ELECTRIFYING CANADA
AN INITIATIVE OF THE TRANSITION ACCELERATOR

Household Energy Affordability in a Net-Zero Future

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The listing of individuals above does not imply endorsement of the report, and any errors or omissions are the responsibility of the authors.

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About Electrifying Canada

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

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The 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
L'Accélérateur de transition

transitionaccelerator.ca

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.

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Executive Summary

Canada's transition to a net-zero economy by 2050 requires a profound technological transformation of the country's energy systems, with widespread electrification playing a central role. This transition could significantly impact energy affordability as consumers purchase electrified equipment to power their daily lives and our electricity systems make investments to align with net-zero goals, which could impact the overall cost of consuming electricity.

This report examines how household energy wallets may change between today and 2050 in the absence of mitigating policies and supports to protect affordability as households decarbonize their energy use through electrification and as provincial electricity systems evolve to align with net-zero goals. Energy wallets incorporate the household costs of buying, operating, and maintaining equipment for heating, cooling, and transportation.

Recognizing that affordability is not a binary concept but rather exists on a gradient, our analysis focuses on how absolute household energy wallet expenditures are likely to change in an electrified net-zero economy by 2050. While this approach does not directly measure affordability, it provides a clear indication of whether affordability concerns are likely to rise or fall as the transition progresses, assuming no additional policies or support mechanisms are implemented.

Understanding how Canada's technological transition to a net-zero economy could impact household energy affordability is critical. If this transition leads to higher energy costs and no mitigating actions are taken, it could worsen energy poverty and erode public support for the investments in the electricity system necessary to meet climate goals.

Key Findings

Widespread Electrification Can Deliver Household Savings

Our analysis shows that Canada can invest in net-zero electricity systems capable of supporting widespread electrification while **most households experience energy wallet savings** by transitioning to electric vehicles and heat pumps. We assessed energy wallet impacts under three 2050 electricity rate scenarios—Low, Mid, and High—all of which assume higher rates than today. Even in the High-rate scenario, the median household saves about $150 per year. Under the Low-rate scenario, the median household reduces their energy wallet by over $1,000 annually.

Median % Impact on Household Energy Wallet	Savings of 2% to 12%
Median $ Change in Annual Energy Wallet	Reduction of $143 to $1,135
Net Annual Pan-Canadian Impact in 2050	Benefits of $1.9B to $20.6B

Transforming provincial electricity systems to support electrification will create upward pressure on rates if no mitigating actions are taken. However, the efficiency of electric technologies—requiring far less energy than fossil fuel systems to deliver the same performance—along with economies of scale that drive down costs, and the displacement of costly fuels like heating oil and propane, more than offset the impact of rising electricity rates for most households in our analysis.

In the Atlantic provinces, where many households heat their homes with oil and propane, and where energy wallets and rates of energy poverty are currently among the highest, some of the largest reductions in energy wallets are seen in an electrified future. For example, the median household in Nova Scotia experiences a 24% reduction in their energy wallet—equivalent to approximately $2,400 per year. In these regions, the transition to an electrified future will substantially improve energy affordability.

Some Households Will Need Support to Enjoy Energy Wallet Savings

While a majority of households will experience energy wallet savings under the full range of electricity rate scenarios, a significant portion of households will see increases in their energy wallet costs relative to today. For these households, energy affordability concerns will grow absent mitigating supports or other policy interventions.

Under the Low and Mid scenarios, 23% and 33% of households experience higher energy wallet costs, respectively, with a median annual increase in their energy wallets of between $764 and $861. This proportion rises to 48% of households under the High rate scenario with a median increase of over $1,000.

Rate Scenario	Lower Energy Wallet Costs		Higher Energy Wallet Costs	
	% of Households	Median Change	% of Households	Median Change
Low	77%	-$1,311	23%	$764
Mid	67%	-$1,174	33%	$861
High	52%	-$1,038	48%	$1,041

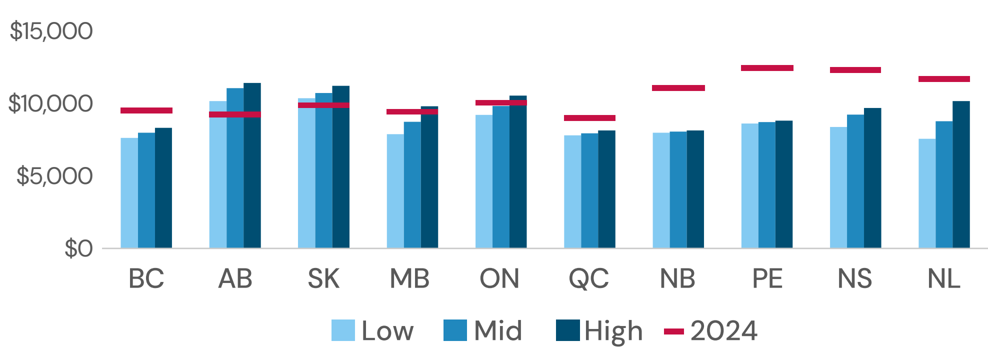
Households with increasing energy costs tend to be one of two types of households:

- **Households that do not own a personal vehicle.** These households miss out on the transportation-related cost savings associated with switching from gasoline or diesel vehicles to electric vehicles. Since transportation makes up a significant portion of the typical energy wallet, households without personal vehicles are more vulnerable to increased costs from other areas of the energy wallet, such as heating and electricity rates.
- **Households that currently heat their homes with natural gas and reside in regions with high projected 2050 electricity rates.** These households face increased energy wallets as they transition to electric heating systems. While the unabated combustion of natural gas is not net-zero compatible, the fuel has historically been one of the least expensive heating options, and the projected rise in electricity rates in these provinces means that the shift to electric heat pumps or other electric systems may not offer the same financial benefits that households in other regions experience.

These two trends lead to varying energy wallet impacts for income groups and regions:

- **Lower-income households**, which have the least capacity to absorb additional energy costs, are more likely to experience increasing energy wallets than other income groups due to a higher proportion that do not benefit from energy savings upon electrification of personal transportation. Without the ability to capitalize on savings from electrified personal transportation, these households may be disproportionately impacted by rising home energy costs in the absence of mitigating policy interventions by government.
- **Households in Alberta and Saskatchewan**, where most rely on natural gas for heating and projected electricity rates are among the highest in our analysis, struggle to experience energy wallet improvements in 2050 relative to today. The majority of households in these provinces face worsening energy wallets in the absence of mitigating policies and supports under all rate scenarios, making policy interventions critical to ensuring energy affordability does not erode.

Median Annual Energy Wallet Cost in 2050 vs. 2024



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

Key Conclusions

Good News for Most Canadian Households

The transition to using electricity for more of our household needs can make energy more affordable for most households. Efficiency gains and other improvements from electric vehicles and heat pumps can outweigh potential electricity rate increases, especially in regions with high current energy costs like the Atlantic provinces, where electrification can dramatically reduce energy burdens.

Support Is Crucial

Not all households will benefit equally. Those in regions with high natural gas use and projected higher electricity rates, such as Alberta and Saskatchewan, are more likely to face rising energy wallets. Lower-income households across Canada, especially those without access to personal transportation, are particularly vulnerable, highlighting the need for targeted support to ensure fairness.

Crucially, however, these findings assume no proactive measures are taken to mitigate rising energy costs for households facing higher energy wallets. In reality, we are not passive observers. The savings generated by the energy transition far outweigh any negative impacts on vulnerable households. Addressing these affordability challenges is essential to maintaining public trust and support for the transition.

Proactive Policies Can Ensure Affordability

Governments have the tools to make the transition affordable for all households. Proactive measures that support households in reducing their energy wallets through increased energy efficiency and behavioural change, the targeted deployment of alternative technologies where typical electrification technologies are not as cost-effective, and policies that mitigate increasing electricity costs and/or shift them from those who can least afford it can create even more energy wallet savings across more Canadian households.

Collaboration between provincial and federal governments on implementing these tools will be essential. The geographic differences in energy wallet impacts underscore the need for coordinated efforts to achieve affordable electrification nationwide. Through cooperation, the benefits of a net-zero economy can be more equitably distributed, ensuring energy affordability is improved across the country.

Energy Affordability, Indigenous Households, and Reconciliation

Our analysis does not specifically examine the energy wallet impacts of Indigenous households due to data limitations. However, existing research clearly shows that Indigenous households face disproportionately higher energy burdens within Canada alongside critical housing issues, such as overcrowding and substandard living conditions.[1] Addressing these systemic challenges through targeted policies and programs will be essential, not only to improve energy affordability for Indigenous households but also to address the key infrastructure improvements required to tackle the broader housing inequalities faced by Indigenous communities in Canada.

Additionally, our analysis highlights the importance of minimizing the costs of an electricity system buildout to accommodate increasing electrification. However, minimizing costs cannot overshadow other critical societal goals, such as Canada's commitment to Indigenous reconciliation. Grid expansion offers an opportunity to advance reconciliation through Indigenous ownership and partnerships in electrification projects. As emphasized by the First Nations Major Project Coalition's National Indigenous Electrification Strategy, focusing solely on maintaining low electricity rates risks "undermining Indigenous ownership in electricity assets" and, by extension, undermining reconciliation efforts. Ensuring Indigenous ownership, partnership, and adherence to the principle of free, prior, and informed consent (FPIC) is essential for a just and equitable energy transition.

[1] Canadian Climate Institute and Indigenous Clean Energy. (2024). Beyond Sustainability: The Power of Indigenous Healthy Energy Homes.

Introduction

Achieving a net-zero economy by 2050 in a cost-effective manner (i.e., with the least amount of total expenditures) will require the decarbonization of our electricity system and a significant increase in electricity use across all sectors with the attendant growth in the electricity system to meet the new demand.[2] A technological pathway focused on increased production and use of clean electricity will require two critical changes to our energy systems:

» **Consumer Energy Transition.** Energy users will need to shift from fossil fuels to electricity for most of their energy use, requiring changes in their choice of energy-consuming equipment.

» **Electricity System Transformation.** The electricity grid must grow and evolve to meet rising demand while decarbonizing and maintaining affordability and reliability.

While this electrification-first approach offers the most cost-effective route to net-zero emissions, it will also likely have complex implications for energy costs. In particular:

» **Consumer Transition Costs.** Transitioning to electricity involves adopting different equipment than used currently, each with distinct upfront, maintenance, and operating costs.

» **Electricity System Transformation Costs.** Decarbonizing and growing the electricity system will change its operational costs and require significant new infrastructure investments in generation, transmission, and distribution—all of which can affect the overall cost of electricity consumption.

For households, these consumer transition and electricity system costs could significantly impact energy affordability. As residential consumers transition from fossil fuels to electricity, adopting technologies like electric vehicles and heat pumps, they will face a mix of technology costs and evolving electricity rates as provincial systems adapt to growing demand across the country.

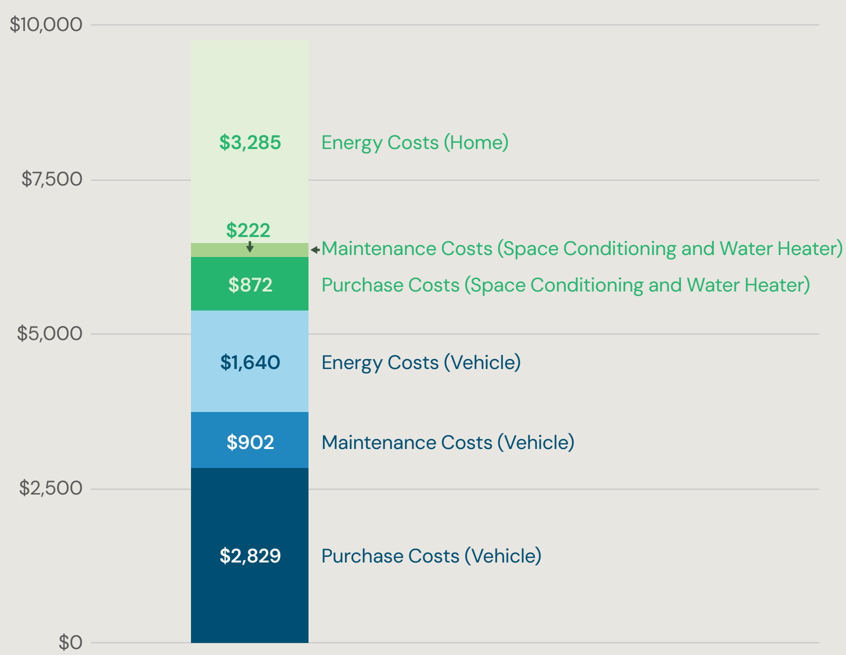
[2] Techno-economic modelling studies consistently show that cost-effective net-zero pathways in Canada rely heavily on electrification—shifting existing fossil fuel use to electricity. See: Canada's Energy Future 2023 (Canada Energy Regulator), Canadian Energy Outlook 3rd Edition (Institut de l'énergie Trottier), Canadian National Electrification Assessment (EPRI).

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.)

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



This report examines the potential impacts to household energy affordability of a highly electrified technological transition by comparing the **energy wallets** of fully electrified households in 2050 with those of today, for each province. We focus on energy wallets—rather than just energy costs—to account for any changes in equipment costs households may face as they transition to a net-zero future. As part of this analysis, we also consider how the transformation of the electricity system to support economy-wide electrification could influence electricity rates which in turn impacts future energy wallets. By comparing 2050 to today, we aim to understand how energy wallets will be affected once the necessary investments have been made in both consumer equipment and the electricity system.

Electricity Everywhere, All at Once?

Our analysis is not forecasting that every household will rely solely on electricity for all their energy needs. We use full household electrification as a simplified model to approximate the financial impacts of achieving net-zero by 2050. While electrifying light-duty vehicles and home heating will likely play a central role in Canada's pathway to net-zero, alternative options—such as hybrid heating (i.e., electric heat pumps with non-electric backup systems), hydrogen, or renewable natural gas—may also be viable where they are more cost-effective than electrification.

To conduct this analysis, we modelled household energy wallets in 2024 and 2050 using a granular, bottom-up approach that estimates the cost of full electrification across different provinces, climate zones, and household characteristics (e.g., heating systems, vehicle types, etc.) accounting for expected cost reductions and performance improvements for technologies such as electric vehicles and heat pumps.[3] This approach enables us to explore cost implications for a variety of households across jurisdictions with varying energy use patterns. A more detailed description of our methodology is included in the accompanying Technical Report.

Our analysis models current household energy wallet costs based on their existing heating systems and vehicles, comparing them to projected energy wallet costs in 2050 for fully electrified households.

	2024 Household	2050 Household
Space Heating	Gas/oil/propane furnace or electric resistance baseboards	Electric air source heat pump
Domestic Hot Water	Gas/oil/propane/electric storage water heater	Electric water heater
Transportation	Internal combustion engine vehicle	Battery electric vehicle

Importantly, our analysis accounts for potential rate impacts from the decarbonization and expansion of the electricity system by modelling energy wallets under various projected residential electricity rates for 2050. These rates are based on bottom-up estimates of provincial electricity system costs derived from electric power system modelling conducted in third-party studies, which simulate net-zero scenarios for Canada in 2050. Our estimates consider the recovery of future capital and operational costs, along with the current financial realities (i.e., existing utility debt and amortization costs) of provincial electricity systems that will persist through 2050.

[3] Due to data limitations and the unique characteristics of their energy systems, Canada's North (i.e., Yukon, Northwest Territories, and Nunavut) is not included in our analysis.

Proactive Measures to Reduce Costs and Improve Affordability

It is critical to recognize that **our analysis does not account for the imposition of policies and supports that could reduce overall costs of the transition and manage the affordability of household energy wallet costs**. Instead, we focus on isolating the impact of technology and energy costs on households during the energy transition. In practice, however, government interventions can significantly alter both the distribution and scale of these costs—often working to reduce the direct financial burden on households. If such actions are taken by governments, our analysis is likely overstating the direct impact on household energy wallets.[4] We discuss some of the tools available to governments to reduce these modelled energy wallet costs later in this report.

The remainder of this report focuses on exploring household energy affordability implications beginning with a short discussion on why energy affordability is a critical issue in Canada. Detailed explanations and presentations of our methodology and results can be found in the accompanying Technical Report.

Why Energy Affordability Matters

Affordable energy is essential not only for individual well-being, competitiveness, and broader economic prosperity but also for the success of Canada's net-zero transition. Energy wallets—covering energy bills as well as the upfront and maintenance costs of personal vehicles, home space conditioning, and water heating equipment—represent a significant portion of household expenses and have a direct impact on Canadians' quality of life. On average, Canadian households spend over $10,000 annually on their energy wallets, representing more than 10% of median after-tax household income.[5] Furthermore, energy demand is generally inelastic, as expenditures on essential needs like heating, cooling, and transportation are largely unavoidable to maintain personal health and well-being.

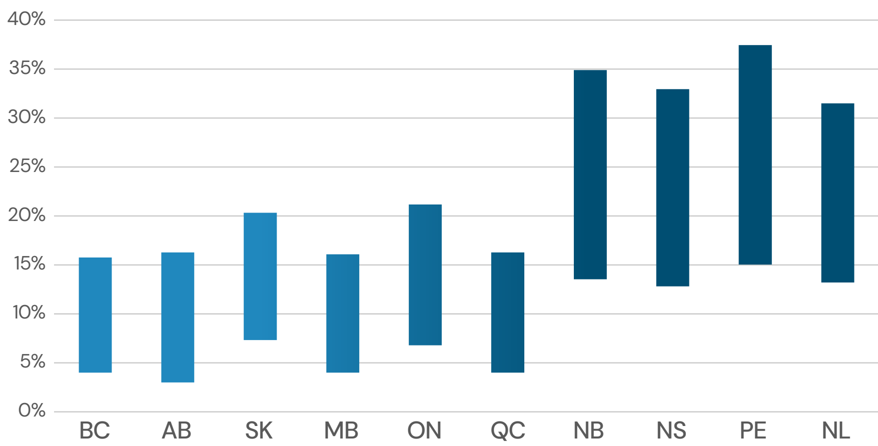
However, the concept of "affordability" is complex and difficult to quantify. There is no single definition of what makes energy "affordable" for households, although it is typically defined in relation to household income. In reality, whether household energy costs are considered affordable can vary greatly depending on individual circumstances, regional differences, and personal perceptions.

Energy poverty is one approach to understanding and measuring energy affordability,

[4] Government policies, such as subsidies or tax credits, may lower direct energy costs for households. However, these interventions often shift costs elsewhere, such as through higher taxes or increased prices for other goods and services. As a result, while household energy wallet burdens may be reduced, a portion of the overall financial impact would still be absorbed by consumers indirectly.
[5] Values based on Statistics Canada Tables 11-10-0222-01 and 98-10-0056-01

but even this concept is challenged by varying definitions and measurement techniques. Broadly, the term is used to describe "the inability to access and achieve adequate levels of social and material needs through energy services."[6] While the concept generally considers both household energy expenditures and income, there is no universally accepted method for measuring it. Estimates suggest that between 6% and 19% of households in Canada experience some form of energy poverty.[7] Despite differences in how energy poverty is measured, studies consistently show that it is more prevalent in the Atlantic provinces, with some findings indicating that up to one in three households in these regions may be affected (Figure 2).

Figure 2. Estimated Provincial Energy Poverty Rate Ranges



Note: Figure illustrates a range of energy poverty estimates across each province from two studies using different methodologies.[8]

Energy affordability is also a critical issue faced by Indigenous households in Canada. Existing research clearly shows that Indigenous households face disproportionately higher energy burdens alongside critical housing issues, such as overcrowding and substandard living conditions.[9] These challenges contribute to higher rates of illness and shorter life expectancies among Indigenous people compared to the non-Indigenous population, and they are rooted in a legacy of past and ongoing policies that have exacerbated housing insecurity for Indigenous households today.

[6] Das RR, Martiskainen M, Bertrand LM, MacArthur JL (September 2022). A review and analysis of initiatives addressing energy poverty and vulnerability in Ontario, Canada. Renewable and Sustainable Energy Reviews.
[7] Riva, M., et al. (October 2021). Energy poverty in Canada: Prevalence, social and spatial distribution, and implications for policy.
[8] Riva, M., et al. (October 2021). Energy poverty in Canada: Prevalence, social and spatial distribution, and implications for policy; Das, R. R., & Martiskainen, M. (February 2022). Quantifying the prevalence of energy poverty across Canada: Estimating domestic energy burden using an expenditures approach. The Canadian Geographer.
[9] Canadian Climate Institute and Indigenous Clean Energy. (2024). Beyond Sustainability: The Power of Indigenous Healthy Energy Homes.

Addressing these systemic issues will require targeted policies and programs that not only improve energy affordability but also focus on the infrastructure improvements needed to address the broader housing inequities faced by Indigenous communities.[10]

Because of its immediate impact on quality of life, energy affordability is also crucial for sustaining public support for climate action. While many Canadians prioritize addressing climate change, this support can wane if rising energy costs are perceived to threaten their financial stability—a point underscored by recent polls.

A January 2024 poll by the Innovative Research Group reported a 14-percentage-point drop in net support for increasing electricity rates to fund the energy transition over the past year, with 84% of respondents citing inflation as a direct financial concern.[11] Similarly, a Nanos Research poll showed a significant decrease in support for prioritizing environmental goals at the expense of economic growth, influenced by the onset of historically high inflation following the COVID-19 pandemic.[12]

Given these dynamics, understanding how Canada's technological transition to a net-zero economy could impact household energy affordability is critical. If this transition leads to higher energy costs and no mitigating actions are taken, it could worsen energy poverty and erode public support for the investments in the electricity system necessary to meet climate goals.

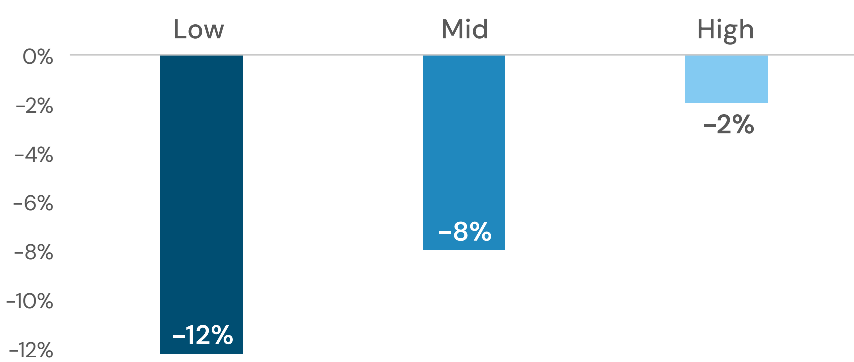
Recognizing that affordability is not a binary concept but rather exists on a gradient, our analysis focuses on how absolute household energy wallet expenditures are likely to change in an electrified net-zero economy by 2050. While this approach does not directly measure affordability, it provides a clear indication of whether affordability concerns are likely to rise or fall as the transition progresses, assuming no additional policies or support mechanisms are implemented.

[10] Indigenous Clean Energy. (2023). Enabling Efficiency: Pathways and recommendations based on the perceptions, barriers, and needs of Indigenous people, communities, and organizations.
[11] Innovative Research Group. (February 2024). Energy Transition Public Opinion Research.
[12] In March 2015, 67% of respondents indicated that "protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs". In July 2020, this value had declined to 49%. Nanos National Survey, November 2023.

Electrification Can Improve Energy Affordability for Most Canadian Households

Our analysis shows that **Canada can invest in net-zero electricity systems capable of supporting widespread electrification while most households decrease their energy wallet costs by transitioning to electric vehicles and heat pumps**.[13] If electricity system costs are high (High rate scenario), the median household's energy wallet is still 2% lower in 2050 compared to today, saving approximately $150 annually (Figure 3).[14] In scenarios where system costs are lower, the vast majority of households see even greater savings, with the median household reducing its energy wallet by over $1,000 annually under the Low-rate scenario.

Figure 3. Median Percent Change in Household Energy Wallets by Rate Scenario (2024 vs. 2050)



If we aggregate these savings across all households in 2050, Canadians will spend $21 billion less on their energy wallets under the lowest rate scenario compared to today. Even under the highest rate scenario, Canadians still benefit from $1.9 billion in collective savings on energy wallets. These savings are driven by the inherent efficiency of electrification, economies of scale bringing down technology costs and improving capabilities, and the diversion of investment in fossil fuel equipment and infrastructure.

These outcomes are also achieved despite projected increases in average provincial electricity rates across all scenarios in 2050 (Figure 4). Our rate analysis indicates that the average cost of producing and delivering a kilowatt-hour (kWh) of electricity is expected to rise in nearly every province by 2050, as utilities invest in maintaining, expanding, and cleaning the electricity systems necessary for economic competitiveness and to meet Canada's climate goals.[15]

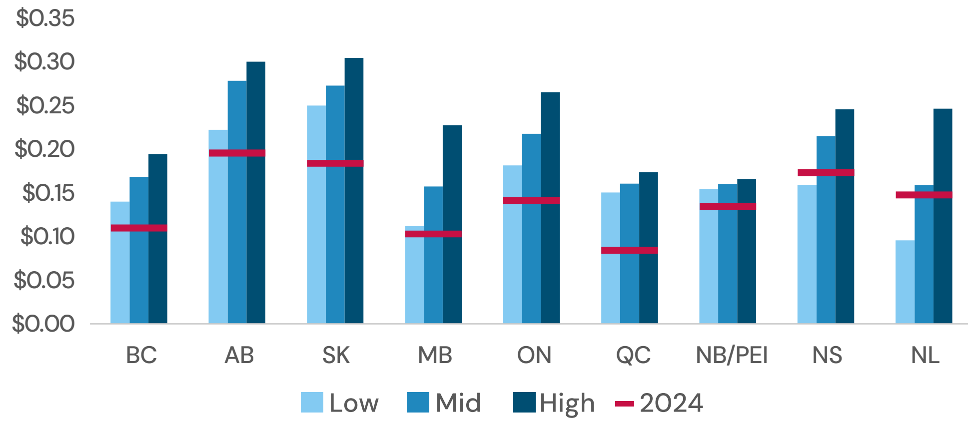
Rate Scenarios

Throughout our analysis, we present results under a range of 2050 electricity rates. This range represents the minimum (Low), median (Mid), and maximum (High) 2050 rate estimates for the included modelled electricity system transformation pathways as shown in Figure 4.

[12] This finding is consistent to similar analyses, notably the Canadian Climate Institute's Clean Electricity, Affordable Energy, which finds that "average household spending on energy is expected to decrease 12 per cent by 2050".
[14] Throughout this report, we express results in term of the "median" household. In this context, it means that 50% of households experience greater savings than the median household, and 50% experience fewer savings.
[15] The lone exceptions are estimated rate decreases in Nova Scotia and Newfoundland and Labrador under the Low-rate scenario, driven by electricity transformation pathways that feature significant amounts of low-cost wind generation above and beyond domestic needs, which is likely exported to other markets.

If these increased costs are not mitigated and are fully passed on to ratepayers (as we assume in our analysis), the average cost of a kWh sold in Canada will need to rise between 35% and 83% above the rate of inflation from today through 2050—equating to an annual growth rate of approximately 1.0% to 2.3% above inflation.[16]

Figure 4. Estimated Average Residential Electricity Rates in 2050 ($/kWh)



Note: New Brunswick and PEI are grouped together for the rate analysis due their high degree of interconnectivity. All monetary values are expressed in 2024 Canadian dollars (CAD).

The upward pressure on electricity rates is driven by the need for substantial investments in the electricity system, estimated between $1.1 to $2.0 trillion from 2025 to 2050.[17] These investments represent the cost of maintaining existing infrastructure, accommodating growing demand, and transitioning to cleaner energy sources—much of which would still be needed even without aligning the grid to net-zero goals as aging infrastructure is replaced and load grows for reasons beyond decarbonization.[18] These estimates, based on third-party electric power system modelling, represent the capital required for generation, transmission, and distribution upgrades and expansion. As system costs increase, more revenue will need to be collected for each kWh sold to cover these expenses.

Ultimately, these costs will be reflected in consumer rates through higher revenue requirements, including depreciation, financing costs (e.g., interest payments on debt), tax obligations, and returns on equity. By 2050, a greater share of these revenue requirements will be tied to fixed capital expenses rather than variable operational and fuel costs in nearly every province. 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.

[16] The national average is calculated by averaging provincial rate estimates weighted by each province's forecasted population in 2050.

[17] The significant range in investment costs, and consequently, the estimated provincial rate impacts, reflect the diverse model inputs and methodologies used in the studies leveraged for this analysis. Analyzing the specific components driving these differences is challenging due to the multitude of factors that influence model outcomes, as well as confidentiality agreements surrounding the models. Ultimately, such an analysis was beyond the scope of our work.

[18] Attribution of electricity system costs directly attributable to net-zero goals is not possible with the data available and was outside the scope of our analysis.

Why Electrification Pays Off

While higher electricity rates will increase the cost of consuming electricity at the same time households will be using more of it, households will ultimately benefit from the technological shift to electrification for three key reasons:

- **The Efficiency of Electrification.** Technologies like electric vehicles and heat pumps require significantly less energy to deliver the same performance as their fossil fuel counterparts.
- **Economies of Scale.** As electrification technologies are adopted at scale worldwide, their costs will continue to decrease while performance improves.
- **Expensive Heating Options Today.** Fossil fuels like heating oil and propane, as well as electric resistance heating, are simply expensive today. By reducing reliance on these fuels and technologies, households can achieve significant financial savings in the future.

Together, these factors more than offset the impact of rising electricity rates, leading to energy wallet savings for the majority of households.

The Efficiency of Household Electrification

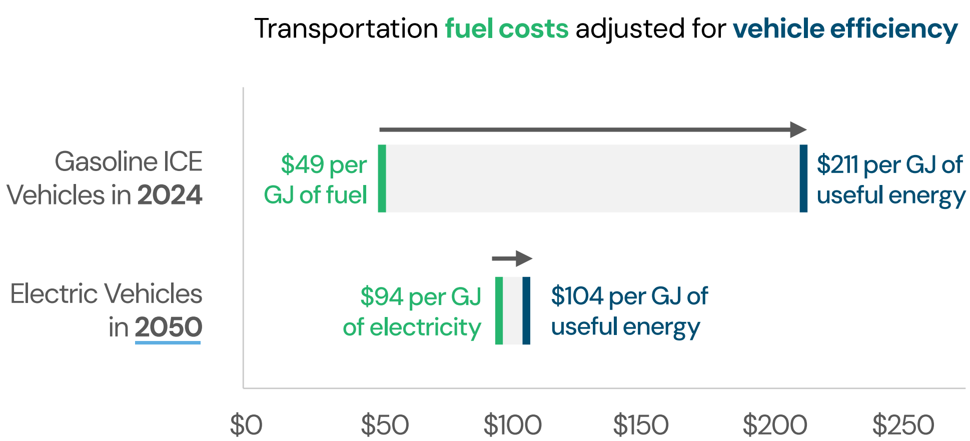
One of the main reasons we can expect energy wallet savings in a net-zero future is the remarkable efficiency of using electricity to power our vehicles and heat our homes. For example, electric vehicles convert about 90% of the electricity used to charge them into useful locomotive energy, whereas conventional internal combustion engine (ICE) vehicles only convert 20-25% of the energy in gasoline or diesel into useful energy—the rest is lost as heat.[19] While burning fuel for space heating is more efficient than using it for transportation, with gas, propane, and oil furnaces operating at 85-95% efficiency, electric heat pumps are even more efficient.[20] They can exceed 300% efficiency by transferring heat rather than generating it, delivering multiple units of heat output per unit of electricity input.[21]

[19] FuelEconomy.gov. Where the Energy Goes: Electric Cars. U.S. Department of Energy.
[20] U.S. Energy Information Administration (March 2023). Updated Buildings Sector Appliance and Equipment Costs and Efficiencies.
[21] Crownhart, C. (February 2023). Everything you need to know about heat pumps. MIT Technology Review.

Because of the superior efficiency of electric technologies, the difference in cost between electricity and fossil fuels has a smaller effect on overall energy expenses, often resulting in financial benefits. To illustrate this point, Figure 5 compares the average fuel cost of an energy-equivalent amount of gasoline in 2024 and electricity in 2050 to power a vehicle, both before and after adjusting for vehicle efficiency.

For gasoline, the average cost at the pump is $49 per gigajoule (GJ)—approximately $1.70 per litre. However, when adjusting for the efficiency of a typical ICE vehicle, the effective cost rises to $211 per GJ of locomotive energy, equivalent to about $7.31 per litre. In contrast, electricity purchased at the meter in 2050 under the Mid rate scenario is nearly double the pump price of gasoline in 2024. However, thanks to the efficiency advantage of electric vehicles, **the cost to power an EV in 2050 is less than half the cost of fuelling a gasoline vehicle today**.

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).

Economies of Scale

As countries around the world shift toward electrifying their economies, the cost of electricity-using technologies is expected to decrease due to mass production and technological advancements. As more electric vehicles, heat pumps, and other electrification technologies are manufactured and deployed at scale, production efficiencies improve, supply chains mature, and competition increases—resulting in lower costs. This widespread adoption will also drive innovation and increase competition, improving performance while reducing prices, making these technologies more accessible and affordable over time.

For example, our analysis assumes that, by 2050, battery electric vehicles will cost approximately the same as equivalent ICE vehicles today. This is a conservative estimate as EVs are likely to reach cost parity by the 2030s and may have the potential to become less expensive to purchase than ICE vehicles.[22] Once electric vehicles reach cost parity without subsidies, the primary impact on energy wallets will come from reduced fuelling costs, along with additional savings from lower maintenance requirements, as electric vehicles generally require less upkeep than ICE vehicles.[23] For heat pumps, our analysis assumes that upfront costs decline by 25% as both installation and equipment manufacturing costs decline driven by increased demand leading to manufacturing and supply chain efficiencies, as well as increased competition reducing profit margins across the value chain.[24]

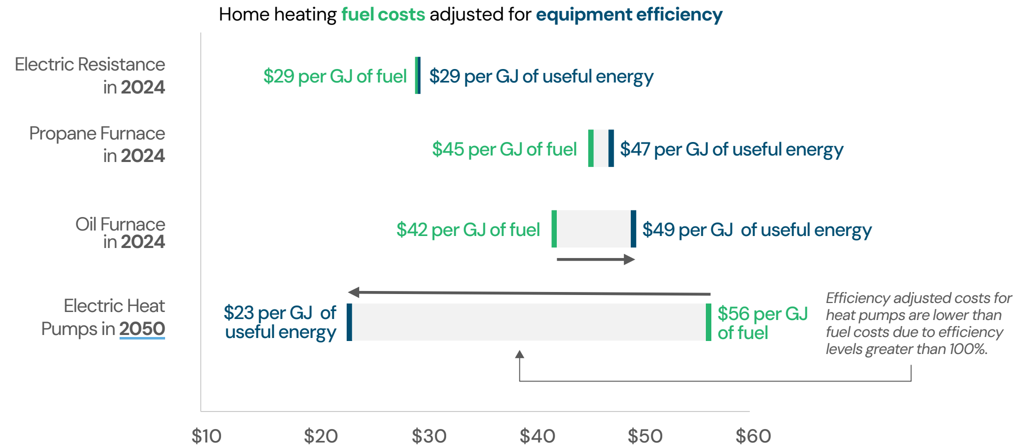
Expensive Heating Options Today

The final reason electrifying household energy needs can generate financial gains in a net-zero future is that many of the heating options we use today are simply expensive. The clearest examples are fuel oil and propane, and electric resistance heating for space heating. Households using electric resistance heating, which is currently used for approximately 25% of residential space heating, are projected to see 89% of households achieve energy wallet savings by 2050 under the Mid-rate scenario.[25] While fuel oil and propane are used by a smaller share of households, representing only about 6% of residential space heating, our analysis shows that every household currently heating with oil and nearly every household (98%) heating with propane will see energy wallet savings by 2050.[26]

Figure 6 illustrates this point by comparing the average fuel costs for oil, propane, and electric resistance-based heating systems in 2024, as well as heat pump-based systems in 2050, both before and after adjusting for system efficiency. As shown, the energy-equivalent cost of oil and propane is higher than heating with electric resistance today, meaning households using these fossil fuels could save on energy costs by switching to electricity—even with less efficient electric resistance heating. By 2050, although the energy-equivalent cost of electricity under the Mid rate scenario is projected to be higher than oil and propane today, **the efficiency of heat pumps makes electricity cost less than half as much to heat a home compared to oil or propane**.

[22] Our analysis estimates that by 2050, a battery electric car will cost 3% less than an equivalent internal combustion engine (ICE) car today, and a battery electric truck will only cost 1.5% more than a comparable ICE truck. **These assumptions likely understate potential EV cost improvements** as the assumption is based on EV price projections for 2033 as cited in the regulatory analysis for proposed federal Zero Emission Vehicle regulations. We conservatively assume no further cost improvements occur by 2050.
[23] U.S. Department of Energy, Alternative Fuels Data Center. Maintenance and Safety of Electric Vehicles.
[24] Delta Energy & Environment Ltd (October 2021). What is the potential for cutting the cost of an installed heat pump?
[25] Natural Resources Canada (2021). Comprehensive Energy Use Database – Residential Sector, Canada, Table 10: Space Heating Secondary Energy Use by System Type
[26] Natural Resources Canada (2021). Comprehensive Energy Use Database – Residential Sector, Canada, Table 10: Space Heating Secondary Energy Use by System Type

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).

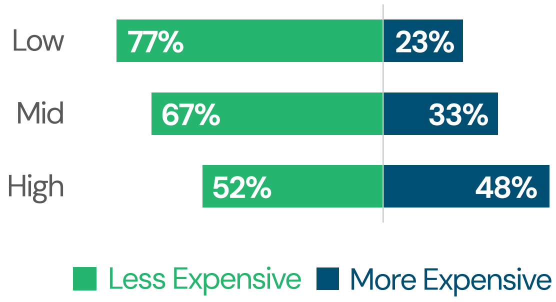
Some Households Will Need Support to Enjoy Savings

While a majority of households will experience energy wallet savings under the full range of electricity rate scenarios, a significant portion of households will see increases in their energy wallet costs relative to today, absent mitigating supports or other policy interventions. Figure 7 shows the percentage of households with more or less expensive energy wallets across the Low, Mid, and High-rate scenarios. Under the Low and Mid scenarios, 23% and 33% of households experience higher energy wallet

[27] Natural Resources Canada (2021). Comprehensive Energy Use Database – Residential Sector, Canada, Table 32: Heating System Stock Efficiencies

costs, respectively. This proportion rises to 48% of households under the High rate scenario, where nearly half of all households could face increased energy costs.

Figure 7. Percent Households with More and Less Expensive Energy Wallets by Rate Scenario in 2050



In the absence of mitigating policies and support, nearly one-quarter to one-half of households will experience **increasing energy wallets** in 2050 relative to today.

Regardless of rate scenario, the households experiencing worsening energy wallets tend to belong to at least one of the following two groups:

- Households that do not own and regularly drive a personal vehicle, and
- Households that currently heat their homes with natural gas and reside in regions with high projected 2050 electricity rates.

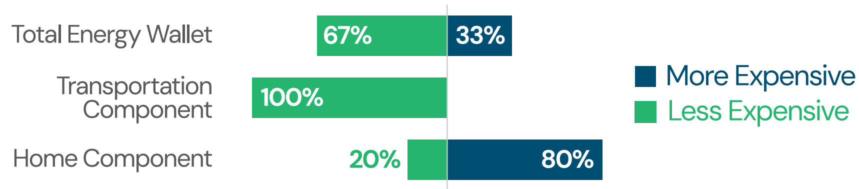
Households Without a Vehicle

Under the Mid-rate scenario, 81% of households without a personal vehicle experience increasing energy wallets relative to only 25% of households with a vehicle. Household energy wallets account for the costs of heating, cooling, and powering the home, as well as private transportation. When disaggregating energy wallet costs into home and transportation components, we find that transportation consistently delivers significant savings for those households with personal vehicles. In every rate scenario, 100% of households that regularly drive a personal vehicle will save money on their private transportation costs. This is due in part to anticipated declines in EV costs, which are expected to reach price parity with ICE vehicles by 2050 at the latest as previously discussed. When combined with substantial fuel and maintenance savings, electrifying personal transportation offers clear financial benefits for households that drive regularly.[28]

In contrast, the home component of household energy wallets is less favorable in the absence of mitigating policies and actions, with 80% of households experiencing rising home energy costs under the Mid-rate scenario (Figure 8). For households that do not own or regularly use private transportation, the impact on energy wallets is more pronounced because there is no transportation component to offset increases in the home component.[29] These households, typically located in dense urban areas where alternatives like walking, biking, and public transit are more viable, have smaller energy wallets overall since they avoid vehicle purchase, maintenance, and fuel costs.

[28] Clean Energy Canada (April 2022). The True Cost.
[29] It should be noted that households without a vehicle do often have transportation related costs that are not reflected in the energy wallet analysis (e.g., public transit costs).

Figure 8. Energy Wallet Costs by Component (Mid Rate Scenario)



Several factors contribute to the challenges in the home component of energy wallets:

» **First**, the efficiency advantage of EVs compared to ICE vehicles is much more pronounced than the efficiency gains of heat pumps over conventional heating systems. ICE vehicles convert 25% or less of gasoline or diesel energy into useful power, with the rest lost as heat. In contrast, EVs convert around 90% of the electricity used to charge them into useful locomotive energy, making them nearly four times more efficient than ICE vehicles. This drastic efficiency gain translates into significant transportation cost savings for households switching to EVs.

In comparison, while heat pumps are more efficient than conventional heating options like gas furnaces or electric resistance heating, the efficiency gains are less dramatic. Natural gas furnaces already operate at efficiencies above 95%, and electric resistance heating is 100% efficient. Heat pumps are projected to have an average weighted efficiency across Canada of roughly 250% for space heating by 2050, meaning they are about 2.5 times more efficient than a typical gas furnace. While this efficiency advantage reduces household energy costs, it does not lead to the same level of savings as switching from an ICE vehicle to an EV.

» **Second**, our study assumes the gap in costs between heat pumps and conventional options will narrow but not entirely close even by 2050.[30] The complexity of heat pumps—due to features like variable-speed compressors and sophisticated control systems—will likely limit the extent of cost reductions, maintaining a price premium that exerts upward pressure on household energy wallets. This price premium, however, is limited by cost savings for homes that have or would have installed an air conditioner since heat pumps provide space cooling.

» **Third**, the home component of household energy wallets includes the electricity required for appliances, lighting, and other uses beyond space conditioning and hot water. Our analysis assumes that non-space conditioning and water heating electricity consumption remains constant through 2050, although it will likely change with efficiency improvements and the adoption of new electricity-consuming technologies decreasing and increasing electricity consumption, respectively. As electricity rates rise, this component of the energy wallet also grows, exacerbating the financial burden on households.

[30] Delta Energy & Environment Ltd (October 2021). What is the potential for cutting the cost of an installed heat pump?

Households with Low Gas Rates Today and High Electricity Rates in 2050

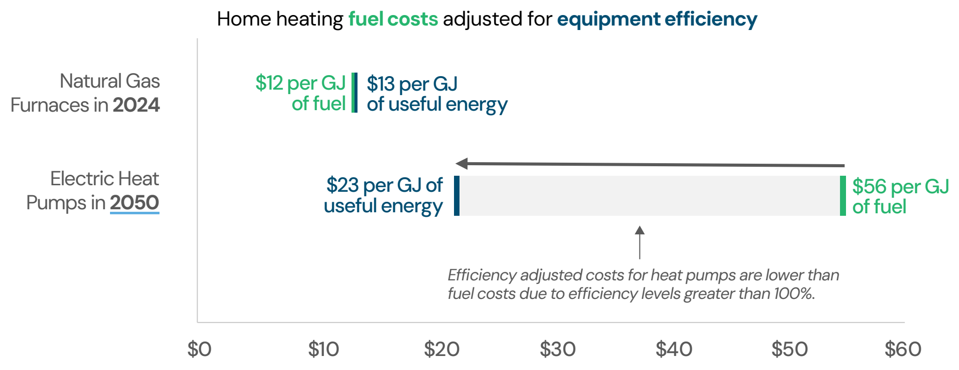
Under the Mid-rate scenario, slightly over half of households that heat with natural gas today experience increasing energy wallets in 2050. These households, however, are concentrated in provinces with the highest projected average electricity costs.

Significant regional differences in electricity rates exist today, and these differences persist in 2050 in our analysis. Provinces with high current electricity costs, such as Alberta and Saskatchewan, are expected to remain among the highest-cost jurisdictions. In these regions, nearly every household heating with natural gas today will face higher energy wallets in 2050, as savings from electrifying transportation are outweighed by increased home energy costs.

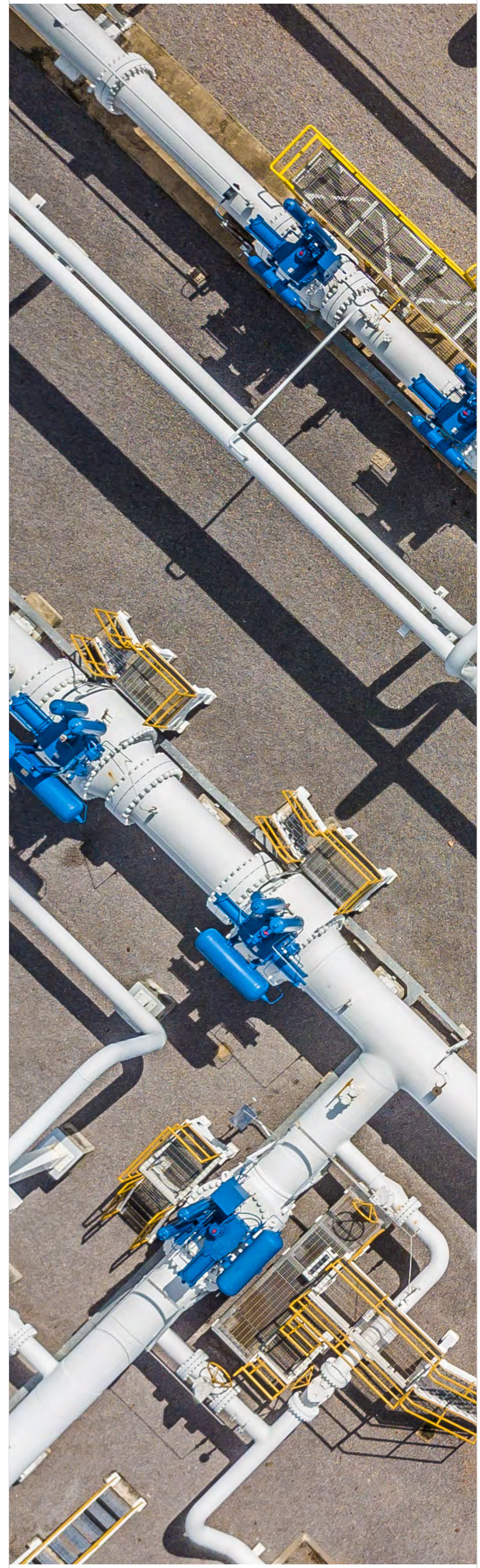
In provinces like British Columbia and Ontario—where natural gas is also widely used for heating but projected electricity rates are not as high—the picture is more mixed. While many households heating with natural gas will see increasing energy wallets in these provinces, our analysis suggests that the majority of natural gas heating households will still experience overall energy wallet savings.

It is undeniable that heating with natural gas is one of the least expensive options for consumers today when they do not bear the full environmental cost. This creates a challenging baseline when considering a switch to alternative heating options, which are generally more expensive relative to this standard. Today, the weighted average cost of natural gas delivered to households is approximately $12 per GJ. With the efficiency of a typical natural gas furnace (96%), the efficiency adjusted cost increases to $13 per GJ. This is still significantly below the efficiency adjusted cost of electric heat pumps in 2050 as shown in Figure 9.

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).

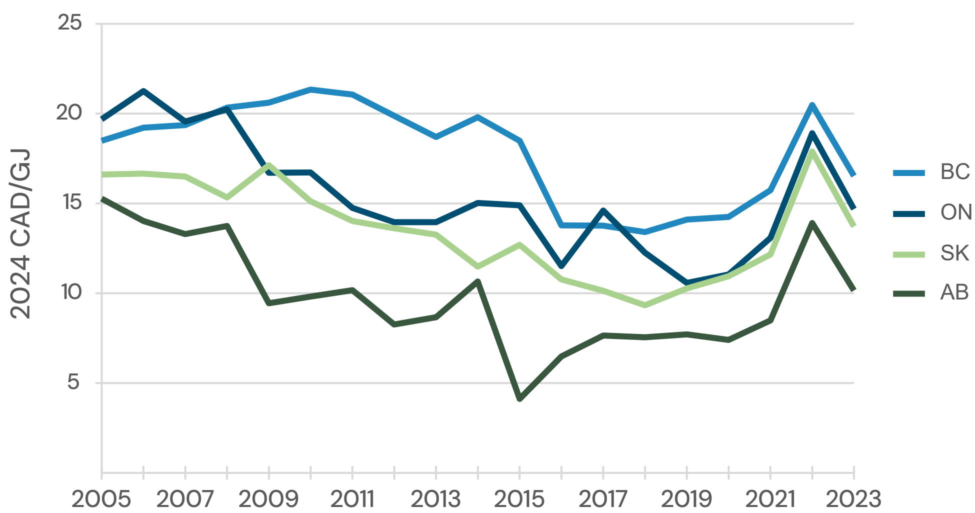


[31] Natural Resources Canada (2021). Comprehensive Energy Use Database – Residential Sector, Canada, Table 32: Heating System Stock Efficiencies

While heating one's home with natural gas is cheap for households today, it does not necessarily follow that it will be cheap in the future. The affordability of natural gas is partly due to historically low prices in 2024. Although recent years have seen price increases driven by rising commodity costs and higher carbon pricing, average residential natural gas prices are still 16% to 25% lower today than their peak levels over the last two decades in British Columbia, Alberta, Saskatchewan, and Ontario—the provinces with the highest proportion of households relying on natural gas for heating (Figure 10).

While current natural gas prices are a challenging baseline for our energy wallet analysis, there is no certainty these prices will stay low in the future. In fact, **any credible pathway to net-zero is likely to lead to rising natural gas prices for consumers** whether through explicit policies like carbon pricing or the need for more expensive measures to offset emissions, such as direct air capture. Additionally, as electrification increases, the reduced utilization of the natural gas distribution system will raise delivery costs, as the fixed costs of maintaining the system are spread over fewer consumers, further driving up prices.[32] For these reasons, maintaining natural gas for home heating at today's levels is generally not considered a viable large-scale solution in a net-zero economy.

Figure 10. Average Residential Delivered Natural Gas Prices



Source: Canada Energy Regulator – Canada's Energy Future 2023 (adjusted to 2024 $CAD).

Vulnerable Households Will Be the Most in Need of Supports

Lower-income households, which have the least capacity to absorb additional energy costs, are expected to face greater challenges in adopting electrification technologies. These households are often less able to afford the upfront costs of electric vehicles,

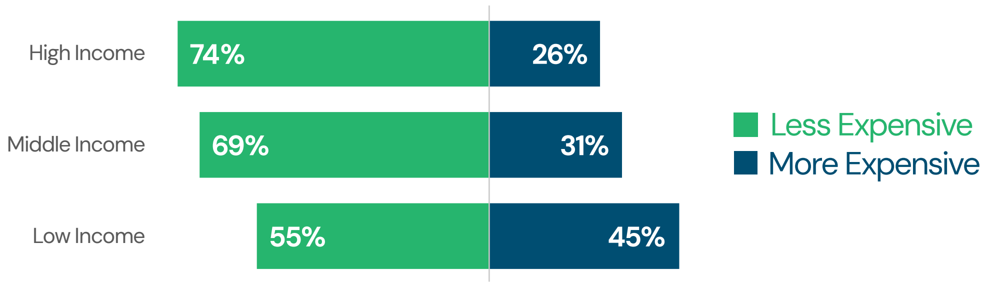
[32] Canadian Climate Institute. (2024). Heat Exchange – How today's policies will drive or delay Canada's transition to clean, reliable heat for buildings.

heat pumps, or energy-efficient home retrofits, even when government rebates or incentives are available. Furthermore, the potential savings from electrification may not be realized quickly enough to outweigh the financial barriers they face.

While national data stratifying household archetypes by income level is limited, we can use data from Statistics Canada to examine differences in personal vehicle ownership across income groups.33 By accounting for this characteristic, our analysis shows that a larger proportion of low-income households experience increasing energy wallets relative to higher income groups. Under the Mid-rate scenario, for example, 45% of households in the lowest income quintile have more expensive energy wallets relative to only 26% of households in the highest income quintile (Figure 11). This is primarily due to their inability to benefit from the cost savings associated with electrified personal transportation.

However, it's important to note that even though low-income households are more likely to face rising costs, a majority of these households will still experience energy wallet savings under the Mid-rate scenario. This demonstrates that while targeted support is essential, electrification can still provide financial benefits for most low-income households.

Figure 11. Energy Wallet Impacts by Income Level (Mid Rate Scenario)



While low-income households that do not own a personal vehicle generally have smaller overall energy wallets, they are still highly sensitive to changes in their relative energy costs. Without the potential savings from personal transportation electrification, even moderate increases in home energy costs—such as heating or electricity—risk impacting their financial well-being absent supports.

[33] Statistics Canada. Survey of Household Spending, Public Use Microdata File

Energy Burdens for Indigenous Households

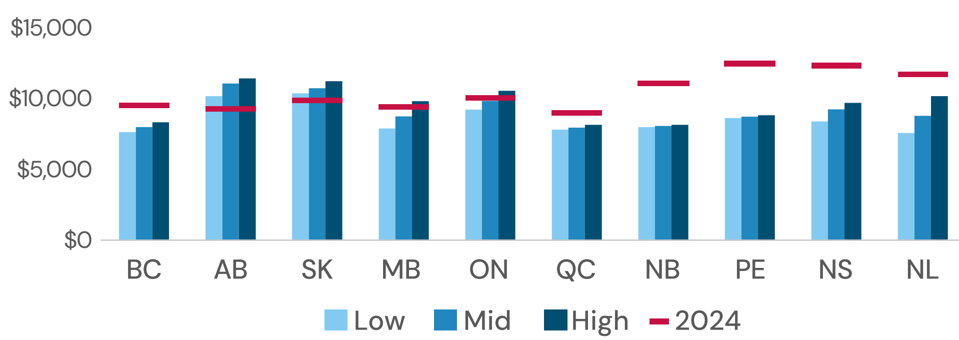
Due to data limitations, our analysis does not distinguish between the energy wallet costs of Indigenous and non-Indigenous households. However, it is reasonable to conclude that Indigenous households will face similar, if not more acute, challenges in realizing the potential financial benefits of an electrified future as low-income households in general.

For example, First Nation households are significantly more likely to require major repairs compared to non-Indigenous households.[34] These existing disparities in housing quality can directly compete with or hinder the adoption of electrification technologies such as heat pumps, as urgent needs like ensuring homes are safe and healthy take priority over upgrading heating systems. Addressing these housing challenges is essential for enabling Indigenous households to fully participate in and benefit from the transition to a net-zero economy.

Provincial Differences in Energy Wallet Impacts

The combination of heating with natural gas today, exposure to high future electricity rates, and (to a lesser degree) not regularly driving a personal vehicle leads to varying aggregate impacts at both the provincial level and across different income groups. Figure 12 illustrates the median annual energy wallet cost in each province in 2024 and 2050 across all rate scenarios.[35] While households experience energy wallet savings in most provinces across all rate scenarios, this is not true for all regions.

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



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

[34] Statistics Canada. (2023). Study: Housing experiences and well-being among First Nations people living off reserve, Métis and Inuit, 2018.

[35] The annual monthly energy wallet cost represents the average annual expenditure on energy (e.g., fuel or electricity), as well as the amortized costs of personal vehicles, HVAC equipment, and water heaters, including the necessary maintenance expenses.

The following key observations highlight these regional differences:

- In the **Atlantic provinces** (NB, PE, NS, and NL), households see the largest reductions in energy wallets, as households in this region currently have some of the highest energy costs, providing more room for savings. Most households here rely on expensive heating systems like oil and electric resistance, with limited access to natural gas.[36] Additionally, gasoline prices are typically higher in these provinces, making the switch to electric vehicles particularly advantageous. This is an encouraging finding, as the provinces that benefit most from energy wallet savings are also those with some of the highest rates of energy poverty today.

- **British Columbia** and **Quebec** also experience energy wallet savings across all rate scenarios, though to a lesser extent than the Atlantic provinces due to the lower prevalence of high-cost oil heating. These savings are primarily driven by relatively low electricity rates compared to other regions.

- In **Ontario** and **Manitoba**, the median household experiences energy wallet savings under the Low and Mid-rate scenarios but faces slight increases under the High-rate scenario. These provinces have high reliance on natural gas for home heating, which contributes to the energy wallet increases under higher rate scenarios.

- Finally, **Alberta** and **Saskatchewan** are the only provinces where the median household experiences energy wallet increases across all rate scenarios. This outcome is driven by several factors: both provinces currently have some of the lowest fossil fuel costs and the highest rates of natural gas heating in the country. Additionally, they are projected to have some of the highest electricity rates by 2050. These combined factors make it challenging for households in Alberta and Saskatchewan to achieve energy wallet savings absent support and other policy intervention when benchmarked against today's costs. While their current energy wallets are among the least expensive in Canada, their highly electrified energy wallets in 2050 are expected to be among the largest due to the projected high electricity rates. However, it is important to note that even under the High-rate scenario, the median household in these provinces will still pay less than the median household in most Atlantic provinces today.

To provide additional context, Figure 13 shows the median energy wallet as a proportion of **current median after-tax income** in each province for 2024 and 2050. The changes from 2024 to 2050 reflect the patterns discussed above but also reveal several notable insights:

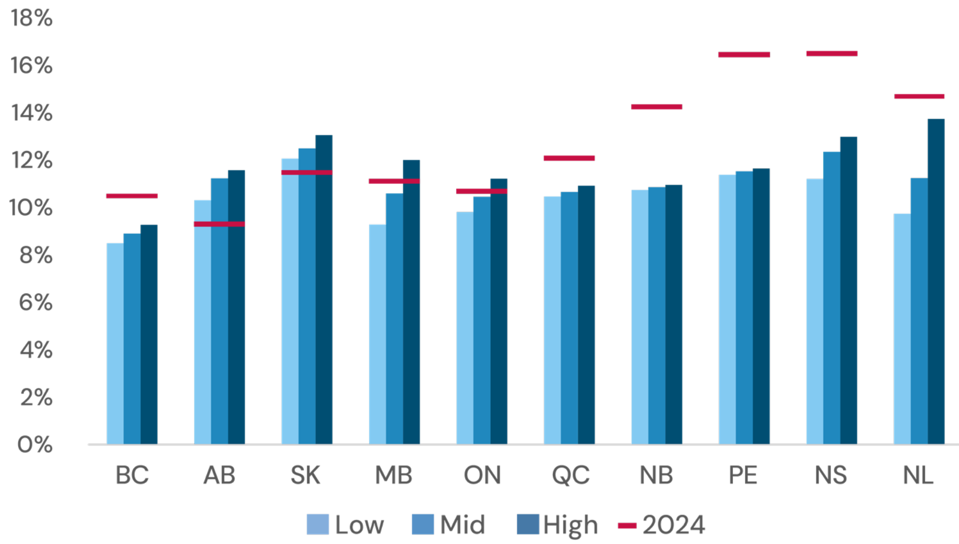
- **Atlantic Provinces**: The proportion of after-tax income allocated to household energy wallets declines substantially in the Atlantic provinces, with 3.4% to 4.8% of after-tax income freed up under the Mid rate scenario—representing some of the largest provincial declines. However, despite these significant reductions, the Atlantic provinces, which have the highest energy wallet burdens in 2024, remain among the provinces with the highest burdens in 2050, although the gap narrows considerably.

[36] 2024 retail rates for gasoline and heating oil are sourced from Statistics Canada Table 18-10-0001-01; 2024 retail rates for natural gas are sourced from Table 25-10-0059-01. Retail electricity rates for 2024 were derived from a variety of sources including utility financial reports, regulatory reports, and www.energyhub.org

» **Alberta**: The portion of after-tax income allocated to the energy wallet increases across all scenarios for Alberta, resulting in an additional 1.1% to 2.7% of after-tax income spent on energy. In 2024, the median Albertan spends less on their energy wallet as a percentage of after-tax income than households in any other province. However, by 2050, as Alberta's median energy wallet increases while those in most other provinces decline, Alberta moves to the middle of the pack, ranking 4th or 5th in terms of the smallest energy wallet as a proportion of income compared to other provinces.

» **Saskatchewan**: In 2024, the median household in Saskatchewan allocates 11.8% of their after-tax income to their energy wallet, placing them in the lower half of provinces in terms of energy wallet costs. However, by 2050, even though this proportion increases by less than two percentage points under the highest rate scenario, it is enough to shift Saskatchewan into the upper half of provinces, where households spend a larger share of their income on energy wallet costs.

Figure 13. Median Energy Wallet in 2050 as Percentage of After Tax Income



Note: Energy wallet costs in 2050 are compared to 2024 median after tax income.

Importantly, this comparison uses current median incomes as a reference point, even though long-term trends typically show real incomes rising.[37] As a result, this likely overstates the portion of income that energy wallets will occupy in 2050, since incomes are expected to be higher than they are today.

[37] Canada Mortgage and Housing Corporation (July 2024). Real Average Before-Tax Household Income by Quintiles.

Tools for Improving Energy Affordability

While our analysis does not account for the range of proactive measures that can reduce financial impacts on household energy wallets, many steps can—and likely will—be taken to mitigate these effects. These strategies, which include managing household energy consumption, leveraging technological advancements, and implementing targeted measures to address rate increases, can help soften the financial challenges that some households and regions may face. The remainder of this section discusses these strategies in more detail.

Managing Energy Consumption

In an electrified future, households can reduce their utility bills—and potentially their overall energy wallets—by managing their energy consumption through energy efficiency and behavioural changes. With **energy efficiency**, households can lower energy use for space conditioning, water heating, and other needs by buying or renting higher-performing homes, upgrading building envelopes, and adopting efficient appliances and lighting. 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, but if energy efficiency is pursued aggressively, the impact on household energy use could be significant.

Assuming households in 2050 benefit from 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, average household energy bills in 2050 could be reduced by 15-17% relative to our baseline assumptions in this analysis.[38]

While achieving these savings will typically involve upfront costs that may offset some of the savings, most energy-consuming equipment is expected to become more efficient compared to today's options without significant additional costs. The main exception is retrofitting existing building envelopes, where costs can be substantial and vary widely depending on the building. In some cases, retrofits may be cost-effective, while in others, they may not make financial sense. If envelope improvement savings—accounting for roughly half of the estimated 15-17% bill reductions—are excluded, the proportion of households with increasing energy wallets under the Mid-rate scenario drops by nearly one-third, from 33% to 25%.

In addition to adopting energy efficient technologies, households can also manage their energy costs through **behavioural changes**. In the short term, households can achieve incremental savings by adjusting energy-use habits, such as setting

[38] To estimate energy efficiency savings, we assume households adopt 100% LED lighting, low-flow water fixtures, drain water heat recovery systems in new homes, and electric appliances matching the efficiency levels of today's most efficient models. For envelope improvements, we assume half of existing homes perform deep retrofits and new homes are built to more stringent standards resulting in 40% reductions in heating loads. Please see the accompanying Technical Report for more details.

more efficient default temperatures for heating and cooling or reducing hot water usage. These behaviour changes can be encouraged through feedback mechanisms like Home Energy Reports, which compare a household's energy use to that of its neighbors and typically reduce consumption by 1-2%.[39]

In the longer term, changes in urban planning and infrastructure could provide households with significant opportunities to reduce their energy wallets, especially in transportation. Expanding and enhancing public transit and biking infrastructure could lessen the need for personal vehicle ownership, enabling households to further reduce their energy costs.

Government policies and programs can support households in managing their energy wallets by promoting energy efficiency, encouraging behavioural changes, and offering alternative transportation options. Building codes, equipment standards, and efficiency programs can drive energy savings, while investments in public transit and biking infrastructure reduce the need for personal vehicles, helping households lower costs and energy use.

Alternative Technological Options

Our analysis assumes households decarbonize by adopting air source heat pumps (standard or cold-climate models, as appropriate) and electric-powered storage water heaters (either electric resistance or heat pump models). While this approach uses full electrification as a proxy for the costs consumers might face in achieving economy-wide net-zero emissions by 2050, we do not anticipate that all household energy needs will be met solely through electrification.

In reality, households are likely to decarbonize using a mix of both electric and non-electric technologies. For personal transportation, EVs are expected to be the dominant technology, but alternatives such as hydrogen fuel cell vehicles may be optimal in niche cases.[40] For home heating, air source heat pumps are likely to play the most dominant role in Canada's building decarbonization efforts.[41] However, due to the country's cold climate and the prevalence of non-electric heating options, other technologies may also play key roles, including:

- **Ground source heat pumps.** These systems offer higher efficiency than air source heat pumps, especially in colder climates, resulting in lower operating costs and longer lifespans. However, they require significant upfront investments and may not be feasible for all properties. Unlike air source heat pumps, they maintain high efficiency even in very low outdoor temperatures, which can significantly reduce their contribution to peak electricity demand.[42]
- **Alternative net-zero fuels.** Fuels like hydrogen or renewable natural gas can be useful where electrification is less practical or cost-effective, though they come with challenges. Hydrogen requires net-zero production methods (e.g., electrolysis or carbon capture), the adoption of H2-compatible heating equipment, and substantial upgrades to or build out

[39] IEA (2021). The Potential of Behavioural Interventions for Optimizing Energy Use at Home.
[40] IEA (2023). Global EV Outlook 2023: Catching up with Climate ambitions.
[41] Poirier, M. and Cameron, C. (2023). The Case for Building Electrification in Canada.
[42] HRAI (2020). The Economic Value of Ground Source Heat Pumps for Building Sector Decarbonization.

of H2 distribution systems, while renewable natural gas faces feedstock limitations and supply constraints that could drive up costs.[43]

- **Thermal energy networks.** These systems, which can be powered by waste heat as well as electric-based heating systems, distribute heating and cooling through shared infrastructure, offering the potential to reduce individual household costs. They are particularly viable in areas with higher population density, where buildings are closer together, but require more coordination among market actors for effective implementation.[44]

Beyond these alternatives, some households may also turn to technologies that allow them to produce and use their own electricity. are becoming increasingly cost-effective, and with the potential for higher electricity rates, self-supply could become a viable option if the levelized cost of onsite generation and storage is lower than the marginal cost of grid electricity.[45] The viability of self-generation depends on factors such as the ability to site equipment and utility rate structures, which can affect the realized value of self-supply systems.

Despite their challenges, alternative technologies may be more affordable for some households than the fully electrified options modelled in this analysis, especially in provinces where future electricity rates are expected to be high. Importantly, the value of these alternatives will be heavily influenced by the interaction between electrification and electricity costs. For instance, while air source heat pumps may offer financial benefits individually, their widespread adoption—especially when paired with electric resistance backup systems—could increase demand on the grid, driving up rates and diminishing those benefits. Conversely, technologies like onsite generation and storage could reduce system costs, easing rate pressure for everyone.[46] Thus, alternative technologies, despite their challenges, may improve the overall cost-effectiveness of the net-zero transition by mitigating system-wide costs and preventing rate increases, as explored in the next section.

Mitigating Increasing Electricity Costs

Our analysis estimates potential changes to residential electricity rates that could result from developing electricity systems aligned with the needs of a net-zero economy in 2050. It assumes that the modelled electricity system transformation pathways and associated costs are passed entirely to ratepayers.[47]

These studies generally assume that infrastructure projects will be built optimally—without excessive permitting delays, supply chain disruptions, or other inefficiencies. Therefore, it is essential to work toward a system that minimizes these issues to manage the cost of the electricity system buildout. Making it less expensive to build infrastructure through streamlined permitting,

[43] Jan Rosenow (2023). A meta-review of 54 studies on hydrogen heating. Cell Reports Sustainability.
[44] Canadian Climate Institute. (2024). What's the deal with thermal energy networks?
[45] Canada Energy Regulator (2023). Market Snapshot: Residential Solar is Financially Viable in Some Provinces and Territories, but Not in Others.
[46] Electric Power Systems Research (2024). Valuing distributed energy resources for non-wires alternatives.
[47] The only notable exceptions are adjustments made to include costs for transmission and distribution (T&D) expansion and maintenance, where these were not explicitly accounted for in the original model outputs, and the inclusion of federal investment tax credits for clean electricity infrastructure, which reduce the capital costs borne by ratepayers for certain technologies built through the mid-2030s.

loan guarantees, supply chain improvements, and other means can help reduce the capital costs required for net-zero electricity systems. This is particularly crucial for future electricity costs, as our rate analysis shows that the cost structure will become increasingly capital-intensive over time.

Our analysis also assumes that households in 2050 do not bear any costs related to legacy energy systems they no longer directly use, such as the natural gas distribution system. However, as energy consumption patterns shift on the pathway to net-zero, there is a risk of the gas distribution system becoming a stranded asset, with revenues from remaining users insufficient to recover the capital costs of building the system. If this occurs, and all or part of the stranded costs are passed on to former gas consumers or households through taxes, it could harm household energy affordability. It is therefore crucial that governments plan for this transition and incorporate the risk of stranded gas assets into their decision-making.

Balancing Cost and Indigenous Reconciliation Commitments

Managing the cost of the electricity system buildout will be a complex task, requiring a careful balance with other societal priorities such as Canada's commitment to Indigenous reconciliation. Grid expansion presents an opportunity to advance Indigenous reconciliation through Indigenous ownership and partnerships in electrification projects. **This priority must always be considered when pursuing potential cost reductions for ratepayers**. As emphasized by the First Nations Major Project Coalition's *National Indigenous Electrification Strategy*, focusing solely on maintaining low rates risks "undermining Indigenous ownership in electricity assets" and, consequently, undermining reconciliation efforts. Ensuring Indigenous ownership, partnership, and adherence to the principle of free, prior, and informed consent (FPIC) is essential to an equitable and sustainable energy transition.

However, there are several strategies not well represented in our analysis or the modelling studies it draws from that could be implemented to reduce upward pressure on retail electricity rates. These strategies include:

- **Optimize the System:** There are many opportunities to optimize the electricity system beyond current designs, which can reduce the amount of infrastructure that needs to be built and improve the system's overall efficiency. Methods such as increasing inter-regional transmission, grid modernization and rate design can enhance system performance and flexibility, ultimately reducing the costs needed to deliver reliable power.[48] These opportunities are often not fully represented in many modelling analyses, including the ones leveraged in this study, which means they may not capture the full potential of system-wide optimization strategies. Pursuing these optimizations in practice could lead to lower costs than those estimated in this analysis, benefiting ratepayers.
- **Demand-Side Management:** In addition to directly reducing household costs, demand-side management (DSM) has significant potential to reduce system costs by optimizing consumption across existing infrastructure. Measures such as energy efficiency, demand response and flexibility, rate design, and beneficial electrification can help lower peak demand and reduce the need for costly new infrastructure, thereby alleviating upward pressure on electricity rates.[49] Notable examples include Ontario's Peak Perks program, which adjusts smart thermostats for participating customers during peak electricity demand periods, and HydroQuébec and Énergir's dual-energy offer, which incentivizes customers to electrify while using gas heating only during peak demand hours.

  While DSM solutions are represented to some degree in the modelling studies used in this analysis, they are often underrepresented, as they are assumed components rather than explicitly modelled strategies. In reality, as electricity rates face upward pressure, the value of DSM will likely grow, making a stronger case for investing in these solutions than current models suggest. Procuring additional DSM resources in practice could further help manage system costs, increasing affordability as we transition to a more electrified future.

Reducing overall system costs is the most sustainable approach to protecting energy affordability in an electrified future and should be prioritized. Implementing these cost-reduction strategies can help keep electricity rates down, benefiting households across the board. However, even with these measures, it is unlikely that all negative impacts can be fully mitigated for every household.

For some, particularly vulnerable groups, there may still be increases in energy wallets despite efforts to lower system costs. In these cases, tools that shift costs—either from ratepayers to taxpayers or from those who cannot easily afford them to those who can—may be necessary to protect households from the most acute financial burdens. Some possible tools include:

[48] IEA. (2019). Status of Power System Transformation 2019 – Power System Flexibility.
[49] Efficiency Canada (2024). Canada Electricity Advisory Council Recognizes the Demand Side.

Supporting the deployment of technology via:

- **Public Investment in Electricity Systems:** Investment tax credits and other mechanisms could lower the capital costs of building the electricity system, ultimately reducing the burden on ratepayers. This would be particularly beneficial in provinces where high infrastructure costs could lead to substantial rate increases. Public investment can also help distribute electricity costs more fairly, since paying through taxes tends to place less financial strain on lower-income households compared to covering costs solely through electricity bills.50
- **Subsidizing Equipment Costs:** Consumer rebates, similar to those offered by existing federal and provincial programs, could be expanded to offset the costs of purchasing energy-efficient appliances and electrification technologies like electric vehicles and heat pumps. Income-tested supports could make electrification more affordable for lower-income households, particularly those facing high upfront costs.

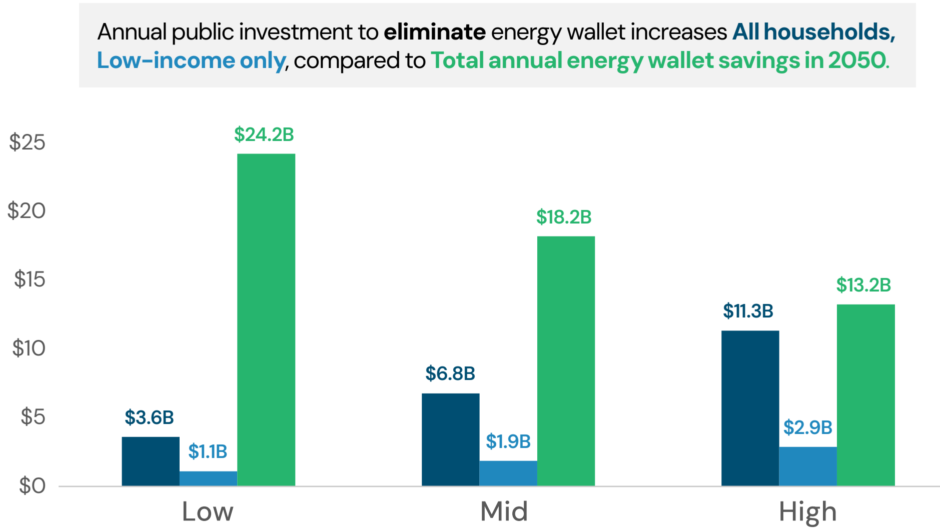
Providing direct rate relief via:

- **Directly Reducing Electricity Bills:** Exempting electricity bills from sales tax, for instance, could lower the final cost of electricity by 5-15%, providing immediate relief for all households, especially those in lower-income brackets.[51]
- **Innovative Rate Designs:** Rate structures could be reformed to redistribute costs more equitably among ratepayers. For instance, means-tested rates or designs that favour lower levels of consumption could reduce the energy burden on low-income households and those more vulnerable to rising costs.[52]

The cost of financial support would depend on the type and scope of the subsidy. To provide insight into the magnitude and feasibility of such supports, Figure 14 shows the estimated annual public investment required to eliminate all energy wallet increases, both nationally and for households in the lowest income quintile, in the absence of any mitigating actions to reduce costs discussed above. These figures are compared to the total energy wallet savings projected for households that experience cost reductions.

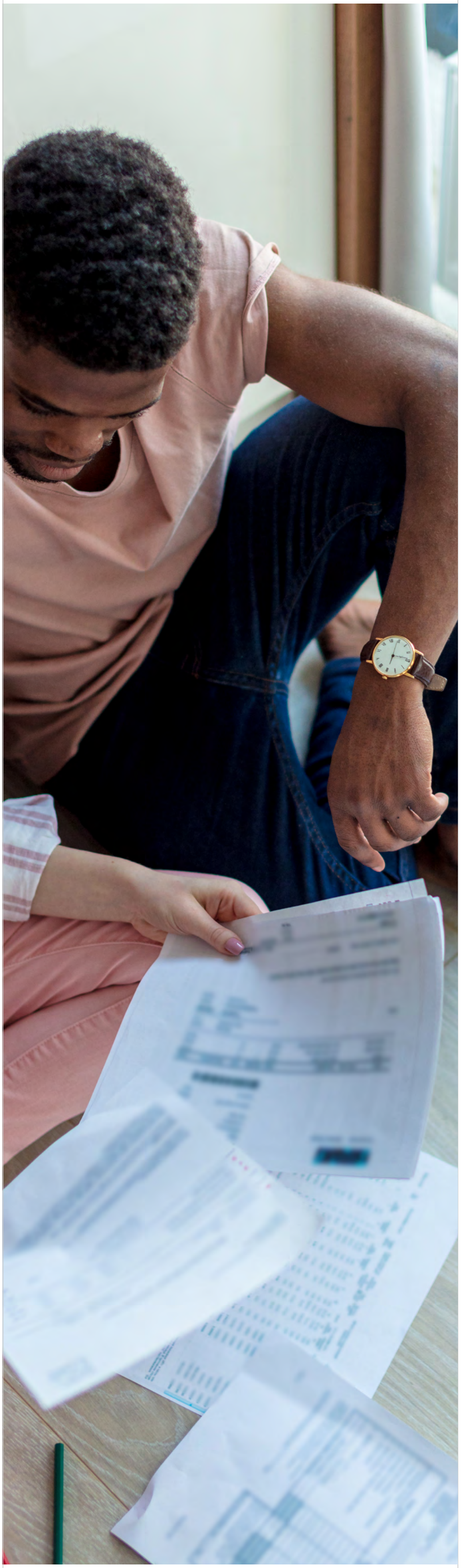
[50] Government of Canada (June 2024). Government of Canada Launches the First Clean Economy Investment Tax Credits. Natural Resources Canada.
[51] Such an action has already been pursued by British Columbia, which removed PST from electricity bills and heat pump purchases, both of which benefit the energy wallets of British Columbians.
[52] Trabish, H. K. (November 2020). Rate design innovations are boosting the energy transition. Smart Cities Dive.

Figure 14. Estimated Annual Public Investment Needed to Eliminate Energy Wallet Increases vs. Total Savings ($B)



This illustrative example demonstrates that under the lower-rate scenarios, annual financial supports representing less than half of the savings enjoyed by households with reduced energy wallets would be enough to eliminate all negative impacts for households facing increased costs. Even under the high-rate scenario, the required subsidies approach, but do not exceed, the total savings accrued by other households. When financial supports are targeted specifically at low-income households, the required funds represent only a small fraction of the potential aggregate savings. In other words, **the savings created by the energy transition are more than sufficient to offset any negative impacts on those vulnerable to increased costs**.

While reducing overall system costs is the ideal pathway to maintaining affordability, additional financial tools can ensure that the most vulnerable households are not left behind. With thoughtful implementation of both cost-reduction strategies and targeted support, Canada can ensure a fair transition to a net-zero future, protecting affordability for all households.



Conclusion

As Canada works toward its net-zero goals, the shift to a highly electrified economy presents both opportunities and challenges for households. Our analysis shows that this technological shift can yield energy wallet savings for most households but also highlights that not all households will benefit equally. With proactive policy and strategic interventions, negative impacts can be mitigated, ensuring a fair and equitable transition for all Canadians.

Good News for Most Canadian Households

A highly electrified net-zero future holds the potential for energy wallet savings for most households across Canada—improving energy affordability. Addressing climate change and protecting affordability are two critical challenges, and our analysis shows that both can be tackled at the same time. While electricity rates may face upward pressure as we build electricity systems that align with our net-zero goals, these increases can be offset by the efficiency gains from electrification—especially in transportation and heating—resulting in overall savings for the majority.

Moreover, households with the largest energy wallets today are likely to see the biggest savings. For instance, households in the Atlantic provinces, which face some of the country's highest energy costs due to the prevalence of heating oil and higher costs for fuels like gasoline, could see significant reductions in their energy burdens. This presents a unique opportunity to alleviate energy poverty in regions currently experiencing the highest levels of financial strain.

Ensuring Fairness in the Transition

Not all households will see these benefits from this technological transition if we do not take mitigating actions. Some, particularly in provinces with high use of low-cost natural gas and higher projected electricity rates in 2050, will face rising energy wallets. The geographic concentration of these impacts poses a risk to public and provincial government support for the net-zero transition. Ensuring that no region is disproportionately burdened will be essential to maintaining broad political backing for the transition.

Lower-income households are especially vulnerable. With a higher proportion of households without vehicles, they miss out on transportation savings from electrification, and many face greater challenges in upgrading their homes for energy efficiency.

Action is both necessary and feasible. The cost savings from the energy transition can be sufficient to counterbalance any negative impacts on vulnerable households. Addressing both real and perceived affordability challenges is vital for maintaining public trust. Without targeted supports, public backing for the transition could wane, delaying the progress needed to meet climate targets.

Strategic Action for Affordable Electrification

We are not powerless. Proactive policies and programs can mitigate negative impacts. By improving energy efficiency, supporting alternative technologies, and taking action to mitigate increasing electricity costs, we can ensure households benefit from the energy transition. Governments and decision-makers must prioritize electrification as part of Canada's net-zero strategy, keeping energy affordability central. A highly electrified future offers clear benefits to Canadian households.

Collaboration between provincial and federal governments will be essential. Geographic differences in energy wallet impacts underscore the need for coordinated efforts to achieve affordable electrification nationwide. Through cooperation, the benefits of a net-zero economy can be more equitably distributed, ensuring energy affordability is improved across the country.

Finally, ongoing research and analysis will be crucial to identifying the most effective policy tools for addressing affordability challenges. By continuing to explore new strategies, Canada can ensure that the pathway to net-zero is both effective and equitable. The solutions exist—it's time to use them.

ELECTRIFYING CANADA

AN INITIATIVE OF THE TRANSITION ACCELERATOR