Household Energy Affordability in a Net-Zero Future

TECHNICAL REPORT

November 2024

ELECTRIFYING CANADA
AN INITIATIVE OF THE TRANSITION ACCELERATOR
ÉLECTRIFIER LE CANADA
UNE INITIATIVE DE L'ACCÉLÉRATEUR DE TRANSITION

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About Electrifying Canada

Electrifying Canada is a multi-year initiative of the Transition Accelerator. Our mission is to accelerate Canada's transition to a robust future energy system where net-zero electricity meets a much higher percentage of Canada's total energy needs in 2050 than it does today. We pursue our mission through:

- **Sustained Collaboration.** We coordinate, convene, and facilitate national and regional dialogues among diverse partners. These dialogues strengthen relationships and facilitate the sharing of knowledge and perspectives on the challenges and solutions to electrifying Canada's economy.
- **Analysis & Insights.** Informed by partner collaboration and input, we produce qualitative and quantitative analyses to advance electricity system pathways to meet the energy needs of a net-zero Canadian economy.
- **Thought Leadership.** Leveraging our analysis, insights, and partner input, we develop frameworks and create practical tools to guide key decision-makers. Our thought leadership offers the rational and reasonable solutions required in the real world to address key barriers to the net-zero-aligned electricity systems.

About The Transition Accelerator

The Transition Accelerator exists to support Canada's transition to a net-zero future while solving societal challenges. The Transition Accelerator works with innovative groups to create visions of what a socially and economically desirable net zero future will look like and build out transition pathways that will enable Canada to get there. The Accelerator's role is that of an enabler, facilitator, and force multiplier that forms coalitions to take steps down these pathways and get change moving on the ground.

Acknowledgements and Disclaimer

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Acknowledgements

This report builds on analysis conducted in the winter of 2024 in support of the Canada Electricity Advisory Council and cited in their Final Report. The authors acknowledge the valuable input and feedback provided by Council members during the original analysis. The underlying analysis has been updated slightly to incorporate additional refinements and updates to inputs and assumptions. These updates did not materially change the results and conclusions of the analysis.

The authors would also like to acknowledge the valuable contributions, input, and review received from individuals and organizations across the electricity sector, as well as the assistance provided by those who supplied data used in this analysis. In particular, we thank Jason Dion (Canadian Climate Institute), Brett Dolter (University of Regina), Philippe Dunsky (Dunsky Energy + Climate Advisors), Bob Elton (Chair – Capital and Affordability Working Group – Canada Electricity Advisory Council), Ahmed Hanafy (Dunsky Energy + Climate Advisors), Kate Harland (Canadian Climate Institute), Robert Hornung (Independent Consultant), Andrew Mandyam (Utilis Consulting), Chris Milligan (Nova Scotia Power), Brandon Ott (Utilis Consulting), Evan Pivnick (Clean Energy Canada), and Dr. Suzanne von der Porten (First Nations Major Projects Coalition), among many others, for their thoughtful and valuable insights and feedback. The listing of individuals here does not imply endorsement of the report, and any errors or omissions are the responsibility of the authors.

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Disclaimer

This document was prepared by The Transition Accelerator on behalf of Electrifying Canada. The content represents The Transition Accelerator's professional judgement based on available data and information at the time of preparation. The opinions, conclusions, and recommendations expressed in this document are those of The Transition Accelerator and do not necessarily reflect the views or positions of all Electrifying Canada partners.

Overview

The following Technical Report complements the Summary Report by providing a detailed explanation of our methodology and a more granular presentation of our analytical results. The Summary Report focuses on high-level outcomes and offers important contextual information and analytical insights that are not covered in this Technical Report.

Our primary analytical goal is to assess how household energy wallets in 2050 might change relative to today if Canada meets its net-zero emissions target by 2050. The term "energy wallet" refers to all costs associated with purchasing, operating, and maintaining the energy and technology needed for household energy needs, including power, heating, cooling, and personal transportation.

The analysis is based on two key assumptions:

1. Households decarbonize by fully electrifying their home and personal transportation energy needs with air-source heat pumps and electric vehicles.
2. Provincial electricity systems transform to align with the requirements of a net-zero Canadian economy by 2050 including some degree of electrification in other sectors of the economy.

We use full electrification as a simplified approach to model the household impacts of decarbonization. While electrifying light-duty vehicles and home heating is expected to be a major part of Canada's pathway to net-zero, alternative options—such as hydrogen or renewable natural gas—may also play roles where electrification is less cost-effective. Therefore, we are not forecasting that every household will use electricity for every energy need, but rather, using electrification as a proxy for the costs of achieving net-zero emissions by 2050.

Accounting for the transformation of provincial electricity systems is a critical part of the analysis, as aligning these systems with a net-zero economy will impact electricity system costs. These changes will, in turn, affect electricity prices, at the same time that electricity will constitute a larger portion of household energy wallets as electrification expands. Higher electricity consumption means that even small rate increases could significantly impact household energy costs in a future where electricity represents a much larger share of overall household energy consumption. While we do not conduct original power system modelling, we leverage existing third-party studies that model net-zero-aligned electricity systems to produce a range of potential future electricity system costs.

Our methodology is structured around three key research questions, answered in a sequential process:

1. **Estimate Electricity System Transformation Capital Costs:** Using third-party power system modelling studies, we estimate a range of capital investments required to maintain and expand electricity generation, transmission, and distribution infrastructure under various net-zero-aligned electricity transformation pathways.
2. **Estimate Electricity Rate Impacts**: Building on these capital investment estimates, we project how these costs—along with shifts in the electricity supply mix and operating

costs—will affect the provincial electricity system's annual revenue requirements and average electricity rates by 2050.

3. **Estimate Household Energy Wallets:** Using the range of projected 2050 electricity rates, we model household energy wallets for various archetypes in both 2024 and 2050. This archetype approach allows us to assess distributional impacts across income levels, regions, and household characteristics, identifying who benefits and who may face challenges in an electrified future.

The estimation of capital costs for transforming the electricity system and its impacts on electricity rates builds on prior research and methodological advancements by the Canadian Climate Institute (CCI).[1]

The remainder of this Technical Report provides detailed descriptions of the methodology and results for each step of the analysis.

Estimate Electricity System Capital Costs

Methodology

We construct a time series of annual electricity system capital expenditures by asset class (i.e., generation, transmission, and distribution) and generation type (e.g., hydro, nuclear, wind) based on data from third-party studies that include a power system modeling component representing a range of electricity system transformation pathways for a net-zero economy by 2050. Many modeling efforts at both the national and provincial levels have explored potential pathways to net-zero electricity systems—those capable of meeting rising electricity demand while producing net-zero greenhouse gas emissions.

Study Inclusion

We include national and provincial studies that meet the following criteria:

- Represent at least one scenario of a net-zero economy by 2050.
- Include a broad range of electricity technologies.
- Provide sufficient data granularity (e.g., provincial-level data).

For studies with multiple net-zero-aligned scenarios, we prioritized those that: (1) represented the highest degree of electrification and load growth and (2) incorporated the proposed federal Clean Electricity Regulations (CER).

Accessing the necessary data posed significant challenges. In many cases, the required model outputs were not publicly available. To address this, we directly requested and obtained unpublished model outputs from the study authors, often under confidentiality agreements that required us to aggregate findings to ensure non-disclosure. When data requests were denied due to

[1] Canadian Climate Institute. 2022. *Electricity Affordability and Equity in Canada's Energy Transition*. Canadian Climate Institute. 2023. *Clean Electricity, Affordable Energy*.

confidentiality or time constraints, we estimated the required outcomes based on available study documentation where possible.

Our final analysis incorporates four national and three provincial studies as detailed in Table 1.

Table 1. Power System Modeling Studies Included in Analysis

Study	Study and Scenario Description
Canadian National Electrification Assessment **by Electric Power and Research Institute (EPRI)**	The EPRI study models economy-wide electrification and electricity system transformation pathways under various policy scenarios. We use results from the Net Zero scenario, which applies aggressive policy assumptions to achieve net-zero economy-wide CO2 emissions by 2050. These policy assumptions include accelerated carbon pricing and zero-emission standards for light-duty vehicles, but do not include policies akin to the proposed CER.
Canada's Energy Future 2023 **by Canada Energy Regulator (CER)**	The CER study explores pathways to achieving net-zero emissions by 2050 under three scenarios. We use results from the Canada Net-Zero scenario, which envisions Canada achieving net-zero emissions by 2050 while the rest of the world reduces GHG emissions more slowly. This scenario includes a representation of the draft framework for the CER.
Unveiling the Clean Electricity Regulation **by Energy Modelling Hub (EMH)**	The EMH study applies the Canadian Opportunities for Planning and Production of Electricity Resources (COPPER) framework – an electricity capacity expansion model – to assess the implications of the draft CER released in August 2023. We use results from the scenario modeling "High Growth" electricity demand in conjunction with the draft CER.
Independent Assessment 2030 Emissions Reduction Plan **by Navius Research**	This study, on behalf of the Canadian Climate Institute (CCI), explores the impact of Canada's 2030 Emissions Reduction Plan. Our analysis uses results from an updated scenario developed by the study authors that builds on the "announced" policy package, including the draft CER and a post-2030 emission cap driving the economy to net zero by 2050.
Evergreen Integrated Resource Plan (IRP) 2023 **by Nova Scotia Power (NS Power)**	NS Power's IRP informs its long-term electricity strategy, aligning with Nova Scotia's 2030 environmental targets. We use results from the NZ35 scenario (CE1-E3-R2), which involves achieving net-zero electricity production by 2035 without the Atlantic Loop, alongside significant sectoral electrification (e.g., heating and transportation).
Pathways to Decarbonization **by Ontario's Independent Electricity System Operator (IESO)**	The IESO study explores pathways for Ontario's electricity system to meet decarbonization goals. We use results from the Pathways scenario, which assumes a decarbonized supply mix by 2050 to meet increased electricity demand from electrification, incorporating elements of the 2022 draft CER framework. The Pathways scenario includes two sensitivities for transmission costs. For our rate analysis, we include the High Transmission Cost sensitivity.
2024 Long-term Outlook (LTO) Preliminary Update **by the Alberta Electric System Operator (AESO)**	AESO's LTO guides transmission planning and market evaluations. In the 2040 LTO Preliminary Update, AESO includes two regulatory scenarios exploring decarbonization pathways. We use results from the Decarbonization by 2035 scenario, which assumes a higher level of electrification and includes draft CER restrictions and other key policy assumptions.

The studies included in our analysis encompass a variety of policy frameworks that could significantly influence the technological shifts and financial outcomes of their modeled electricity systems. In some cases, these policy representations are used to force models towards outcomes that align with net zero. In other cases, they are included to emulate the impact these policies will have on the pathway to net zero. These policies include:

- Carbon pricing and/or emission caps
- Federal investment tax credits (ITCs) for clean electricity infrastructure
- Proposed federal Clean Electricity Regulations (CER)

Drawing strong and precise conclusions about the impact of specific policies is a complex task within this analysis. This complexity arises from the challenge of distinguishing the effects of individual modeling assumptions, including but not limited to policy representations, across various studies. Other variables such as model architecture, technology inputs and assumptions, and other variables will exert influence as well. Additionally, confidentiality agreements regarding some of the data restrict our ability to detail certain studies' model outputs fully. As a result, we do not comment on the specific impacts of these policies in our analysis.

Regarding the Clean Electricity Regulations (CER), it's important to note that our analysis took place during the formulation of these regulations. The CER aims to establish new emission standards for electricity generators, contributing to the goal of achieving net-zero greenhouse gas emissions across the economy by 2050. The portrayal of this policy in the studies we reviewed varies significantly. Some studies do not account for the CER, while others base their assumptions on early interpretations of the 2022 draft CER framework or its initial publication in Part I of the Canada Gazette. Therefore, the range of outcomes presented in our analysis should be seen as indicative of the potential direction of CER impacts, though they may not fully align with the latest or final version of the regulations.[2]

[2] In February, the federal government released an update on the Clean Electricity Regulations (CER) that telegraphed potential changes to the CG1 iteration. None of the studies included in this analysis reflect these changes.

Table 2. Key Policies Represented in Included Power System Modeling Studies

Study	Key Policies Modeled
EPRI	• Federal carbon pricing backstop, accelerating by 10% annually thereafter[3]
CER	• Clean Electricity Regulation (2022 framework) • Federal ITCs • Provincial and federal carbon pricing backstop
EMH	• Clean Electricity Regulation (CG1) • Federal ITCs • Federal carbon pricing backstop
Navius	• Clean Electricity Regulation (CG1) • Federal ITCs • National emissions cap starting in 2030
NS Power	• Clean Electricity Regulation (2022 framework) • Federal ITCs • Federal carbon pricing backstop
IESO	• Clean Electricity Regulation (2022 framework) • Federal carbon pricing backstop, with a carbon price continuing to rise by $15/tonne from 2030-2035, and thereafter increases with the rate of inflation
AESO	• Clean Electricity Regulation (CG1) • Federal ITCs • Federal carbon pricing backstop

[3] Federal Carbon Pricing Backstop has reached $50/tonne in 2022 and will increase by $15/year until $170/tonne in 2030.

Data Collection

For each study, we collected model outputs representing key metrics necessary for estimating the annual costs of the electricity system transformation at the provincial level. This included:

- Annual electricity production
- Annual capital expenditures for generation, inter- and intra-provincial transmission, and distribution infrastructure
- Annual variable costs, including fuel, variable O&M (operation and maintenance), and fixed O&M costs.

In some instances, not all of these data components were readily available from the models. When gaps occurred, we developed supplemental proxy values based on reasonable assumptions and available literature to ensure that all cost components were included. The table below outlines the specific data collected from each study and, where applicable, the proxy values developed to fill any gaps in available data. Descriptions of the derivation of proxy values follow the table below.

Table 3. Summary of Direct Data and Proxy Values from Power System Modeling Studies

Study	Available Data	Estimated Proxy Values
EPRI	• Annual electricity generation & installed capacity *(shared under confidentiality terms)* • Annual capital expenditures & O&M costs related to generation *(shared under confidentiality terms)* • Inter-provincial and intra-provincial transmission & distribution costs *(shared under confidentiality terms)*	• None
CER	• Electricity generation & installed capacity (publicly available) • Annual capital expenditures *(shared under confidentiality terms)* • Inter-provincial transmission costs *(shared under confidentiality terms)*	• Intra-provincial transmission and distribution capital expenditures
EMH	• Electricity generation & installed capacity (publicly available) • Annual capital expenditures & O&M costs *(publicly available)*	• Inter- and intra-provincial transmission & distribution capital expenditures
Navius	• Electricity generation & installed capacity *(shared under confidentiality terms)* • Annual capital expenditures & O&M costs *(shared under confidentiality terms)* • Intra-provincial transmission & distribution costs *(shared under confidentiality terms)*	• Inter-provincial transmission capital expenditures
NS Power	• Electricity generation & installed capacity (publicly available) • Annual capital expenditures & O&M costs *(shared under confidentiality terms)* • Inter-provincial transmission costs *(shared under confidentiality terms)*	• Intra-provincial transmission and distribution capital expenditures
IESO	• Electricity generation & installed capacity for 2050 only (publicly available) • Transmission costs (publicly available)	• Annual generation capital expenditures • Annual O&M costs • Distribution capital expenditures
AESO	• Electricity generation & installed capacity up to 2043 (publicly available)	• Annual generation capital expenditures • Annual O&M costs • Transmission & distribution capital expenditures

Data Adjustments

Estimating Proxy Values:

In cases where cost components were not directly available from the studies, we used the following approaches for estimating proxy values:

- For generation capital expenditures, we use values as reported by the included studies. For the IESO and AESO studies, we manually derived annual capital expenditures based on the studies' documented generation capital cost assumptions ($/kW) and reported capacity build out. We assume these expenditures represent all generation capital expenditures over the analysis period.
- For transmission and distribution (T&D) infrastructure capital expenditures, we use expenditures as reported by the included studies, where available. These expenditures were the most commonly missing from the included studies. For studies that do not report these expenditures, we estimated proxy values by applying a ratio of generation to T&D expenditures derived from the studies that report this information.
- For annual O&M costs, we use values as reported by the included studies. For the IESO and AESO studies, we manually derived annual O&M costs based on the studies' documented O&M cost assumptions for generation and reported installed capacity. We assume these expenditures represent generation-related O&M costs only. In the case of the AESO study, we estimated annual fuel costs using natural gas costs based on the 2023 AECO-C price, with future year costs adjusted according to the trajectory of natural gas costs in CER's Canada Net-Zero scenario.[4]

ITC Adjustments:

We generally accept the capital expenditure values reported by the studies as provided. However, several studies were conducted after the federal investment tax credits (ITCs) for clean electricity infrastructure were announced and included the policy in their analysis, while other studies conducted earlier did not account for this policy. To ensure consistency across studies, we apply a high-level ITC adjustment to eligible technologies in the latter studies to reflect the reduction in capital expenditure borne by the electricity system. This adjustment captures the expected shift in capital costs from ratepayers to taxpayers due to the ITC, ensuring an apples-to-apples comparison across studies. However, it should be noted that this adjustment does not alter the technological pathways modeled in the studies. The inclusion of the ITC might influence investment preferences within the models, as the tax credit applies only to certain technologies.

Capital Expenditures to Maintain the Existing Electricity System:

We assume the T&D expenditures reported by the studies represent the costs of expanding the grid, not maintaining existing infrastructure. To account for the ongoing costs of maintaining the current grid, we assume that capital expenditures are made annually through 2050 to sustain the estimated gross asset value of each province's existing T&D system. This gross asset value is derived from

[4] Alberta Energy Regulator. (n.d.). *Alberta Energy Outlook (ST98) - Natural Gas Prices – AECO-C Price*.

utility financial documents and is further discussed in the section on estimating electricity rate impacts.

Annual Capital Expenditures

The results output of this analytical step is a time series of annual electricity system capital expenditures by asset class (i.e., generation, T&D) and generation type (e.g., hydro, nuclear, wind, etc.) for each province and each study included in our analysis. This time series feeds directly into our methodology for estimating electricity rate impacts.

Results

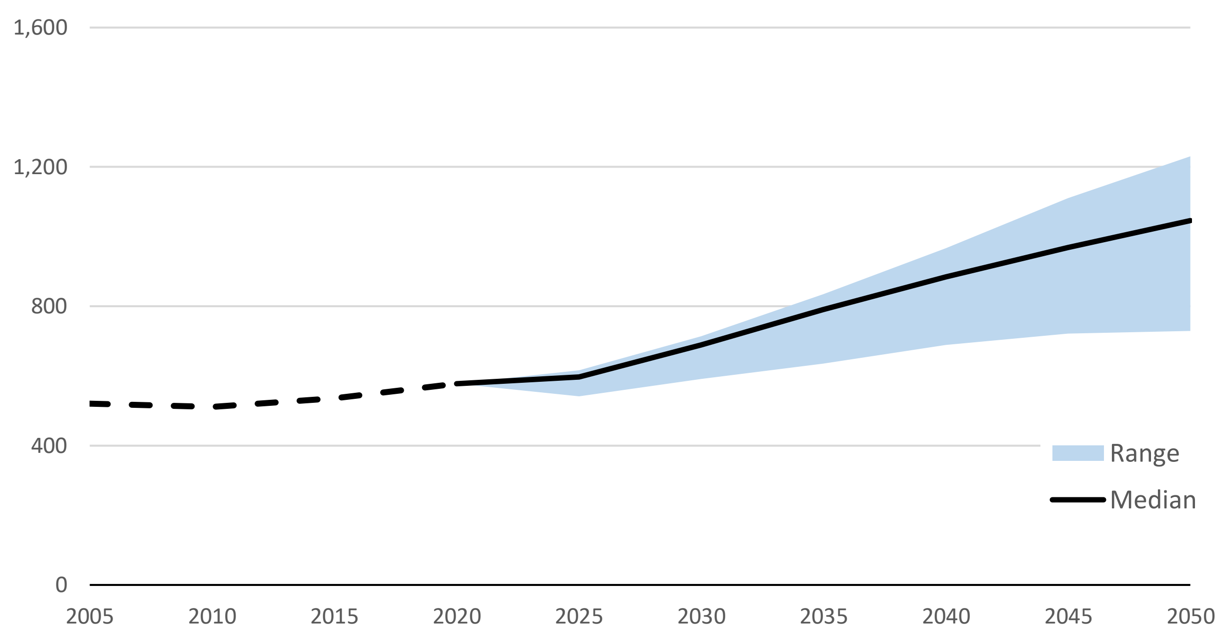
Power System Pathways

The included studies represent a range of pathways for transforming provincial electricity systems to align with net-zero goals. The following figures and tables provide a summary of these pathways at the Pan-Canadian level for the scenarios in our analysis.

Electricity Demand

Figure 1 illustrates projected Pan-Canadian electricity demand from the included national studies. All studies anticipate substantial growth in electricity demand, with increases ranging from 26% to 113%, and the median growth representing an increase of 81% compared to 2020.

Figure 1. Pan-Canadian Electricity Demand for Included National Studies (TWh)



The increase in electricity demand is a product of each study's treatment of:

- **Electrification**: Every study reflects increasing electrification to various degrees, but no study contemplates electrifying everything. For national studies like CER23 and EPRI, electricity will satisfy between 40% and 60% of total end-use demand by 2050, respectively.
- **Industrial Growth**: Some studies model significant demand growth from industrial processes. In particular, the EMH study, which assumes the same residential, commercial, and transportation electricity consumption as CER23, adds significant electricity demand to power the production of hydrogen via electrolysis.[5]
- **Efficiency**: Energy efficiency assumptions in CER, EMH, and EPRI scenarios anticipate improvements over time, driven by technological advancements, fuel switching, and increased adoption of electricity-utilizing devices, contributing to reduced end-use demand and final energy consumption.
- **General Growth**: Canada's population and economy will grow overtime, requiring more energy. Based on reported assumptions in study documentation, the studies are relatively consistent in population and economic growth assumptions.

Table 4 lists the minimum, median, and maximum provincial electricity demand values from the included national and provincial studies, where applicable, along with the relative growth in these metrics compared to 2022 values. As observed, the estimates for each province vary significantly between the pathways represented by the included studies.

Table 4. Provincial Electricity Demand for Included Studies (TWh)

Province	2022	2050		
		Minimum	Median	Max
AB	78	130 (66%)	156 (99%)	248 (217%)
BC	62	75 (22%)	131 (112%)	154 (149%)
MB	23	31 (37%)	40 (77%)	47 (108%)
NB	14	15 (6%)	20 (40%)	24 (65%)
NL	11	11 (-8%)	13 (14%)	62 (442%)
NS	11	12 (11%)	15 (35%)	57 (420%)
ON	145	215 (48%)	294 (102%)	414 (185%)
PE	2	3 (52%)	3 (81%)	4 (136%)
QC	206	199 (-3%)	254 (23%)	280 (36%)
SK	24	36 (49%)	48 (96%)	56 (130%)

Note: Percentage values represent relative change from 2022.

Electricity Production

Figure 2 illustrates the range of Pan-Canadian electricity generation from the included national studies. As can be seen, the studies' modeled electricity transformation pathways are all characterized by a growing system. After several decades of limited load growth (~0.4% annually), generation grows between 1.6% to 3.7% annually through 2050 in the modeled pathways. All

[5] CER23 provincial end-use demand data (used in this chart) reports the consumption of energy. It does not include electricity demand resulting from hydrogen production from electrolysis.

studies anticipate substantial growth in electricity generation, with increases ranging from 56% to 179%, and the median growth representing an increase of 87% compared to 2020.

Figure 2. Pan-Canadian Electricity Generation for Included National Studies (TWh)

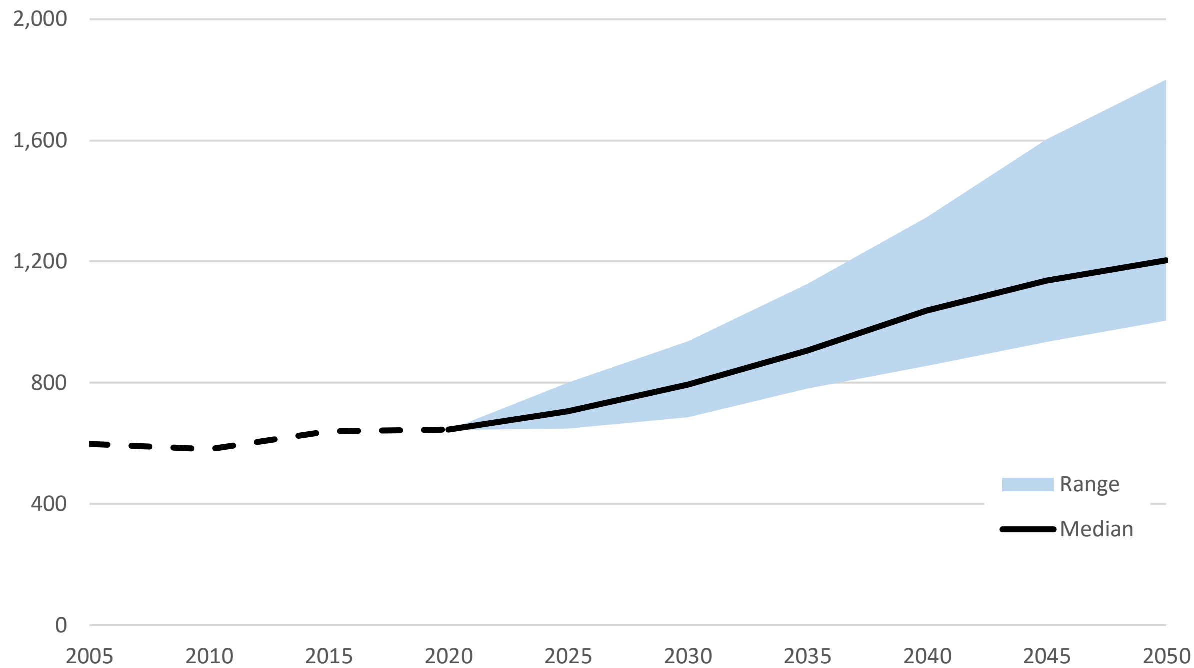


Table 5 lists the minimum, median, and maximum provincial electricity generation results from the included national and provincial studies, where applicable, along with the relative growth in these metrics compared to 2022 values. As observed, the estimates for each province vary significantly between the pathways represented by the included studies.

Table 5. Provincial Electricity Generation for Included Studies (TWh)

Province	2022	2050		
		Minimum	Median	Max
AB	84	159 (89%)	168 (99%)	244 (190%)
BC	69	114 (64%)	128 (84%)	230 (232%)
MB	31	40 (30%)	61 (100%)	86 (182%)
NB	13	17 (30%)	18 (42%)	22 (72%)
NL	45	43 (-3%)	46 (2%)	84 (88%)
NS	9	14 (66%)	18 (115%)	112 (1221%)
ON	156	276 (77%)	304 (95%)	614 (293%)
PE	1	2 (140%)	3 (214%)	5 (389%)
QC	213	203 (-4%)	301 (42%)	431 (103%)
SK	24	42 (75%)	49 (103%)	58 (139%)

Note: Percentage values represent the relative change from 2022.

Installed Capacity

Figure 3 displays the growth of installed electricity generation capacity through 2050. Across all the national studies reviewed, the net-zero-aligned electricity system pathways show a sharp increase in installed capacity, with projections indicating more than a doubling of current capacity by 2050. This expansion is primarily driven by growth in wind, solar, and natural gas generation (with and without carbon capture and storage, CCUS). Hydroelectric capacity remains steady across all studies, while only half of the scenarios model significant expansions in nuclear generation. All studies anticipate substantial growth in installed capacity, with increases ranging from 210% to 360%, and the median growth representing a 245% increase compared to 2020.

Figure 3. Pan-Canadian Installed Capacity for Included National Studies (GW)

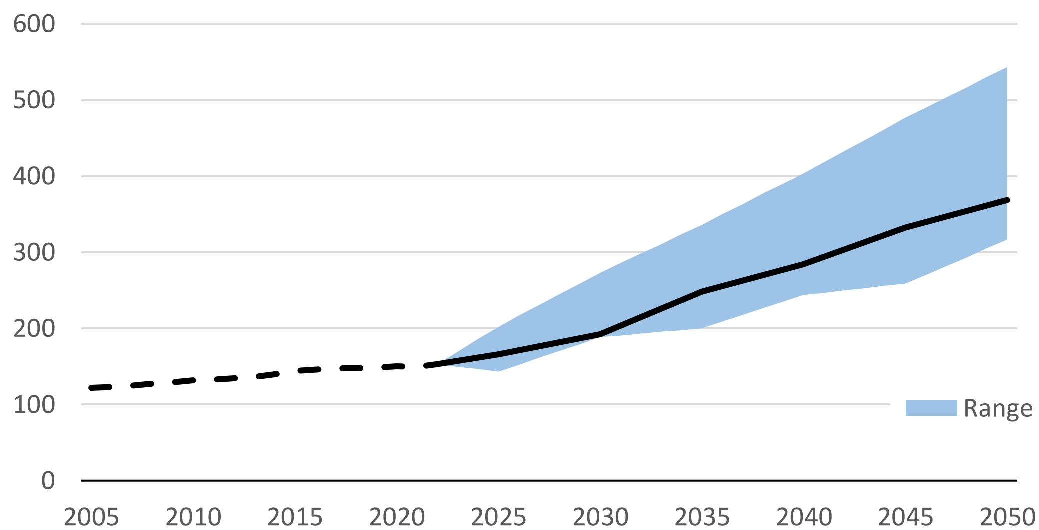


Table 6 lists the minimum, median, and maximum provincial installed capacity results from the included national and provincial studies, where applicable, along with the relative growth in these metrics compared to 2022 values. As observed, the estimates for each province vary significantly between the pathways represented by the included studies.

Table 6. Provincial Installed Capacity for Included Studies (GW)

Province	2022	2050		
		Minimum	Median	Max
AB	20	55 (232%)	62 (273%)	106 (537%)
BC	19	33 (80%)	44 (137%)	75 (305%)
MB	7	9 (38%)	10 (50%)	29 (321%)
NB	5	5 (5%)	6 (35%)	10 (115%)
NL	9	8 (-7%)	9 (5%)	22 (148%)
NS	3	7 (136%)	8 (164%)	23 (620%)
ON	41	88 (111%)	130 (211%)	188 (349%)
PE	0	1 (104%)	1 (127%)	2 (370%)
QC	47	49 (4%)	64 (36%)	117 (148%)
SK	4	14 (208%)	17 (279%)	20 (342%)

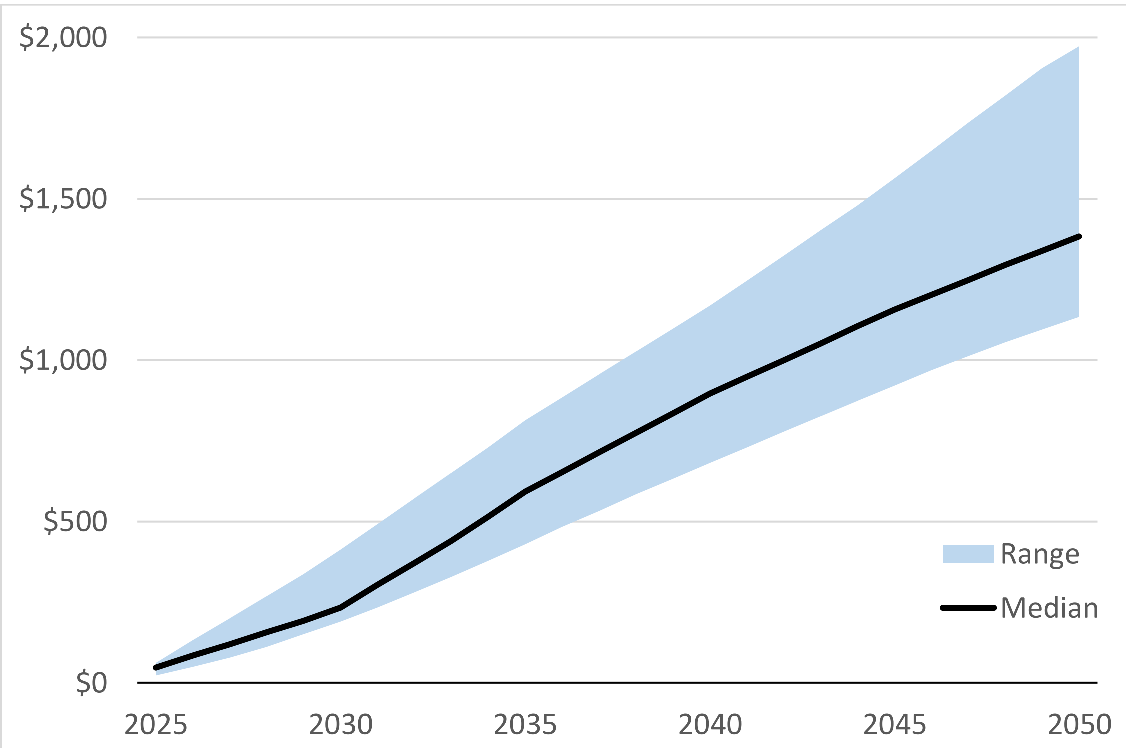
Note: Percentage values represent relative change from 2022.

Electricity System Capital Expenditures

Total Capital Expenditures

Figure 4 displays the range of cumulative estimated electricity system capital expenditures through 2050. Our analysis estimates that between $1.1 and $2.0 trillion will need to be invested in the electricity system between 2025 and 2050 to achieve the net-zero pathways described in the reviewed national models. The median value of this range is $1.4 trillion as the national models are clustered on the lower end of the range.

Figure 4. Estimated Pan-Canadian Cumulative Electricity System Capital Expenditures ($B)



These estimates include capital expenditures for:

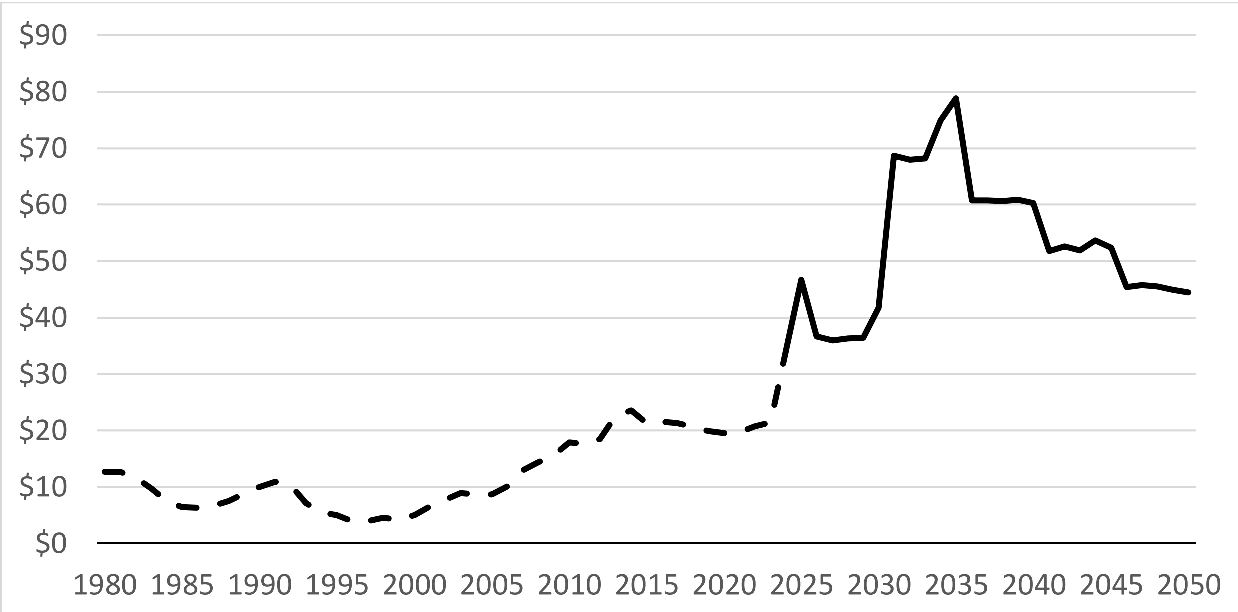
- **New generation**: to accommodate additional electricity demand and replace retiring generation.
- **New T&D infrastructure**: to accommodate additional generation and load.
- **Maintaining existing T&D infrastructure**: as the existing system ages and is renewed.

Figure 5 shows the median value for estimated annual electricity system capital expenditures along with historical annual expenditures. The values are adjusted for inflation and expressed in terms of 2024 Canadian dollars.[6] Historically, annual capital spending on the electricity system was consistently under $10 billion. Between 2010 and 2024, this spending jumped to an average of $22 billion per year. However, our analysis shows that to achieve net-zero goals, much larger investments will be needed. Based on national models, annual capital expenditures are expected

[6] Historical capital expenditures are derived from Statistics Canada – [Table 36-10-0608-01.](Table 36-10-0608-01)

to rise to a median of $39 billion from 2025 to 2030, $66 billion from 2031 to 2040, and $49 billion from 2041 to 2050.

Figure 5. Annual Median Electricity System Capital Expenditures ($B)

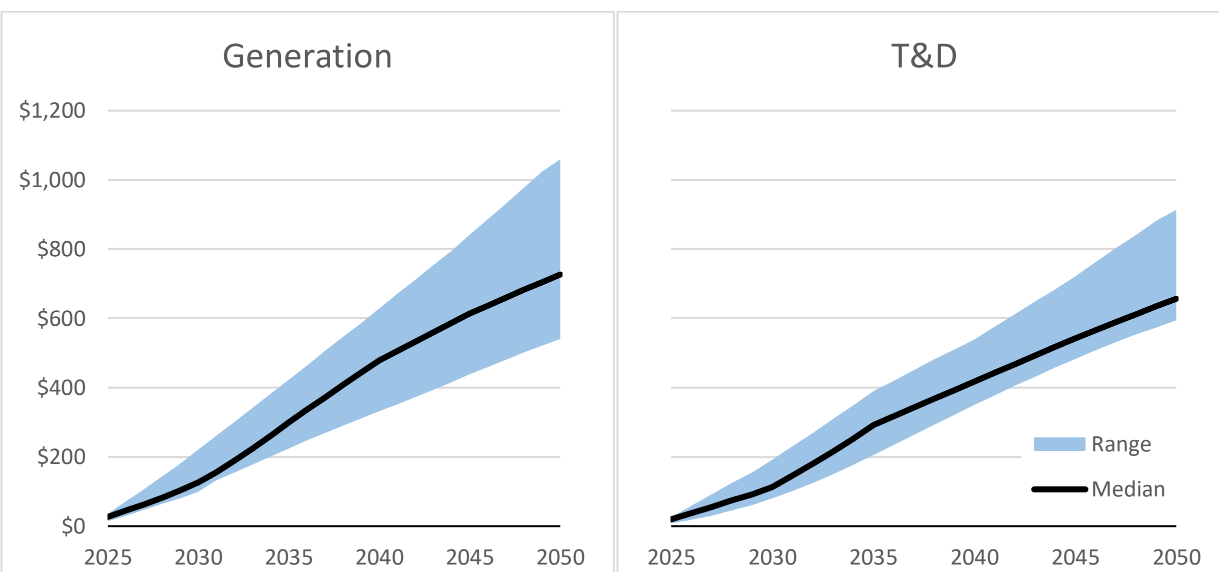


Note: The figure includes historical data starting from 1980, a period marked by relatively low demand growth and minimal electricity system buildout, especially in contrast to the period prior to the 1980s.

Capital Expenditures by Asset Class

Figure 6 displays the range of cumulative estimated electricity system capital expenditures through 2050, broken down by generation and transmission and distribution (T&D) asset classes.

Figure 6. Cumulative Capital Expenditures by Asset Class ($B)



As can be seen, capital expenditures are roughly evenly divided between generation and T&D infrastructure. For T&D infrastructure, annual expenditures are projected to average between $20 and $40 billion per year, representing a significant increase compared to the estimated $10 billion spent on T&D infrastructure in 2022.[7]

Robustness of Expenditure Estimates

Generation capital expenditures are derived directly from the reviewed models, based on the modeled capacity expansion and assumed technology capital costs. This "bottom-up" approach makes the projections of generation capital expenditures reasonably robust, as they are tied to specific capacity additions and technology cost assumptions. However, discrepancies between projected and actual technology capital costs could result in deviations between our estimates and real expenditures.

Transmission and distribution (T&D) capital expenditures are less reliable. Only half of the reviewed national studies explicitly report capital expenditure estimates for T&D. For studies without these estimates, we approximate values based on the scale of the studies' generation expenditures. his approach is admittedly rough and may overestimate or underestimate investment needs if T&D costs are not directly correlated with generation investments. Even where T&D estimates are provided, they are often derived from high-level "top-down" approaches that correlate historical T&D costs with changes in electricity demand, rather than detailed, bottom-up modeling.

Given the potential scale of future T&D investments, improving the accuracy of T&D expenditure projections will require more detailed modeling and a deeper understanding of the cost drivers involved in these infrastructure upgrades.

Total Capital Expenditures by Province

Table 7 shows the minimum, median, and maximum cumulative electricity system capital expenditures between 2025 and 2050 for the included studies. As observed, the estimates for each province vary significantly between the pathways represented by the included studies.

Table 7. Estimated 2025-2050 Provincial Cumulative Electricity System Capital Expenditures ($B)

Province	Minimum	Median	Maximum
BC	$144	$157	$219
AB	$46	$197	$263
SK	$74	$76	$89
MB	$43	$70	$109
ON	$388	$570	$805
QC	$131	$231	$388
NB + PEI	$16	$22	$25
NS	$18	$23	$76
NL	$18	$47	$76

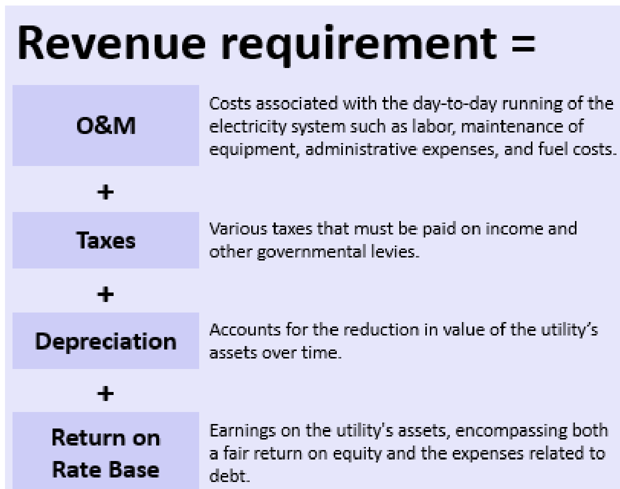
Note: The sum of minimum, median, and maximum provincial values does not necessarily equal the pan-Canadian totals, as the values may not represent the same modeled pathway (i.e., study) for all provinces.

[7] Bloomberg L.P. (2023). New Energy Outlook: Grids

Estimate Electricity Rate Impacts

Methodology

Using current electric utility financial data and the modeling results from the third-party studies cited in the previous section, we construct bottom-up estimates of partial revenue requirements for each province's electricity system through 2050. This partial revenue requirement estimate includes all operational and maintenance (O&M) expenses, depreciation expenses, tax obligations, and debt servicing costs. One key component traditionally included in utility revenue requirements, the return on equity, is not included here but will be incorporated in a later step.



Next, we combine these estimated revenue requirements with modeled electricity production to forecast changes in the average revenue required per unit of electricity produced for each province and study. To translate these values into average residential electricity rates used in the energy wallet analysis, we adjust the average revenue required per unit of electricity to reflect observed differences between total utility revenue requirements and average residential rates. This adjustment is based on current utility financial documents and accounts for existing differences between overall utility costs and residential electricity rates, which implicitly includes recovery of any return on equity.

We provide a more detailed explanation of this approach by outlining each step of the analysis below.

Methodological Steps

Step 1: Estimate Gross and Net Asset Values to Estimate Depreciation Expenses

We begin by constructing a time series of gross and net asset values for provincial electricity infrastructure. This is based on estimates of each province's existing system asset values and projected annual capital expenditures derived from the Electricity System Capital Costs analysis.

Depreciation expenses are then calculated using the straight-line method, with assumed economic useful lives (EUL) assigned to each asset class (generation, transmission, and distribution) and generation type. For existing utility assets, we estimate average EULs by asset class using gross asset values and depreciation expenses from recent utility financial reports.

The gross asset value assumes that assets are retired at the end of their EUL.

For modeled capital expenditures, net asset values are derived from gross asset values, factoring in accumulated depreciation. For existing assets, we apply the same ratio of gross to net asset value as reported in recent utility financial data.

Table 8. Economic Useful Life (EUL) Assumptions by Asset Type

Asset Type	EUL
Hydro	75
Nuclear	60
Thermal	30
Wind	30
Geothermal	30
Biomass	30
Solar	25
Storage	13
Other	30
T&D	40

Step 2: Estimate Debt Financing Expenses

Financing expenses (a component of the return on rate base) are calculated based on net asset values, assumed debt-to-equity ratios, and interest rates.

Debt-to-equity ratios and financing rates are sourced from financial reports of the predominant electric utility in each province or representative utilities, with adjustments made to reflect the entire provincial electricity system, including public utilities and independent power producers.

For the purposes of this analysis, we assume that debt-to-equity ratios and interest rates remain constant throughout the study period.

Table 9. Debt-to-equity and Debt Financing Rates by Province

	BC	AB	SK	MB	ON	QC	NB + PEI	NS	NL
Debt to Equity	70%	60%	75%	90%	60%	45%	80%	60%	65%
Financing Rate	3.0%	5.7%	4.4%	3.4%	4.6%	4.7%	4.4%	7.0%	7.0%

Step 3: Estimate Annual O&M Expenses

For most studies, we rely on reported **annual operating and maintenance (O&M) expenses** for generation assets, which include fuel costs as well as fixed and variable O&M costs.

In cases where O&M costs are not provided, we develop proxy values based on available data, as outlined in the Electricity System Capital Costs methodology.

We assume that reported O&M expenses pertain only to generation assets and do not account for general administrative costs or costs related to operating and maintaining the transmission and distribution (T&D) system. To incorporate these additional costs, we estimate an O&M adder based on the average O&M expense (excluding fuel and generation O&M) per MWh generated, using utility financial filings. This value ranges from $10 to $30 per MWh.

Step 4: Estimate Tax Expenses

We assume **tax expenses** are a static portion of overall net asset value based on recent utility financial reports. Across all reviewed utility filings, taxes represented approximately 1.4% of net asset values in 2022.

Step 5: Estimate Average Cost of Electricity Produced

We sum annual depreciation, financing, O&M, and tax expenses to estimate annual total expenses. We then divide this total by the amount of electricity generated as reported in each study to estimate the average cost per unit of electricity generated. We calibrate this value to the estimated average cost per unit of electricity in each province based on utility financial filings.

Step 6: Estimate Average Retail Electricity Rate

We estimate average retail rates by using the average cost per unit of electricity generated and applying the ratio of this value to the average revenue per unit of electricity sold for each province, based on 2022 utility financial filings.

This method ensures that retail rates reflect the same percentage change as the average cost of electricity. Additionally, this approach implicitly captures how costs are allocated between rate classes and includes the **return on equity** (as a component of return on rate base) inherent in provincial retail rates. The ratio of cost to revenue is held constant throughout the analysis period, assuming that cost allocations and return on equity remain unchanged.

Caveats and Limitations

Our approach for estimating electricity rate impacts comes with several caveats and limitations that should be noted when interpreting the results:

- **3rd party power system modeling**: This analysis relies on outputs from third-party studies that incorporate power system modeling components. We make only minimal adjustments to these outputs, mainly to account for costs that are not directly represented. We do not alter the power system pathways in these studies (e.g., installed capacity increases, electricity demand growth). These pathways reflect the specific modeling assumptions of each study, which can vary significantly. For instance, some studies include assumptions for expanded interprovincial transmission, while others do not. Similarly, assumptions around energy efficiency and other demand-side solutions may differ in scope and granularity. As noted, isolating the effect of individual modeling assumptions is challenging, but it is essential to recognize that the pathways represented here encompass a wide range of assumptions and potential outcomes.
- **Average costs**: Our analysis focuses on average costs for producing and consuming electricity. For retail rates, these costs reflect the total revenue utilities receive from

customers per kilowatt-hour (kWh) sold, including both fixed and variable charges. The future allocation between fixed and variable charges, which will likely be determined through rate cases or regulatory decisions, could affect how electricity use impacts household finances. However, our analysis does not attempt to project how this allocation may evolve over time.

- **Evolving financial conditions**: We do not account for potential shifts in key financial indicators, such as debt-to-equity ratios, return on equity, interest rates, or the distribution of costs among different rate classes. Our analysis uses data from 2022 utility filings and assumes these financial conditions remain constant. Any future changes to these metrics could have substantial impacts on revenue requirements and the financial burden on different rate classes.
- **Electricity imports and exports**: Due to data constraints, we have not factored in the potential impact of changing electricity imports and exports on provincial rates. These factors could significantly affect rates. For example, a province exporting electricity at prices higher than production costs could use the profits to offset local electricity rates, thereby subsidizing consumption.
- **Other data limitations**: The financial metrics we constructed, such as gross and net asset values, aim to comprehensively reflect the financial health of provincial electricity systems. Since these assets are owned by multiple entities with varying levels of financial disclosure, we have applied reasonable assumptions to bridge any information gaps in the available data.

Results

In the studies included in our analysis, the electricity system transformation pathways generally place upward pressure on the average costs of electricity generation and delivery across most provinces, with median provincial increases ranging from 20% to 87% above the rate of inflation. Table 10 provides the average residential electricity rates by province for 2024 and 2050. The table includes the minimum, median, and maximum 2050 rate forecasts for each province based on the studies analyzed. These forecasts serve as the foundation for the Low, Mid, and High rate scenarios used in the **Household Energy Wallets** methodology. For most provinces, these values are derived from provincial-level results from the national studies. However, for Alberta (AB), Ontario (ON), and Nova Scotia (NS), province-specific study results are incorporated into the estimates. The table also includes the average compound annual growth rate (CAGR) between 2024 and 2050 for each 2050 forecast value.

Table 10. Forecasted 2050 Average Residential Electricity Rates

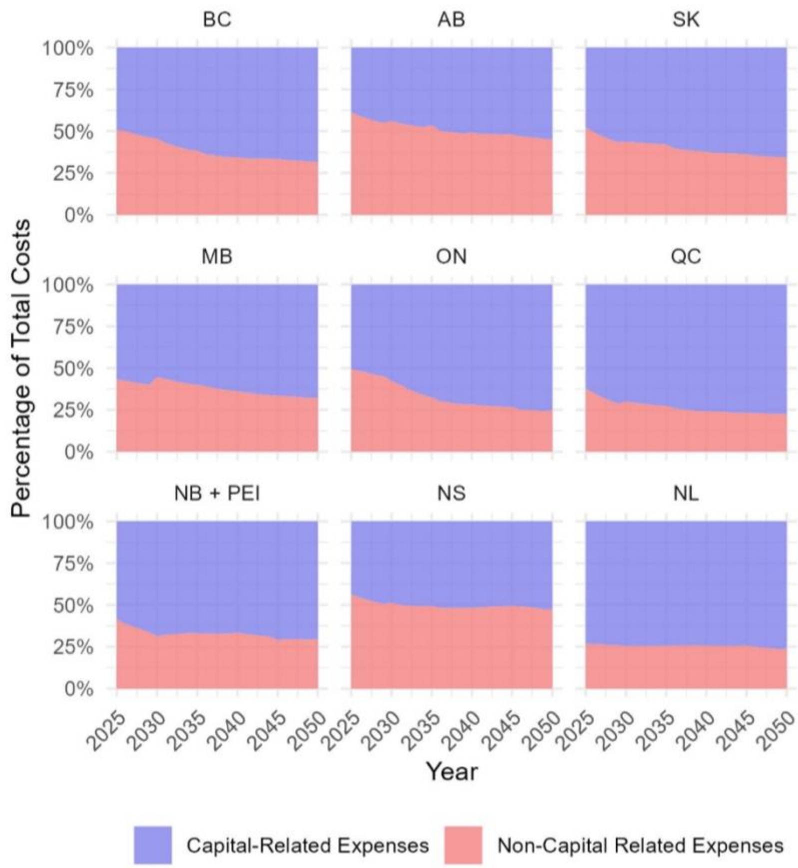
		2050 Forecast					
	2024	Minimum (Low)		Median (Mid)		Maximum (High)	
Province	$/kWh	$/kWh	CAGR	$/kWh	CAGR	$/kWh	CAGR
BC	$0.110	$0.140	0.9%	$0.168	1.7%	$0.195	2.2%
AB	$0.195	$0.222	0.5%	$0.279	1.4%	$0.300	1.7%
SK	$0.184	$0.250	1.2%	$0.273	1.5%	$0.305	2.0%
MB	$0.103	$0.112	0.3%	$0.157	1.6%	$0.228	3.1%
ON	$0.141	$0.182	1.0%	$0.218	1.7%	$0.265	2.5%

QC	$0.084	$0.151	2.3%	$0.161	2.5%	$0.174	2.8%
NB+PEI	$0.135	$0.154	0.5%	$0.160	0.7%	$0.166	0.8%
NS	$0.173	$0.159	-0.3%	$0.215	0.8%	$0.246	1.4%
NL	$0.148	$0.096	-1.7%	$0.159	0.3%	$0.246	2.0%

In certain cases—particularly in Nova Scotia and Newfoundland and Labrador—specific pathways model a decrease in average costs. These patterns are driven by provincial scenarios that feature significant deployment of new, high-capacity wind generation, likely exceeding internal demand and leading to potential exports. While this could lower the average production cost of electricity in these provinces, it does not necessarily imply a corresponding decline in retail electricity rates, as rate-setting processes must account for factors such as the allocation of export revenues and other regulatory considerations. This trend is only observed in a single pathway for each province and represents the minimum – or Low scenario – value.

Because we use a bottom-up approach to estimate electricity rate impacts by constructing estimates for each component of the revenue requirement, we can track changes in the relative structure of these costs. Figure 7 shows the average proportion of electricity system costs allocated to capital and non-capital expenses across all studies included in the analysis. Capital expenses include depreciation, debt servicing, and tax obligations, as taxes are typically tied to the return on equity. Non-capital expenses cover all operating and maintenance (O&M) expenses and fuel costs. As illustrated in the figure, the share of electricity costs attributed to capital-related expenses increases over the study period.

Figure 7. Average Projected Proportion of Capital and Non-Capital Related Electricity Costs



This shift stems from electricity systems increasingly powered by sources with low operational expenses (e.g., wind and solar) as modelled in the third-party party studies leveraged for this analysis. In other words, electricity systems are expected to become more capital-intensive and less exposed to volatile variable expenses, such as fossil fuel costs, as they adapt to meet the demands of a net-zero economy.

Estimate Household Energy Wallets

Methodology

To estimate how household energy wallet costs may change between now and 2050, we use an energy consumer archetype approach, comparing energy wallet costs for households today (2024) with those in a net-zero future (2050). This approach allows us to directly compare the energy wallets of current households to fully electrified households in 2050, providing insights into how energy costs might shift under different circumstances.

The inputs, assumptions, and calculations used to estimate household energy wallets are largely adapted from the Building Decarbonization Alliance's Open Source Model (BDA-OSM), a tool designed to assess decarbonization pathways for Canada's residential, commercial, and institutional buildings.

Calculating Household Energy Wallets in 2024

The 2024 household archetypes are defined by several key variables listed in Table 11. These archetypes are structured by province and climatic zones within each province to account for geographic differences in energy costs, heating and cooling loads, and heat pump performance. The archetypes are also differentiated by vehicle type, presence of air conditioning, space and water heating energy source, and income quintile.

We assume that space heating equipment in 2024 households is either a fossil-fuel-fired furnace, electric resistance baseboard, or electric air source heat pump (ASHP). For water heating, we assume households use the same fuel source as their space heating equipment, with electrically heated homes exclusively using electric resistance water heaters.

Energy costs are calculated based on average 2024 residential energy costs by province including any applicable carbon costs.

Table 11. Household Archetype Variables

Variable	Values
Provinces	AB, BC, MB, NB, NS, ON, QC, SK, NL, PE
Climate zones[8]	4, 5, 6, 7A, 7B,8
Vehicle types	Car/SUV, Pickup, None
Heating loads	Above Average, Average, Below Average
Air Conditioning	Air Conditioning, No Air Conditioning
Heating Energy Sources	Natural Gas, Oil, Propane, Electricity (Resistance or ASHP)
Income Quintiles	Bottom 20%, Middle 20%, Top 20%

Calculating Household Energy Wallets in 2050

For the 2050 household archetypes, we assume the following key differences compared to 2024:

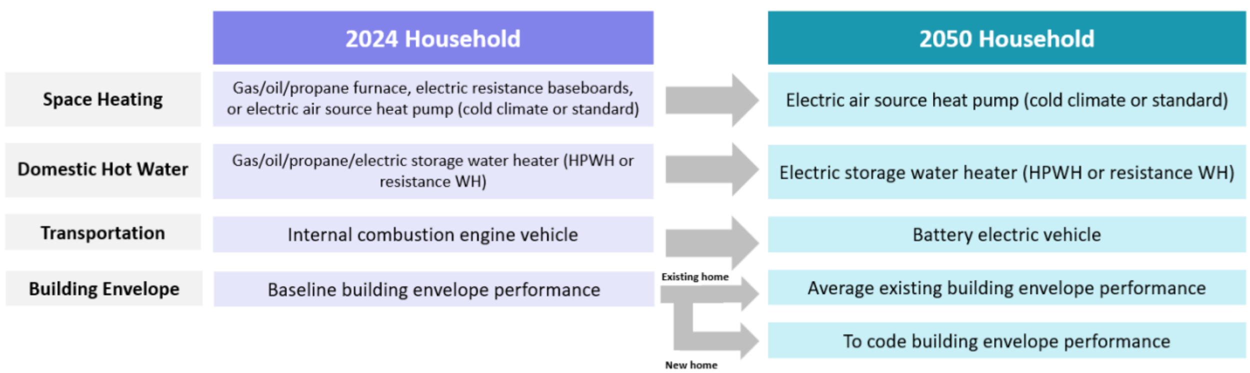
[8] Climate zones are based on heating degree days, as defined by the National Energy Code of Canada for Buildings

- Households own and drive an electric vehicle (if they have a vehicle),
- Households use an electric air source heat pump (either standard efficiency or cold climate) for space heating and cooling,
- Domestic hot water is provided by an electric storage water heater (either electric resistance or heat pump water heater).

Each archetype is assigned the most cost-effective combination of heat pump and water heater to minimize their 2050 energy wallet.

Aside from changes in space heating, domestic hot water, and transportation technologies, all other archetype variables are assumed to remain constant. For instance, if a household drives a pickup truck in 2024, they continue to do so in 2050. Additionally, we assume that electricity consumption for end-uses other than space conditioning and water heating remains constant.

We do not assume building envelope retrofits for existing homes but do account for the fact that many 2050 households will reside in homes built between now and 2050. Newly constructed homes are assumed to be more efficient than the average home in the current housing stock. Additionally, no changes are assumed for household electricity use beyond space heating, cooling, and domestic hot water.



The energy costs in 2050 are solely from the consumption of electricity and are calculated based on the range of estimated average provincial electricity rates derived in **Electric Rate Impacts** analysis. We assume that any household currently heating with a non-electric fuel source (gas, oil, propane) must upgrade their electrical panel.

Other Calculations

Annualized Energy Wallet Costs

Total annualized costs are calculated by adding first year energy costs, average annual maintenance costs, and annualized upfront costs (equipment and labour). Upfront costs are annualized over the service life of the equipment (Table 12) using a real discount rate of 3%.

Table 12. Assumed Service Life of Equipment Included in Household Energy Wallets

Equipment	Assumed service life (years)
Window AC	10

Central AC	15
Air source heat pump	15
Furnace (gas/oil/wood/propane)	20
Electric baseboards	30
All water heater types	15
All vehicle types	12

Statistics

To estimate median, mean, and other statistics, we apply weightings to each household archetype combination based on the relative proportion of households with specific characteristics (e.g., heating system, vehicle ownership) by province. Due to data limitations, these weightings are treated independently for most variables. The only exception is for vehicle ownership and income quintile, where data allows us to capture the correlation between these two variables.

Inputs and Assumptions

The following section documents the inputs and assumptions used to calculate household energy wallets.

Transportation Component

The transportation component of household energy wallets consists of three key elements: the purchase cost of the vehicle, annual maintenance costs, and annual fuel costs. To estimate these, we base our calculations on representative vehicle models for both internal combustion engine (ICE) vehicles and battery electric vehicles (BEV). Table 13 outlines the representative models used in our analysis, along with their corresponding purchase costs and fuel economy figures.

Table 13. Vehicle Costs and Fuel Economy Assumptions

Vehicle Type	Powertrain	Representative Model	Year	Purchase Cost	Fuel Economy	
					MPGGE	MJ/km
Car	ICE	2023 Toyota Camry	2024	$34,205	29	2.84
Truck	ICE	2023 Ford F150	2024	$48,450	22	3.74
Car	BEV	2023 Hyundai Kona	2024	$45,229	120	0.69
Truck	BEV	2023 Ford F150 Lightning	2024	$55,613	68	1.21
Car	BEV	N/A	2050	$33,205	133	0.62
Truck	BEV	N/A	2050	$49,175	76	1.09

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

Purchase Costs

The purchase costs for internal combustion engine (ICE) vehicles are based on the manufacturer's suggested retail price (MSRP) of 2023 model year vehicles, sourced from dealership websites (accessed in January 2024).

For electric vehicles (EVs) in 2050, the purchase costs are calculated relative to ICE vehicle costs, with the price differences derived from the regulatory analysis for proposed federal Zero Emission Vehicle regulations.[9] According to this analysis, electric cars are projected to be approximately 3%

[9] Based on the Government of Canada - [Canada Gazette Part II, Vol. 157, No. 26 (Table 2; page 4023)]

cheaper than equivalent ICE cars by 2033, and battery electric trucks are expected to be around 1.5% more expensive than comparable ICE trucks. We assume no real change in ICE vehicle purchase costs through 2050, so these adjustments are applied directly to the assumed 2024 purchase costs for ICE vehicles.

Annual Fuel Costs

Annual vehicle fuel costs are a product of the archetype vehicle's fuel economy, annual vehicle kilometers travelled (VKT), and fuel prices.

For fuel economy, the miles per gallon of gasoline-equivalent (MPGGE) for 2023 model year vehicles were sourced from the U.S. Department of Energy.[10] For the 2050 model year vehicles, BEVs were assumed to be 10% more efficient than current models.[11] For fuel conversions, the energy content of gasoline was assumed to be 35 MJ/L.[12]

For annual VKT, we assumed a value of 15,000 km by taking a rounded average for passenger cars and light trucks, as reported by Natural Resource Canada – Comprehensive Energy Use Database (CEUD) – Transportation Sector, Tables 32 and 60). The annual VKT value was informed by data from 2015 to 2019, as vehicle usage during 2020 and 2021 was atypical due to the COVID-19 pandemic.

Annual Maintenance Costs

Annual maintenance costs were informed by the American Automobile Association, which provides typical maintenance costs for the top selling models on an annual basis.[13] These maintenance cost estimates, which are provided on a 'per mile' basis for various vehicle types (e.g., sedans, SUVs, pickup trucks, EVs), were converted to annual amounts based on our assumed annual VKT of 15,000 km, and converted to Canadian dollars using a currency exchange rate of 1.34 CAD per USD.

Archetype Weightings

Table 14 indicates the weightings related to the vehicle type owned by households in each province.

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[10] U.S. Department of Energy. *Fuel Economy*

[11] Argonne National Laboratory (October 2021). *A Detailed Vehicle Modeling & Simulation Study Quantifying Energy Consumption and Cost Reduction of Advanced Vehicle Technologies Through 2050*.

[12] Statistics Canada. *Report on Energy Supply and Demand in Canada: Explanatory Information - Energy conversion factors*

[13] American Automobile Association (2023). *Your Driving Costs*

Table 14. Archetype Variable Weightings - Transport Component

Province	Vehicle Type		
	Car/SUV	Pickup	None
AB	0.70	0.23	0.07
BC	0.72	0.16	0.11
MB	0.68	0.22	0.10
NB	0.70	0.19	0.10
NL	0.64	0.24	0.12
NS	0.72	0.17	0.11
ON	0.71	0.11	0.18
PE	0.72	0.20	0.08
QC	0.74	0.09	0.16
SK	0.62	0.29	0.08

Vehicle Ownership Rates

Table 15 shows the vehicle ownership rates, which were estimated based on an analysis of the 2019 Survey of Household Spending public use microdata file.[14]

Table 15. Vehicle Ownership Rates by Province and Income Quintiles

Province	Income Quintile				
	1	2	3	4	5
AB	79%	92%	98%	96%	98%
BC	74%	87%	90%	96%	98%
MB	67%	91%	95%	97%	100%
NB	67%	90%	98%	96%	100%
NL	63%	87%	94%	98%	98%
NS	76%	81%	93%	96%	98%
ON	63%	83%	86%	88%	94%
PE	69%	98%	100%	100%	100%
QC	58%	78%	91%	95%	96%
SK	75%	88%	96%	99%	100%

Home Component

The home component of the energy wallet consists of the following elements:

- Equipment purchase, maintenance, and energy costs for space conditioning (heating and cooling)
- The equipment purchase, maintenance, and energy costs for domestic hot water
- Energy costs for other home energy end-uses not related to space conditioning or water heating

All other home energy end-uses, which include lighting and major electrical appliances (e.g., refrigerator, stove, dryer, etc.), were grouped into a single category. We assumed uniform energy consumption across all households for this category, with reference loads based on the average

[14] Statistics Canada – Survey of Households Spending: Public Use Microdata File, 2019

electricity consumption per household for the lighting and appliance end uses reported by the CEUD – Residential Sector, Tables 4 and 17.

Space Conditioning

Space conditioning costs are determined by the purchase cost of heating and, where applicable, air-conditioning equipment, along with average annual maintenance costs and the energy costs required to operate the equipment.

Equipment Costs

Table 16 highlights the space conditioning equipment costs. Average installation cost values represent the best estimates of the total cost of installation, including equipment, labor, and mark-up in 2024 based on publicly available data from HVAC contractors (Bryan's Fuel), retailers (Furnace Store, 1Click), and the general public (Heat Pump Quote Comparisons). Furnaces and air conditioners were sized (and costed) based on the heating loads of the various archetypes.

In 2024, households with ACs include its cost in their energy wallet calculations. We assume that by 2050, all households will have switched to heat pumps, and all households use their heat pumps for space cooling. We conservatively do not adjust for any change in the natural adoption of air conditioning between 2024 and 2050, which likely overstates the relative impact on 2050 energy wallets.

The analysis assumes heat pump installation costs will decrease by 25% by 2050 (real dollars) based on increased demand leading to manufacturing and supply chain efficiencies, and increased competition leading to reduced profit margins across the value chain (Delta-EE).

Table 16. Space Conditioning Equipment Costs

Equipment Type	Average Installation Costs in 2024		
Heat pumps and air conditioners	**2 ton**	**3 ton**	**4 ton**
Central cold-climate ASHP	$19,700	$21,800	$23,500
Central ASHP	$10,400	$11,600	$13,600
Ductless mini-split cold-climate ASHP	$7,800	$10,600	$13,400
Ductless mini-split ASHP	$6,500	$8,800	$11,100
Central air conditioner	$3,800	$4,200	$5,300
Window air conditioner	$1,800	$2,700	$3,600
Furnaces	**40 kBTU/h**	**60 kBTU/h**	**80 kBTU/h**
Natural gas furnace	$4,200	$4,300	$4,800
Oil furnace (105 kBTU/h)	$16,700		

Space Heating Loads

Table 17 provides the modeled annual space heating load for the existing building stock in each province. The residential building stock was divided into three "heating load" tiers, wherein the "average" tier represents the weighted average heating load across all households, and "below average" and "above average" tiers are used to represent heating loads that are at least one standard deviation below and above the weighted average, respectively. This methodology results in approximately 60% of households falling into the "average" heating load tier, and 20% of households falling into each of the "below average" and "above average" heating load tiers. Heating load values for each tier were derived from CEUD – Residential Sector, Table 32.

Table 17. Annual Space Heating Load for Existing Building Stock by Heating Load Tier (GJ)

Province	Below average	Average	Above average
AB	31.5	67.7	97.5
BC	16.9	40.0	68.6
MB	28.5	58.4	83.6
NB	25.3	49.8	98.2
NL	32.7	58.7	90.3
NS	22.6	51.1	96.4
ON	27.8	69.5	118.2
PE	22.2	52.8	91.1
QC	28.2	52.2	130.8
SK	30.0	61.5	101.8

To better assess the performance of air-source heat pumps across different climate zones, annual heating loads were converted to a series of hourly heating loads through the simplifying assumption that a building's heating load is directly proportional to the temperature difference between indoor and outdoor air. Using this simplifying assumption, a unique "load vs temperature differential" line could be fit for each combination of weather profile and annual heating load. To carry out this exercise, we used hourly weather data from Canadian Weather Year for Energy Calculation (CWEC) files pertaining to the largest municipality for each climate zone.

These hourly heating load profiles were then used to determine the energy consumption for air source heat pumps on an hourly basis, using the heat pump's rated heating capacity and COP for each given temperature.

We assume that heat pump water heaters (HPWH) extract heat from the conditioned space. To account for this, the annual space heating load for a home with an HPWH is assumed to be approximately 10 GJ greater than a similar home with a non-HPWH. The precise incremental space heating load varies by climate zone due to the differing lengths of their respective heating seasons as shown in Table 18. A similar adjustment is made that reduces annual cooling loads for homes with a HPWH.

Table 18. Incremental Heating Load for Homes with HPWHs

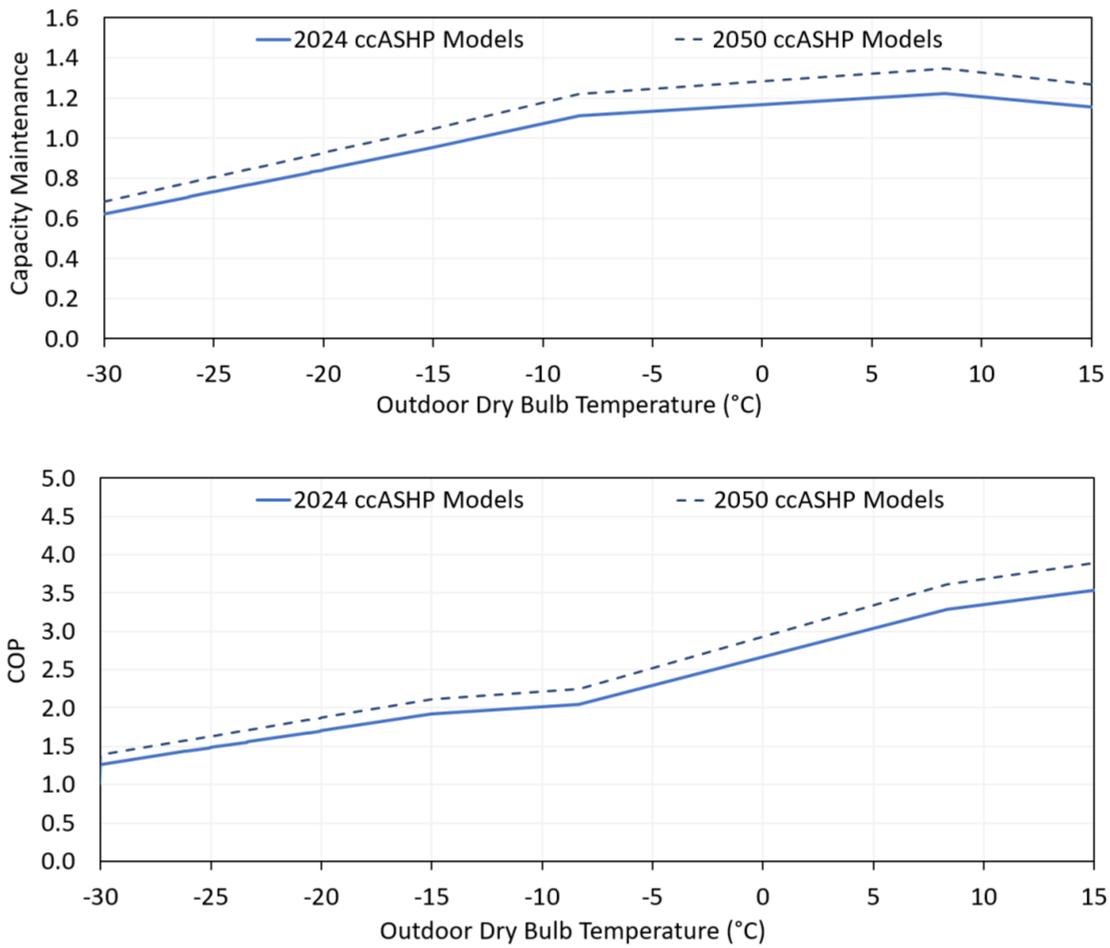
Climate Zone	Representative Municipality	HDDs	Incremental Heating Load (GJ)
4	Vancouver, BC	2,810	10.1
5	Toronto, ON	3,520	9.9
6	Montreal, QC	4,131	9.7
7A	Edmonton, AB	5,514	11.7
7B	Prince Albert, SK	6,175	11.2
8	Thompson, MB	7,312	12.1

ASHP Specifications

Performance curves for cold climate air source heat pumps (ccASHPs) were developed by averaging data from the Northeast Energy Efficiency Partnerships (NEEP) database for three popular models. To account for ongoing advancements in heat pump technology, we assumed that by 2050, ccASHPs will achieve a modest 10% improvement in both COP and capacity maintenance across all temperatures within its operating range, as displayed in Figure 8.[15]

Both the cost and performance of standard air source heat pumps were assumed to remain constant, as we assumed research and development efforts are put towards ccASHPs.

Figure 8. Modeled Performance of Cold Climate Air Source Heat Pumps



These performance curves were used in conjunction with the hourly heating load estimates described above to derive seasonal heating COPs for each combination of climate zone and heating load tier. The modeled average seasonal heating COPs are summarized below in Table 19.

[15] Northeast Energy Efficiency Partnerships (2024). [Cold Climate Air Source Heat Pump Specification and Product List]

Table 19. Modeled Seasonal COP for ASHPs

Climate Zone	ASHP	ccASHP
4	2.7	4.4
5	2.5	3.5
6	2.0	3.0
7A	2.0	2.9
7B	1.6	2.5
8	1.5	2.3

Building Stock

Table 20 highlights the evolution of the residential building stock by comparing 2024 numbers with 2050. All housing stock numbers were extracted from the Reference Case of the Building Decarbonization Alliance's Open-Source Model, wherein future housing stock is calibrated to the CMHC housing stock forecast for 2030 and increases proportionally with forecasted population growth thereafter. [16,17] Demolitions are based on historical home demolition rates, imputed from CEUD – Residential Sector, Table 15. On average, the heating load for newly built homes is assumed to be about 25% less than that of a comparable home within the existing housing stock. The efficiency of newly constructed homes relative to the stock average was estimated by comparing the gross thermal requirements for homes built between 2016 and 2020 to the weighted average gross thermal requirements for the entire housing stock, as reported in CEUD – Residential Sector, Table 32.

Table 20. Evolution of the Residential Building Stock

Province	Housing Stock, 2024	Housing Stock, 2050	Demolitions, 2024-2050	New Builds, 2024-2050	New Builds (2024-2050), Share of 2050 Stock
AB	1,711,755	2,742,507	249,375	1,310,345	47.8%
BC	2,139,973	3,285,938	635,233	1,814,133	55.2%
MB	515,562	768,830	157,480	418,713	54.5%
NB	338,495	412,523	129,649	206,203	50.0%
NL	227,628	226,106	59,486	57,831	25.6%
NS	418,577	512,096	144,552	241,077	47.1%
ON	5,782,855	7,772,465	824,716	2,877,433	37.0%
PE	67,811	86,060	18,072	36,951	42.9%
QC	3,767,473	4,927,283	654,372	1,851,780	37.6%
SK	448,323	556,487	167,067	278,872	50.1%

[16] CMHC (September 2023). *Housing shortages in Canada: Updating how much housing we need by 2030*
[17] Statistics Canada Table 17-10-0057-01

Domestic Hot Water

The national average DHW load per household was derived from CEUD – Residential Sector, Table 14 and was used across all archetypes. Material cost estimates for DHW equipment were informed by listed prices from big box retailers, while installation and maintenance costs were sourced from the reference document used for the U.S. Energy Information Administration's Annual Energy Outlook.[18]

For the 2024 energy wallet, it was assumed that households use the same energy source for both space and water heating, with the exception of homes heated by propane or wood, which were assumed to use electric storage water heaters.

For the 2050 energy wallet, all households are assumed to use electricity for water heating. Each archetypal household was assigned the more cost-effective option between an electric resistance storage water heater and a heat pump water heater. The relative cost-effectiveness of these two options is influenced by electricity prices and climate zones, with higher electricity rates and milder climates favouring heat pump water heaters.

The assumed installation cost and efficiency for each type of hot water heater is listed in Table 21. The installation cost represents the sum of equipment cost (based on popular models available from big box retailers) and labour costs (derived from the U.S. EIA reference document by subtracting equipment cost from total cost).

Table 21. DHW Equipment Efficiency and Cost

DHW Equipment Type	Efficiency (Uniform Energy Factor)	Installation Cost
Natural gas storage water heater	0.67	$1,960
Oil storage water heater	0.66	$5,550
Electric resistance storage water heater	0.92	$1,035
Heat pump water heater	3.75	$3,415

Archetype Weightings

Table 22, Table 23, and Table 24 outline the specific weightings for each province, factoring in climate zones, heating loads, energy sources for heating, and AC availability.

Table 22. Archetype Variable Weightings – Climate Zone

Province	Climate Zone					
	4	5	6	7A	7B	8
AB			0.071	0.898	0.030	
BC	0.670	0.167	0.118	0.044		
MB				0.944	0.033	0.023
NB			0.913	0.087		
NL			0.921	0.032	0.047	
NS		0.590	0.410			
ON		0.734	0.239	0.027		
PE			1.000			
QC			0.863	0.131	0.006	

[18] U.S. Energy Information Administration (March 2023). [Updated Buildings Sector Appliance and Equipment Costs and Efficiencies]

SK				0.868	0.132	

Table 23. Archetype Variable Weightings – Heating Load

Province	Heating Load		
	Above Average	Average	Below Average
AB	0.18	0.60	0.23
BC	0.31	0.42	0.27
MB	0.19	0.60	0.21
NB	0.21	0.66	0.14
NL	0.23	0.62	0.14
NS	0.23	0.61	0.16
ON	0.18	0.61	0.22
PE	0.23	0.61	0.16
QC	0.10	0.84	0.05
SK	0.19	0.65	0.16

Table 24. Archetype Variable Weightings – Air Conditioning and Heating Energy Source

Province	Air Conditioning		Heating Energy Source					
	AC	No AC	Natural Gas	Propane	Oil	Wood	Baseboard	ASHP
AB	0.29	0.71	0.91	0.01	0.00	0.01	0.06	0.01
BC	0.31	0.69	0.58	0.01	0.00	0.04	0.34	0.03
MB	0.85	0.15	0.49	0.01	0.00	0.04	0.42	0.04
NB	0.33	0.67	0.02	0.01	0.22	0.15	0.57	0.03
NL	0.04	0.96	0.00	0.01	0.22	0.16	0.60	0.01
NS	0.29	0.71	0.01	0.00	0.45	0.17	0.33	0.04
ON	0.78	0.22	0.81	0.05	0.02	0.04	0.03	0.06
PE	0.28	0.72	0.00	0.04	0.58	0.25	0.12	0.01
QC	0.35	0.65	0.10	0.01	0.05	0.13	0.68	0.04
SK	0.92	0.08	0.86	0.01	0.00	0.02	0.09	0.02

Energy Efficiency Sensitivity

Our analysis does not include energy efficiency measures beyond the inherent efficiency of electrification technologies like electric vehicles and heat pumps as well as the improved thermal performance of new homes expected by 2050. However, we perform a high-level sensitivity analysis to understand the potential impacts on household energy wallets in 2050 from improved energy efficiency by assuming improved building envelopes (through retrofitting existing homes and higher performance building codes), hot water efficiency measures (e.g., low-flow fixtures and drain water heat recovery systems), and more efficient lighting and appliances.

For improved building envelopes, we assume that under a higher energy efficiency scenario, half of all existing homes will reduce their heating load by 40% through deep retrofits. Additionally, new homes will achieve a similar 40% reduction in heating load by adhering to more stringent building codes.[19]

For hot water efficiency, we assume that, on average, households can reduce hot water demand by 30% through the adoption low-flow fixtures, and all newly built homes are able to reduce hot water demand by a further 20% by installing a drain water heat recovery system. These load reductions were informed by the 2024 Illinois Statewide Technical Reference Manual for Energy Efficiency.

For appliances and lighting, we assumed that, by 2050, all appliances will meet the efficiency standards of the most energy-efficient models available today, and households have fully transitioned to 100% LED lighting. We compared the average unit electricity consumption (UEC) of the current stock (CEUD – Residential Sector, Table 38) with the most efficient Energy Star products available in 2024. For each appliance type, all potential efficiency gains were applied to the current consumption of the existing stock (CEUD – Residential Sector, Table 18). Comparing the total energy consumption of the current stock to that of an "efficient appliance" scenario resulted in an estimated load reduction of approximately 25% that was then applied to electricity consumption for the other home energy end-uses category.

Table 25. Potential Efficiency Savings for "Other" End Uses (Appliances & Lighting)

	UEC (kWh/year)		Total Energy Consumption (PJ)	
End Use	**Stock Average**	**Efficient Appliance**	**Current Appliances**	**Efficient Appliances**
Refrigerator	448	218	28.0	13.6
Freezer	355	249	9.5	6.7
Dishwasher	74	71	2.2	2.1
Clothes Washer	35	26	1.4	1.1
Clothes Dryer	833	122	33.5	4.9
Range	552	187	25.0	8.5
Other Plug Loads[20]	N/A		100.6	100.6
Lighting[21]	N/A		52.9	46.7
Total	**N/A**		**253.1**	**184.1**

[19] The 40% reduction value is a high-level assumption based on the analysis within A Toolkit for Affordability Driven Home Energy Efficiency Retrofits Through Local Improvement Charge Programs by Volta Research.
[20] We did not assume any efficiency improvements for other unlisted appliances/plug loads
[21] We assume 12% savings from lighting based on 13% of households not using any form of energy-efficient lighting (Statistics Canada, Table 38-10-0048-01), and considering that LED lighting consumes up to 90% less energy than traditional incandescent bulbs (U.S. Department of Energy. *Lighting Choices to Save You Money*).

Other Inputs and Assumptions

Energy rates

2024 household energy bills are calculated based on average provincial retail energy rates (Table 26). Retail energy rates for gasoline, natural gas, and heating oil were sourced for each province from Statistics Canada.[22] Average retail electricity rates for 2024 were derived from a variety of sources including utility financial reports, regulatory reports, and EnergyHub.org. Average retail electricity rates for 2050 are sourced directly from the **Electricity Rate Impacts** analysis.

For electricity consumed to power EVs, we assume that 60% of EV charging occurs at home, 15% using public Level 2 chargers, and 25% using public DC fast chargers, reflecting a mix of residential and public charging behavior expected in the future.[23] We apply incremental costs of $0.12/kWh and $0.46/kWh for Level 2 and DC fast charging, respectively, on top of the provincial average residential electricity rates. These incremental costs are derived from a review of current prices at public EV chargers rates relative to current provincial average residential electricity rates.[24]

Table 26. Retail Energy Rates

Energy Source	Year	Units	AB	BC	MB	NB	NL	NS	ON	PE	QC	SK
Gasoline	2024	$/GJ	43.50	55.83	40.28	49.58	52.73	50.49	47.37	50.62	50.79	44.65
Natural gas	2024	$/GJ	7.47	15.24	10.81	18.74	N/A	25.68	12.96	N/A	14.86	12.00
Heating oil	2024	$/GJ	39.29	46.96	35.06	40.26	35.42	38.95	43.64	35.07	46.06	37.94
Propane	2024	$/GJ	41.65	46.31	63.47	37.53	37.53	37.53	45.16	37.53	44.26	49.82
Wood	2024	$/GJ	20.85	20.85	20.85	20.85	20.85	20.85	20.85	20.85	20.85	20.85
Electricity	2024	$/kWh	0.195	0.110	0.103	0.135	0.148	0.173	0.141	0.135	0.084	0.184
Electricity - Low	2050	$/kWh	0.222	0.140	0.112	0.154	0.096	0.159	0.182	0.154	0.151	0.250
Electricity - Mid	2050	$/kWh	0.279	0.168	0.157	0.160	0.159	0.215	0.218	0.160	0.161	0.273
Electricity - High	2050	$/kWh	0.300	0.195	0.228	0.166	0.246	0.246	0.265	0.166	0.174	0.305

Median after tax income

Table 27 shows the median after-tax income by province and income quintile, which were derived from Statistics Canada Table 98-10-0056-01, and adjusted to 2024 values. These values were used to estimate the cost of the energy wallet relative to household income for different income quintiles.

[22] 2024 retail rates for gasoline and heating oil are sourced Statistics Canada Table 18-10-0001-01; 2024 retail rates for natural gas are sourced from Table 25-10-0059-01

[23] BloombergNEF Electric Vehicle Outlook 2024

[24] Data points sourced from Plugshare in August 2024

Table 27. Median After-tax Income, by Province and Income Quintiles

Province	Income Quintile				
	1	2	3	4	5
AB	$34,777	$67,668	$98,695	$137,996	$216,499
BC	$30,064	$59,848	$89,902	$129,242	$207,229
MB	$29,959	$55,959	$81,830	$113,142	$171,994
NB	$28,209	$50,119	$73,286	$101,830	$156,805
NL	$27,934	$49,413	$74,596	$106,048	$168,894
NS	$27,614	$50,146	$73,698	$102,675	$159,154
ON	$32,100	$63,632	$94,147	$133,508	$212,145
PE	$28,514	$51,421	$75,826	$104,539	$158,894
QC	$27,857	$50,405	$74,613	$105,613	$164,695
SK	$30,316	$58,208	$86,008	$120,625	$184,388

Results

The summary report focuses primarily on presenting and interpreting our household energy wallet results. The following sections provide more granular results in tabular format.

Median Impacts

The following tables provide energy wallet results for the median household, broken down by rate scenario and key household archetype variables. Each table lists the median annual energy wallet costs for households in 2024 and 2050, along with the absolute and percentage change between these two values, to illustrate the potential financial impact of electrification across different scenarios and household types. The median statistic represents the midpoint, meaning half of households will have higher values, and half will have lower values than those reported. All monetary values are expressed in 2024 Canadian dollars.

Table 28. Median Energy Wallet Impact Results by Rate Scenario

Rate Scenario	Median Energy Wallet		Change in Energy Wallet	
	2024	2050	($)	(%)
Low	$9,736	$8,512	-$1,157	-12%
Medium	$9,736	$8,774	-$742	-8%
High	$9,736	$9,411	-$143	-2%

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

Table 29. Median Energy Wallet Impact Results by Rate Scenario and 2024 Heating Fuel

Rate Scenario	2024 Heating Fuel	Median Energy Wallet		Change in Energy Wallet	
		2024	2050	($)	(%)
Low	Electricity	$9,364	$7,811	-$1,549	-17%
Low	Natural gas	$9,700	$9,305	-$570	-6%
Low	Heating oil	$13,760	$8,535	-$4,812	-37%
Low	Propane	$11,936	$9,233	-$2,631	-24%
Low	Wood	$10,792	$8,542	-$2,209	-21%
Medium	Electricity	$9,364	$7,956	-$1,195	-13%
Medium	Natural gas	$9,700	$9,859	$70	1%
Medium	Heating oil	$13,760	$8,780	-$4,344	-33%
Medium	Propane	$11,936	$9,844	-$2,092	-19%
Medium	Wood	$10,792	$8,720	-$1,811	-16%
High	Electricity	$9,364	$8,145	-$994	-10%
High	Natural gas	$9,700	$10,557	$849	8%
High	Heating oil	$13,760	$9,411	-$3,965	-30%
High	Propane	$11,936	$10,557	-$1,505	-13%
High	Wood	$10,792	$8,954	-$1,236	-12%

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

Table 30. Median Energy Wallet Impact Results by Rate Scenario and Province

Rate Scenario	Province	Median Energy Wallet		Change in Energy Wallet	
		2024	2050	($)	(%)
Low	BC	$9,522	$7,639	-$1,854	-19%
Low	AB	$9,261	$10,173	$879	10%
Low	SK	$9,877	$10,382	$504	5%
Low	MB	$9,415	$7,891	-$1,287	-15%
Low	ON	$10,059	$9,233	-$744	-7%
Low	QC	$9,013	$7,811	-$1,209	-13%
Low	NB	$11,081	$7,997	-$2,279	-23%
Low	PE	$12,468	$8,628	-$3,666	-30%
Low	NS	$12,321	$8,391	-$3,638	-32%
Low	NL	$11,718	$7,583	-$3,558	-33%
Medium	BC	$9,522	$8,003	-$1,435	-15%
Medium	AB	$9,261	$11,081	$1,712	19%
Medium	SK	$9,877	$10,738	$861	9%
Medium	MB	$9,415	$8,756	-$595	-7%
Medium	ON	$10,059	$9,844	-$200	-2%
Medium	QC	$9,013	$7,956	-$1,058	-12%
Medium	NB	$11,081	$8,084	-$2,195	-22%
Medium	PE	$12,468	$8,737	-$3,543	-29%
Medium	NS	$12,321	$9,252	-$2,864	-24%
Medium	NL	$11,718	$8,780	-$2,603	-24%
High	BC	$9,522	$8,341	-$1,166	-11%
High	AB	$9,261	$11,430	$2,032	23%
High	SK	$9,877	$11,230	$1,353	14%
High	MB	$9,415	$9,822	$390	4%
High	ON	$10,059	$10,557	$520	5%
High	QC	$9,013	$8,145	-$868	-10%
High	NB	$11,081	$8,160	-$2,122	-21%
High	PE	$12,468	$8,834	-$3,435	-29%
High	NS	$12,321	$9,709	-$2,435	-20%
High	NL	$11,718	$10,184	-$1,284	-12%

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

Table 31. Median Energy Wallet Impact Results by Rate Scenario and Vehicle Type

Rate Scenario	Vehicle Type	Median Energy Wallet		Change in Energy Wallet	
		2024	2050	($)	(%)
Low	None	$3,239	$3,527	$480	16%
Low	Car	$9,945	$8,694	-$1,253	-13%
Low	Truck	$12,002	$11,019	-$1,018	-9%
Medium	None	$3,239	$3,746	$714	28%
Medium	Car	$9,945	$9,026	-$1,027	-11%
Medium	Truck	$12,002	$11,676	-$618	-5%
High	None	$3,239	$4,278	$1,009	39%
High	Car	$9,945	$9,707	-$616	-6%
High	Truck	$12,002	$12,630	$139	1%

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

Table 32. Median Energy Wallet Impact Results by Rate Scenario and Income Quintile

Rate Scenario	Income Quintile	Median Energy Wallet		Change in Energy Wallet	
		2024	2050	($)	(%)
Low	Lowest	$9,331	$7,811	-$744	-8%
Low	Middle	$9,829	$8,542	-$1,194	-13%
Low	Highest	$10,059	$8,979	-$1,203	-13%
Medium	Lowest	$9,331	$8,162	-$200	-2%
Medium	Middle	$9,829	$8,903	-$744	-8%
Medium	Highest	$10,059	$9,599	-$911	-9%
High	Lowest	$9,331	$8,723	$390	5%
High	Middle	$9,829	$9,709	-$169	-2%
High	Highest	$10,059	$10,154	-$356	-4%

Note: Middle income quintile represents the middle 20% of households. All monetary values are expressed in 2024 Canadian dollars (CAD).

Distribution of Impacts

The following tables show the distribution of relative energy wallet impacts for the median household, broken down by rate scenario and key household archetype variables. Each table lists the proportion of households experiencing changes in their household energy wallet costs by percentage change between 2024 and 2050. Households with a negative change in their energy wallet costs will experience savings in 2050 compared to 2024, while those with a positive change will face increased costs relative to 2024.

Table 33. Distribution of Relative Energy Wallet Impacts

Rate Scenario	Less Expensive				More Expensive			
	-30% and below	-30% to -20%	-20% to -10%	-10% to 0%	0% to 10%	10% to 20%	20% to 30%	30% and above
Low	6%	15%	33%	23%	10%	6%	4%	3%
Medium	3%	8%	33%	23%	13%	8%	5%	8%
High	2%	4%	23%	22%	19%	12%	7%	10%

Table 34. Distribution of Relative Energy Wallet Impacts by 2024 Heating Fuel

Rate Scenario	2024 Heating Fuel	Less Expensive				More Expensive			
		-30% and below	-30% to -20%	-20% to -10%	-10% to 0%	0% to 10%	10% to 20%	20% to 30%	30% and above
Low	electricity	4%	25%	57%	4%	2%	1%	6%	0%
Low	natural gas	0%	4%	22%	39%	16%	10%	4%	5%
Low	oil	93%	7%	0%	0%	0%	0%	0%	0%
Low	propane	14%	62%	21%	2%	0%	0%	0%	0%
Low	wood	5%	47%	42%	2%	4%	0%	0%	0%
Medium	electricity	1%	16%	62%	10%	2%	2%	2%	4%
Medium	natural gas	0%	0%	14%	33%	21%	13%	7%	12%
Medium	oil	74%	26%	0%	0%	0%	0%	0%	0%
Medium	propane	6%	35%	51%	5%	2%	0%	0%	0%
Medium	wood	1%	17%	67%	10%	3%	3%	0%	0%
High	electricity	1%	6%	44%	36%	3%	2%	2%	7%
High	natural gas	0%	0%	8%	16%	31%	19%	12%	14%
High	oil	51%	43%	6%	0%	0%	0%	0%	0%
High	propane	1%	13%	58%	23%	3%	1%	1%	0%
High	wood	0%	6%	57%	27%	5%	4%	1%	0%

Table 35. Distribution of Relative Energy Wallet Impacts by Province

Rate Scenario	Province	Less Expensive				More Expensive			
		-30% and below	-30% to -20%	-20% to -10%	-10% to 0%	0% to 10%	10% to 20%	20% to 30%	30% and above
Low	BC	1%	41%	49%	3%	2%	0%	3%	1%
Low	AB	1%	4%	4%	5%	47%	32%	0%	7%
Low	SK	1%	3%	8%	10%	60%	12%	1%	6%
Low	MB	2%	29%	47%	18%	3%	2%	0%	1%
Low	ON	3%	9%	20%	51%	4%	4%	5%	4%
Low	QC	5%	7%	66%	8%	4%	1%	8%	1%
Low	NB	26%	45%	27%	1%	1%	0%	0%	0%
Low	PE	51%	26%	22%	1%	0%	0%	0%	0%
Low	NS	57%	38%	5%	0%	0%	0%	0%	0%
Low	NL	82%	18%	0%	0%	0%	0%	0%	0%
Medium	BC	0%	19%	64%	9%	2%	2%	1%	4%
Medium	AB	0%	1%	5%	3%	5%	48%	26%	12%
Medium	SK	0%	1%	8%	4%	47%	31%	2%	7%
Medium	MB	0%	1%	36%	41%	15%	1%	1%	4%
Medium	ON	2%	3%	14%	42%	24%	2%	2%	11%
Medium	QC	5%	4%	63%	14%	2%	3%	3%	6%
Medium	NB	25%	45%	27%	2%	1%	0%	0%	0%
Medium	PE	34%	43%	22%	1%	0%	0%	0%	0%
Medium	NS	24%	51%	22%	2%	1%	0%	0%	0%
Medium	NL	20%	54%	24%	2%	0%	0%	0%	0%
High	BC	0%	5%	60%	25%	2%	2%	2%	5%
High	AB	0%	0%	4%	4%	1%	30%	47%	13%
High	SK	0%	1%	5%	7%	12%	57%	11%	7%
High	MB	0%	1%	1%	32%	42%	16%	2%	7%
High	ON	1%	2%	7%	18%	43%	14%	2%	13%
High	QC	4%	2%	39%	40%	1%	2%	2%	9%
High	NB	25%	43%	29%	2%	1%	0%	0%	0%
High	PE	33%	42%	24%	1%	0%	0%	0%	0%
High	NS	11%	42%	37%	8%	1%	1%	0%	0%
High	NL	0%	17%	45%	31%	5%	1%	2%	0%

Table 36. Distribution of Relative Energy Wallet Impacts by Vehicle Type

Rate Scenario	Vehicle Type	Less Expensive				More Expensive			
		-30% and below	-30% to -20%	-20% to -10%	-10% to 0%	0% to 10%	10% to 20%	20% to 30%	30% and above
Low	None	7%	4%	9%	6%	9%	14%	29%	22%
Low	Car	6%	18%	38%	25%	9%	3%	0%	0%
Low	Truck	3%	8%	33%	31%	14%	11%	0%	0%
Medium	None	5%	3%	5%	7%	9%	7%	12%	53%
Medium	Car	4%	10%	40%	25%	12%	7%	3%	1%
Medium	Truck	1%	5%	27%	28%	19%	12%	8%	1%
High	None	4%	1%	3%	5%	6%	8%	8%	65%
High	Car	2%	5%	29%	24%	21%	12%	6%	1%
High	Truck	1%	3%	14%	30%	21%	17%	13%	1%

Table 37. Distribution of Relative Energy Wallet Impacts by Income Quintile

Rate Scenario	Income Quintile	Less Expensive				More Expensive			
		-30% and below	-30% to -20%	-20% to -10%	-10% to 0%	0% to 10%	10% to 20%	20% to 30%	30% and above
Low	Lowest	6%	13%	27%	19%	10%	8%	10%	7%
Low	Middle	6%	15%	34%	24%	10%	6%	3%	2%
Low	Highest	6%	16%	37%	26%	10%	5%	1%	1%
Medium	Lowest	4%	7%	26%	19%	12%	8%	7%	18%
Medium	Middle	3%	8%	34%	23%	13%	8%	4%	6%
Medium	Highest	3%	9%	37%	25%	13%	8%	4%	3%
High	Lowest	3%	4%	18%	18%	16%	11%	8%	22%
High	Middle	2%	4%	24%	23%	19%	12%	7%	8%
High	Highest	2%	5%	26%	25%	21%	12%	7%	3%

Note: Middle income quintile represents the middle 20% of households.