HEATING ENERGY CHOICES for SUSTAINABLE DECARBONIZATION

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ASHRAE Manitoba Chapter

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Manitoba Hydro's Mission Statement

- Help Manitobans efficiently navigate the evolving energy landscape, leveraging their clean energy advantage while ensuring safe, reliable energy at the lowest possible cost.

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Corporate Highlights

LENGTH OF DISTRIBUTION LINES[1] 75,909 km	TOTAL REVENUE (ELECTRIC AND GAS) $2.6 billion	NATURAL GAS CUSTOMERS 296,138	TOTAL ELECTRICITY CAPABILITY 6,054 megawatts	TOTAL ASSETS $31.41 billion	TOTAL DEBT $24.61 billion
SERVICE AREA 650,000 km²	LENGTH OF NATURAL GAS LINES 10,771 km	LENGTH OF TRANSMISSION LINES[2] 14,329 km	FULL-TIME EQUIVALENT EMPLOYEES[3] 5,143	EXPORT REVENUE $1.1 billion	
ELECTRICITY CUSTOMERS 616,289	NET INCOME $655 million	COMMUNITIES WITH NATURAL GAS SERVICE 132			

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Target Customers

EXISTING RESIDENTIAL, COMMERCIAL/INSTITUTIONAL, INDUSTRIAL BUILDINGS

Considering abandoning or removing their natural gas service and replacing with new larger electrical service.

NEW RESIDENTIAL, COMMERCIAL/INSTITUTIONAL, INDUSTRIAL BUILDINGS

Considering not extending gas service and going all electric.

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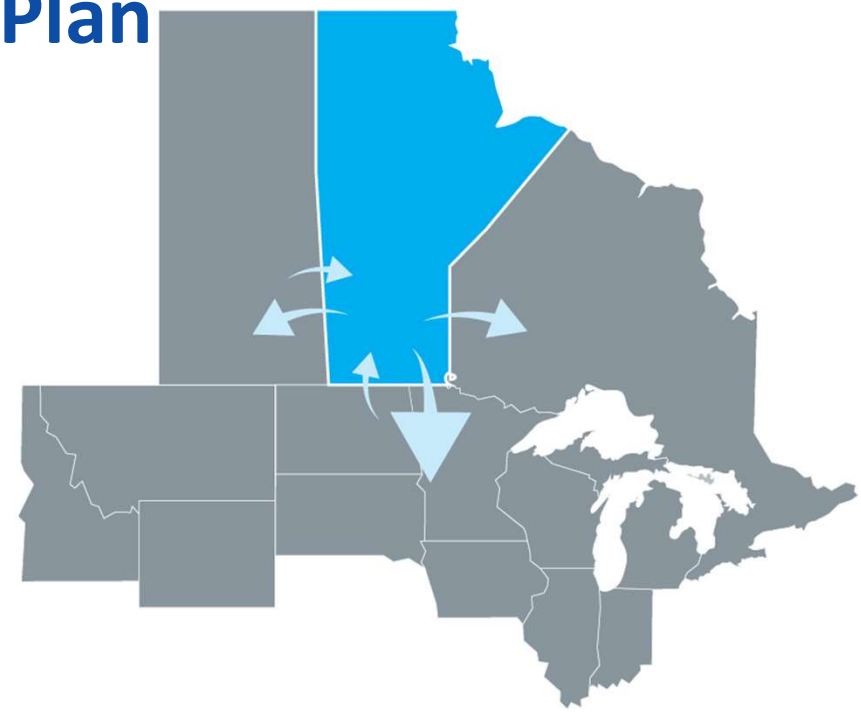
2023 Integrated Resource Plan

- Foundation for understanding the impacts of the energy transition from carbon fuels to renewable electricity sources.
- Investments over the last 100 years have resulted in reliable low-cost electricity supply.
- Decarbonization will increase demand for capacity.
- Consume the last of the current small surplus of capacity (< 3% of total capacity)
- Drive the need for new resources and put upward pressure on Hydro costs and customer rates in the coming years.



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IRP Near Term Priorities

Actively manage the increasing winter peak load.

Explore and implement dual-energy system programs for space and process heating customers.

Encourage customers to retain or install natural gas heating equipment to be used during cold winter weather (e.g. < -10 C) to avoid winter peak.

Develop programs & rates to encourage use of electric heat or ASHP only during mild winter weather.

We need Natural Gas to Meet Winter Peak Loads

Better to use **80% to 95%** gas heating equipment than **20% to 30%** gas turbine peaking plants.

Solar and wind can help meet higher energy loads but can't help much with winter peak loads.

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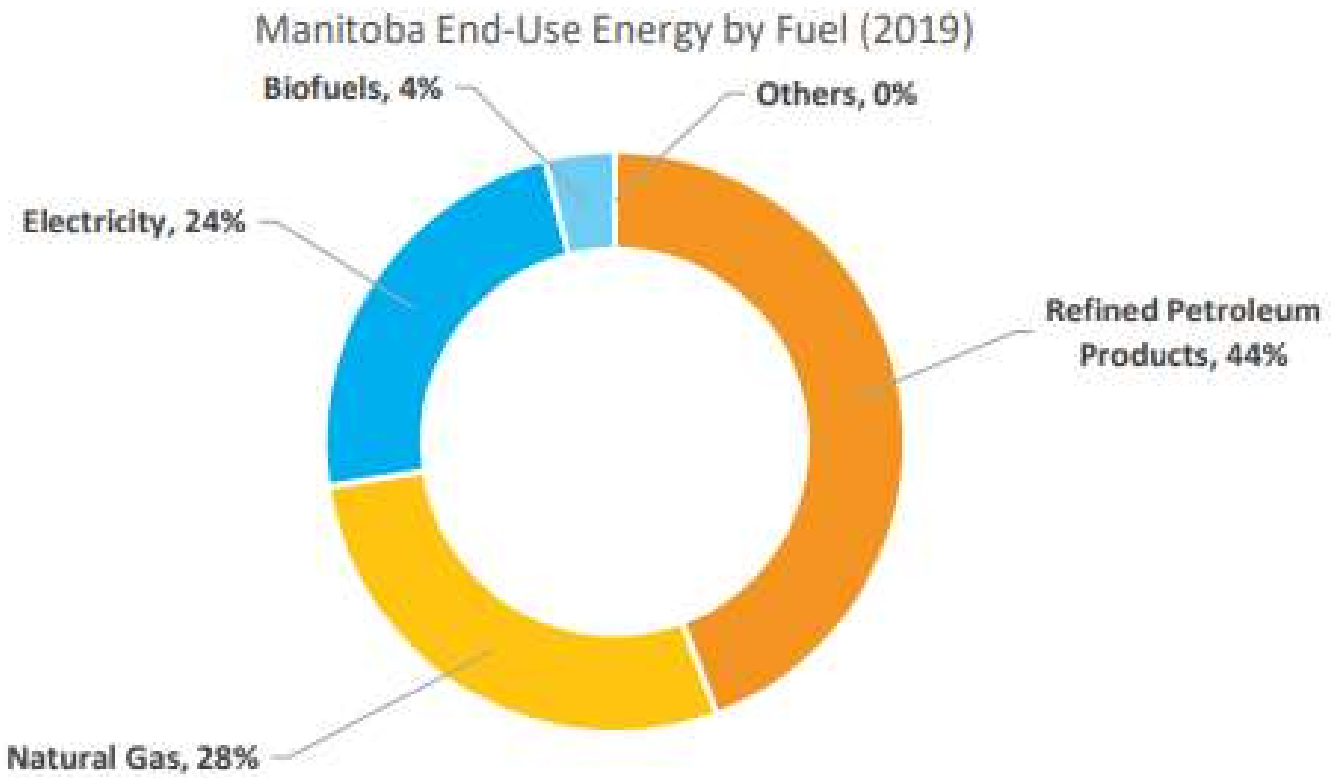

Figure A1.2 – End-Use Energy by Fuel[1]

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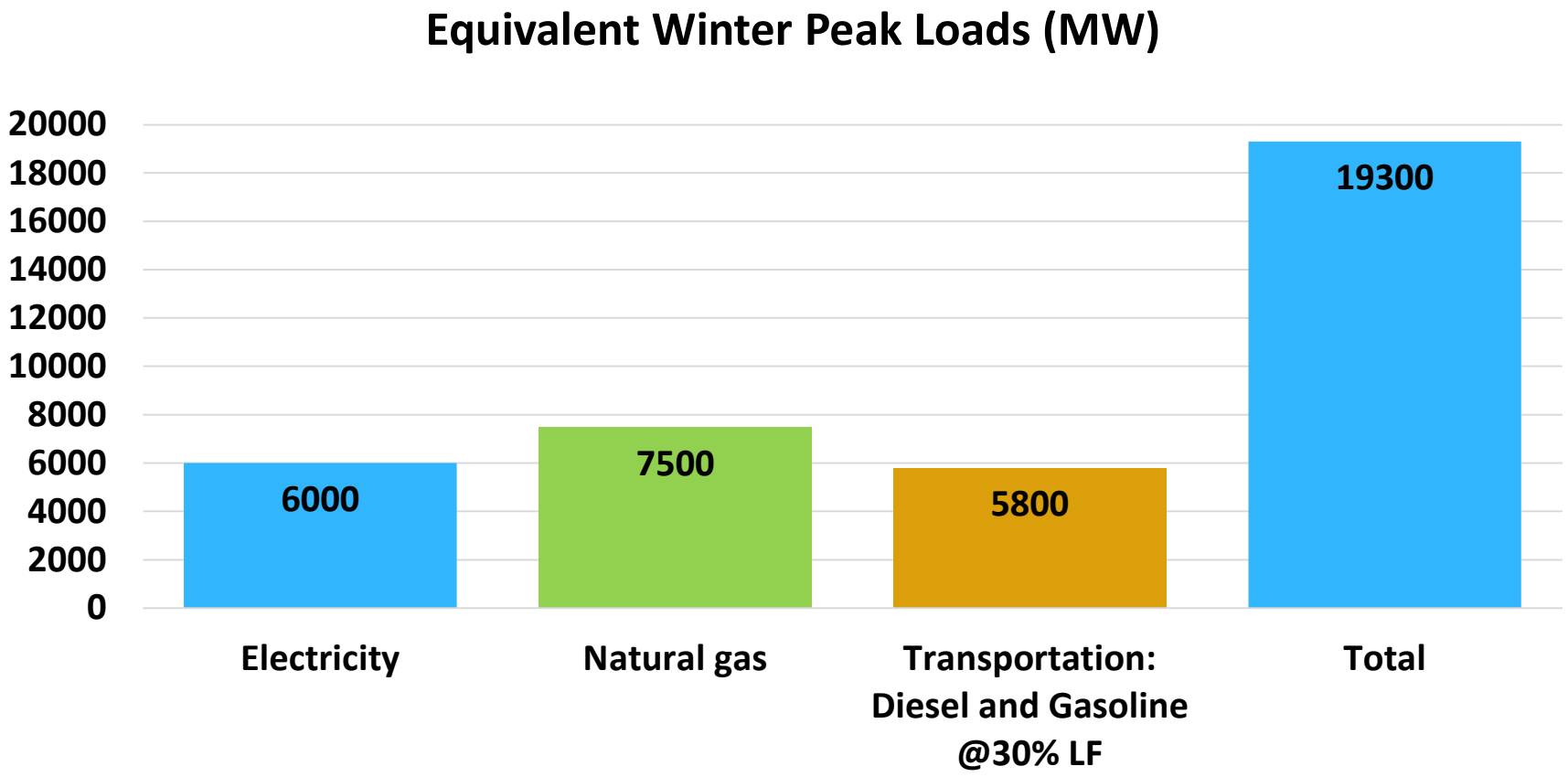
Electric capacity >3X without fossil fuels



Five Customer Benefits of Dual Energy

1. LOWER ENERGY COSTS.

2. PROTECT FUTURE ENERGY OPTIONS.

3. MINIMIZE ELECTRIC RATE INCREASES.

4. REDUCE MANITOBA CARBON EMISSIONS.

5. IMPROVED HEATING SYSTEM & ELECTRIC GRID RELIABILITY.

1. Lower Energy Costs

Natural gas remains the lowest cost heating source even with escalating carbon charges.

Using natural gas/electric hybrid systems gives customers the ability to minimize impacts of demand charges on electric bills.

Be well positioned to participate in future rate programs at more attractive electric rates.

Summary of Operating Cost Examples:

Customer Type	N. Gas Cost ($/yr)	Carbon Charge ($/yr)	Total Gas & Carbon Charge ($/yr)	Total Incremental Electricity Cost ($/yr)	Cost Increase with Electricity ($/yr)	Carbon Charge for cost parity ($/tonne)
Multi-Residential	$ 6,700	$ 4,300	$ 11,000	$ 36,000	**$ 25,000**	$ 430
High School	$ 71,000	$ 45,000	$ 116,000	$ 240,000	**$ 124,000**	$ 232
Commercial	$ 178,000	$ 130,000	$ 308,000	$ 690,000	**$ 382,000**	$ 265
Industrial	$ 5.4 million	$ 2.0 million	$ 7.4 million	$ 17.3 million	**$ 9.9 million**	$ 390

Operating Cost Example 1
Small Multi-residential Customer

- End use – space and water heating
- **Natural gas**
  - Annual consumption of 35,000 $m.^3$/yr. at LGS rate
  - Annual energy costs of $6,700 in gas costs + $4,300 in carbon charge = $11,000
- **Electricity equivalent**
  - Annual consumption of 223,000 kWh, 270 kW of winter peak load
  - Annual energy costs of $26,000 demand + $10,000 energy = $36,000
- **$25,000 increase in annual energy cost after switching to electric heat.**
- **Carbon charge would have to rise from $65/tonne to $430/tonne for natural gas and electricity to be equivalent.**
- **270 kW of winter peak load as a cost share of Keeyask would equate to $3.2 million.**

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Operating Cost Example 2
Vocational High School

- End use – Central space and water heating for 174,000 sq.ft. facility
- **Natural gas**
  - Annual consumption of 366,000 $m.^3$/yr. at LGS rate
  - Annual energy costs of $71,000 in gas costs + $45,000 in carbon charge = $116,000
- **Electricity equivalent**
  - Annual consumption of 3.1 million kWh, 1600 kW of winter peak load
  - Annual energy costs of $100,000 demand + $140,000 energy = $240,000
- **$124,000 increase in annual energy cost after switching to electric heat.**
- **Carbon charge would have to rise from $65/tonne to $232/tonne for natural gas and electricity to be equivalent.**
- **1600 kW of winter peak load as a cost share of Keeyask would equate to $19 million.**

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Operating Cost Example 3
Medium Commercial Customer

- End use – Central space and water heating facility
- **Natural gas**
  - Annual consumption of 1 million m^3/yr. at LGS rate
  - Annual energy costs of $178,000 in gas costs + $130,000 in carbon charge = $308,000
- **Electricity equivalent**
  - Annual consumption of 8,780 MWh, 5 MW of winter peak load
  - Annual energy costs of $370,000 energy + $320,000 demand = $690,000
- **$382,000 increase in annual energy cost after switching to electric heat.**
- **Carbon charge would have to rise from $65/tonne to $265/tonne for natural gas and electricity to be equivalent.**
- **5 MW of winter peak load as a cost share of Keeyask would equate to $59 million.**

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Operating Cost Example 4
Large Industrial Customer

- End use – process boilers and space/ventilation heating
- **Natural gas**
  - Annual consumption of 50 million m^3/yr., peak flow of 200 MCF per hour
  - Annual energy costs of $5.4 million in gas costs + $2 million in carbon charge = $7.4 million
- **Electricity equivalent**
  - Annual consumption of 347 GWh, 54 MW of winter peak load
  - Annual energy costs $4.3 million demand + $13 million energy = $17.3 million
- **$9.9 million increase in annual energy cost after switching to electric heat.**
- **Carbon charge would have to rise from $65/tonne to $390/tonne for natural gas and electricity to be equivalent.**
- **54 MW of winter peak load as a cost share of Keeyask would equate to $640 million.**

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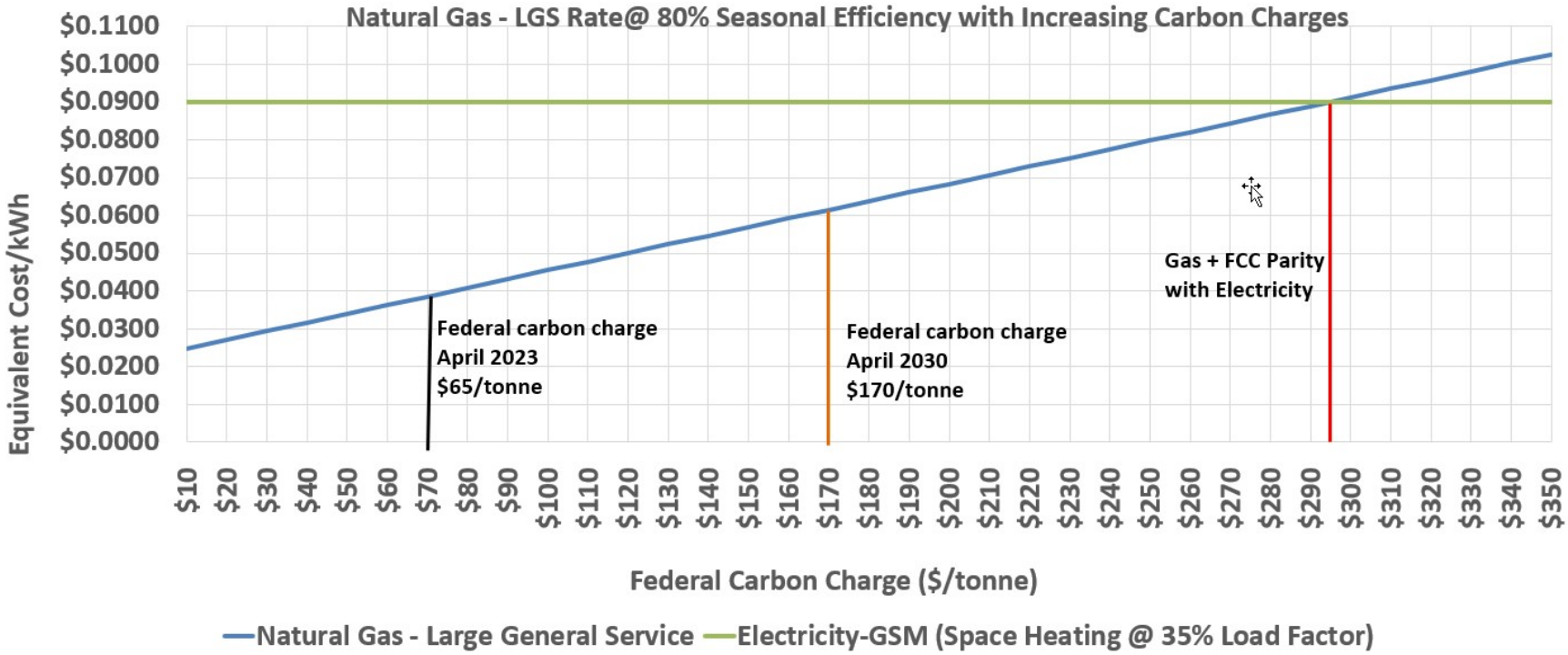
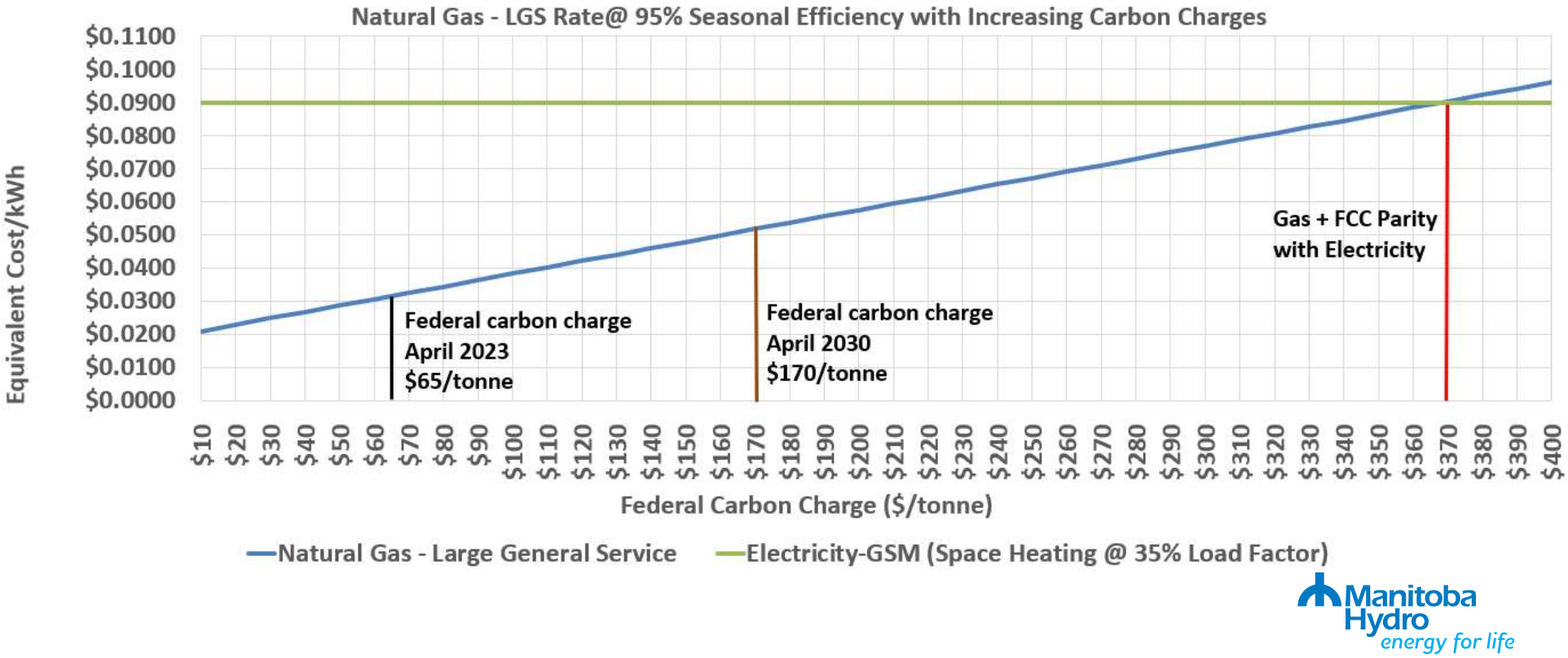
Gas less expensive even with carbon charge





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Alternative Heating Fuel Cost Comparison

Fuel Type	Volume Units	Cost per Unit	Costs in Cents/kWh @ Various Seasonal Efficiencies 25%	30%	50%	60%	70%	75%	80%	85%	90%	92%	95%
Natural Gas	**Cubic metre**	Centra Gas Sales Service Rates - Nov 1, 2023 (PUB approved). Includes $65/tonne Federal Carbon C. of:											$ 0.1239 /cu.m.
Small General Service (<22,771 cu.m/yr)	including	$0.35009	13.09	10.91	6.55	5.46	4.68	4.36	4.09	3.85	3.64	3.56	3.45
Large General Service (<680,000 cu.m/yr)	FCC	$0.31689	11.85	9.88	5.93	4.94	4.23	3.95	3.70	3.49	3.29	3.22	3.12
High Volume Firm (HVF) @35% Load Factor		$0.29635	11.08	9.24	5.54	4.62	3.96	3.69	3.46	3.26	3.08	3.01	2.92
HVF (>680,000 cu.m/yr) @75% Load Factor		$0.27402	10.25	8.54	5.12	4.27	3.66	3.42	3.20	3.01	2.85	2.79	2.70
Interruptible Service (I.S.) @ 35% Load Factor		$0.26569	9.94	8.28	4.97	4.14	3.55	3.31	3.11	2.92	2.76	2.70	2.62
I.S. (>680,000 cu.m/yr) @ 75% Load Factor		$0.25460	9.52	7.94	4.76	3.97	3.40	3.17	2.98	2.80	2.65	2.59	2.51
Fuel Oil	**Litre**	$1.80	67.32	56.10	33.66	28.05	24.04	22.44	21.04	19.80	18.70	N.A.	N.A.
	including	$1.75	65.45	54.55	32.73	27.27	23.38	21.82	20.45	19.25	18.18	N.A.	N.A.
	FCC	$1.70	63.58	52.99	31.79	26.49	22.71	21.19	19.87	18.70	17.66	N.A.	N.A.
		$1.65	61.71	51.43	30.86	25.71	22.04	20.57	19.29	18.15	17.14	N.A.	N.A.
		$1.60	59.84	49.87	29.92	24.94	21.37	19.95	18.70	17.60	16.62	N.A.	N.A.
		$1.55	57.97	48.31	28.99	24.16	20.71	19.32	18.12	17.05	16.10	N.A.	N.A.
		$1.50	56.10	46.75	28.05	23.38	20.04	18.70	17.53	16.50	15.58	N.A.	N.A.
		$1.45	54.23	45.19	27.12	22.60	19.37	18.08	16.95	15.95	15.06	N.A.	N.A.
		$1.40	52.36	43.64	26.18	21.82	18.70	17.45	16.36	15.40	14.55	N.A.	N.A.
		$1.35	50.49	42.08	25.25	21.04	18.03	16.83	15.78	14.85	14.03	N.A.	N.A.
Propane	**Litre**	$1.20	67.70	56.41	33.85	28.21	24.18	22.57	21.15	19.91	18.80	18.40	17.81
	including	$1.15	64.88	54.06	32.44	27.03	23.17	21.63	20.27	19.08	18.02	17.63	17.07
	FCC	$1.10	62.05	51.71	31.03	25.86	22.16	20.68	19.39	18.25	17.24	16.86	16.33
		$1.05	59.23	49.36	29.62	24.68	21.15	19.74	18.51	17.42	16.45	16.10	15.59
		$1.00	56.41	47.01	28.21	23.51	20.15	18.80	17.63	16.59	15.67	15.33	14.85
		$0.95	53.59	44.66	26.80	22.33	19.14	17.86	16.75	15.76	14.89	14.56	14.10
		$0.90	50.77	42.31	25.39	21.15	18.13	16.92	15.87	14.93	14.10	13.80	13.36
		$0.85	47.95	39.96	23.98	19.98	17.13	15.98	14.98	14.10	13.32	13.03	12.62
		$0.80	45.13	37.61	22.57	18.80	16.12	15.04	14.10	13.27	12.54	12.26	11.88
		$0.75	42.31	35.26	21.15	17.63	15.11	14.10	13.22	12.44	11.75	11.50	11.13

Electricity Firm	kWh	Sept. 1/23 @ 100 %Eff.	Averages
G.S.L. >100kV. LF=95% to 25%		4.85 to 7.88	6.37
GSM. LF=95% to 25%		6.21 to 10.94	8.58
GSM. 24/7 MUA / Space Heat		7.90 to 9.83	8.87
GSM. 8h/d, 5d/wk MUA Heat		19.11 to 23.98	21.55
GS Small (Non-Demand)		7.277 to 9.485	8.38
Residential		9.455	

Heating Values of Fuels used in the above Table

Fuel Oil	36,500	BTU/Litre		
Propane	24,200	BTU/Litre		
Natural Gas	36,500	BTU/Cu.m.		
Coal (Lignite)	7,000	BTU/lb	2,000	lb/ton

Federal Carbon Charge - April 1/23 $65 /tonne
LGS to SGS break even consumption 22,771 cu.m/yr

Effective Costs in Cents/kWh vs. Load Factor & Power Factor

General Service Medium Rate - Effective September 1, 2023

Demand Charge	$11.71	per kVa	
Energy Charge	$0.04519	per kWh	over 19,500 kWh/month
Tax Rate	0%		

Load Factor	Power Factor 1.0	0.98	0.96	0.94	0.92	0.9	0.88	0.86	0.84	0.82	0.8	0.75	0.7
100%	6.12	6.16	6.19	6.23	6.26	6.30	6.34	6.38	6.43	6.48	6.52	6.66	6.81
95%	6.21	6.24	6.28	6.32	6.35	6.40	6.44	6.48	6.53	6.58	6.63	6.77	6.93
90%	6.30	6.34	6.38	6.42	6.46	6.50	6.54	6.59	6.64	6.69	6.75	6.90	7.07
85%	6.41	6.44	6.48	6.53	6.57	6.62	6.66	6.71	6.77	6.82	6.88	7.04	7.21
80%	6.52	6.57	6.61	6.65	6.70	6.75	6.80	6.85	6.91	6.96	7.03	7.19	7.38
75%	6.66	6.70	6.75	6.79	6.84	6.90	6.95	7.01	7.07	7.13	7.19	7.37	7.57
70%	6.81	6.86	6.91	6.96	7.01	7.07	7.12	7.18	7.25	7.31	7.38	7.57	7.79
65%	6.99	7.04	7.09	7.14	7.20	7.26	7.32	7.39	7.46	7.53	7.60	7.81	8.04
60%	7.19	7.25	7.30	7.36	7.42	7.49	7.56	7.63	7.70	7.78	7.86	8.08	8.34
55%	7.44	7.50	7.56	7.62	7.69	7.76	7.83	7.91	7.99	8.08	8.16	8.41	8.69
50%	7.73	7.79	7.86	7.93	8.01	8.08	8.16	8.25	8.34	8.43	8.53	8.80	9.10
45%	8.08	8.16	8.23	8.31	8.39	8.48	8.57	8.66	8.76	8.87	8.97	9.27	9.61
40%	8.53	8.61	8.70	8.79	8.88	8.97	9.08	9.18	9.29	9.41	9.53	9.87	10.25
35%	9.10	9.20	9.29	9.39	9.50	9.61	9.73	9.85	9.98	10.11	10.25	10.63	11.07
30%	9.87	9.98	10.09	10.21	10.33	10.46	10.60	10.74	10.88	11.04	11.20	11.65	12.16
25%	10.94	11.07	11.20	11.34	11.49	11.65	11.81	11.98	12.16	12.34	12.54	13.07	13.69
20%	12.54	12.70	12.87	13.05	13.24	13.43	13.63	13.85	14.07	14.30	14.54	15.21	15.98
15%	15.21	15.43	15.66	15.90	16.14	16.40	16.67	16.95	17.25	17.56	17.89	18.78	19.80
10%	20.56	20.89	21.23	21.58	21.95	22.34	22.75	23.17	23.62	24.08	24.57	25.91	27.43
5%	36.60	37.26	37.94	38.65	39.39	40.17	40.98	41.82	42.71	43.64	44.62	47.30	50.35

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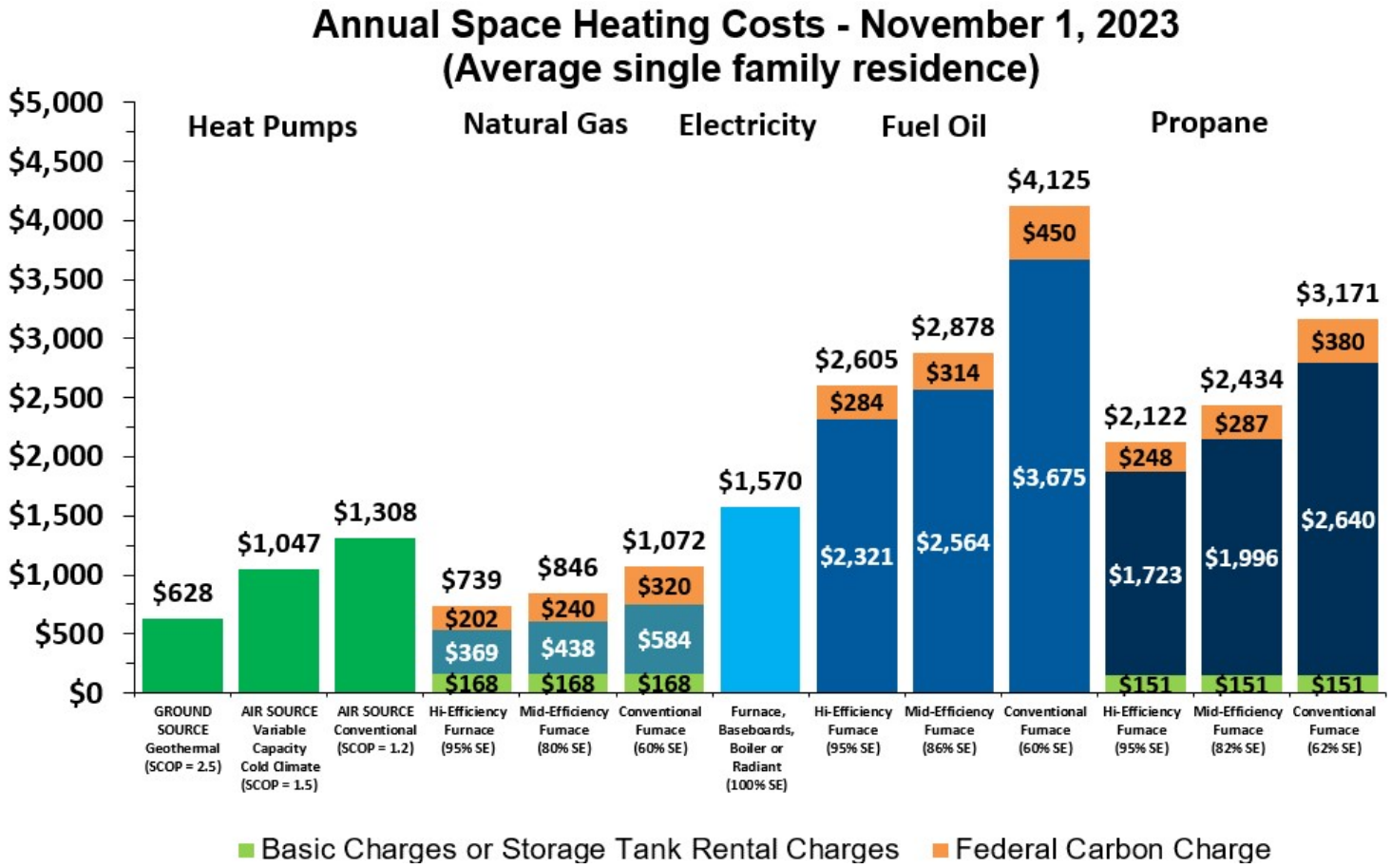

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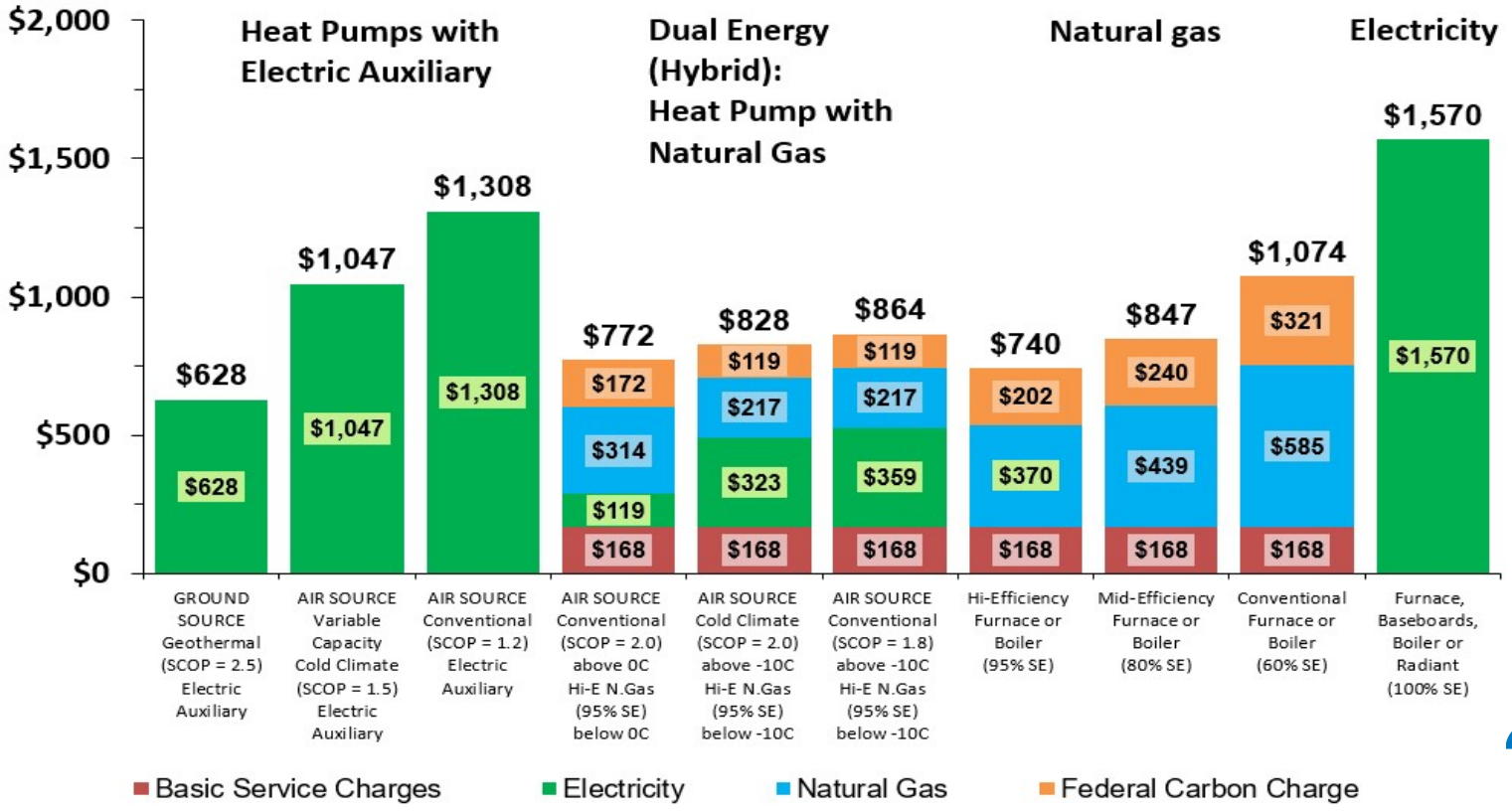
Annual Space Heating Costs - November 1, 2023
(Average single family residence)



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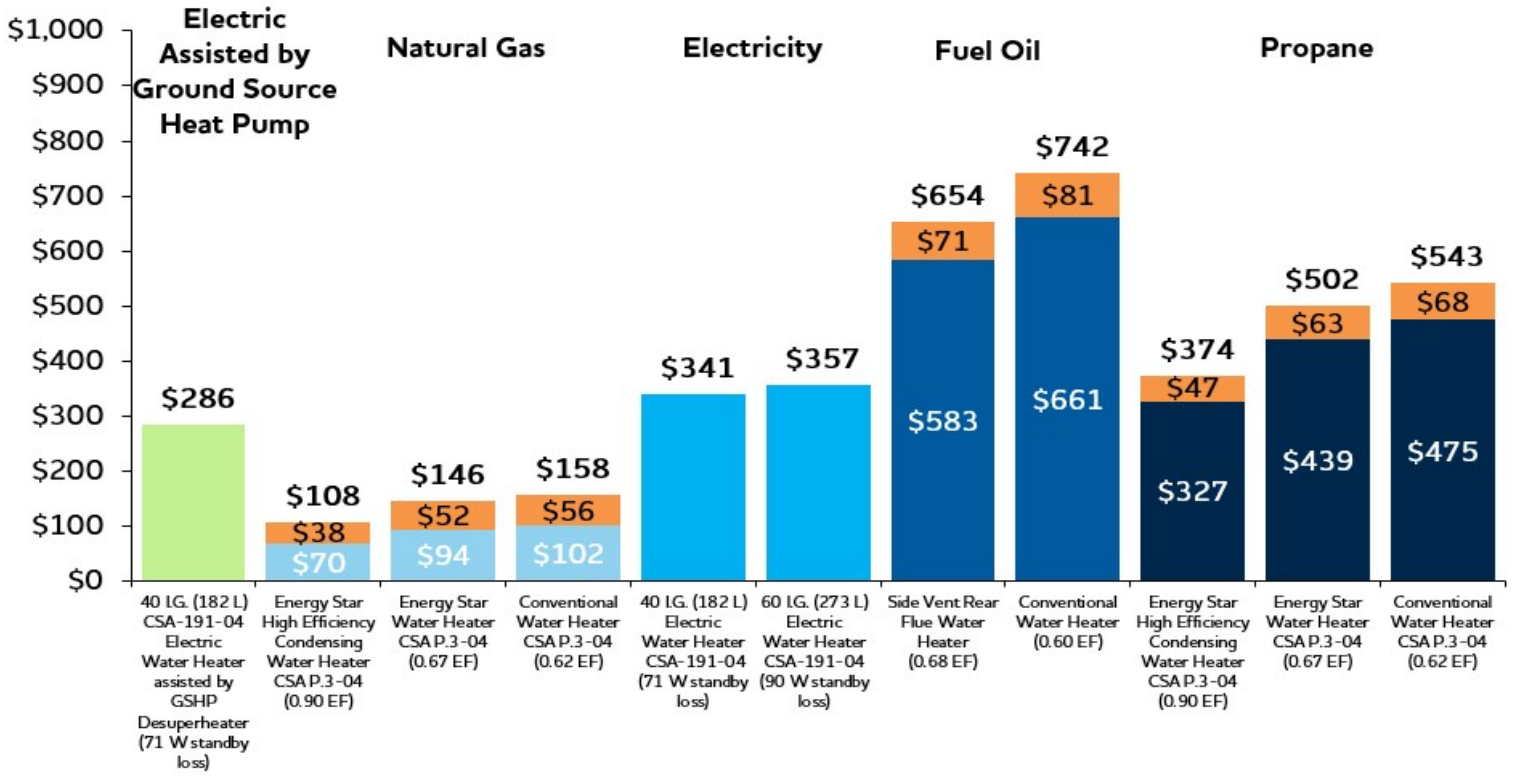
Annual Water Heating Costs

(Based on average annual hot water usage of 2.4 people)



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2. Protect Future Energy Options

- Retain the option to switch back to gaseous fuel if:
  - Electric rates rise faster than expected:
    - Time of Use, Curtailable rates or Critical Peak Pricing are adopted.
  - Natural gas rates reduce.
  - Renewable fuels become an option. (RNG, Hydrogen)
  - GHG offsets become available.
  - Carbon charges are paused or eliminated.
  - Electricity is in short supply (load > capacity, droughts or natural disasters)

3. Minimize electric rate increases

- MH could avoid or delay the need for constructing inefficient natural gas turbine peaking plants for use during cold weather.
- Existing customer owned gas heating plants are bought and paid for, just need to maintain them.

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4. Reduce Manitoba Carbon Emissions

- Existing gas heating plants are more efficient @ 60 - 95% efficiency with lower carbon emissions.
- Simple cycle gas turbine are less efficient @ 20 - 30% efficiency with higher carbon emissions. (Brandon G.S.: 280 MW @ 28% efficiency)
- Using gas only below -10 C reduces gas consumption/carbon emissions by 45% for heating loads and 75% for high load factor process loads.

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5. Improved Heating System Reliability

- Having dual energy (hybrid) heating systems provides redundancy of energy supply.
- In the event of extreme drought, or an extended electric outage due to ice or windstorm, gas pipelines maintain gas pressure. A smaller gas standby generator could provide the power to operate fans, pumps, boilers required to operate the gas boiler and heat the building.
- Diversity of heating sources gives the option of switching sources if there is an equipment breakdown.

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Lost Opportunity for Existing Customers that are Fuel Switching

- Potentially unhappy if MH launches a dual energy incentive/rate program in the near future that they could have benefited from.
- Removal is not free & once they remove their gas equipment and gas service it will be more costly to replace.

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Questions?

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