Affordability in the Energy Transition

Presentation to EMTF

Brett Dolter

October 1st, 2025

Will people save money if they switch to electric vehicles and heat pumps?

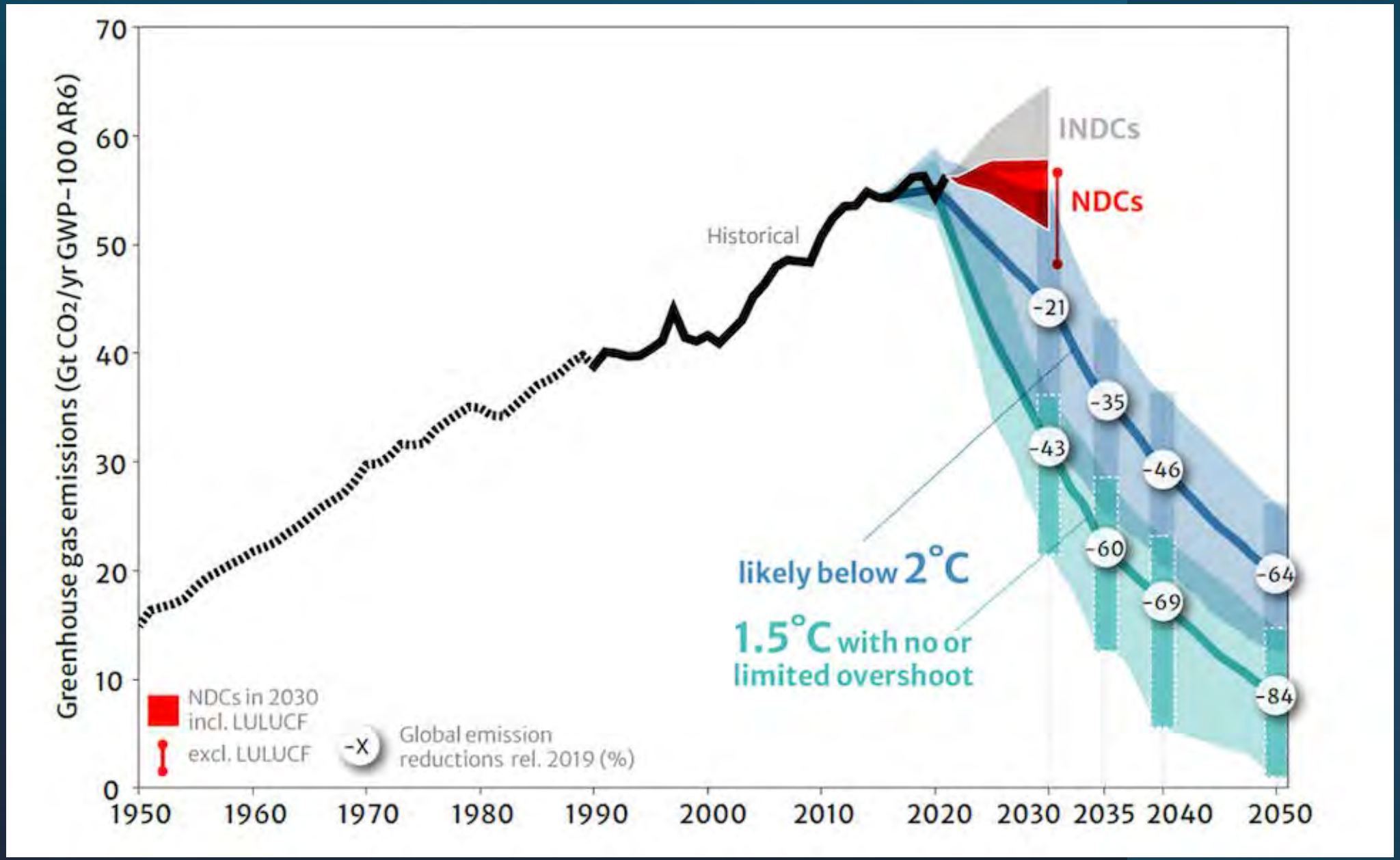
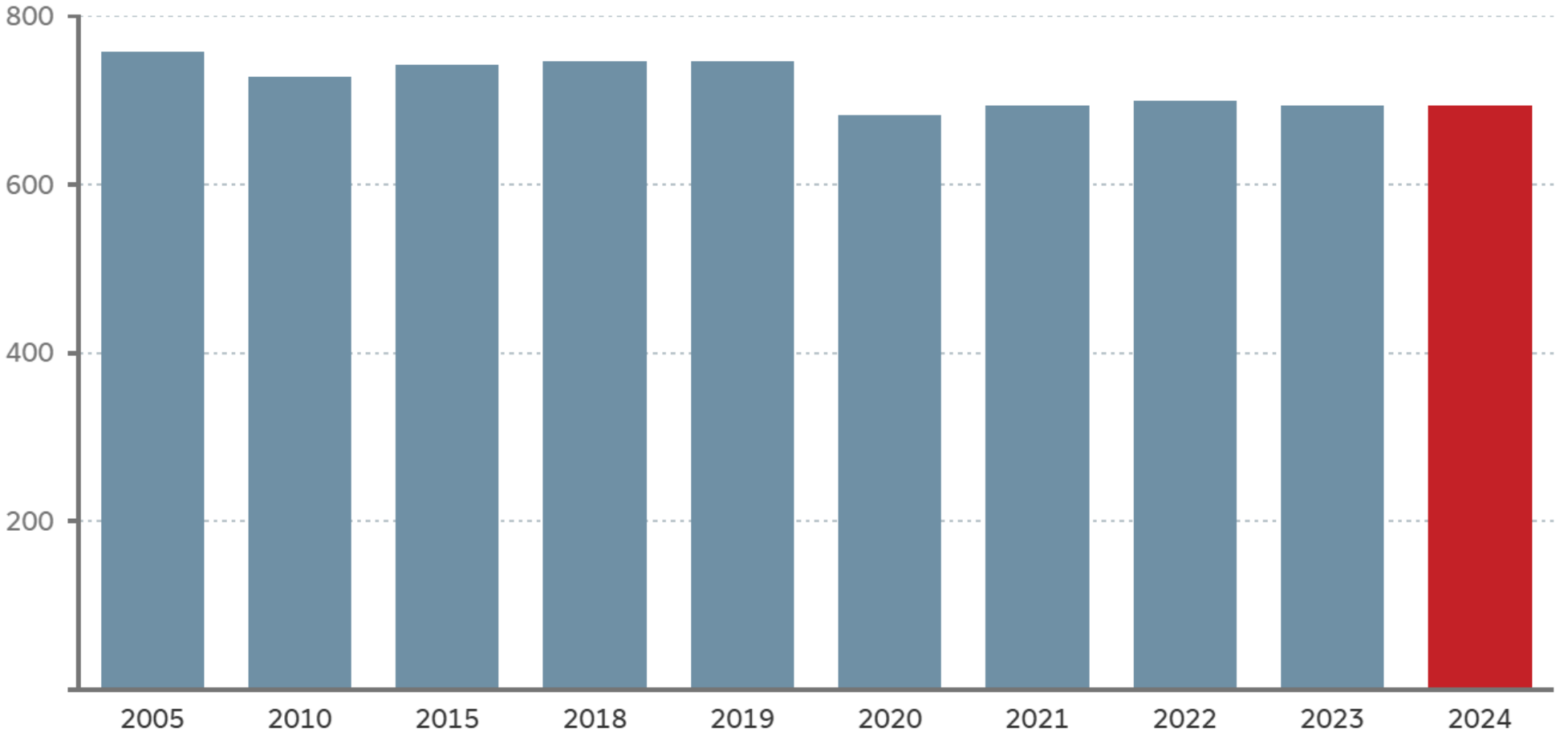


Image from: Yale Climate Connections with data from UNFCCC

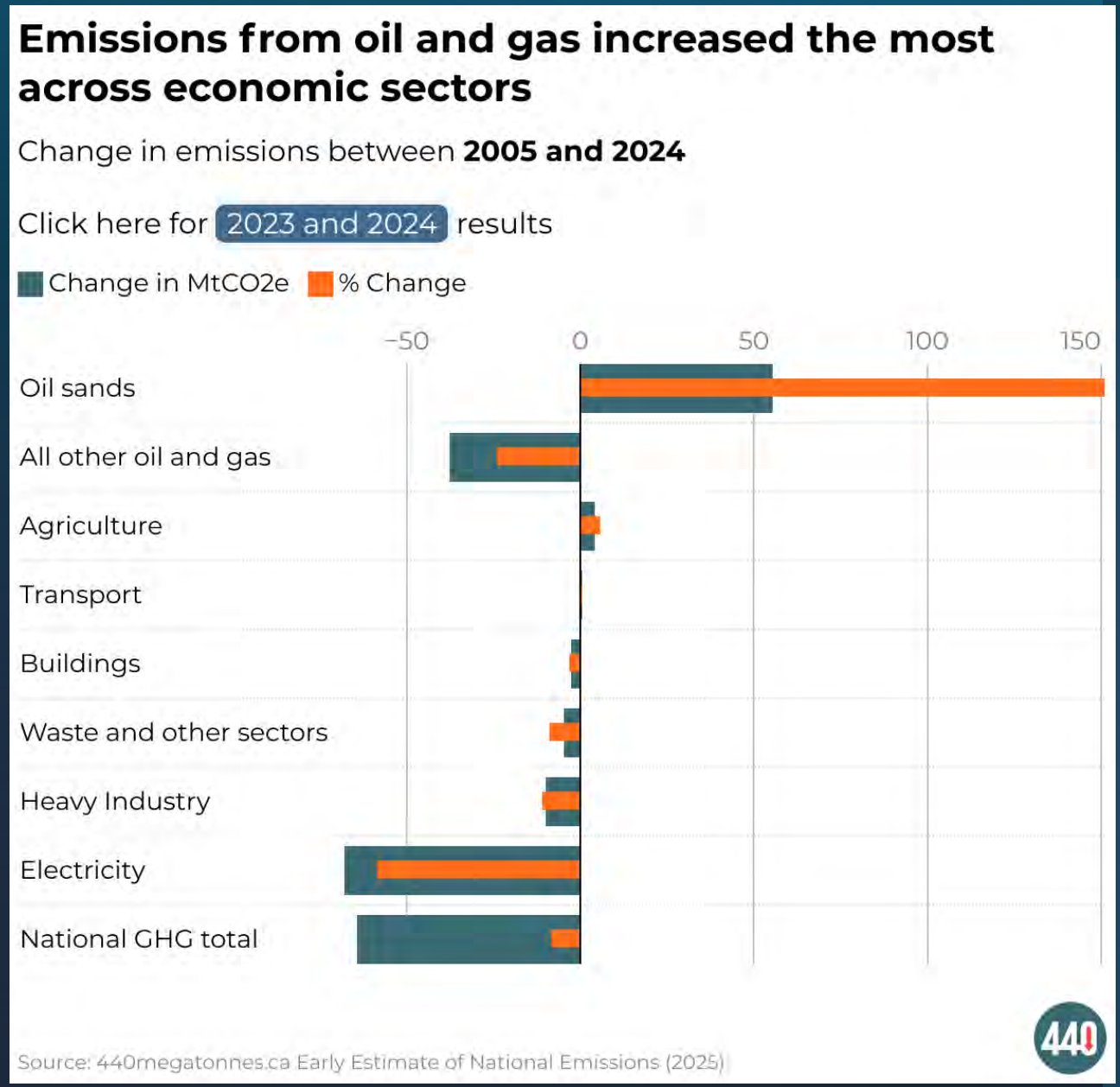
Early estimate of national emissions for 2024

National greenhouse gas emissions (Megatonnes of carbon dioxide equivalent)



Land use, land-use change and forestry not included

Source: Canadian Climate Institute

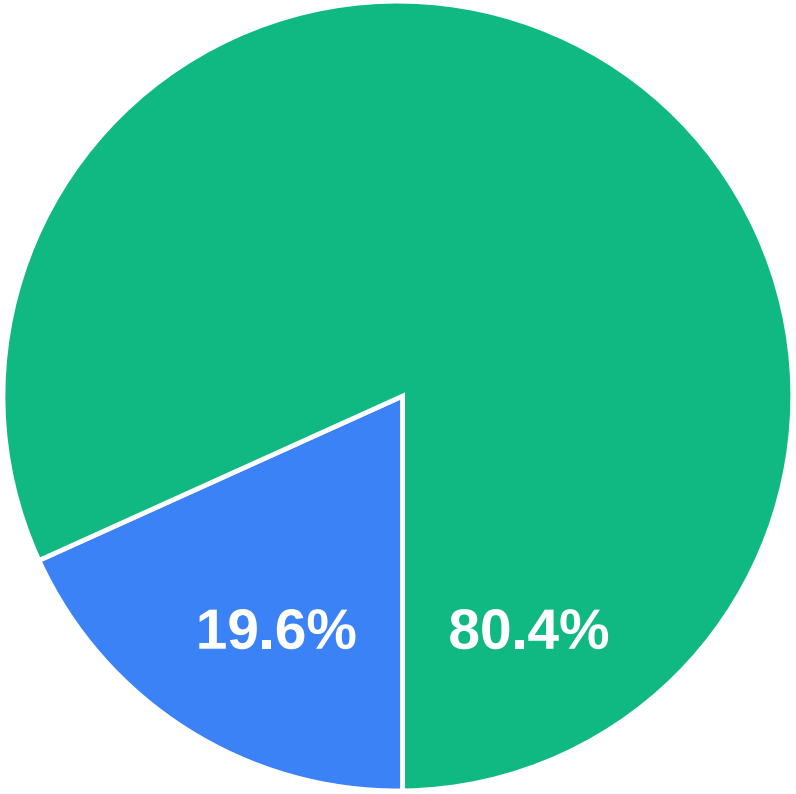


Canadian Climate Institute 440 Megatonnes

Residential Greenhouse Gas Emissions

Share of Total Canadian GHG Emissions, 2023

Source: National Inventory Report 1990–2023 (Table A10-2), Statistics Canada



Residential Sector: 136.20 Mt CO_2 eq

All Other Sectors: 557.72 Mt CO_2 eq

Getting to Zero Action Summary

#1 Improve Efficiency

#2 Clean Up Electricity

#3 Electrify Everything

#4 Switch to low-carbon fuels

#5 Decarbonize Industry Strategically

#3 Electrify Everything

People will save money if they switch to electric vehicles and heat pumps!

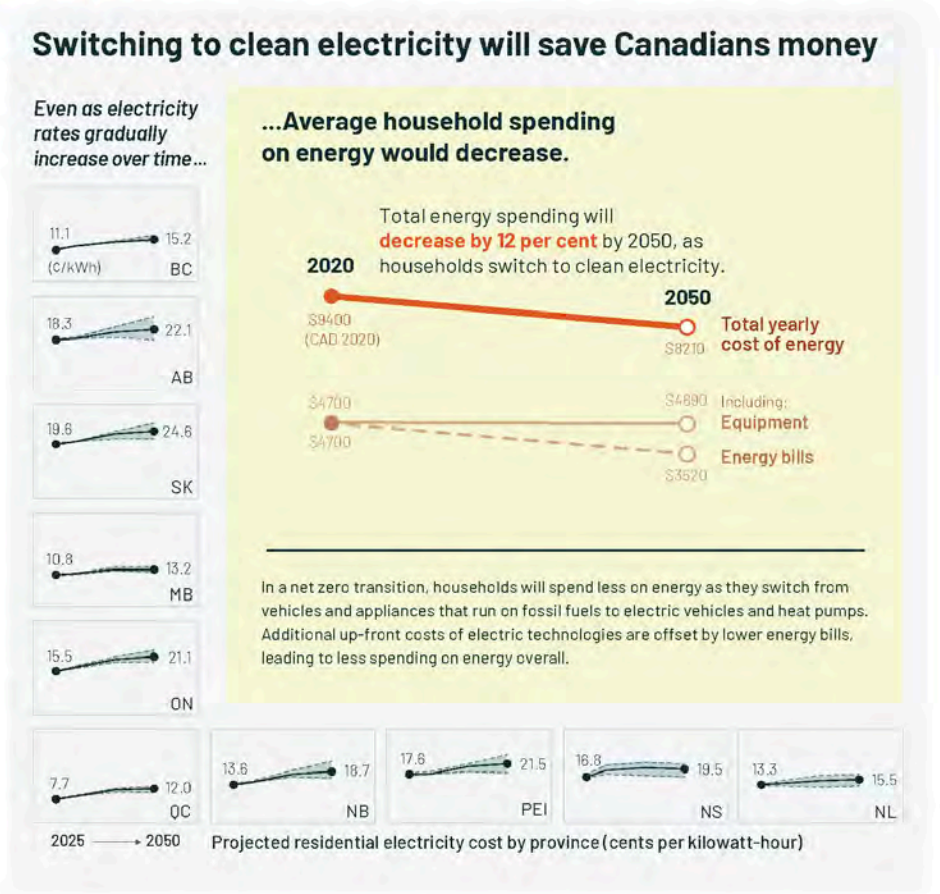
CLEAN ELECTRICITY, AFFORDABLE ENERGY

HOW FEDERAL AND PROVINCIAL GOVERNMENTS CAN SAVE CANADIANS MONEY ON THE PATH TO NET ZERO

JUNE 2023

CANADIAN CLIMATE INSTITUTE / L'INSTITUT CLIMATIQUE DU CANADA

FIGURE 2.



"Total energy spending will **decrease by 12 per cent by 2050**, as households switch to clean electricity"

Opening the Door

Clean energy solutions can save households hundreds of dollars every month, but some Canadians still face upfront barriers to adoption. Governments at all levels can help.

October 2024

CLEAN ENERGY CANADA

TOWNHOUSE

Living the clean energy life

Toronto

MONTHLY BILL

	OPERATING COSTS	EQUIPMENT COSTS*	TOTAL
Vehicle 1: Hatchback	$323	$206	$529
Vehicle 2: SUV	$326	$240	$566
VEHICLE TOTAL			**$1,094**
Heating and cooling	$53	$71	$123
Natural gas connection costs			
Water heating	$17	$16	$33
Appliances (incl. stove)	$23	$19†	$42
Other electricity usage (lighting, personal electronics, etc.)	$49		$49
HOME TOTAL			**$247**
Carbon pricing rebate	$(81)		$(81)
TOTAL	**$709**	**$551**	**$1,260**

$1,260 PER MONTH

SAVINGS OF UP TO $421

Emissions reductions from the household changes: -93%

Vancouver

MONTHLY BILL

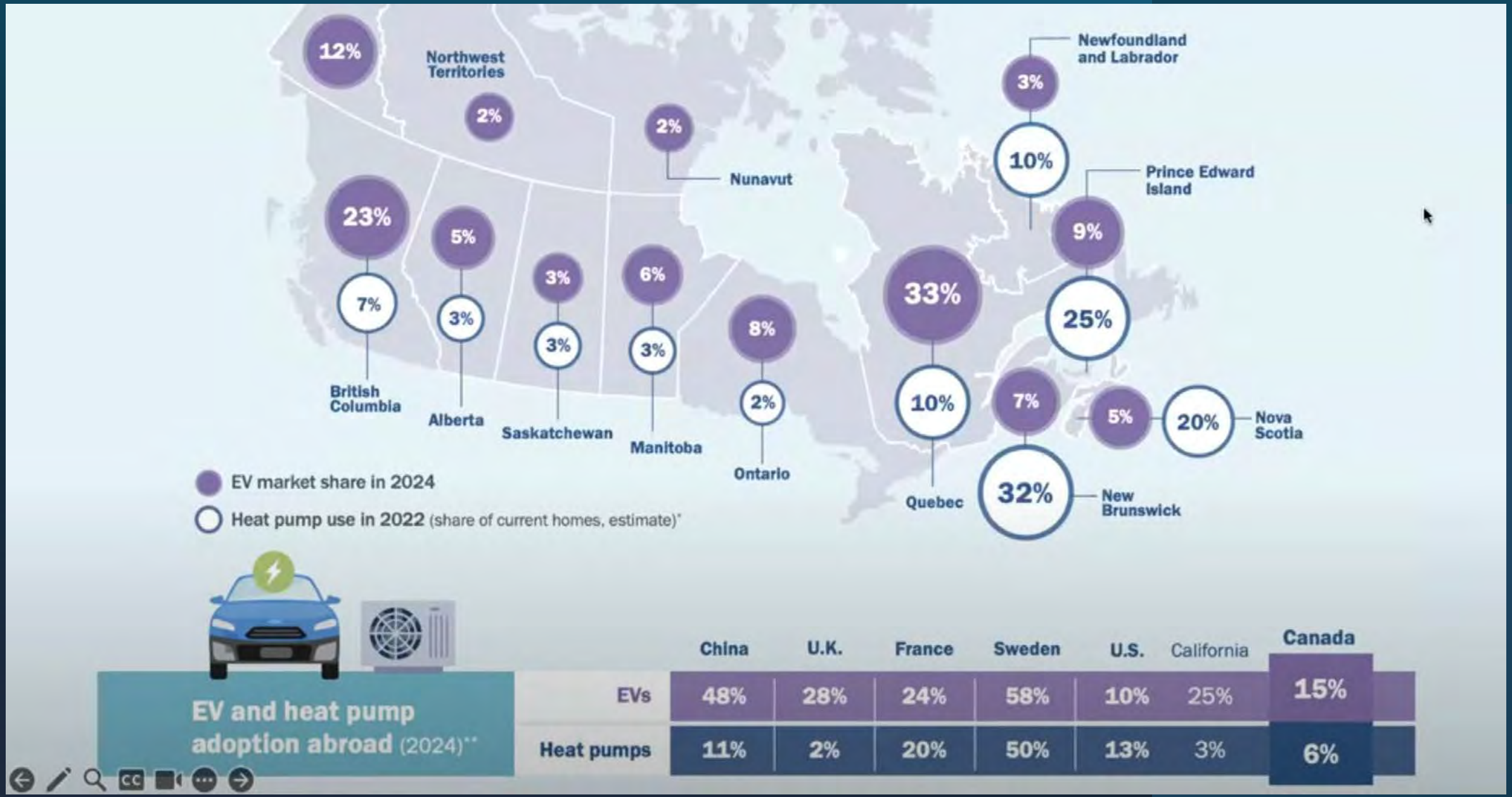
	OPERATING COSTS	EQUIPMENT COSTS*	TOTAL
Vehicle 1: Hatchback	$323	$169	$492
Vehicle 2: SUV	$327	$235	$562
VEHICLE TOTAL			**$1,054**
Heating and cooling	$26	$15	$41
Natural gas connection costs			
Water heating	$16	$13	$29
Appliances (incl. stove)	$24	$18†	$42
Other electricity usage (lighting, personal electronics, etc.)	$50		$50
HOME TOTAL			**$162**
Carbon pricing rebate			
TOTAL	**$766**	**$451**	**$1,217**

$1,217 PER MONTH

SAVINGS OF UP TO $596

Emissions reductions from the household changes: -97%

* Monthly equipment costs do not include interest. Upfront purchase costs are spread out over the ownership period of the technology to ensure all costs are captured in the monthly comparison. † Only the stove is included in the equipment cost calculation because it is the only appliance that changes in the different scenarios (whereas the cost of the stove along with other appliances are included in the energy cost calculation)



	China	U.K.	France	Sweden	U.S.	California	Canada
EVs	48%	28%	24%	58%	10%	25%	15%
Heat pumps	11%	2%	20%	50%	13%	3%	6%

Clean Energy Canada, 2025

Which people will save money if they switch to electric vehicles and heat pumps?

ELECTRIFYING CANADA
AN INITIATIVE OF THE TRANSITION ACCELERATOR

Household Energy Affordability in a Net-Zero Future

November 2024

Nick Martin, Lead Author | Director of Electrification, The Transition Accelerator
Daniel Bowie | Senior Electrification Analyst, The Transition Accelerator
Rami Fakhoury | Energy Systems Analyst, The Transition Accelerator
Moe Kabbara | Vice President, The Transition Accelerator

What Is an Energy Wallet?

An energy wallet represents all costs associated with purchasing, operating, and maintaining the energy and technology needed for household energy needs, covering power, heating, cooling, and personal transportation. The energy wallet includes:

- Energy costs (e.g., electric and natural gas utility bills, heating oil and propane, and gasoline and diesel fuel)
- Equipment purchase and installation costs including personal vehicles, space conditioning equipment (e.g., heat pumps, furnaces, air conditioners) and water heaters
- Equipment maintenance costs (e.g., furnace tune-ups, filter replacements, brake services, etc.)

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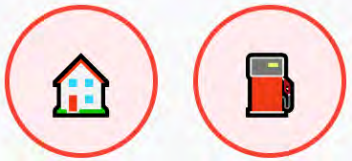
Energy Wallet for Households

Figure 1. Estimated average annual energy wallet cost for households in 2024

Household Energy Wallet Expenditure Analysis Methodology

1

Reference Energy Wallet



Space Heating System + Gasoline Vehicle

- Capital costs
- Fuel/Energy costs
- Maintenance costs

→

2

Electrification Energy Wallet

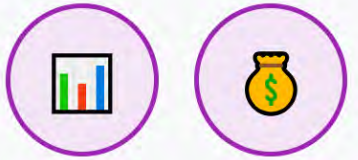
CC-ASHP + Electric Vehicle

- Capital costs
- Fuel/Energy costs
- Maintenance costs

→

3

Calculate Difference



Electrification Costs - Reference Costs = Net Change

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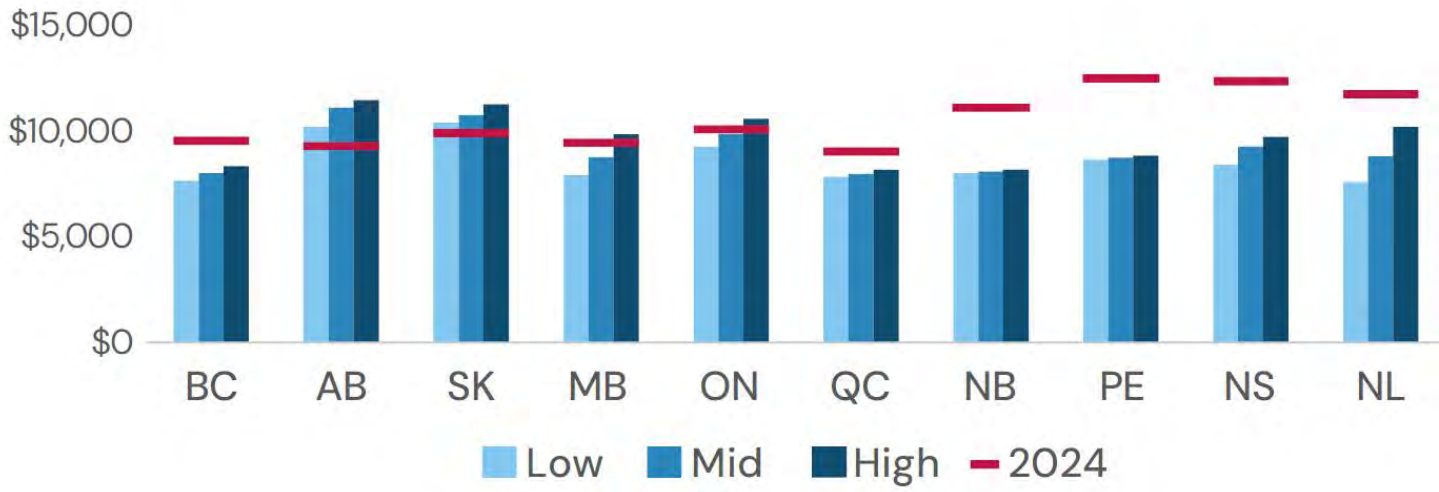
Energy Wallet for Households

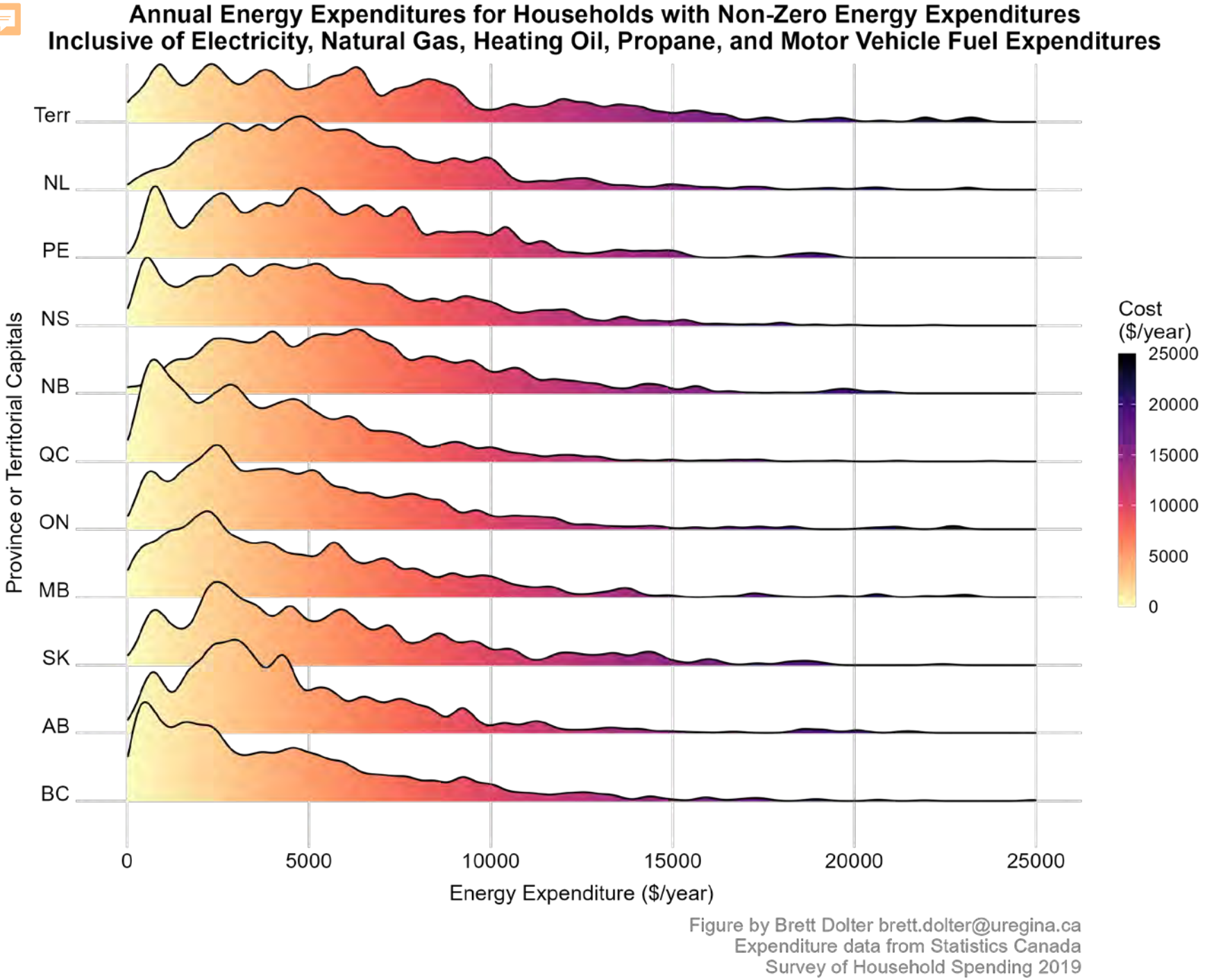
Figure 12. Median Annual Energy Wallet Cost in 2050 vs. 2024



Note: All monetary values are expressed in 2024 Canadian dollars (CAD).

Data in Brief – Expenditure Data

- **Data source**: Statistics Canada (2019) Survey of Household Spending
- This survey data contains 7930 observations
- Covers all ten provinces and the territorial capitals
- Includes data on household characteristics, income, expenditure, and energy expenditures
- **Key energy expenditures**:
  - Electricity
  - Natural Gas
  - Other fuels: includes heating oil
  - Motor vehicle fuels (gasoline and diesel)



Understanding the Plot

This figure shows the distribution of energy expenditures by province.

The height of the ridge indicates the relative frequency of households with expenditures in that range.

Annual energy expenditure levels are along the x-axis.

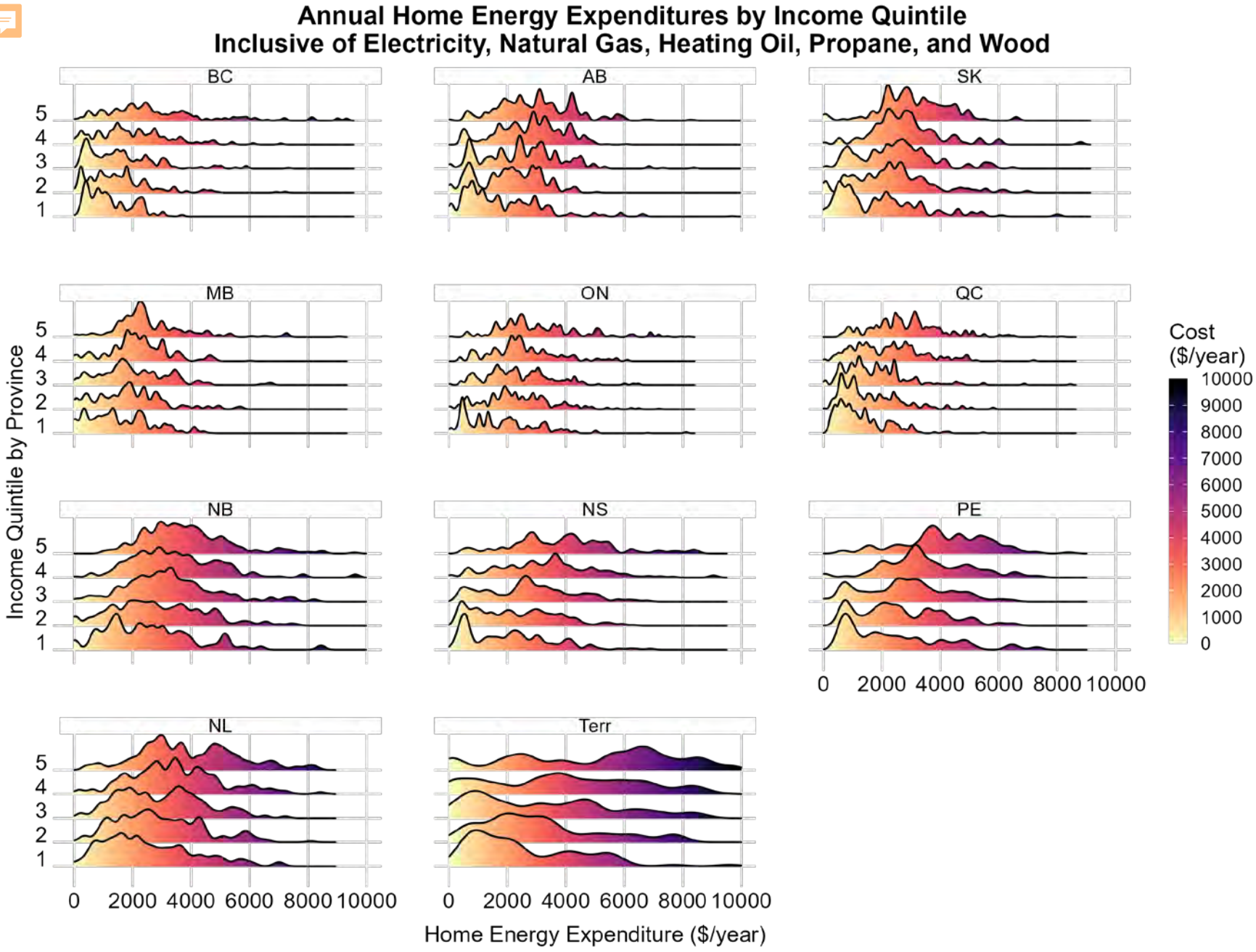


Figure by Brett Dolter brett.dolter@uregina.ca
Expenditure data from Statistics Canada Survey of Household Spending 2019
Note: Includes only households with non-zero home energy expenditures

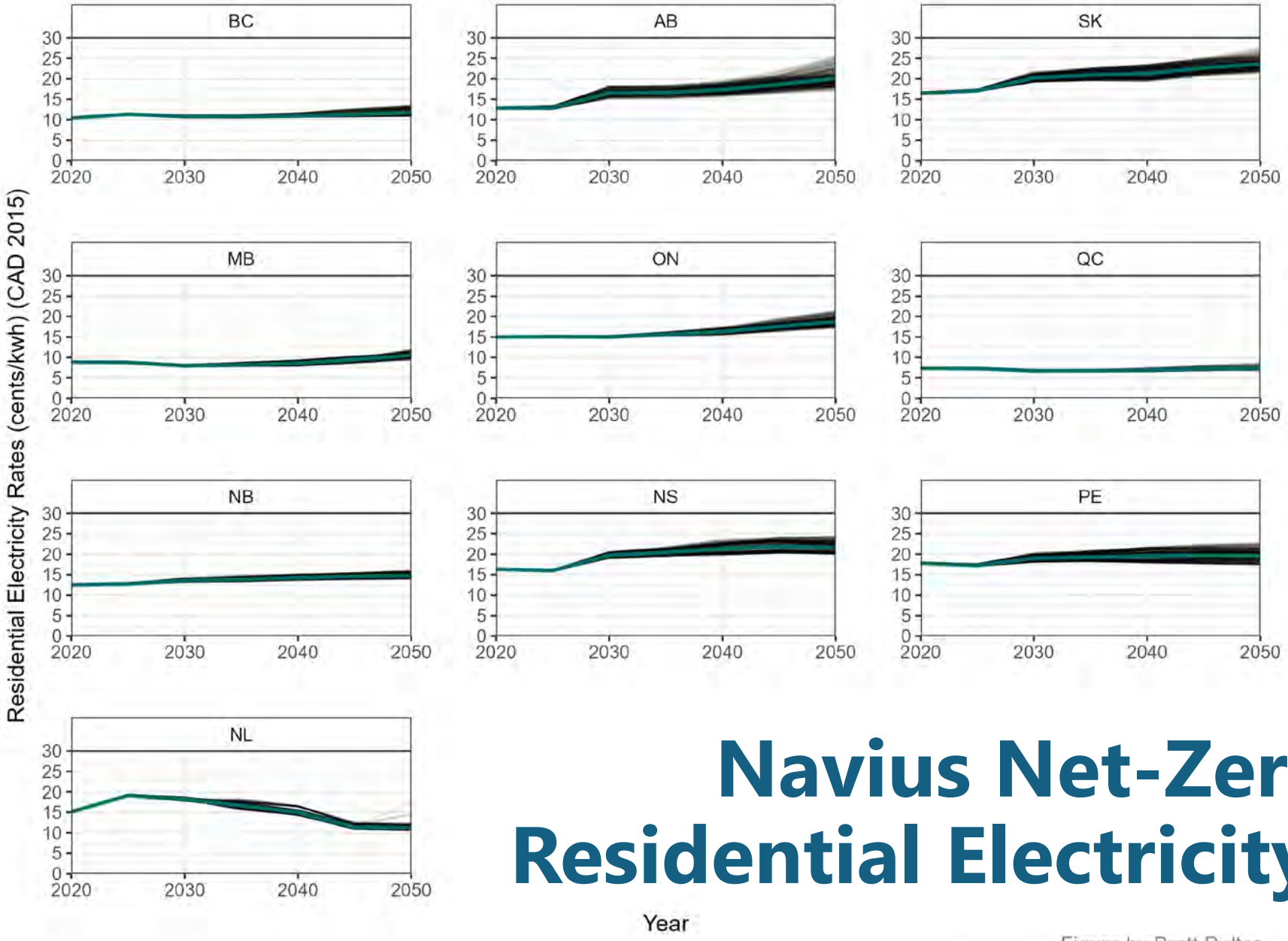
Understanding the Plot

This figure shows the distribution of energy expenditures by province and income group.

Income group 1 includes the 20% of households with the lowest incomes. Income group 5 includes the 20% of households with the highest incomes.

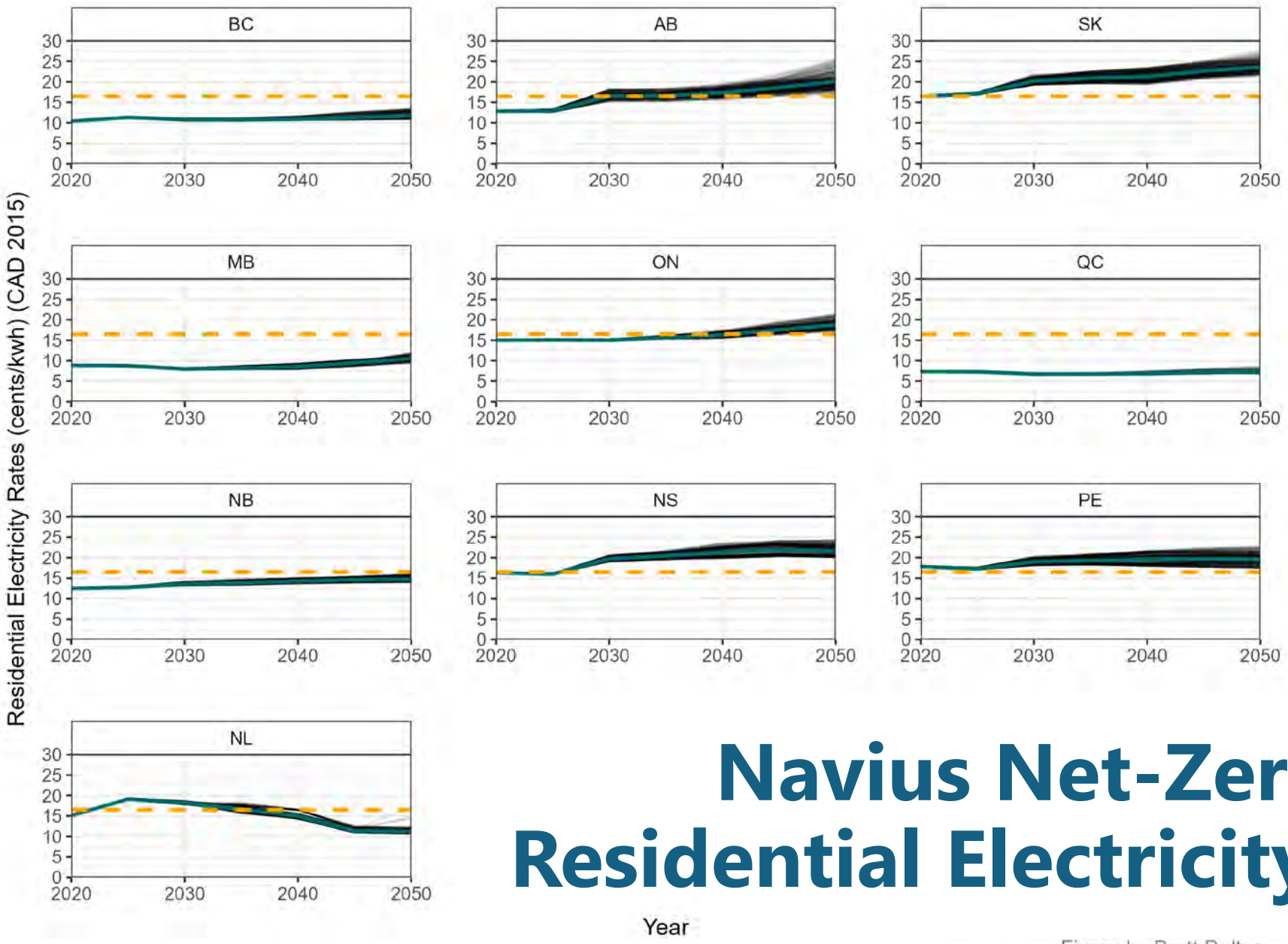
Data in Brief – Energy Prices

- **Electricity prices for future years:** Navius Canada Energy Dashboard (https://canadaenergydashboard.com/index.html)
- **Gasoline and heating oil prices**:
  - Kent Prices for 2019 year; used for imputing energy usage (Source: Kent Group)
  - Future years modelled using a price of $1.35/litre for gasoline and heating oil. Gasoline is differentiated by province to reflect regional gasoline price differences.
- **Natural gas prices**: I calculate a reference price for each province using Canada's Energy Future 2023 (Source: Canada Energy Regulator).
- I add **carbon pricing** to gasoline, heating oil, and natural gas.



Navius Net-Zero Residential Electricity Rates

Figure by Brett Dolter
Modelling data provided by Navius



Navius Net-Zero Residential Electricity Rates

Figure by Brett Dolter
Modelling data provided by Navius

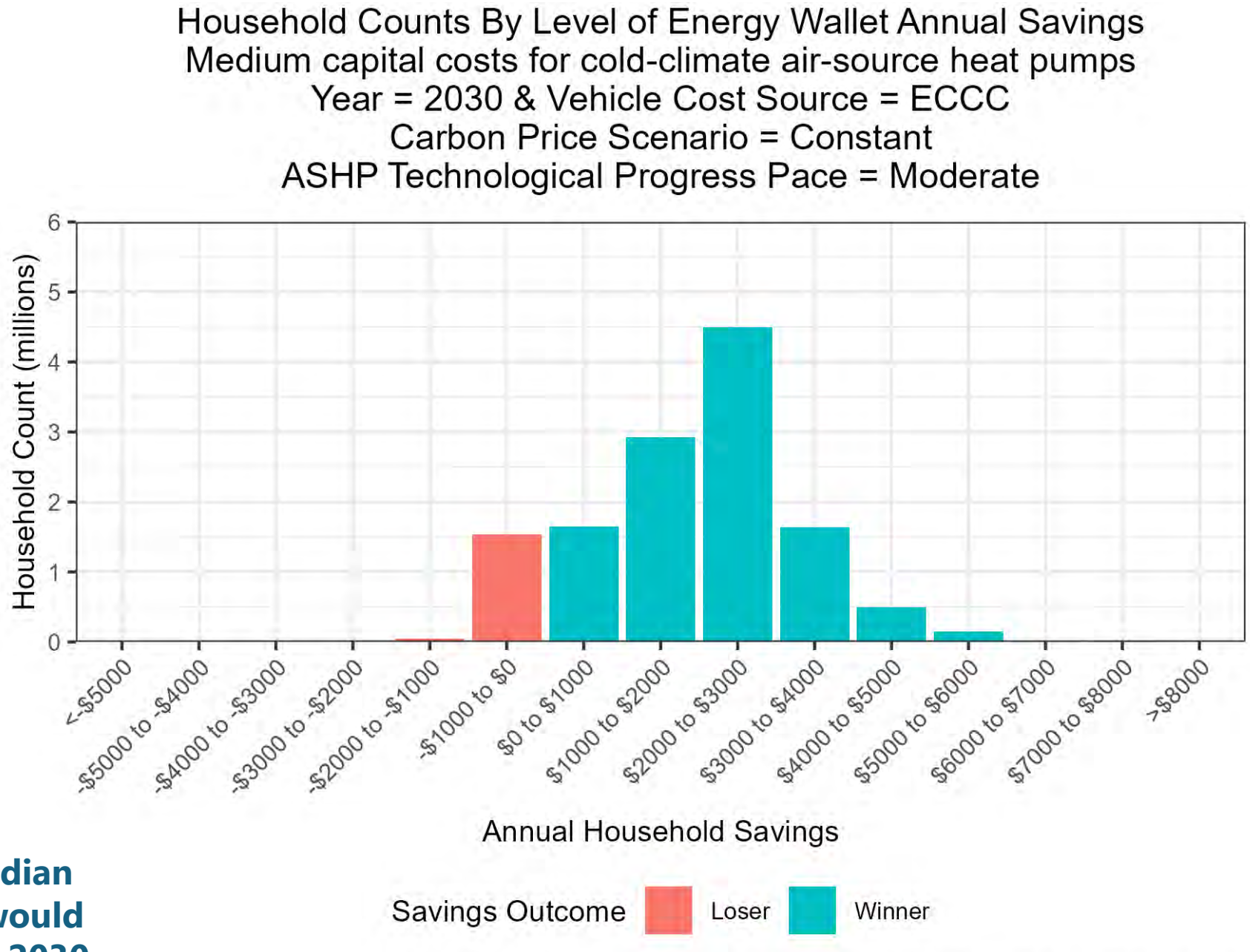
Permutations

There are several input variations that impact household energy wallet expenditures. The permutations that result from these variations are multiplicative. The permutations are as follows:

1. **Years** – This analysis is carried out for two time-steps: 2030 & 2050 **(2)**
2. **EV Price differentials** – ECCC RIAS 2023 and EIA AEO 2023 **(2)**
3. **CC-ASHP cost and efficiency progress** – "Slow", "Moderate" and "Rapid" (NREL, 2017) **(3)**
4. **Carbon pricing** – None, Constant at $170/tonne after 2030, Escalating at $15/tonne/year in nominal terms after 2030 **(3)**

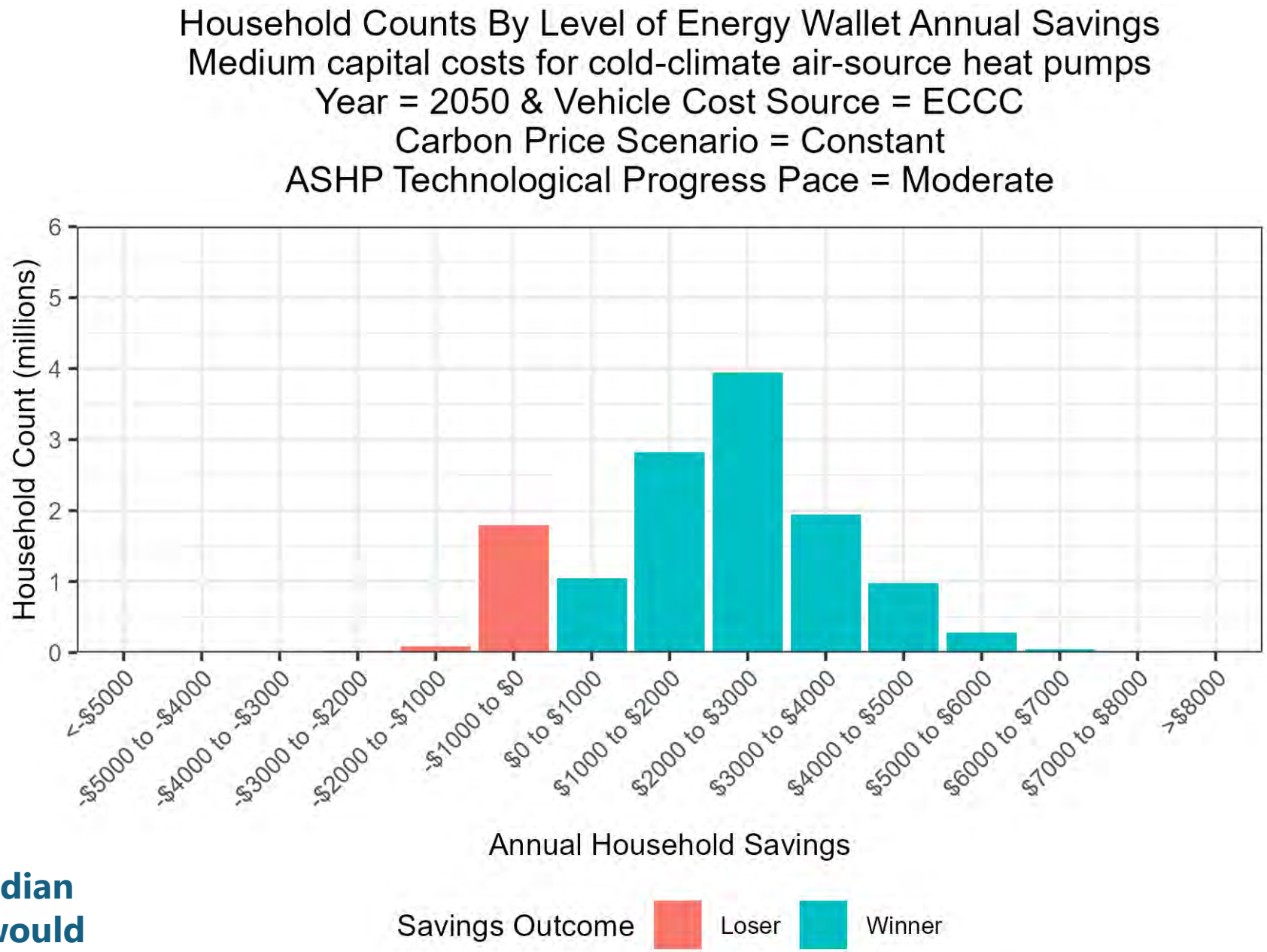
In total this produces 2 x 2 x 3 x 3 = **36 permutations**.

Energy Wallet Results



87% of Canadian households would be winners in 2030

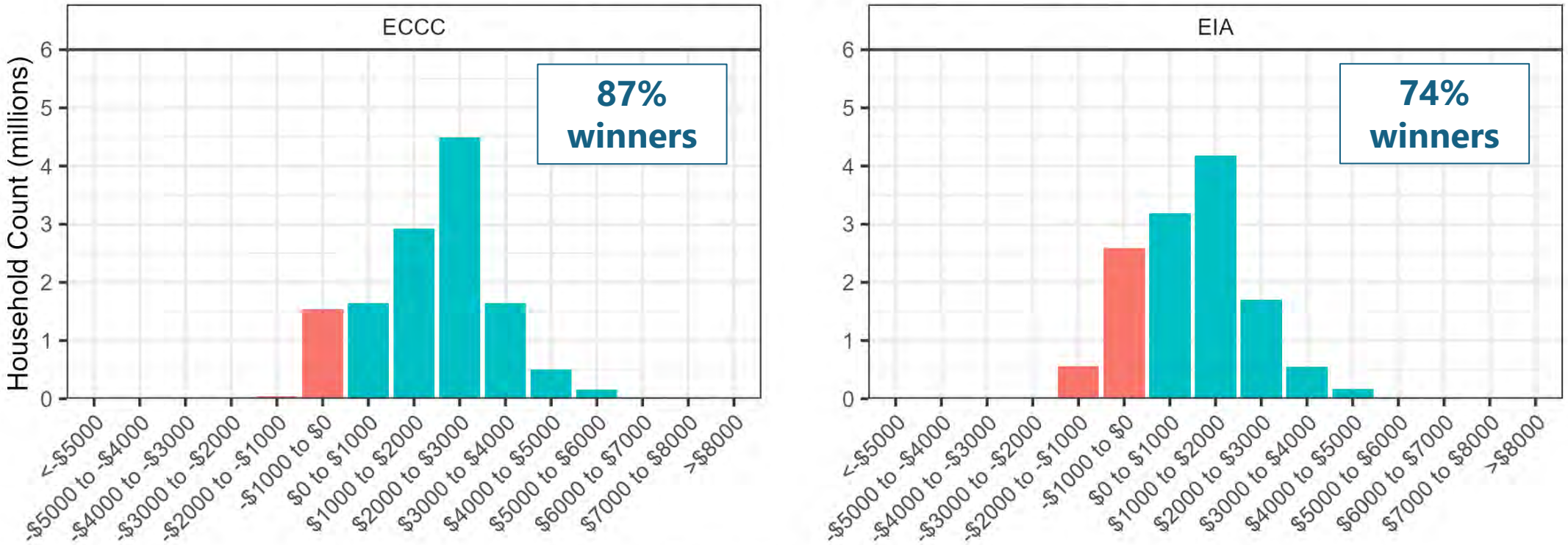
Figure by Brett Dolter: brett.dolter@uregina.ca



85% of Canadian households would be winners in 2050

Figure by Brett Dolter: brett.dolter@uregina.ca

Household Counts By Level of Energy Wallet Annual Savings by EV Price
Medium capital costs for cold-climate air-source heat pumps
Year = 2030
Carbon Price Scenario = Constant
ASHP Technological Progress Pace = Moderate



The purchase price of EVs is important. The sooner we see purchase price parity, the more households can win in the energy transition

Figure by Brett Dolter: brett.dolter@uregina.ca

Losing the consumer carbon price makes electrification less attractive. However, many households can still be winners.

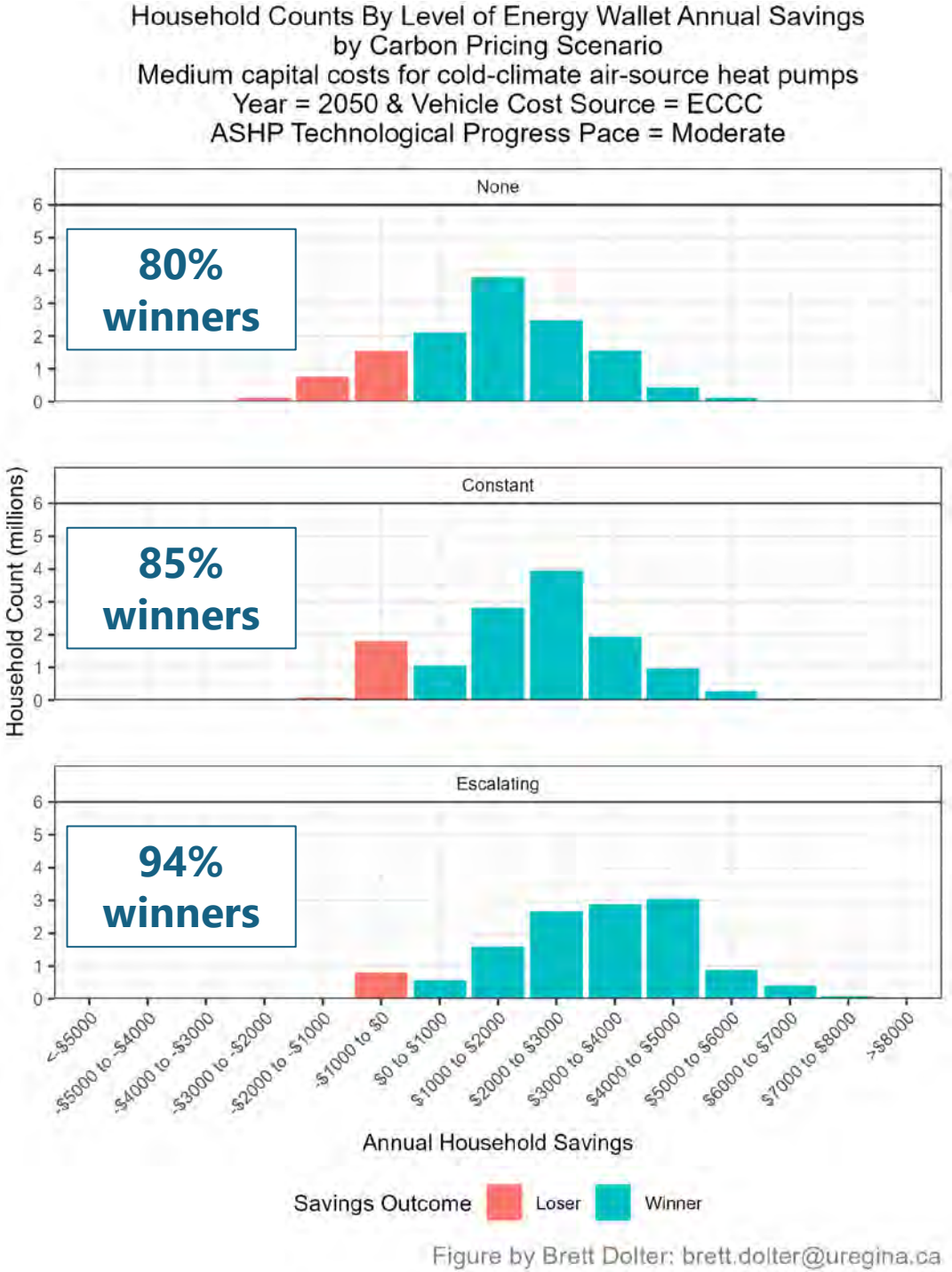
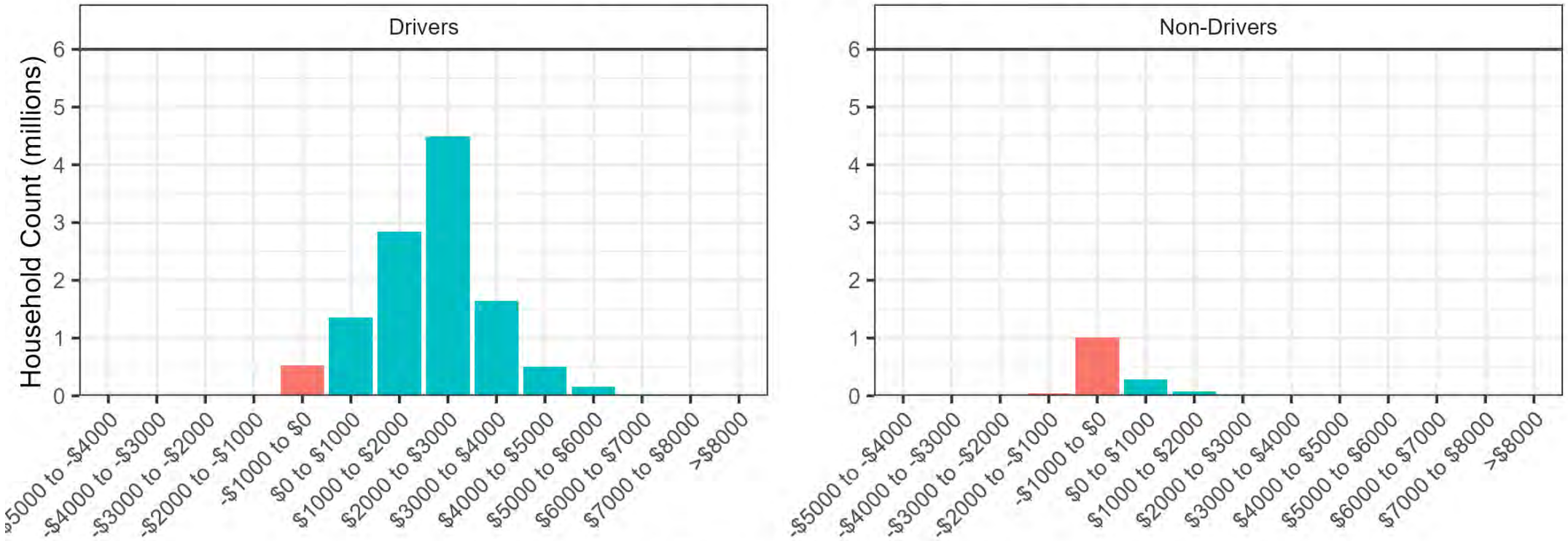


Figure by Brett Dolter: brett.dolter@uregina.ca

Household Counts By Level of Energy Wallet Annual Savings by Driving Status
Medium capital costs for cold-climate air-source heat pumps
Year = 2030 & Vehicle Cost Source = ECCC
Carbon Price Scenario = Constant
ASHP Technological Progress Pace = Moderate



Electric Vehicles are the big driver of savings. Households that don't drive are much more likely to lose when electrifying space conditioning.

Figure by Brett Dolter: brett.dolter@uregina.ca

Provincial Household Counts By Level of Energy Wallet Annual Savings
Medium capital costs for cold-climate air-source heat pumps
Year = 2030 & Vehicle Cost Source = ECCC
Carbon Price Scenario = Constant
ASHP Technological Progress Pace = Moderate

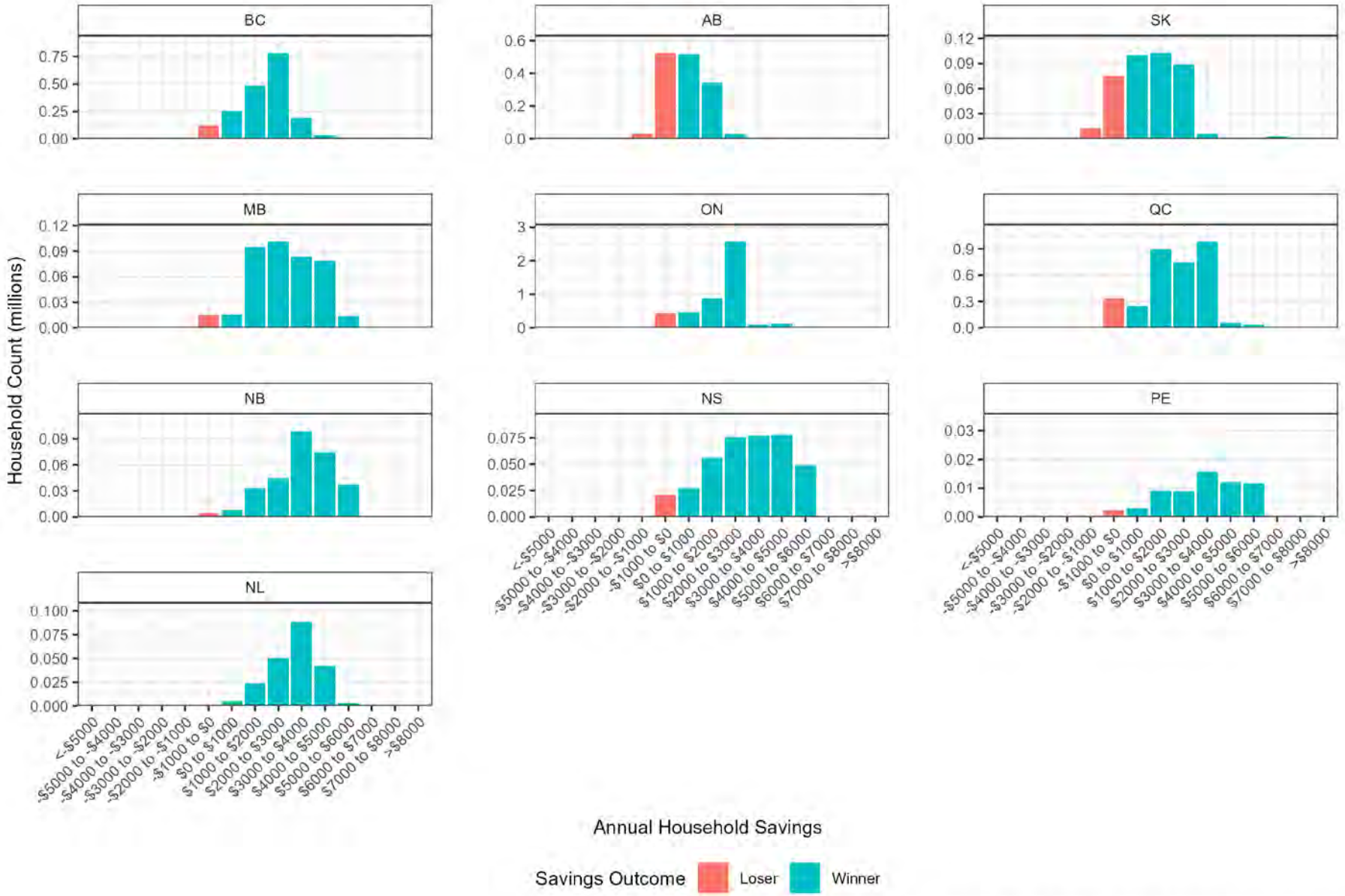
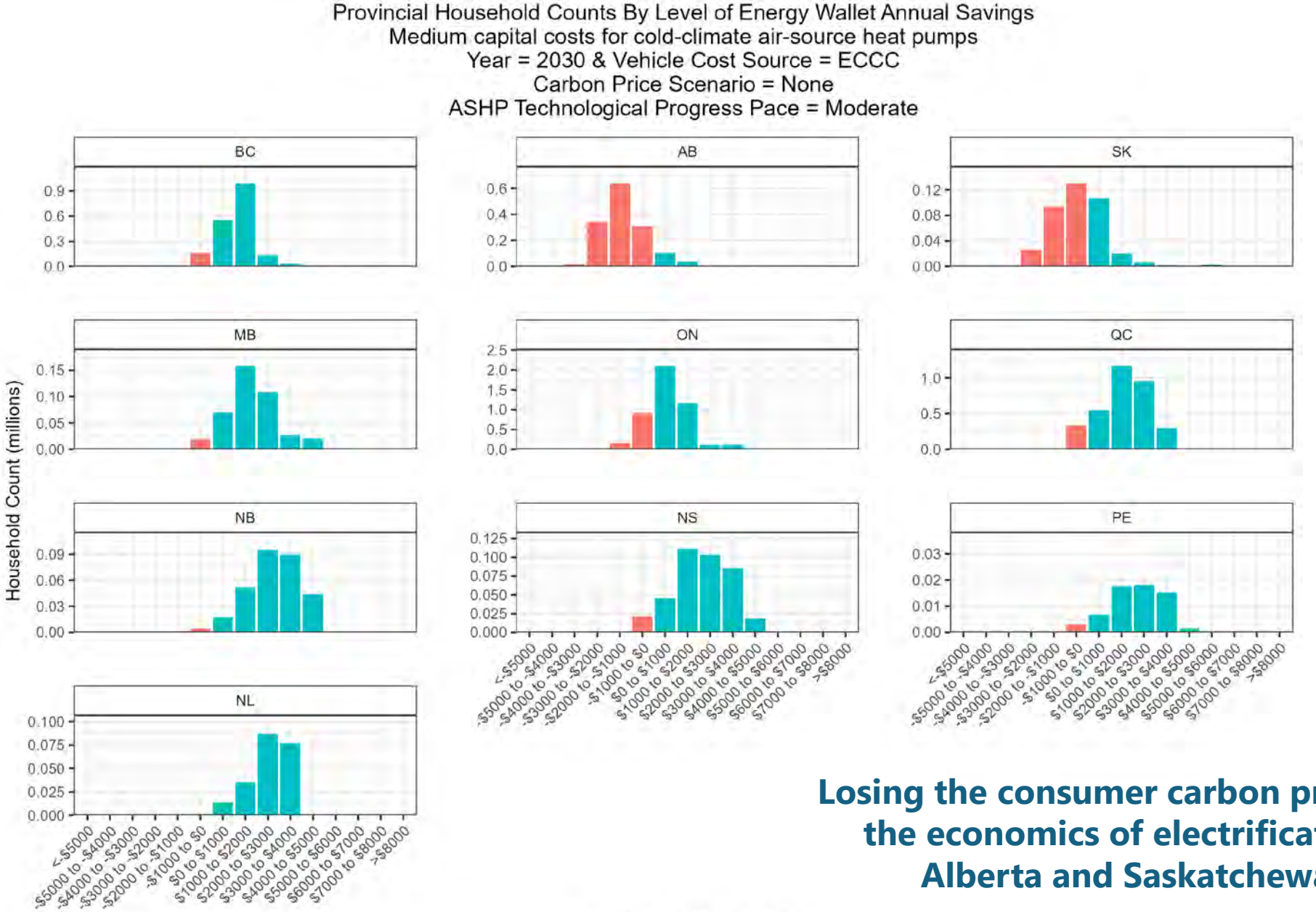


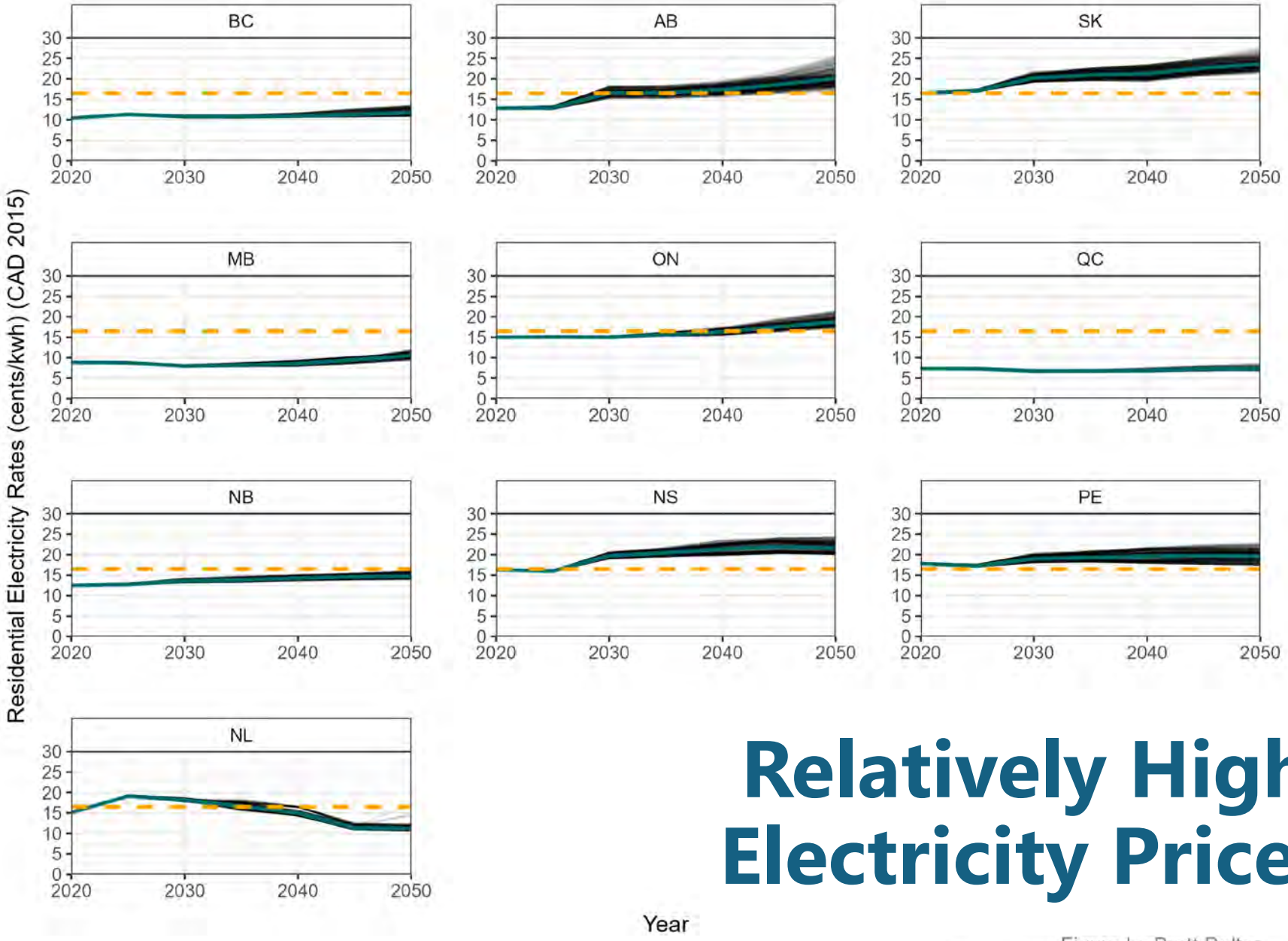
Figure by Brett Dolter: brett.dolter@uregina.ca



Losing the consumer carbon price hurts the economics of electrification in Alberta and Saskatchewan.

Figure by Brett Dolter: brett.dolter@uregina.ca

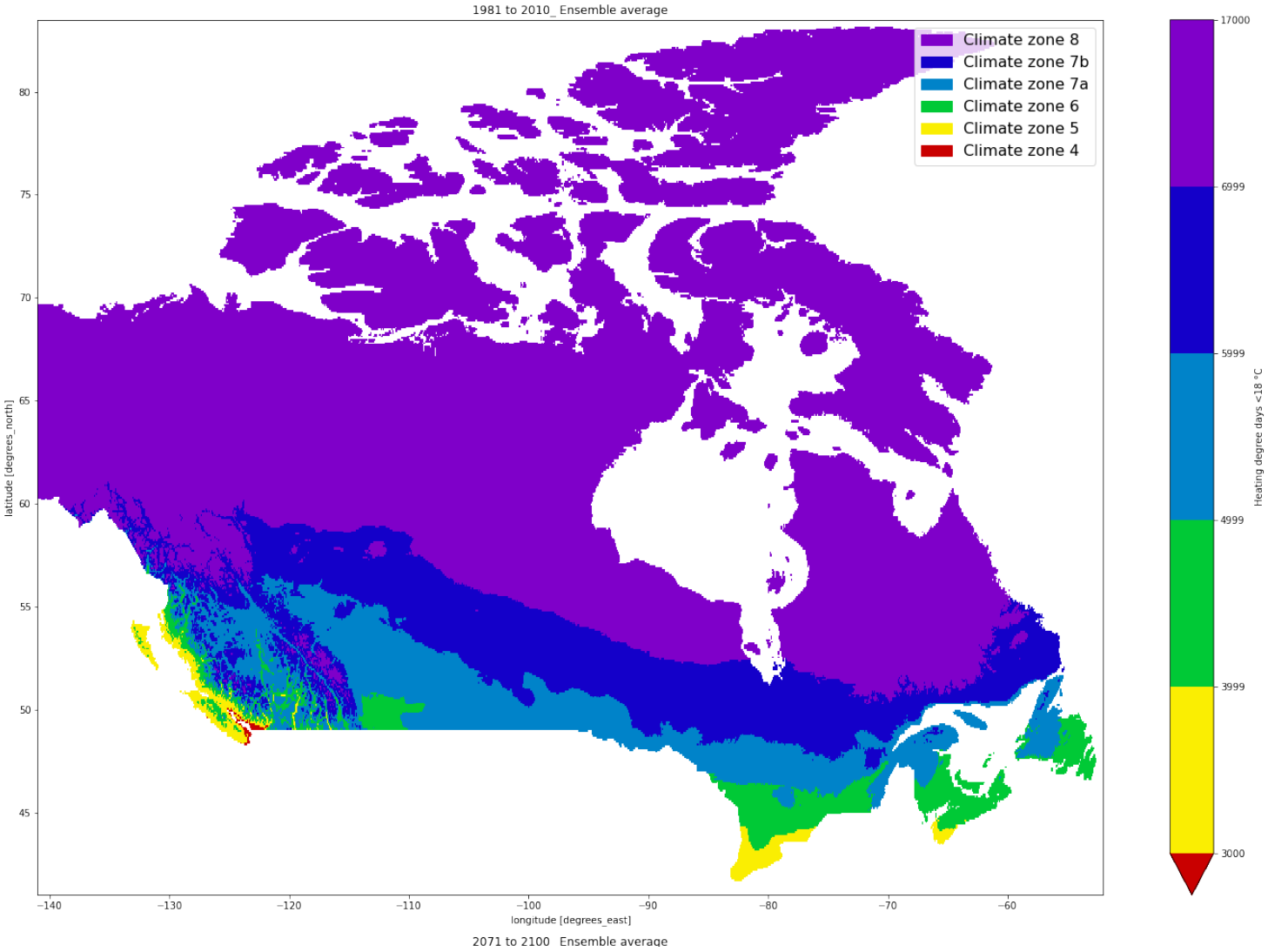
Why Don’t Alberta and Saskatchewan Households Win More Often?



Relatively High Electricity Prices

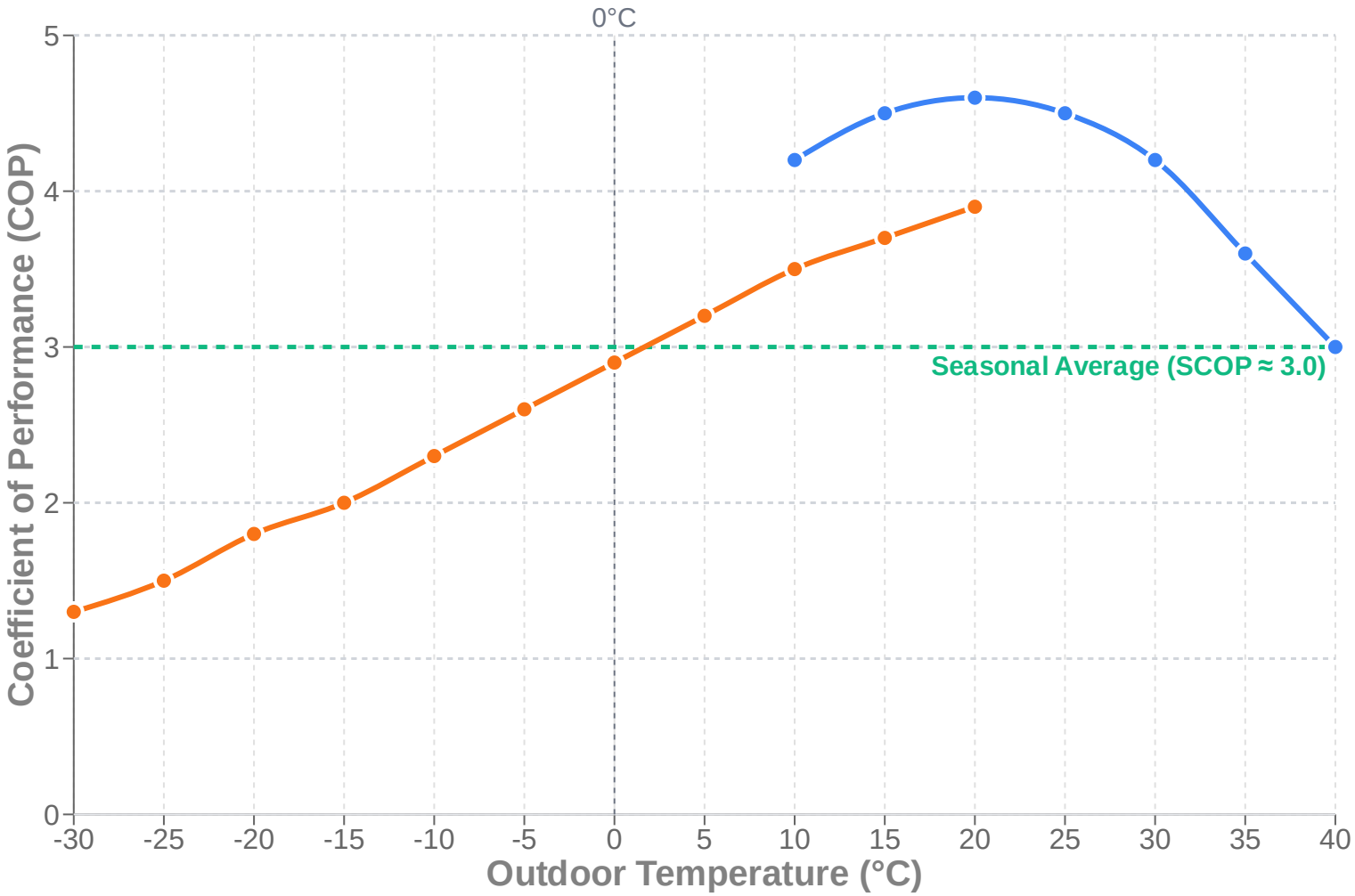
Figure by Brett Dolter
Modelling data provided by Navius

Cold Climates leading to…



(Climate Data, 2024)

Lower CC-ASHP Coefficients of Performance



Province	sCOP	Heating Load Covered by Heat Pump
BC	3.70	100%
AB	2.67	90%
SK	2.61	90%
MB	2.66	90%
ON	3.12	98%
QC	2.83	94%
NB	2.87	98%
NS	3.13	98%
PE	2.91	98%
NL	2.87	90%

Conclusions

- The purchase price of electric vehicles is an important factor influencing energy wallet outcomes. If EVs reach purchase price parity by 2030-2035 (like ECCC assumes), then more households will be net winners.
- The cancellation of Canada's consumer carbon price reduces the number of households that will save money in the energy transition. The move makes ICE vehicles and natural gas furnaces relatively more competitive when compared to EVs and CC-ASHP heating systems.

Conclusions

- Drivers are most likely to save money in the energy transition because EVs generate a lot of operational savings. The more you drive, the more you can save by buying an EV.
- The results vary across provinces. Alberta and Saskatchewan stand out as places where households are less likely to save money in the energy transition. This is a result of three key factors:
  - Relatively high electricity prices
  - Relatively low natural gas prices
  - Cold climates that reduce the efficiency of CC-ASHP heating systems
- CC-ASHP offer operational savings relative to heating oil and electric resistance heat, but not natural gas heat.

Policy Advice

- People get hung up on high upfront cost and discount (put less value on) long-run savings.
- We need to keep working to lower the price of EVs. Clean Energy Canada suggests Canada should allow more EVs to be sold in Canada (e.g. European and Korean EVs) to increase the number of EVs that cost less than $40,000.
- The federal government is reviewing the ZEV mandate. If we aren't going to have a carbon price, then we need other policies to make adoption of EVs and heats pumps desirable.
- A ZEV mandate can reduce the price of EVs and get us closer to purchase price parity

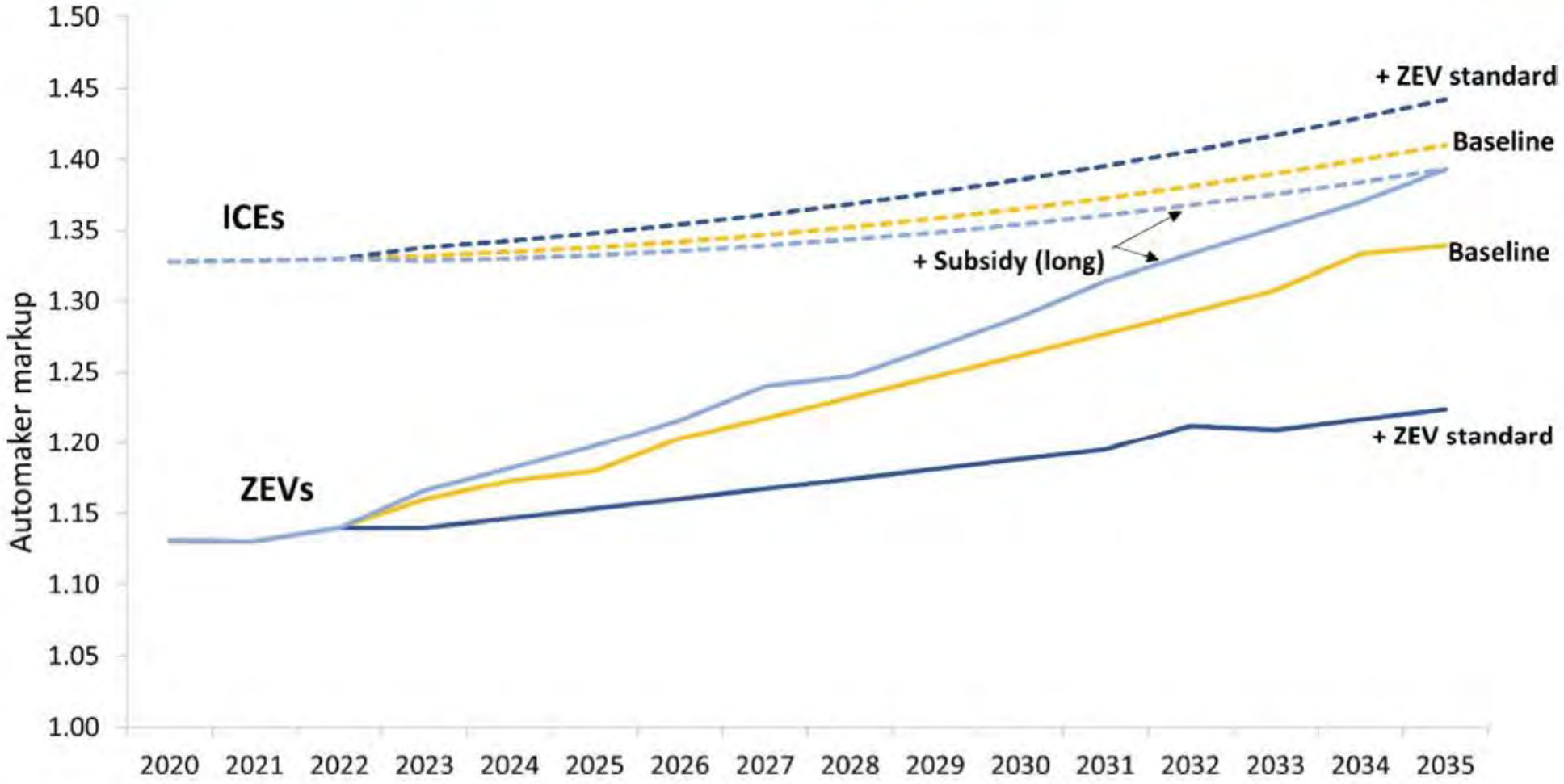


Figure 4. Automaker markups (median simulations).

Jonn Axsen and Chandan Bhardwaj (2025) Subsidies, Standards, or Both? Trade-Offs among Policies for 100% ZEV Sales.

Policy Advice

- We need to keep working to lower the price of heat pumps, and to get them working more efficiently at low temperatures. Research is needed!

Town & Country
Plumbing • Heating • Electrical
352-HEAT (4328)

WORK ORDER - INVOICE

WORK ORDER:

CUSTOMER: Brett Dolter
STREET:
CITY:

DESCRIPTION: Supply & Install Mitsubishi PUZ-HAZ30NKA heat pump. 5 Year Parts & 1 Year labour warranty. Includes duct trunk rebuild, moving humidifier and all necessary heats, Supply & Install Healthy Climate Merv 16 Cabinet and filter.

CALL TYPE: Refrigeration

TROUBLE REPORTED: Retrofit / Sales

WORK PERFORMED: --

PARTS

QUANTITY	DESCRIPTION	UNIT	TOTAL
1	Supply & Install Mitsubishi PUZ-HA30 Hyper Heat Pump	$18,856.82	$18,856.82
1	Supply & Install Healthy Climate MERV 16 cabinet and filter	$728.00	$728.00

SALE AMOUNT $19,584.82
SALES TAX $2,154.33
BALANCE $21,739.15

Policy Advice

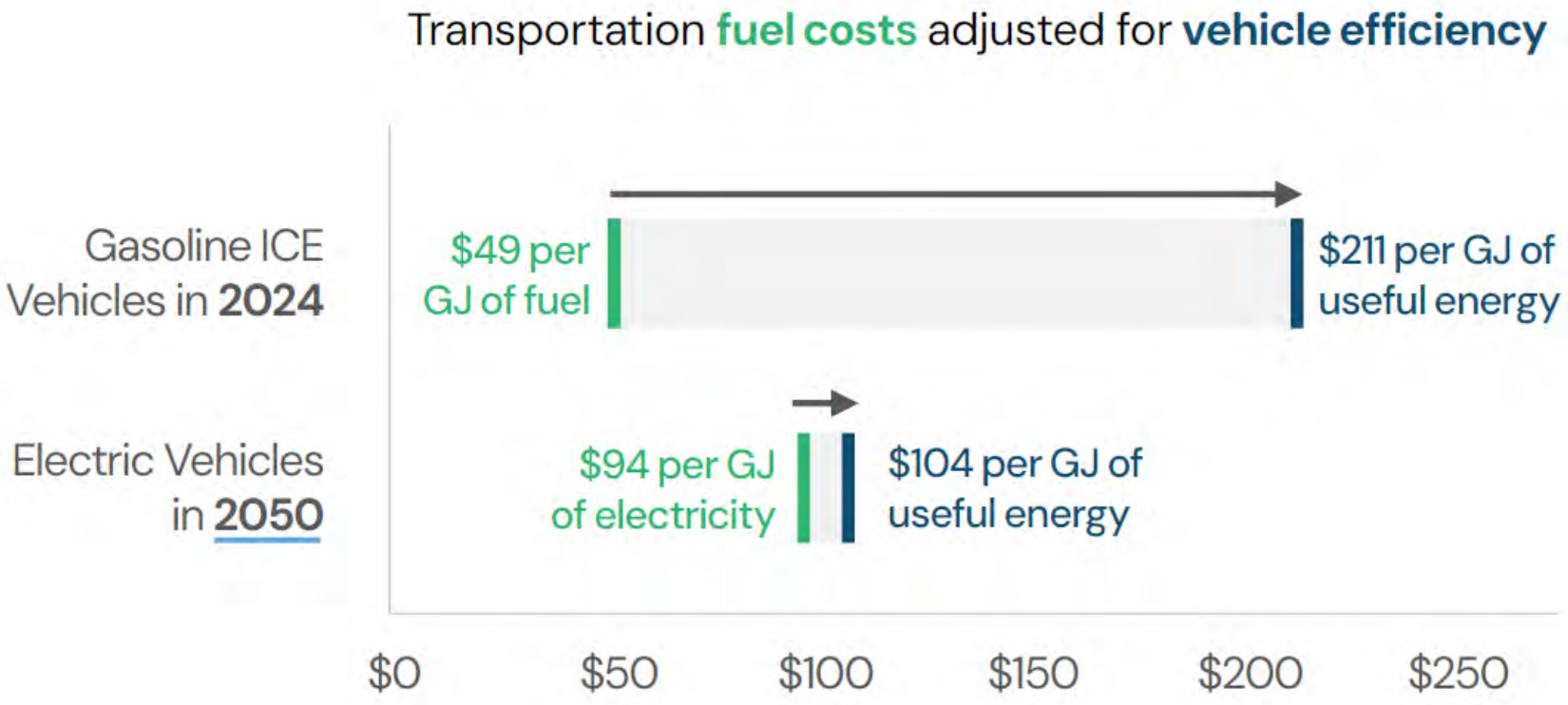
- We need to keep working to lower the price of heat pumps, and to get them working more efficiently at low temperatures. Research is needed!
- On the prairies it's also useful to think about other ways to electrify our heating systems. Can we get better at installing ground-source heat pumps? Or can we start building thermal networks to serve multiple buildings in our communities?

Thanks!

Brett.Dolter@uregina.ca

Supplementary Slides

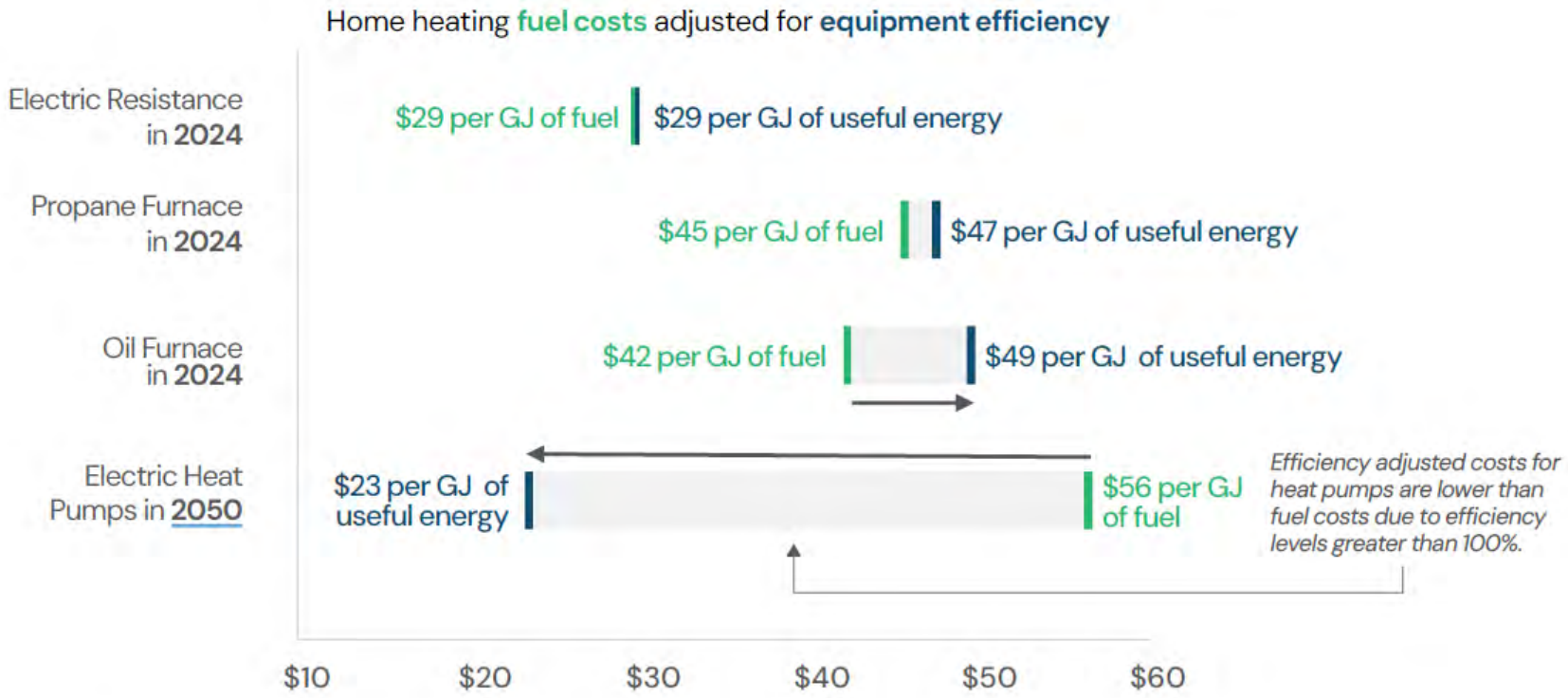
Figure 5. Transportation Energy Equivalent and Efficiency Adjusted Fuel Costs



Note: Electric rates for EVs in 2050 are based on the Mid rate scenario and reflect the weighted average cost of both home and public charging. Efficiency adjusted fuel costs reflect the effective cost per unit of locomotive output and are based on assumed efficiencies of 23% for ICE vehicles and 90% for electric vehicles. All monetary values are expressed in 2024 Canadian dollars (CAD).

Electrifying Canada (2024) Household Energy Affordability in a Net-Zero Future. Figure 5

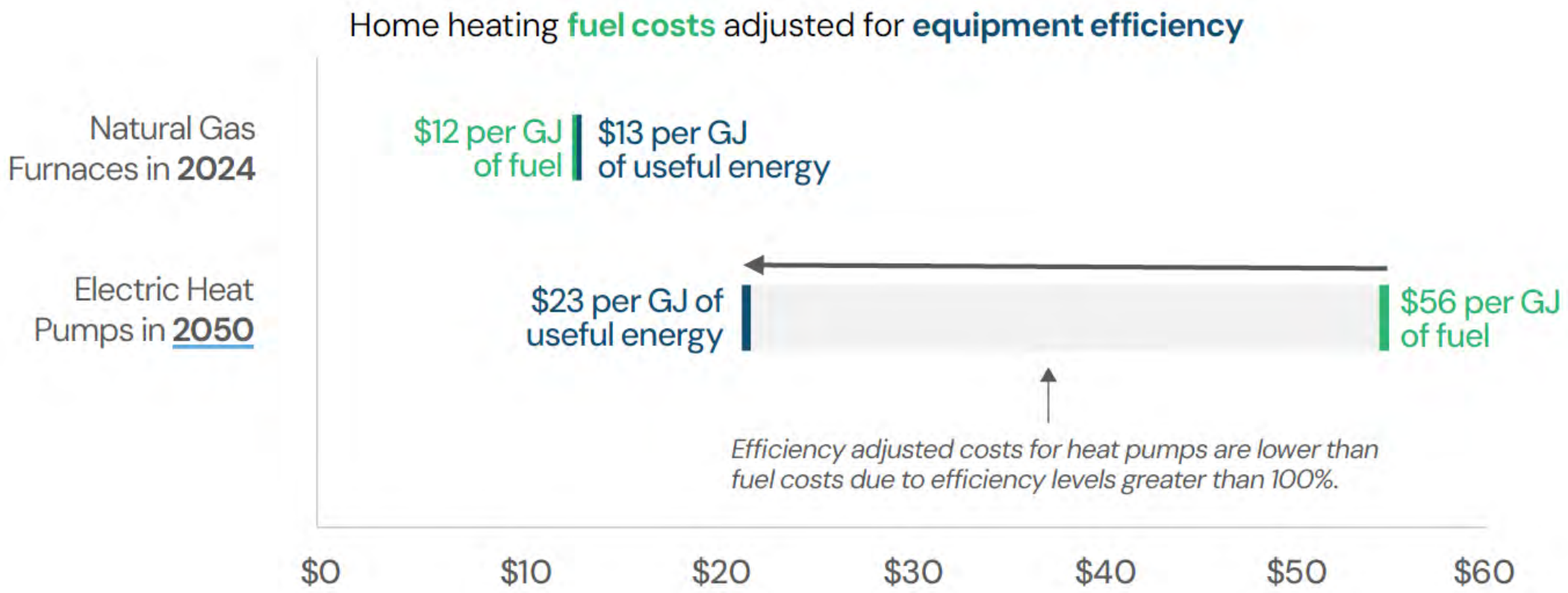
Figure 6. Home Space Heating Energy Equivalent and Efficiency Adjusted Fuel Costs (Oil, Propane, Electricity)



Note: Electricity rates for electric heat pumps in 2050 are based on the Mid rate scenario. Efficiency adjusted fuel costs reflect the effective cost per unit of heat output and are based on assumed efficiencies 85% for oil furnaces, 90% for propane furnaces, and 100% for electric resistance.[27] For electric heat pumps in 2050, the average efficiency is projected at 247%, reflecting the combined performance of heat pumps and electric resistance backup systems. All monetary values are expressed in 2024 Canadian dollars (CAD).

Electrifying Canada (2024) Household Energy Affordability in a Net-Zero Future. Figure 6

Figure 9. Home Space Heating Energy Equivalent and Efficiency Adjusted Fuel Costs (Natural Gas and Electricity)



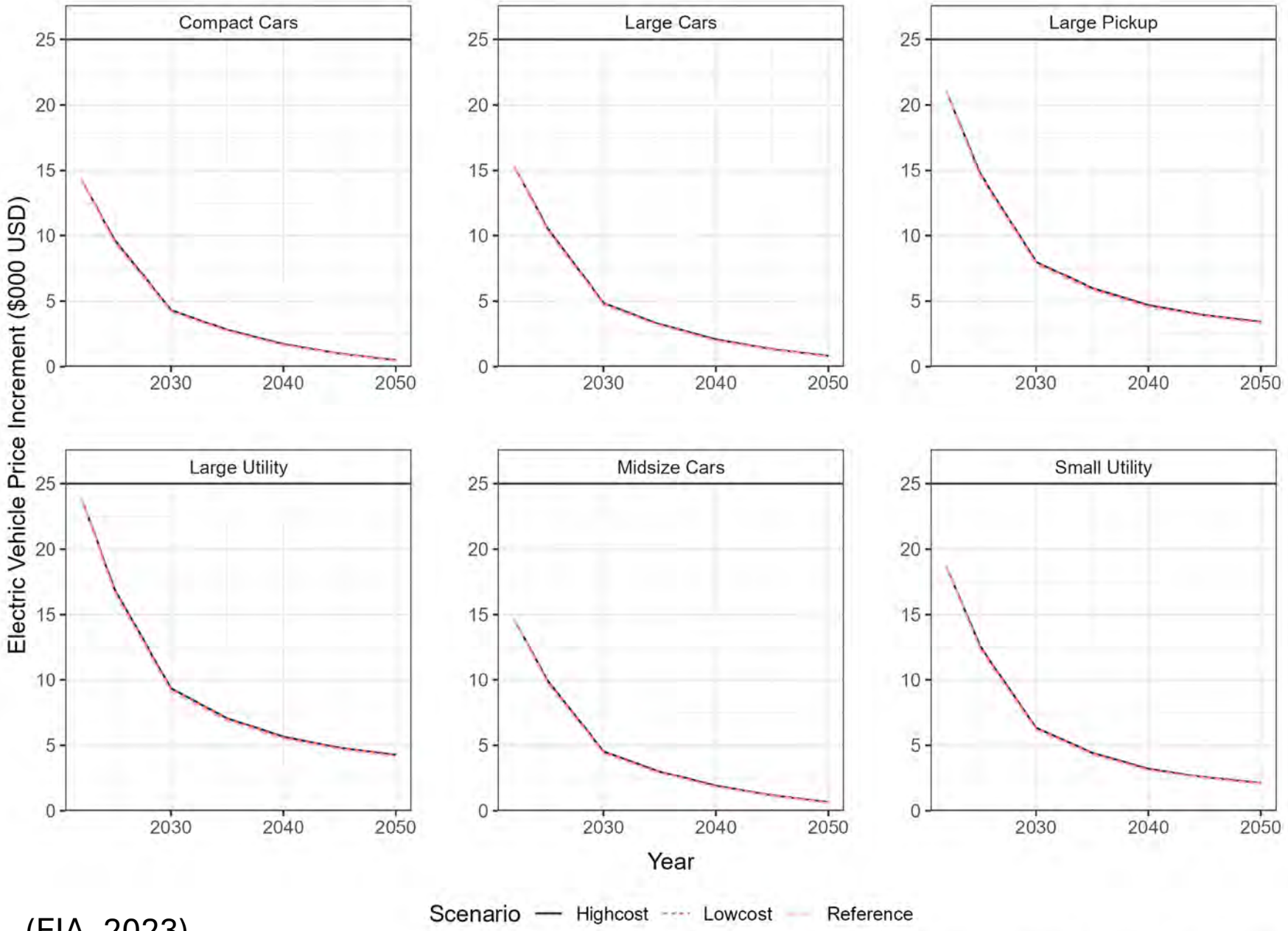
Note: Electricity rates for electric heat pumps in 2050 are based on the Mid rate scenario. Efficiency adjusted fuel costs reflect the effective cost per unit of heat output and are based on assumed efficiencies 85% for oil furnaces and 100% for electric resistance.[31] For electric heat pumps in 2050, the average efficiency is projected at 247%, reflecting the combined performance of heat pumps and electric resistance backup systems. All monetary values are expressed in 2024 Canadian dollars (CAD).

Electrifying Canada (2024) Household Energy Affordability in a Net-Zero Future. Figure 9

Incremental Cost of Electric Vehicles by Year and Type

Table 2: Incremental ZEV prices (savings) for select vehicles in select years (in constant $2022)

Type of zero-emission vehicles	2026	2030	2035
Battery electric cars	3,650	1,085	(875)
Battery electric light trucks	7,880	3,805	725
Plug-in hybrid electric cars	4,375	3,500	2,805
Plug-in hybrid electric trucks	6,305	4,975	3,950



EIA 2023 Annual Energy Outlook Incremental EV Costs

(EIA, 2023)

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CC-ASHP Capital Cost

The National Renewable Energy Laboratory (NREL) produced forecasts for improvements to CC-ASHP in a 2017 report. NREL outlined three scenarios for both capital cost reductions and increased seasonal coefficients of performance (sCOP). Capital cost improvements help reduce the cost differential between CC-ASHP and reference heating systems. I use the following capital cost reduction assumptions to create three cost improvement scenarios:

- Slow: .7%/year cost reduction
- Moderate: 1%/year cost reduction
- Rapid: 1.5%/year cost reduction

sCOP Values

Similarly, NREL forecast three scenarios for improvements to sCOP values. Increased sCOP values mean that the CC-ASHP can provide more heat with less electricity. This improves the operational competitiveness of CC-ASHP relative to reference heating systems, including high-efficiency natural gas furnaces. NREL defines the three scenarios in terms of when a CC-ASHP system would achieve a COP of 3.0 at a temperature of -25°C. Efficiency improvements by scenario are:

- Slow: achieve this goal by 2050
- Moderate: achieve this goal by 2040
- Rapid: achieve this goal by 2030

Vehicle Analysis

Drivers by Income Quintile

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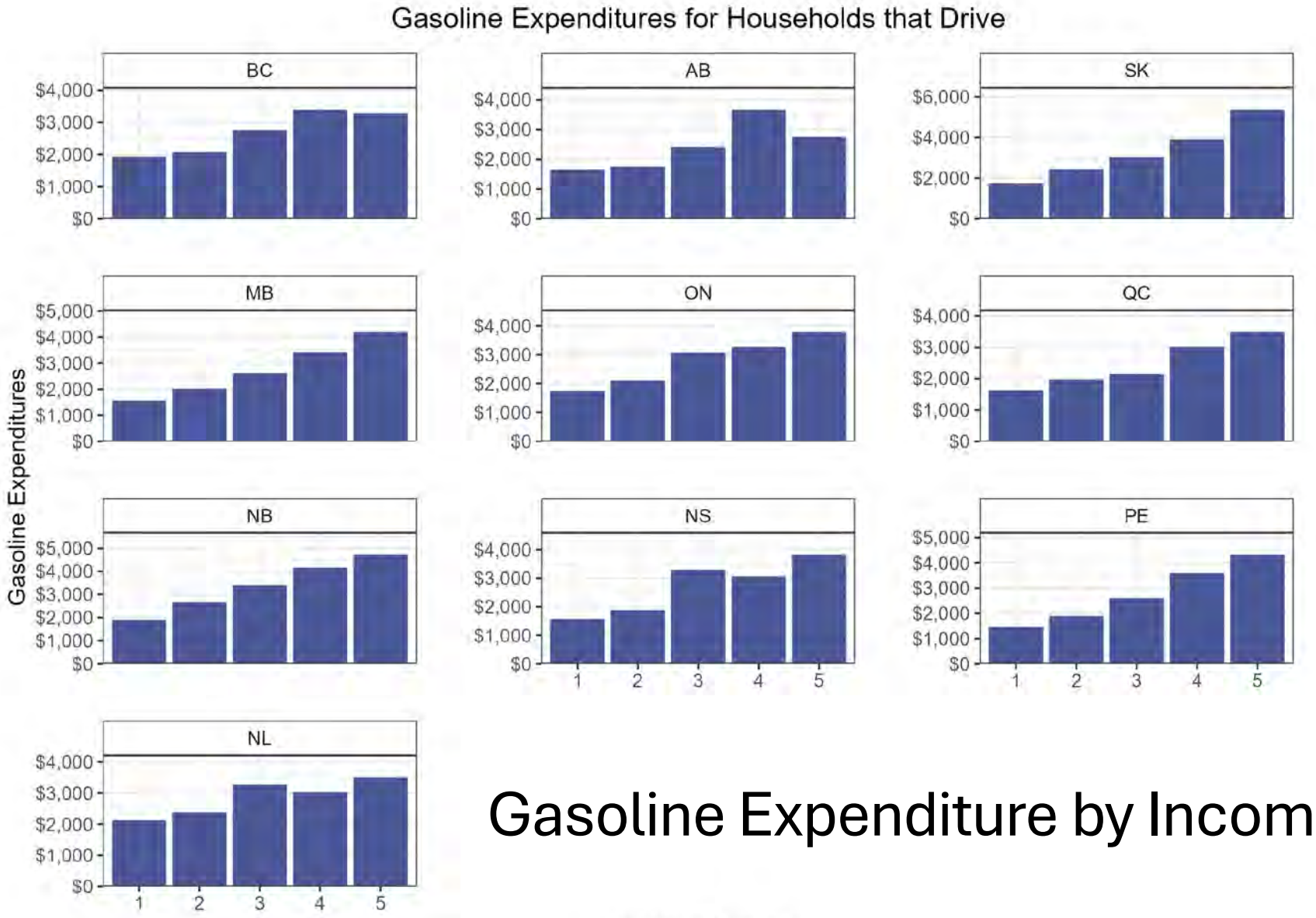
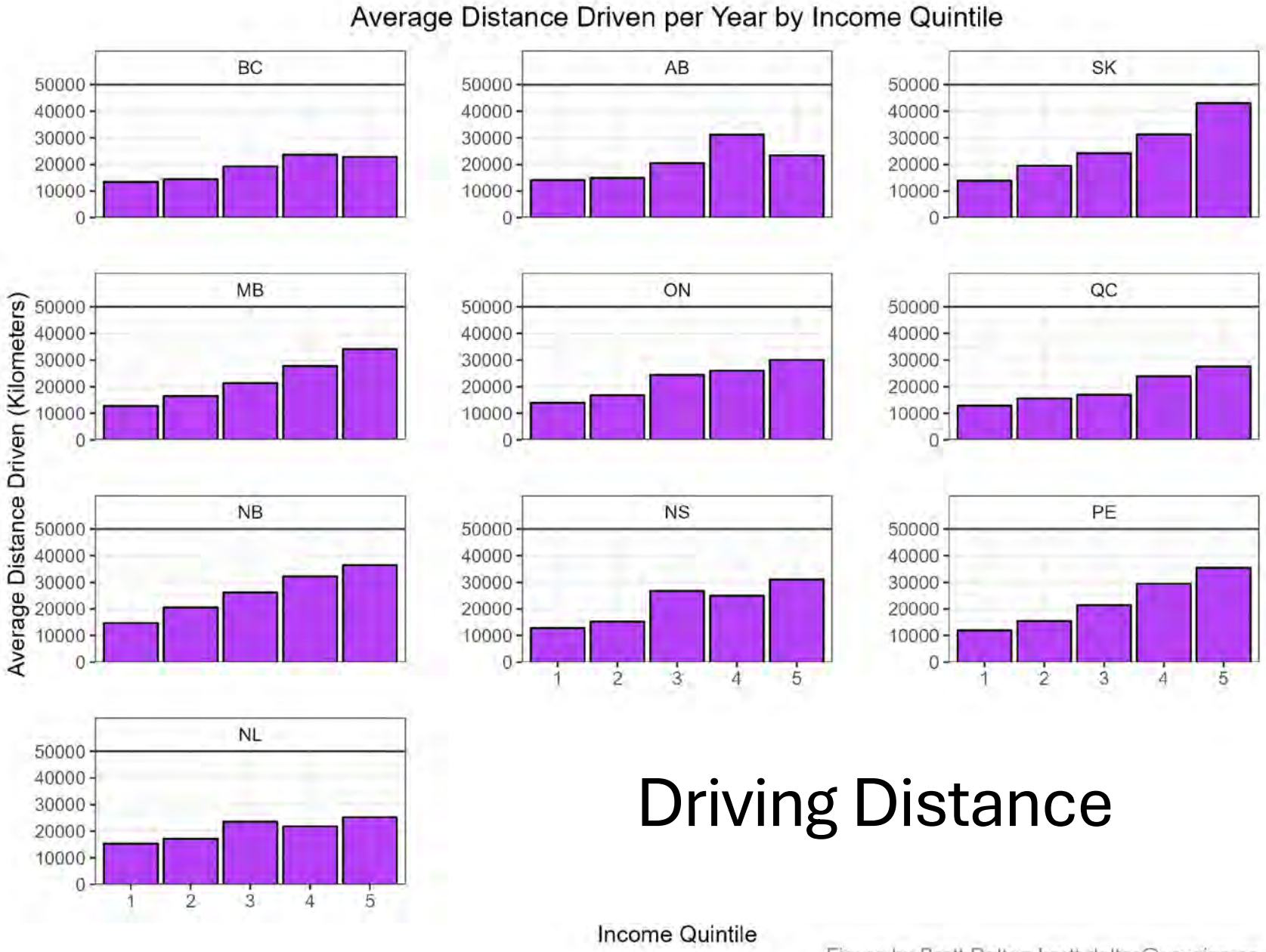
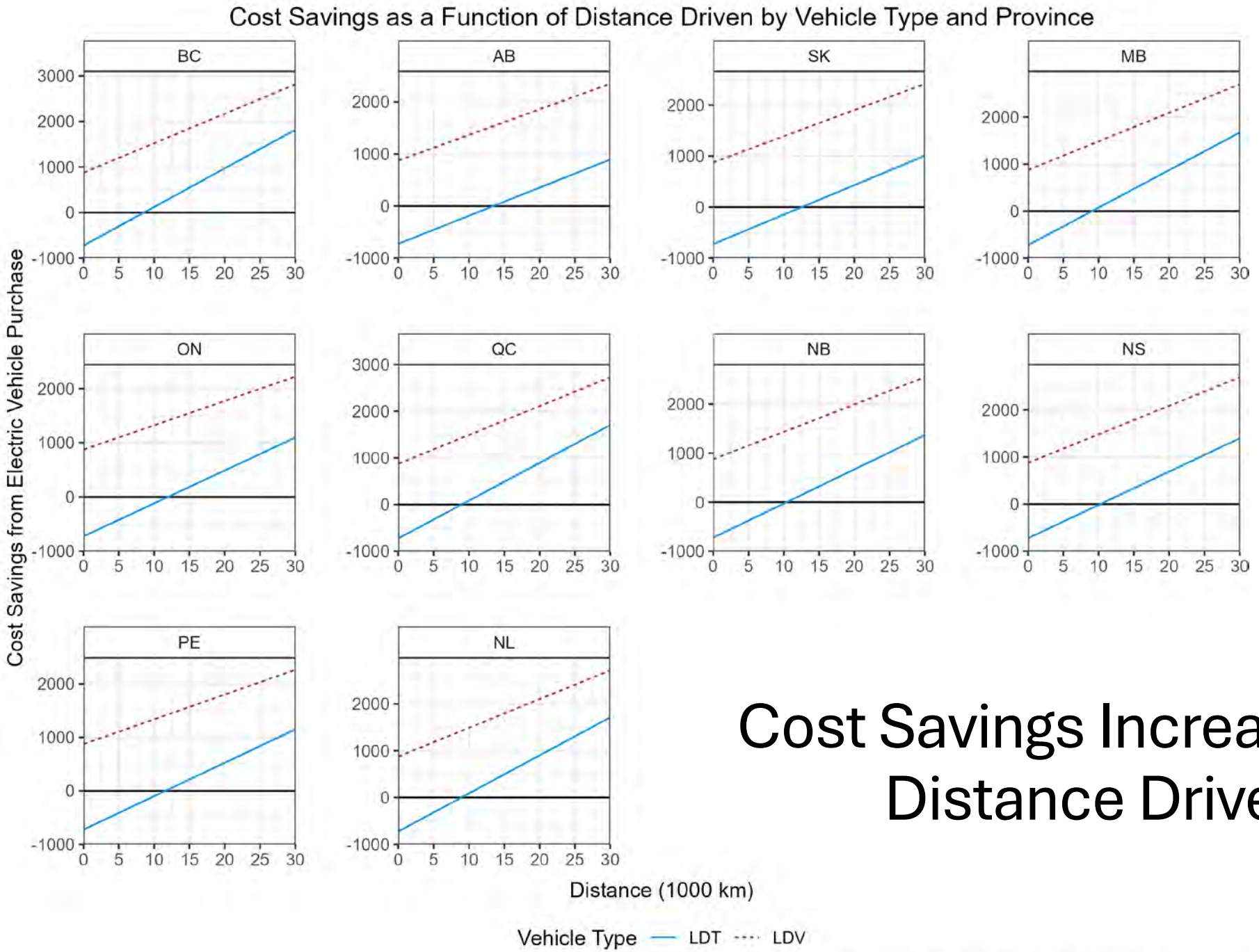
Data from Statistics Canada (2019) Survey of Household Spending



Gasoline Expenditure by Income Quintile



Driving Distance



Cost Savings Increase with Distance Driven

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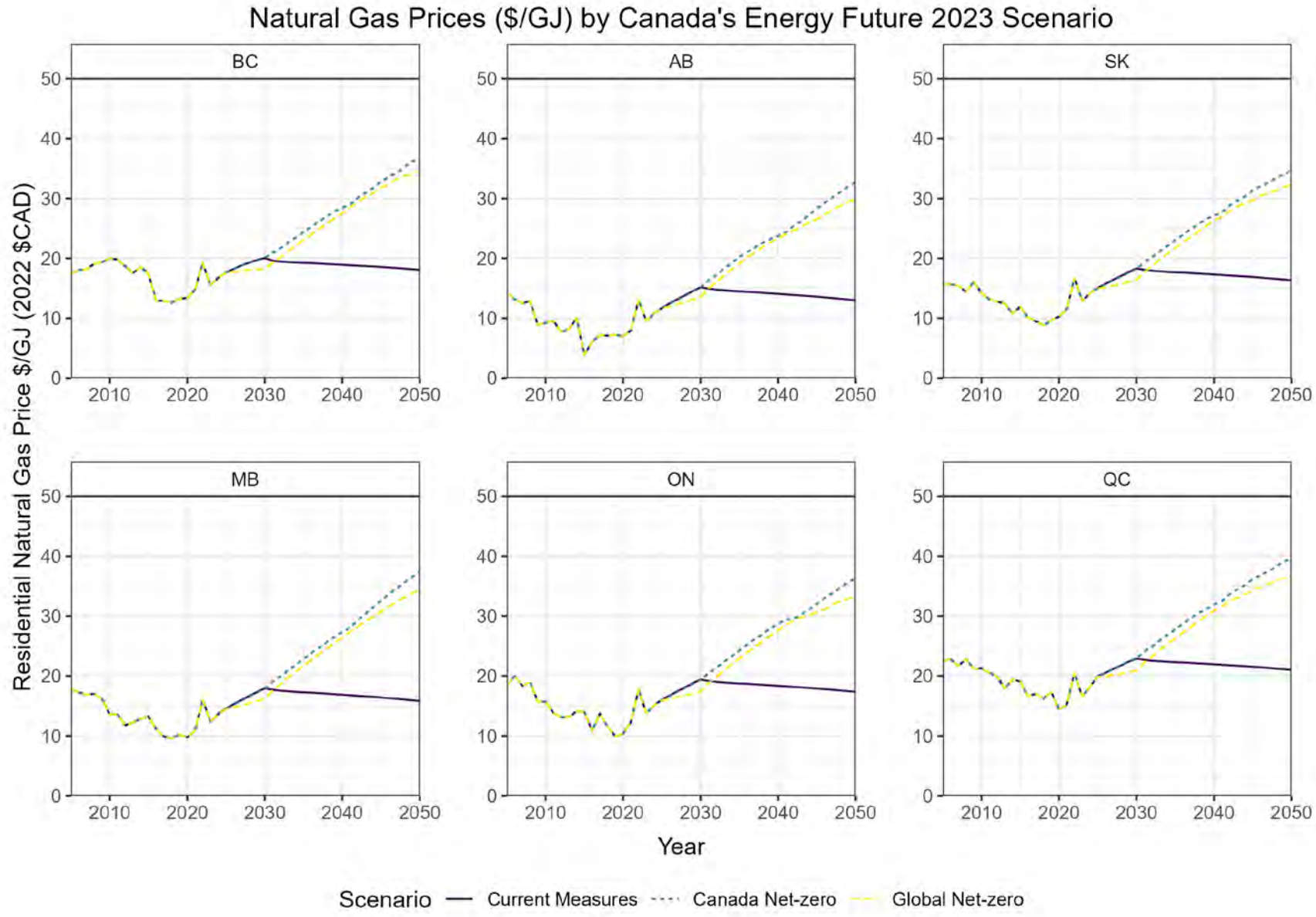
Building Analysis



Data source: Canada Energy Regulator (2023) Canada's Energy Future
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