Nihtat Energy Ltd. Business Case Study: Barging Biomass to NWT Remote Communities

InterGroup CONSULTANTS

Prepared for: Nihtat Energy Ltd.

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1.0 INTRODUCTION

Nihtat Energy Ltd. (NEL), working with the Government of the Northwest Territories (GNWT), has completed the following business case study (the Study), funded by Natural Resources Canada (CERRC program), to examine and outline the conditions for the supply of barge-delivered wood pellets (biomass) to be a cost-effective and cleaner heating fuel option in 12 remote communities along, or in the vicinity of, the Mackenzie River. The study aims to directly support one of the Strategic Objectives of the NWT 2030 Energy Strategy by looking at ways to advance towards the goal of reaching 40% share of renewable energy used for space heating in the NWT building sector by 2030.

InterGroup Consultants Ltd. (InterGroup) was retained by NEL to provide research and reporting for the Study, including the assessments required for the following stages of this assessment:

- **Stage 1** – Logistical Review (included development of community heat load profiles, review of heat load from GNWT buildings, logistical requirements to supply wood pellets for current heating energy demands, alternative approaches and gaps in current wood pellet supply chain, and potential best ways to address any gaps).
- **Stage 2** – Landed Cost Assessment (included providing an estimate of existing landed cost of wood pellets at buildings in the communities, and where relevant, the potential landed cost of wood pellets delivered by the barging option).
- **Stage 3 –** Scenario Assessment (included developing scenarios to explore the impact on logistical requirements and wood pellet costs from meeting various heating loads, and assessment of changes required to the current supply chain).
- **Stage 4 –** Reporting (included the development of a draft report for review by NEL and GNWT, followed by one final report).

In October of 2023, NEL and InterGroup completed an interim draft report providing an integrated summary review of outcomes from Stages 1 and 2 of the Study, reflecting the overlaps in analysis for the two initial stages, and resulting recommended approaches for Stage 3 Scenario Assessment. The draft interim report was subsequently provided to GNWT for review and comments.

Following GNWT review of the interim report, NEL and InterGroup continued work to complete Stage 3 Scenario Assessment of the Study, including further research regarding the success of biomass in the Sahtu region and potential options to consider for the Beaufort Delta region. Research involved multiple meetings with an entrepreneur (Brian Lickoch of Norman Wells) who contributed to the development of the Sahtu region's supply chain with Green Energy NWT, communication with a wood pellet specialized consulting firm from Maine, US,[1] and a workshop in February of 2024 with various GNWT departments and GNWT's Marine Transportation Services (MTS) to review specific findings from Stage 3 Scenario Assessment. A summary of notes and key

[1] Communication was conducted through William Strauss, the founder and president of FutureMetrics and the co-founder of Maine Energy Systems (MESys), the largest wood pellet boiler manufacturer in North America. MESys helped supply Brian Lickoch of Norman Wells with biomass boilers back in the late 2000s when his operation was starting out.

points of discussion from the February workshop is provided in Appendix E and is discussed in Section 7.0 and Section 8.0 of the report.

The following report provides an integrated summary review of outcomes from InterGroup's work on all stages of the Study. The report's summary review of outcomes is provided in the following sections:

- Overview of Mackenzie River Communities
- Community and GNWT Buildings Heat Load Profiles: Biomass Barging Options
- Current Wood Pellet Biomass Use in GNWT Buildings
- Existing Landed Costs: Wood Pellets & Other Fuels ($/GJ)
- Mackenzie River Region Biomass Heating Supply Chain Challenges, Gaps and Deficiencies
- Scenario Assessment.
- Potential Solutions in the Beaufort Delta Region and Next Steps

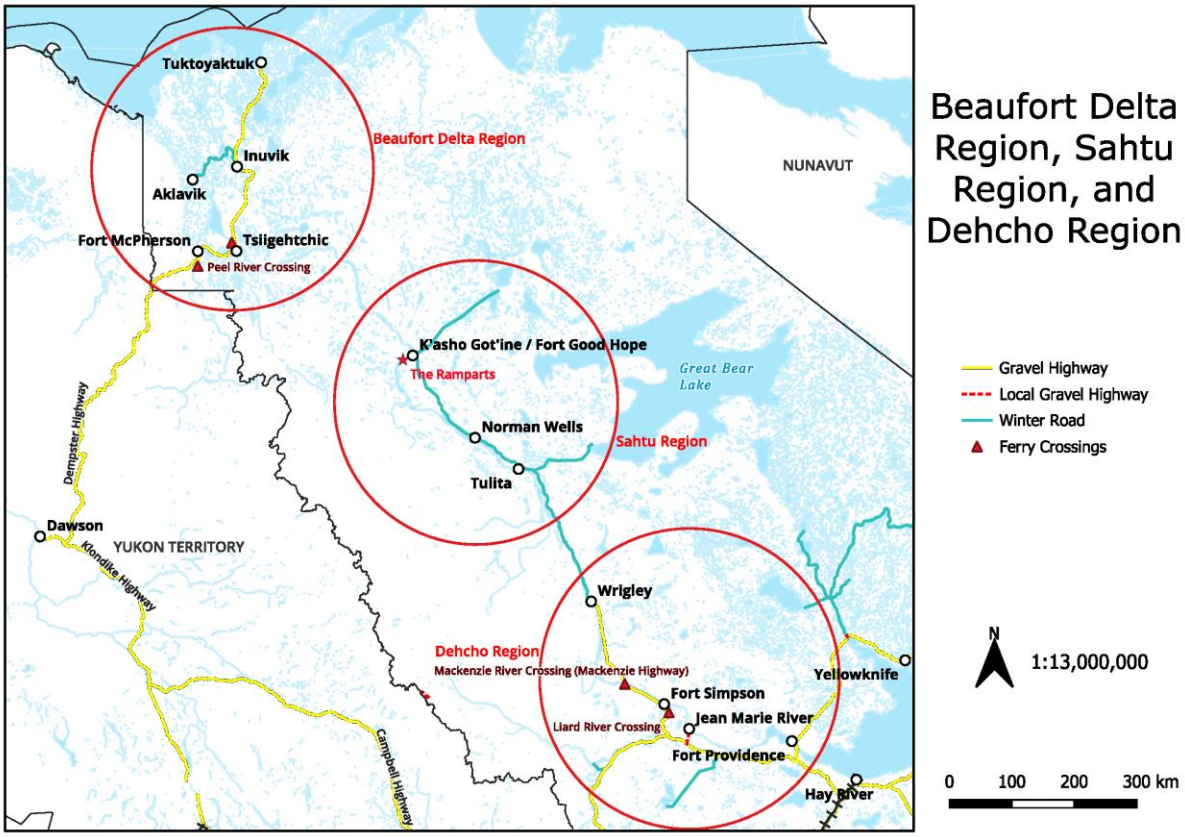
Supporting information, tables and figures are provided in the attached appendices.

2.0 OVERVIEW AND HEAT LOAD PROFILES OF MACKENZIE RIVER COMMUNITIES

Figure 1 shows the 12 remote communities along, or in the vicinity of, the Mackenzie River for which wood biomass barging for heating is assessed in the Study. The communities are in three separate regions (see Appendix B for added detail on road infrastructure serving each region):

- **Beaufort Delta Region** – This most northern region includes five communities along or in the vicinity of the Mackenzie River, four of which are road accessible through Yukon via the Dempster Highway, except during transition seasons when Peel River and Mackenzie River ferries or ice bridges are not available; the remaining community (Aklavik) is accessible by a winter road from Inuvik when ice conditions permit. Mackenzie River barge access is possible to all communities except Fort McPherson.
- **Sahtu Region** – This middle region includes three communities along or in the vicinity of the Mackenzie River, each of which is barge accessible and has no road access except during winter, when each community is accessible by a winter road connected to the Mackenzie Highway at Wrigley.
- **Dehcho Region –** This most southern region includes four communities along or in the vicinity of the Mackenzie River, all of which are potentially barge accessible as well as road accessible via the Mackenzie Highway (except for Wrigley and Fort Simpson during transition seasons when the Liard River and Mackenzie River ferries or ice bridges are not available).

Figure 1: Mackenzie River Communities – Beaufort Delta, Sahtu and Dehcho Regions



GNWT's Marine Transportation Services (MTS) currently provides scheduled barge service to six of the 12 communities in the three Mackenzie River regions, including all three Sahtu Region communities plus three Beaufort Delta Region communities (Inuvik, Tuktoyaktuk and Aklavik). In late July 2023, MTS barge shipments planned to communities in Beaufort Delta and in the Beaufort Sea from Hay River were, due to low water conditions on the Mackenzie River, instead trucked to Inuvik for subsequent barge delivery where needed. MTS is one of the two barging services used by the communities in the study, the other being Cooper's Barging Services which is used primarily by Norman Wells in the Sahtu region for reasons pertaining to cost, flexibility, and scheduling. While Cooper's is paramount to the Norman Wells wood pellet supply chain, notable is the fact that MTS has no direct mechanism to lower their barging costs since they use a cost recovery model with little room to maneuver.

In August 2023, the third and final MTS barge shipments to Norman Wells and Tulita were cancelled due to low water conditions – an increasingly common challenge for barging on the Mackenzie River. In low-water years, a section of the Mackenzie River known as the Ramparts regularly presents significant complications to barging. The Ramparts is a section of rapids in a long canyon where the Mackenzie River shrinks to about one third of its usual width, flanked by towering 40m tall limestone cliffs on either side. In this section of the river, the water depth can sometimes

decline to under 2 metres, making it impassable for tugs and barges to pass through,[2] such as in the summer of 2023. While low-water levels tend to exacerbate the problems here, they typically don't have any material effect until months later in the barging season.

The Beaufort Delta region population of 5,944 accounts for 60% of the 9,850 population in the 12 Mackenzie River communities (see Table 1 below); the Dehcho region communities have the next largest population (2,031 people, 21% of the total), followed closely by the Sahtu region communities (1,875 people, 19% of the total).[3]

Arctic Energy Alliance community energy profiles for 2018 (see Table 1 below) provide a high-level estimate of overall energy use in each community and region. Heating energy use accounts for 34% to 46% of total energy use in 8 of 12 communities (40% average for all 12 communities):[4]

- **Home Heating Use** – Home heating accounts for 49% of overall heating energy use in the 12 communities in 2018 (variances by community/region). Fossil fuels account for 85% of overall home heating energy – heating oil is the main fuel source except for Inuvik, where a mix of imported propane and natural gas is dominant (in recent years, the mix has consisted largely of propane); propane is also used in two communities. Firewood is used in each community and is the major home heating renewable fuel (overall about 12% of home heating); wood pellets are used in four communities (overall 3% of home heating).[5]
- **Other Buildings Heating Use** – Fossil fuels account for 89% of overall other buildings heating energy use in the 12 communities in 2018 (heating oil is the main fuel source except for Inuvik where a mix of propane and natural gas is dominant; propane is also used in seven communities, and accounts for approximately 3% of overall other buildings heating energy). Wood pellets were used in seven communities (overall 11% of other buildings heating).[6]

[2] Rudy Y.-J. Sung, Donald H. Burn, and Eric D. Soulis, A Case Study of Climate Change Impacts on Navigation on the Mackenzie River, Canadian Water Resources Journal, March 2006.
[3] Northwest Territories Bureau of Statistics, Population Estimates by Community, 2022.
[4] Arctic Energy Alliance, Community Energy Profiles, 2018.
[5] Ibid.
[6] Ibid.

Table 1: Mackenzie River Communities – Population, Total Energy and Heating Energy Use

	Population[1]	Total Energy[2] GJ/yr	Heating Energy (2018, GJ/yr)[3]										
			Total-All Heating		Homes					Other Buildings			
			GJ/yr	% of Total Energy	Heating Oil	Natural Gas	Propane	Firewood	Wood Pellets	Heating Oil	Natural Gas	Propane	Wood Pellets
Beaufort Delta Region													
Tuktoyaktuk	1,058	151,800	70,060	*46%*	22,780			2,900		44,220		160	
Inuvik	3,214	872,100	346,780	*40%*	-	161,000	-	14,700	2,400	84,500	69,000	6,060	9,120
Aklavik	708	99,500	50,310	*51%*	21,528			3,510		25,272			
Ft. McPherson	759	217,000	62,000	*29%*	24,748			3,670		29,052			4,530
Tsiigehtchic	205	27,900	12,970	*46%*	5,031			1,270		6,669			
Total Region	5,944	1,368,300	542,120	*40%*	74,087	161,000	-	26,050	2,400	189,713	69,000	6,220	13,650
% of Heating					*14%*	*30%*	*0%*	*5%*	*0%*	*35%*	*13%*	*1%*	*3%*
Sahtu Region													
Fort Good Hope	628	89,100	37,850	*42%*	13,865			6,870		15,635			1,480
Norman Wells	704	218,600	126,263	*58%*	44,086			5,320	1,480	49,714		363	25,300
Tulita	543	85,800	39,660	*46%*	17,420			4,140		16,080			2,020
Total Region	1,875	393,500	203,773	*52%*	75,371	-	-	16,330	1,480	81,429	-	363	28,800
% of Heating					*37%*	*0%*	*0%*	*8%*	*1%*	*40%*	*0%*	*0%*	*14%*
Dehcho Region													
Wrigley	126	24,800	8,747	*35%*	2,322			1,380		4,508		537	
Ft. Simpson	1,100	289,900	99,210	*34%*	35,672		6,672	9,680	2,420	37,128		1,668	5,970
Jean Marie River	94	11,100	4,102	*37%*	1,204			984		1,806		108	
Ft. Providence	711	170,400	47,508	*28%*	22,425		3,250	4,280	518	10,075		3,250	3,710
Total Region	2,031	496,200	159,567	*32%*	61,623	-	9,922	16,324	2,938	53,517	-	5,563	9,680
% of Heating					*39%*	*0%*	*6%*	*10%*	*2%*	*34%*	*0%*	*3%*	*6%*
Total All Communities	9,850	2,258,000	905,460	*40%*	211,081	161,000	9,922	58,704	6,818	324,659	69,000	12,146	52,130
% of Heating					*23%*	*18%*	*1%*	*6%*	*1%*	*36%*	*8%*	*1%*	*6%*

Notes

1 2022 populations - Northwest Territories Burueau of Statistics (2022)

2 2018 - Arctic Energy Alliance (AEA) - Community Energy Profiles 2018 - Total all energy sources for all community uses.

3 2018 - Arctic Energy Alliance (AEA) - Community Energy Profiles 2018 - Heating Uses by Energy Resource

3.0 GNWT BUILDINGS HEAT LOAD PROFILES

The Study is focused on assessing potential feasibility of wood biomass barging options for heating loads in the 12 identified Mackenzie River communities, and on any opportunities biomass barging may offer to move more quickly towards the NWT objective of 40% share of renewable energy used for space heating in the building sector by 2030.

While the objective of 40% of renewable energy for space heating by 2030 is to be met by the NWT building sector as a whole, GNWT is leading the effort by converting many of its buildings to biomass systems. In fact, 34% of GNWT buildings' space heating was met by renewable sources in 2022-2023 (32% wood pellets and 2% electricity or residual heat), with significant variation in penetration between communities. GNWT intends to continue converting some of its assets to biomass heating when feasible through the Capital Assets Retrofit Fund, thus helping build capacity and expand wood pellets supply chains across the NWT.[7]

Based on readily available heat load information, as well as the major potential lead opportunities for wood biomass use, community heat load profiles for the Study are based on 2020-2023 GNWT information on GNWT building heat loads in each community. Home heating biomass use in general (e.g., cordwood, wood pellets), as well as non-GNWT building heat uses, are not addressed. As such, this study explores the hypothesis that GNWT buildings' heat load could be sufficient to enable barging as a practical and viable option to supply wood pellets to these communities. Existing wood biomass use in GNWT buildings in these communities during 2020-2023 is wood pellets, and in some cases in recent years was delivered by road (including winter road) from La Crete, Alta.

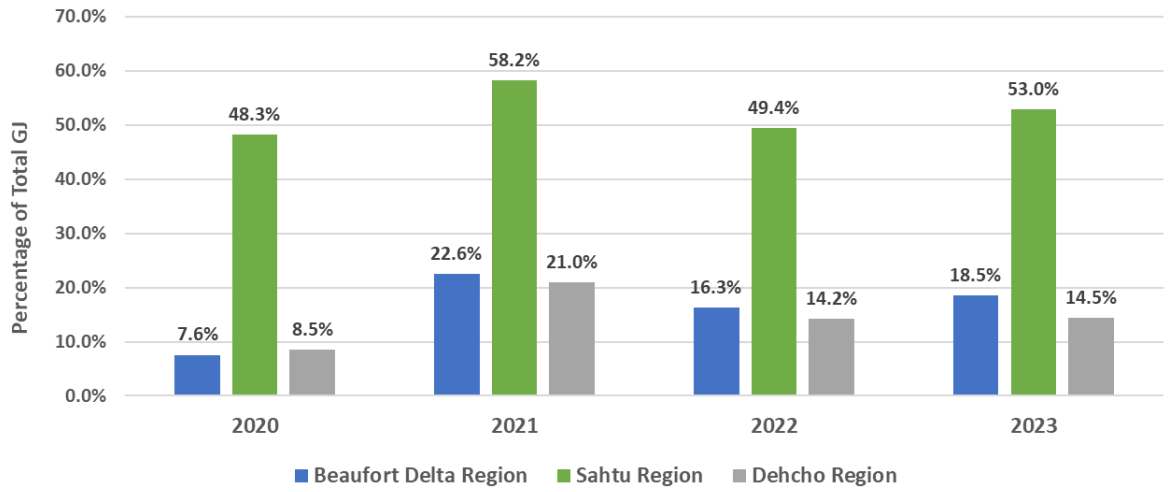
Table 2 provides a summary of GNWT building heat loads by community and region for the years 2020 to 2023, indicating total annual GJ heating loads (total fuel use), wood pellet fuel use, and the number of GNWT buildings. Key highlights from this information include (see Appendix A for details):

- **All Fuel Total:** Overall, the four-year average for these community GNWT buildings (average of 175 buildings, ranging from 171 to 183 buildings) is a total heating load of 166,458 GJ/yr, with a range from 162,780 GJ in 2020 to 176,153 GJ in 2021 and with 166,936 GJ in the latest year (2023).[8] There is considerable annual fluctuation and no clear trend. It appears that the four-year average reflects a reasonable annual overall heat load profile for these community GNWT buildings to be assessed for this Study. This heat load represents about 36% of the 2018 AEA estimated heat load for all non-home buildings in these communities.
- **Biomass:** Wood pellets on average supply 23.6% of the overall four-year heat load for these GNWT buildings, ranging from 14.6% (4,731 GJs) in the Dehcho region and 16.5% (16,394 GJs) in the Beaufort Delta region to 52.1% (18,387 GJs) in the Sahtu region.[9] The four-year biomass average tends to slightly understate the most recent year (2023) wood pellet use performance. Figure 2 highlights varying biomass use levels by region for these

[7] GNWT, *2022-2023 Energy Initiatives Report*, 2024.
[8] Data on community heat load volumes for the years 2020-2023 was received from GNWT and used for analysis by InterGroup.
[9] Ibid.

GNWT buildings based on Table 2. These values highlight the Sahtu region's success in biomass infrastructure, logistics, and distribution.

Figure 2: Average GNWT Building Heating Load to Wood Pellets, by Region – All GNWT Buildings (2020-23)



Source: GNWT

Notes:

1. Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre;
2. Wood pellets 19.5 GJ/tonne (La Crete).
3. GNWT data are for fiscal years 2019/20 to 2022/23.

Table 2: GNWT Buildings Heat Energy Use 2020-2023 (GJ/yr) – Mackenzie River Communities

	2020	2021	2022	2023	4-yr Average	% of Total Heat Load
Beaufort Delta Region						
Total Region	**96,011**	**108,900**	**91,660**	**101,505**	**99,051**	**100.0%**
(# buildings)	*82*	*82*	*77*	*77*		
High Load Buildings	**72,325**	**85,194**	**69,550**	**76,897**	**75,991**	**76.7%**
(# of High Load Buildings)	*22*	*22*	*22*	*22*		
(% of total buildings)	*27%*	*27%*	*29%*	*29%*		
Sahtu Region						
Total Region	**35,337**	**34,570**	**38,065**	**33,216**	**35,297**	**100.0%**
(# buildings)	*39*	*42*	*39*	*39*		
High Load Buildings	**28,814**	**28,385**	**31,293**	**27,209**	**28,925**	**81.9%**
(# of High Load Buildings)	*11*	*11*	*11*	*11*		
(% of total buildings)	*28%*	*26%*	*28%*	*28%*		
Dehcho Region						
Total Region	**30,932**	**33,413**	**32,610**	**32,216**	**32,293**	**100.0%**
(# buildings)	*53*	*59*	*56*	*55*		
High Load Buildings	**21,555**	**23,455**	**23,406**	**23,369**	**22,946**	**71.1%**
(# of High Load Buildings)	*12*	*12*	*12*	*12*		
(% of total buildings)	*23%*	*20%*	*21%*	*22%*		
Total All Regions	**162,280**	**176,884**	**162,336**	**166,936**	**166,641**	**100.0%**
(# buildings)	*174*	*183*	*172*	*171*		
High Load Buildings	**122,694**	**137,034**	**124,249**	**127,475**	**127,863**	**76.7%**
(# of High Load Buildings)	*45*	*45*	*45*	*45*		
(% of total buildings)	*26%*	*25%*	*26%*	*26%*		

Source: GNWT
Notes:

1. Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre;
2. Wood pellets 19.5 GJ/tonne (La Crete).
3. GNWT data are for fiscal years 2019/20 to 2022/23.

GNWT building heat loads in these communities tend to be concentrated in larger facilities accounting for about one-quarter of all buildings. Across all three regions, approximately 77% of the four-year average heat load was located in 45 buildings (25.7% of all buildings). Wood pellet

use during this period was almost entirely located within 12 to 14 of these larger buildings, supplying 30.9% of the four-year average heat load for all 45 buildings (see Appendix A, Tables A-1 to A-4, for details). The rest of the GNWT heating load largely exists in smaller buildings dispersed throughout the regions, these buildings employ (at times) forced-air systems, and within the context of the previous larger facilities are understood to not exhibit the same level of potential for switching to wood pellets.

4.0 CURRENT WOOD PELLET USE IN GNWT BUILDINGS

Wood pellet use in 12 to 14 GNWT buildings in Mackenzie River communities from 2020 to 2023 highlights a range of fuel supply shares between buildings, and between years for the same building (challenging relevance of 4-year average in some cases).[10] Variations from an overall four-year weighted average of 49.1% (39,822 GJs) wood pellet supply for all GNWT buildings using biomass reflect different wood pellet heating installations (biomass use in almost all cases retains some level of other existing fossil fuels), varying annual heat loads, and constraints on wood pellet road deliveries in some instances:

- **Beaufort Delta Region** – Wood pellet use occurred in 2 Inuvik buildings in 2020, and another building was added in Aklavik in 2023,[11] wood pellets supplied 42.9% (18,785 GJs) of the overall heat load for all three buildings. Across all four years, wood pellets supplied an average of 40.0% (16,624 GJs) of the overall heating load for buildings using biomass. Wood pellet use accounted for a range of heat loads, varying by building and by year for each building as summarized below (see Appendix A, Table A-2 for details).

	Wood Pellet Volume (GJ) and Share of Building Heat Load				**4-yr**
	2020	**2021**	**2022**	**2023**	**Average**
Inuvik Buildings					
Inuvik Regional Hospital	861	13,015	8,121	11,161	8,424
	3.6%	*47.6%*	*49.3%*	*35.8%*	*34.0%*
Inuvik Schools	6,416	11,563	6,818	5,749	7,636
	52.1%	*80.6%*	*64.3%*	*71.3%*	*67.5%*
Aklavik Buildings					
Moose Kerr School	0	0	0	1,874	435
	0.0%	*0.0%*	*0.0%*	*41.5%*	*9.6%*

- **Sahtu Region –** Wood pellet use during 2020 to 2023 occurred in five Norman Wells buildings, one Fort Good Hope building (starting in 2021), and two Tulita buildings. In 2023, wood pellets supplied 68.4% (17,592 GJs) of the overall heat load for all eight buildings. Across all four years, wood pellets supplied an average of 67.7% (18,439 GJs) of the overall heating load for buildings using biomass. Wood pellet use accounted for a range of heat loads, varying by building and by year for each building (see Appendix A, Table A-3 for details).

[10] Data on community heat load volumes for the years 2020-2023 was received from GNWT and used for analysis by InterGroup.
[11] In Inuvik, one building had wood pellets only for part of 2020. In Aklavik, Moose Kerr School began using biomass in 2023.

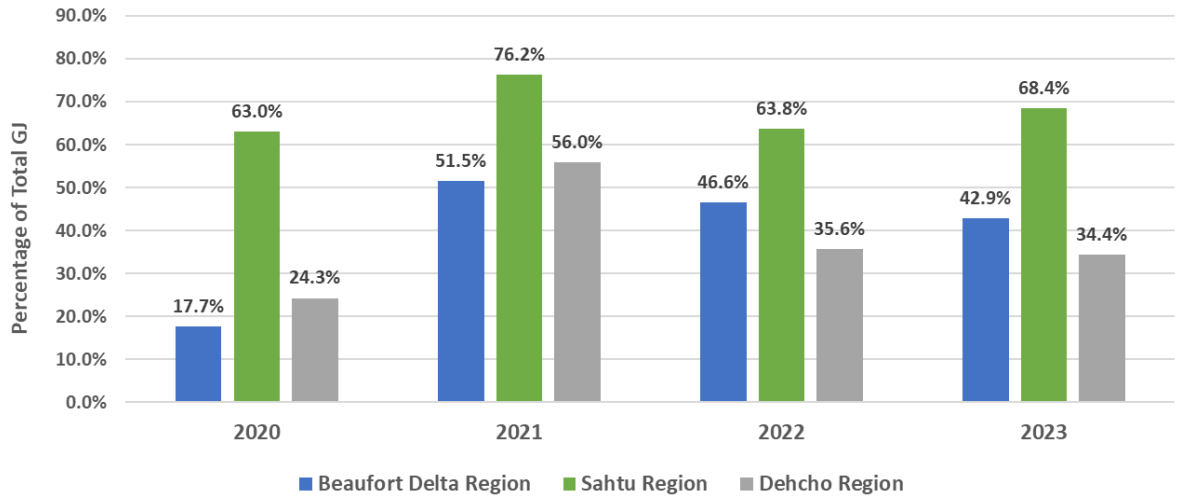
	Wood Pellet Volume (GJ) and Share of Building Heat Load				4-yr
	2020	2021	2022	2023	Average
Norman Wells Buildings					
Airport Maintenance Garage	1,793	1,748	1,944	1,425	1,741
	77.4%	*100.0%*	*55.2%*	*100.0%*	*81.9%*
Airport Terminal Building	2,359	2,490	2,466	1,957	2,331
	80.1%	*82.2%*	*85.1%*	*84.8%*	*83.0%*
Mackenzie Mountain School	2,461	2,782	2,729	2,378	2,595
	87.3%	*93.6%*	*89.1%*	*77.5%*	*87.1%*
Norman Wells Health Centre and LTC	7,063	8,106	7,073	7,503	7,422
	61.4%	*74.5%*	*61.3%*	*73.1%*	*67.2%*
Norman Wells Shop	845	731	924	644	794
	90.3%	*82.3%*	*94.5%*	*95.7%*	*90.7%*
Fort Good Hope Buildings					
Fort Good Hope School	0	2,012	1,614	1,647	1,354
	0.0%	*58.9%*	*46.1%*	*40.3%*	37.3%
Tulita Buildings					
ENR District Office Tulita	690	261	275	283	378
	82.7%	*86.5%*	*63.7%*	*63.7%*	*73.7%*
New Chief Albert Wright School	1,848	1,974	1,764	1,756	1,831
	58.9%	*63.1%*	*49.9%*	*51.1%*	*55.5%*

- **Dehcho Region –** Wood pellet use during 2020 to 2023 occurred in two Fort Providence buildings and one Fort Simpson building. In 2023, wood pellets supplied 34.4% (4,659 GJs) of the overall heat load for all three buildings. Across all four years, wood pellets supplied an average of 37.9% (4,641 GJs) of the overall heating load for buildings using biomass. Wood pellet use accounted for a range of heat loads, varying by building and by year for each building (see Appendix A, Table A-4 for details).

	Wood Pellet Volume (GJ) and Share of Building Heat Load				4-yr
	2020	2021	2022	2023	Average
Fort Providence Buildings					
Deh Gah School	1,386	1,939	1,623	2,120	1,787
	60.5%	*76.2%*	*71.1%*	*64.6%*	68.2%
Fort Providence New Health Centre	119	136	159	459	228
	24.5%	*18.5%*	*27.4%*	*51.3%*	31.2%
Fort Simpson Buildings					
Central Heating Steam Plant	891	4,945	2,836	2,080	2,738
	12.6%	*53.4%*	*28.1%*	*22.2%*	29.6%

Figure 3 highlights the varying average biomass use levels by region and year for the above 12 to 14 GNWT buildings using wood pellets. The eight Sahtu region GNWT buildings consistently show the highest biomass share of building heat load as well as the smallest inter-year variation in this period, reaching from 63.0% (17,059 GJs) in 2020, up to 76.2% (20,105 GJs) in 2021. In contrast, the three Dehcho region wood pellet buildings overall biomass annual weighted average share of heat load does not equal even 40% in three of the four years, i.e., only one of the Fort Providence GNWT buildings consistently shows biomass share of annual heat load at 60% or higher – in 2021 GNWT buildings with biomass usage accounted for 56.0% (7,019 GJs) of annual heat load. Similarly, only one of the three wood pellet supplied buildings in the Beaufort Delta region consistently shows biomass annual average share of heat load at 52% or higher – Inuvik School with a four-year average of 67.5% (7,692 GJs).

Figure 3: Average GNWT Building Heating Load to Wood Pellets, by Region – Wood Pellet Buildings (2020-23)



Source: GNWT
Notes:

1. Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre;
2. Wood pellets 19.5 GJ/tonne (La Crete).
3. GNWT data are for fiscal years 2019/20 to 2022/23.

For 11 buildings of the above 14 wood pellet supplied buildings, the only remaining fuel source is fuel oil; in two buildings the only remaining fuel source is propane (one building in each of Inuvik and Norman Wells); the remaining fuel sources for the other wood pellet supplied building in Inuvik (Inuvik Regional Hospital) are fuel oil and natural gas with respective four-year averages of 48% (11,925 GJs) and 18% (4,553 GJs) of total building heat load respectively.

5.0 EXISTING LANDED COSTS: WOOD PELLETS & OTHER FUELS ($/GJ)

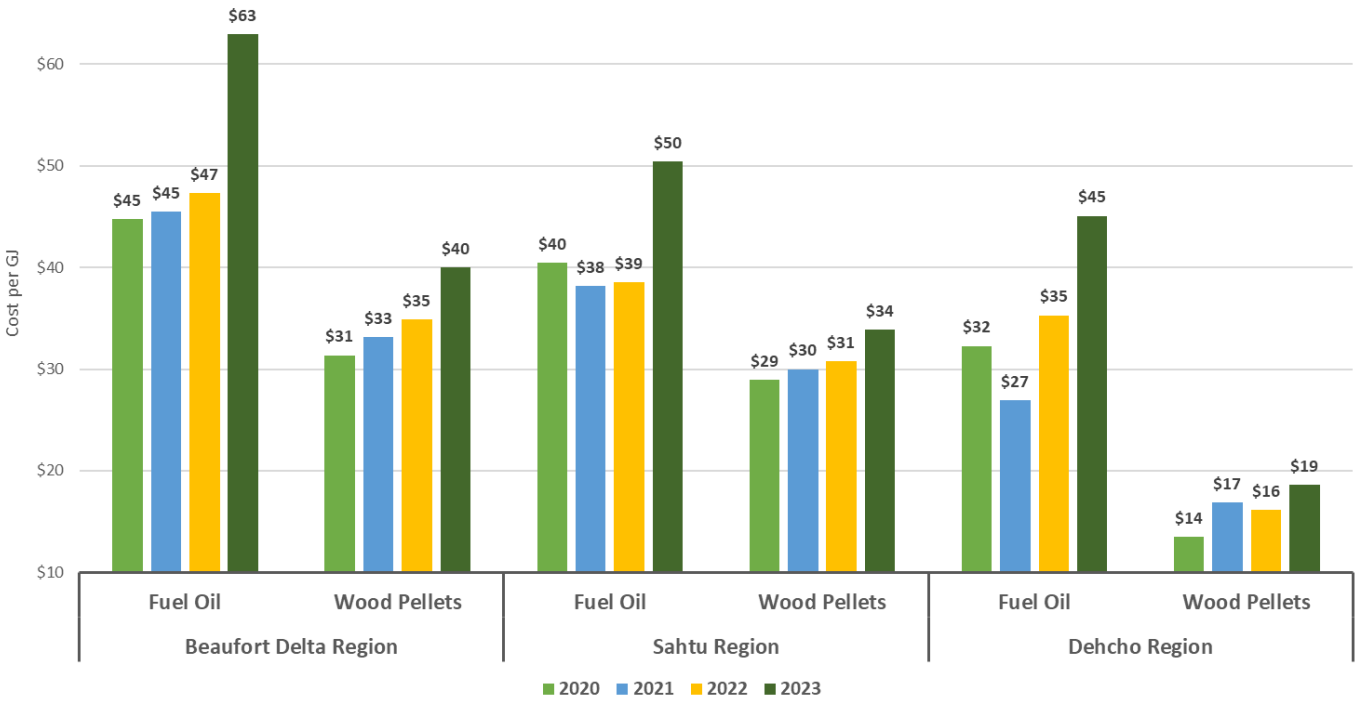
Existing landed costs of fuel use ($/GJ) for 2020 to 2023 at GNWT buildings using wood pellets are estimated based on GNWT costs for fuel used at each building (see Appendix A, Table A-5). Wood pellet landed costs vary between regions but tend to be similar between communities within a region.[12] As reviewed above, fuel oil is currently the main other fuel used in these and other GNWT buildings in the Mackenzie River community regions, and fuel oil costs tend to be similar between communities within a region (see Table A-5). Propane is supplied to two buildings using wood pellets,[13] and natural gas and fuel oil are both supplied to one building in the Beaufort Delta region using biomass.[14] Figure 4 below shows annual average landed costs ($/GJ) for wood pellets and fuel oil for all GNWT buildings in each of the Mackenzie River regions from 2020 to 2023. Wood pellet costs are consistently lower than fuel oil costs in each year and each region. Landed fuel costs are highest in the Beaufort Delta region and in fiscal year 2023. Sahtu region landed fuel costs are lower than Beaufort Delta region costs by 10-20% for fuel oil and 8-15% for wood pellets. Dehcho region landed fuel costs are lower than Sahtu Delta region costs by 8-30% for fuel oil and 43-56% for wood pellets, i.e., landed costs for wood pellets are much lower in the Dehcho region than in the other two Mackenzie River regions.

[12] Wood pellet costs are notably higher in Aklavik than in Inuvik, and in Fort Simpson than in Fort Providence (see Table A-5).

[13] Propane landed costs ($/GJ) are higher than fuel oil costs in each region (see Table A-5).

[14] Natural gas is used only in Inuvik. Table A-5 shows natural gas landed costs ($/GJ) are well below fuel oil costs and very close to wood pellet costs in Inuvik (in 2023, natural gas costs are below wood pellet costs). Accordingly, wood pellets would face cost competitive issues when used in Inuvik buildings where natural gas is the primary existing heating fuel (8 of 14 Inuvik GNWT buildings with higher heat loads [Table A-1], accounting for 25% [15,763 GJ] of total heat load for these 14 Inuvik buildings in 2023).

Figure 4: Landed Fuel Oil & Wood Pellet Costs – All GNWT Buildings 2020-23 (Avg $/GJ)



Source: GNWT

Notes:

1. See Appendix A, Table A-5 for landed costs for fuel used at each GNWT building using wood pellets.
2. Costs per GJ for heat energy from each fuel source will also be impacted by any differences in fuel heating efficiency (typically assume each fuel efficiency at about 85%).
3. Wood pellet costs are assuming 19.5 GJ/tonne.
4. GNWT building average wood pellet landed costs in fiscal 2023 ranged from $363/tonne in the Dehcho region to $659/tonne in the Sahtu region and $780/tonne in the Beaufort Delta region.

Existing wood biomass use in GNWT buildings in these Mackenzie River communities during 2020-2023 is wood pellets almost always from La Crete, Alta., delivered by road (including winter road) and (in Norman Wells for Sahtu region communities) also by barge delivery.[15] Regional variances each year for these wood pellet landed costs therefore primarily reflect road delivery related cost differences rather than any material differences in wood pellet manufacturer supply costs. Landed wood pellet costs also reflect supply contracts with GNWT with prices typically being set without reference to the supplier's actual costs for deliveries.

- **Dehcho region** – Landed wood pellet costs are significantly lower in this region compared to Sahtu and Beaufort Delta regions, reflecting the shorter road haul distance required plus

[15] Confirmed with suppliers in each region for current wood pellet deliveries and known to apply for Beaufort Delta region in all referenced years. La Crete wood pellet purchase costs vary depending on scale and type of purchase, e.g., bulk loading to tridem or super B trailers versus 1-tonne totes versus 42lb bags.

the ability to use all-year road access for direct delivery to each building (without any need for intermediate storage or transshipments).

- **Sahtu region** – Wood pellets for this region's GNWT buildings are delivered by both summer barge and winter road, where a distribution system based out of Norman Wells receives the wood pellets and supplies the region. Barging services used consist of both MTS and Cooper's Barging Services (Cooper's), with Cooper's as the primary supplier and imperative to the operation for reasons pertaining to cost, flexibility, and scheduling.[16]

  In the summer, wood pellets from La Crete, Alta. in 44-tonne super-b trailers are typically trucked along Highway 1 to Fort Simpson, where Cooper's barging facility is located. Upon arrival, the trailers are then backed onto the barge until, at most, five super-b trailers are loaded on to the barge for a maximum load of 220-tonnes of wood pellets (4,290 GJs). When reaching Norman Wells, a dedicated tractor then pulls the trailers off the barge and to a bulk storage facility for offloading. Once empty, the trailers are returned to Fort Simpson to repeat the process. Time between barging tows is typically two to three weeks which allows for the trucks to make a return trip to La Crete and fill the super-b trailers up again.[17]

  In the winter, wood pellets are delivered by tridem trailer via winter road. This method has normally brought in substantially less wood pellets than barging since trucks must travel by winter road beginning north of Wrigley and cannot employ super-b trailers, as they are not suited for the winter road terrain of the Sahtu region.[18] The low volume of pellets arriving by truck exemplifies the success of barging infrastructure and logistics in this region.

  In Norman Wells, Green Energy NWT Inc. has installed a large pellet distribution plant consisting of 13 storage silos with a maximum capacity of 1,380 tonnes. The 13 silos consist of ten 105-tonne silos and three 110-tonne silos.[19] Once a year during winter-road season, pellets are distributed from silo storage in Norman Wells using trucks with specialized hopper-bottom grain trailers to storage at each participating GNWT building in other Sahtu region communities – Fort Good Hope and Tulita.[20]

- **Beaufort Delta region** – Wood pellets for Inuvik GNWT buildings are delivered by truck via the Dempster Highway (approximately one-way 3,100 km driving distance, bulk haul and one tonne tote options), a much longer haul distance than required for the other

[16] Confirmed by Brian Lickoch of Norman Wells via personal communication in February 2024.
[17] Ibid.
[18] Ibid. In recent years, the summer and winter supply options have had similar delivered costs to Norman Wells, differing from initial years where barging was normally the more cost-effective solution.
[19] Ibid.
[20] Norman Wells silo storage of 1,380 tonnes (about 71% of 4-year average GNWT building wood pellet use in this region), with distribution using the company's five belly dump trailers and three pneumatic delivery trucks. (See section 5.2, page 14 - Dresser, Murray and Panah (2020). Pellet Central Heating Information Heat from domestically produced wood pellets. Prepared for the Provincial Territorial Advisory Committee Wood Pellet Association of Canada British Columbia Canada.)

regions.[21] Wood pellets were delivered for heating in 2022/23 to the GNWT building in Aklavik by truck from Inuvik via winter road (supplied from Inuvik silo storage).

Due to its two ferry/ice road crossing seasonal constraints, the Dempster Highway used for wood pellet deliveries for this region's GNWT buildings is typically open for heavy traffic only from mid-January to the end of March, and again from beginning of July to mid-September. Significant issues have been noted with this supply chain, including:

- Climate change effects on road infrastructure – related to increased snow and rain in winter and summer have resulted in road closures. For example, the September 2022 Dawson City mud-slide closed Dempster Highway for 2 weeks;[22] there have also been ongoing mud slides in the Ogilvie section of this highway; increased snow fall in winter often leaves multiple trucks stranded in Whitehorse for weeks; melting permafrost under the highway can result in poor driving conditions, resulting in increased time required for deliveries and added costs.
- Climate change effects on barging availability. For example, in August 2023, the third and final MTS barge shipments to Norman Wells and Tulita were cancelled due to low water conditions – an increasingly common challenge for barging on the Mackenzie River. Barges must pass through a section north of Norman Wells known as the Ramparts that regularly presents significant complications to barging. Barging difficulties posed by the Ramparts are exacerbated by low-water levels typically caused by climate change, as seen in the Summer 2023 barging season.
- Limited supply of skilled drivers – and most experienced drivers are at capacity.
- The delivered cost of biomass to Inuvik using trucking leaves little if any margin below current fossil fuel heating costs to cover ongoing maintenance costs (which are higher for biomass than for fossil fuels).
- Deliveries for GNWT's larger volume Inuvik uses at the Inuvik school and hospital have experienced significant, critical and worsening road access disruptions over recent winter periods. During the 2022/23 heating season no biomass was able to be delivered by truck prior to winter 2023; after the winter road opened in January 2023, deliveries over the winter road were sporadic and unreliable.

The two Inuvik GNWT buildings receiving biomass were planned for direct wood pellet delivery without reliance on (or access to) any local silo storage – intermittent storage being a crucial aspect for the supply of wood pellets. This has resulted in supply issues when Dempster Highway constraints prevent any required trucking deliveries, resulting in increased fossil fuels use in the region. Delta Enterprises Inc. (Delta) currently has three 100-tonne silo storage units (300-tonnes storage) in Inuvik, developed for supplying wood pellets to five non-GNWT buildings. In 2023, Delta sought funding to expand this storage by a further six 100-tonne units (600-tonnes added storage) to help address Inuvik building requirements for local pellet distribution facilities.

NEL received 2023 funding for a phased biomass barging pilot program, resulting in approximately 670-tonnes of La Crete wood pellets being delivered in one-tonne totes by barge from Hay River

[21] For example, one-way winter driving distance from La Crete to Norman Wells (the distribution plant location for Sahtu region wood pellet deliveries in winter) is only approximately 1,143 km.
[22] Chris MacIntyre, Yukon's North Klondike Highway remains closed after multiple landslides, CBC News, 2022.

to Inuvik in summer 2023 – deliveries which ended up being critical for biomass use in GNWT Inuvik buildings during the early heating season given the issues noted above that year with no Dempster Highway wood pellet trucking deliveries. The following landed delivery costs of $464/tonne (see below) were incurred for these barge wood pellet deliveries to Inuvik (in addition wood pellet tote purchase cost at $175/tonne with $25/tonne deposit refund when tote bag returned, and $15/tonne provision for delivery of the pellets from storage area to buildings), representing a cost saving relative to truck delivery of these totes over the Dempster Highway (estimated 2022/23 truck option cost at $549.45/tonne):[23]

- Truck delivery to Hay River from La Crete $76/tonne
- MTS barge transport – Hay River to Inuvik $374/tonne
- Offloading to storage area in Inuvik $13.7/tonne
- Total Barge Delivery Cost $463.7/tonne

Other than the Inuvik pilot reviewed above, no other existing barge option landed costs for wood pellet deliveries have been incurred for reference in this region. The Inuvik barging pilot highlights the added transshipment costs inherent for the barging option, i.e., truck delivery to the barge departure point plus transport of pellets to a storage area on barge arrival.

In the Sahtu region, where a storage distribution plant has been established at Norman Wells, a similar barge option with totes would presumably incur similar 2022/23 costs per tonne as shown above for Inuvik regarding truck delivery cost to Hay River and offloading to local storage, while MTS barging costs per tonne to Norman Wells is likely (based on MTS 2023 rates – see Appendix D) to approximate 70% of the MTS barging cost to Inuvik. In summary, given the much greater trucking option distance needed for Inuvik than for Norman Wells, barging competitive costing relative to trucking is likely to be much more difficult to secure for the Sahtu region than for the Beaufort Delta region.

In the Dehcho region the barge option offers no apparent basis for consideration. Wood pellet landed costs in this region are already comparatively low using year-round truck delivery options. Barging would not offer any opportunities for cost savings or delivery reliability improvements.

[23] Source: NEL. The cost comparison does not address bulk pellet supply trucking options with lower La Crete purchase price and bulk trucking delivery directly to the GNWT building. Barge tote total delivery cost totals $654/tonne with local delivery but before deposit recovery ($33.5/GJ). MTS barge price for this same delivery in 2023 summer was much higher than the $374/tonne in 2023, at $547/tonne, and trucking option costs were also higher – highlighting the volatility of these landed costs from year-to-year for each option.

6.0 MACKENZIE RIVER REGION BIOMASS HEATING SUPPLY CHAIN CHALLENGES, GAPS AND DEFICIENCIES

Focusing on heating in GNWT buildings, some have very high penetration of biomass in heat load, such as the Sahtu Region (53% wood pellet contribution to building heat energy in 2023). Wood pellet contributions to GNWT building heat energy in 2023 in the other regions was only 25% in the Dehcho Region, and only 19% in the key Beaufort Delta Region that accounted for approximately 61% of Mackenzie River community GNWT building heat energy in 2023. Existing biomass heating fuel deliveries to all Mackenzie River region communities are supplied from La Crete, Alta. by the existing infrastructure of all weather road, winter road and ice roads as well as by barge to the Sahtu Region.

Supply for all three regions has historically been sourced from La Crete, Alta. Recently, there have been a number of significant concerns regarding the domestic supply capacity of the La Crete plant. In recent years, Green Energy NWT in Norman Wells has used alternate suppliers sporadically, and in early 2024 has apparently had to resort to sourcing pellets out of a supplier in Slave Lake, as La Crete has export contracts that take precedent over domestic ones.[24] Furthermore, there is speculation that La Crete could be bought by new owners who are largely focused on export markets for biomass, putting further pressure on domestic supply concerns. In April 2024, Green Energy NWT had a successful resupply via winter road, using five trucks with tridem hopper trailers. Approximately 250-tonnes of wood pellets were sourced from a supplier out of Slave Lake, Alta., and the remainder out of La Crete.[25]

The challenges, gaps and deficiencies of this infrastructure that are reviewed in Appendix B by region, and have been summarized above, include the following:

- **Seasonal limitations** – except for two communities in the Dehcho region that have year-round road access without seasonal interruptions, all Mackenzie River communities have seasonal wood pellet supply disruptions when at least ice bridge roads must be established, and all communities in the Sahtu region are road connected only during winter with the annual winter road that is likely to be open for slightly over three months.

  However, notwithstanding the Sahtu region's most severe seasonal access limitations, the highest wood pellet use (as percent of total heat fuel requirement) for GNWT buildings currently occurs in this region due to the supply chain infrastructure established for Norman Wells pellet storage and local wood pellet distribution throughout this region's communities.

  As mentioned in Section 2.0, low-water seasons play a significant role in the Beaufort Delta region's challenges related to barging. Over the last few years, the MTS barging program has experienced a plethora of issues related to climate change including historic low and high water levels, flooding, debris disruptions, low-water levels, difficulties finding crew, and forest fires leading to the evacuation of MTS (losing seven weeks of the 2023 season).[26] The 2023 barging season was particularly challenging, characterized by low-water levels affecting the ability to complete deliveries and barges getting stuck in previously

[24] Noted by Brian Lickoch via personal communication in March 2024.
[25] Noted by Brian Lickoch via personal communication in April 2024.
[26] Confirmed by MTS in February 2024 workshop with GNWT and MTS.

unexpected locations. The variability of water levels on the Mackenzie River from year-to-year makes predicting the feasibility of barging difficult – water-levels during the summer 2023 season were entirely different than the previous years, where water-levels were too high.[27]

- **Beaufort Delta Region Added Challenges –** The Beaufort Delta region faces added road supply chain challenges related to the Dempster Highway access distances, climate impacted road conditions and disruptions, and other factors that can constrain wood pellet supply deliveries even when the above seasonal limitations do not apply. This region has a deficiency gap in needed local wood pellet storage and local distribution delivery capacity needed to ensure reliable wood pellet supply throughout each heat season. Natural gas use in Inuvik also poses added challenges to wood pellet ability to be cost competitive.
- **Wood Pellet Heating Limits for Building Use –** Wood pellet use requires installation of wood boiler infrastructure in existing buildings, and the resulting percentage contribution to a building's heat energy is affected by the selected installation. The 14 GNWT buildings with wood pellet use in 2023 showed varying heat contribution levels:
    - **Sahtu Region –** shows high penetration in available buildings, and in wood pellet use within these selected buildings (wood pellets in 8 out of 11 higher heat load buildings [as defined in Table A-1], contributing 68% of 2023 heat energy to these 8 buildings – with wood pellets contributing from 73% to 100% of heat energy in the 5 Norman Wells buildings, 51-64% in the two Tulita buildings, and 40% in the one Fort Good Hope building).
    - **Beaufort Delta Region –** shows low penetration in available buildings, and wide variability in wood pellet use within these selected buildings (wood pellets in 3 out of 22 higher heat load buildings [as defined in Table A-1], contributing 44% of 2023 heat energy to these 3 buildings – with wood pellets contributing from 36% to 71% of heat energy in the 2 Inuvik buildings, and 42% in the one Aklavik building).
    - **Dehcho Region –** shows low penetration in available buildings, and wide variability in wood pellet use within these selected buildings (wood pellets in 3 out of 12 higher heat load buildings [as defined in Table A-1], contributing 34% of 2023 heat energy to these 3 buildings – with wood pellets contributing from 51% to 65% of heat energy in the 2 Providence buildings, and 22% in the one Fort Simpson building).

[27] Ibid.

7.0 SCENARIO ASSESSMENT

This Study has assessed conditions for the supply of barge-delivered wood pellets to be a cost-effective and cleaner heating fuel option to increase the use of wood pellet biomass for building heating, when practical, in 12 remote communities along, or in the vicinity of, the Mackenzie River. The above sections and their review of existing community building heat load profiles and landed costs for heating fuel use in GNWT buildings was used to provide recommended communities where new barge option scenario assessment could be warranted and potential scenario options that merit consideration for these communities.

In summary, new barge option scenario assessment for wood pellets is recommended to be warranted only for Mackenzie River communities in the Beaufort Delta region, and (based on experience to date) with wood pellets supplied mainly from La Crete, Alta. Concerns have been noted regarding security of wood pellet supply from La Crete, and alternate wood pellet supply options will therefore also likely need to be considered (See Section 6.0 for further discussion).

When considering the three regions for scenario assessment, the following factors indicate no reasonable basis for considering further either the Dehcho Region or the Sahtu Region for enhanced wood pellet barge delivery for heating:

- **Dehcho Region:** The current low wood pellet use in GNWT buildings in this region is not explained by supply chain issues. This region has the least effects from supply chain limitations, the lowest wood biomass cost levels, and the biggest cost saving levels relative to fossil fuels for GNWT buildings in the Mackenzie River communities. Barging options do not appear to offer any opportunities in this region to improve wood pellet use.
- **Sahtu Region**: Similarly, new barging options do not appear currently to offer any material opportunities in the Sahtu Region to improve the already relatively high level of wood pellet use and established barge and winter road supply chains. Concerns have been noted, however, about the sustained ability to rely on barging if Cooper's, a family firm, is closed. Cooper's has been able to offer adaptability and costs needed for the successful wood pellet barge supply chain to the Sahtu Region.[28] MTS to date has not been considered likely to have the capacity to provide comparable barging services for wood pellet delivery.

The Beaufort Delta Region, however, has the most serious apparent supply chain challenges and appears to offer potentials for barging options to improve wood pellet use. Key factors and options guiding the scenario assessment of this region include:

- Target buildings for expanded wood pellet use within larger GNWT buildings and other building use of wood pellets, and assessment of potential ability to contribute to the NWT-wide 40% renewable heating objective for at least GNWT buildings by 2030.

[28] Noted by Brian Lickoch in various conversations regarding the Sahtu region supply chain in January and February 2024. Lickoch stated that if Cooper's were to close, the only available option for barging is MTS. According to Lickoch, MTS to date has not been able to provide required costs and adaptability. See also Appendix E, workshop outcomes.

- Options to develop wood pellet storage and distribution plant as needed to support barging options and improve wood pellet supply security in this region (consider learnings from the Sahtu Region success in this regard).
- Options for barge supply routing –options of Hay River versus Fort Simpson reflect MTS versus Cooper's for current barge loading; when focusing on delivery to the Beaufort Delta region, discussions to date have not identified feasible more northern locations for barge loading.
- Options for barge design and timing planning – for example:
    - tote versus bulk wood pellet shipment options, impacts on load / unload options and on overall supply chain reliability and operating costs;
    - barge size and dedicated versus not-dedicated barge options, considering options for unload versus storage when barge arrives at its destination; and
    - with dedicated barges the options for design, for use for winter storage at the destination, and potential for multiple barges that enable swapping (i.e., when deliver barge(s) at the earliest opportunity in summer to minimize drought effect risks, pick up an empty barge(s) for return to loading location for next year).

The assessment of barge options for wood pellet heating use in the Beaufort Delta region needs to consider mitigating drought related risks as shown in summer 2023, as well as other potential barge operation issues, including:

- Draft allowable for river loaded barge, and the related impacts on allowable barge size and weight (and how this varies during barge season);
- Impacts of high water in spring and low water later in summer, as regards shipment of loaded vs empty barges;
- Options to reduce costs for return of empty barges; and
- Docking capacity at selected locations and safe place availability if want to winter barge(s) in Beaufort Delta, e.g., for possible storage options regarding wood pellets (among other considerations needs to survive spring high water and ice flows in river).

Separate from the above, the potential impacts of planned carbon tax increases to 2030 need review in future scenario assessments, including application of carbon taxes to these heating uses, impacts of carbon taxes on barging versus truck delivery options for wood pellets, and potential options for renewable fuel use in barging and truck delivery options.

Scenario assessment for the Beaufort Delta region highlighted several gaps and deficiencies in the region's supply chain, notably:

- For a barging-based supply chain, significant barriers such as inadequate bulk-storage and high costs must be addressed. Given the amount of demand and infrastructure already in-place for the region, bulk-storage at Inuvik is perhaps the most needed link in the Beaufort Delta's supply chain gaps relating to the transport and uptake of biomass.
- Developing and utilizing a long-term storage solution at Inuvik would significantly enhance wood pellet supply reliability to the region to meet demand, delivered either by barge on

the Mackenzie River or by truck via Dempster Highway; this storage would also be a requirement for developing the barge supply option, given the limited summer period available for such deliveries.

- While the Sahtu region has had immense success in wood pellet supply chain infrastructure and logistics, barging biomass to the Beaufort Delta region is an entirely different situation given added distance, Rampart Rapids, and the market scale potentials in each set of communities. While the success of Norman Wells and the Sahtu region can partly be attributed to an expertise in Mackenzie River logistics and supply chain management, noteworthy is the fact that the region made the switch to biomass at a time when demand for any new heating fuel was exceptionally high. Green Energy NWT was built up during a transition period for Norman Wells when Imperial Oil's natural gas supply was depleting, and the community was looking for the next cheapest alternative to natural gas.[29] Although a significant amount of risk was involved in the switch to biomass (the region was facing huge costs with both the switching of infrastructure to accommodate biomass and in fuel price), a strong, steady, and largely unique circumstance for the demand for an alternative fuel in the region is what helped Green Energy NWT become paramount for biomass uptake in the Sahtu region.
- The significance of the added barging distance required to supply the Beaufort Delta region compared to the Sahtu region has become increasingly apparent given the rising unpredictability of water-levels on the Mackenzie River.
- While optimizing the existing supply chain on the Mackenzie River is the most feasible and logical solution for the time being, alternative solutions, such as sourcing biomass and barging out of the west coast of Canada and around Alaska may be worth exploring when considering the potential future effects of climate change on the Mackenzie River.[30]
- Biomass has been delivered by truck to the Beaufort Delta region via the Dempster Highway, a much longer haul distance than required for the other two regions. As mentioned in Section 5.0 and Appendix B, the Dempster Highway also has its own

[29] Confirmed by GNWT during the February 2024 workshop with GNWT and MTS.

[30] Following a call with Brian Lickoch in February 2024, the model of transporting wood pellets around Alaska was considered as a possible future alternative to barging on the Mackenzie River, due to the remoteness of the Beaufort Delta relative to the port of departure of barges in Hay River or Fort Simpson, and evidence that wood pellet supply from the west coast was being shipped to Alaska. This was further explored through communications and a meeting with FutureMetrics, a consulting firm from Maine recommended by Brian Lickoch that specializes in wood pellet biomass. FutureMetrics advised that while there are no technical reasons why this method would not be feasible, cost and supply would likely be the largest concerns affecting success; no confirmation could be provided as to current Alaska biomass shipping supplies; review of wood biomass export supply costs from western Canada to Europe by ship confirmed the relatively higher costs associated with supplying the Mackenzie River regions relevant to the Study. During the February 2024 workshop, GNWT and MTS expressed concerns regarding the idea of supplying the Beaufort Delta by shipping around Alaska, specifically noting that the Tuktoyaktuk harbour doesn't have the depth required and the biomass would likely have to be transloaded, which takes a significant amount of time. The presence of ice in the Beaufort Sea was also a point of concern for this method. Following the workshop with feedback from both GNWT and MTS, it is understood that transporting biomass sourced from the west coast of Canada around Alaska is largely outside the scope of the current Study.

difficulties and is not a reliable delivery route. The initial deployment and supply of a bulk storage solution in the Beaufort Delta region is likely to necessitate initial summer use of the Dempster Highway (in tandem with barging) to rapidly supply the region with depository of pellets.

Various barging components were considered, with particular focus regarding options to reduce costs, various shipment options, and the Sahtu region's logistical success in this area.

With the estimated potential demand for biomass in the Beaufort Delta region equaling over 1,500 tonnes per year,[31] the most effective method for barging would be some form of bulk shipping as opposed to totes. Considering the volume and distance required for barging to the Beaufort Delta region, the use of totes is not recommended as they are far more susceptible to environmental risks (such as rain spoiling the pellets),[32] complicate transloading processes, and are more suited to low-volume retail consumers of biomass. In the Sahtu region, Green Energy NWT has developed the potentially applicable and highly successful method of filling multiple super-b trailers and barging them to Norman Wells, supported by infrastructure and vehicles at both the port of departure and port of arrival.

To apply the Sahtu region's barging model in the Beaufort Delta would involve barging double the distance, as well as much greater volumes, and be considerably more expensive. As mentioned previously by Green Energy NWT in Norman Wells, one of the primary reasons for their preference of Cooper's Barging Services over MTS is due to cost (and flexibility). In early 2024, it was discovered that Cooper's upcoming summer season may be their last as the owner is looking to get out of the business. Accordingly, options to reduce the costs of barging and strengthen the Beaufort Delta supply chain embellished by the help of Cooper's were explored and are categorized in Section 8.0 as a potential solution to the gaps and deficiencies of the Beaufort Delta region supply chain.

[31] As estimated by InterGroup using data received from GNWT regarding community heat load volumes for the years 2020-2023. Estimates were calculated considering historical values and current installed capacity of the region.
[32] Confirmed by Brian Lickoch in communication, and by MTS during the February 2024 workshop with GNWT and MTS.

8.0 POTENTIAL SOLUTIONS IN THE BEAUFORT DELTA REGION AND NEXT STEPS

As outlined in Section 7.0 above, the Study outlines three main components needed for a successful biomass supply chain in the Beaufort Delta region:

- Inuvik Bulk Storage System
- Cost-Effective & Reliable Barging Model
- Secure Wood Pellet Biomass Supply

Inuvik Bulk Storage System

The first component involves the immediate development of a bulk storage system in Inuvik to meet existing demand and maximize use in the Beaufort Delta region. Locating the storage and distribution centrally in Inuvik could be undertaken in harmony with the development of smaller capacity installations in the surrounding communities. This would allow for the transport and installation of smaller individual silos throughout the region in a reasonable amount of time. This scenario would be preferred to one involving the development of multiple bulk storage systems in each community, as logistics involved for larger systems are significantly more intensive.[33] For Inuvik, a handful of storage options present themselves for immediate consideration:

- A bulk silo storage system consisting of a large grouping of small silos similar to the storage facility in Norman Wells. The Norman Wells facility consists of 13 silos developed over many years with a combined overall capacity of over 1300-tonnes. Options for Inuvik could involve a higher number of similar sized silos versus the development of a few larger sized silos.[34]
- A flat, covered storage facility. This solution would allow for loose storage of wood pellets in a weatherproof facility. This option was recommended for consideration during a meeting with William Strauss of FutureMetrics and Maine Energy Systems in February of 2024.[35]
- The use of barges or super-b trailers as storage is possible. The first of two methods discussed employs the use of dedicated barge storage wherein barges would park over the winter, for them to return for loading next barging season (access to multiple barges would allow for added flexibility for this option). This method would involve the acquisition of a safe place to park a barge over the winter, as well as a confirmed distribution process. The second method would involve multiple, parked super-b trailers as storage in Inuvik and would be the least feasible for reasons pertaining to cost, space, and transport of storage

[33] For example, the development of the Inuvik Regional Hospital system required the use of one entire truckload. Note that this is in addition to significant costs incurred for transport and installation.
[34] Ibid.
[35] William Strauss is the founder and president of FutureMetrics and the co-founder of Maine Energy Systems (MESys), the largest wood pellet boiler manufacturer in North America. MESys helped supply Brian Lickoch of Norman Wells with biomass boilers back in the late 2000s when his operation was starting out.

options, as the estimated total demand of pellets[36] and required storage would involve the use of a many trailers. Super-b trailers can store roughly 44-tonnes of wood pellets.

In summary, the region would greatly benefit from a centralized storage and distribution system During the February workshop, GNWT expressed preference towards building up a storage facility in Inuvik with a similar capacity to that of Norman Wells (1,380-tonnes). The development of a bulk storage facility in Inuvik would involve the transport and installation of storage facility components, either by highway or barge, and would be a significant portion of the total cost as the logistics to undertake such a development would be intensive (grant funding could address concerns in this regard).

Cost-Effective and Reliable Barging Model

The second component involves working cooperatively with GNWT, MTS, and Cooper's Barging Services to find a cost-effective and reliable barging model for the Beaufort Delta region, which improves upon the current Mackenzie River arrangement.

Discussion with Cooper's Barging Services is needed to access barging options for the Beaufort Delta wood biomass supply chain, based on their successful supply experience for the Sahtu region. It will be important to understand options for future involvement of Cooper's and its facilities.

Future development of a barging model in these regions may be bolstered by GNWT taking responsibility for shipping low-carbon fuels such as biomass to remote communities, similar to their current model of shipping diesel and gasoline via MTS.

In early 2024, it was learned that MTS has acquired a new tugboat with long term plans to become the designated harbour tugboat in Tuktoyaktuk.[37] Also learned was the presence of several parked and currently unused barges owned by MTS that could potentially be repurposed for barging biomass. The use of the tugboat in combination with the parked barges and/or barges and tugboat from Cooper's was discussed to be a possible method to increase the flexibility of MTS' barging capabilities on the Mackenzie River, and to decrease the current high costs of barging.[38]

During the February workshop, MTS noted a strong preference for the use of super-b trailers for the transportation of wood pellets as they offer faster offloading, higher capacity, a low rental cost, spoil pellets less, and are overall an easier method to barge pellets than options with totes, containers, or other bulk-storage methods.

One of the largest determinants of MTS' high cost compared to Cooper's is due to tugboat size and related crew size, with MTS barges typically made up of a unionized 13-man crew whereas Cooper's are made up of a 4-man crew. The introduction of the new smaller MTS tugboat is significant in this regard as it would require a 5-man crew, being far less expensive. Notable is the fact that MTS has no direct control over barging costs, as they use a cost recovery model with little room to lower costs.

[36] Target volumes and future demand for wood pellets were estimated by InterGroup using data received from GNWT regarding community heat load volumes for the years 2020-2023. Estimates were calculated considering historical values and current installed capacity of the region.
[37] As noted by MTS during the February 2024 workshop with GNWT and MTS.
[38] Ibid.

The reliability and availability of fuel delivery trucks for remote communities in NWT is also pertinent for reliable biomass barging as well as trucking wood pellet supply options examined in this report, given their vital position at the end of the supply chain. Bulk storage of pellets in northern communities, such as in Norman Wells, requires the use of specialized trucks to deliver the product to the final location. The Fuel Services Division (FSD) of GNWT noted that their specialized fuel delivery trucks needed for remote community fuel supply are becoming increasingly more expensive, harder to get, more technological in nature, and generally not suited to operate in an extreme, northern environment.[39] It is reasonable to anticipate similar issues for local wood pellet delivery truck requirements, including need for back-up capability rather than reliance on a single vehicle.

Reliable Wood Biomass Supply

Concerns have been noted recently regarding the security of wood pellet supply from La Crete, and wood pellet supply options will therefore also likely need to be considered. Due to constraints at La Crete, Green Energy in Norman Wells has apparently had to obtain supplies from Slave Lake.[40] Other potential manufacturer supply sources identified to date for potential consideration include a plant located at High Level, or local mills in British Columbia close to the Alberta border (Dawson Creek, Fort St. John).

Issues related to reliable wood pellet biomass supply obviously raise broad and critical concerns affecting all wood biomass heating supply for the NWT communities currently relying on La Crete supplies, which could ultimately prevent the NWT from achieving its 2030 objective of 40% of renewable space heating across the building sector by 2030. Accordingly, it is anticipated that GNWT will want to address options and plans to secure long term reliable wood pellet biomass supply for all affected communities, whether supplied by truck or by barge.

Summary Next Steps

In summary, the key points of concern for the next steps following the Study are recommended to be focused on, but not limited to:

- The immediate development of added storage capacity in the Beaufort Delta region, with adequate bulk storage in Inuvik, to meet the demand and installed capacity of the region,
- The continued exploration and refinement of barging supply chain options and alternatives, particularly relating to Cooper's Barging Services and capabilities of a modified MTS barging model, and
- The addressing of La Crete biomass supply concerns in the face of increasing pressures on domestic pellet suppliers to meet export demand.

[39] FSD noted, by way of example, that it is currently paying between about $250,000 and $400,000 for a single fuel delivery truck with a tank capacity of either 3,000L or 9,000L for diesel fuel.
[40] Noted by Brian Lickoch via personal communication in February 2024.

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APPENDIX A: GNWT HEAT ENERGY USE 2020-2023 – MACKENZIE RIVER COMMUNITIES

Table A-1: GNWT Heat Energy Use 2020-2023 (GJ/yr) – All Mackenzie River Communities

	All GNWT Buildings (GJ/yr)					Selected Higher Load GNWT Buildings* (GJ/yr)					
	2020	2021	2022	2023	4-yr Average	2020	2021	2022	2023	4-yr Average	% of All Buildings
Beaufort Delta Region						**Beaufort Delta Region**					
Inuvik	73,730	78,932	66,893	78,694	74,562	Inuvik	58,103	65,457	52,478	63,258	59,824	*80.2%*
Aklavik	9,373	10,676	9,371	8,900	9,111	Aklavik	7,070	8,543	7,112	4,882	6,902	*75.7%*
Tuktoyaktuk	5,977	6,053	5,807	6,673	6,128	Tuktoyaktuk	3,859	3,346	3,767	4,519	3,873	*63.2%*
Tsiigehtchic	3,008	3,766	2,691	2,355	2,955	Tsiigehtchic	744	1,019	1,209	994	992	*33.6%*
Ft. McPherson	3,922	9,473	6,899	4,882	6,294	Ft. McPherson	2,549	6,828	4,984	3,244	4,401	*69.9%*
Total Region	**96,011**	**108,900**	**91,660**	**101,505**	**99,051**	**Total Region**	**72,325**	**85,194**	**69,550**	**76,897**	**75,991**	***76.7%***
Wood Pellets	*7,277*	*24,578*	*14,938*	*18,785*	*16,394*	*Wood Pellets*	*7,277*	*24,578*	*14,938*	*18,785*	*16,394*	*100.0%*
Wood Pellets %	*7.6%*	*22.6%*	*16.3%*	*18.5%*	*16.5%*	*Wood Pellets %*	*10.1%*	*28.8%*	*21.5%*	*24.4%*	*21.6%*	
(# buildings)	*82*	*82*	*77*	*77*	*80*	*(# buildings)*	*22*	*22*	*22*	*22*	*22*	*27.7%*
Sahtu Region						**Sahtu Region**					
Norman Wells	22,834	21,991	24,409	19,928	22,290	Norman Wells	20,526	19,525	21,990	17,742	19,946	*89.5%*
Fort Good Hope	6,186	6,886	6,969	6,910	6,738	Fort Good Hope	3,297	4,481	4,356	4,711	4,211	*62.5%*
Tulita	6,317	5,694	6,688	6,377	6,269	Tulita	4,991	4,380	4,947	4,756	4,768	*76.1%*
Total Region	**35,337**	**34,570**	**38,065**	**33,216**	**35,297**	**Total Region**	**28,814**	**28,385**	**31,293**	**27,209**	**28,925**	***81.9%***
Wood Pellets	*17,059*	*20,105*	*18,790*	*17,592*	*18,387*	*Wood Pellets*	*17,059*	*20,105*	*18,790*	*17,592*	*18,387*	*100.0%*
Wood Pellets %	*48.3%*	*58.2%*	*49.4%*	*53.0%*	*52.1%*	*Wood Pellets %*	*59.2%*	*70.8%*	*60.0%*	*64.7%*	*63.6%*	
(# buildings)	*39*	*42*	*39*	*39*	*40*	*(# buildings)*	*11*	*11*	*11*	*11*	*11*	*27.7%*
Dehcho Region						**Dehcho Region**					
Fort Providence	6,978	7,685	7,493	8,580	7,684	Fort Providence	4,447	5,044	5,003	6,364	5,214	*67.9%*
Fort Simpson	21,474	23,290	22,449	21,186	22,100	Fort Simpson	15,159	16,561	16,618	15,432	15,942	*72.1%*
Wrigley	2,307	2,232	2,290	2,238	2,267	Wrigley	1,950	1,850	1,786	1,573	1,790	*79.0%*
Jean Marie River	174	206	378	212	242	Jean Marie River	-	-	-	-	-	-
Total Region	**30,932**	**33,413**	**32,610**	**32,216**	**32,293**	**Total Region**	**21,555**	**23,455**	**23,406**	**23,369**	**22,946**	***71.1%***
Wood Pellets	*2,628*	*7,019*	*4,618*	*4,659*	*4,731*	*Wood Pellets*	*2,397*	*7,019*	*4,618*	*4,659*	*4,673*	*98.8%*
Wood Pellets %	*8.5%*	*21.0%*	*14.2%*	*14.5%*	*14.6%*	*Wood Pellets %*	*11.1%*	*29.9%*	*19.7%*	*19.9%*	*20.4%*	
(# buildings)	*53*	*59*	*56*	*55*	*56*	*(# buildings)*	*12*	*12*	*12*	*12*	*12*	*21.5%*
Total All Regions	**162,280**	**176,884**	**162,336**	**166,936**	**166,641**	**Total All Regions**	**122,694**	**137,034**	**124,249**	**127,475**	**127,863**	*76.7%*
Wood Pellets	*26,964*	*51,702*	*38,346*	*41,036*	*39,512*	*Wood Pellets*	*26,733*	*51,702*	*38,346*	*41,036*	*39,454*	*99.9%*
Wood Pellets %	*16.6%*	*29.2%*	*23.6%*	*24.6%*	*23.7%*	*Wood Pellets %*	*21.8%*	*37.7%*	*30.9%*	*32.2%*	*30.9%*	
(# buildings)	*174*	*183*	*172*	*171*	*175*	*(# buildings)*	*45*	*45*	*45*	*45*	*45*	*25.7%*

Source: GNWT

Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).

GNWT data are for fiscal years 2019/20 to 2022/23.

Source: GNWT

** Includes total for all GNWT buildings excluding buildings with heat loads under about 400 GJ/yr and some other buildings, e.g., building using heat recovery, some buildings with federal government use , e.g., some RCMP facilities.*

Table A-2: GNWT Heat Energy Use 2020-2023 (GJ/yr) – Beaufort Delta Mackenzie River Communities

All GNWT Buildings (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Inuvik						
Fuel oil	32,199	24,264	15,938	26,974	24,844	*33%*
Nat. gas	27,898	27,206	32,103	32,360	29,892	*40%*
Propane	6,356	2,885	3,914	2,449	3,901	*5%*
Wood Pellets	7,277	24,578	14,938	16,911	15,926	*21%*
Total	73,730	78,932	66,893	78,694	74,562	100%
Wood Pellets %	*9.9%*	*31.1%*	*22.3%*	*21.5%*	*21.4%*	
(# buildings)	*44*	*41*	*38*	*38*		
Aklavik						
Fuel Oil	9,373	10,676	9,371	7,026	9,111	*95%*
Wood Pellets	-	-	-	1,874	468	*5%*
Total	9,373	10,676	9,371	8,900	9,580	100%
Wood Pellets %	*0.0%*	*0.0%*	*0.0%*	*21.1%*	*4.9%*	
(# buildings)	*10*	*11*	*10*	*10*		
Tuktoyaktuk						
Fuel Oil/Total	5,977	6,053	5,807	6,673	6,128	*100%*
(# buildings)	*12*	*13*	*14*	*14*		
Tsiigehtchic						
Fuel Oil/Total	3,008	3,766	2,691	2,355	2,955	*100%*
(# buildings)	*6*	*8*	*7*	*6*		
Ft. McPherson						
Fuel Oil/Total	3,922	9,473	6,899	4,882	6,294	*100%*
(# buildings)	*10*	*9*	*8*	*9*		
Total Region						
Fuel oil	54,479	54,232	40,706	47,910	49,332	*50%*
Nat. gas	27,898	27,206	32,103	32,360	29,892	*30%*
Propane	6,356	2,885	3,914	2,449	3,901	*4%*
Wood Pellets	7,277	24,578	14,938	18,785	16,394	*16%*
Total	96,011	108,900	91,660	101,505	99,519	100%
Wood Pellets %	*7.6%*	*22.6%*	*16.3%*	*18.5%*	*16.5%*	
(# buildings)	*82*	*82*	*77*	*77*		

GNWT Buildings with Wood Pellets (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Inuvik						
Inuvik Regional Hospital						
Fuel Oil	19,636	11,322	2,271	14,471	11,925	*48%*
Nat.gas	3,490	3,023	6,080	5,539	4,533	*18%*
Wood Pellets	861	13,015	8,121	11,161	8,289	*33%*
Total	23,987	27,360	16,472	31,171	24,748	100%
Wood Pellets %	*3.6%*	*47.6%*	*49.3%*	*35.8%*	*33.5%*	
Inuvik Schools						
Propane	5,896	2,775	3,781	2,319	3,693	*33%*
Wood Pellets	6,416	11,563	6,818	5,749	7,636	*67%*
Total	12,312	14,338	10,598	8,068	11,329	100%
Wood Pellets %	*52.1%*	*80.6%*	*64.3%*	*71.3%*	*67.4%*	
Aklavik						
Moose Kerr School						
Fuel Oil	4,927	6,020	4,991	2,642	4,645	*91%*
Wood Pellets	0	0	0	1,874	468	*9%*
Total	4,927	6,020	4,991	4,516	5,113	100%
Wood Pellets %	*0.0%*	*0.0%*	*0.0%*	*41.5%*	*9.2%*	
Total Region						
Fuel oil	24,563	17,342	7,262	17,112	16,570	*40%*
Nat. gas	3,490	3,023	6,080	5,539	4,533	*11%*
Propane	5,896	2,775	3,781	2,319	3,693	*9%*
Wood Pellets	7,277	24,578	14,938	18,785	16,394	*40%*
Total	41,225	47,718	32,061	43,755	41,190	100%
Wood Pellets %	*17.7%*	*51.5%*	*46.6%*	*42.9%*	*39.8%*	
(# pellet buildings)	*2*	*2*	*2*	*3*		

Source: GNWT (see Table A-1)

Note: Fort McPherson Health Centre current biomass use not in GNWT data.

Table A-3: GNWT Heat Energy Use 2020-2023 (GJ/yr.) – Sahtu Region Mackenzie River Communities

All GNWT Buildings (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Norman Wells						
Fuel oil	7,788	6,133	7,695	6,021	6,909	*31%*
Propane	525	-	1,578	-	526	*2%*
Wood Pellets	14,521	15,857	15,136	13,907	14,855	*67%*
Total	22,834	21,991	24,409	19,928	22,290	100%
Wood Pellets %	*63.6%*	*72.1%*	*62.0%*	*69.8%*	*66.6%*	
(# buildings)	*14*	*13*	*12*	*13*		
Fort Good Hope/ K'asho Got'ine						
Fuel Oil	6,186	4,874	5,354	5,263	5,419	*80%*
Wood Pellets	-	2,012	1,614	1,647	1,318	*20%*
Total	6,186	6,886	6,969	6,910	6,738	*100%*
Wood Pellets %	*0.0%*	*29.2%*	*23.2%*	*23.8%*	*19.6%*	
(# buildings)	*13*	*15*	*14*	*13*		
Tulita						
Fuel Oil	3,778	3,458	4,649	4,339	4,056	*65%*
Wood Pellets	2,538	2,236	2,039	2,038	2,213	*35%*
Total	6,317	5,694	6,688	6,377	6,269	*100%*
Wood Pellets %	*40.2%*	*39.3%*	*30.5%*	*32.0%*	*35.3%*	
(# buildings)	*12*	*14*	*13*	*13*		
Total Region						
Fuel oil	17,753	14,466	17,697	15,623	16,385	*46%*
Propane	525	-	1,578	-	526	*1%*
Wood Pellets	17,059	20,105	18,790	17,592	18,387	*52%*
Total	35,337	34,570	38,065	33,216	35,297	100%
Wood Pellets %	*48.3%*	*58.2%*	*49.4%*	*53.0%*	*52.1%*	
(# buildings)	*39*	*42*	*39*	*39*		

Source: GNWT (see Table A-1)

GNWT Buildings with Wood Pellets (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Norman Wells						
Airport Maintenance Garage						
Propane	525	0	1,578	0	526	*23%*
Wood Pellets	1,793	1,748	1,944	1,425	1,728	*77%*
Total	2,318	1,748	3,522	1,425	2,253	100%
Wood Pellets %	*77.4%*	*100.0%*	*55.2%*	*100.0%*	*76.7%*	
Airport Terminal Building						
Fuel Oil	588	539	430	350	477	*17%*
Wood Pellets	2,359	2,490	2,466	1,957	2,318	*83%*
Total	2,947	3,030	2,896	2,307	2,795	100%
Wood Pellets %	*80.1%*	*82.2%*	*85.1%*	*84.8%*	*82.9%*	
Mackenzie Mountain School						
Fuel Oil	359	191	334	692	394	*13%*
Wood Pellets	2,461	2,782	2,729	2,378	2,587	*87%*
Total	2,820	2,972	3,063	3,070	2,981	100%
Wood Pellets %	*87.3%*	*93.6%*	*89.1%*	*77.5%*	*86.8%*	
Norman Wells Health Centre and LTC						
Fuel Oil	4,443	2,780	4,458	2,765	3,611	*33%*
Wood Pellets	7,063	8,106	7,073	7,503	7,436	*67%*
Total	11,506	10,886	11,531	10,268	11,048	100%
Wood Pellets %	*61.4%*	*74.5%*	*61.3%*	*73.1%*	*67.3%*	
Norman Wells Shop						
Fuel Oil	91	157	54	29	83	*10%*
Wood Pellets	845	731	924	644	786	*90%*
Total	936	888	978	672	869	100%
Wood Pellets %	*90.3%*	*82.3%*	*94.5%*	*95.7%*	*90.5%*	
Fort Good Hope/ K'asho Got'ine						
Fort Good Hope School						
Fuel Oil	2,600	1,405	1,884	2,439	2,082	*61%*
Wood Pellets	0	2,012	1,614	1,647	1,318	*39%*
Total	2,600	3,417	3,499	4,086	3,400	100%
Wood Pellets %	*0.0%*	*58.9%*	*46.1%*	*40.3%*	*38.8%*	
Tulita						
ENR District Office Tulita						
Fuel Oil	145	41	156	161	126	*25%*
Wood Pellets	690	261	275	283	377	*75%*
Total	835	302	431	444	503	100%
Wood Pellets %	*82.7%*	*86.5%*	*63.7%*	*63.7%*	*75.0%*	
New Chief Albert Wright School						
Fuel Oil	1,289	1,155	1,768	1,681	1,473	*45%*
Wood Pellets	1,848	1,974	1,764	1,756	1,836	*55%*
Total	3,138	3,129	3,532	3,437	3,309	100%
Wood Pellets %	*58.9%*	*63.1%*	*49.9%*	*51.1%*	*55.5%*	
Total Region						
Fuel oil	9,515	6,268	9,085	8,117	8,246	*30%*
Propane	525	0	1,578	0	526	*2%*
Wood Pellets	17,059	20,105	18,790	17,592	18,387	*68%*
Total	27,099	26,373	29,453	25,709	27,158	100%
Wood Pellets %	*63.0%*	*76.2%*	*63.8%*	*68.4%*	*67.7%*	
(# pellet buildings	*7*	*8*	*8*	*8*		

Table A-4: GNWT Heat Energy Use 2020-2023 (GJ/yr) – Dehcho Region Mackenzie River Communities

All GNWT Buildings (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Fort Providence						
Fuel oil	3,996	4,156	4,477	4,911	4,385	*57%*
Propane	1,476	1,455	1,235	1,090	1,314	*17%*
Wood Pellets	1,505	2,075	1,782	2,579	1,985	*26%*
Total	6,978	7,685	7,493	8,580	7,684	100%
Wood Pellets %	*21.6%*	*27.0%*	*23.8%*	*30.1%*	*25.8%*	
(# buildings)	*20*	*21*	*17*	*16*		
Fort Simpson						
Fuel Oil	20,351	18,345	19,613	19,106	19,354	*88%*
Wood Pellets	1,122	4,945	2,836	2,080	2,746	*12%*
Total	21,474	23,290	22,449	21,186	22,100	*100%*
Wood Pellets %	*5.2%*	*21.2%*	*12.6%*	*9.8%*	*12.4%*	
(# buildings)	*25*	*27*	*27*	*26*		
Wrigley						
Fuel Oil/Total	2,307	2,232	2,290	2,238	2,267	*10%*
(# buildings)	*7*	*10*	*10*	*12*		
Jean Marie River						
Fuel Oil/Total	174	206	378	212	242	*1%*
(# buildings)	*1*	*1*	*2*	*1*		
Total Region						
Fuel oil	26,828	24,939	26,757	26,468	26,248	*81%*
Propane	1,476	1,455	1,235	1,090	1,314	*4%*
Wood Pellets	2,628	7,019	4,618	4,659	4,731	*15%*
Total	30,932	33,413	32,610	32,216	32,293	100%
Wood Pellets %	*8.5%*	*21.0%*	*14.2%*	*14.5%*	*14.6%*	
(# buildings)	*53*	*59*	*56*	*55*		

GNWT Buildings with Wood Pellets (GJ/yr)

	2020	2021	2022	2023	4-yr Average	Fuel %
Fort Providence						
Deh Gah School						
Fuel Oil	905	605	661	1,160	833	*32%*
Wood Pellets	1,386	1,939	1,623	2,120	1,767	*68%*
Total	2,291	2,544	2,283	3,280	2,600	100%
Wood Pellets %	*60.5%*	*76.2%*	*71.1%*	*64.6%*	*68.0%*	
Fort Providence New Health Centre						
Fuel Oil	367	599	421	435	456	*68%*
Wood Pellets	119	136	159	459	218	*32%*
Total	486	735	580	893	674	100%
Wood Pellets %	*24.5%*	*18.5%*	*27.4%*	*51.3%*	*32.4%*	
Fort Simpson						
Central Heating Steam Plant						
Fuel Oil	6,199	4,322	7,264	7,299	6,271	*70%*
Wood Pellets	891	4,945	2,836	2,080	2,688	*30%*
Total	7,090	9,267	10,100	9,379	8,959	100%
Wood Pellets %	*12.6%*	*53.4%*	*28.1%*	*22.2%*	*30.0%*	
Total Region						
Fuel oil	7,471	5,526	8,346	8,894	7,559	*62%*
Wood Pellets	2,396	7,019	4,618	4,659	4,673	*38%*
Total	9,867	12,545	12,964	13,553	12,232	100%
Wood Pellets %	*24.3%*	*56.0%*	*35.6%*	*34.4%*	*38.2%*	
(# pellet buildings)	*3*	*3*	*3*	*3*		

Source: GNWT (see Table A-1)

Table A-5: Mackenzie River Communities GNWT Buildings with Wood Pellets – Landed Fuel Costs 2020-2023 ($/GJ)

Beaufort Delta GNWT Buildings with Wood Pellets ($/GJ)

	2020	2021	2022	2023
Inuvik				
Inuvik Regional Hospital				
Fuel Oil	$45.2	$48.1	$49.0	$64.8
Nat.gas	$35.3	$35.4	$35.4	$35.4
Wood Pellets	$31.4	$33.2	$35.4	$39.2
Inuvik Schools				
Propane	$56.7	$56.7	$59.4	$62.5
Wood Pellets	$31.4	$33.1	$34.2	$39.6
Aklavik				
Moose Kerr School				
Fuel Oil				$62.6
Wood Pellets				$46.2
Total Region (All GNWT Buildings)				
Fuel oil	$44.8	$45.5	$47.3	$63.0
Nat. gas	$34.9	$35.0	$35.4	$35.5
Propane	$56.7	$56.7	$59.4	$62.5
Wood Pellets	$31.4	$33.1	$34.9	$40.0

Sahtu Region GNWT Buildings with Wood Pellets ($/GJ)

	2020	2021	2022	2023
Norman Wells				
Airport Maintenance Garage				
Propane	$34.4		$54.3	
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Airport Terminal Building				
Fuel Oil	$38.8	$34.4	$40.1	$50.3
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Mackenzie Mountain School				
Fuel Oil	$39.0	$31.7	$39.6	$52.8
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Norman Wells Health Centre and LTC				
Fuel Oil	$37.3	$33.4	$40.5	$53.4
Wood Pellets	$30.0	$30.0	$30.8	$33.4
Norman Wells Shop				
Fuel Oil	$39.9	$32.7	$39.6	$61.5
Wood Pellets	$30.0	$30.0	$30.6	$33.8
Fort Good Hope/ K'asho Got'ine				
Fort Good Hope School				
Fuel Oil	0	$43.4	$38.2	$51.2
Wood Pellets	0	$30.0	$30.8	$33.8
Tulita				
ENR District Office Tulita				
Fuel Oil	$40.8	$40.0	$34.5	$44.3
Wood Pellets	$35.3	$30.0	$30.8	$39.0
New Chief Albert Wright School				
Fuel Oil	$40.8	$39.6	$34.5	$46.9
Wood Pellets	$29.0	$30.0	$30.8	$33.8
Total Region (All GNWT Buildings)				
Fuel oil	$40.5	$38.2	$38.5	$50.4
Propane	$34.4	-	$54.3	-
Wood Pellets	$30.1	$30.0	$30.8	$33.8

Dehcho Region GNWT Buildings with Wood Pellets ($/GJ)

	2020	2021	2022	2023
Fort Providence				
Deh Gah School				
Fuel Oil	$35.9	$27.4	$37.9	$53.4
Wood Pellets	$14.3	$14.1	$14.3	$16.4
Fort Providence New Health Centre				
Fuel Oil	$34.7	$28.3	$37.6	$51.6
Wood Pellets	$14.3	$14.3	$14.3	$16.4
Fort Simpson				
Central Heating Steam Plant				
Fuel Oil	$31.1	$24.7	$35.3	$43.4
Wood Pellets	$12.3	$18.0	$17.3	$21.4
Total Region (All GNWT Buildings)				
Fuel oil	$32.3	$26.9	$35.3	$45.1
Wood Pellets	$13.5	$16.9	$16.1	$18.6

Source: GNWT (costs paid for fuel used at each building – see Tables A-2, A-3 and A-4 for GJ per year per building)

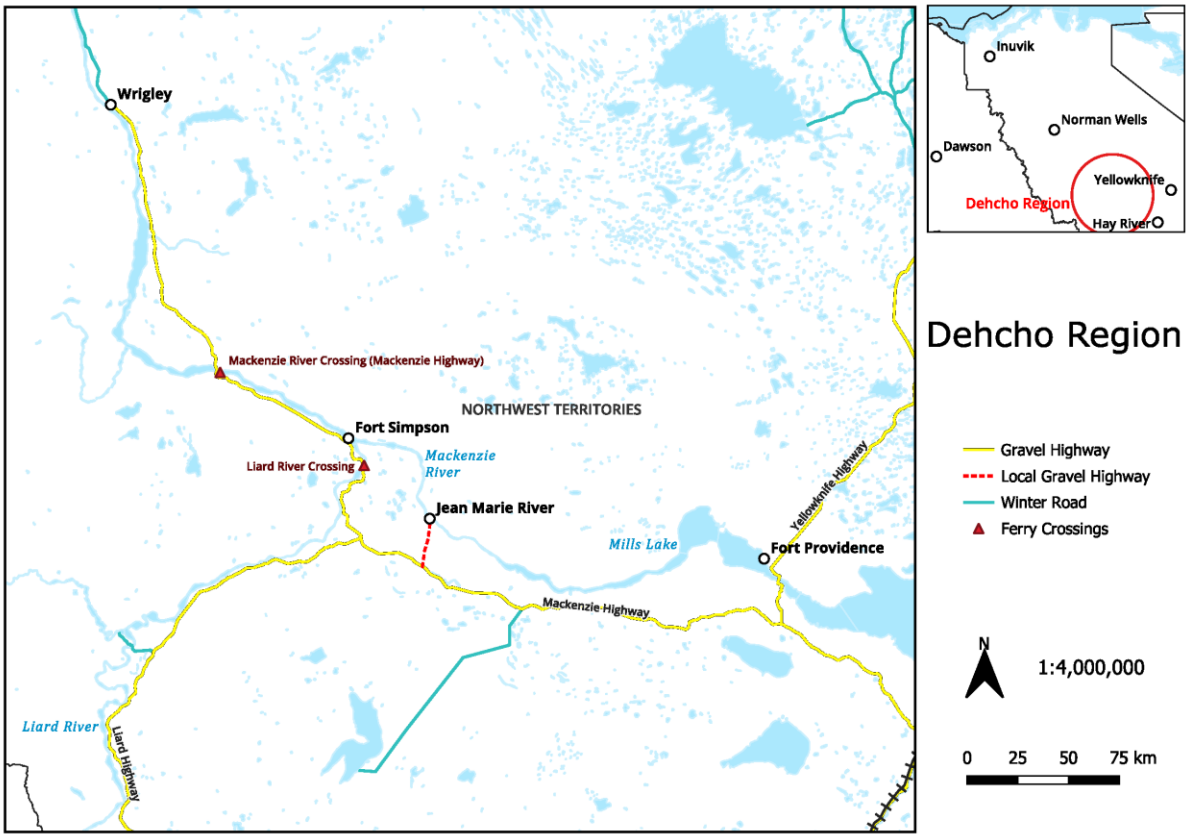
APPENDIX B: MACKENZIE RIVER REGION ROAD INFRASTRUCTURE

The Mackenzie River region road infrastructure is a system of all weather road, winter road and ice roads.

Dehcho Region

An all-weather highway system that comes from Alberta connects the Dehcho region communities throughout its route until terminating at Wrigley (see Figure B-1). Ferry/ ice road crossings are located on the Liard River (before Fort Simpson) and on the Mackenzie River between Fort Simpson and Wrigley. Available data, based on a 20-year average, estimate that winter access to the road to Wrigley is opened by December 17th and closed by April 11th.

Figure B-1: Dehcho Region Road Infrastructure



Sahtu Region

Road access to Sahtu Region communities is via winter road connecting Wrigley to Fort Good Hope through Wrigley-Tulita-Norman Wells-Fort Good Hope route (see Figure B-2). Table B-1 provides summary information on five and twenty-year average open and closure dates in this region (1993-2022). Heavy equipment use of the winter road may be more restrictive than indicated by the open and closure dates.

Figure B-2: Sahtu Region Road Infrastructure

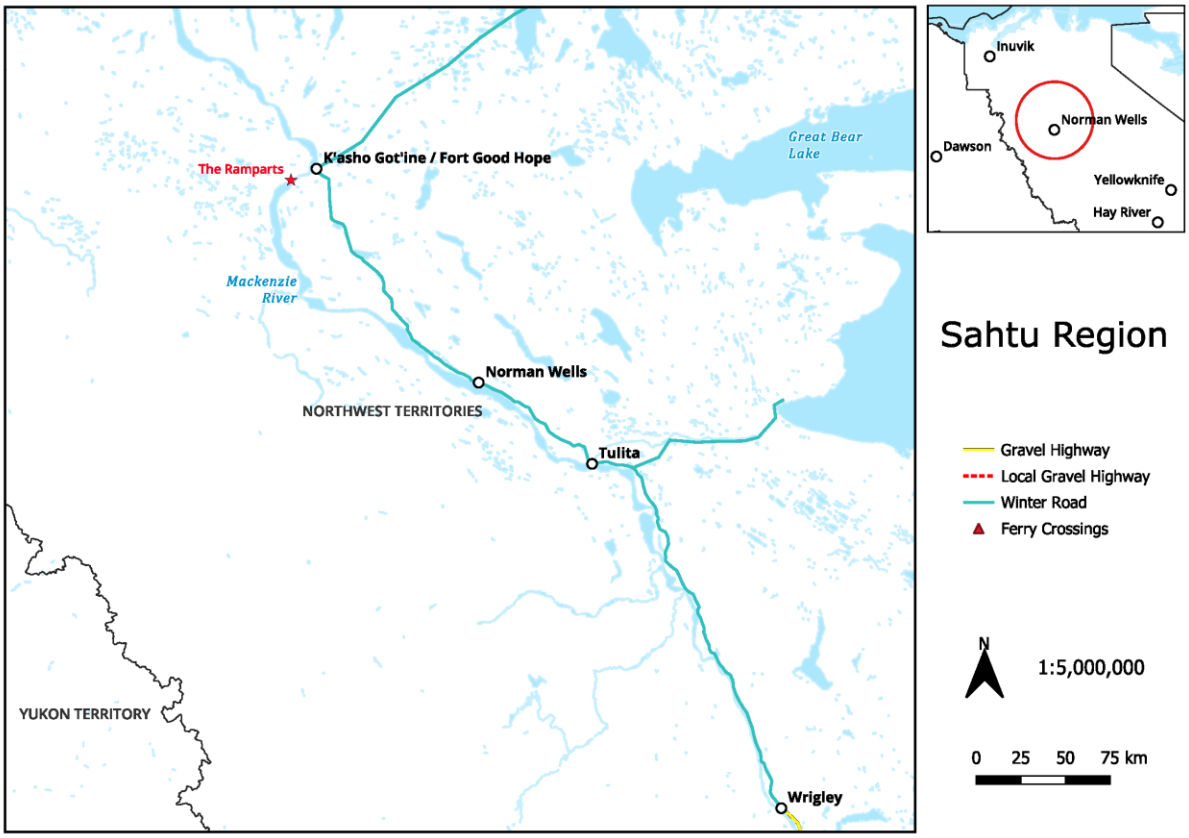


Table B-1: Five-year and Twenty-year Average Open and Closure Dates in Sahtu Region (1993-2022)

	Winter Road condition	**Wrigley - Tulita**	**Tulita – Norman Wells**	**Norman Wells – Fort Good Hope**
Last 20-year average	Open	23 – December	25 December	22 - December
	Closed	28 - March	1 - April	1 - April
Last 5-year average	Open	16 – December	19 – December	19 - December
	Closed	27 March	29 - March	29 - March

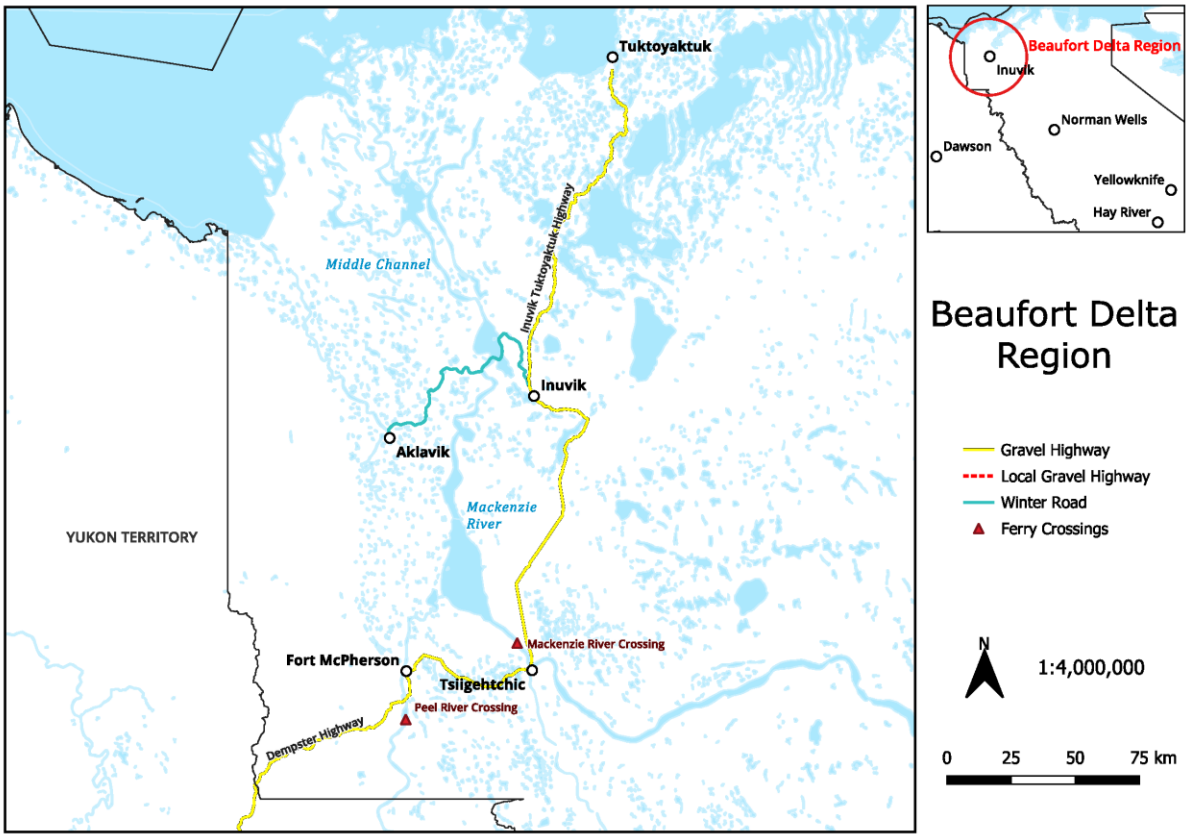
Source: Tables B-3 and B-4

Beaufort Delta Region

No road connects the Sahtu region to the Beaufort Delta region.

Highway road access to the Beaufort Delta Region from La Crete, Alberta is via the Dempster Highway from Yukon, which is connected to the Alaska Highway from northern British Columbia and the Klondike Highway between Whitehorse and Dawson City, Yukon (see Figure 1). The Dempster Highway connects to Fort McPherson, Tsiigehtchic, Inuvik and (since 2017) to Tuktoyaktuk. A winter ice road connects Inuvik to Aklavik in the east. (See Figure B-3.)

Figure B-3: Beaufort Delta Region Road Infrastructure



There are two ferry/ ice road crossings of the Dempster Highway, at Fort McPherson (Peel River) and Tsiigehtchic (Mackenzie River). Table B-2 provides summary information on five and twenty-year average open and closure dates in this region (1993-2022). Heavy equipment use of winter road/ ice roads may be more restrictive than indicated by the open and closure dates. For example, the Dempster Highway use for wood pellet deliveries for this region's GNWT buildings is typically open for heavy traffic only from mid-January to the end of March, and again from beginning of July to mid-September (even though Table B-2 notes last five-year average winter open and closure dates in early December and early May respectively). Significant issues for reliable wood pellet delivery to the Beaufort Delta region have been noted with the Dempster Highway's supply chain, including:

- Climate change effects on road infrastructure – related to increased snow and rain in winter and summer have resulted in road closures. For example: fall 2022 Dawson City mud-slide closed Dempster Highway for 2 weeks; there have also been ongoing mud slides in the Ogilvie section of this highway; increased snow fall in winter often leaves multiple trucks stranded in Whitehorse for weeks; melting permafrost under the highway can result in poor driving conditions, resulting in increased time required for deliveries and added costs.
- Climate change effects on barging availability.
- Limited supply of skilled drivers – and most experienced drivers are at capacity.
- The delivered cost of biomass to Inuvik using trucking leaves little if any margin below current fossil fuel heating costs to cover ongoing maintenance costs (which are higher for biomass than for fossil fuels).
- Deliveries for GNWT's larger volume Inuvik uses at the Inuvik school and hospital have experienced significant, critical and worsening road access disruptions over recent winter periods. During the 2022/23 heating season no biomass was able to be delivered by truck prior to winter 2023; after the winter road opened in January 2023, deliveries over the winter road were sporadic and unreliable.

Table B-2: Five-year and Twenty-year Average Open and Closure Dates for Two Roads in Beaufort Delta Region (1993-2022)

	Ice Road condition	**Aklavik Road**	**Mackenzie River Ice Crossing at Tsiigehtchic**
Last 20-year average	Open	25 – December	24 – November
	Closed	1 - April	5 – May
Last 5-year average	Open	19 – December	1 – December
	Closed	29 - March	5 – May

Source: Tables B-3 and B-4

Table B-3: Historical Winter Road Opening Dates – Beaufort Delta and Sahtu Regions (1993-2022)

	Beaufort Delta Region Ice Roads			**Sahtu Winter Roads**		
	Tuktoyaktuk	Aklavik	Mackenzie River Crossing at Tsiighetchic	Wrigley - Tulita	Tulita - Norman Wells	Norman Wells -Ft Good Hope
2021/2022	NA	20-Dec	24-Nov	23-Dec	25-Dec	22-Dec
2020/2021	NA	11-Dec	1-Dec	11-Dec	24-Dec	NA
2019/2020	NA	11-Dec	25-Nov	20-Dec	23-Dec	NA
2018/2019	NA	24-Dec	28-Nov	18-Dec	20-Dec	NA
2017/2018	NA	22-Dec	30-Nov	11-Dec	16-Dec	NA
2016/2017	8-Dec	8-Dec	9-Dec	17-Dec	17-Dec	17-Dec
2015/2016	11-Dec	11-Dec	15-Dec	18-Dec	21-Dec	21-Dec
2014/2015	3-Dec	3-Dec	2-Dec	12-Dec	20-Dec	17-Dec
2013/2014	23-Dec	23-Dec	27-Nov	19-Dec	27-Dec	28-Dec
2012/2013	3-Dec	11-Dec	28-Nov	20-Dec	16-Dec	19-Dec
2011/2012	10-Dec	7-Dec	24-Nov	20-Dec	20-Dec	20-Dec
2010/2011	22-Dec	22-Dec	22-Nov	23-Dec	23-Dec	14-Dec
2009/2010	18-Dec	21-Dec	20-Nov	23-Dec	23-Dec	23-Dec
2008/2009	18-Dec	19-Dec	17-Nov	12-Jan	23-Dec	16-Dec
2007/2008	17-Dec	19-Dec	28-Nov	21-Dec	24-Dec	8-Dec
2006/2007	5-Dec	6-Dec	24-Nov	22-Dec	20-Dec	21-Dec
2005/2006	9-Jan	13-Jan	1-Dec	19-Dec	19-Dec	29-Dec
2004/2005	7-Dec	6-Dec	12-Nov	13-Dec	4-Jan	13-Dec
2003/2004	17-Dec	23-Dec	20-Nov	19-Dec	29-Dec	19-Dec
2002/2003	17-Dec	17-Jan	21-Nov	22-Jan	22-Jan	20-Jan
2001/2002	2-Dec	31-Dec	9-Nov	20-Dec	10-Jan	11-Jan
2000/2001	20-Dec	24-Jan	20-Nov	19-Jan	15-Jan	8-Jan
1999/2000	14-Dec	17-Jan	5-Nov	3-Feb	11-Jan	24-Dec
1998/1999	16-Dec	14-Dec	20-Nov	1-Feb	31-Dec	7-Jan
1997/1998	2-Jan	26-Jan	1-Dec	6-Feb	23-Jan	14-Jan
1996/1997	20-Dec	12-Jan	19-Nov	14-Feb	14-Jan	14-Jan
1995/1996	19-Dec	19-Dec	30-Nov	26-Jan	8-Jan	8-Jan
1994/1995	22-Dec	23-Dec	25-Nov	12-Jan	18-Jan	NA
1993/1994	5-Jan	18-Jan	24-Nov	23-Dec	29-Dec	NA

Source: GNWT (2022). Infrastructure-Highways, Ferries, and Winter Roads. Winter Roads Average Open/Close Dates.

Table B-4: Historical Winter Road Closing Dates – Beaufort Delta and Sahtu Regions (1993-2022)

	Beaufort Delta Region Ice Roads			**Sahtu Winter Roads**		
	Tuktoyaktuk	Aklavik	Mackenzie River Crossing at Tsiighetchic	Wrigley - Tulita (HWY #1)	Tulita - Norman Wells (HWY #1)	Norman Wells -Ft Good Hope/K'asho Got'ine (HWY #1)
2022/2021	NA	29-Apr	5-May	28-Mar	1-Apr	1-Apr
2020/2021	NA	25-Apr	5-May	1-Apr	7-Apr	NA
2019/2020	NA	29-Apr	8-May	20-Mar	20-Mar	NA
2018/2019	NA	29-Apr	30-Apr	20-Mar	20-Mar	NA
2017/2018	NA	26-Apr	8-May	31-Mar	11-Apr	NA
2016/2017	29-Apr	24-Apr	3-May	2-Apr	2-Apr	2-Apr
2015/2016	23-Apr	24-Apr	3-May	31-Mar	31-Mar	31-Mar
2014/2015	23-Apr	23-Apr	3-May	31-Mar	31-Mar	31-Mar
2013/2014	29-Apr	29-Apr	12-May	7-Apr	14-Apr	14-Apr
2012/2013	7-May	7-May	12-May	29-Mar	2-Apr	2-Apr
2011/2012	25-Apr	25-Apr	11-May	6-Apr	2-Apr	2-Apr
2010/2011	3-May	11-May	14-May	29-Mar	29-Mar	29-Mar
2009/2010	20-Apr	20-Apr	28-Apr	31-Mar	31-Mar	31-Mar
2008/2009	26-Apr	27-Apr	4-May	5-Apr	5-Apr	5-Apr
2007/2008	24-Apr	1-May	11-May	9-Apr	9-Apr	9-Apr
2006/2007	2-May	4-May	4-May	31-Mar	9-Apr	9-Apr
2005/2006	9-May	8-May	9-May	7-Apr	7-Apr	7-Apr
2004/2005	27-Apr	25-Apr	4-May	1-Apr	1-Apr	1-Apr
2003/2004	27-Apr	26-Apr	12-Apr	16-Mar	16-Mar	31-Mar
2002/2003	26-Apr	27-Apr	13-May	18-Mar	10-Apr	10-Apr
2001/2002	2-May	2-May	9-May	18-Mar	18-Mar	18-Mar
2000/2001	9-May	8-May	9-May	15-Mar	5-Apr	31-Mar
1999/2000	17-Apr	17-Apr	5-May	15-Mar	15-Mar	15-Mar
1998/1999	20-Apr	21-Apr	20-Apr	16-Mar	16-Mar	15-Mar
1997/1998	15-Apr	16-Apr	17-May	16-Mar	13-Mar	16-Mar
1996/1997	25-Apr	25-Apr	10-May	17-Mar	17-Mar	17-Mar
1995/1996	19-Apr	26-Apr	28-Apr	20-Mar	20-Mar	20-Mar
1994/1995	24-Apr	24-Apr	2-May	19-Mar	26-Mar	NA
1993/1994	28-Apr	28-Apr	5-May	29-Mar	30-Mar	NA

Source: GNWT (2022). Infrastructure-Highways, Ferries, and Winter Roads. Winter Roads Average Open/Close Dates.

APPENDIX C: EXISTING POTENTIAL WOOD PELLET SOURCES

Table C-1 provides a list of potential sources of wood pellets for Mackenzie River communities, their capacity, and distance from Hay River (assuming the focus for the Study is potential barge delivery of wood pellets that could be loaded at Hay River). These listed plants, however, may not have pellets available on demand due to their existing contract commitments for pellet supply (including world markets).

La Crete Sawmills Ltd. has continued to be the selected source of wood pellet supply to each of the three Mackenzie River communities – including Beaufort Delta region communities where existing pellet truck deliveries must go through northern British Columbia and Yukon. These purchases by multiple parties are presumed to indicate that assessments to date have confirmed that this supply source has available wood pellets at competitive prices.

The Pinnacle Renewable Energy plant at High Level Alta. is another facility in close proximity to Hay River.

For the purpose of this Study, potential consideration of other supply options for wood pellets as such for Mackenzie River community heating is not an apparent critical factor affecting the choice to date to use truck delivery rather than barge delivery.

Table C-1: Existing Potential Wood Pellet Sources for Mackenzie River Communities

Company	Address	Capacity (Metric tons/year)	Distance to Hay River (km)
Alberta			
La Crete Sawmills Ltd	Highway 697 – 7km South of La Crete, AB, T0H 2H0	140,000	426
Northern Pellets LP (Pinnacle Renewable Energy)	9401 - 124th Avenue, T0H 1Z0 High Level	200,000	313
Vanderwell Contractors limited	44061 W. Mitsue Ind. Road Mitsue Ind. Park, Slave Lake, AB Canada, T0G 2A0	60,000	808
British Columbia			
Canfor Energy North Ltd. (Houston Pellet Limited Partnership)	Houston, BC	230,000	1,508
Chetwynd Sawmill	Chetwynd	100,000	900
Fort St. John		750,000	809
Drax-Armstrong		75,000	1,826
Drax-Burns Lake		400,000	1,428
Drax-Lavington		300,000	1,862
Drax-Meadowbank		280,000	
Drax-Princeton		90,000	1,692
Drax-Smithers		140,000	1,822
Drax-Williams Lake		240,000	1,441
Skeena Bioenergy Ltd	Highway 16 in Terrace, British Columbia	75,000	1,775
Premium Pellets Ltd	2301 Campbell Rd, Vanderhoof, BC V0J 3A0	170,000	1,302

Source: Biomass Magazine (2023). Canadian Biomass 2023 Pellet Mill Map. Accessed on July 13, 2023.

APPENDIX D: MTS INTRA-COMMUNITY SHIPPING RATES – 2023

Table D-1 provides MTS General Cargo shipping rates, and Table D-2 provides MTS Containerized Pallet shipping rates, for 2023 related to Mackenzie River communities. MTS also provides shipping rates for other specific cargoes, e.g., containers and different sized trailers.

Table D-1: MTS intra-communities shipping rates – General Cargo (2023)

	Ship To						
Ship From	**Hay River**	**Tulita**	**Norman Wells**	**Fort Good Hope**	**Inuvik**	**Aklavik**	**Tuktoyaktuk**
Hay River		324	324	388	464	492	522
Tulita	210		141	204	280	308	338
Norman Wells	210			204	280	308	338
Fort Good Hope	210				216	245	275
Inuvik	302					205	134
Aklavik	321						170
Tuktoyaktuk	339				88	111	

Source: GNWT (2023). Department of Infrastructure. Programs and services. Marine Transportation Services. 2023 Sailing schedule and final cargo acceptance dates.

Notes:

1. Taxes: All prices are exclusive of GST.
2. Rates presented are in metric: One revenue tonne will apply per metric tonne (1000 kilograms) of gross weight OR 2.5 cubic meters whichever produces the highest revenue price.
3. A fuel surcharge of 18% will be applied to all cargo items for 2023 shipments – due to increases in global fuel costs.

Table D-2: MTS intra-communities shipping rates – Containerized Pallet (2023)

	Ship To						
Ship From	**Hay River**	**Tulita**	**Norman Wells**	**Fort Good Hope**	**Inuvik**	**Aklavik**	**Tuktoyaktuk**
Hay River		348	348	413	495	551	557
Tulita	225		Call	Call	285	345	348
Norman Wells	225			Call	Call	311	Call
Fort Good Hope	270				218	311	280
Inuvik	322					311	130
Aklavik	356						Call
Tuktoyaktuk	361				85	Call	

Source: GNWT (2023) Department of Infrastructure. Programs and services. Marine Transportation Services. 2023 Sailing schedule and final cargo acceptance dates.

Notes:

1. Taxes: All prices are exclusive of GST.
2. Containerized pallet standard size is a maximum 48” long by 40” wide and 66” high, total weight does not exceed 2,000 lbs.
3. A fuel surcharge of 18% will be applied to all cargo items for 2023 shipments – due to increases in global fuel costs.

APPENDIX E: FEBRUARY 2024 WORKSHOP WITH GNWT AND MTS ON BUSINESS CASE STUDY: BARGING BIOMASS TO REMOTE NWT COMMUNITIES

On February 23, 2024, NEL and GNWT held a workshop to review key findings from the draft NEL/InterGroup report as well as subsequent reviews with GNWT and others (Brian Lickoch and FutureMetrics), and to receive further feedback from both GNWT and MTS. The PowerPoint materials used for the workshop is provided at Attachment E-1.

Participants of the workshop included individuals from GNWT:

- Benjamin Israel (Senior Coordinator – Energy, Energy Division, Department of Infrastructure),
- David Hatto (Senior Technical Officer – Mechanical, Construction Project Management Division, Department of Infrastructure),
- Tylor Bradbury (Technical Officer – Mechanical, Design & Technical Services Division, Department of Infrastructure),
- Lorne Browne (Director, Fuel Services Division, Department of Infrastructure),
- Sheena Adams (Project Manager – Energy Infrastructure, Energy Division, Department of Infrastructure), and
- Steve Hagerman (Director, Marine Transportation Services, Department of Infrastructure).

As well as:

- Grant Sullivan, President of NEL,
- Cam Osler (Chair & Principal), Mona Pollitt-Smith (Principal & Consultant), and Colin Osler (Research Analyst) of InterGroup.

The workshop consisted of two parts:

- Part 1 – Overview of Biomass Case Study (a summary of objectives, key activities, study approach, takeaways, and key findings from each region).
- Part 2 – Discussion – this was the majority of the workshop, and was focused on reviewing the success of biomass heating to date in Norman Wells and Sahtu Region, potential solutions for enhancing biomass supply chain for heating in the Beaufort Delta Region, and potential next steps and recommendations.

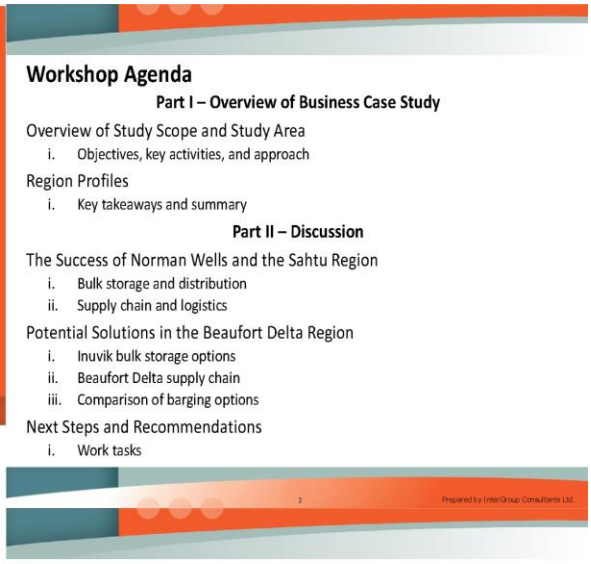
Key points from discussion included:

- Domestic supply concerns regarding the La Crete plant in Alberta were noted. Historically, the bulk of wood pellets used in the NWT has been produced by La Crete Sawmills in Alberta.
- Bulk storage options and strategies in Inuvik were discussed, with preference from GNWT towards building up a storage facility with a similar capacity to that of Norman Wells (1,380-tonnes). Other options would suggest higher storage capacity being needed for Inuvik given the much larger potential scale for biomass heating in Inuvik compared with Norman Wells.

- Barging transportation options were discussed with MTS noting a preference towards super-b trailers in a method similar to the Norman Wells model, as they offer faster offloading, higher capacity, a low rental cost, spoil pellets less often, and are overall an easier method to barge wood pellets than options with totes, containers, or other bulk storage methods.
- Discussion on barging costs and options for wood pellets was extensive, with a focus on cost determinants and methods needed for MTS to reduce costs and increase ability to adapt to wood pellet supply chain requirements. MTS noted that one of the largest factors in their high-cost and constraints in adapting to this supply chain relative to Cooper's (who has been the primary wood pellet barge supplier for Norman Wells) is their tugboat size.[41]
- As MTS uses a cost recovery model with little room to lower costs, indirect methods to reduce costs might focus on the use of a new tugboat recently acquired by MTS. The tugboat utilizes a 5-man crew, and is able to be used in a similar manner to that of Cooper's. However, it was acquired to address priorities other than wood pellet supply delivery.
- MTS also noted the presence of currently parked barges that could be used to supply the Beaufort Delta region with pellets alongside their new tugboat.
- In terms of policy, GNWT noted a commitment to make sure there are no stranded assets in the Beaufort Delta region and to realize the potential of those assets.
- The model of supplying the Beaufort Delta region by transporting pellets around Alaska was further explored during the workshop and it was concluded that there is little support or interesting in exploring it further at this time. GNWT and MTS cited various concerns regarding the idea, most notably that the depth of the Tuktoyaktuk harbour would necessitate transloading onto barges offshore of Tuktoyaktuk. Alongside cost, presence of ice in the Beaufort Sea was also a point of concern.

[41] MTS has a 13-man crew whereas Cooper's has a 4-man crew, reflecting very different tugboat sizes.

ATTACHMENT E-1: FEBRUARY 2024 WORKSHOP PRESENTATION MATERIALS



Part I – Overview of Business Case Study

Overview of Study Scope and Regions

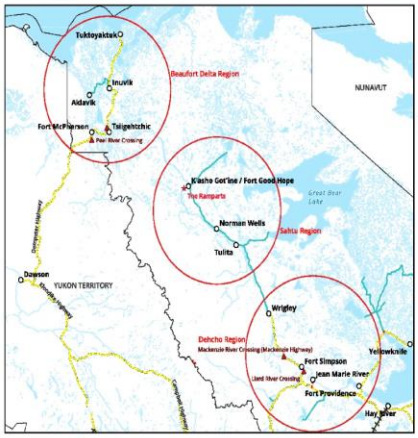
Current Study
Barging Biomass to Remote NWT Communities

Study Objective

- To outline the conditions for barge-delivered biomass as a cost-effective and cleaner alternative for heating fuel in 12 remote communities along or in the vicinity of the Mackenzie River

Key Activities to Date

- Focus on logistical requirements, costs, and comparison of existing sources to alternative sources of supplying biomass to:
  - **Beaufort Delta region**: Tuktoyaktuk, Inuvik, Aklavik, Fort McPherson, Tsiigehtchic
  - **Sahtu region**: Fort Good Hope, Norman Wells, Tulita
  - **Dehcho region**: Wrigley, Fort Simpson, Fort Providence, Jean Marie River



Beaufort Delta Region, Sahtu Region, and Dehcho Region

Overall Energy Use Across the Three Regions

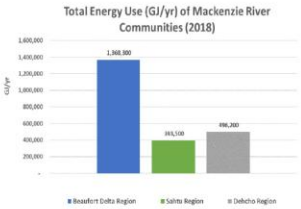
Beaufort Delta region population: 5,944

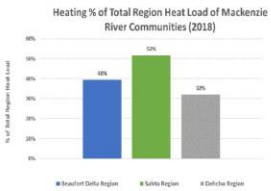
Sahtu region population: 1,875

Dehcho region population: 2,031

Key Takeaways

- Beaufort Delta region accounts for 60% of the total population of all three regions
- Heating accounted for 40% of total energy use across all three regions in 2018 – 49% of this in homes, 51% in other buildings
- Fossil fuels accounted for 89% of other building heating energy use in the 12 communities in 2018 – wood pellets used in seven communities (the other 11%)





Study Approach for 12 Mackenzie River Communities

- Focus on wood biomass option for the heating of GNWT buildings
  - Use of GNWT data for 2020 to 2023 fiscal years
  - Total heating GJ requirements to supply individual GNWT buildings
  - Current fuels used to supply this heating and costs to GNWT
  - Current biomass wood pellet use for heating
- Develop learnings from supply chain used to date to provide biomass wood pellets to GNWT buildings.

Existing Biomass Supply Chains from La Crete, Alta.

Beaufort Delta Region

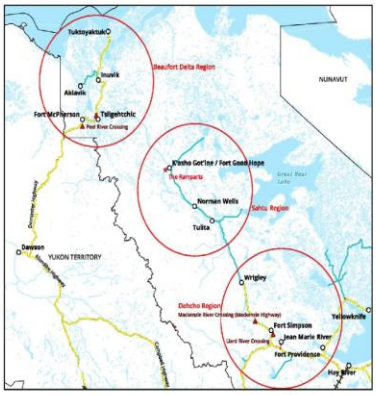
- Delivered by truck to Inuvik via Dempster Highway
- Aklavik received pellets for 2022/23 season via winter road from Inuvik

Sahtu Region

- Combination of barge and winter road delivery
- Use of super-b trailers on barge from Fort Simpson
- Established supply chain with 1300-tonnes storage in Norman Wells with delivery to Tulita and Fort Good Hope

Dehcho Region

- Delivered by truck via all-season highway



Higher Load GNWT Buildings

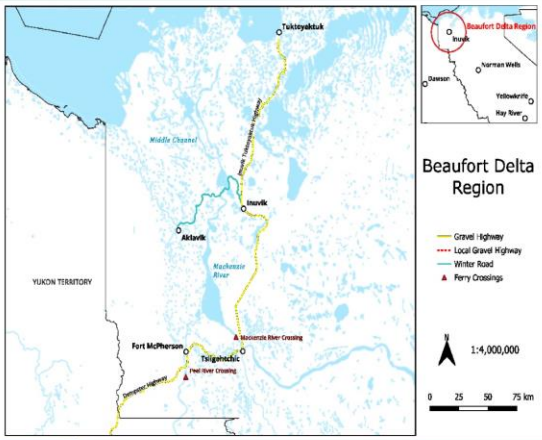
Selected Higher Load GNWT Buildings

- Exclusion of buildings under 400 GJ/yr for all fuel types and some others using heat recovery systems, federal government buildings, and some RCMP buildings
- 76.7% of region heat loads are found in 26% of buildings

Selected Higher Load GNWT Buildings* (GJ/yr)

	2020	2021	2022	2023	4-yr Average	% of Total Heat Load
Beaufort Delta Region						
Total Region	96,011	108,900	91,660	101,505	99,051	100.0%
(# buildings)	82	82	77	77		
High Load Buildings	72,325	85,194	69,550	76,897	75,991	76.7%
(# of High Load Buildings)	22	22	22	22		
(% of total buildings)	27%	27%	29%	29%		
Sahtu Region						
Total Region	35,337	34,570	38,065	33,216	35,297	100.0%
(# buildings)	39	42	39	39		
High Load Buildings	28,814	28,385	31,293	27,209	28,925	81.9%
(# of High Load Buildings)	11	11	11	11		
(% of total buildings)	28%	26%	28%	28%		
Dehcho Region						
Total Region	30,932	33,413	32,610	32,216	32,293	100.0%
(# buildings)	53	59	56	55		
High Load Buildings	21,555	23,455	23,406	23,368	22,946	71.1%
(# of High Load Buildings)	12	12	12	12		
(% of total buildings)	23%	20%	21%	22%		
Total All Regions	162,280	176,884	162,336	166,936	166,641	100.0%
(# buildings)	174	183	172	171		
High Load Buildings	122,694	137,034	124,249	127,475	127,863	76.7%
(# of High Load Buildings)	45	45	45	45		
(% of total buildings)	26%	25%	26%	26%		

Beaufort Delta Region



GNWT Buildings with Biomass Use 2020-2023 (GJ/yr) – Beaufort Delta Region

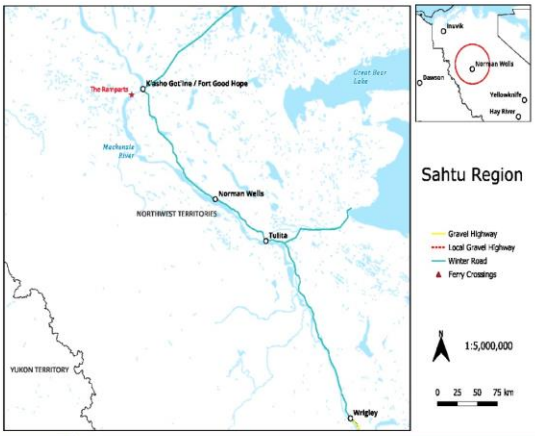
Key Takeaways

- Biomass use occurred in two buildings until 2022, with Moose Kerr School added in 2023
- In 2023, biomass supplied 42.9% (18,785 GJs) of the overall heat load in 3 GNWT buildings using biomass
- Average biomass share of heat load for **all GNWT buildings** in region: 16.5% (16,394 GJs)
- Average biomass share of heat load for **GNWT buildings using biomass**: 40.0% (16,624 GJs)

	Wood Pellet Volume (GJ) and Share of Building Heat Load				4-yr
	2020	2021	2022	2023	Average
Inuvik Buildings					
Inuvik Regional Hospital	861	13,015	8,121	11,161	8,424
	3.6%	*47.6%*	*49.3%*	*35.8%*	*34.0%*
Inuvik Schools	6,416	11,563	6,818	5,749	7,636
	52.1%	*80.6%*	*64.3%*	*71.3%*	*67.5%*
Aklavik Buildings					
Moose Kerr School	0	0	0	1,874	435
	0.0%	*0.0%*	*0.0%*	*41.5%*	*9.6%*

Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

Sahtu Region



GNWT Buildings with Biomass Use 2020-2023 (GJ/yr) – Sahtu Region

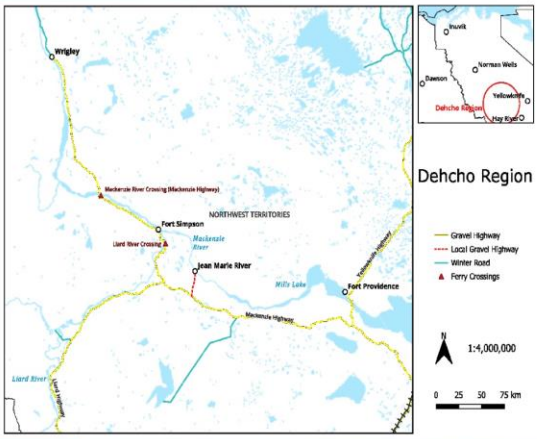
Key Takeaways

- Biomass use in the Sahtu region is significant
- In 2023, biomass supplied 68.4% (17,592 GJs) of the overall heat load in 8 GNWT buildings using biomass
- Average biomass share of heat load for **all GNWT buildings** in region: 52.1% (18,387 GJs)
- Average biomass share of heat load for **GNWT buildings using biomass**: 67.7% (18,439 GJs)

	Wood Pellet Volume (GJ) and Share of Building Heat Load				4-yr
	2020	2021	2022	2023	Average
Norman Wells Buildings					
Airport Maintenance Garage	1,793	1,748	1,944	1,425	1,741
	77.4%	*100.0%*	*55.2%*	*100.0%*	*81.9%*
Airport Terminal Building	2,359	2,490	2,466	1,957	2,331
	80.1%	*82.2%*	*85.1%*	*84.8%*	*83.0%*
Mackenzie Mountain School	2,461	2,782	2,729	2,378	2,585
	87.3%	*93.6%*	*89.1%*	*77.5%*	*87.1%*
Norman Wells Health Centre and LTC	7,063	8,106	7,073	7,503	7,422
	61.4%	*74.5%*	*61.3%*	*73.1%*	*67.2%*
Norman Wells Shop	845	731	924	644	794
	90.3%	*82.3%*	*94.5%*	*95.7%*	*90.7%*
Fort Good Hope Buildings					
Fort Good Hope School	0	2,012	1,614	1,647	1,354
	0.0%	*58.9%*	*46.1%*	*40.3%*	*37.3%*
Tulita Buildings					
ENR District Office Tulita	690	261	275	283	378
	82.7%	*86.5%*	*63.7%*	*63.7%*	*73.7%*
New Chief Albert Wright School	1,948	1,974	1,764	1,756	1,861
	58.9%	*63.1%*	*49.9%*	*51.1%*	*55.5%*

Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

Dehcho Region



Key Takeaways

- Lowest usage of biomass across all three regions, despite being the closest to a road network and having the lowest landed costs
- In 2023, biomass supplied 34.4% (4,659 GJs) of the overall heat load in 3 GNWT buildings using biomass
- Average biomass share of heat load for **all GNWT buildings** in region: 14.6% (4,731 GJs)
- Average biomass share of heat load for **GNWT buildings using biomass**: 37.9% (4,731 GJs)

GNWT Buildings with Biomass Use 2020-2023 (GJ/yr) – Dehcho Region

	Wood Pellet Volume (Gj) and Share of Building Heat Load				4-yr
	2020	2021	2022	2023	Average
Fort Providence Buildings					
Deh Gah School	1,386	1,939	1,623	2,120	1,787
	60.5%	76.2%	71.1%	64.6%	68.2%
Fort Providence New Health Centre	119	136	159	459	228
	24.5%	18.5%	27.4%	51.3%	31.2%
Fort Simpson Buildings					
Central Heating Steam Plant	891	4,965	2,836	2,080	2,738
	12.6%	53.4%	28.1%	22.2%	29.6%

Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

Summary

Barging Biomass to Remote NWT Communities Key Findings

Beaufort Delta Region

- Highest potential for biomass usage
- Demand for biomass is already present, supply must follow
- A bulk storage solution and reliable supply chain are both needed to utilize installed infrastructure

Sahtu Region

- Significant biomass usage and infrastructure due to success in logistics and distribution

Dehcho Region

- Lowest potential for biomass barging due to proximity to and reliance on an established road network

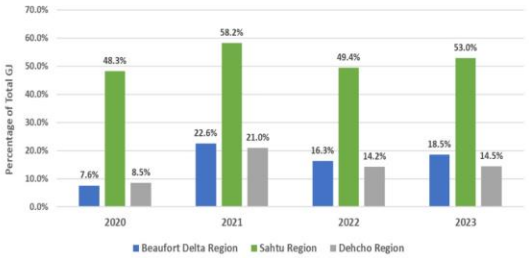
GNWT Buildings (GJ/yr)

	2020	2021	2022	2023	4-yr Average
Beaufort Delta Region					
Total Region	96,011	108,900	91,660	101,505	99,051
(# buildings)	*82*	*82*	*77*	*77*	
Total Biomass	7,277	24,578	14,938	18,785	16,394
(# buildings)	*2*	*2*	*2*	*3*	
Sahtu Region					
Total Region	35,337	34,570	38,065	33,216	35,297
(# buildings)	*39*	*42*	*39*	*39*	
Wood Pellets	17,059	20,105	18,790	17,592	18,387
(# buildings)	*7*	*8*	*8*	*8*	
Dehcho Region					
Total Region	30,932	33,413	32,610	32,216	32,293
(# buildings)	*53*	*59*	*56*	*55*	
Wood Pellets	2,628	7,019	4,618	4,659	4,731
(# buildings)	*3*	*3*	*3*	*3*	
Total All Regions					
Total	162,280	176,884	162,336	166,936	166,641
(# buildings)	*174*	*183*	*172*	*171*	
Wood Pellets	26,964	51,702	38,346	41,036	39,512
(# buildings)	*12*	*13*	*13*	*14*	

Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

21 Prepared by InterGroup Consultants Ltd.

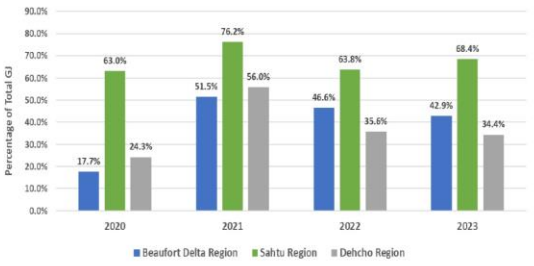
Average GNWT Building Heating Load to Wood Pellets, by Region – All GNWT Buildings (2020-23)



Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

22 Prepared by InterGroup Consultants Ltd.

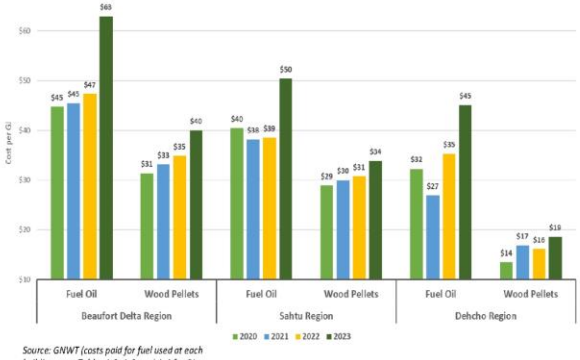
Average GNWT Building Heating Load to Wood Pellets, by Region – Wood Pellet Buildings (2020-23)



Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (La Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

23 Prepared by InterGroup Consultants Ltd.

Mackenzie River Communities Landed Fuel Oil and Wood Pellet Costs – All GNWT Buildings 2020-2023 (Average $/GJ)



Source: GNWT (costs paid for fuel used at each building – see Tables A-2, A-3, and A-4 for GJ per year for each building)

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Part II – Discussion

Items for discussion

The Success of Norman Wells and the Sahtu Region

i. Bulk storage and distribution
ii. Supply chain and logistics
iii. Lessons learned

Potential Solutions in the Beaufort Delta Region

i. Biomass potential
ii. Inuvik bulk storage options
iii. Beaufort Delta supply chain
iv. Comparison of barging options

Next Steps and Recommendations

i. Business Case Study
ii. Beaufort Delta Solutions
iii. West coast barging

The Success of Norman Wells and the Sahtu Region

Sahtu Region

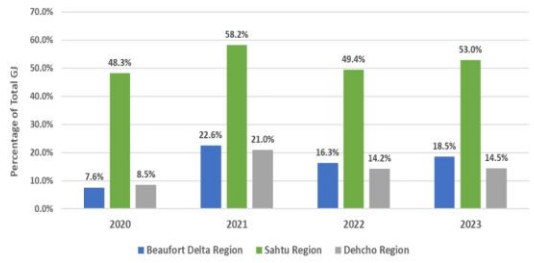
Bulk storage and distribution

- Norman Wells possesses a storage with a maximum capacity of roughly 1300-tonnnes, consisting of 13 silos and three trucks
- Biomass is distributed from Norman Wells to Fort Good Hope and Tulita once annually, using hopper-bottom grain trailers to silos at participating GNWT buildings

Supply chain and logistics – Cooper's Barging Services from Ft. Simpson

- Biomass is sourced from La Crete, Alta. and trucked to Fort Simpson
- Cooper's Barging Services plays a central role in the Sahtu region's supply chain
- Majority of supply arrives during the summer using barges full of super-b trailers
- In Norman Wells, a dedicated truck then hauls the trailers off the barge and unloads wood pellets at the silo storage facility
- The empty super-b trailers are barged back to Fort Simpson, and the process repeats until the end of barging season
- In the winter, a smaller portion of the region's annual wood pellets are delivered by tridem trailer via winter-road

Average GNWT Building Heating Load to Wood Pellets, by Region – All GNWT Buildings (2020-23)



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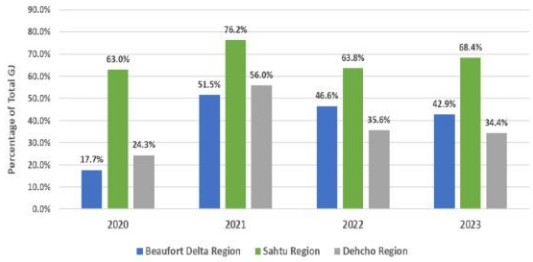
Average GNWT Building Heating Load to Wood Pellets, by Region – Wood Pellet Buildings (2020-23)



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GNWT data are for fiscal years 2019/20 to 2022/23.

Potential Solutions in the Beaufort Delta Region

Higher Load GNWT Buildings

All GNWT Buildings

- Sahtu region had the highest wood pellet share of region heat load with a four-year average of 52.1%
- The other two regions' four-year average for wood pellet share of region heat load did not reach above 17%

Selected Higher Load GNWT Buildings

- Exclusion of buildings under 400 GJ/yr for all fuel types and some others using heat recovery systems, federal government buildings, and some RCMP buildings
- 76.7% of region heat loads are found in 26% of buildings

Selected Higher Load GNWT Buildings* (GJ/yr)

	2020	2021	2022	2023	4-yr Average	% of Total Heat Load
Beaufort Delta Region						
Total Region	96,011	108,900	91,660	101,505	99,051	100.0%
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(# of High Load Buildings)	12	12	12	12		
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Total All Regions	162,280	176,884	162,336	166,936	166,641	100.0%
(# buildings)	174	183	172	171		
High Load Buildings	122,694	137,034	124,249	127,475	127,863	76.7%
(# of High Load Buildings)	45	45	45	45		
(% of total buildings)	26%	25%	26%	26%		

Inuvik Bulk Storage Options

Context

- Storage and transport issues must be solved in tandem, not as a sequence
- Inuvik needs bulk storage to utilize the infrastructure and demand in place for the Beaufort Delta region
- Norman Wells has built up storage over three phases, 500-tonnes followed by another 500-tonnes, then an additional 300-tonnes later

Storage options for Inuvik

- Bulk silo storage (1000-2000 tonnes)
- Flat storage (covered warehouse)
- Long-term supply (1-year, 2-years worth of wood pellets)

Beaufort Delta Supply Chain

Gaps and Deficiencies

- Biomass is delivered by truck via the Dempster Highway, a much longer haul distance than required for the other two regions
- The Dempster Highway has its own difficulties and is not a reliable delivery route
- High cost of barging compared to the other two regions
- Barging distance from Hay River and potential for low-water years is a major concern (Ramparts)

MTS and Cooper's Barging Services

- For the Sahtu region, Cooper's Barging Services has been preferred due to cost, flexibility, and scheduling
- Cooper's Barging Services may be closing business next year
- Ability to secure barging services costs and scheduling needed for effective Beaufort Delta supply chain

Comparison of Barging Options

On-barge options

- Tote vs. bulk shipment (one-tonne tote vs. super-b trailer)
- Loading and unloading options for one-tonne tote vs. super-b trailer

Barge options

- Dedicated vs. non-dedicated barge (storage vs. unload on arrival)
- Dedicated barge: winter storage on barge at destination
- Use of multiple barges to enable swapping (upon early summer delivery, use empty barge to return to loading location for next year)

Other considerations

- Options to mitigate low water risks in summer/ high water risks in spring
- Options to reduce costs for return of empty barges
- Docking capacity at selected locations
- Safe place availability if use of winter storage on barge

Next Steps and Recommendations

Work Tasks

Business Case Study

- Update draft report for GNWT and NEL by mid-March
- Finalize the Barging Biomass to Remote NWT Communities report by March 31

Beaufort Delta Solutions

- Look into bulk-storage systems for Inuvik and associated costs
- Explore any potential opportunities for alternative shipping methods to the region
- Assess Inuvik regional storage as basis for distribution hub in the Beaufort Delta

West Coast Barging

- Gather more information on the feasibility of shipping biomass up the west coast and around Alaska
- Fuel Service Division and their experience last year (Washington state to Tuktoyaktuk, transloading onto MTS barges)

Thank you!

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Appendices

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Appendix A: Mackenzie River Communities – Population, Total Energy and Heating Energy Use

	Population[1]	Total Energy[2] GJ/yr	Total-All Heating		Heating Energy (2018, GJ/yr)[3] Homes					Other Buildings			
			GJ/yr	% of Total Energy	Heating Oil	Natural Gas	Propane	Firewood	Wood Pellets	Heating Oil	Natural Gas	Propane	Wood Pellets
Beaufort Delta Region													
Tuktoyaktuk	1,058	151,800	70,060	46%	22,780			2,900		44,220		160	
Inuvik	3,214	872,100	346,780	40%	-	161,000	-	14,700	2,400	84,500	69,000	6,080	9,120
Aklavik	708	99,500	50,310	51%	21,528			3,510		25,272			
Ft. McPherson	759	217,000	62,000	29%	24,748			3,670		29,052			4,530
Tsiigehtchic	205	27,900	12,970	46%	5,031			1,270		6,669			
Total Region	5,944	1,368,300	542,120	40%	74,087	161,000	-	26,050	2,400	189,713	69,000	6,220	13,650
% of Heating					14%	30%	0%	5%	0%	35%	13%	1%	3%
Sahtu Region													
Fort Good Hope	628	89,100	37,850	42%	13,865			6,870		15,635			1,480
Norman Wells	704	218,600	126,263	58%	44,086			5,320	1,480	49,734		363	25,300
Tulita	543	85,800	39,660	46%	17,420			4,140		16,080			2,020
Total Region	1,875	393,500	203,773	52%	75,371	-	-	16,330	1,480	81,429	-	363	28,800
% of Heating					37%	0%	0%	8%	1%	40%	0%	0%	14%
Dehcho Region													
Wrigley	126	24,800	8,747	35%	2,322			1,380		4,508		537	
Ft. Simpson	1,100	289,900	99,210	34%	35,672		6,672	9,680	2,420	37,128		1,668	5,970
Jean Marie River	94	11,100	4,102	37%	1,204			984		1,806		108	
Ft. Providence	711	170,400	47,508	28%	22,425		3,250	4,280	518	10,075		3,250	3,710
Total Region	2,031	496,200	159,567	32%	61,623	-	9,922	16,324	2,938	53,517	-	5,563	9,680
% of Heating					39%	0%	6%	10%	2%	34%	0%	3%	6%
Total All Communities	9,850	2,258,000	905,460	40%	211,081	161,000	9,922	58,704	6,818	324,659	69,000	12,146	52,130
% of Heating					23%	18%	1%	6%	1%	36%	8%	1%	6%

Notes
1 2022 populations - Northwest Territories Bureau of Statistics (2022)
2 2018 - Arctic Energy Alliance (AEA) - Community Energy Profiles 2018 - Total all energy sources for all community uses.
3 2018 - Arctic Energy Alliance (AEA) - Community Energy Profiles 2018 - Heating Uses by Energy Resource

Appendix B: Mackenzie River Communities GNWT Buildings with Wood Pellets – Landed Fuel Costs 2020-2023 ($/GJ)

Beaufort Delta GNWT Buildings with Wood Pellets ($/GJ)	2020	2021	2022	2023
Inuvik				
Inuvik Regional Hospital				
Fuel Oil	$45.2	$48.1	$49.0	$64.8
Nat.gas	$35.3	$35.4	$35.4	$35.4
Wood Pellets	$31.4	$33.2	$35.4	$39.2
Inuvik Schools				
Propane	$56.7	$56.7	$59.4	$62.5
Wood Pellets	$31.4	$33.1	$34.2	$39.6
Aklavik				
Moose Kerr School				
Fuel Oil				$62.6
Wood Pellets				$46.2
Total Region (All GNWT Buildings)				
Fuel oil	$44.8	$45.5	$47.3	$63.0
Nat. gas	$34.9	$35.0	$35.4	$35.5
Propane	$56.7	$56.7	$59.4	$62.5
Wood Pellets	$31.4	$33.1	$34.9	$40.0

Sahtu Region GNWT Buildings with Wood Pellets ($/GJ)	2020	2021	2022	2023
Norman Wells				
Airport Maintenance Garage				
Propane	$34.4		$54.3	
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Airport Terminal Building				
Fuel Oil	$38.8	$34.4	$40.1	$50.3
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Mackenzie Mountain School				
Fuel Oil	$39.0	$33.7	$39.6	$52.8
Wood Pellets	$30.0	$30.0	$30.8	$33.8
Norman Wells Health Centre and LTC				
Fuel Oil	$37.3	$33.4	$40.5	$53.4
Wood Pellets	$30.0	$30.0	$30.8	$33.4
Norman Wells Shop				
Fuel Oil	$39.9	$32.7	$39.6	$61.5
Wood Pellets	$30.0	$30.0	$30.6	$33.8
Fort Good Hope/ K'asho Got'ine				
Fort Good Hope School				
Fuel Oil	0	$43.4	$38.2	$51.2
Wood Pellets	0	$30.0	$30.8	$33.8
Tulita				
ENR District Office Tulita				
Fuel Oil	$40.8	$40.0	$34.5	$44.3
Wood Pellets	$35.3	$30.0	$30.8	$39.0
New Chief Albert Wright School				
Fuel Oil	$40.8	$39.6	$34.5	$46.9
Wood Pellets	$29.0	$30.0	$30.8	$33.8
Total Region (All GNWT Buildings)				
Fuel oil	$40.5	$38.2	$38.5	$50.4
Propane	$34.4 -		$54.3 -	
Wood Pellets	$30.1	$30.0	$30.8	$33.8

Dehcho Region GNWT Buildings with Wood Pellets ($/GJ)	2020	2021	2022	2023
Fort Providence				
Deh Gah School				
Fuel Oil	$35.9	$27.4	$37.9	$53.4
Wood Pellets	$14.3	$14.1	$14.3	$16.4
Fort Providence New Health Centre				
Fuel Oil	$34.7	$28.3	$37.6	$51.6
Wood Pellets	$14.3	$14.3	$14.3	$16.4
Fort Simpson				
Control Heating Steam Plant				
Fuel Oil	$31.1	$24.7	$35.3	$43.4
Wood Pellets	$12.3	$18.0	$17.3	$21.4
Total Region (All GNWT Buildings)				
Fuel oil	$32.3	$26.9	$35.3	$45.1
Wood Pellets	$13.5	$16.9	$16.1	$18.6

Source: GNWT (costs paid for fuel used at each building – see Tables A-2, A-3, and A-4 for GJ per year for each building)

Appendix C: GNWT Heat Energy Use 2020-2023 (GJ/yr) – All Mackenzie River Communities

	All GNWT Buildings (GJ/yr) 2020	2021	2022	2023	4-yr Average
Beaufort Delta Region					
Inuvik	73,739	78,932	66,893	78,994	74,582
Aklavik	9,373	13,676	9,371	8,949	9,111
Tuktoyaktuk	5,977	6,963	5,897	6,673	6,128
Tsiigehtchic	3,008	3,766	2,691	2,955	2,955
Ft. McPherson	3,922	9,473	6,999	4,882	6,294
Total Region	**96,011**	**108,900**	**91,660**	**101,505**	**99,051**
Wood Pellets	*7,277*	*24,578*	*14,930*	*18,785*	*16,394*
Wood Pellets %	*7.6%*	*22.6%*	*16.3%*	*18.5%*	*16.5%*
(# buildings)	*82*	*82*	*77*	*77*	*80*
Sahtu Region					
Norman Wells	22,834	21,991	24,406	19,928	22,290
Fort Good Hope	6,186	6,886	6,999	6,910	6,738
Tulita	6,317	5,684	6,688	6,377	6,269
Total Region	**35,337**	**34,570**	**38,065**	**33,215**	**35,297**
Wood Pellets	*17,059*	*20,105*	*18,790*	*17,592*	*18,387*
Wood Pellets %	*48.3%*	*58.2%*	*49.4%*	*53.0%*	*52.1%*
(# buildings)	*39*	*42*	*39*	*39*	*40*
Dehcho Region					
Fort Providence	8,978	7,985	7,493	8,580	7,684
Fort Simpson	21,474	23,298	22,448	21,186	22,100
Wrigley	2,397	2,232	2,299	2,238	2,267
Jean Marie River	174	286	378	212	242
Total Region	**30,932**	**33,453**	**32,620**	**32,216**	**32,293**
Wood Pellets	*2,628*	*7,019*	*4,618*	*4,669*	*4,733*
Wood Pellets %	*8.5%*	*21.0%*	*14.2%*	*14.5%*	*14.6%*
(# buildings)	*53*	*59*	*56*	*55*	*56*
Total All Regions	**162,280**	**176,884**	**162,345**	**166,936**	**166,641**
Wood Pellets	*26,964*	*51,702*	*38,346*	*41,036*	*39,512*
Wood Pellets %	*16.6%*	*29.2%*	*23.6%*	*24.6%*	*23.7%*
(# buildings)	*174*	*183*	*172*	*171*	*175*

Source: GNWT
Assumed fuel densities: Fuel oil 0.03673 GJ/litre; Propane 0.02559 GJ/litre; Wood Pellets 19.5 GJ/tonne (ta Crete).
GNWT data are for fiscal years 2019/20 to 2022/23.

	Selected Higher Load GNWT Buildings* (GJ/yr) 2020	2021	2022	2023	4-yr Average	% of All Buildings
Beaufort Delta Region						
Inuvik	58,108	65,457	52,478	63,258	59,824	80.2%
Aklavik	7,909	8,543	7,112	4,882	6,862	75.3%
Tuktoyaktuk	3,859	3,346	3,767	4,519	3,873	63.2%
Tsiigehtchic	744	1,019	1,209	934	952	33.6%
Ft. McPherson	2,549	6,828	4,984	3,244	4,401	69.9%
Total Region	**72,325**	**85,194**	**69,550**	**76,837**	**75,991**	**76.7%**
Wood Pellets	*7,277*	*24,578*	*14,930*	*18,785*	*16,394*	*100.0%*
Wood Pellets %	*10.1%*	*28.8%*	*21.5%*	*24.4%*	*21.6%*	
(# buildings)	*22*	*22*	*22*	*22*	*22*	*27.7%*
Sahtu Region						
Norman Wells	20,526	19,525	21,959	17,742	19,946	89.5%
Fort Good Hope	3,297	4,481	4,356	4,711	4,211	62.5%
Tulita	4,991	4,389	4,947	4,756	4,768	76.1%
Total Region	**28,814**	**28,395**	**31,293**	**27,209**	**28,925**	**81.9%**
Wood Pellets	*17,059*	*20,105*	*18,790*	*17,592*	*18,387*	*100.0%*
Wood Pellets %	*59.2%*	*70.8%*	*60.0%*	*64.7%*	*63.6%*	
(# buildings)	*11*	*11*	*11*	*11*	*11*	*27.5%*
Dehcho Region						
Fort Providence	4,447	5,044	5,003	6,364	5,214	67.9%
Fort Simpson	15,159	16,561	16,618	15,432	15,942	72.1%
Wrigley	1,959	1,850	1,786	1,573	1,790	79.0%
Jean Marie River						
Total Region	**21,555**	**23,455**	**23,406**	**23,369**	**22,946**	**71.1%**
Wood Pellets	*2,397*	*7,019*	*4,618*	*4,669*	*4,673*	*98.8%*
Wood Pellets %	*11.1%*	*29.9%*	*19.7%*	*19.9%*	*20.4%*	
(# buildings)	*12*	*12*	*12*	*12*	*12*	*21.5%*
Total All Regions	**122,694**	**137,044**	**124,249**	**127,475**	**127,353**	**76.7%**
Wood Pellets	*26,733*	*52,702*	*38,346*	*41,036*	*39,454*	*99.9%*
Wood Pellets %	*21.8%*	*37.7%*	*30.9%*	*32.2%*	*30.9%*	
(# buildings)	*45*	*45*	*45*	*45*	*45*	*25.7%*

Source: GNWT
** Includes total for all GNWT buildings excluding buildings with heat loads under about 400 GJ/yr and some other buildings, e.g., building using heat recovery, some buildings with federal government use , e.g., some RCMP facilities.*

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