</i>	exempt <i>exempté</i>	exempt <i>exempté</i>
3	Butane (L)	\$0.035	\$0.053	\$0.071	\$0.089
4	Diesel (L)	\$0.055	\$0.082	\$0.109	\$0.137
5	Gasoline <i>Essence</i> (L)	\$0.047	\$0.070	\$0.094	\$0.117
6	Naphtha <i>Naphte</i> (L)	\$0.051	\$0.077	\$0.102	\$0.128
7	Natural gas <i>Gaz naturel</i> (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 benefit** 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, a Tsiigehtchic family will receive \$104 per adult and \$120 per child under the age 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 the 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 Tsiigehtchic, consequently, does not have a community energy plan.

Federal Level

Details on how federal legislation provides or fails to provide support for renewable energy in Tsiigehtchic 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 Northwest Territories. 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 mid-scale 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 Tsiigehtchic, 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.

NWT Economic Opportunities Strategy

The last economic strategy was launched by the GNWT in 2013, and it considers both renewable and non-renewable 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

Historic Shifts and Embeddedness

1948	Establishment of Northwest Territories Power Commission, a federal crown corporation
1956	The federal corporation is renamed to Northern Canada Power Commission (NCPC)
1988	Government of the Northwest Territories acquires NCPC from federal government
1989	The Commission is renamed the Northwest Territories Power Corporation (NTPC) NWT Public Utilities Board commences partial regulation of the Corporation.
1992	Full regulation of the Corporation by the NWT Public Utilities Board.
1997	Community-based rates established.
2007	The GNWT creates the Northwest Territories Hydro Corporation (NT Hydro). The new corporate structure includes NTPC as one of three NT Hydro subsidiaries. Energy for the Future, an Energy Plan for the NWT
2008	Establishment of the Energy Priorities Framework for NWT
2009	Creating a brighter future: a review of electricity regulation, rates and subsidy programs in the NWT
2013	NWT Energy Action Plan 2013 - 2016
2014	Devolution occurs; NWT gains more powers over its land, waters and natural resources
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

Tsiigehtchic does not have a community energy plan. However, a climate change plan, with the title of Gwichya Gwich'in Climate Change Adaptation Planning Project exists for the community. The project was

funded by Indian and Northern Affairs Canada's Adaptation and Impacts Research Division. It was completed in partnership with Ecology North in 2010. This section describes the nature and scope of Tsiigehtchic's community climate change plan as it relates to energy, including community energy goals or objectives, key gaps, date established and most recent update (Ecology North, 2010).



Figure 5 Gwich'ya Gwich'in Climate Change Adaptation Planning Project (Ecology North, 2010)

Vision for Tsiigehtchic in 2050

The Local Advisory Committee developed a vision for how they see the community in 2050 (Ecology North, 2010). It was:

“Our community of Tsiigehtchic will be a resilient, self-sufficient community which celebrates and practices its culture and promotes renewable economic development within our traditional lands.”

Community Energy Goals

The Local Advisory Committee of Tsiigehtchic's community climate change project created a list of priorities for the community (Ecology North, 2010). Those related to energy are listed below:

Local Advisory Committee Priorities

- Assessing fuel tanks
- Pellet stoves and alternative energies

Key Gaps

The community created a list of recommended adaptations, which were categorized by the anticipated difficulty of the implementation of the respective adaptations and placed in specific themes (Ecology North, 2010). Below are those which related to energy:

- **Theme: Housing Issues**
 - Adaptation: Inventory and replace rigid fuel line connections with flexible connections in all heating oil tanks

Included in the recommended adaptations were those which related to the reduction of fossil fuel use. It was noted that there was considerable community interest in mitigating issues that may lead to the reduction of the cost of living (Ecology North, 2010). It was also said that the community is developing a Community Energy Plan that will address mitigation and the high cost of living, but several recommended adaptations to begin the energy plan work include:

- Develop closer ties with Arctic Energy Alliance
- Work with Environment and Natural Resources Forestry Management Division to complete a forest resource assessment for Tsiigehtchic
- Investigate the potential of using willows and forests as a biomass fuel source
- Investigate using wood pellets and in-stream hydro as options to reduce dependence on fossil fuels

Recent Updates

The Climate Change Adaptation Planning Project was established in March of 2010, and it has not been updated (Ecology North, 2010).

Energy Champion

Clean Energy Advisor, Inuvialuit Regional Corporation

Leigh Ann Williams-Jones, Clean Energy Coordinator

Tel: 867-777-7054, Email: williams-jones@inuvialuit.com

Address:

Inuvialuit Regional Corporation

Attn: Innovation, Science & Climate Change

Bag Service #21

Inuvik, NT X0E 0T0

- 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 X0E 0T0

- 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

Address:

Beaufort-Delta Regional Office

#205–125 Mackenzie Road

PO Box 3342

Inuvik, NT X0E 0T0

- Participating in events such as the Tsiigehtchic Community Healthy Living Fair. Where she spoke with residents about energy related questions and donated a set of LED Christmas lights to the community prize table.
- Meeting with homeowners, community groups and the school to hold conversations about alternative energy, energy conservation, and the rebates available through the Energy Efficiency Incentive Program.
- Supervising the Wood Energy Transfer Technology (WETT) certification of seven wood stoves that were recently installed.

Regional Director, Government of Northwest Territories

Peter Clarkson, Regional Director for all of Beaufort Delta

Tel: 867-777-7445, Email: peter_clarkson@gov.nt.ca

Address:

Government of the Northwest Territories

Department of Executive

Regional Director

Bag 1

Inuvik, NT X0E 0T0

Local Advisory Committee

Through the development of the Gwichya Gwich'in Climate Change Adaptation Planning Project, a community-based Local Advisory Committee was developed and a Community Coordinator was recognized. The Community Coordinator of the project was Itai Katz. The members of the Local Advisory Committee were: Peter Ross, Maureen Clark, Sonny Blake, Ruby Lennie, Charlotte Moore, Archie Norbert and Itai Katz (Ecology North, 2010). The Community Coordinator and Local Advisory Committee's contact information were not available, however these will be found once communication with the town of Tsiigehtchic begins. These community members have shown interest in the wellbeing and sustainability of Tsiigehtchic, therefore although they are not a specified energy committee, they will be of great use.

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). The information available in terms of both the current technical skills and the community training and education is lacking. Interviews with the listed Energy Champions, Community Leadership, the Community Coordinator and the Local Advisory Committee of the Climate Change Adaptation Project will help to fill this gap.

Current Technical Skills

NT Petroleum Products Program

The NT Petroleum Products Program supports small businesses that distribute/dispense heating oil and vehicle fuel in the participating communities. Tsiigehtchic participates through an all-weather road, with Inuvik being the regional office. The fuel provider is Joyce Andre at M&J Services. Joyce Andre's contact

information is: PO Box 37, Tsiigehtchic NT, X0E 0B0. Phone: (867)953-3113. Fax: (867)953-3078 (Government of Northwest Territories, n.d.).

Community Training and Education

Aurora College Programs: http://www.auroracollege.nt.ca/_live/pages/wpPages/ProgramsAtoZ.aspx

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

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. The information available is limited. The information available in terms of the community investments is lacking. Interviews with the listed Energy Champions, Community Leadership, the Community Coordinator and the Local Advisory Committee of the Climate Change Adaptation Project will help to fill this gap.

Wood Stoves

Through the Wood Energy Transfer Technology (WETT) seven wood stoves that were recently installed were certified in 2014, under the supervision of Inuvik's regional energy project coordinator ("Arctic Energy Alliance • Wood Stoves in Tsiigehtchic | Blog," n.d.). 5% of the community's energy comes from cordwood in the 2016 energy profile, at a cost of \$26,000. This consists of 66 cords and approximately 2 tonnes of greenhouse gases. 100% of the cordwood used within Tsiigehtchic is used in residential homes (Arctic Energy Alliance, 2016).

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.

NT Petroleum Products Program

The NT Petroleum Products Program supports small businesses that distribute/dispense heating oil and vehicle fuel in the participating communities. Tsiigehtchic participates through an all-weather road, the regional office being in Inuvik. The fuel provider is Joyce Andre at M&J Services. Whose contact information is: PO Box 37, Tsiigehtchic NT, X0E 0B0. Phone: (867)953-3113. Fax: (867)953-3078 (Government of Northwest Territories, n.d.).

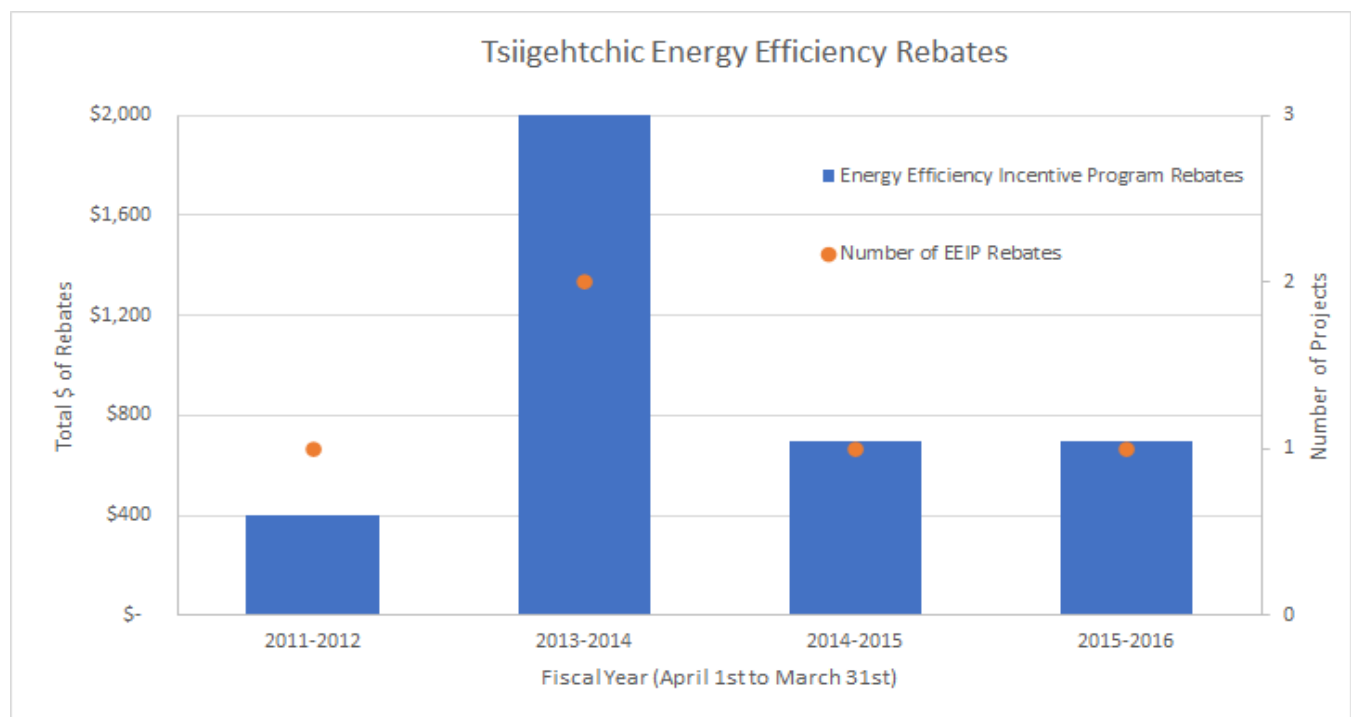


Figure 6 Distribution of Energy Efficiency Projects in Tsiigehtchic (Arctic Energy Alliance, 2015)

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.

Climate Change Impacts and Potential Opportunities

The Climate Change Adaptation Planning Project recognized multiple climate change impacts and potential opportunities as developed by the Local Advisory Committee (Ecology North, 2010). Climate change impacts and subsequent potential opportunities related to energy are listed below.

- Impact: More willows and faster willow growth
 - Opportunity: Potential for biomass harvesting
- Impact: Longer growing season, taller faster growing trees
 - Opportunity: Potential for greater biomass or wood production industry
- Impact: Longer growing season for vegetables
 - Opportunity: Community garden and cold storage
- Impact: Shorter winter heating season
 - Opportunity: Reduce the high cost of living

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.). The five recommended adaptations of the Climate Change Adaptation Planning Project that relate to energy, as displayed in the Key Gaps section above, are expanded upon to include a description of the best course of action. This included a breakdown of the anticipated cost, effort required, who should lead the adaptation, and an estimate of when the adaptation should occur in order to schedule all the adaptations (Ecology North, 2010). This is seen below in the respective adaptation sections.

Replace Fuel Line Connections in Heating Oil Tanks

The adaptation of creating an inventory and replacing rigid fuel line connections with flexible connections in all heating oil tanks was placed in the theme of a housing issue. Water quality was considered a key concern for the community, and fuel spills are a leading cause of water pollution. It was recognized that there is a considerable risk of fuel spills from old tanks and rigid fuel tank connections. An inventory of tank age and connections and workshop on how to maintain tanks was recommended in order to reduce the risk of spills. It was considered that the community could help subsidize the cost of replacing the connections and bring in an expert or tradesperson, or use community staff to do the work, or government funding could be used (Ecology North, 2011) .

- Cost: The cost was rated considerable
- Effort: The effort was rated considerable
- Lead: The Chartered Community and Housing Corporation was recommended to lead the adaptation
- When: The idealized time of when the adaptation should occur was summer 2010

Develop Closer Ties with Arctic Energy Alliance

The adaptation of developing closer ties with Arctic Energy Alliance (AEA), was recognized as there are substantial cost and energy savings potential within the community to be realized. It was identified that Arctic Energy Alliance has an office in Inuvik and they are trying to reach out to communities. It was also noted that AES has the expertise to identify options, and the GNWT's Environment and Natural Resources has funding to pay for energy savings (Ecology North, 2011).

- Cost: It was noted that AEA and NWT's ENR would fund the options and much of the work associated
- Effort: It was noted that there needs to be clear direction and interest by community staff
- Lead: The Chartered Community and AEA were recommended to lead the adaptation
- When: The idealized time of when the adaptation should occur was continuing

Complete a Forest Resource Assessment

The adaptation of working with Environment and Natural Resources Forestry Management Division to complete a forest resource assessment for Tsiigehtchic was recognized for the purpose of providing information on forest types and where accessible lumber and firewood are located. It was recognized that it would be helpful for managing and increasing firewood use and reducing fossil fuel reliance (Ecology North, 2011).

- Cost: It was noted that ENR would fund the assessment
- Effort: It was noted that some effort would be required to work with ENR
- Lead: The Chartered Community and ENR were recommended to lead the adaptation
- When: The idealized time of when the adaptation should occur was continuing

Investigate Biomass Fuel Sources

The adaptation of investigating the potential of using willows and forests as a biomass fuel source was recognized as it was noted that there is potential that willows or forests could provide both electricity and a greater portion of heating for Tsiigehtchic. It was also noted that this should be investigated with the help of ENR and AEA (Ecology North, 2011).

- Cost: It was noted that this would not cost anything
- Effort: The effort was rated moderate
- Lead: The Chartered Community, ENR and AEA were recommended to lead the adaptation
- When: The idealized time of when the adaptation should occur was continuing

Investigate Other Renewable Energy Sources

The adaptation of investigating using wood pellets and in-stream hydro as options to reduce dependence on fossil fuels was recognized. It was noted that these options could help reduce fossil fuel use and keep more money in the community (Ecology North, 2011).

- Cost: It was noted that this would not cost anything
- Effort: The effort was rated moderate
- Lead: The Chartered Community, ENR and AEA were recommended to lead the adaptation

- When: The idealized time of when the adaptation should occur was continuing

VULNERABILITIES AND SECURITY

The off-grid nature of Tsiigehtchic 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 Tsiigehtchic. 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 Tsiigehtchic (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 Tsiigehtchic 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 Tsiigehtchic.

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 Tsiigehtchic

Little information is available regarding how power outages affect Tsiigehtchic residents. 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 Tsiigehtchic,
2. Trends of power outages in Tsiigehtchic 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 Tsiigehtchic can be obtained through interviews with community leaders and residents. Additionally, outage implication data may be obtained from Tsiigehtchic's emergency response plan. If the community has one, requests can be made to community leaders to view it.

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

Tsiigehtchic receives heating diesel, diesel for transportation and gasoline from the GNWT Fuel Services Division (FSD) as part of the Petroleum Products Program. Under this program, FSD manages the purchase, transport and storage of fuel in the community. Fuel is delivered to M & J Services, a local contractor, who sells and distributes it to community members and businesses (Government of the Northwest Territories, n.d.).

Delivery Route

Fuel is delivered from FSD's regional office in Inuvik to Tsiigehtchic by an all-weather road (Government of the Northwest Territories, n.d.). Inuvik receives fuel through a combination of marine and winter-road transport (Northwest Territories Power Corporation, 2010). 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 Inuvik (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).

Gaps in Data Availability

1. The exact shipping routes for fuels need to be determined and confirmed, and
2. Information about fuel supply disruptions needs to be collected.

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

The only information available regarding the age and condition of energy infrastructure in Tsiigehtchic is that one of the three diesel generators was replaced by NTPC in 2012 (Northwest Territories Power Corporation, n.d.).

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). This criterion - commonly known as N-1 - 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). According to this criterion, Tsiigehtchic has sufficient back-up power available for when a generator fails, but it provides no information about whether the community is under load restriction. The average annual electrical load is 89 kW and the installed electrical generation capacity is 500 kW, suggesting that there is sufficient capacity to meet the load (Northwest Territories Power Corporation, n.d., 2019b). However, because the peak annual electrical load is 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 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). Tsiigehtchic's fuel storage tanks are maintained by FSD as part of the Petroleum Products Program (Government of the Northwest Territories, n.d.).

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 Tsiigehtchic's infrastructure specifically (2019a).

Gaps in Data Availability

The gaps surrounding Tsiigehtchic's energy infrastructure are:

1. The age and condition of most of its energy infrastructure 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 Tsiigehtchic's energy infrastructure.

Most of this information can be gained from NTPC through formal data requests and interviews with 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

In phase II of their 2016-19 general rate application, NTPC states 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).

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 Tsiigehtchic, the allowable RET capacity is 18 kW and to date none of the allowable capacity has been used (Northwest Territories Power Corporation, 2019b). 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. No information on the economic vulnerability of Tsiigehtchic was found by document review. This information can be obtained through interviews with community leaders to identify Tsiigehtchic's key economic sectors, and interviews with employers and employees who work in those sectors.

REFERENCES

- Arctic Energy Alliance • About Us. (n.d.). Retrieved March 30, 2020, from <http://aea.nt.ca/about-us>
- Arctic Energy Alliance • Wood Stoves in Tsiigehtchic | Blog. (n.d.). Retrieved March 30, 2020, from <http://aea.nt.ca/blog/2014/11/wood-stoves-in-tsiigehtchic>
- Arctic Energy Alliance. (2015). *Tsiigehtchic Energy Efficiency and Renewable Energy Projects*. 3265.
- Arctic Energy Alliance. (2016). *Tsiigehtchic Energy Profile*. 2016.
- Canadian Electricity Association. (n.d.). Retrieved March 24, 2020, from <https://electricity.ca/>
- Ecology North. (2010). *Gwichya Gwich'in Climate Change Adaptation Planning Project*. (March).
- Ecology North. (2011). *Gwichya Gwich'in Climate Change Adaptation Implementation Plan*.
- Government of Canada. (2017). Energy Efficiency Act. Retrieved from <https://laws-lois.justice.gc.ca/eng/acts/e-6.4/page-3.html#h-219224>
- Government of Canada. (2019). Canadian Energy Regulator Act. Retrieved from <https://laws-lois.justice.gc.ca/eng/acts/C-15.1/page-2.html#docCont>
- Government of Canada. (2019). The New Canadian Energy Regulator Handbook. Retrieved from <https://www.canada.ca/en/services/environment/conservation/assessments/environmental-reviews/national-energy-board-modernization/cer-handbook.html>
- Government of Canada. (2019, August 28). *Provincial and Territorial Energy Profiles – Northwest Territories*. Canada Energy Regulator. <https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/nt-eng.html>
- Government of Northwest Territories. (2011). Northwest Territories Energy Report. Retrieved from <https://www.ntassembly.ca/sites/assembly/files/11-05-20td36-166.pdf>
- Government of Northwest Territories. (2013). Community Planning and Development Act. Retrieved from justice.gov.nt.ca/en/files/legislation/community-planning-and-development/community-planning-and-development.a.pdf.
- Government of Northwest Territories. (2013). Community Planning and Development Regulations. Retrieved from <https://www.justice.gov.nt.ca/en/files/legislation/community-planning-and-development/community-planning-and-development.r1.pdf>
- Government of Northwest Territories. (2013). Economic Opportunities Strategy - Connecting Businesses and Communities to Economic Opportunities. Retrieved from https://www.iti.gov.nt.ca/sites/iti/files/0004-704_econ_opp_strat_-_low-res.pdf
- Government of Northwest Territories. (2016). Natural Resources Conservation Act. Retrieved from <https://www.justice.gov.nt.ca/en/files/legislation/natural-resources-conservation-trust/natural-resources-conservation-trust.a.pdf>.

- Government of Northwest Territories. (2018). 2030 NWT Climate Change Strategic Framework 2019 - 2023 Action Plan. Retrieved from https://www.enr.gov.nt.ca/sites/enr/files/resources/128-climate_change_ap_proof.pdf
- Government of Northwest Territories. (2018). Energy Initiatives Report. Retrieved from https://www.inf.gov.nt.ca/sites/inf/files/resources/2017_energy_initiatives_report_web.pdf
- Government of Northwest Territories. (2018). NWT Petroleum Resources Strategy Released. Retrieved from <https://www.iti.gov.nt.ca/en/newsroom/nwt-petroleum-resources-strategy-released>
- Government of Northwest Territories. (2019). 2030 Energy Estrategy. Retrieved from https://www.inf.gov.nt.ca/sites/inf/files/resources/gnwt_inf_7272_energy_strategy_web-eng.pdf
- Government of Northwest Territories. (2019). 2030 NWT Climate Change Strategix Framework. Retrieved from https://www.enr.gov.nt.ca/sites/enr/files/resources/128-climate_change_strategic_framework_web.pdf
- Government of Northwest Territories. (2019). GHG Grant Program Guide for Government. Retrieved from https://www.inf.gov.nt.ca/sites/inf/files/resources/ghg_grant_program_guide_english_gov_nov2019.pdf
- Government of Northwest Territories. (n.d.). Energt Action Plan 2018 - 2021. Retrieved from https://www.inf.gov.nt.ca/sites/inf/files/resources/7274_energy_strategy_action_plan_revised_web.pdf
- Government of Northwest Territories. (n.d.). Fuel Services | Infrastructure. Retrieved March 30, 2020, from <https://www.inf.gov.nt.ca/en/services/fuel-services>
- Government of the Northwest Territories. (2020). *2020 Sailing Schedule and Final Cargo Acceptance Dates*. <https://www.inf.gov.nt.ca/en/services/marine-transportation-services/2020-sailing-schedule-and-final-cargo-acceptance-dates>
- Government of the Northwest Territories. (n.d.). *Communities*. Fuel Services. Retrieved March 25, 2020, from <https://www.inf.gov.nt.ca/en/services/service-d%E2%80%99approvisionnement-en-combustibles/communities>
- Government of Yukon. (2019). Government of Yukon's Independent Power Production policy implemented. Retrieved from <https://yukon.ca/en/news/government-yukons-independent-power-production-policy-implemented>
- Heerema, D., & Lovekin, D. (2019). Power Shift in Remote Indigenous Communities A cross-Canada scan of diesel reduction and clean energy policies.
- Hossain, Y., Loring, P. A., & Marsik, T. (2016). Defining energy security in the rural North—Historical and contemporary perspectives from Alaska. *Energy Research & Social Science*, 16, 89–97. <https://doi.org/10.1016/j.erss.2016.03.014>
- Implementing the NWT Carbon Tax. (2019). Retrieved from Government of Northwest Territories:

https://www.gov.nt.ca/sites/flagship/files/documents/implementing_nwt_carbon_pricing.pdf

Kiushkina, V. R., & Antonenkov, D. V. (2019). Specifics of assessing energy security of isolated energy service areas in territories with harsh climatic conditions. *International Journal of Energy Technology and Policy*, 15(2/3), 236. <https://doi.org/10.1504/IJETP.2019.098971>

Legislation of the Northwest Territories. (n.d.). Retrieved from Department of Justice, NWT: <https://www.justice.gov.nt.ca/en/legislation/>

Legislative Assembly of the Northwest Territories. (2017). Annual Report 2017 - 18. Retrieved from https://www.ntassembly.ca/sites/assembly/files/td_283-183.pdf

Natural Resources Canada. (2016, July 20). *Northwest Territories' Electric Reliability Framework*. Natural Resources Canada. <https://www.nrcan.gc.ca/our-natural-resources/electricity-infrastructure/electricity-canada/canadas-electric-reliability-fra/northwest-territories-electric-reliability-framework/18838>

Northwest Territories Gazette. (2019, August). Retrieved from https://www.justice.gov.nt.ca/en/files/northwest-territories-gazette/2019/08_2.pdf

Northwest Territories Tourism. (2019). Tsiigehtchic. Retrieved from <https://spectacularnwt.com/destinations/western-arctic/tsiigehtchic>

Northwest Territories Power Corporation. (2010). *Report of the NTPC Review Panel*. <https://www.ntassembly.ca/sites/assembly/files/10-03-03td6-165.pdf>

Northwest Territories Power Corporation. (2017). *Northwest Territories Power Corporation's 2016/19 General Rate Application Phase II*. <https://www.nwtpublicutilitiesboard.ca/sites/default/files/supporting/1%20NTPC%20letter%20and%202016-19%20Phase%20II%20General%20Rate%20Application%20March%201%202017.pdf>

Northwest Territories Power Corporation. (2018). *Adding Renewables to Electricity Grids*. [http://www.ntpc.com/docs/default-source/default-document-library/community-capacity-for-integrating-renewables-\(february-2018\).pdf?sfvrsn=2](http://www.ntpc.com/docs/default-source/default-document-library/community-capacity-for-integrating-renewables-(february-2018).pdf?sfvrsn=2)

Northwest Territories Power Corporation. (2019a). *2018-2019 Annual Report*. <http://www.ntpc.com/docs/default-source/Reports/ntpc---2018-19-annual-report---final---web---revised.pdf?sfvrsn=4>

Northwest Territories Power Corporation. (2019b). *Northwest Territories Power Corporation Renewable Microgrid Capacity by Community As of August 27, 2019*. <http://www.ntpc.com/docs/default-source/customer-service-docs/net-metering-capacity.pdf?sfvrsn=2>

Northwest Territories Power Corporation. (n.d.). Corporate Structure. Retrieved from ntpc.com/about-ntpc/corporate-structure

Northwest Territories Power Corporation. (n.d.). *Here's how we supply power in your community*. Retrieved March 25, 2020, from <https://www.ntpc.com/our-community/community-map>

- NWT Public Utilities Board. (2018). Net Metering Guidelines. Retrieved from <https://www.nwtpublicutilitiesboard.ca/sites/default/files/documents/Net%20Metering%20Guidelines%20July%2011%2C%202018.pdf>
- Parliament of Canada. (2014). Northwest Territories Devolution Act. Retrieved from <https://www.parl.ca/DocumentViewer/en/41-2/bill/C-15/royal-assent>
- Petroleum Products and Carbon Tax Act (September 1, 2019). Retrieved from <https://www.justice.gov.nt.ca/en/files/legislation/petroleum-products-carbon-tax/petroleum-products-carbon-tax.r1.pdf>
- Supply, Transport and Delivery of Diesel Fuel. (2018). Retrieved from <https://contracts.opennwt.ca/tenders/supply-transport-and-delivery-of-diesel-fuel/ocds-v9mmex-GNWT1-17-0000001122/>