Community Energy Analysis

Sucker River

Contents

Purpose

This document details how the community's current energy use and projected outcomes of community energy actions were determined.

It summarizes key data sources, the logic of key assumptions used for analysis, and the results of the analyses completed as part of the Community Energy Planning process. These results were used to help prioritize actions in the implementation plan, as outlined in Sucker River's Community Energy Plan. Based on the implementation plan, the analysis is also being used to estimate Business-As-Recommended projections for the community to compare with the current trajectory of Business-As-Usual.

Data Sources

The following section highlights data and assumptions used for modelling and assessment activities.

Population

Table 1 highlights the population of Sucker River between 2015 and 2022. This data was used to project future energy usage and greenhouse gas (GHG) emissions. The population projections were calculated from the average growth from 2015 to 2022 and estimated to be 0.7% annually.

Table 1: Population of Sucker River, 2015–2022

Year	Population
2015	434
2016	415
2017	425
2018	447
2019	432
2020	442
2021	447
2022	456

Energy Units and Conversions

Table 2 includes the standard units of energy sources in the report and the equivalent of the common units in gigajoules (GJ).

Table 2: Energy Sources, Common Units, and Energy Equivalents (GJ)

Energy Source	Common Unit	Energy Equivalent (GJ)[1]
Electricity	1.0 kWh	0.0036 GJ
Natural Gas	1.0 m^3	0.0399 GJ
Propane	1.0 L	0.0255 GJ
Wood	1.0 kg	0.0180 GJ
Gasoline	1.0 L	0.003466 GJ

GHG Emissions Factors

Table 3 highlights the GHG emission factors used to calculate the tonnes of carbon dioxide equivalent (tCO_2e) associated with each energy source. In cases where the tCO_2e equivalent was unavailable, the equivalent CO_2 of methane (CH_4) and nitrous oxide (N_2O) was calculated using global warming potential (GWP) values of 25 and 298, respectively. The emissions factor associated with SaskPower's electricity grid varied annually based on the mixture of fuel sources (e.g., natural gas, coal, hydro) used to generate electricity yearly and is reported in SaskPower's Annual Report.

[1] Canada Energy Regulator. (2016). Energy conversion tables. Retrieved from: https://apps.cer-rec.gc.ca/Conversion/conversion-tables.aspx; SaskEnergy. (2023). Residential Rates. Retrieved from: https://www.saskenergy.com/manage-account/rates/residential-rates; Province of British Columbia. (2013). Conversion Factors for Fuel. Ministry of Finance Tax Information Sheet. Retrieved from: https://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/conversion-factors-by-fuel.pdf; Province of British Columbia. (2020). Best Practices Methodology for Quantifying Greenhouse Gas Emissions. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2020-pso-methodology.pdf

Table 3: Greenhouse Gas (GHG) Emission Factors Associated with Energy Sources, 2018–2022

Energy Source	Unit	Equivalent to (tCO_2e)	Sources
Electricity	1.0 kWh	0.000695 – 0.000561	SaskPower[2]
Natural Gas	1.0 m^3	0.001931	ECCC[3]
Propane	1.0 L	0.001548	
Wood	1.0 kg	0.001897	
Gasoline	1.0 L	0.002315	

Previous SaskPower annual reports have also provided projected emissions factors for 2027 and 2028. Using these projections and the assumption that emissions will reduce to zero by 2050 (as announced by SaskPower by in August 2023),[4] emissions were estimated from 2023–2049 using simple interpolation. **Table 4** highlights the forecasted gradual reduction in GHG emissions associated with SaskPower's electricity between 2025 and 2050 in five-year increments.

Table 4: Forecasted Emissions Factors for SaskPower, 2025–2050

Year	Forecasted Emissions Factor (tCO_2e/kWh)
2025	0.000498159
2030	0.000395743
2035	0.000296807
2040	0.000197872
2045	0.000098936
2050	0

The emissions factors for natural gas, propane, and wood are assumed to remain constant between 2025 and 2050.

[2] https://www.saskpower.com/about-us/our-company/current-reports/past-annual-reports
[3] Environment and Climate Change Canada (ECCC). Retrieved from: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system/emission-factors-reference-values.html
[4] Dayal, P. (2023, August 16). Sask. premier says federal net-zero electricity targets would double power rates, experts dispute that. CBC News. Retrieved from: https://www.cbc.ca/news/canada/saskatoon/experts-say-net-zero-electricity-targets-are-possible-in-sask-1.6937188

Energy Costs

Table 5 highlights the energy costs by unit used in the report between 2018 and 2023. The energy costs for electricity, natural gas, and propane were based on data from energy providers. Assumptions were made about the price and quantity of wood deliveries based on information provided by Lac La Ronge Indian Band (LLRIB). Gasoline data was based on the average price of regular unleaded gasoline at self-service filling stations in Saskatoon and Regina in 2023.

Table 5: Costs by Energy Source, 2018–2022

Year	Electricity ($/kWh)	Natural Gas ($/m^3)	Propane ($/L)	Wood ($/kg)	Gasoline ($/L)
2018	$0.16	$0.23	$0.41	$0.22	-
2019	$0.16	$0.21	$0.42	$0.23	-
2020	$0.17	$0.20	$0.45	$0.23	-
2021	$0.17	$0.20	$0.50	$0.24	-
2022	$0.17	$0.23	$0.60	$0.25	-
2023	-	-	-	-	$1.53
Source	SaskPower	SaskEnergy	Super Propane; Co-op Propane	LLRIB	Statistics Canada[5]

[5] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101&pickMembers%5B0%5D=2.2&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2023&cubeTimeFrame.endMonth=12&cubeTimeFrame.endYear=2023&referencePeriods=20230101%2C20231201

Table 6 highlights the projected annual cost increase for each energy source. For electricity and natural gas, projected increases stated by SaskPower and SaskEnergy were used. For propane, wood, and gasoline, future costs were projected based on assumptions about future inflation and the Federal Carbon Tax, given historical increases and how inflation and the carbon tax have impacted increases so far.

Table 6: Projected Annual Cost Increase for Energy Sources

Energy Source	Projected Annual Cost Increase	Rationale
Electricity	2.6%	Calculated based on inflation and assuming the carbon tax will decrease over time as the grid emissions intensity improves
Natural Gas	7%	Projected increase from SaskEnergy[6]
Propane	~3%	Calculated based on Carbon Tax[7] increases to 2030 and inflation from 2031 onward
Wood	3%	Calculated based on inflation
Gasoline	3%	Calculated based on the average cost from 2023 for Saskatoon and Regina,[8] increasing annually based on inflation

[6] https://www.saskenergy.com/manage-account/federal-carbon-tax#:~:text=April%202022%20%E2%86%92%20%2450%20per%20tonne%20(%240.0979%20per%20cubic%20metre)

[7] https://www.canada.ca/en/department-finance/news/2021/12/fuel-charge-rates-for-listed-provinces-and-territories-for-2023-to-2030.html

[8] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000101&pickMembers%5B0%5D=2.2&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2023&cubeTimeFrame.endMonth=12&cubeTimeFrame.endYear=2023&referencePeriods=20230101%2C20231201

Baseline Energy and Business as Usual Forecast

Baseline Energy

The following section summarizes Sucker River's baseline energy usage, greenhouse gas emissions, and energy costs from 2018 to 2022. **Table 7** provides the sources of data used for this analysis and any notes.

Table 7: Sources for Data Used in Baseline and Energy Forecast

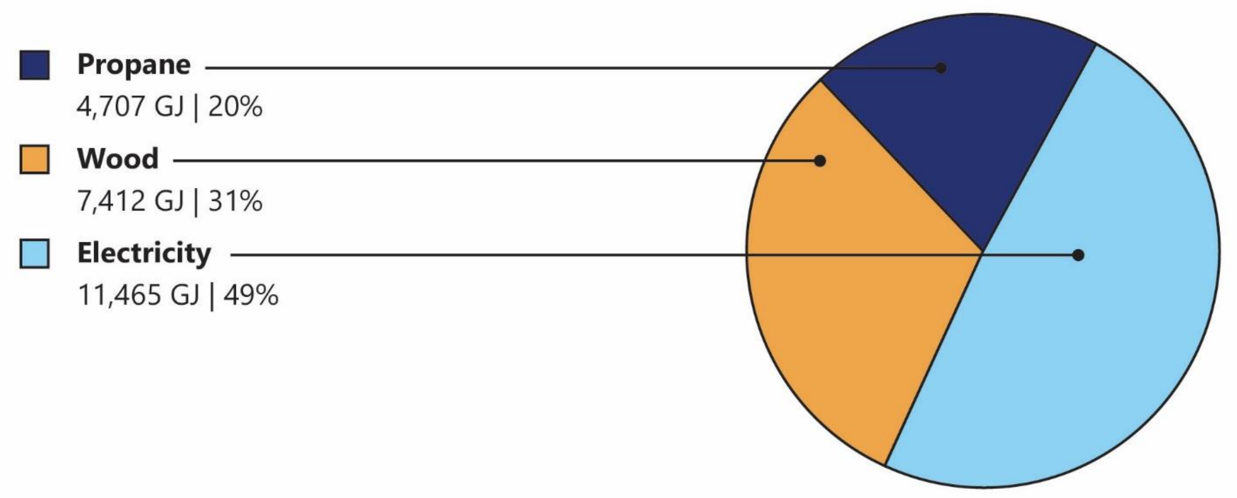
Fuel type	Data	Years	Source	Units	Notes
Electricity	Annual electricity bills for all serviced on-reserve buildings	2018–2022	SaskPower – requested by LLRIB	Kilowatt-hours (kWh) per year, Dollars ($) per year	Building-specific, scrubbed of identifiers
Propane	Annual Propane bills for all serviced on-reserve buildings	2018–2022	Co-op Propane – requested by LLRIB	Litres (L) per year Dollars ($) per year	Compiled for all accounts across all communities, grouped by residential and commercial
Wood	Annual wood bills for all band-serviced on-reserve buildings	2022	LLRIB	Dollars ($) per year	Building-specific, no weights of wood

It should be noted that while electricity, natural gas, and propane usage data was provided for every year between 2018 and 2022, wood data was only provided for 2022.

Energy Use

Figure 1 below depicts Sucker River's average annual energy usage from 2018 to 2022 by energy source. For each energy type, the average only includes years where complete data was provided. Electricity accounts for nearly half (49%) of the community's energy usage, at over 11,000 gigajoules (GJ) annually. Wood is responsible for another 31% of energy usage, followed by propane (20%).

Figure 1: Average Annual Energy Consumption by Energy Source, Based on Energy Bills from 2018–2022 (GJ, %)

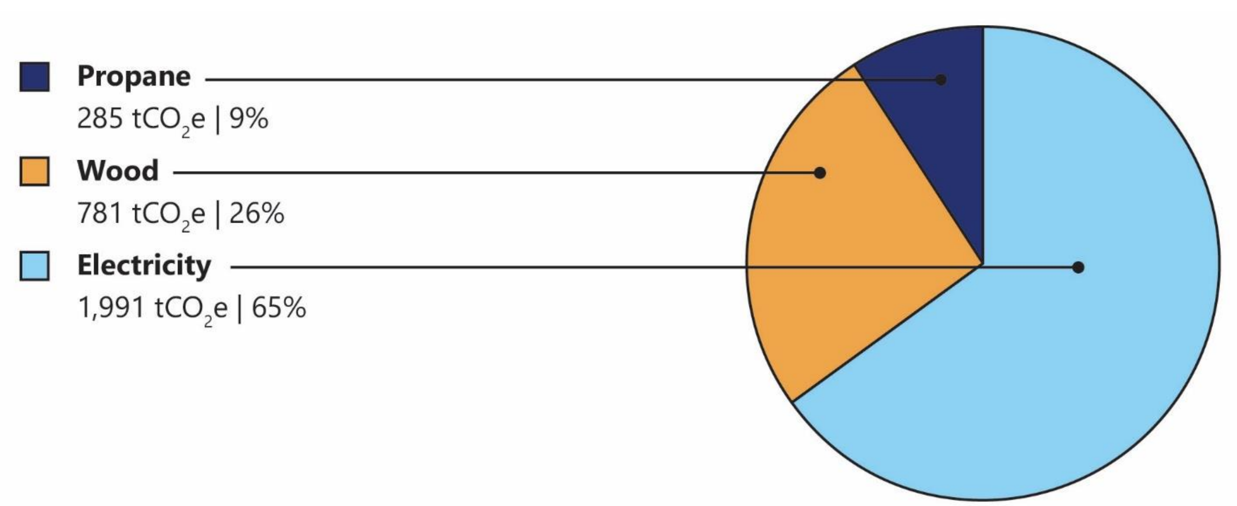


GHG Emissions from Energy Use

Each energy source emits different levels of greenhouse gases, reflected in their emissions factor, as provided in **Table 3**.

Figure 2 highlights the average annual greenhouse gas emissions by energy source. For each energy type, the average only includes years where complete data was provided. As shown, nearly two-thirds (65%) of the community's greenhouse gas emissions are associated with electricity consumption, even though electricity only accounts for 49% of the community's energy usage. This is because a large portion of electricity in Saskatchewan is generated by burning coal and natural gas. Wood use in the community accounts for 26% of Sucker River's greenhouse gas emissions, while propane (9%) is responsible for the remainder.

Figure 2: Average Annual Greenhouse Gas Emissions by Energy Source, Based on Energy Bills from 2018–2022 (tCO_2e, %)



Estimated Spending from Energy Use

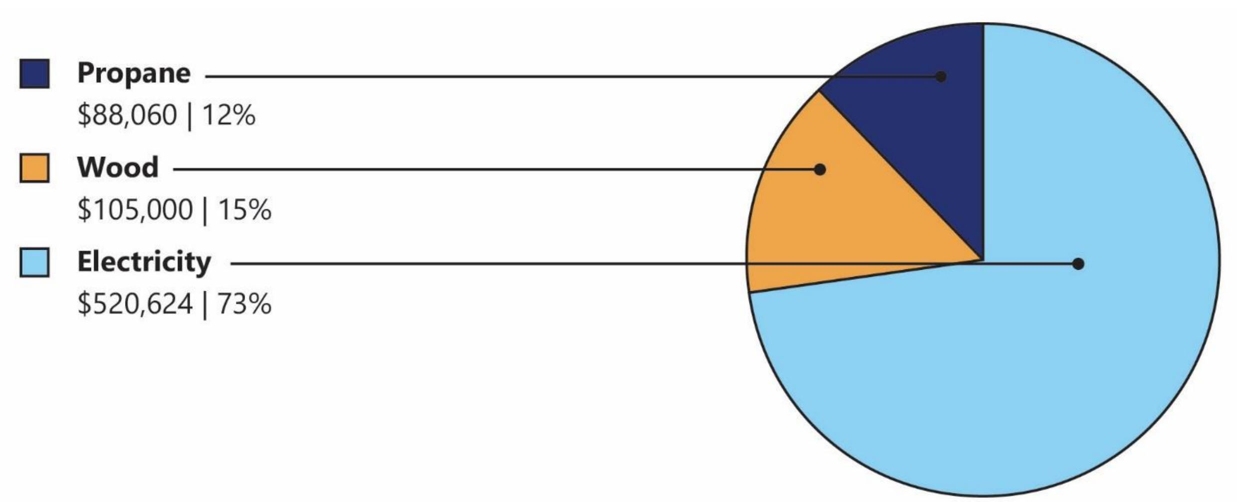
Each energy source has different costs associated with it. The annual average cost for each energy source in Sucker River between 2018–2023 is summarized in **Table 5**, with the overall average and its conversion to cost per GJ ($/GJ) shown in **Table 8**. Electricity has the highest rate per GJ, while natural gas has the lowest rate.

Table 8: Average Energy Cost ($/GJ) by Energy Source, Based on Energy Bills From 2018–2022

Energy Source	Average Cost	Average Cost ($/GJ)
Electricity	$.167/kWh	$45.41/GJ
Propane	$0.47/L	$18.71/GJ
Wood	$0.23/kg	$14.17/GJ

Figure 3 depicts Sucker River's average annual energy spending from 2018 to 2022 by energy source. For each energy type, the average only includes years where complete data was provided. On average, Sucker River spends $238,000 per year on energy. As shown, electricity accounts for 73% ($520,600) of the community's energy costs, even though it only accounts for 49% of its energy consumption. This is due to the high cost of electricity compared to other energy sources. In contrast, wood accounts for 31% of the community's annual energy usage but only 15% of the community's energy costs.

Figure 3: Average Annual Energy Spending by Energy Source, Based on Energy Bills from 2018–2022 ($, %)



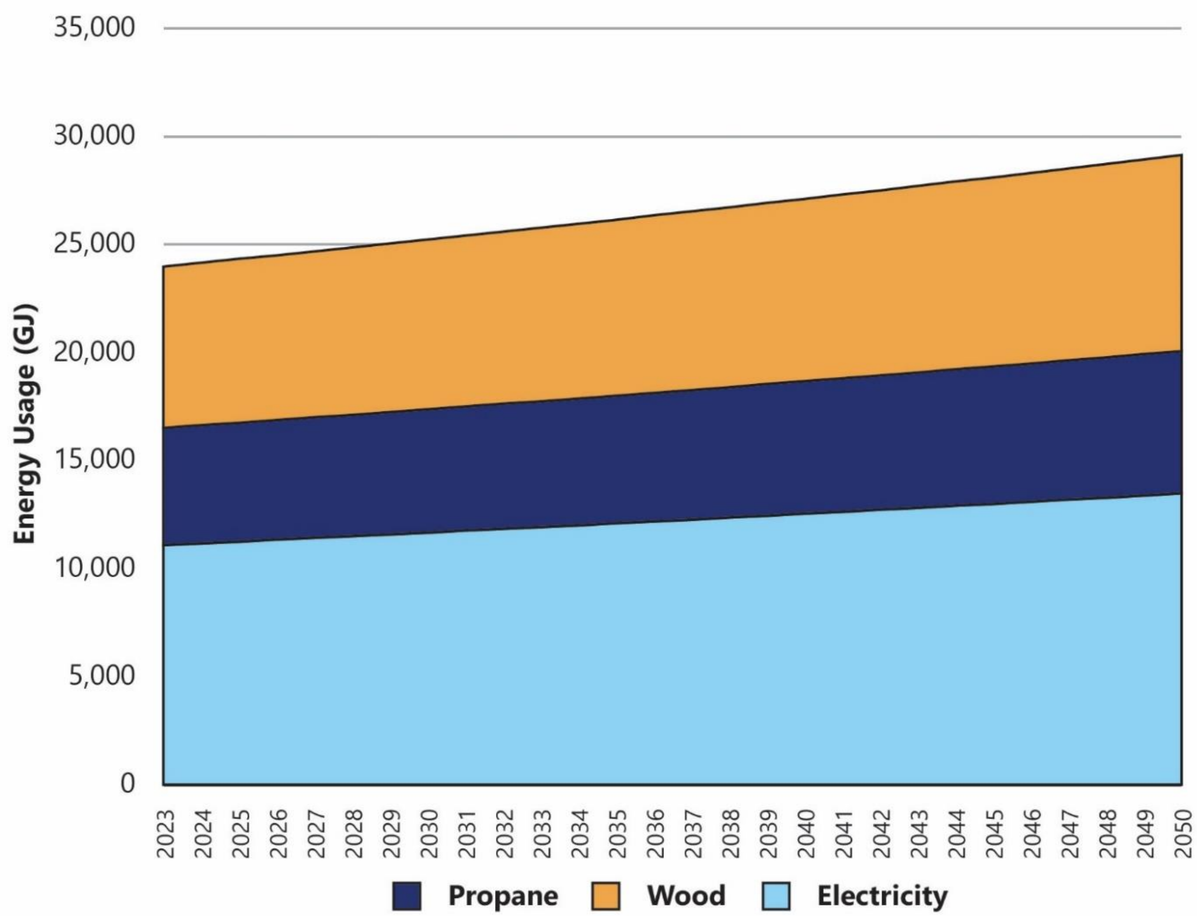
Business-As-Usual Forecasts

Business-As-Usual (BAU) forecasts use energy usage trends from the baseline period and population projections to forecast Sucker River's future energy usage. As this represents energy usage in an "as usual" scenario, this forecast does not include new developments in the community, proposed renewable energy projects, or the implementation of energy conservation or retrofits that would reduce community energy usage. This scenario is intended to show the cost of "doing nothing" to energy usage in the community to provide an estimate of what energy trends may look like in the future.

Energy Use

Figure 4 highlights the Business-As-Usual energy usage forecast for Sucker River from 2024 to 2050. As shown, energy usage is anticipated to increase by approximately 22% over the forecast period, from approximately 24,000 GJ in 2023 to approximately 29,000 GJ in 2050. The forecast assumes that energy usage is correlated to population growth and will align with changes in on-reserve members throughout the forecast period. The forecast also assumes that the distribution of energy use sources remains the same until 2050.

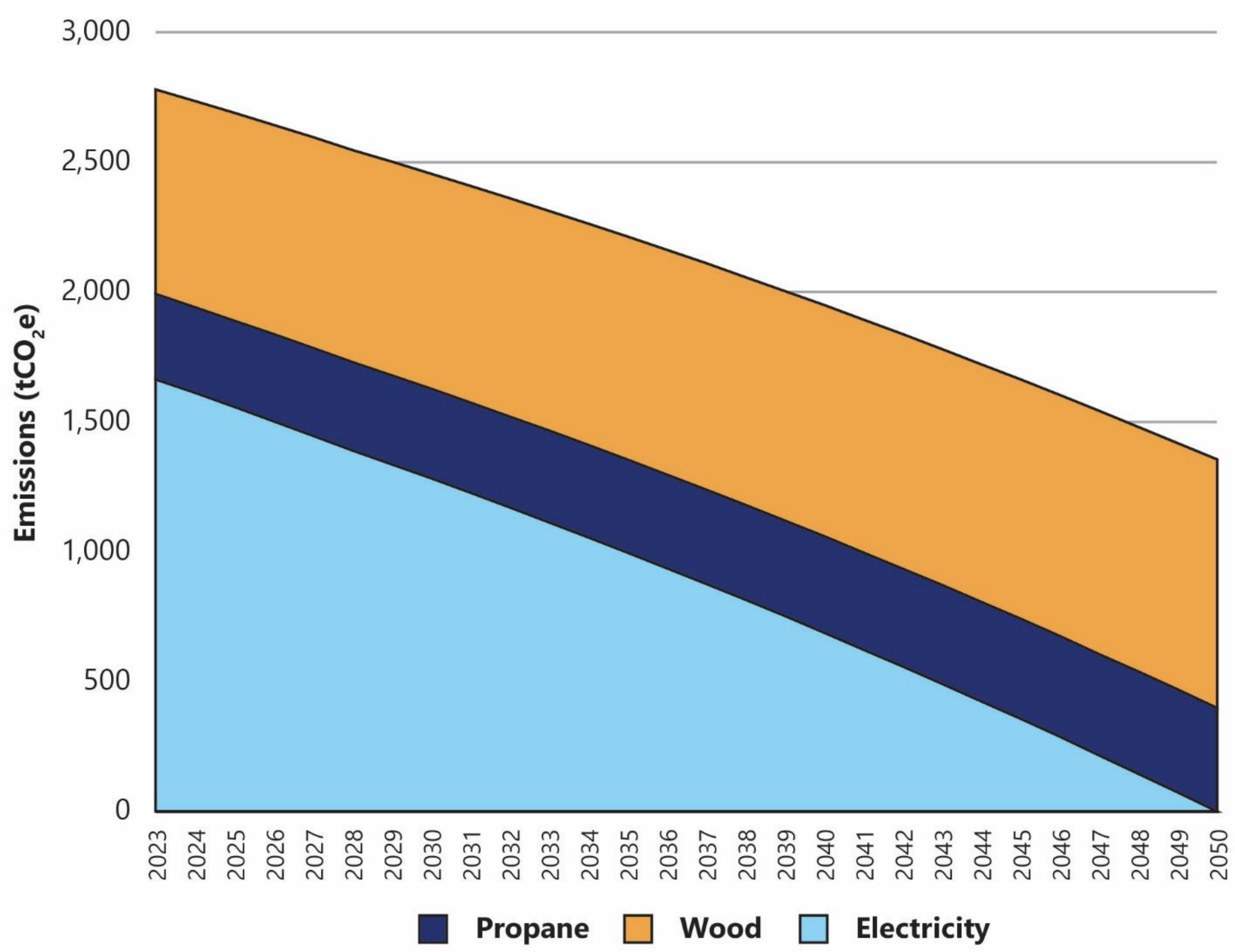
Figure 4: Business-As-Usual Energy Usage Projection by Energy Source, 2023–2050 (GJ)



GHG Emissions from Energy Use

Figure 5 highlights the Business-As-Usual emissions forecast by energy source. As shown, the greenhouse gas emissions from propane and wood increase by approximately 22% between 2023 and 2050. However, greenhouse gas emissions from electricity will be eliminated by 2050 based on the assumption that the SaskPower electricity grid will achieve net-zero emissions as planned.[9] In other words, this means that although Sucker River would continue to use electricity, the electricity generated by SaskPower would no longer emit greenhouse gases.

Figure 5: Business-As-Usual Greenhouse Gas Emissions Projection by Energy Source, 2023–2050 (tCO_2e)

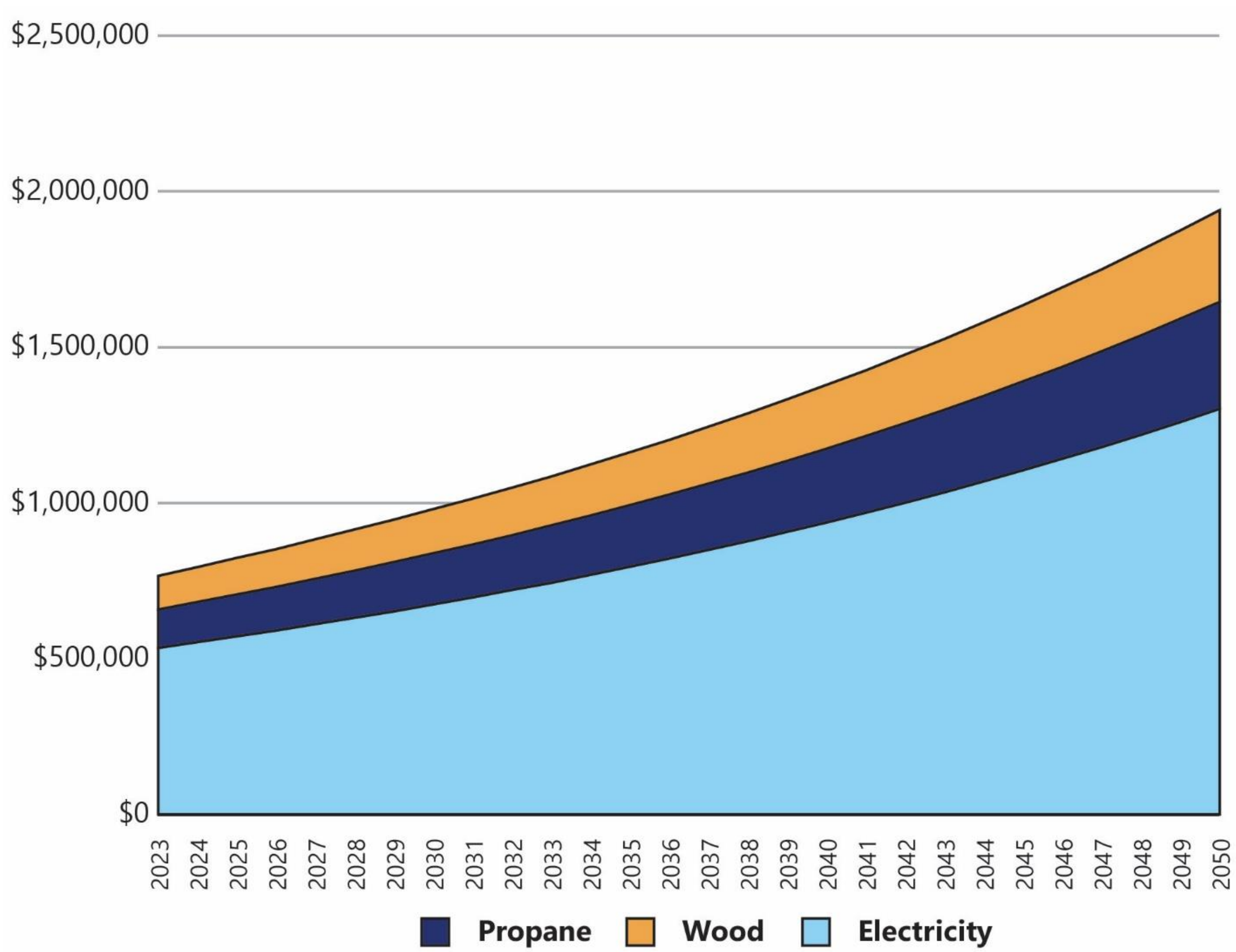


[9] Dayal, P. (2023, August 16). Sask. premier says federal net-zero electricity targets would double power rates, experts dispute that. CBC News. Retrieved from: https://www.cbc.ca/news/canada/saskatoon/experts-say-net-zero-electricity-targets-are-possible-in-sask-1.6937188

Estimated Spending from Energy Use

Figure 6 highlights the total community spending by energy source between 2023 and 2050 in the Business-As-Usual forecast. Electricity spending is projected to increase by 5% annually, while propane and wood spending will increase by 7% and 6% per year, respectively. According to this forecast, the community's annual energy spending will be approximately $1.9MM annually by 2050. Electricity would account for roughly 67% of these costs, while propane (18%) and wood (15%) would account for the remaining costs per year.

Figure 6: Business-As-Usual Cost Projection by Energy Source, 2023–2050 ($)



Energy Conservation

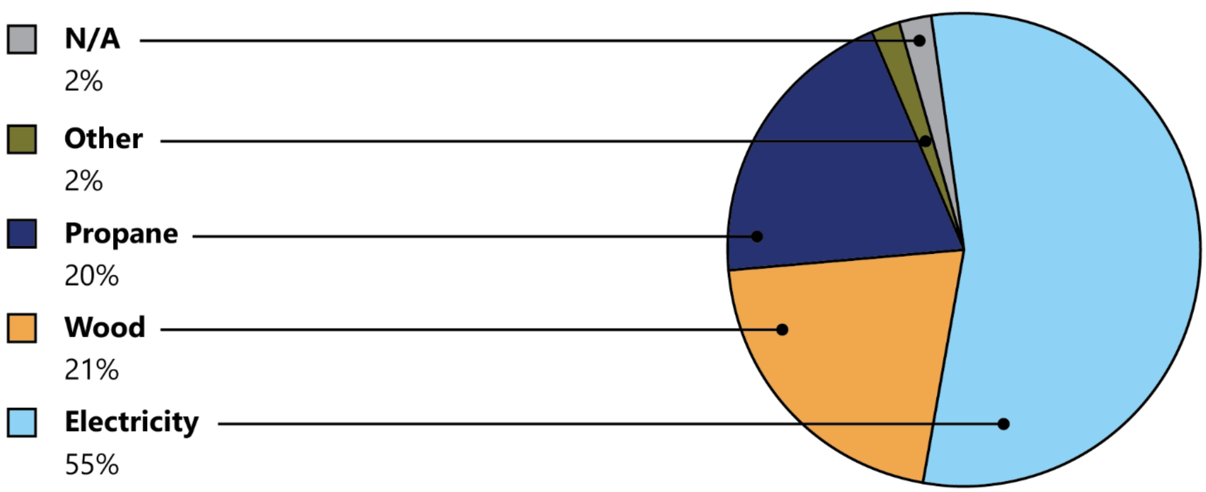
Modelling Assumptions for Homes

LLRIB's Public Works department provided building blueprints used since 2019 and housing condition assessment reporting from 2019 to understand housing stock in Sucker River. Also, in 2023, 64 LLRIB homes, including seven in Sucker River, were surveyed on energy use through in-person home energy assessment visits provided by the Pithesowiskotew team.[10]

The following summarizes the housing information used to analyze impacts on conservation and retrofit actions.

First, the primary space heating source in homes in 2019 is highlighted in **Figure 7**. Most homes are heated primarily by electricity; wood (21%) and propane (20%) are the next most common heating sources.

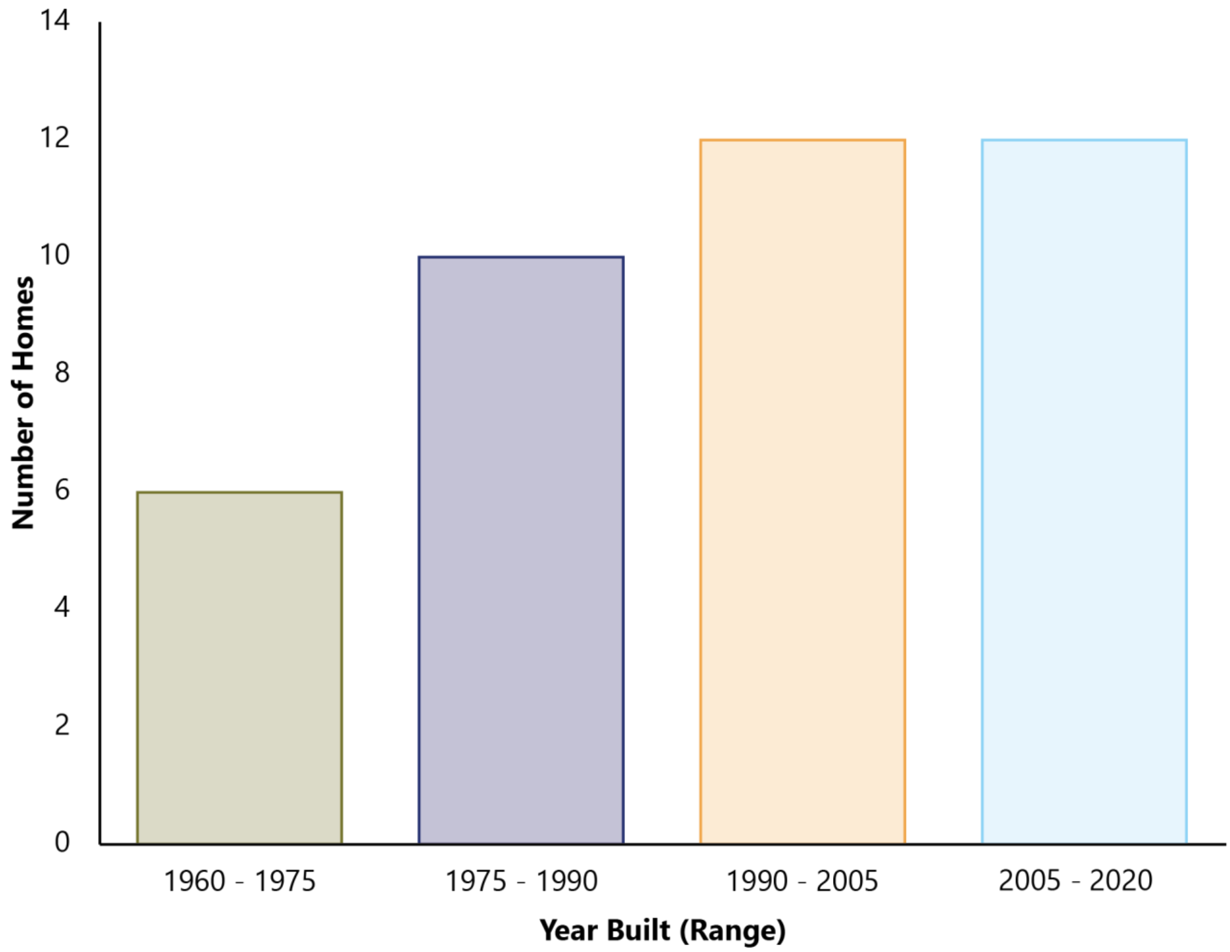
Figure 7: Primary Fuel Source for Space Heating Homes in Sucker River



[10] 7 homes in Sucker River were surveyed on energy use through in-person home energy assessment visits provided by the Pithesowiskotew team https://www.saskpower.com/Power-Savings-and-Programs/Home/Tools-to-Analyze-Your-Power-Use/Online-Energy-Assessment-for-Homes

Figure 8 provides an understanding of the age of a home in Sucker River in 2019. The graph shows that over half of the homes were built after 1990.

Figure 8: Sucker River Housing Stock by Year Built



Given this information, four types of homes were modelled – a newer home with a propane furnace (1A), a newer home with an electric furnace (1B), an older home with a natural gas furnace (24), and an older home with an electric furnace (2B). **Table 9** highlights the assumptions used for these modelled homes. The heating settings, insulation, and lighting assumptions were based on the homes surveyed through home energy assessment visits.

Table 9: Baseline Settings for Modelled Houses

	Model House 1A	Model House 1B	Model House 2A	Model House 2B
Assumptions	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Dimensions	26 x 40 x 8 ft			
Size	1040 sq ft			
Basement	n/a			
Heating System	Propane Furnace, 75% seasonal efficiency	Electric Furnace, 75% seasonal efficiency	Propane Furnace, 70% seasonal efficiency	Electric Furnace, 70% seasonal efficiency
Water Heating System	Electricity, 75% seasonal efficiency		Electricity, 70% seasonal efficiency	
Baseline Heating Settings (°C)	21.5°C	20.8°C	21.5°C	20.8°C
Baseline Cooling Settings (°C)	23.6°C	21.3°C	23.6°C	21.3°C
Hot Water Usage	300L/Day			
A/C System	Window Air Conditioner (Typical COP: 2.4)			
Roof Insulation	Asphalt roofing, 4 inches of sprayed polyurethane, and gypsum board. (Effective R-Value: 4.5)		Asphalt roofing, 1-inch air cavity, 3 inches of mineral fibre, and gypsum board. (Effective R-Value: 2.3)	
Exterior Wall Insulation	Cement stucco, 6 inches of mineral fibre, gypsum board. (Effective R-Value: 4.2)		Cement stucco, 1-inch air cavity, 3 inches of mineral fibre, gypsum board. (Effective R-Value: 2.3)	
Windows	Double-glazed windows with wood/vinyl frames (U-Value: 2.84)			
Air Sealing	Medium			

	Model House 1A	Model House 1B	Model House 2A	Model House 2B
Window Sealing	Medium			
Door Sealing	Medium			
Lights	4 incandescent (60 W) lights, 4 LED (10 W) lights		8 incandescent (60 W) lights	
Appliances	Computer (50 W), Dishwasher (1800 W), Microwave (1000 W), Stove (5000 W), Refrigerator (500 W), Toaster (1100 W), TV (200 W)		Computer (50 W), Dishwasher (2400 W), Microwave (1200 W), Stove (5000 W), Refrigerator (725 W), Toaster (1400 W), TV (300 W)	
Laundry	Dryer (3000 W), Washer (400 W)		Dryer (5000 W), Washer (500 W)	
Baseline Electricity consumed annually	15,225 kWh/year	32,097 kWh/year	18,005 kWh/year	41,934 kWh/year
Baseline Propane Consumed Annually	2,612 L/year	n/a	3,698 L/year	n/a
Baseline Energy Costs	$4,316/year	$5,023/year	$5,555/year	$6,563/year

Given the above assumptions, the following section analyzes the potential savings from several simple, low-cost energy conservation actions an individual can take at home.

Heating

The project team analyzed how reducing heating settings to 20°C impacts energy usage in the four variations of typical houses. **Table 10** highlights the modelled annual energy and cost savings associated with reducing the heating settings.

Table 10: Potential Energy and Cost Savings from Reducing Heating Settings

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Baseline Heating Settings (°C)	21.5°C	20.8°C	21.5°C	20.8°C
Conservation Heating Settings (°C)	20°C			
Electricity Savings (%)	0%	3%	0%	3%
Propane Savings (%)	10%	N/A	10%	N/A
Approximate Annual Cost Savings ($)	$170	$150	$545	$215

Cooling

Using the online home assessment data collected from 64 homes in the LLRIB communities, the team modelled the average cooling settings in houses compared with a cooling setting of 25°C. **Table 11** highlights the modelled annual energy and cost savings associated with increasing the cooling settings. The modelling suggests the savings associated with this change would be negligible.

Table 11: Potential Energy and Cost Savings from Increasing Cooling Settings

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Baseline Cooling Settings (°C)	23.6°C	21.3°C	23.6°C	21.3°C
Conservation Cooling Settings (°C)	25°C			
Electricity Savings (%)	1%	1%	1%	1%
Approximate Annual Cost Savings ($)	-	-	-	-

Lighting

Table 12 highlights the modelled annual energy and cost savings associated with reducing the use of incandescent lights. The modelling suggests that residents could save over $100 per year by cutting the usage of eight lights on for eight hours per day in half. This could be achieved with fewer lights on or less time spent with lights on.

Table 12: Potential Energy and Cost Savings from Reducing the Use of Incandescent Lights

Baseline Hours Per Day	8
Number of Lights	8
Wattage per Light	60
Electricity (kWh)	1,400 kWh
Electricity Savings Through 50% Reduction (kWh)	700 kWh
Approximate Annual Cost Savings Through 50% Reduction ($)	$110

Water

Numerous conservation actions can reduce water usage – including retrofitting fixtures to have a lower flow and switching to more water-efficient appliances. Given the overlap with retrofit actions, anticipated energy savings from reducing hot water use by one-third have been modelled in the Low-Flow Fixtures section of Energy Efficiency – Improvements and Switches.

Laundry

The project team modelled the annual energy and cost savings associated with reducing the use of laundry machines. **Table 13** highlights the savings associated with reducing the use of high- and low-efficiency clothes washers and dryers from an average of one hour per day to an average of half an hour per day – this could be achieved by spot-cleaning clothes and re-wearing items before washing them. The largest impact would be to hang clothes to dry instead of using a dryer – the modelling suggests that cutting the use of a low-efficiency dryer in half could save residents just over $70 per year.

Table 13: Potential Energy and Cost Savings from Reducing the Use of Laundry Machines

	Clothes Washer, High-Efficiency	Clothes Washer, Low-Efficiency	Clothes Dryer, High-Efficiency	Clothes Dryer, Low-Efficiency
Wattage	350	500	1,800	5,000
Duty Cycle	60%		50%	
Baseline Average Hours/Day	1.0			
Conservation Average Hours/Day	0.5			
Approximate Electricity Savings (kWh)	38	55	164	456
Approximate Annual Cost Savings ($)	$6	$9	$26	$71

Kitchen

Table 14 highlights the modelled annual energy and cost savings associated with reducing the use of ovens and dishwashers from an average of one hour per day to half an hour per day. This could be done by running dishwashers fuller and cooking larger meals at once to reheat by microwave throughout the week. **Table 15** highlights the modelled annual energy and cost savings associated with using smaller appliances for cooking smaller meals. Switching one hour cooked with an oven range to a toaster or microwave oven could save between $50 and $70 per year.

Table 14: Potential Energy and Cost Savings from Reducing the Use of Large Kitchen Appliances

	Range	Dishwasher, High-Efficiency	Dishwasher, Low-Efficiency
Wattage	5,000	1,200	2,400
Duty Cycle	40%	60%	
Baseline Average Hours/Day	1		
Conservation Average Hours/Day	.5		
Electricity Savings (kWh)	365	130	260
Approximate Annual Cost Savings ($)	$60	$20	$40

Table 15: Potential Energy and Cost Savings from Using Smaller Kitchen Appliances for Cooking

	Microwave Oven	Toaster Oven
Range Baseline Wattage	5,000	
Appliance Wattage	1,000	1,100
Duty Cycle	80%	100%
Electricity Savings (kWh)	440	320
Approximate Annual Cost Savings ($)	$70	$50

Electronics

Table 16 highlights the modelled annual energy and cost savings associated with reducing the use of electronics such as computers, televisions, and radios from an average of four hours per day to two hours per day. Residents could often achieve these changes by turning off electronics when not in use. The modelling suggests that residents could save around $21 a year by reducing their desktop computer usage and another $22 per year by reducing their television usage.

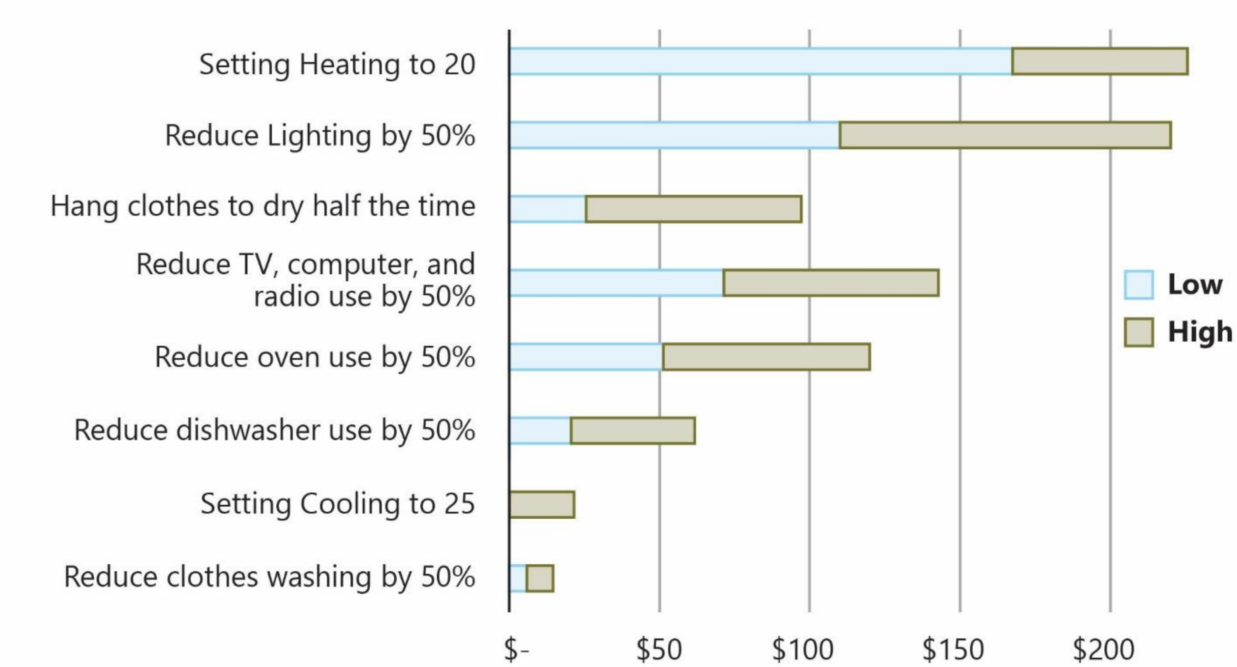
Table 16: Potential Energy and Cost Savings from Reducing Electronics Usage

	Notebook Computer	Desktop Computer	Television	Radio
Wattage	50	250	190	210
Duty Cycle	75%		100%	
Baseline Average Hours/Day	4			
Conservation Average Hours/Day	2			
Electricity Savings (kWh)	27	137	139	153
Approximate Annual Cost Savings ($)	$4	$21	$22	$24

Summary and Considerations

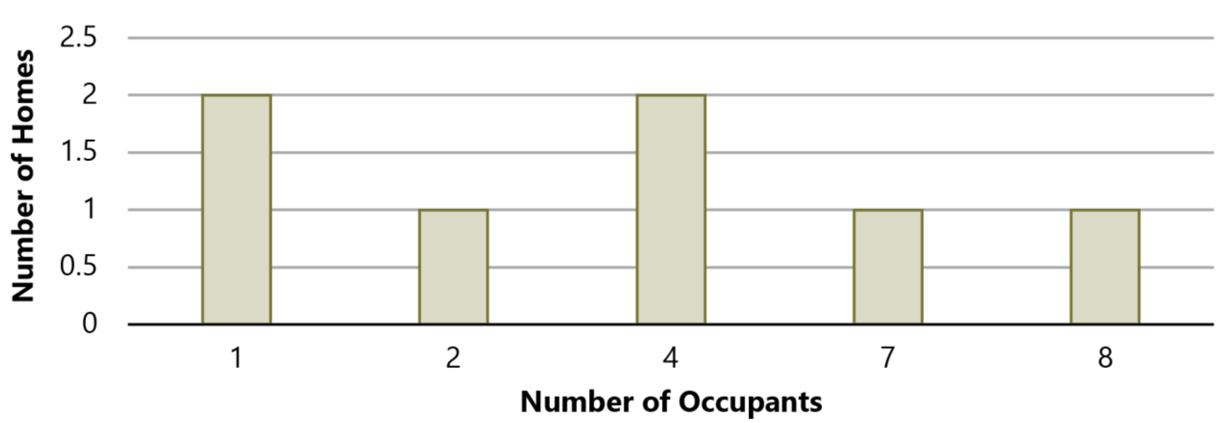
A summary of conservation actions and their range of savings modelled are shown in **Figure 9** below.

Figure 9: Potential Savings by Energy Conservation Actions



The range of savings a house may experience will depend greatly on the home itself and its occupants' current behaviours. One example that can create a large variation is the number of occupants in a home. With more occupants, there is more need for energy use in the homes, from larger or more meals cooked, more spaces occupied that need lighting, more clothes and dishes to wash, and more electronic devices in use by multiple people. From the sample of homes surveyed, the number of occupants reported are shown in **Figure 10.**

Figure 10: Number of Occupants in Homes Surveyed - Sucker River



Energy Efficiency – Improvements and Switches

Individual retrofit initiatives were modelled for the type of house described in the Energy Conservation section above. These retrofit initiatives included upgrading the heating system, insulating the roof and walls, air sealing walls, upgrading appliances, and installing low-flow fixtures. The assumptions associated with each retrofit initiative are highlighted in **Table 17.** The assumed annual electricity consumed is less than what was used for energy conservation, assuming that conservation actions have been implemented and retrofits are the subsequent actions being implemented.

Table 17: Modelling Assumptions Associated With Each Retrofit Initiative

Retrofit	Model 1 Improvements		Model 2 Improvements	
	Low	**High**	**Low**	**High**
Heating System	Propane Furnace, 80% seasonal efficiency	Electric Furnace, 90% seasonal efficiency	Propane Furnace, 80% seasonal efficiency	Electric Furnace, 90% seasonal efficiency
Water System	80% seasonal efficiency	90% seasonal efficiency	80% seasonal efficiency	90% seasonal efficiency
A/C System	Standard DX A/C (Typical COP: 3)	High Efficiency A/C (Typical COP: 3.5)	Standard DX A/C (Typical COP: 3)	High Efficiency A/C (Typical COP: 3.5)
Roof Insulation	Additional Insulation (Effective R-Value: 5.2)	Additional Insulation (Effective R-Value: 6)	Additional Insulation (Effective R-Value: 4.2)	Additional Insulation (Effective R-Value: 6)
Exterior Wall Insulation	Additional Insulation (Effective R-Value: 4.5)	Additional Insulation (Effective R-Value: 6)	Additional Insulation (Effective R-Value: 4.5)	Additional Insulation (Effective R-Value: 6)

Retrofit	Model 1 Improvements		Model 2 Improvements	
	Low	High	Low	High
Window Replacement	Triple Glazed Windows (U-Value 2.01)	Triple Glazed Windows (U-Value 1.18)	Triple Glazed Windows (U-Value 2.01)	Triple Glazed Windows (U-Value 1.18)
Natural Air Filtration (Walls)	Tight			
Natural Air Filtration (Windows)	Tight			
Natural Air Filtration (Doors)	Tight			
Lights	8 LED (10 W) lights		4 Incandescent (60 W) lights, 4 LED (10 W) lights	8 LED (10 W) lights
Appliances	Computer (50 W), Dishwasher (1200 W), Microwave (750 W), Stove (5000 W), Refrigerator (300 W), Toaster (800 W), TV (80 W)		Computer (50 W), Dishwasher (1200 W), Microwave (1200 W), Stove (5000 W), Refrigerator (300 W), Toaster (1400 W), TV (80 W)	Computer (50 W), Dishwasher (1200 W), Microwave (750 W), Stove (5000 W), Refrigerator (300 W), Toaster (800 W), TV (80 W)
Laundry	Dryer (1800 W), Washer (350 W)		Dryer (2000 W), Washer (500 W)	Dryer (2000 W), Washer (350 W)
Low Flow Fixtures	250 L/Day	200 L/Day	250 L/Day	200 L/Day
Baseline Electricity Consumed Annually	15,137 kWh/year	31,030 kWh/year	17,891 kWh/year	40,409 kWh/year

Retrofit	Model 1 Improvements		Model 2 Improvements	
	Low	**High**	**Low**	**High**
Baseline Propane Consumed Annually	2,261 L/year	n/a	3,341 L/year	n/a
Baseline Energy Costs	$4,095/year	$4,856/year	$5,334/year	$6,324/year

The project team estimated each retrofit initiative's energy and cost savings. This did not involve modelling the cumulative impact of multiple retrofit initiatives together, which would have resulted in a smaller energy reduction than the sum of the individual initiatives.

Home Retrofits

Air Sealing

The project team modelled how reducing drafts, which are natural air infiltration in walls, windows, and doors, impacts energy usage in the four variations of typical houses in the community. **Table 18** highlights the total modelled annual energy and cost savings associated with reducing natural infiltration around walls, windows, and doors individually. In particular, the team found that improving wall air sealing could significantly reduce energy consumption and greenhouse gas emissions.

Table 18: Potential Energy and Cost Savings from Reducing Natural Air Filtration Around Walls, Windows, and Doors

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Natural Gas Furnace	Older House, Propane Furnace
Electricity Savings (%)	0%	24%	0%	20%
Propane Savings (%)	47%	N/A	36%	N/A
Approximate Annual Cost Savings ($)	$790	$1,180	$890	$1,290

Insulation

The project team modelled how improving the effective resistance (R-value) of insulation in the walls and roof could reduce energy consumption. The effective R-value is typically lower than the nominal R-value as it accounts for studs and other thermal bridging in the building envelope. **Table 19** and **Table 20** respectively highlight the modelled annual energy and cost savings associated with improving roof and wall insulation. The modelling suggests that improving insulation in older houses with minimal existing insulation can significantly reduce costs for homes heated with an electric furnace.

Table 19: Potential Energy and Cost Savings from Improving Roof Insulation

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Electricity Savings (%)	0%	24%	0%	20%
Propane Savings (%)	6%	N/A	23%	N/A
Approximate Annual Cost Savings ($)	$100	$1,180	$570	$1,290

Table 20: Potential Energy and Cost Savings from Improving Wall Insulation

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Electricity Savings (%)	0%	3%	0%	13%
Propane Savings (%)	7%	N/A	18%	N/A
Approximate Annual Cost Savings ($)	$120	$155	$440	$800

Water Heating

The project team modelled how upgrading the electric water heating system to a more energy-efficient heater could reduce energy consumption and greenhouse gas emissions. **Table 21** highlights the modelled annual energy and cost savings associated with upgrading the electric water heating system across the four variations of houses. The modelling suggests upgrading the heater could save homeowners hundreds of dollars annually. It is important to note that the electricity savings represent a smaller proportion of the overall electricity usage in houses with electric furnaces. Still, the total amount of electricity saved is the same within houses built in similar eras.

Table 21: Potential Energy and Cost Savings from Upgrading the Electric Water Heater

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Electricity Savings (%)	10%	5%	12%	5%
Electricity Savings (kWh)	1,480		2,100	
Approximate Annual Cost Savings ($)	$230		$330	

Low-Flow Fixtures

Table 22 highlights the modelled annual energy and cost savings associated with reducing hot water consumption by a third across the four variations of houses. The modelling suggests low-flow fixtures could save residents with older homes up to $500 per year – accounting for nearly 10% of their total energy bill(s). Like the previous example, the total amount of electricity saved is the same within housing vintages. However, this represents a smaller percentage of total electricity usage in houses with electric furnaces.

Table 22: Potential Energy and Cost Savings from Reducing Hot Water Consumption

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Electricity Savings (%)	20%	10%	18%	8%
Electricity Savings (kWh)	2,970		3,180	
Approximate Annual Cost Savings ($)	$460		$500	

Windows

Table 23 highlights the modelled annual energy and cost savings associated with upgrading existing windows to triple-glazed ones with argon insulating gas and an insulated spacer. The modelling suggests that homeowners with electric furnaces could save hundreds of dollars by upgrading their windows, given the higher cost per GJ of heating delivered by electric furnaces.

Table 23: Potential Energy and Cost Savings from Improving Windows

	Newer House, Propane Furnace	Newer House, Electric Furnace	Older House, Propane Furnace	Older House, Electric Furnace
Electricity Savings (%)	0%	6%	0%	5%
Propane Savings (%)	12%	N/A	9%	N/A
Approximate Annual Cost Savings ($)	$200	$290	$220	$320

Lighting

The final three initiatives are modelled independent of the type of home and the type of heating, as their impact is determined solely by their individual efficiency.

Another way to reduce energy consumption is by replacing inefficient lightbulbs with more energy-efficient options. **Table 24** highlights the modelled annual energy and cost savings associated with replacing up to eight incandescent lights with light-emitting diode (LED) lights. The modelling suggests that residents could save up to $185 annually on electricity by switching eight incandescent lights to LED lights.

Table 24: Potential Energy and Cost Savings from Replacing Incandescent Lightbulbs with LED Lightbulbs

Baseline Lighting	8 incandescent lights (60 W)
Upgraded Lighting	8 LED lights (10 W)
Electricity Savings (kWh)	1,200 kWh
Approximate Annual Cost Savings ($)	$185

Kitchen Appliance Upgrade

Residents can also save money and reduce energy by upgrading their appliances to more energy-efficient options. **Table 25** highlights the potential energy and cost savings associated with upgrading kitchen appliances. As expected, the greatest cost savings were associated with upgrading less efficient appliances. Most notably, the modelling suggests that residents could save nearly $200 annually by upgrading an inefficient refrigerator with a more energy-efficient version.

Table 25: Potential Energy and Cost Savings from Upgrading Kitchen Appliances in a Newer Home

	Dishwasher	Microwave	Refrigerator	Toaster
Baseline Wattage	1,800–2,400	1,000–1,200	500–725	1,100–1,400
Upgraded Wattage	1,200	750	300	800
Duty Cycle	60%	80%	30%	100%
Hours/Day	1	0.2	24	0.2

	Dishwasher	Microwave	Refrigerator	Toaster
Electricity Savings (kWh)	130–260	15–25	525–1,115	20–40
Approximate Annual Cost Savings ($)	$20–$40	$0–$5	$80–$175	$5

Laundry Machine Upgrade

Finally, in addition to upgrading kitchen appliances, residents can also upgrade laundry machines. **Table 26** highlights the potential energy and cost savings associated with upgrading laundry washers and dryers. The modelling suggests that upgrading an inefficient dryer has the potential to save the most energy and costs. Residents may save up to $140 annually by switching from an inefficient dryer to an energy-efficient version.

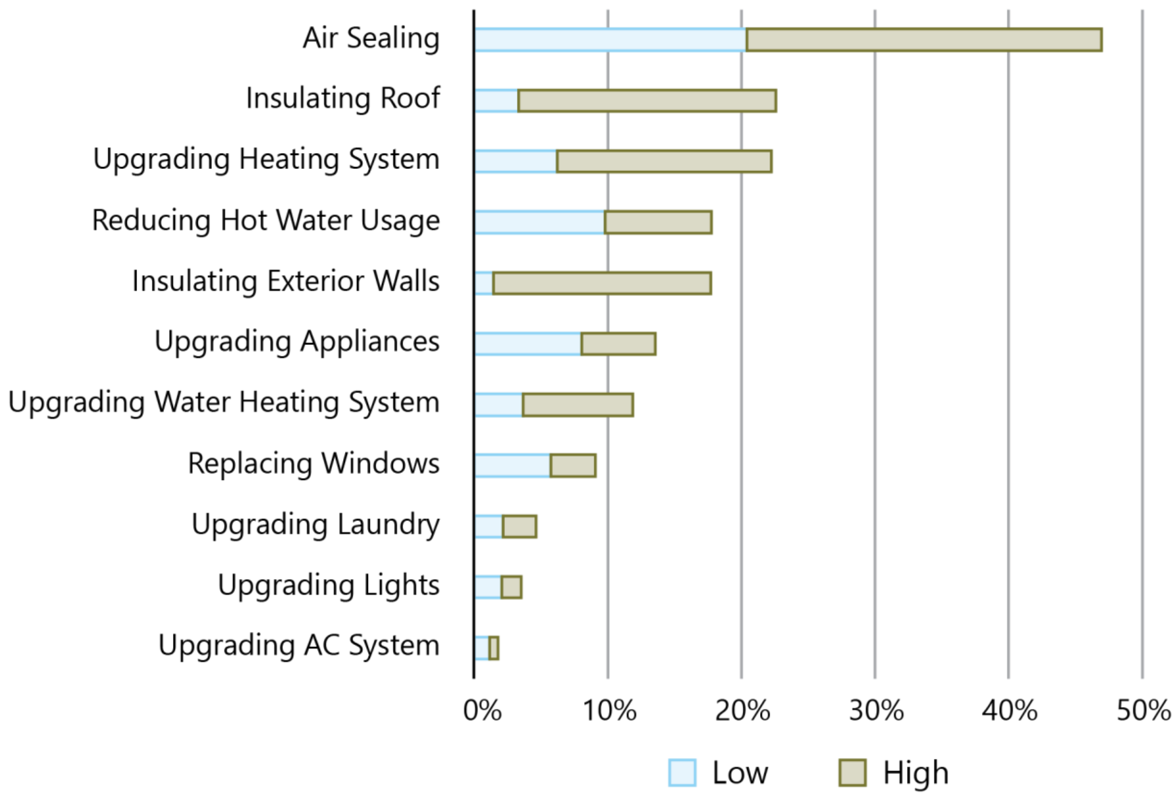
Table 26: Potential Energy and Cost Savings from Upgrading Laundry Machines

	Laundry Washer	Laundry Dryer
Baseline Wattage	400–500	3,000–5,000
Upgraded Wattage	350	1,800
Duty Cycle	60%	50%
Hours/Day	1.5	
Electricity Savings (kWh)	15–50	330–875
Approximate Annual Cost Savings ($)	$0–$10	$50–$140

Savings from Home Retrofits

Using RETScreen® Clean Energy Management Software, the project team modelled 13 potential retrofit initiatives on the community's four variations of typical houses to determine their energy impact. Two variations were houses with propane furnaces, while the others had electric furnaces. The total range of potential energy savings is included in **Figure 11**. The modelling suggests that air sealing and improving roof insulation would have the largest impact on energy savings.

Figure 11: Potential Savings from Retrofits in Sucker River



Community Building Retrofits

The project team performed a desktop analysis to inventory community buildings found in Sucker River and their accompanying building conditions. These conditions are based on data in the 2018 Asset Condition Reporting System (ACRS) reports for Sucker River, supplemented with information from a discussion with Lac La Ronge administration.

Table 27 shows each community building from Sucker River, with an accompanying set of energy recommendations based on the most recent reports of the building conditions as of 2018. The recommendations suggest ways to improve energy efficiency and comfort within the buildings based on the building's operational, interior, and exterior conditions.

For each of the community buildings, priority levels for further investigation were also assigned based on the following criteria:

- The amount of energy-related recommendations for a building (i.e., the buildings with four or more recommendations were given higher priority).
- The estimated years remaining of the building's life as of 2023 (i.e., the buildings with a lifespan of 10 years or more remaining were given higher priority).
- The typical occupancy of the buildings (e.g., buildings that community members frequent on a daily basis – such as a school – were given a higher priority level compared to buildings that are not frequented as often or for extended periods, such as lift stations).

Buildings that met all three of the criteria were given the highest priority. Buildings that only met two of the criteria were given medium priority. Buildings that met only one criterion were given low priority. Buildings with no years remaining were given the lowest priority, as these buildings may require to be rebuilt entirely.

Table 27: Community Building Observations

Community Building	ACRS Observation													
	Repair Exterior	Repair Interior	Replace Weatherstripping	Temperature Control Issues	Constructed 20+ years ago	Replace Window	Replace Door	Repair Water Piping	Low Efficiency Lighting[11]	Electricity Issues	Repair Roof	Replace Thermostat	Est. years remaining (from 2023)	Priority Level for Assessment
Chief Moses Ratt School	✓	✓			✓				✓				20	High
Band Hall	✓	✓			✓				✓				10	High
Band Office	✓	✓			✓								10	Medium
WTP Storage	✓	✓			✓		✓		✓				20	Medium
Pumphouse	✓				✓		✓		✓				20	Medium
Cree Class Culture Room	✓								✓				20	Medium
Daycare (big building with Emily McKenzie)		✓							✓				15	Medium
Emily McKenzie Memorial Centre		✓							✓				15	Medium
Headstart (big building with Emily McKenzie)		✓							✓				15	Medium
Fire Hall	✓	✓							✓				20	Low
Lake Intake Pumphouse	✓				✓				✓				20	Low
School Storage	✓				✓				✓				20	Low
Sewage Lift Station #1	✓				✓				✓				20	Low
Sewage Lift Station #2	✓				✓								20	Low

[11] Low efficiency lighting refers to fluorescent, incandescent, mercury vapour, and/or metal halide lighting.

	ACRS Observation													
Community Building	**Repair Exterior**	**Repair Interior**	**Replace Weatherstripping**	**Temperature Control Issues**	**Constructed 20+ years ago**	**Replace Window**	**Replace Door**	**Repair Water Piping**	**Low Efficiency Lighting**[11]	**Electricity Issues**	**Repair Roof**	**Replace Thermostat**	**Est. years remaining (from 2023)**	**Priority Level for Assessment**
Water Treatment Plant	✓				✓				✓				20	Low
Maintenance Shop		✓			✓				✓				5	Low
Portable Classroom	✓				✓				✓				5	Low
Storage									✓				15	Low
Cold Storage													15	Low
Energy Improvement Opportunity	Increase exterior insulation and airtightness	Increase internal insulation and airtightness	Increase airtightness with new weatherstripping	Increase airtightness, insulation, and/or HVAC system	Upgrade heating system (assuming the system was installed when constructed)	Upgrade to ENERGY STAR® windows	Upgrade to ENERGY STAR® doors	Use water jackets and/or pipe insulation	Upgrade to LED or high-efficiency lights	Have an electrician assess the building for its capacity to install solar PV and/or EV charging stations	Upgrade roof to support solar panels	Upgrade to programmable thermostat		

Fuel-Switching

A desktop assessment of heating systems was completed, and energy and cost modelling were compared using RETScreen®. **Table 28** highlights the assumed fuel source, efficiency, costs, and life expectancy associated with different heating systems used in the modelling.

Table 28: Heating System Assumptions for Comparison

System	Fuel Source	Efficiency	Capital Cost	Replacement Cost	Life Expectancy (years)
Natural Gas Furnace	Natural Gas	70%	$1,800	$1,800	15
Propane Furnace	Propane	70%	$1,800	$1,800	15
Electric Furnace	Electricity	100%	$1,800	$1,800	20
Air-Source Heat Pump	Electricity	165%	$28,500	$28,500	15
Electric Resistance	Electricity	100%	$1,950	$1,950	15
Electric A/C	Electricity	400%	$2,700	$2,700	15
Natural Gas Boiler	Natural Gas	70%	$3,900	$3,900	15
Propane Boiler	Propane	70%	$3,900	$3,900	15
Electric Boiler	Electricity	100%	$3,900	$3,900	15
Wood Stove	Wood	50%	$2,850	$2,850	15

All models assumed that there was existing central air conditioning (A/C) powered by electricity. **Table 29** highlights the key variables used to determine the base heating and cooling loads for each building. Where data was available, the load calculation variables were adjusted to ensure the total estimated cooling and heating energy aligned with the actual building usage.

Table 29: RETScreen® Base Case Heating and Cooling System Parameters

Base Case Heating System	
Heated Floor Area for Building	Variable
Fuel Type	Variable
Seasonal Efficiency	Typical Seasonal Efficiencies of Heating Systems[12]
Heating Load Calculation	
Heating Load for Building	Variable[2,13]
Domestic Hot Water Heating Base Demand	10%[14]
Base Case Cooling System	
Cooled Floor Area for Building	Variable
Fuel Type	Electricity
Coefficient Of Performance – Seasonal	4 kW/kW[15]
Cooling Load Calculation	
Cooling Load for Building	Variable[2,16]
Non-Weather Dependant Cooling	0%

Once the base case heating systems and loads were established, the parameters shown in **Table 30** were used to model the proposed heating and cooling systems. To avoid oversizing the system for most of the year, the air-source heat pump was sized to meet 80% of the peak heating load. The remainder of the heating load was assumed to be offset by the base case heating system, which would be left in place to meet peak load demands.

Since cooling loads are lower than heating loads in all locations, the proposed air-source heat pump would meet all cooling requirements throughout the year, and a peak load cooling system was not included.

[12] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 237)
[13] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 238)
[14] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 34)
[15] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 237)
[16] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 238)

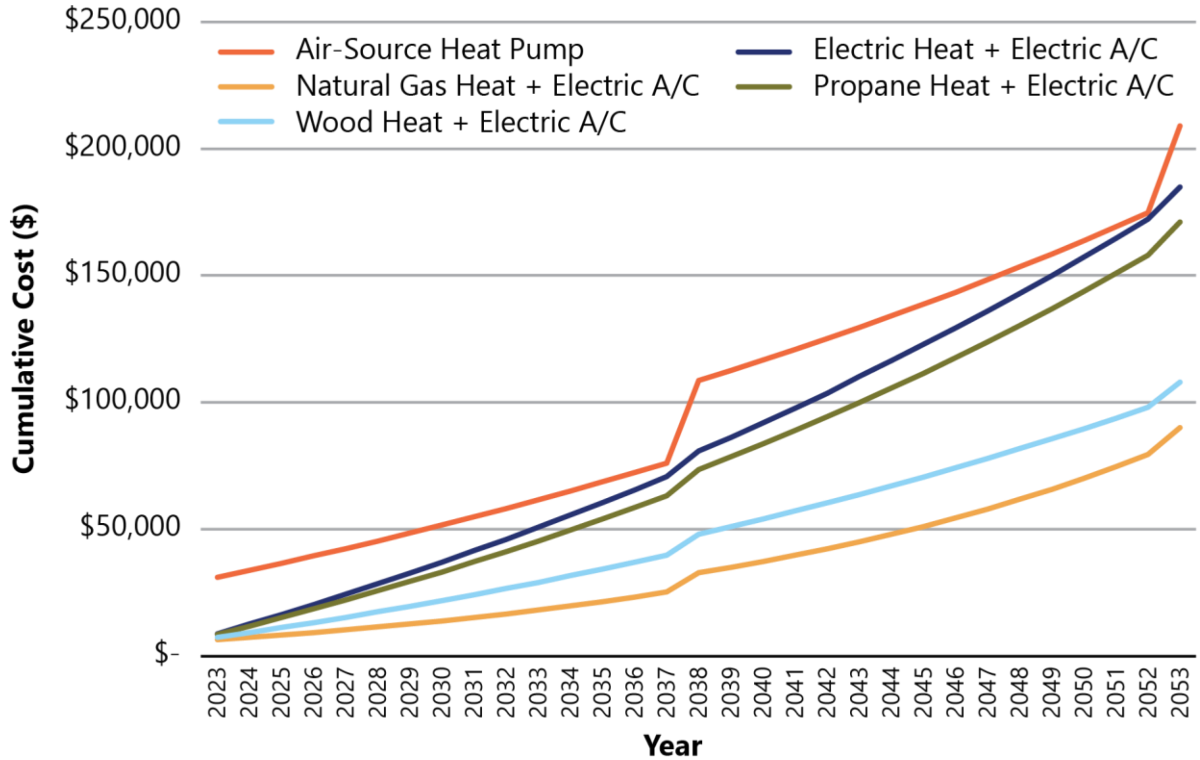
Table 30: RETScreen® Air-Source Heat Pump Heating and Cooling System Parameters

Proposed Case Heating System	
Fuel Type	Electricity
Capacity	Sized to meet 80% of peak heating load
Seasonal Efficiency	165%[17]
Proposed Case Cooling System	
Fuel Type	Electricity
Capacity	Sized to meet 80% of peak heating load
Coefficient of Performance – Seasonal	2 kW/kW[18]
Peak Load Heating System	
Technology	Variable
Fuel Type	Variable
Capacity	Sized to meet suggested capacity to meet peak heating demands
Seasonal Efficiency	Typical seasonal efficiencies of heating systems[19]

Based on cost information from RETScreen®, the cumulative costs from 2023–2053 for the average lifespan of heating and cooling systems by fuel source are shown in **Figure 12**.

[17] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 237)
[18] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 237)
[19] https://publications.gc.ca/collections/Collection/M39-121-2005E.pdf (page 237)

Figure 12: Heating System Cumulative Cost Comparison, 2023–2053

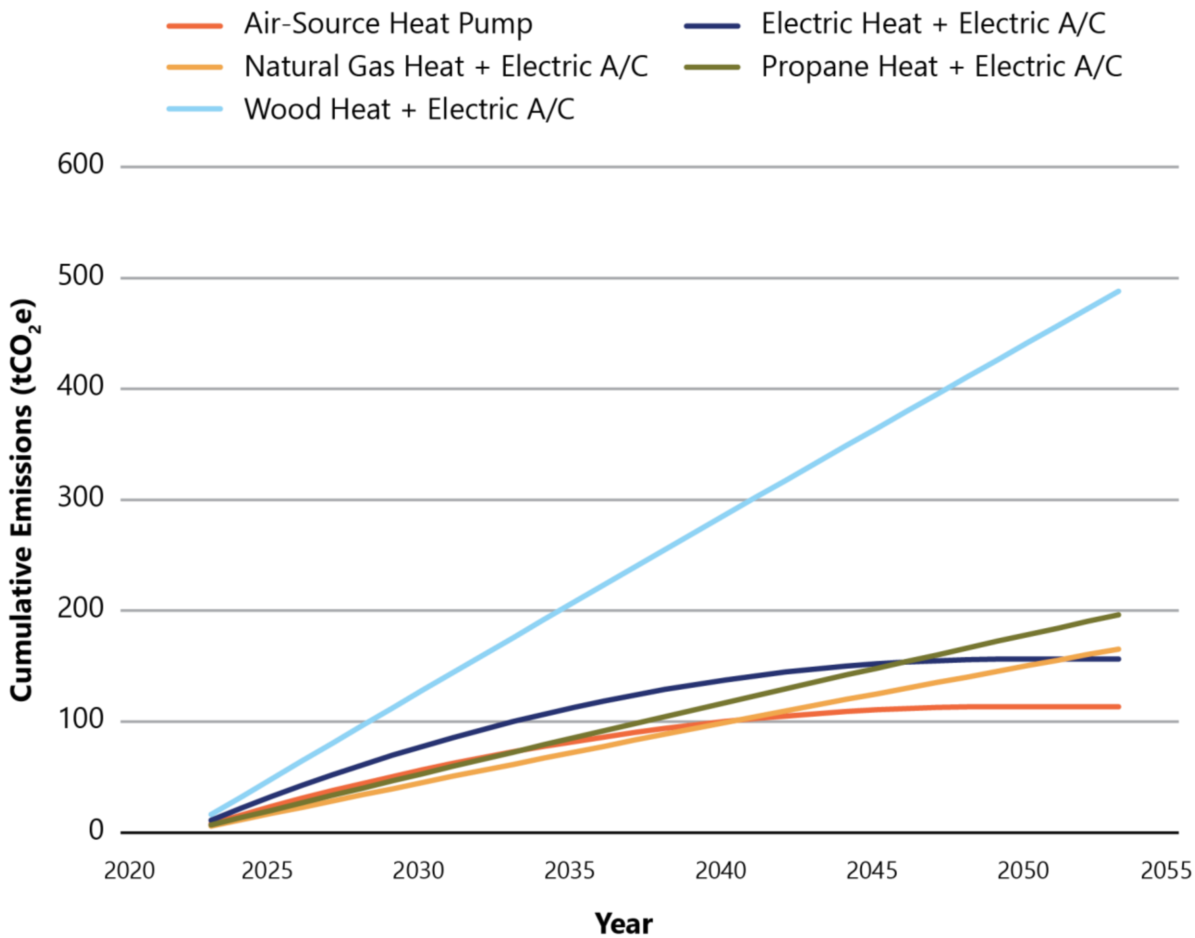


The comparison shows that despite their high capital cost, the cumulative costs for air-source heat pumps are comparable to those of propane and electric heating systems towards their end of life at year 15. Regardless of heating technology, natural gas stands out as the lowest-cost fuel over the 30 years due to its high energy density.

Note that heat pumps can heat and cool, so an electric A/C unit was added to the other heating systems' cost to better compare each system to an air-source heat pump.

Figure 13 accounts for each system's efficiency and fuel source to compare their cumulative emissions from 2023–2053.

Figure 13: Heating System Cumulative Emissions Comparison, 2023–2053



Note that all electrically-powered heating systems will see a reduction in emissions by 2050 as the province phases out fossil-fuel-powered generation. Due to their high efficiency, heat pumps are the lowest emitters of greenhouse gases. Wood contributes the most emissions while heating due to its low efficiency and high greenhouse gas emissions from burning wood.

Vehicles

The following section highlights the key assumptions unique to modelling related to switching to Electric Vehicles (EVs). **Table 31** provides the fuel efficiencies used for calculating the electricity and gasoline costs. These were an average of all 2023 models listed in the Fuel Consumptions Ratings data provided by Natural Resources Canada.[20]

[20] https://open.canada.ca/data/en/dataset/98f1a129-f628-4ce4-b24d-6f16bf24dd64

Table 31: Average Fuel Consumption for 2023 Vehicle Models

	Battery Electric Vehicles (BEVs)	Plug-In Hybrid Electric Vehicles (PHEVs)	Internal Combustion Engine (ICE) Vehicle
Compact	26.2 kWh/100 km	28.3 kWh/100 km	9.0 L/100 km
Mid-size	21.3 kWh/100 km	28.7 kWh/100 km	9.8 L/100 km
Sport Utility Vehicle	26.6 kWh/100 km	38.4 kWh/100 km	12.9 L/100 km

The assumptions used for estimating EV charging station costs are summarized in **Table 32**. The years to repay loans deviate from what was used in energy modelling. This number is based on a conservative understanding of the life of a charging station.

Table 32: Cost Estimates for EV Charging Stations

	Level 2 Charging Stations	Level 3 Charging Stations	Source
Equipment Costs	$4,500/port	$85,000/port	Industry supplier
Installation Costs	$6,250/port	$50,000/port	Industry supplier
Operations & Maintenance Costs	$400/port	$400/port	Industry supplier
Electricity Delivered	12 kW/h	200 kW/h	Industry average
Project Life & Years to Repay Loan	10	10	Industry average

Using current vehicle registrations and assuming the Sucker River community population continues to grow at its current rate, with vehicle registrations increasing at the same rate as the population, **Figure 14** shows the projected total number of vehicles in Sucker River up to 2050. The proportion of EVs in the total vehicle population is also projected, assuming an incremental increase in EV sales that aligns with the mandatory targets provided by the Government of Canada, with the associated annual electricity needs to charge them, assuming the average vehicle travels 16,400 km annually.[21] As shown, the electricity needed to charge EVs in Sucker River will increase significantly. Based on Business-As-Usual forecasts assumptions, switching to EVs will increase the community's electricity consumption by **20%.**

[21] NEUD transportation data, average from 2017-2020: https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=tran&juris=sk&year=2020&rn=21&page=0

Figure 14: Vehicle and Electricity Projections for Sucker River

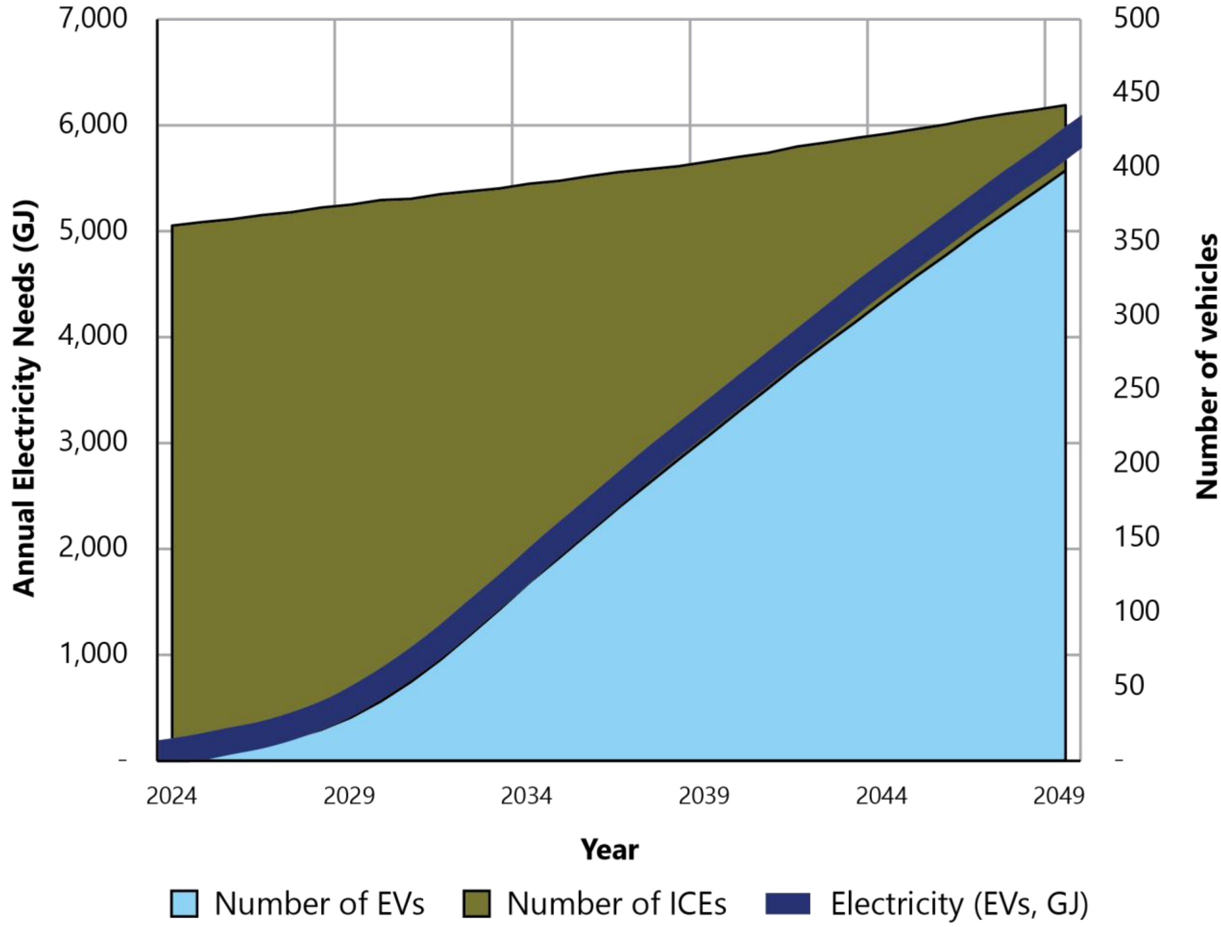


Figure 15 and Figure 16

Figure 16 estimate the combined emissions and costs from Sucker River's vehicle population from 2024–2050. With the electricity grid anticipated to comply with net-zero emissions requirements by 2050, the emissions associated with recharging the EVs also become net-zero. The average per-vehicle refuelling/recharging costs community-wide are also estimated to decrease with the transition to EVs.

Figure 15: Emissions Projections for Vehicles in Sucker River

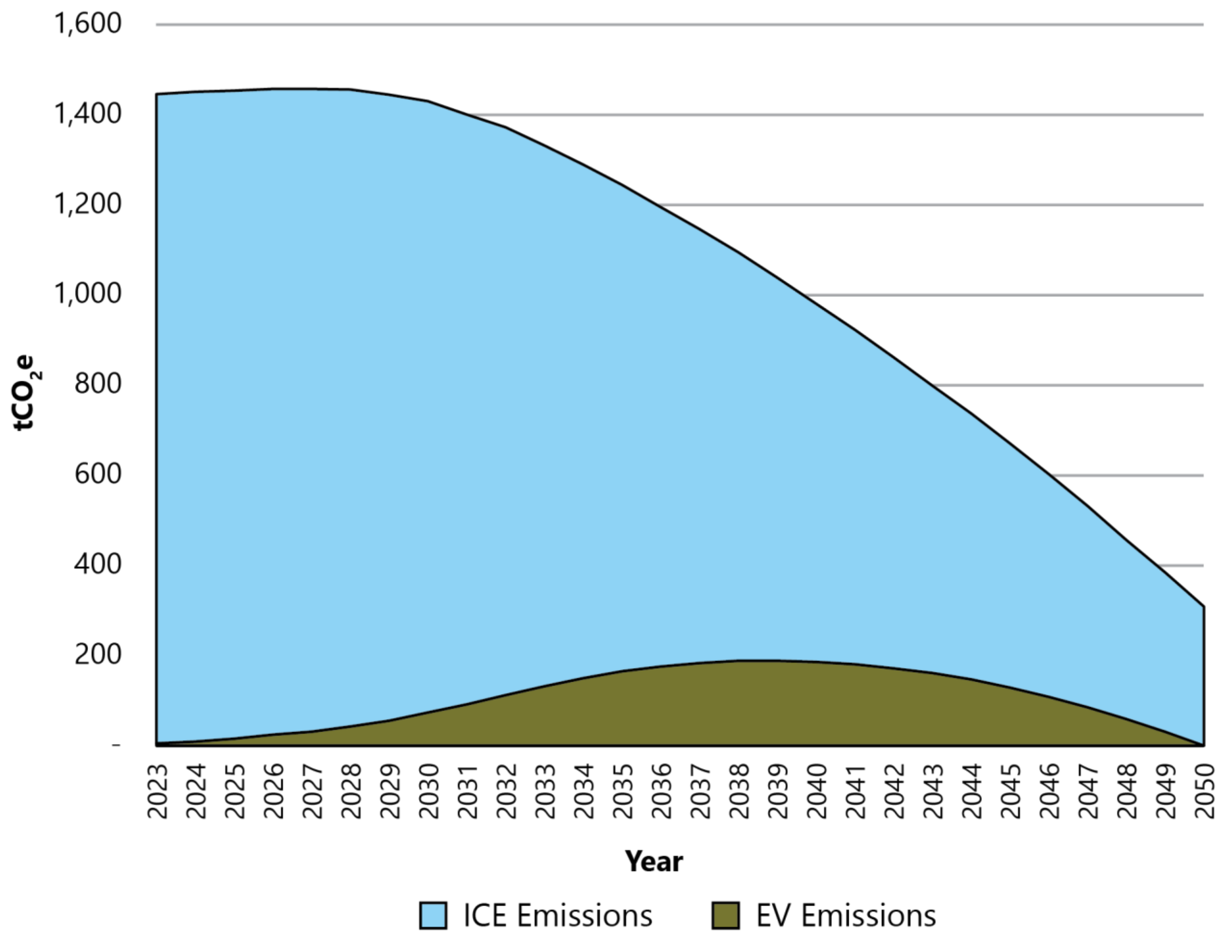
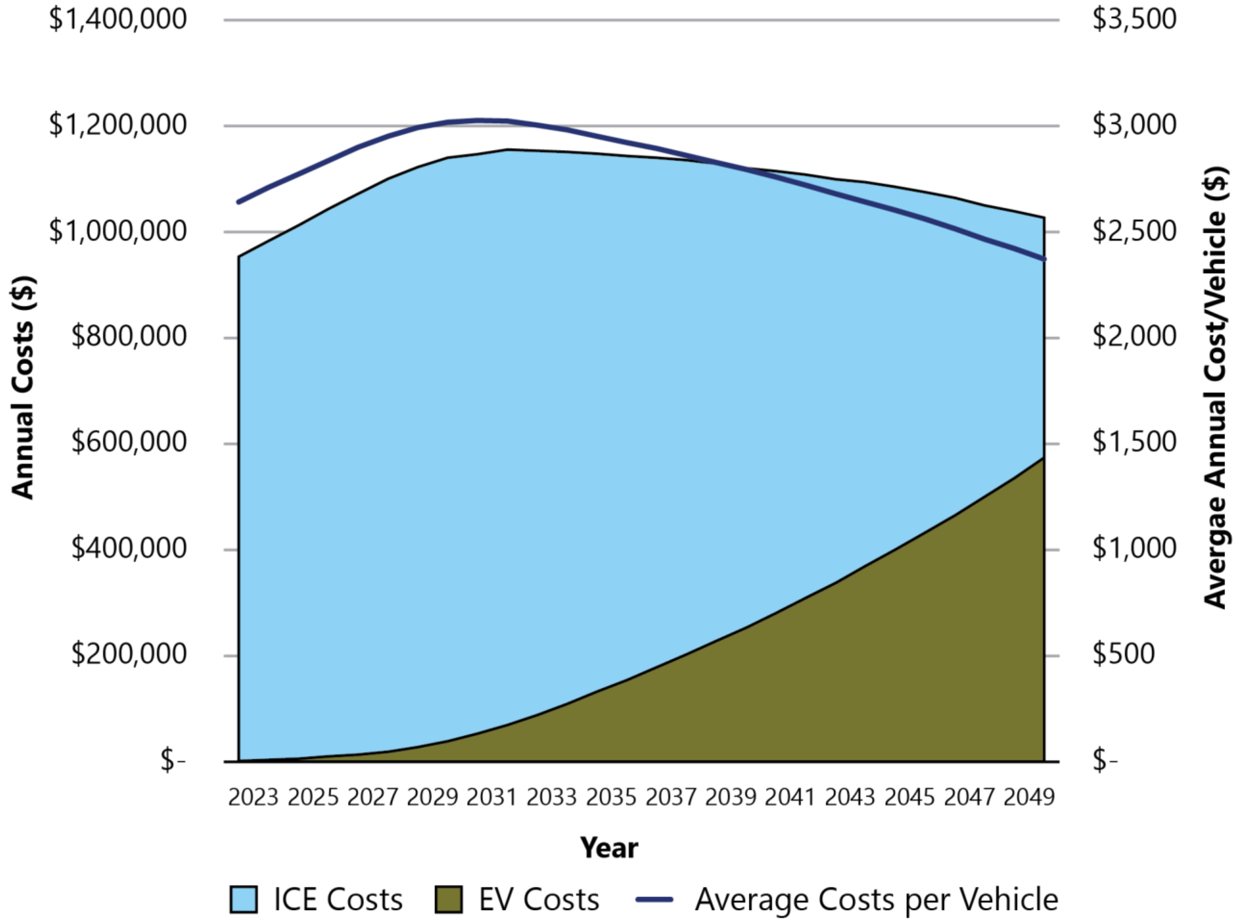


Figure 16: Combined Gas and Electricity Costs for Sucker River



Charging Stations

EV charging is supplied through an EV charger. Three different levels of charging infrastructure are currently available in the market: Level 1, Level 2, and Level 3. A comparison of these types is summarized in **Table 33**.[22]

[22] https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/electric-vehicle-charging/25049

Table 33: EV Charging Station Level Comparison

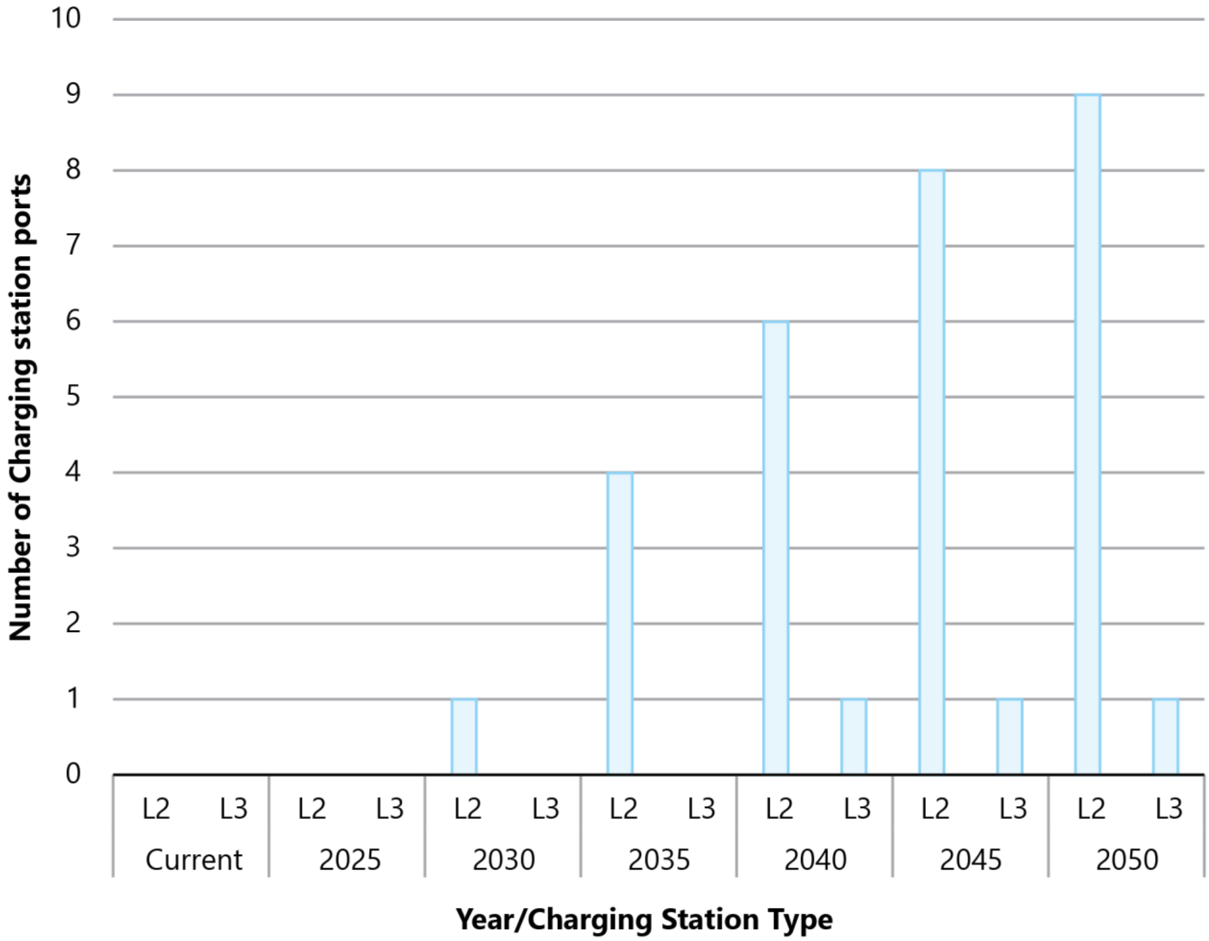
	Level 1 EV Charger	Level 2 EV Charger	Level 3 EV Charger
Input	120 V	208/240 V	480 V
Outlet type	Standard household (e.g., phone charger)	Large household appliance (e.g., oven)	DC outlet (not found in homes)
Time to Charge	8–50+ hours	4–10 hours	25–30 minutes
Range (per hour of charging)	3–8 km	16–50 km	Up to maximum driving range of vehicle
Typical Use	Home charging and back-up situations	Home charging, charging at businesses and public spaces	Charging at dedicated stations, public spaces, and highway corridors
Installation Costs/Port[23]	$	$$	$$$

The number of required public charging ports was estimated based on the projected increase in EV sales and ownership and a recent analysis of charging infrastructure needs prepared for Natural Resources Canada.[24] The conservative assumption was that there would be low access to at-home charging. **Figure 17** highlights the total projected number of Levels 2 and 3 ports required by the region in 2025, 2030, 2035, 2040, 2045, and 2050. According to this analysis, approximately nine Level 2 charging ports and one Level 3 charging station will be needed in Sucker River by 2050.

[23] Varies with site location, potential electrical upgrades, and the need for trenching or alterations to the site

[24] https://natural-resources.canada.ca/sites/nrcan/files/energy/cpcin/2022-ev-charging-assesment-report-eng.pdf, pg 22-23

Figure 17: EV Charging Station Needs for Sucker River



Financial considerations were estimated for Sucker River to install four Level 2 charging stations and one Level 3 charging station by 2025 for public use. **Table 34** summarizes the financial cost considerations of this installation while

Table 35 summarizes the assumptions for revenue scenarios.

Table 34: Financial Cost Considerations for L2 and L3 Charging Stations in 2025

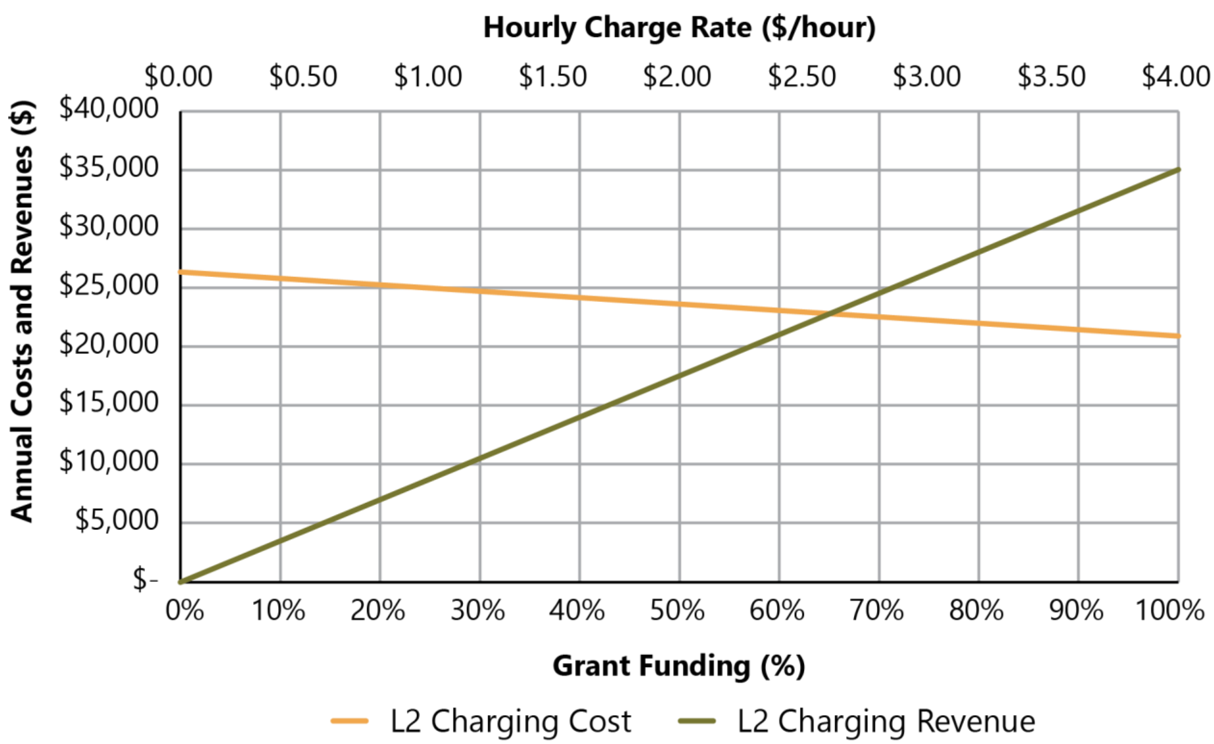
Grant Scenario	0%	50%	90%	0%	50%	90%
Equipment Installed	Four Level 2 Chargers			One Level 3 Charger		
Usage Rate	25%			5%		
Annual Electricity Use (kWh)	105,100			65,700		
Capital Investment ($)	$43,000			$135,000		
Annual O&M Costs ($)	$20,900			$12,550		
Life of the Station	10 years					
Community Contribution ($)	$43,000	$21,500	$4,300	$135,000	$67,500	$13,500
Incentives and Grants ($)	$0	$21,500	$38,000	$0	$67,500	$121,500
Debt Ratio	100%	50%	10%	100%	50%	10%
Annual Debt Payment ($)	$5,500	$2,700	$546	$17,150	$8,600	$1,715

Table 35: Revenue Scenarios for L2 and L3 Charging Stations in 2025

Charging Rate Scenario	$0/hour	$2/hour	$4/hour	$0/hour	$20/hour	$40/hour
Equipment Installed	Four Level 2 Chargers			One Level 3 Charger		
Usage Rate	25%			5%		
Annual Revenue	$0	$17,520	$35,040	$0	$8,760	$17,520

Figure 18 shows the cost and revenue for a Level 2 charging station based on different hourly charge rates and grant funding scenarios. On the shown graph, the costs break even with revenue where the two lines intercept. Based on this analysis, Level 2 charging stations would be profitable if the community received at least 65% grant funding to offset costs and charged at least $2.60/hour for their use. Currently, the average pay-per-use hourly charge for Level 2 stations is about $1 to $2.50 per hour.[25]

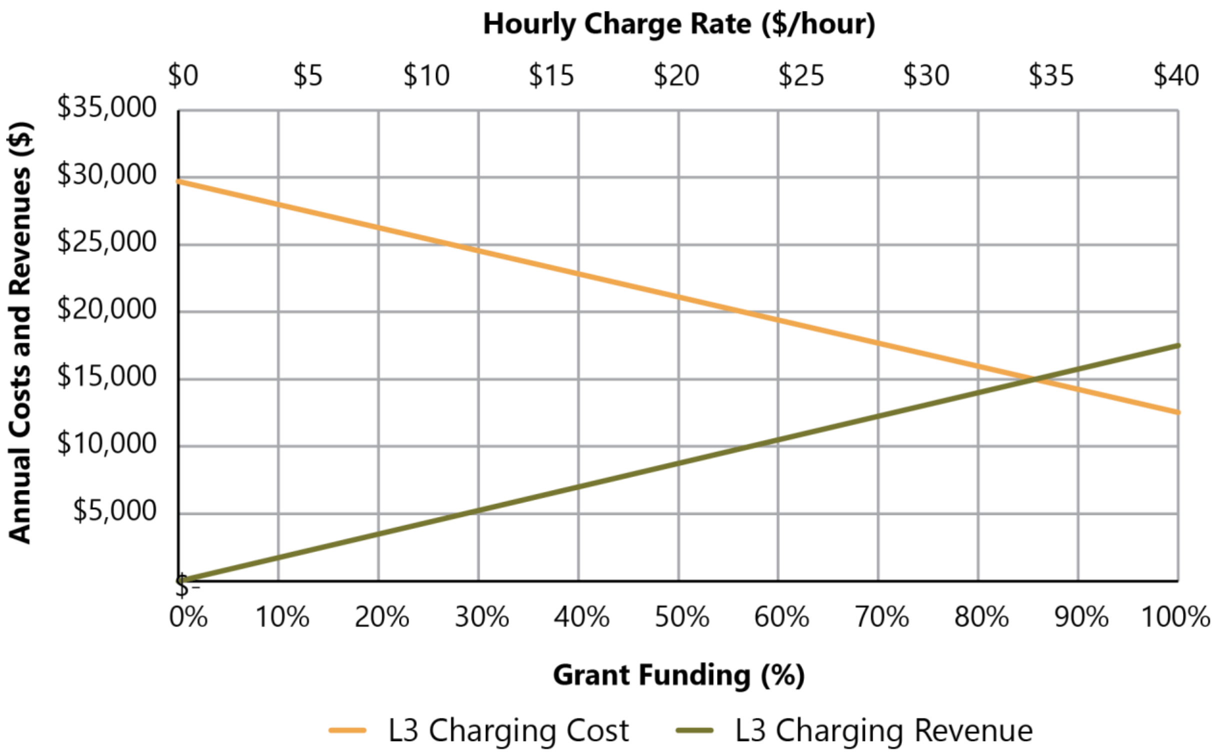
Figure 18: Level 2 Charging Station Cost and Revenue Scenarios



[25] https://www.saskpower.com/Power-Savings-and-Programs/Electric-Vehicles/Electric-Vehicle-Resources/Charging#:~:text=Cost%20to%20Install%3A%20%241%2C000%20to,electrical%20panel%20and%20power%20service.

Figure 19 shows the cost and revenue for a Level 3 charging station based on different hourly charge rates and grant funding scenarios. Like **Figure 18**, the cost breaks even with the revenue when the two lines intercept. Based on this analysis, Level 3 charging stations would be profitable if the community received at least 85% grant funding to offset costs and charged at least $34/hour for their use. Currently, the average pay-per-use hourly charge for Level 3 stations is about $15 per hour.[26]

Figure 19: Level 3 Charging Station Cost and Revenue Scenarios



The usage rate used for these calculations was conservatively low – as more drivers opt to use electric, especially out-of-community drivers benefitting from the charging station along their travels, this number will increase, and more revenue from charging stations could be gained.

For example, assuming the capital investment is 65% funded, if the Level 2 charging stations are used closer to 35% of the time, then their annual costs could break even with revenue at a $2.50/hour rate. However, even if Level 3 charging stations were used 100% of the time, the current assumptions show that their annual costs would never break even with revenue at a $15/hour rate – the minimum charge to break even is closer to $28/hour.

[26] https://ama.ab.ca/electric-vehicles/charging/cost

Renewable and Low-Emission Energy

Renewable energy models estimate a potential system's energy production, cost, and financial payback. Variables such as the renewable energy resource in the area (e.g., wind, solar irradiation, water flow), construction costs, and grant funding opportunities are assessed to determine each technology's potential financial viability.

For all renewable energy models, the assumptions included in **Table 36** were used in RETScreen® to estimate their likely financial viability.

Table 36: RETScreen® Financial Assumptions

Parameter	Value	Source
Energy Escalation Rate	2.6%	SaskPower Data
Inflation Rate	3%	Bank of Canada[27]
Discount Rate	5%	RETScreen®
Reinvestment Rate	5%	RETScreen®
Debt Interest Rate	4.5%	First Nations Finance Authority[28]
Debt Term	20 years	First Nations Finance Authority
Remote Travel Costs	5%	SK Installers
Contingency*	30%	Class D Estimate[29]
Electricity Rate – Residential	$0.159/kWh	SaskPower
Electricity Rate – Small Commercial	$0.161/kWh	SaskPower
Electricity Rate – Standard Commercial	$0.126/kWh	SaskPower
Net Metering Rate	$0.075/kWh	SaskPower
Power Purchase Agreement (PPA)	$0.075/kWh	SaskPower

**Note: Given their higher pricing certainty, a Class 'C' estimate (which only requires a 15% contingency) can be assumed for residential solar projects with low complexity.*

[27] https://tradingeconomics.com/canada/inflation-cpi
[28] https://www.fnfa.ca/en/fnfa/
[29] https://www.cca-acc.com/wp-content/uploads/2016/07/GuideCostPredictability.pdf

The Simple Payback Period was plotted against various grant funding scenarios for each opportunity. This graph provides a visualization of the tipping point at which the Simple Payback Period of each system is less than or equal to the project life. The $/kWh electricity rate was also calculated for the same grant funding scenarios to determine when the electricity production cost for renewable energy systems is less than or equal to SaskPower's current electricity rate. Any project costs not covered through grant funding were assumed to be funded through debt financing.

Based on these results, the early-stage financial viability of all potential projects was estimated. One key indicator considered was the Simple Payback Period, which is the time required to recover the cost of an investment. If this is shorter than the project life, the project may be worth further consideration.

Solar

A desktop assessment of potential solar PV projects was completed for each community. The location and scale of these projects were chosen based on what was heard through discussions at community engagements, along with the following criteria:

Ground Mount Criteria

- Available ground space
- Proximity to interconnection point
- Minimal shading

Roof Mount Criteria

- Available roof space
- Minimal shading
- South-facing angled or flat roof

The footprint for a ground-mounted solar system was estimated based on the criteria outlined in **Table 37**.

Table 37: Solar PV System Footprint

System Size (kW)	System Footprint (m^2/kW)
0–99	5
100–999	10
1000 +	20

For each selected project site, preliminary solar PV assessments were completed using HelioScope Advanced Solar Design Software to determine the system layout and production. **Table 38** highlights key assumptions that were made to model each type of system based on industry best practices.

Table 38: HelioScope Modeling Assumptions

Ground Mount	
PV Module Size	550 W
Racking System	Fixed tilt, portrait orientation, 2 up x 1 wide
Row Spacing	24-30 ft
Inverter Type	String inverter (1.1–1.3 DC/AC ratio)
Azimuth	180°
Tilt	30°
Pitched Roof Mount	
PV Module Size	400–550 W
Racking System	Flush mount
Row Spacing	None
Inverter Type	String inverter (1.1–1.3 DC/AC ratio)
Azimuth	Lined up with roof
Tilt	Same as roof pitch
Flat Roof Mount	
PV Module Size	550 W
Racking System	Fixed tilt
Row Spacing	20–24 in
Inverter Type	String inverter (1.1–1.3 DC/AC ratio)
Azimuth	Lined up with roof
Tilt	10°

RETScreen® was then used to assess the financial viability of each solar system. The assumptions used to assess the installation costs of each solar system are shown in **Table 39**.

Table 39: Solar Assessment Cost Assumptions

Description		Amount	Source
Installation Costs	10 kW Roof-Mounted System	$2,800/kW	Saskatchewan solar installers
	100 kW Roof-Mounted System	$2,700/kW	Saskatchewan solar installers
	Ground-Mounted System	$2,700/kW	Saskatchewan solar installers
O&M Costs	10 kW System	$42/kW/year	RETScreen®
	100 kW System	$27/kW/year	RETScreen®

The average $/kW amount was used to estimate system costs for the energy modelling in this plan.

The standard SaskPower rates were used for any electricity produced by the PV system and consumed directly by the facility. In contrast, net metering rates were used for electricity exported to the grid. Systems were sized to minimize export, and the electricity export rate was adjusted in RETScreen® based on the ratio of electricity consumed by the facility and electricity exported to the grid each month.

The monthly distribution of electricity produced was estimated in HelioScope. Electricity consumption of the building was determined based on historical annual electric bills, with the average of all home bills used for the residential example. The monthly distribution of electricity consumption was estimated based on typical values for building types, summarized in **Table 40** below.

Table 40: Monthly Distribution of Electricity Consumption

Month	% Of Total Annual Electricity Consumption			
	Residential Building[30]		Ice Rink[31]	Non-Residential Building[32]
	Gas Heating	Electricity Heating		
January	9%	15%	10%	10%
February	8%	14%	9%	9%

[30]Using https://www.saskpower.com/Power-Savings-and-Programs/Home/Tools-to-Analyze-Your-Power-Use/Online-Energy-Assessment-for-Homes. Assuming a 550-1,600 sqft house with 4 residents
[31] Property: NRCAN/RNCAN Sample Ice Rink (ID 29761001)
[32]https://www.novascotia.ca/finance/statistics/news.asp?id=16615

Month	% Of Total Annual Electricity Consumption			
	Residential Building[30]		Ice Rink[31]	Non-Residential Building[32]
	Gas Heating	Electricity Heating		
March	9%	14%	9%	9%
April	8%	8%	10%	8%
May	8%	3%	9%	8%
June	8%	2%	7%	8%
July	8%	2%	5%	8%
August	8%	2%	5%	8%
September	8%	3%	8%	8%
October	8%	6%	9%	8%
November	8%	13%	9%	9%
December	9%	18%	10%	9%

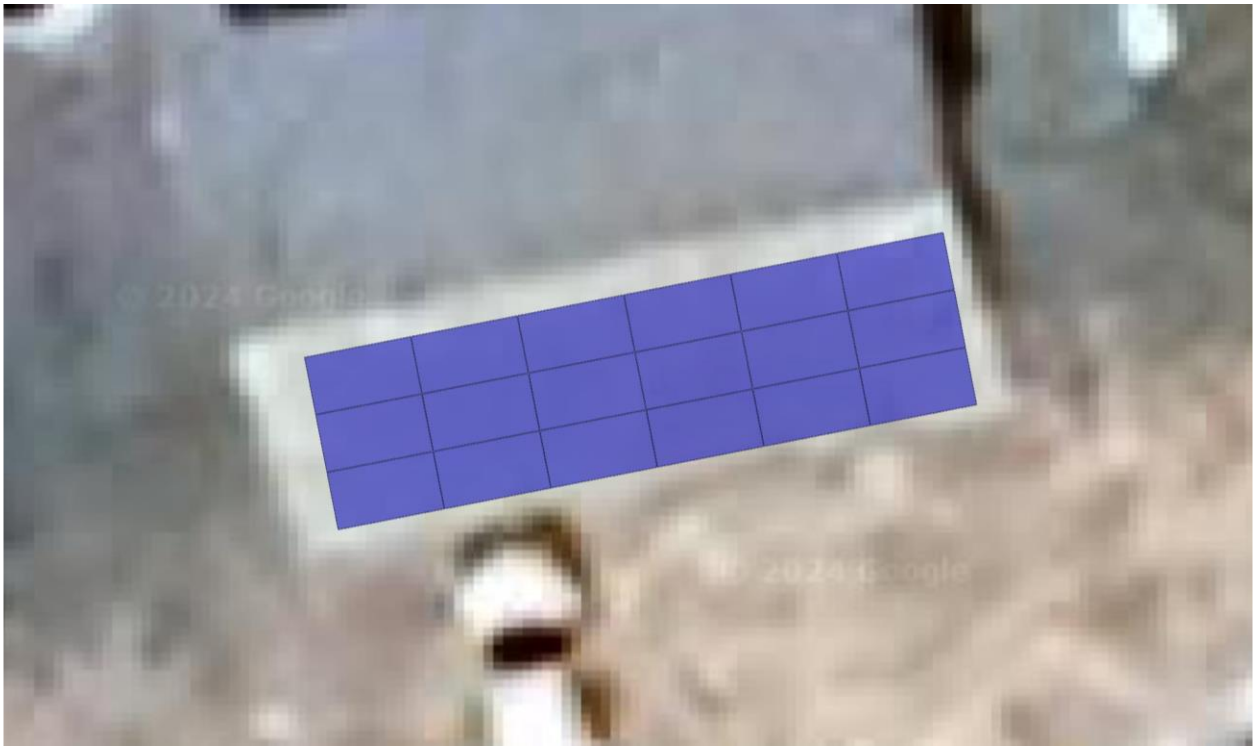
Since more electricity is produced in the summer, systems were sized so that their extra energy credits could be used in the winter. For each system connected with a building, a blended rate was calculated to account for some electricity being credited. For example, if a house used roughly 67% of the energy produced by the solar panels on-site, and 33% of the electricity was credited for another month, the blended rate was calculated using the following equation:

$$\frac{\$0.159}{kW} \times 0.67 + \frac{\$0.075}{kW} \times 0.63 = \$0.131/kW$$

Example Model: Residential House

Based on full-year accounts, between 2018 and 2022, the average house in Sucker River used approximately 16,900 kWh of electricity per year. The monthly distribution of electricity consumption was assumed to coincide with a typical residential home with electricity heating (see **Table 40**). Using HelioScope PV analysis software, an optimal solar PV configuration for a roof-top system on a typical house was reviewed. The proposed configuration, shown below in **Figure 20**, is 7.2 kW and the annual electricity output was determined to be approximately 8,120 kWh, of which 66% would be consumed the month it was produced, and 34% would get credited for an export rate of $0.130/kWh.

Figure 20: Residential Solar PV System Configuration as Designed in Helioscope: Residential Solar PV System Configuration as Designed in HelioScope

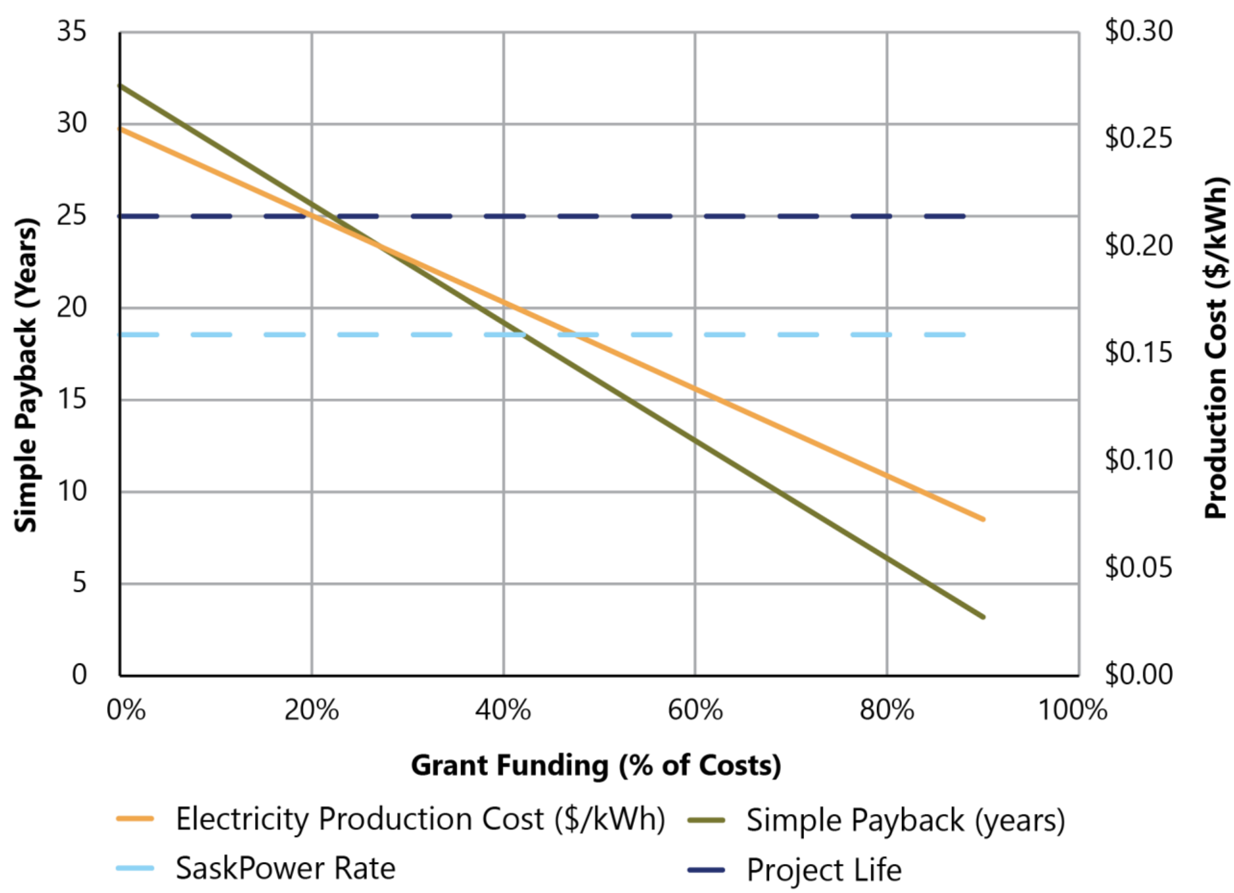


Based on this, a preliminary financial analysis was developed and is highlighted in **Table 41**. The Simple Payback Period and the Electricity Production Cost based on the amount of grant funding received are shown in **Table 41.** Based on this analysis, the project would have a Simple Payback Period of 25 years if the project received 22% grant funding. The project would need to receive a grant worth 47% to produce electricity for the same rate as SaskPower's current residential rate.

Table 41: Residential Solar PV System Preliminary Financial Feasibility Analysis

Grant Scenario	0%	50%	90%
Installed Capacity	7.2 kW		
Annual Electricity Production	8,120 kWh		
Capital Investment	$24,200		
Blended Rate	$0.145/kW		
Incentives and Grants ($)	$0	$12,100	$21,800
Personal Contribution ($)	$24,200	$12,100	$2,400
Electricity Production Cost ($/kWh)	$0.26	$0.15	$0.07
Simple Payback	32 years	16 years	3 years

Figure 21: Payback Period and Electricity Production Cost based on Grant Funding for Residential Solar System



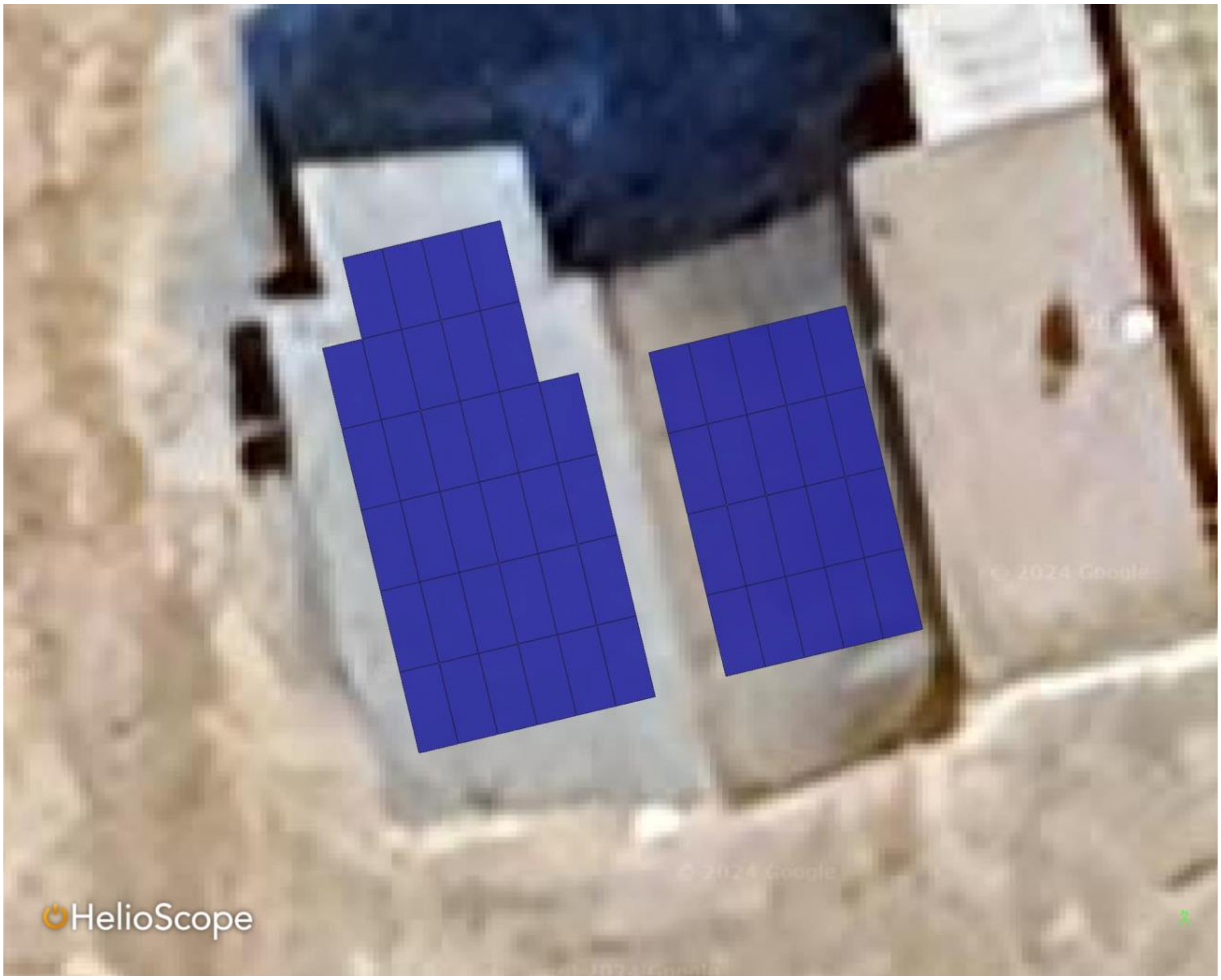
Example Model: Community Building

The Sucker River Community Hall, shown below in **Figure 23:** was identified as a potential candidate for rooftop solar. The project team used data from the community's energy baseline to estimate that the school uses approximately 22,168 kWh of electricity annually. The monthly distribution of electricity consumption was assumed to coincide with the average non-residential building data (see **Table 40**).

Figure 22: Sucker River Community Hall

Using HelioScope PV Analysis software, an optimal solar PV configuration for a roof-top system on the Community Hall was reviewed. The proposed configuration, shown below in **Figure 23**, is 29.2 kW and the annual electricity output was determined to be approximately 26,085 kWh, of which 61% would be consumed the month it was produced, for an export rate of $0.128/kWh. Results from the preliminary feasibility analysis are summarized in **Table 42.**

Figure 23: Sucker River Community Hall's Solar PV System Configuration as Designed in HelioScope

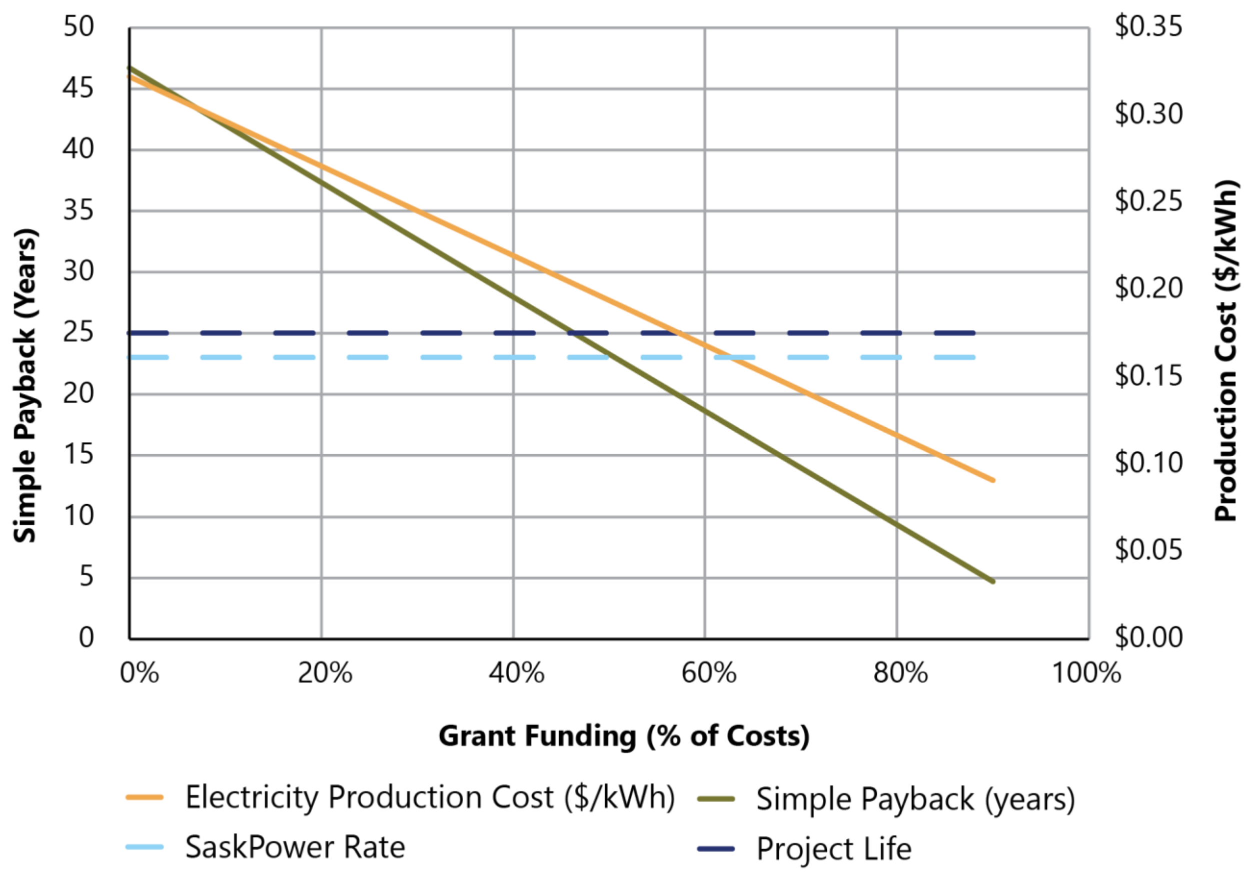


The Simple Payback Period and the Electricity Production Cost based on the amount of grant funding received are shown in **Figure 24**. Based on this analysis, the project would have a Simple Payback Period of 25 years if the community received 47% grant funding to offset costs. However, the community would need to receive a grant worth 63% to produce electricity for the same rate as SaskPower's current standard commercial rate.

Table 42: Sucker River Community Hall Solar PV System Preliminary Financial Feasibility Analysis

Grant Scenario	0%	50%	90%
Installed Capacity	29.2 kW		
Annual Electricity Production	62,085 kWh		
Capital Investment	$98,100		
Blended Rate	$0.128/kW		
Incentives and Grants ($)	$0	$49,100	$88,300
Community Contribution ($)	$98,100	$49,000	$9,800
Electricity Production Cost ($/kW)	$0.32	$0.19	$0.09
Simple Payback	47 years	23 years	5 years

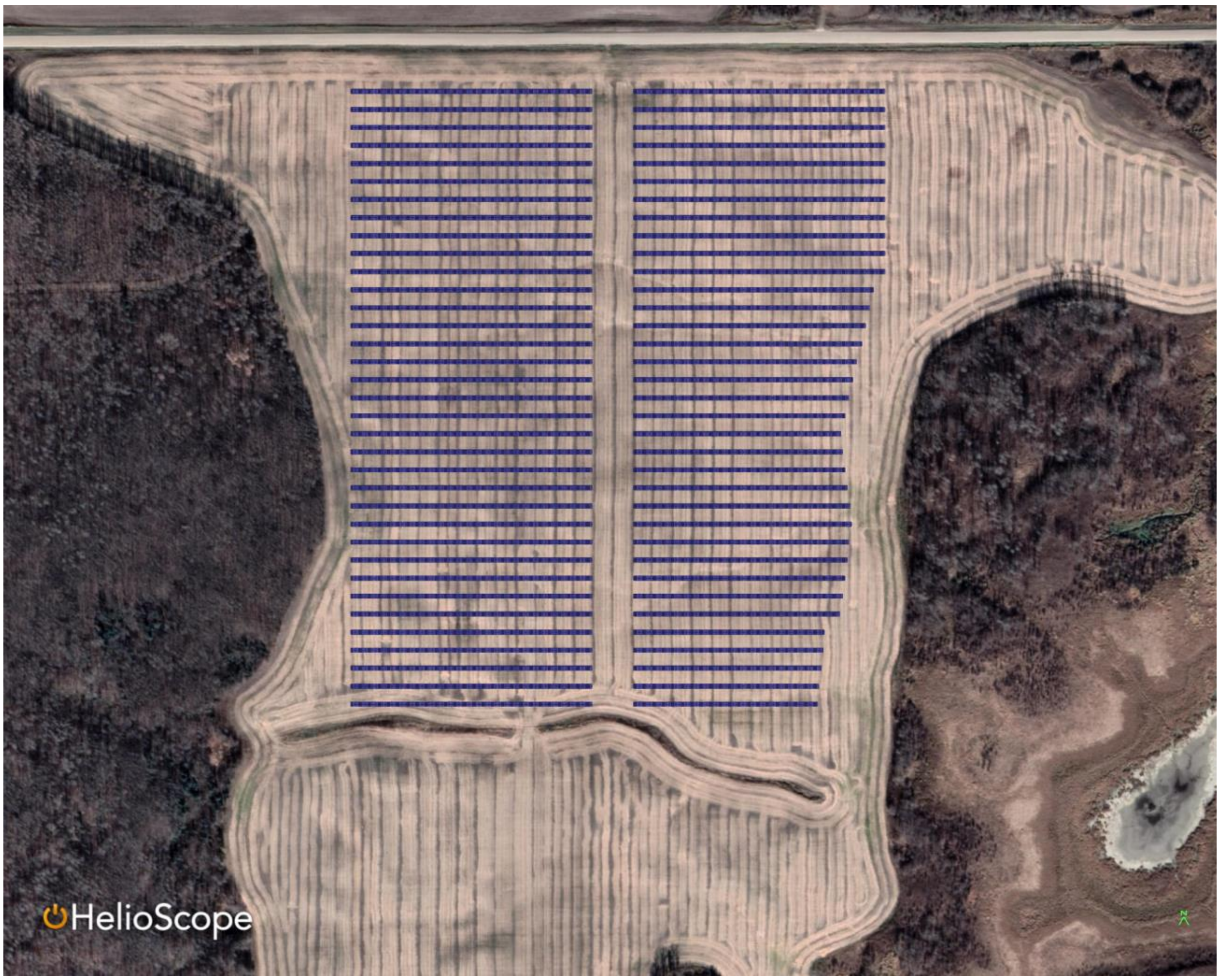
Figure 24: Payback Period and Electricity Production Cost based on Grant Funding for the Sucker River Community Hall Solar



Example Model: Ground-Mount System (Little Red River)

Using HelioScope PV analysis software, the team identified an optimal solar PV configuration in Little Red River for a large-scale ground-mount system for the Lac La Ronge Indian Band to invest in. If all six communities were to invest in one location for a larger-scale project on Band-owned land, the recommendation would be to consider Little Red River's land due to its higher solar potential and larger unshaded land space. The system modelled is shown in **Figure 25**, which is on farmland. The project could use a raised mounting system to enable both solar and food farming on the same lot. The total installed capacity of the proposed system is 13,800 kW, and the annual electricity output was determined to be approximately 17,920,467 kWh.

Figure 25: Ground-Mount Solar PV System Configuration as Designed in HelioScope



The preliminary financial analysis is summarized in **Table 43** below.

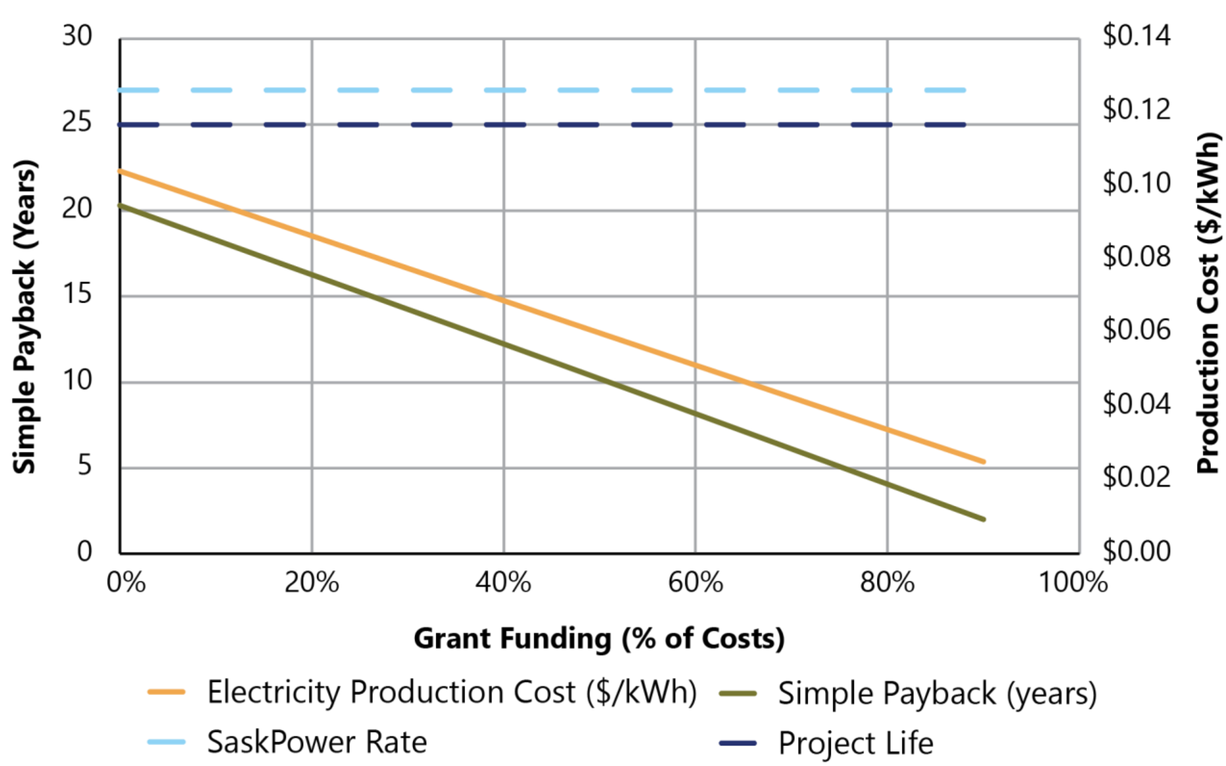
The Simple Payback Period and the Electricity Production Cost based on the amount of grant funding received are shown in **Figure 26**. Based on this analysis, assuming the electricity is exported to the grid at $0.075/kWh, the project would have a Simple Payback Period of 20 years.

Without external grant funding, it could produce electricity below the standard commercial rate of $0.126/kWh. It should be noted that the electricity export rate would be negotiated with SaskPower to determine the actual rate, which will have the biggest impact on the payback period.

Table 43: Ground Mount Solar PV System Preliminary Financial Feasibility Analysis

Grant Scenario	0%	50%	90%
Installed Capacity	13,800 kW		
Annual Electricity Production	17,920,467 kWh		
Capital Investment	$23,084,600		
Electricity Export Rate	$0.075/kW		
Incentives and Grants ($)	$0	$11,542,300	$20,776,100
Community Contribution ($)	$23,084,600	$11,542,300	$2,308,500
Electricity Production Cost	$0.10	$0.06	$0.03
Simple Payback	20 years	10 years	2 years

Figure 26: Payback Period and Electricity Production Cost Based on Grant Funding for the Large-scale Ground-Mount Solar System at Little Red River



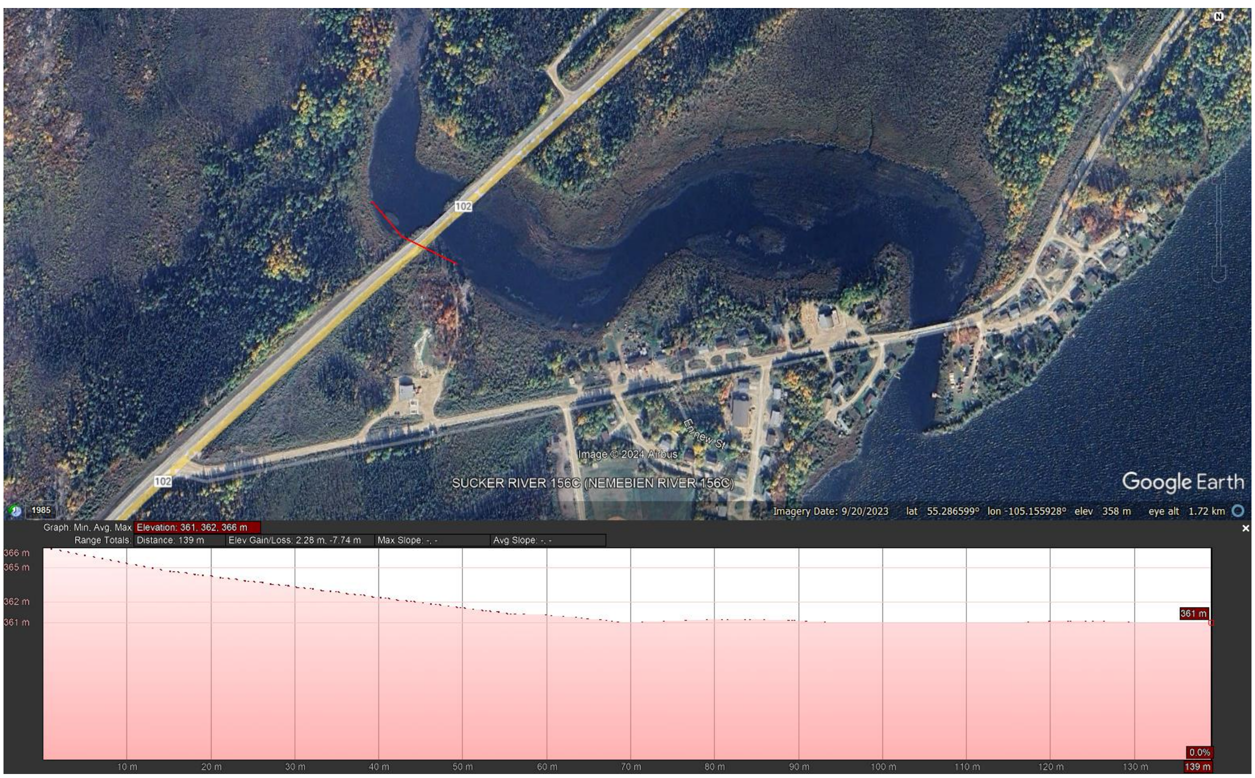
Hydropower

A desktop assessment of potential hydropower projects was modelled through RETScreen® using local watercourse flow data from Environment Canada hydrological monitoring stations. The locations of these projects were chosen based on the following criteria:

- Proximity to nearby buildings or points of interconnection
- Sufficiency of flow and elevation difference for hydropower generation
- Recommendations from community engagement

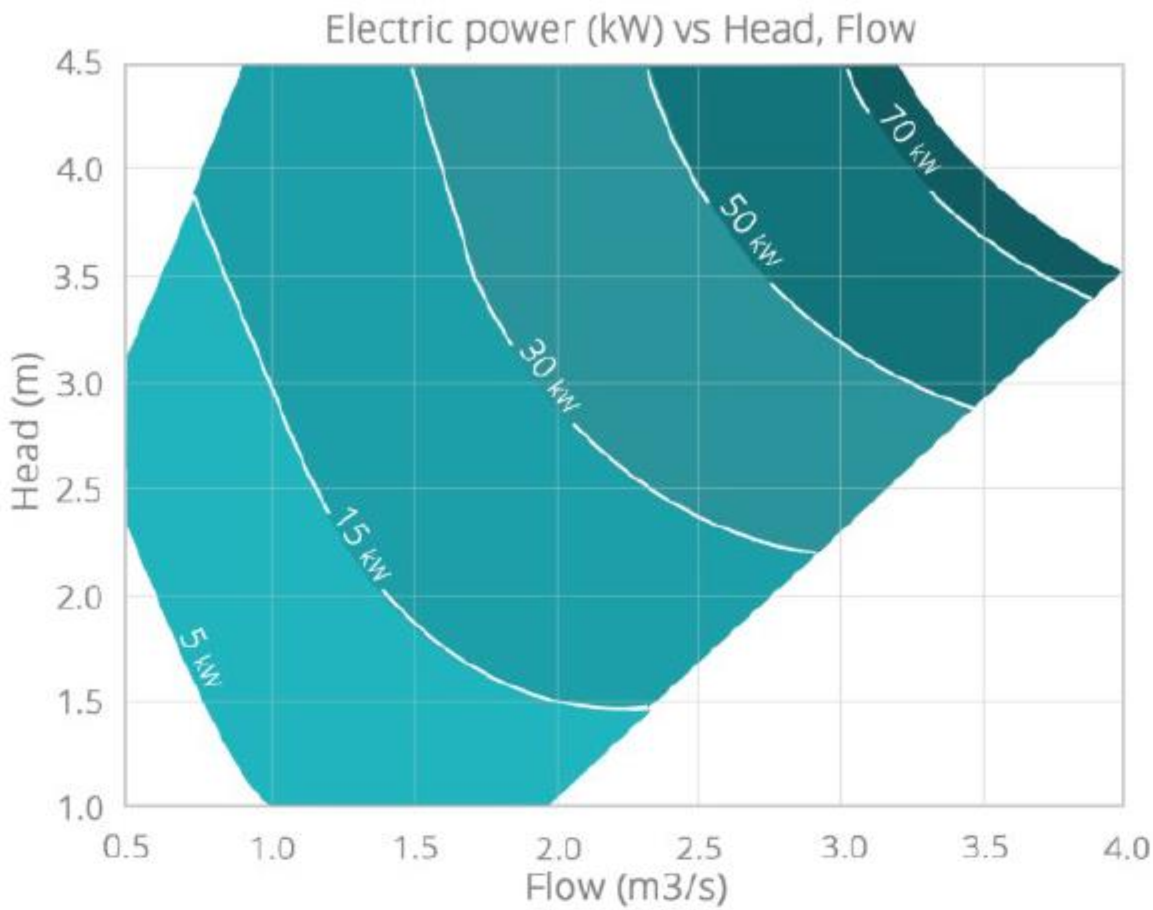
The Nemeiben River, starting just across the highway from the community, was identified by the community energy project team due to its proximity to the community and significant elevation change. There was no gauging station to understand the historical flow of this river. The gross head of the site (height differential from the entry point to the exit point of the hydro installation) was measured using Google Earth, shown in **Figure 27.**

Figure 27: Location of Hydrological Modelling Station



Over the 139 m measured, the elevation changes from 366 m to 361 m, which gives a head of 5 m. The available flow for power was to be estimated based on daily flow, excluding 20% of the historical average daily flow for environmental flow needs, based on other jurisdictions with stricter regulations.

Figure 28: Turbulent Electric Power vs. Head, Flow



Assuming a conservative available flow rate of at least 0.75 m^3/s, the 4.5 m head can achieve the nominal power output of a four 15 kW turbine system. This resulted in the design inputs listed in **Table 44**.

Table 44: Design Inputs

Variable	Value
Design Flow (m^3/s)	3
Gross Head (m)	4.5
Canal Length (m)	139
Nominal Power (kW)	60

The project team worked with a local installer to conduct a preliminary financial analysis for four 15 kW Turbulent B-200 turbines, as shown in **Table 45.**

Table 45: Hydro Assessment Cost Assumptions

<table>
<tr><th>Item</th><th>Cost</th><th>Notes</th><th>Source</th></tr>
<tr><td>Turbine</td><td>$878,000</td><td>Supply & Install</td><td rowspan="9">Pioneer Infrastructure[33] Quote</td></tr>
<tr><td>Basin</td><td>$108,000</td><td>Supply & Install</td></tr>
<tr><td>Electrical</td><td>$97,000</td><td>Supply & Install</td></tr>
<tr><td>Housing</td><td>$26,000</td><td>Supply & Install</td></tr>
<tr><td>Permitting</td><td>$83,000</td><td>Building, Electrical, Water Permits</td></tr>
<tr><td>Canal</td><td>$39,000</td><td>$280/m
Supply & Install</td></tr>
<tr><td>Feasibility Study</td><td>$20,000</td><td>By Turbulent and Partners</td></tr>
<tr><td rowspan="2">O&M</td><td>$0.009/kWh</td><td>Control Software and Maintenance Supplies</td></tr>
<tr><td>5% of CAPEX per year</td><td>Quarterly Production Reports & Analysis, Site Visits, Cleaning & Small Repairs</td></tr>
</table>

[33] https://pioneerinfrastructure.com/about-us/

Assuming a net metering project, the average export rate was estimated to be $0.13/kWh, which is based on the assumption that 33% of the electricity will be credited back to the grid to account for the hours that the facility will be generating electricity and the buildings connected to the facility will not be using power (e.g., on holidays, or when most people are asleep). To incorporate the variable O&M costs, $0.009 was subtracted from this rate. With fixed annual operation and maintenance costs at $61,550/year, the project would need to generate at least **499,100 kWh/year** to make any profit. The preliminary financial analysis was developed and is highlighted in **Table 46**.

Table 46: Nemeiben River Micro-Hydro System Preliminary Financial Feasibility Analysis

Project Detail	Value
Installed Capacity	60 kW
Total Capital Costs	$1,680,500
Annual Fixed O&M - Labour	$61,550
Revenue - Blended Rate Including Variable O&M Costs	$0.124/kW

Given that this assessment is high-level, an actual project may have significantly different financial outcomes without historical flow data for the river assessed. A more in-depth feasibility study with on-site assessments and flow rate monitoring will be required if the community wants to pursue this opportunity further.

Wind Power

A key step in developing a wind energy project is understanding the wind energy resource on the site, estimating the energy production potential, and assessing the project's commercial viability.

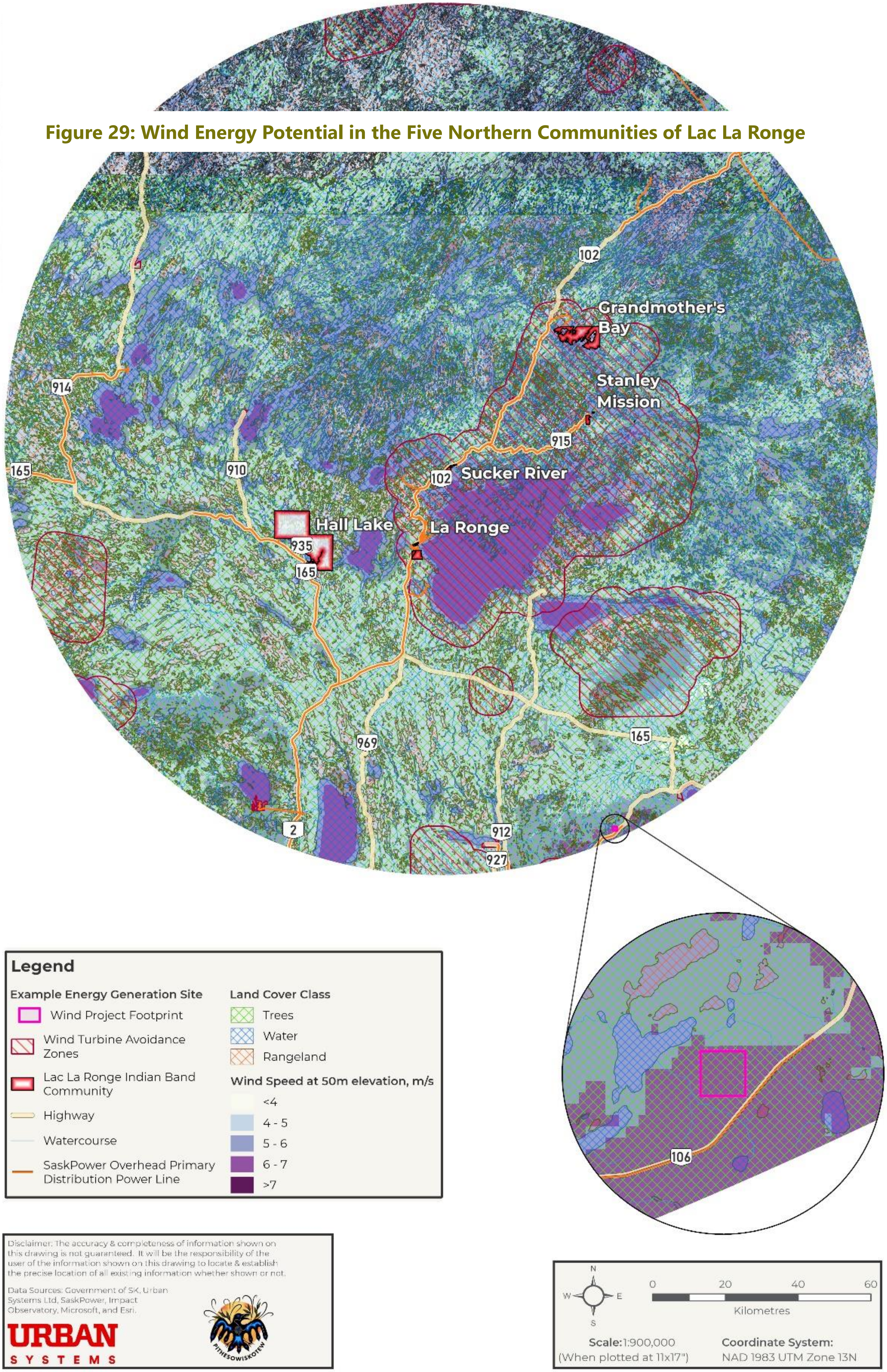
The first resource to reference is a high-level wind map, like the Global Wind Atlas.[34] The Global Wind Atlas is a free, web-based application developed to help policymakers, planners, and investors identify high-wind areas for wind power generation and perform preliminary calculations.

Figure 29 shows the wind potential of the surrounding area for all five northern LLRIB communities. The reserve land that Sucker River resides on is directly located in the "wind turbine avoidance" zones due to its proximity to the Lac La Ronge Lake and the higher risk of impacting migratory birds. This figure also notes that the nearby areas with the highest wind speed and subsequent best potential for wind power generation are situated on water bodies, which, while not all technically included in the "wind turbine avoidance" zone, would have similar impacts on migratory birds as the areas restricted for development.

Identifying a suitable site to develop wind power involved considering the proximity to existing access roads and the electrical grid, land ownership, and ground suitability for installing wind project infrastructure, including turbines, electrical connector lines, and access roads. The proposed project location is outside of the LLRIB reserve land, within 120 km of the five northern communities of Grandmothers Bay, Hall Lake, La Ronge, Stanley Mission, and Sucker River. The area is heavily treed with a nearby road, and the average wind speed at 50 m elevation for this site is about 6 m/s.

[34] https://globalwindatlas.info/en

Figure 29: Wind Energy Potential in the Five Northern Communities of Lac La Ronge



The key findings from the RETScreen® analysis performed on this site are provided in **Table 47** below, alongside statistics and data from comparable projects in Saskatchewan or industry averages, to give a sense of how the potential Lac La Ronge site compares to other projects.

Table 47: Wind Resource Assessment Near the Five Northern LLRIB Communities

Characteristics	Potential Lac La Ronge Site	Comparable Statistic or Data
Average Wind Speed	6.11 m/s at 50 m height	7.3 m/s at 50 m height[35]
Wind Turbine Model	Brand/Model: Enercon Capacity: 3 MW/turbine Hub Height: 99 m Rotor Diameter: 101 m	Capacity: 2.6 MW/turbine Hub Height: 70 m[36]
Total Nameplate Capacity for the Project	15 MW	10 MW to 200 MW[37]
Annual Average Capacity Factor	28.4%	34.4%[38]
Capital Cost ($/kW)	$2,270/kW	$2,270/kW[39]
Estimated Annual Energy Generation (MWh)	37,300,000 kWh	-
Electricity Sell-Back Rate	$0.075[40]	-
Levelized Cost of Energy (LCOE) ($/kWh)	$0.121/kWh	$0.05/kWh[41]
Simple Payback Period	25.1 years	-

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[35]The average wind speed at the existing wind energy projects in southern Saskatchewan https://globalwindatlas.info/en

[36] The average hub height of wind turbines in Saskatchewan

[37] Currently, Saskatchewan's wind power projects are located closer to Regina, primarily south of Highway 1. In 2024, Saskatchewan has a total of 8 wind power projects in operation accounting for up to 617 MW of nameplate capacity with a project size ranging from 10 MW to 200 MW. Source: https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/System-Map

[38] Wind energy projects operating between 2010–2016. Source: Lee M Miller and David W Keith 2018 *Environ. Res. Lett.* 13 104008

[39] For projects of similar size according to RETScreen

[40] Assumed PPA rates - actual rate will vary and depend on SaskPower negotiations

[41]For wind projects in Alberta and Ontario https://cleanenergycanada.org/wp-content/uploads/2023/01/RenewableCostForecasts_CleanEnergyCanada_Dunsky_2023_SlideDeck.pdf

It should be noted that the financial results compared for the potential site near Lac La Ronge did not include any support through incentives or grants. Supposing the project received 50% in grant funding for the capital costs to construct the project, the simple payback period drops to 13 years for the community's costs to construct, and the cost to the community to produce the power drops to $0.076/kWh. If the project could produce power at a rate lower than what the electricity is sold back to SaskPower for, it will most likely be pursued and succeed financially.

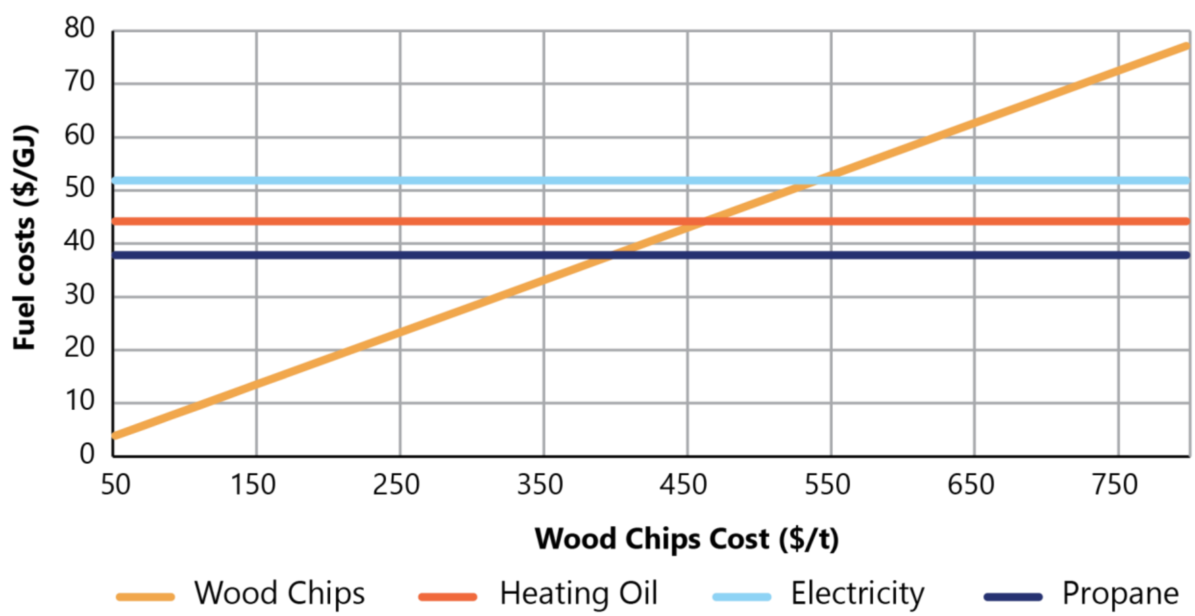
The results from RETScreen® modelling provide a high-level understanding of the project's viability using regional data and assumptions. These results are used as a screening tool to determine if the next step of completing a comprehensive wind data collection and modelling program should be pursued.

Biomass and District Energy

An analysis of the required wood feedstock pricing was completed to understand the viability of utilizing biomass heating instead of existing heating systems in buildings (e.g., systems which use heating oil, propane, or electricity). This analysis was completed to understand the biomass feedstock price required for a biomass heating system to be financially viable for heating buildings in Sucker River.

Figure 30 below provides a summary of the potential wood chip costs at 30% moisture content in comparison to possible "base case" fuel costs (i.e., the cost of existing fuels used to heat community buildings). The points at which lines cross on the graph are where the cost of wood chips and the selected fuel source would be equivalent.

Figure 30: Heating Cost Comparison by System Type



The graph above shows that for a biomass system (wood chip boiler system) to be "cheaper" than an existing heating system, the rates shown in **Table 48** below would be required for wood chips at 30% moisture content.

Table 48: Wood Chip Rates Required

Base Case System	Existing Fuel Cost ($/GJ)	Comparable $/t Fuel Cost for Wood Chips
Heating Oil	$30.93/GJ	$455/t
Propane	$37.8/GJ	$390/t
Electricity	$51.9/GJ	$540/t

Based on research completed for wood chip costs throughout Western Canada, $160/t is the average rate for wood chips.

Given that Sucker River's current heating options have a higher fuel cost than anticipated wood fuel costs, biomass and district energy would be worthwhile to explore further. An underutilized parcel of land was identified as a potentially viable location for the biomass boiler due to its central location in proximity to multiple large community buildings. The proposed project layout is displayed in **Figure 31**.

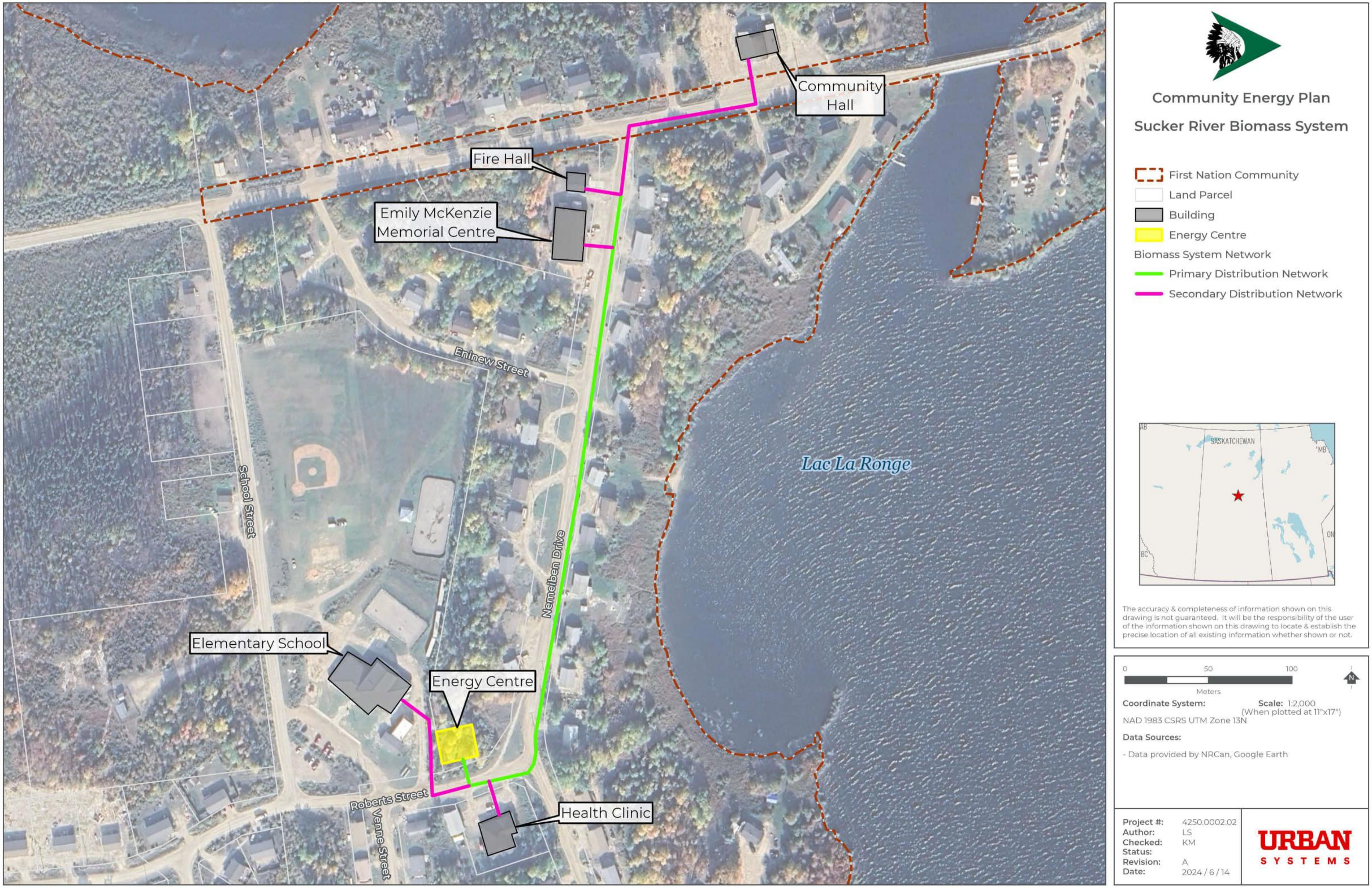


Figure 31: Proposed Biomass Project Layout

Table 49 below summarizes assumptions for the buildings included in the proposed scenario, including their space heating sources and estimated heating load. Building-specific heating data was unavailable, so provincial databases were referenced to estimate the approximate heating load of the buildings included in the scenario. These heating loads were estimated based on the assumed building type and estimated building footprint, summarized in the table below.

Table 49: Assumed Building Details

Building Name	Building Footprint (m^2)	Building Type	Total Estimated Heating Load (GJ)
Community Hall	320	Recreation	
Fire Hall	120	Other	
Emily McKenzie Memorial Centre	560	Recreation	3,530 GJ
Elementary School	1,000	Education	
Health Clinic	400	Health Care	

To further understand if a biomass project may be viable, the following actions would need to be completed:

- Collect building-specific energy usage data (e.g., propane and/or electricity heating bills) to determine the right system size for heating needs.
- Source a biomass fuel source that is comparable to the current system's fuel's heating value. Keep in mind that the moisture content of the material will greatly impact the heating value.

Geothermal

Geothermal energy was determined not to be suitable for the Sucker River community. As shown in **Figure 32**, the reserve land is located on top of cool sedimentary basins, which means that the temperatures of accessible aquifers are not hot enough to efficiently generate steam and turn a turbine to generate power, nor are they warm enough to efficiently heat a building through heat exchange. The community is also situated right on the edge of the Precambrian Crystalline Basement – commonly referred to as the Canadian Shield – which cannot accommodate horizontal drilling and would require multiple vertical holes drilled through thick hard rock. For example, for a 1,200 sq ft home, approximately eight vertical holes would need to be drilled directly 120 feet down,[42] which, at $25/foot,[43] would cost $24,000 before the cost of the geothermal exchange system and its installation. Air-source heat pumps, an alternative to geothermal exchange that does not require drilling, are compared with other heating and cooling technologies in the Energy Conservation section of this report.

[42] Local Saskatchewan Installer (miEnergy)

[43] https://homeguide.com/costs/well-drilling-cost#:~:text=Drilling%20a%20residential%20water%20well,drilled%20and%20the%20well's%20diameter.

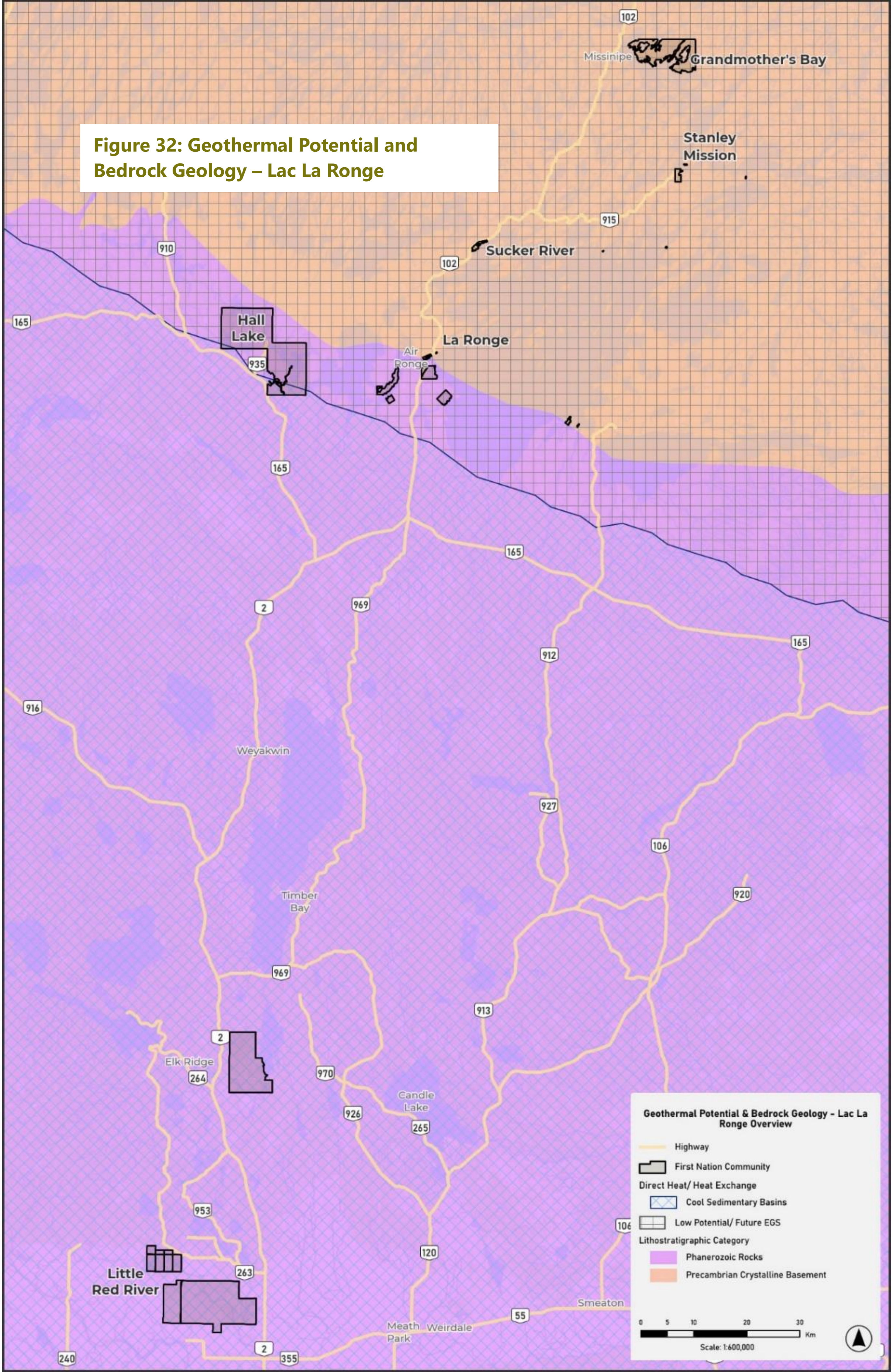


Figure 32: Geothermal Potential and Bedrock Geology – Lac La Ronge
Grandmother's Bay
Missinipe
Stanley Mission
Sucker River
Hall Lake
La Ronge
Air Ronge
Weyakwin
Timber Bay
Elk Ridge
Candle Lake
Little Red River
Smeaton
Meath Park
Weirdale
Geothermal Potential & Bedrock Geology - Lac La Ronge Overview
Highway
First Nation Community
Direct Heat/ Heat Exchange
Cool Sedimentary Basins
Low Potential/ Future EGS
Lithostratigraphic Category
Phanerozoic Rocks
Precambrian Crystalline Basement
Km
Scale: 1:600,000

Nuclear

Nuclear reactors and facilities cannot be realistically implemented at the community level at this time; however, there are ways to be involved in provincial and federal planning that Sucker River may consider. These include:

- **Engaging/Advocating:** The Province of Saskatchewan will be collaborating with Indigenous Peoples and communities, industry, innovators, laboratories, academia, and civil society as part of their feasibility study for adding Small Modular Nuclear Reactors (SMRs) into their supply mix. This is an opportunity for Sucker River to advocate for their position on nuclear energy.
- **Mining:** According to Natural Resources Canada (NRCan), most of the country's uranium reserves are in the world's largest high-grade uranium deposits in northern Saskatchewan's Athabasca Basin. The known uranium deposits will last more than 40 years at current production levels. This means that if nuclear technology is to be further pursued and sustained, all other known and speculated deposits will be considered for mining, including the occurrences of uranium found closer to Lac La Ronge's more northern communities, and reserve lands will likely be assessed for mining suitability in the coming years or decades.
- **Processing:** The world's largest – and Canada's only – uranium refinery is located at Blind River, Ontario, where uranium ore concentrates from Canada and abroad are refined to produce uranium trioxide. This product is shipped to a conversion facility in Port Hope, Ontario, which produces the world's only commercial supply of fuel-grade natural uranium dioxide. Uranium dioxide is shipped to fuel fabrication facilities in Port Hope, Toronto and Peterborough, Ontario, to produce natural uranium fuel for Canada Deuterium Uranium (CANDU) reactors.[44]
- **SMR Demonstration Site:** If the initial demonstration site succeeds, subsequent sites will be pursued. Potential sites will require partnership and collaboration with participating jurisdictions to host the SMRs and utilize the electricity produced.
- **Waste Management:** Some of the waste from making nuclear power is radioactive for a very long time and requires a safe method for its storage. Storage must be in stable rock that won't shift for 400,000 years and must be packaged securely enough to withstand a future ice age. Canada's nuclear waste is the responsibility of the Nuclear Waste Management Organization, which has yet to find a willing host to dispose of it. The two host communities currently being considered are Ignace, Ontario, and South Bruce, Ontario. In

[44] https://natural-resources.canada.ca/energy/energy-sources-distribution/uranium-nuclear-energy/uranium-canada/about-uranium/7695

Saskatchewan, English River, Pinehouse, and Creighton were previously studied as potential host communities but were not selected for further study.[45]

- If, in the future, the search for a nuclear waste disposal host is re-opened, this could be an employment and revenue opportunity that may require consideration from the Band if approached by the Nuclear Waste Management Organization or if the Band decides to approach the same.

Battery Storage

To model the amount of electricity that a community building would use in an emergency any given month, it was assumed that the community would require the use of several appliances during an emergency, including refrigerators and freezers for food, a hot plate for cooking, and a computer and radio for communication. It was also assumed that the emergency building would be primarily heated by its propane furnace if available. However, electricity would be required for auxiliary motors such as the furnace fan motor.

Table 50 highlights the assumed use of electrical appliances and fixtures during an emergency in January, one in July, and the average for the year.

Table 50: Assumed Use of Electricity During an Emergency

	Hours in Use per Day		
	January	July	Annual Average
Block Heater	12	0	4.6
Computer - Monitor and Printer	24		
Hot Plate	2		
Kettle	1		
Refrigerator	24 hours x 2 refrigerators		
Food Freezer	24 hours x 2 freezers		
Radio	8		
Furnace Fan Motor - Continuous	24		
Gas Water Heater - Blower	24		
Lighting	18 hours x 125 lights		
Air Conditioner	0	24	10

[45] https://www.nwmo.ca/en/Site-selection/Study-Areas/Areas-No-Longer-Being-Studied/English-River-First-Nation

The battery specifications in **Table 51** were used to estimate costs and capacities for each scenario model.

Table 51: Battery Model Parameters

Battery Specifications		Source
Energy Capacity	13.5 kWh	Manufacturer
Manufacturer	Tesla	
Model	Powerwall	
Installation Costs	$23,000/Powerwall	Local SK Installer

Based on these assumptions about electricity usage, the team modelled how long one to four Powerwall systems would last in January and July, and the average for the year, shown in **Table 52**. The team found that one Powerwall system would provide less than three hours of energy, on average, for the Sucker River Band Hall during an emergency. On average, four Powerwall systems would provide just over 11 hours of electricity for the Band Hall.

Table 52: Estimated Costs and Hours of Supply by Number of Powerwall Systems and Month

Number of Powerwall Systems	kW of Backup Energy	Estimated Installation Costs	Hours of Supply		
			January	July	Annual Average
1	13.5	$23,000	3.5	2.1	2.9
2	27	$46,000	6.9	4.3	5.8
3	40.5	$69,000	10.4	6.4	8.7
4	54	$92,000	13.8	8.5	11.6

Due to climate change and other emergencies, the community may require backup power at key facilities for outages lasting longer than half a day. Given the high installation costs associated with the Powerwall systems, the project team does not recommend using Telsa Powerwall systems for emergency backup power in community facilities. Instead, the team recommends that the community consider the installation of a backup fuel-based power generator for emergency events.

Business-As-Recommended Forecast

A Business-As-Recommended (BAR) forecast shows how recommended changes may impact a community's energy usage, greenhouse gas emissions, and energy costs compared to the Business-As-Usual (BAU) scenario. These recommended changes include energy conservation initiatives, energy efficiency, and renewable energy projects and reference the estimated outcomes of the assessment work above. The following section highlights the assumptions used to model these changes based on the above assessment.

Energy Conservation

Table 53 highlights the variables used to estimate the implementation and effectiveness of energy conservation initiatives for residential and community buildings in the BAR scenario.

Table 53: Residential and Commercial Variables for Energy Conservation Initiatives

Variable	Residential	Community
Year Energy Conservation Actions Initiated	**2025**	**2030**
Number of Buildings Completing Actions	5% by heating type	3
Maximum % of Buildings Participating	60%	80%
Electricity Savings	2–5%*	5%
Propane Savings	5%	5%

**depending on the fuel source used for space heating.*

Energy Efficiency

Table 54 highlights the variables used to model the implementation and effectiveness of energy retrofits for both residential and community buildings in the BAR scenario.

Table 54: Residential and Commercial Variables for Energy Retrofit Initiatives

Variable	Residential	Community
Year Energy Retrofits Initiated	**2025**	**2027**
Number of Buildings Completing Retrofits	5% by heating type	1 every 4 years
Maximum % of Buildings Participating	70%	100%
Electricity Savings	15–40%*	20%
Propane Savings	40%	20%

**depending on the fuel source used for space heating.*

Table 55 highlights the assumptions used to model the implementation and effectiveness of new building construction standards for both residential and community buildings in the BAR scenario.

Table 55: Residential and Commercial Variables for Improved Building Standards Action

Variable	Residential	Community
Year Improved Building Standards Initiated	**2025**	**2030**
Number of New Buildings Constructed	Based on BAU forecast	1 every 10 years
Electricity Savings in New Buildings	20%	20%
Propane Savings	20%	20%
Year Electrification of New Buildings Initiated	**2030**	**2035**
Increasing % of New Buildings Electrified	5%	100%
Maximum % of New Buildings Electrified	80%	100%

Table 56 highlights the assumptions used to account for fuel switching from propane and natural gas heating to air-source heat pumps incorporated within the improved building

standards modelling. This information is based on Heating System Stock Efficiencies in Saskatchewan.[46]

Table 56: Residential Heating Energy Needs from Switching Heating Systems

Heating System Switch	Percent Energy Needed for New System (%)
Natural Gas to Electric Heat Pump Increased Efficiency	42%
Propane to Electric Heat Pump Conversion Increased Efficiency	26%
Wood to Electric Heat Pump Conversion Increased Efficiency	26%
Electric to Electric Heat Pump Conversion Increased Efficiency	52.6%
Proportion of Energy Dedicated to Space Heating	62%

Renewable Energy Projects

Table 57 highlights the variables used to model the development of renewable energy projects on residential and community buildings in the BAR scenario, as well as a utility-scale (13.8 MW) project, split proportionate to the population between the six communities. Sucker River comprises 7% of the total LLRIB population.

Table 57: Residential and Commercial Variables for Renewable Energy Projects

Variable	Residential	Community Building	Utility-Scale
Year Renewable Energy Projects Initiated	**2035**	**2030**	**2028**
Number of Solar Installations	5 per year	1 every 5 years	1 every 19 years
Maximum % of Buildings With Solar Installations	30%	100%	N/A
Annual Energy Production Per System (kWh)	8,115 kWh	26,085 kWh	1,168,356 kWh

[46] https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=sk&year=2021&rn=26&page=0

Exclusions

Electric vehicles were not included in the Business-As-Usual or Business-As-Recommended projections, as the projections and assumptions are the same for both scenarios. Projections and assumptions can be found in the Vehicles section of the Energy Efficiency – Improvements and Switches action category.

Switches from one type of heating to another (e.g., propane to natural gas) were not considered in the retrofits of homes or community buildings; improved efficiency of heaters, however, is included. More information on the impact of switching heating systems can be found in the Fuel Switching section of the Energy Efficiency – Improvements and Switches action category.

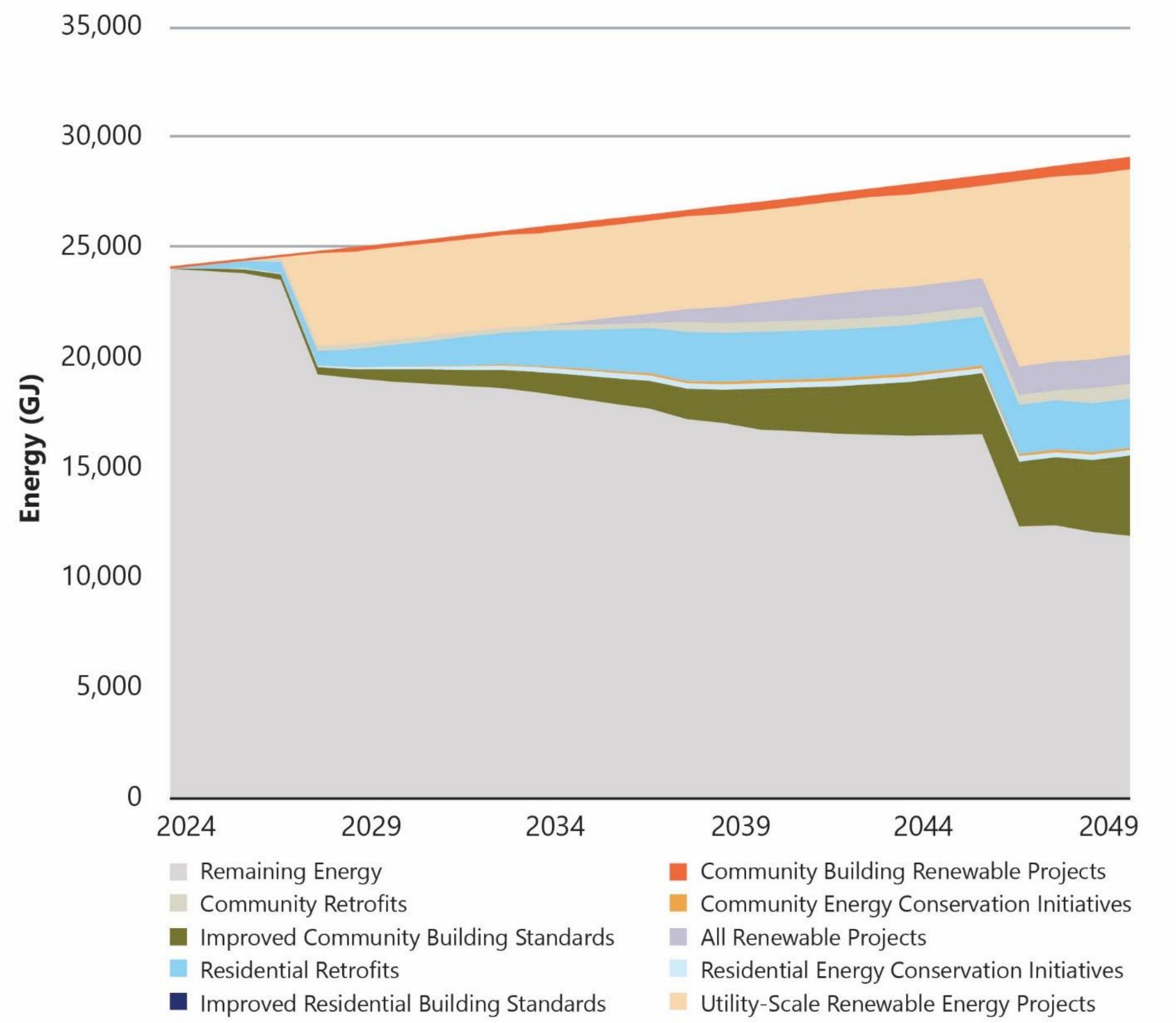
Summary of Savings – Business-As-Recommended

To estimate the energy, emissions, and cost savings from implementing the recommended actions, the annual savings from each action were subtracted from the original Business-As-Usual projections. For example, the annual electricity production for a utility-scale project was subtracted from the total community electricity consumption each year, starting in 2028. It was assumed another project would be built in 19 years, so the additional annual electricity produced from that project was also subtracted from the total community electricity consumption each year, starting in 2047. The reduction in consumption would subsequently reduce the anticipated emissions and costs from the original projections.

Energy Use

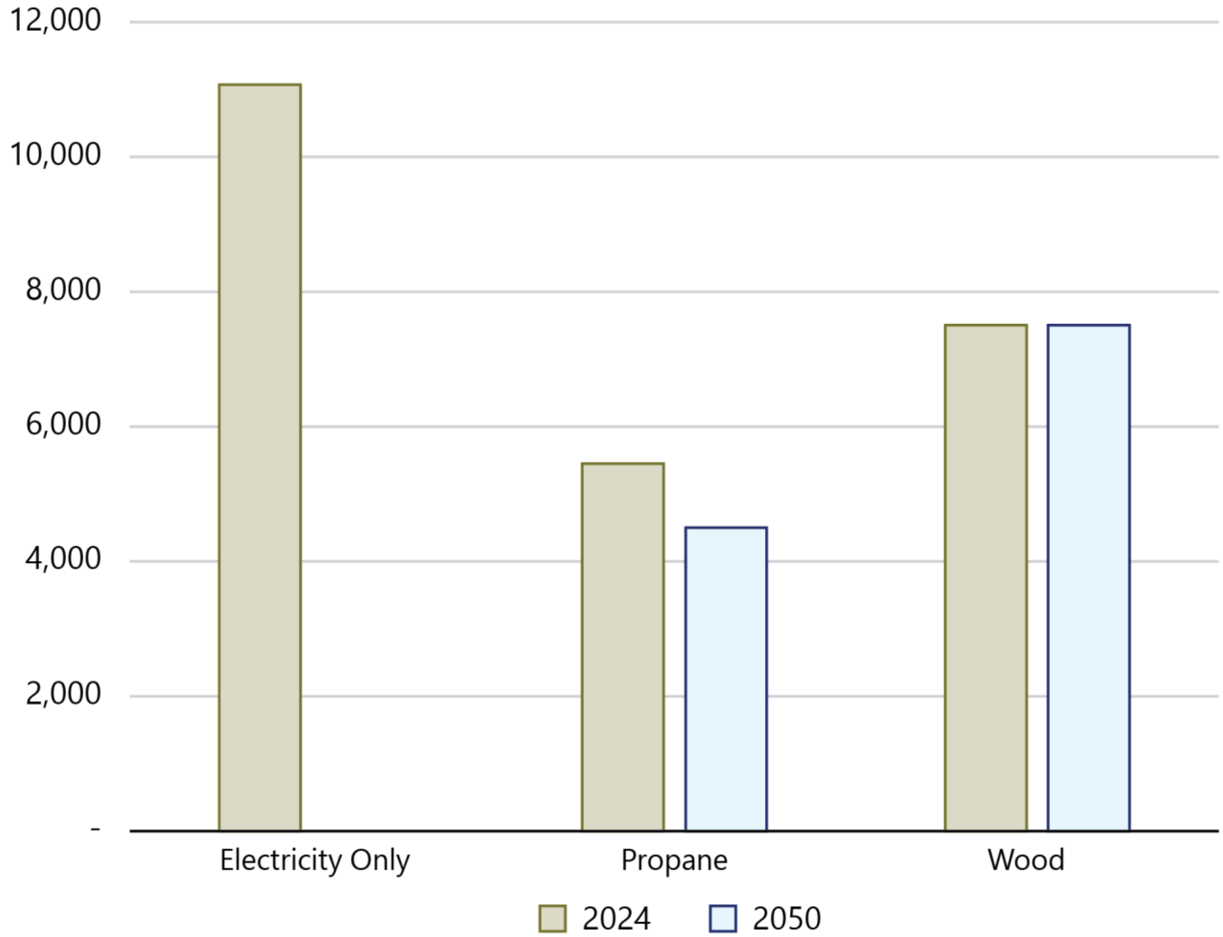
Figure 33 highlights the energy savings (GJ) associated with the eight modelled actions as well as the remaining energy in the BAR scenario between 2024 and 2050. Overall, the modelling suggests the actions would result in a 59% reduction of energy used by 2050 compared to the BAU scenario. The largest reductions are associated with the utility-scale renewable energy project, which would reduce the total amount of energy purchased from the grid by approximately 113,600 GJ (31,600 MWh) between 2024 and 2050.

Figure 33: Energy Savings (GJ) by Action and Remaining Energy in the Business-As-Recommended Scenario, 2024–2050



While the previous figures highlight the energy reductions associated with the modelled actions, **Figure 34** compares the projected energy consumption by type in 2024 and 2050 in the BAR scenario. Electricity use is projected to be completely offset by renewable energy generation; propane use is projected to decrease, while wood usage remains the same, assuming no new homes built by the Band would include wood stoves.

Figure 34: Energy Use (GJ) by Source in the Business-As-Recommended Scenario, 2024 and 2050



GHG Emissions

Figure 35 highlights the greenhouse gas emissions savings (tCO_2e) associated with the modelled action categories and the remaining emissions in the BAR scenario between 2024 and 2050. Overall, the actions are associated with a 21% reduction in emissions compared to the BAU scenario. The largest reductions are associated with utility-scale renewable energy projects, which are projected to save over 6,000 tCO_2e between 2024 and 2050.

Figure 36 compares the greenhouse gas emissions by energy source in 2024 and 2050. By 2050, all emissions are projected to come from the use of propane and wood. While the community will still use electricity, this scenario assumes that the SaskPower electricity grid achieves net-zero emissions as planned and that the community will generate more renewable energy than it consumes.

Figure 35: Reduction of Greenhouse Gas Emissions by Action and Remaining Emissions in the Business-As-Recommended Scenario (tCO_2e), 2024–2050

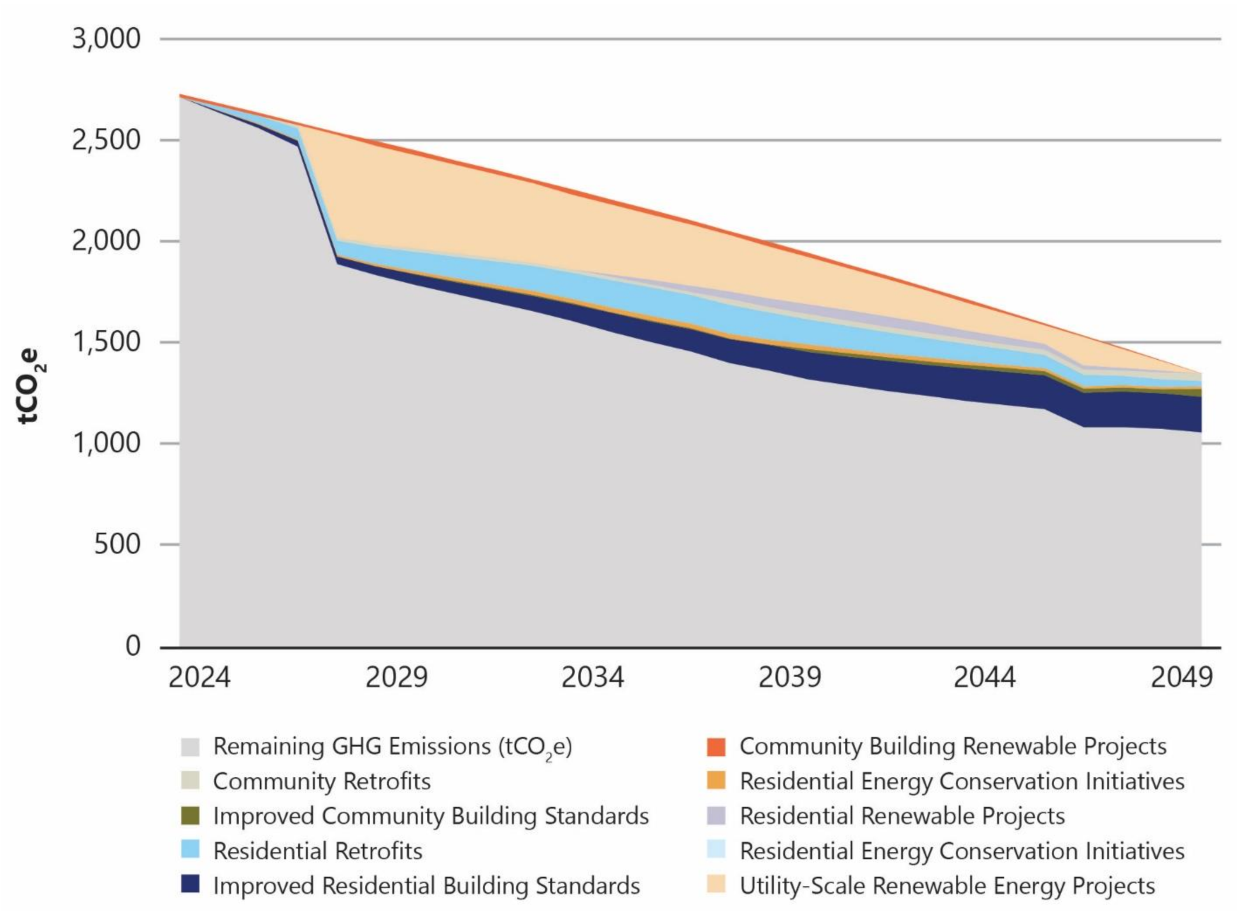
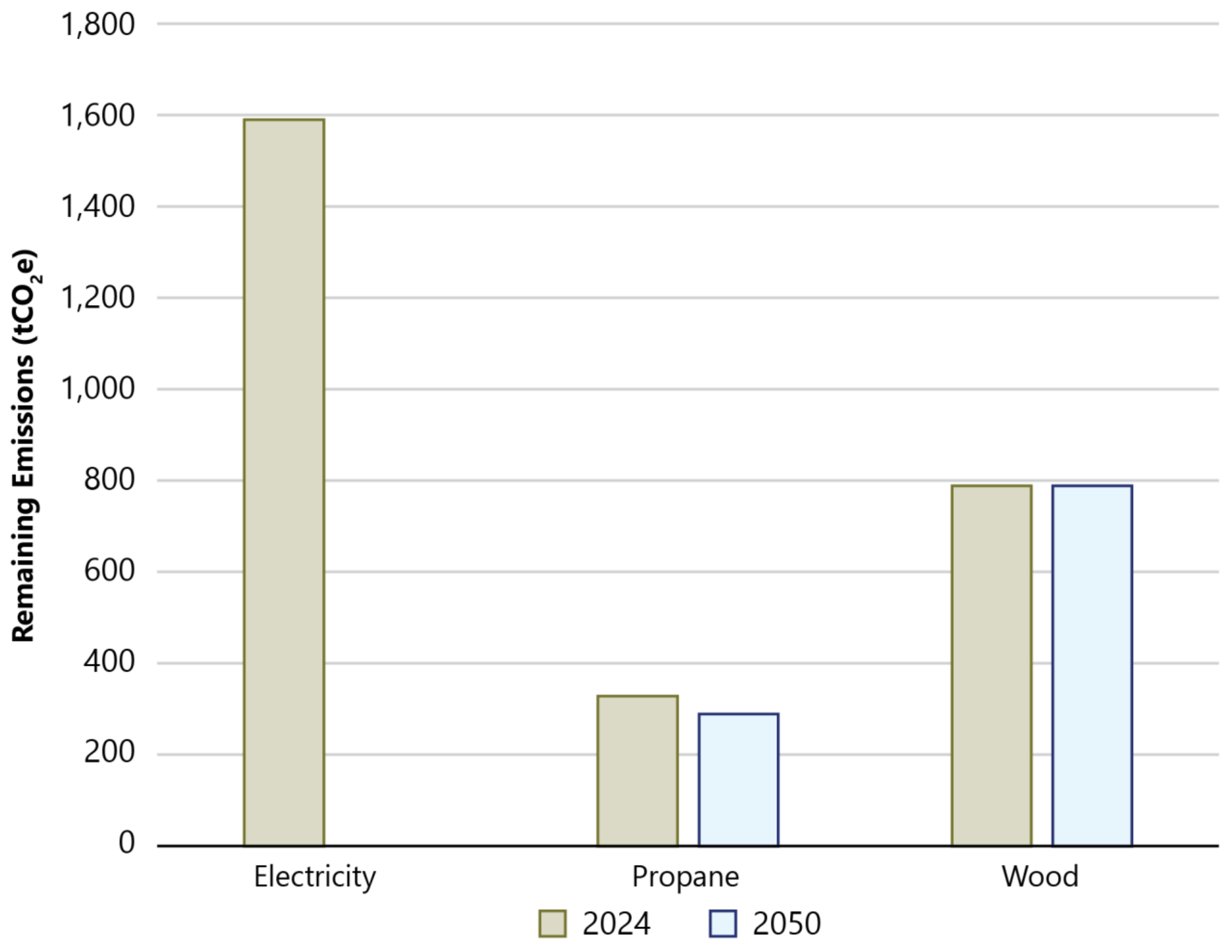


Figure 36: Greenhouse Gas Emissions (tCO_2e) by Source in the Business-As-Recommended Scenario, 2024 and 2050



Estimated Savings

Figure 37 highlights the projected spending on energy in the BAR scenario between 2024 and 2050 compared with the BAU scenario. As shown, the modelled actions are associated with savings of approximately 76% by 2050. It should be noted that this figure only includes the cost of purchasing energy and does not include the cost of implementing any of the actions.

Figure 37: Savings on Energy by Type in the Business-As-Recommended Scenario, 2024–2050