Abstract

Following a read of Dr. Larry Hughes' examination of the financial impacts of the carbon tax in NS, a spin-off of the report was made whereby NS data were interchanged with NB figures.

Largely out of curiosity and in spite of the unrecoverable hours forever lost, the results and differences thereof were thought to be interesting nonetheless and worth sharing.

Emission Sources

Space Heating

Unlike in Nova Scotia, the largest minority of space heating energy consumption is derived from the electrical grid, followed by wood and heating oil.

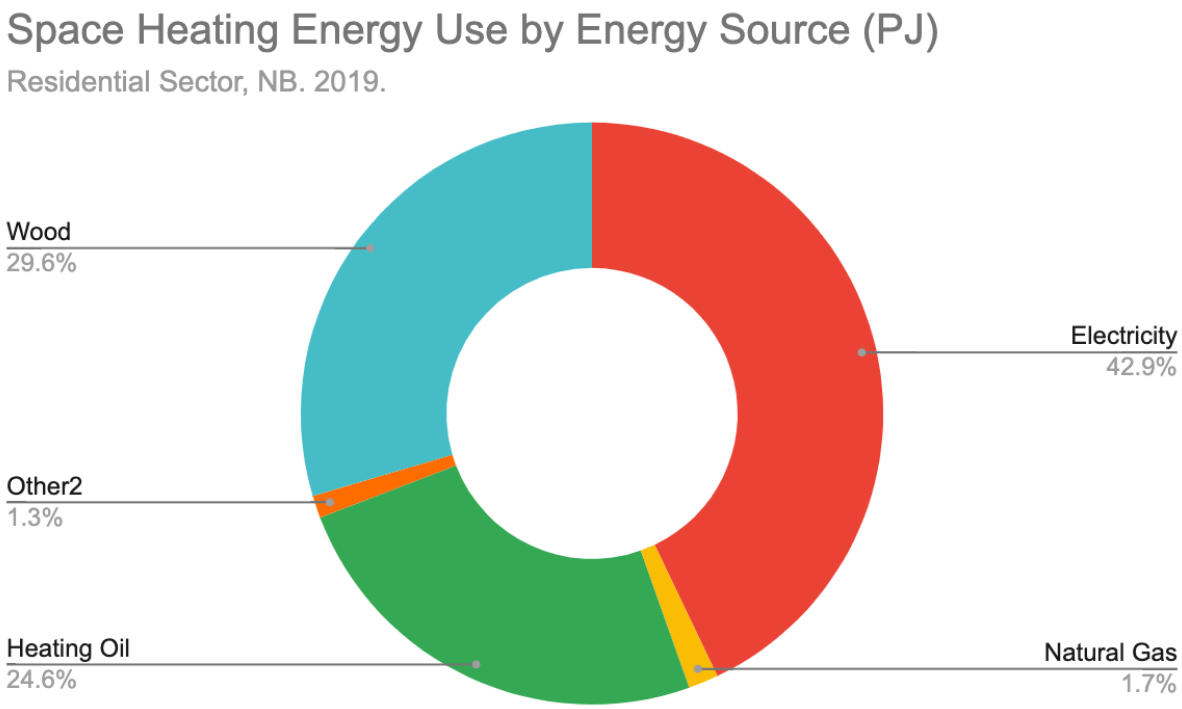


Table 5: Space Heating Energy Use by Energy source for 2017-19

Energy Use by Energy Source (PJ)	2017	2018	2019
Electricity	10.3	10.1	10.3
Natural Gas	0.4	0.4	0.4
Heating Oil	6.8	6.7	5.9
Other2	0.3	0.2	0.3
Wood	6.3	6.7	7.1

[Natural Resources Canada]

It is also notable that the electrical emissions intensity in New Brunswick is also significantly lower, largely attributable to the nuclear and hydroelectric generation in the province.

As seen in Table 4, an electrical emissions intensity of **310 kg/MWh** in NB represents nearly half of the rate in NS. The implications of this figure alone will be responsible for many of the carbon levy differences seen later on.

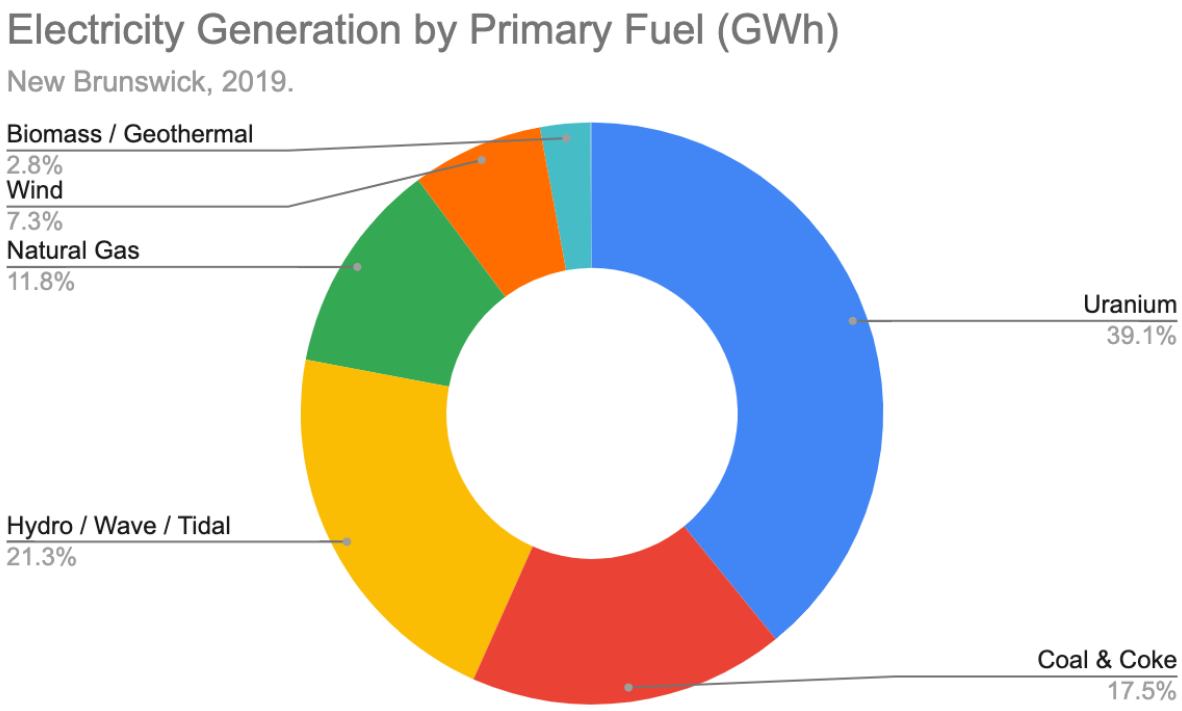


Table 3: Electricity Generation by Primary Fuel Type 2017-19

Primary Fuel	2017	2018	2019
Uranium	4770.25	4770.26	4770.26

Coal & Coke	2657.77	2138.76	2138.6
Hydro / Wave / Tidal	2597.61	2597.62	2597.61
Natural Gas	1652.6	1455.3	1443.88
Wind	891.83	891.83	891.82
Biomass / Geothermal	340.1	340.1	340.1
Oil	316.13	11.22	9.99
Solar	0	0	0

Canada Energy Regulator (2019, Electricity Generation, Reference, Primary Fuel)

It is worth noting that the emissions intensity data taken from the NIR may not consider emissions resulting from out of province generation.

Table 4: Emissions intensity of household energy sources 2017-19

Source	Emissions intensity	Volume to produce one tonne of CO2e	kg CO2e/GJ
Fuel oil (NIR)	2.755 kg/L	363.0 L	79.5
Natural gas (NIR)	51.5 kg/GJ	19.4 GJ	51.5
Electricity 2017 (CER)	300 g/kWh	3.33 MWh	84
Electricity 2018 (CER)	340 g/kWh	2.94 MWh	94
Electricity 2019 (CER)	310 g/kWh	3.22 MWh	86

National Inventory Report (2020) & NIR (1), NIR (2).

In line with the original report, the carbon levy for a hypothetical 1700 sqft household at varying degrees of insulation efficiency and energy systems are considered in Table 5.

Table 7: Minimum and Maximum Carbon Levy Costs from Table 5

Carbon levy cost	New R2000 30 MBTUs	NEW - 50 MBTUs	OLD - 80 MBTUs
Minimum	$45	$76	$121
Maximum	$160	$267	$428

Naturally, the significant cut in emissions intensity for electrical heating in NB drastically reduces the min-max spread in absolute terms (which matters for CAIP reimbursements).

Table 5: Space heating energy demand, emissions, and carbon levy (Assumes 1,700 ft2 home)

Energy source and heating system	Efficiency	Volume (varies by energy source)			CO2e Emissions (kg)			Carbon-levy ($)		
		New R2000 30 MBTU	**New 50 MBTU**	**Old 80 MBTU**	**New R2000 30 MBTU**	**New 50 MBTU**	**Old 80 MBTU**	**New R2000 30 MBTU**	**New 50 MBTU**	**Old 80 MBTU**
Oil		**Litres**			**CO2e kg**			**Levy**		
Oil - Furnace/Boiler - New	85%	967	1,612	2,579	2,664	4,441	7,105	$133	$222	$355
Oil - Furnace/Boiler - Condensing	95%	863	1,439	2,302	2,379	3,965	6,344	$119	$198	$317
Electricity		**kWh**			**CO2e kg**			**Levy**		
Baseboard, Furnace/Boiler	100%	8,792	14,654	23,447	2,726	4,543	7,269	$136	$227	$363
Radiant In-floor, Furnace/Boiler	85%	10,344	17,240	27,584	3,207	5,344	8,551	$160	$267	$428
Time-of-Day Rate - Off-peak	100%	8,792	14,654	23,447	2,726	4,543	7,269	$136	$227	$363
Time-of-Day Rate - On-peak	100%	8,792	14,654	23,447	2,726	4,543	7,269	$136	$227	$363
Heat Pumps - Air-to-Air	190%	4,628	7,713	12,340	1,435	2,391	3,825	$72	$120	$191
Heat Pumps - Mini Splits	250%	3,517	5,862	9,379	1,090	1,817	2,907	$55	$91	$145
Heat Pumps - Geothermal	300%	2,931	4,885	7,816	909	1,514	2,423	$45	$76	$121
Natural gas		**GJ**			**CO2e kg**			**Levy**		
Fireplace or Low Efficiency Appliances	70%	40.6	67.7	108.3	2,093	3,488	5,580	$105	$174	$279
Furnace/Boiler - Medium Efficiency	80%	35.5	59.2	94.8	1,831	3,052	4,883	$92	$153	$244
Furnace/Boiler - High Efficiency or Condensing	93%	30.6	51	81.5	1,575	2,625	4,200	$79	$131	$210

NOTE: Only emissions and carbon levy values for electrically sourced space heating systems have changed from the original report.

Volume data from Efficiency Nova Scoti

Domestic Hot Water (DHW)

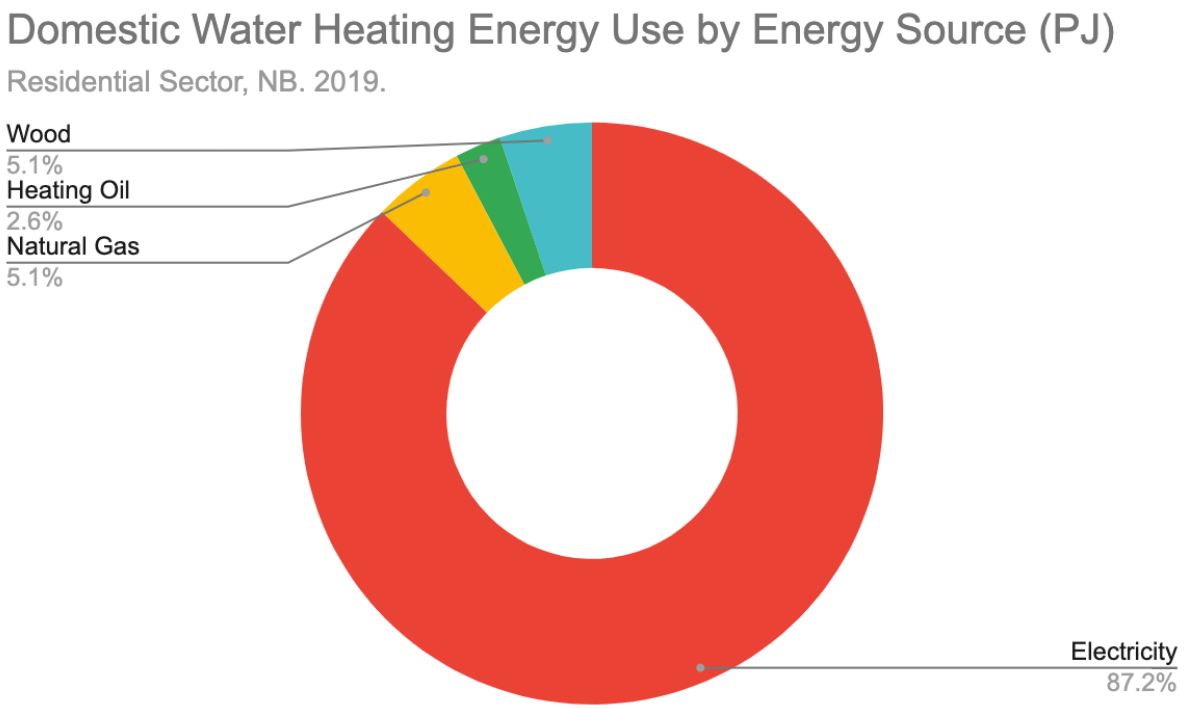


Table 11: Domestic Hot Water Heating Energy Use by Energy Type 2017-19

Energy Use by Energy Source (PJ)	**2017**	**2018**	**2019**
Electricity	3.4	3.7	3.4
Natural Gas	0.2	0.2	0.2
Heating Oil	0.1	0.1	0.1
Other2	0	0	0
Wood	0.2	0.2	0.2

There is little to comment on here besides the obvious, though I wonder whether the electrical water heating dominance in NB exists thanks to NB Power's Hot Water Tank Rentals.

Adopting this kind of policy in NS may be counterproductive from an emissions standpoint so long as the province's electrical emissions intensity remains so high; in fact, NB sits at the edge in this regard (Table 6).

Table 6: HW Carbon-levy costs Seasonal (winter/summer) efficiencies assumes seven months for winter [Oct-Apr] and five months for summer [May-Sep]

System type		Efficiency	Energy			Emissions			Levy		
			Two person	Four person	Six person	Two person	Four person	Six person	Two person	Four person	Six person
Electricity			**kWh/year**			**t CO2e/year**			**Levy**		
Electric water heater - old		85%	2,675	5,350	8,026	0.83	1.66	2.49	$41	$83	$124
Electric water heater - new		90%	2,527	5,053	7,580	0.78	1.57	2.35	$39	$78	$117
Instantaneous heater		95%	2,394	4,787	7,181	0.74	1.48	2.23	$37	$74	$111
Oil			**Litres/year**			**t CO2e/year**			**Levy**		
Stand alone water heater		55%	385	770	1,154	1.06	2.12	3.18	$53	$106	$159
Tankless coil - Winter		75%	282	564	847	0.78	1.56	2.33			
Tankless coil - Summer		25%	847	1,693	2,540	2.33	4.67	7	$71	$143	$214
High efficiency boiler - Winter		75%	282	564	847	0.78	1.56	2.33			
High efficiency boiler - Summer		60%	353	705	1,058	0.97	1.94	2.92	$43	$86	$129
Natural gas			**GJ/year**			**t CO2e/year**			**Levy**		
Stand alone heater - conventional		55%	15	30	45	0.77	1.53	2.3	$38	$77	$115
Instantaneous heater		93%	9	18	26	0.45	0.91	1.36	$23	$45	$68
High efficiency boiler - Winter		90%	9	18	27	0.47	0.94	1.41			
High efficiency boiler - Summer		85%	10	19	29	0.5	0.99	1.49	$24	$48	$72

Lighting and Appliances

Data for NB households of varying sizes (2, 4 or 6 people) were missing, so a per-person estimate of the lighting and appliance energy usage was calculated and scaled linearly.

The average household in New Brunswick houses 2.3 people as per the 2016 census (Statistics Canada) and consumed 20.6 GJ of electrical energy for lighting and appliances.

Table 8: Average Appliance & Lighting Energy Intensity per Household (NB)

	2017	**2018**	**2019**
Appliance Energy Intensity (GJ/household)	16.5	18.2	17.1
Lighting Energy Intensity (GJ/household)	3.5	3.8	3.5
Total	**20**	**22**	**20.6**

Natural Resources Canada, Table 3 & Natural Resources Canada, Table 13.

Table 9: Estimated Lighting & Appliance Energy Intensity per Household Size (NB) 2019

	Two person	Four person	Six person
Consumption (MWh/yr)	4.98	9.95	14.93
Emissions (tonnes)	1.54	3.09	4.63
Levy	$77	$154	$231

Based on Table 8 & Census Data.

Transportation

There are fewer cars in NB than in NS, with a comparable figure of light trucks. However, the average annual distance traveled for both kinds of vehicles are significantly lesser than in the latter.

This somewhat alleviates the average carbon levy per vehicle, but noteworthy differences end there.

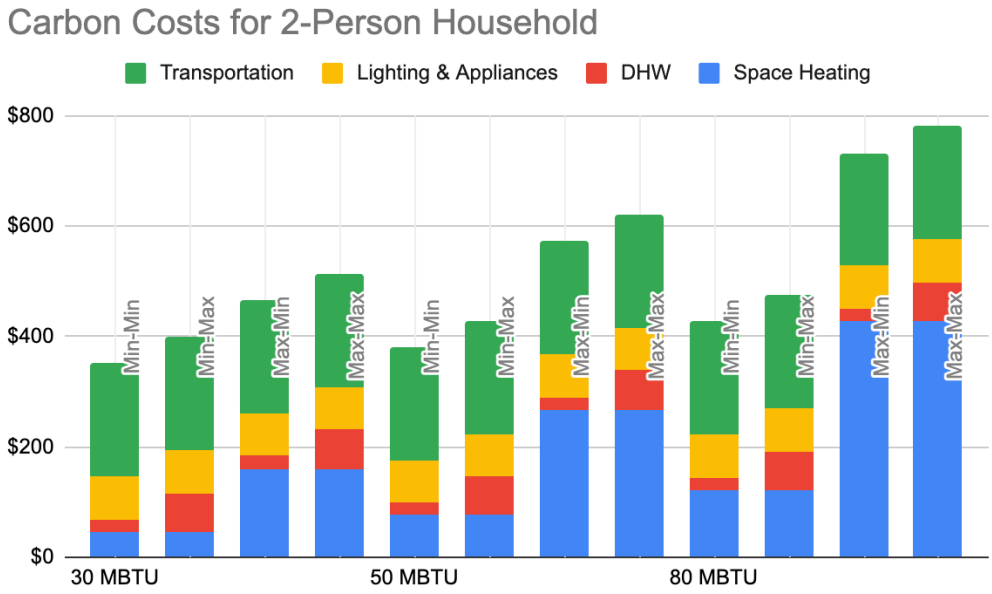
Table 10: Vehicle data for 2019 and carbon prices (NB)

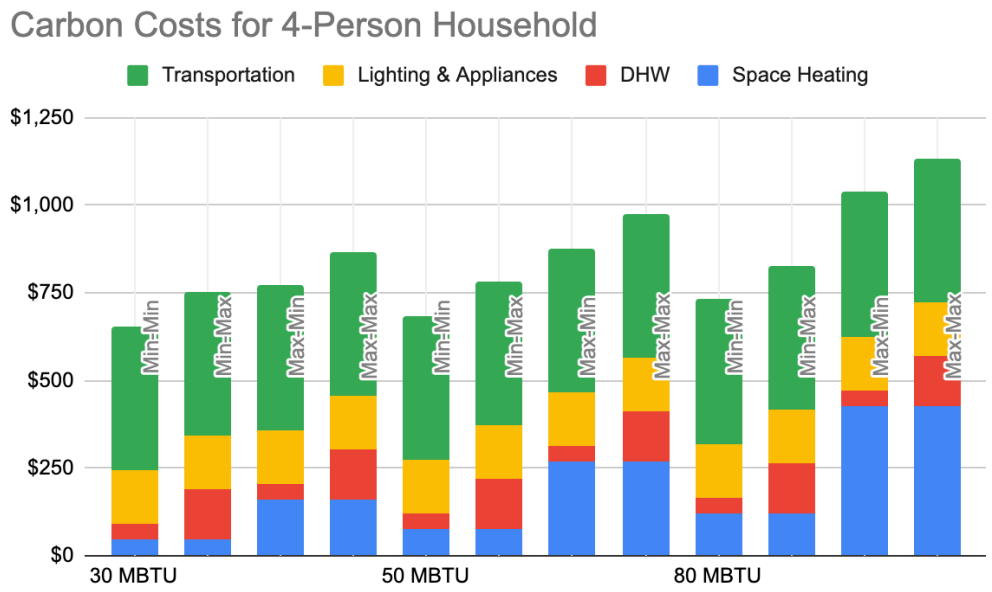
	Cars	Light trucks	Total	**Weighted average**
Stock	281,000	259,000	585,421	
Average annual distance (km)	15,523	16,419		15,953
Fuel consumption (L/100km)	7	10.1		8.49
Estimated annual consumption (L)	1,087	1,658		1,361
Fuel emissions (kg/L)	2.32	2.32		2.32
Total emissions (t)	2.52	3.85		3.16
2023 Cost per vehicle ($65/tonne)	$164	$250		$205

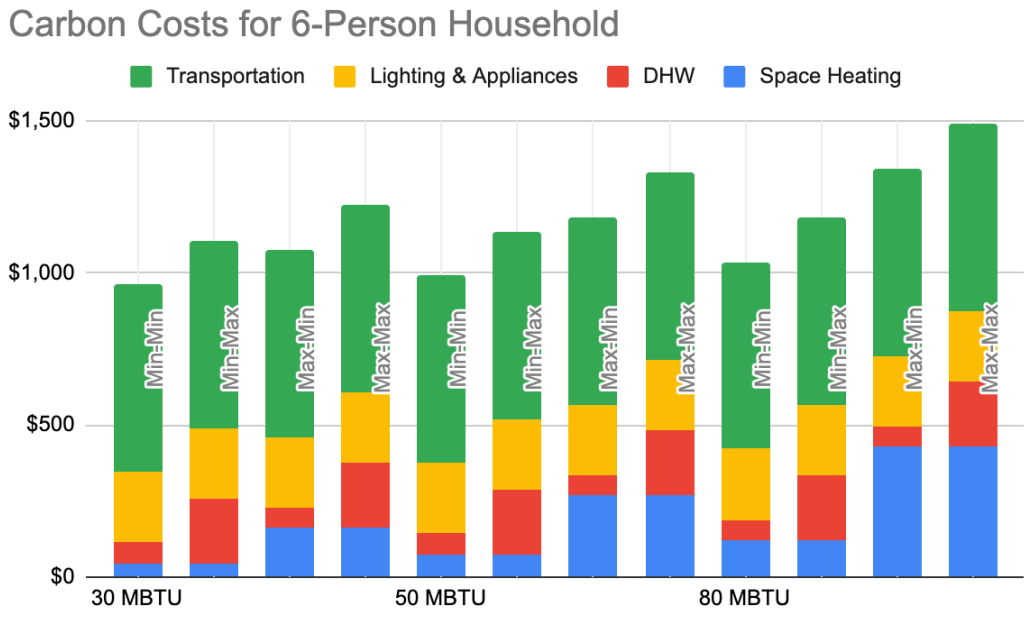
Natural Resources Canada (Cars) & Natural Resources Canada (Light Trucks)

Application of 2022-2023 carbon price

As in the original report, households composed of 2, 4 and 6 residents are broken down into min-max combinations of varying possible carbon levies.







Here, the min-max carbon levies of all scenarios considered range from **$351** to **$1489** for the 2-person 30 MBTU household to the 6-person 80 MBTU household, respectively.

It is encouraging to notice that the geothermal heat pumps in NB stand out as the least carbon intensive form of space heating, which is what I would expect intuitively.

Financial Impact

Considering the estimated carbon costs for space heating, DHW, lighting & appliances and transportation for various energy efficiencies and volumes, it is possible to estimate the net financial loss or gain per household for a given CAIP reimbursement level.

Applying the CAIP reimbursements at levels seen in Ontario, Manitoba, Saskatchewan and Alberta to New Brunswick households as outlined below results is .

Table 9: CAIP for a single adult (or first adult in a couple) for 2022-23

Payment date	ON	MB	SK	AB
July 2022 (Double-Up)	$186.50	$208.00	$275.00	$269.50
Oct-22	$93.25	$104.00	$137.50	$134.75
Jan-23	$93.25	$104.00	$137.50	$134.75
Total	$373	$416	$550	$539

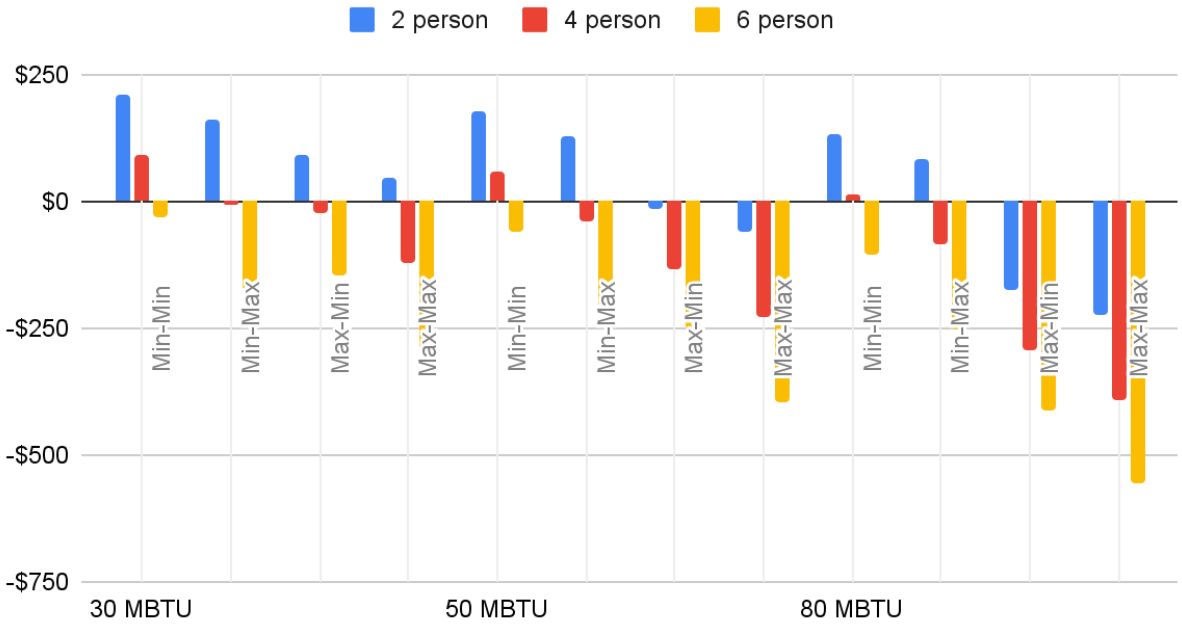
Table 10: CAIP for a second adult in a couple (or first child of a single parent) for 2022-23

Payment date	ON	MB	SK	AB
July 2022 (Double-Up)	$93.00	$104.00	$137.50	$135.00
Oct-22	$46.50	$52.00	$68.75	$67.50
Jan-23	$46.50	$52.00	$68.75	$67.50
Total for 2022-23	$186	$208	$275	$270

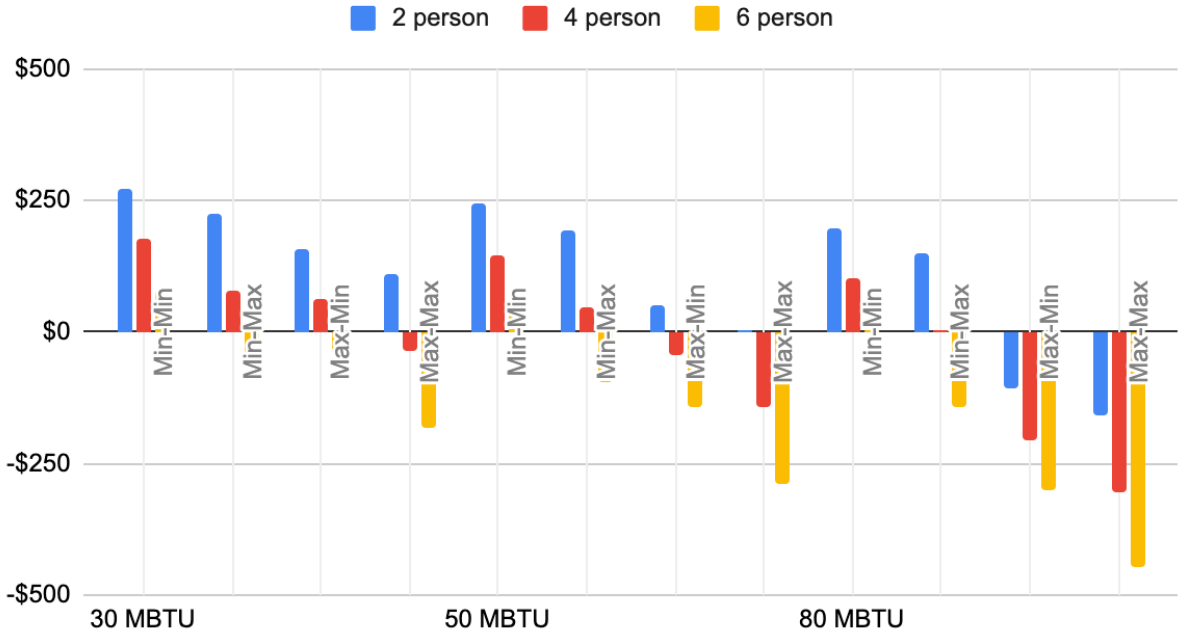
Table 11: CAIP for each child under 18 (starting with the second child for single parents) for 2022-23

Payment date	ON	MB	SK	AB
July 2022 (Double-Up)	$46.50	$52.00	$69.00	$67.50
Oct-22	$23.25	$26.00	$34.50	$33.75
Jan-23	$23.25	$26.00	$34.50	$33.75
Total	$93	$104	$138	$135

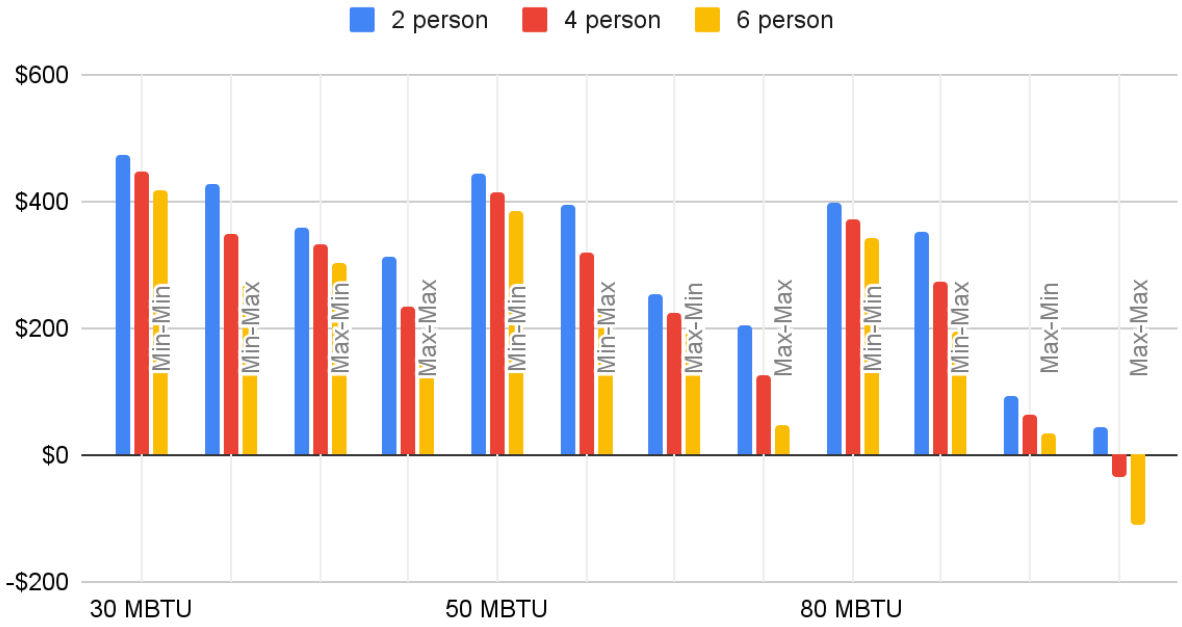
Financial Impact of Ontario CAIP on NB Households



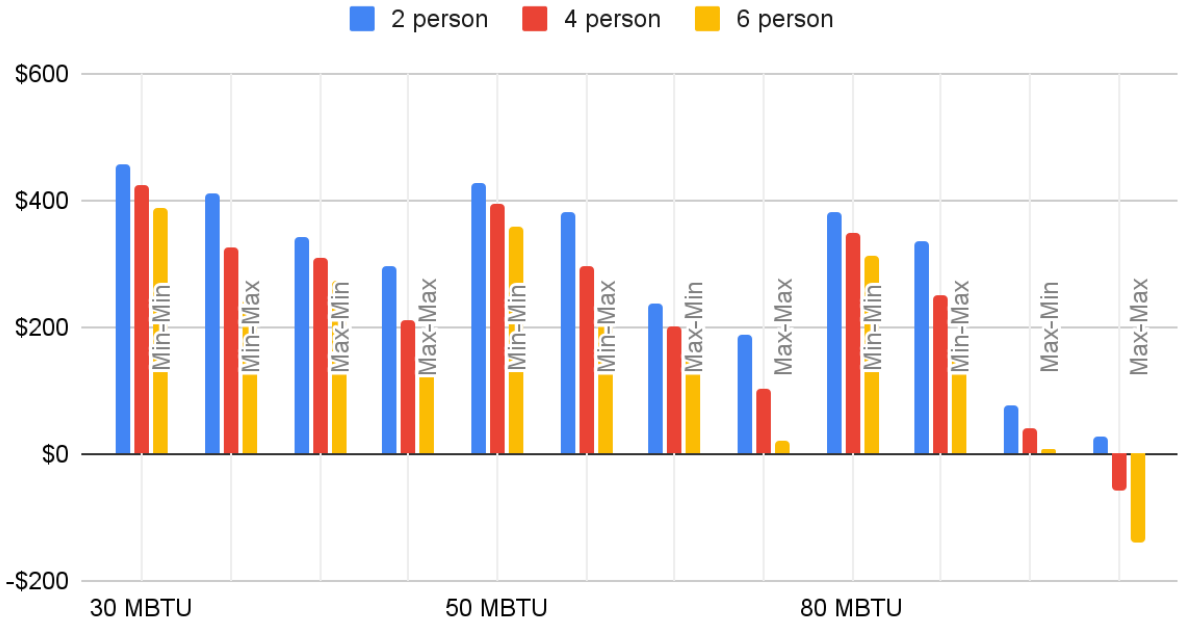
Financial Impact of Manitoba CAIP on NB Households



Financial Impact of Saskatchewan CAIP on NB Households



Financial Impact of Alberta CAIP on NB Households



Discussion

It was found that the lower electrical emissions intensity in New Brunswick played a significant role in reducing the min-max carbon levy spread between the different household configurations considered.

Further, that the dominance of electric DHW heaters in NB would be detrimental from an emissions standpoint if it were not for the lower electrical emissions intensity.

Lastly, when considering the estimated carbon costs for space heating, DHW, lighting & appliances and transportation for various energy efficiencies and volumes,

1. Min-max spread of the carbon levy between different household configurations.