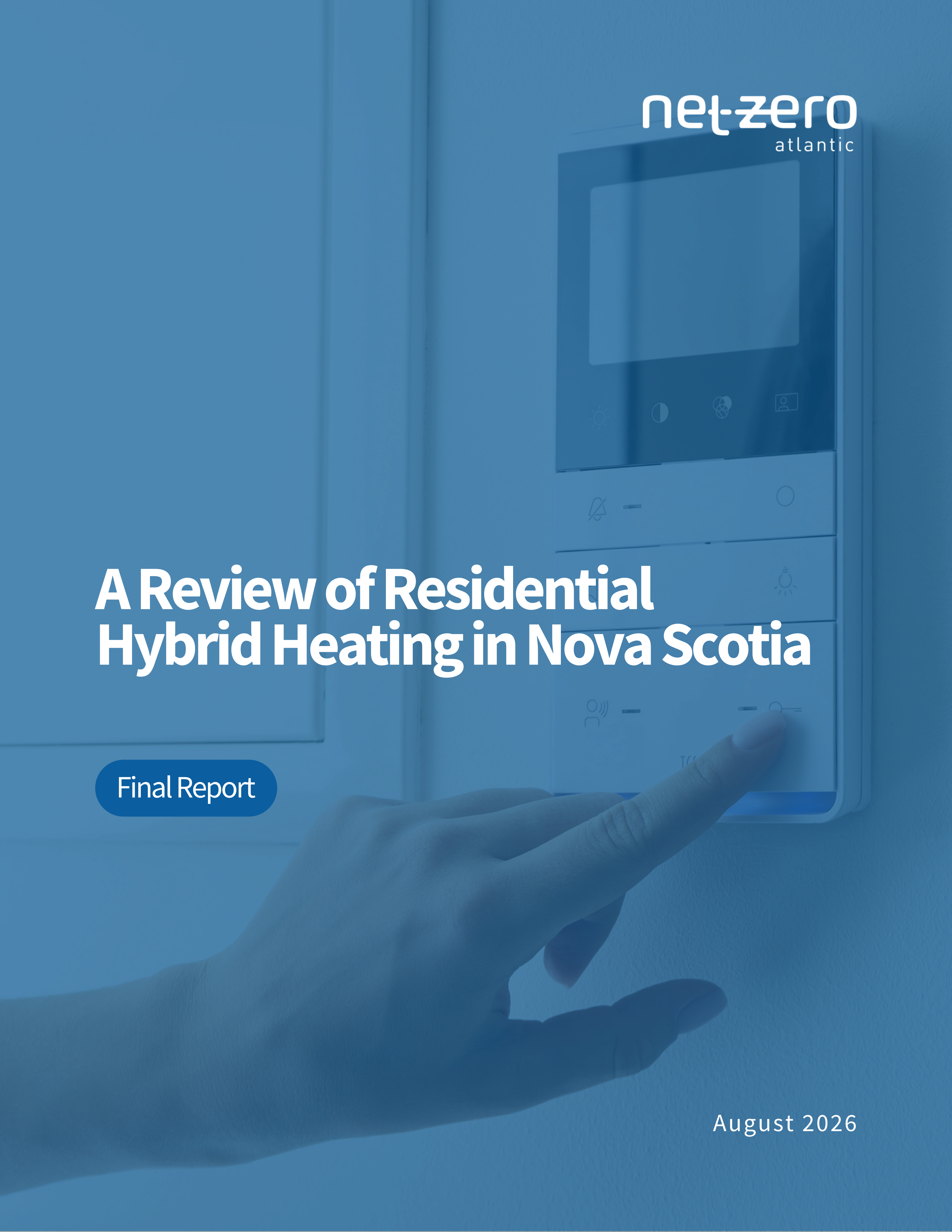

# A Review of Residential Hybrid Heating in Nova Scotia

Final Report

August 2026

# ACKNOWLEDGEMENTS

The Review of Residential Hybrid Heating in Nova Scotia is a research project developed and led by Net Zero Atlantic. The research was conducted in collaboration with technical and sector experts and draws on modelling, jurisdictional analysis, stakeholder engagement, and customer survey research to assess the potential role of hybrid heating in supporting peak demand management.

This project is led and managed by Net Zero Atlantic, with major funding provided by the Province of Nova Scotia. We are also grateful for the additional in-kind support and collaboration provided by Nova Scotia Power, the Independent Electricity System Operator of Nova Scotia (IESO-NS), and EfficiencyOne.

**Letter from Net Zero Atlantic**

Net Zero Atlantic is pleased to present the findings from the Review of Residential Hybrid Heating in Nova Scotia. This study represents an important step in understanding the potential role of hybrid heating systems in managing winter electricity peak demand.

The final report brings together insights from a jurisdictional scan, stakeholder engagement, electricity system modelling, and a customer survey to identify key considerations and design implications for a a residential hybrid heating program.

We would like to thank our project partners and funders for their support of this work, as well as the utilities, and subject-matter experts who shared their time and expertise through interviews and technical discussions. Their contributions were critical in grounding this assessment in real-world program experience.

We also extend our appreciation to the Nova Scotia Power Customers Advisory Panel who participated in the survey. Their feedback provides valuable insight into awareness, interest, and preferences related to hybrid heating, and helps inform possible program design and communication needs.

The findings of this assessment provide a foundation for future discussion and decision-making related to hybrid heating in Nova Scotia, including program design considerations, customer engagement approaches, and alignment with broader demand-side management and decarbonization efforts. Net Zero Atlantic looks forward to continuing to support stakeholders as they explore options to advance reliable, affordable, and low-carbon heating solutions.

Thank you for your interest in this work. For more information, please visit our website to explore related research or to contact us with any questions.

Ryan Keating, Project Manager
Sven Scholtysik, Research Director
Net Zero Atlantic

# Executive Summary

## Context and Opportunity

Nova Scotia has committed to achieving net-zero greenhouse gas (GHG) emissions by 2050, phasing out coal-fired electricity generation, and achieving 80% renewable electricity generation by 2030. One of the province's most pressing challenges is how to decarbonize the building sector, which accounts for 14% of provincial GHG emissions[1], while also supporting overall grid stability during the coldest hours of the year, when energy demand peaks. While heat pumps (HPs) are an energy-efficient solution for heating most of the year, converting all homes to electric heating would place a considerable burden on the electrical grid and lead to costly infrastructure upgrades. To make steady progress while minimizing infrastructure investments, the province could consider interim or transitional approaches that balance emissions reduction objectives, affordability, reliability, and electricity system needs.

Hybrid heating systems could help reduce the impact of increasing electrification on the electrical grid. This kind of system pairs electric heating systems, generally HPs, with backup fuel systems, such as oil, propane, or natural gas. When paired with an existing fossil fuel system, hybrid configurations can reduce GHG emissions by relying primarily on electrical systems supplied by renewable energy, while switching to back-up fuel only on the coldest hours of the year, when electricity demand is highest and heat pump performance declines. As, hybrid heating systems still rely on fossil fuel infrastructure they should be seen as a transitional or interim solution rather than an end-state solution for building sector decarbonization. In this context, hybrid heating may support continued electrification while extending the use of existing fossil-fuel heating systems in a more limited backup role during the transition toward a lower-carbon energy system.

In Nova Scotia, a hybrid heating program could reduce the winter peak, helping to mitigate some generation and transmission infrastructure investments. Electricity system modelling undertaken as part of this study suggests that hybrid heating could reduce peak demand and defer future capacity additions under certain participation and dispatch assumptions. The high-adoption hybrid heating scenarios evaluated in this study achieved modeled peak reductions of approximately 77 MW by 2040 and reduced the need for new combustion turbine and battery storage capacity relative to the Base Case.

Learnings from this project are informed by, a jurisdictional scan, power system modelling, a customer survey, and supporting analyses. Together, these components help build an understanding

1 Government of Canada, C. E. R. (2024, September 10). Provincial and Territorial Energy Profiles - Nova Scotia. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nova-scotia.html#:~:text=GHG%20Emissions,-Nova%20Scotia%27s%20GHG&text=Nova%20Scotia%20emissions%20per%20capita,14%25%20(Figure%206)

of how hybrid heating has been approached in other jurisdictions, how it may perform under Nova Scotia system conditions, and how customers may respond to different program design considerations.

Importantly, the findings of this project are not intended to promote hybrid heating as a predetermined or preferred solution. Rather, they are intended to support a balanced, evidence-based assessment of hybrid heating as one of several potential tools that could be considered within the broader context of demand side management (DSM), strategic electrification (SE), rate-based demand response (DR), emissions reduction, and energy system planning in the province.

## Study Purpose and Approach

This project was undertaken to improve the understanding of residential hybrid heating within the Nova Scotia context. The study combined:

1. A jurisdictional scan of hybrid heating programs;
2. Customer research exploring awareness, interest, motivators, and barriers related to hybrid heating participation; and
3. Electricity system modelling assessing potential impacts on winter peak demand under different adoption and control scenarios.

The study also considered broader program development and regulatory considerations relevant to Nova Scotia’s evolving DSM and electricity planning environment.

The scope of this study is intentionally bounded. It does not seek to finalize program rules, incentive levels, eligibility criteria, program costs, or governance arrangements, nor does it evaluate hybrid heating as a substitute for other peak mitigation strategies. In line with the project proposal, the study is designed to inform a potential decision gate, after which stakeholders could determine whether further work or expanded stakeholder engagement is warranted.

## Jurisdictional Findings

The jurisdictional review demonstrated that hybrid heating programs are already being implemented across several jurisdictions in Canada, the United States, and Europe. Common characteristics identified across jurisdictions include:

- Use of HPs as the primary heating source with fossil-fuel backup during peak periods;
- A range of switching approaches, including manual operation, temperature-based controls, and utility-dispatched DR events;

- Automated controls being more commonly applied in homes with central (ducted) heating systems;
- Integration with broader DSM, SE, and DR strategies;
- Financial incentives, including rebates for HPs and related equipment, as well as rate structures designed to encourage switching during peak demand periods; and
- Increasing interest in hybrid heating as a tool to support SE, manage peak electricity demand, and in some jurisdictions support continued utilization of existing fossil fuel infrastructure.

## Customer Research Findings

Customer survey results indicate moderate interest in hybrid heating participation among Nova Scotia residents, with interest increasing as respondents received additional information regarding potential benefits.

Following an initial explanation of the concept, 39% of respondents indicated willingness to enrol, increasing to 61% after learning more about potential benefits. 32% of respondents indicated they already maintain a non-electric backup heating system and would continue to do so as part of a hybrid heating program, while an additional 11% indicated willingness if incentives were available.

Financial savings were identified as the strongest participation driver, while concerns related to comfort, complexity, continued fossil fuel use, and system control represented key barriers. Respondents generally preferred automated temperature-based switching approaches over direct third-party control of heating systems.

## Modelling and System Findings

Three hybrid heating program scenarios were evaluated using PLEXOS capacity expansion and production cost modelling:

- Program Scenario 1 - A temperature-triggered program with high adoption (50% of households converting from fossil fuel heating to electric heating retain and participate in a hybrid heating configuration);
- Program Scenario 2 – A critical peak event-based program, modelled after NS Power’s Critical Peak Pricing (CPP) program, with high adoption (50%) and;
- Program Scenario 3 - A smaller critical peak event-based program focused on homes with existing central fossil-fuel heating systems with low adoption. (12.3% of households

converting from fossil fuel heating to electric heating retain their central heating system and participate in a hybrid heating configuration[2]).

The modelling suggests that hybrid heating programs could reduce winter peak electricity demand and defer certain electricity system infrastructure investments under specific assumptions. The two high participation program scenarios represented estimated program capacities of up to 139 MW by 2040, where program capacity refers to the estimated residential heating load reduction available through participating hybrid heating systems. These high participation program scenarios resulted in modeled peak demand reductions up to 77 MW, reducing future combustion turbine and battery storage requirements. The smaller event-based program achieved a modeled peak demand reduction of approximately 34 MW by 2040 and primarily reduced battery storage requirements. Across all scenarios, levelized capacity benefits, representing the value of avoided firm capacity requirements needed to meet peak demand and reserve margin requirements, were estimated at $184–$207/kW-year. Levelized avoided energy costs, representing the average avoided electricity supply costs during periods when hybrid heating reduces system load, were estimated at $77–$141/MWh, depending on program design and participation assumptions.

The modelling also indicated that larger hybrid heating programs may experience diminishing returns as future system peaks shift outside targeted event periods. While the scenarios evaluated suggest that a program sized somewhere between the low- and high- participation scenarios evaluated may provide a more balanced relationship between program capacity and actual peak demand reduction. While smaller hybrid heating programs can provide system benefits, avoiding or deferring new generation capacity investments would likely require hybrid heating to either scale to a capacity comparable to a new generation resource (approximately 50 MW) or contribute alongside other DR programs.

The modelling also highlighted important trade-offs between temperature-triggered and event-based program designs. Temperature-triggered approaches may provide sustained load reductions during extended cold-weather events but can also result in backup heating operating during lower-value hours when system demand is lower or renewable generation is more readily available, increasing backup fuel use and GHG emissions. In contrast, event-based approaches can more precisely target periods of highest system value, reducing unnecessary backup fuel operation, but may provide less support if future reliability risks extend beyond predefined event windows. Recent Effective Load Carrying Capability (ELCC) analysis prepared for the Independent Energy System Operator Nova Scotia (IESO NS) provides additional context for interpreting these trade-offs. The analysis indicates that conventional short-duration DR can face limitations when reliability risks extend beyond a four-

2 The 12.3% case represents a more targeted “central systems only” scenario, where participation is limited to homes with forced-air central heating systems. Based on E1’s energy audit data from 2020 to 2026, approximately 61.4% of audited non-electric homes fell into this category. Applying a 20% participation assumption to this subset results in an effective participation rate of approximately 12.3% across the broader non-electric heating customer segment.

hour event window[3]. Hybrid heating differs from conventional short-duration DR because it may be capable of providing sustained winter load reductions over extended cold-weather events, provided that backup heating can maintain customer comfort with a reliable fuel supply. These findings suggest that future hybrid heating programs may benefit from flexible control strategies that balance reliability value, efficient use of renewable electricity, backup fuel consumption, and GHG emissions rather than relying solely on conventional short-duration DR event designs.

The GHG screening results indicate that net emissions impacts vary by program design, ranging from an estimated increase of 170 $ktCO_2e$ to a reduction of 434 $ktCO_2e$ over the 2028–2050 period. The event-based high-adoption program produced the most favourable GHG result because it limited backup oil operation to targeted event hours, while the temperature-triggered program had higher backup fuel use. For context, Nova Scotia's total GHG emissions were approximately 13.6 $MtCO_2e$ in 2023[4], meaning the cumulative impact of the scenarios is modest at the provincial scale but still relevant for comparing program designs. These results suggest that the timing and duration of hybrid heating events are important factors in determining net GHG outcomes.

Lastly, developing program delivery costs and evaluating cost-effectiveness was not in scope for this study. The evaluation of both program delivery costs and cost-effectiveness are led by EfficiencyOne (E1) for incentive-based programs and Nova Scotia Power for rate-based programming. Therefore, these program scenarios and modelling results provide only an indication of the technical potential relevant to the Nova Scotia residential market.

## Key Considerations and Next Steps

Nova Scotia's electricity planning environment continues to evolve through ongoing DSM planning activities and the transition toward the IESO NS. Within this context, hybrid heating remains one of several potential approaches that warrants continued evaluation as part of broader discussions related to winter peak demand management, electrification, affordability, and electricity system reliability.

At present, hybrid heating is not included as a dedicated program within E1's filed 2027–2031 DSM Plan. However, hybrid heating concepts continue to be considered analytically within broader DSM potential studies and integrated resource planning (IRP) activities.

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[3] Independent Energy System Operator Nova Scotia (IESO-NS). (2026, May). 2026 Nova Scotia Electric System ELCC Study. https://ieso-ns.ca/wp-content/uploads/2026/05/2026-Nova-Scotia-Electric-System-ELCC-Study.pdf

4 Government of Canada, C. E. R. (2024, September 10). Provincial and Territorial Energy Profiles - Nova Scotia. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nova-scotia.html#:~:text=GHG%20Emissions,-Nova%20Scotia%27s%20GHG&text=Nova%20Scotia%20emissions%20per%20capita,14%25%20(Figure%206)

The findings of this study suggest that hybrid heating may offer potential benefits under certain conditions, including reduced winter peak demand growth, deferred infrastructure investments, and increased flexibility during the transition toward greater building sector electrification. Hybrid heating systems may also provide a transitional pathway that allows existing heating infrastructure to continue operating in a more limited backup role, potentially reducing premature retirement of existing equipment while enabling reductions in fossil fuel consumption through primary reliance on electric heating systems.

Important uncertainties remain regarding long-term customer participation and backup system retention, program cost-effectiveness, future fuel prices, the pace of electrification and winter peak demand growth, regulatory treatment and funding pathways, emissions impacts, and long-term alignment with provincial decarbonization objectives.

Based on the findings of this work, the following actions are recommended:

1. Continue evaluating hybrid heating within E1's DSM activities and IESO Nova Scotia's IRP processes. Future work should focus on program designs capable of supporting extended-duration deployment, as the ability to sustain load reductions beyond conventional four-hour DR events may represent a key advantage of hybrid heating relative to other residential DR options.

2. Project partners should continue monitoring developments in other jurisdictions and working collaboratively to build a shared understanding of the opportunities, limitations, and potential role of hybrid heating in Nova Scotia. Particular attention should be given to program cost-effectiveness, program funding pathways, program delivery, and alignment with Nova Scotia's electricity system and decarbonization objectives.

3. Consider a pilot-scale demonstration to assess operational performance, customer participation, and program delivery considerations under Nova Scotia conditions prior to broader deployment. A pilot could help determine whether hybrid heating events, including longer-duration events, can be delivered reliably without unacceptable customer comfort impacts, while also providing evidence on program cost-effectiveness, customer response, contractor requirements, backup fuel use, and monitoring and verification needs. Implementation of such a pilot would require the identification of appropriate funding sources.

If a Hybrid Heating program is pursued the following items should be considered:

4. Consider hybrid heating control strategies that balance reliability benefits, emissions outcomes, and efficient utilization of available renewable electricity generation.

5. Consider how Nova Scotia's housing stock, heating fuel mix, customer preferences, and electricity system needs may influence future hybrid heating program design. Given the

diversity of residential heating configurations, a single program design is unlikely to be suitable for all customers. Automated control approaches may be best suited to homes with existing central heating systems, while manual or customer-confirmed approaches may be more appropriate for homes with ductless heat pumps or other non-central heating configurations.

6. Consider developing a customer education and engagement strategy as part of any future program design. Clear communication will be needed to explain program requirements, expected savings, backup fuel use, customer responsibilities, available incentives, and the role of hybrid heating within broader electrification and emissions reduction efforts.

Overall, the findings of this study are intended to support informed, evidence-based discussion regarding the potential role hybrid heating could play within Nova Scotia's evolving energy transition and electricity system planning landscape.

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# 1. Introduction

Nova Scotia is committed to reaching net-zero emissions by 2050. Achieving that goal requires sustained progress in decarbonizing the building sector, which in 2022 produced 14 % of provincial GHG emissions and consumed 43 % of all end-use energy[5]. Electrification, such as replacing gas or oil furnaces with high efficiency HPs, can lower emissions. However, converting non-electric heating systems to electric heating systems increases winter peak demand on the electrical grid, driving the need for generation, transmission, and distribution upgrades.

To reconcile climate objectives with grid realities, this work focuses on hybrid (sometimes referred to as “dual-fuel” or “dual-energy”) heating, a configuration in which an electric heating system handles most of the annual heating needs while a back-up fuel system (e.g. oil, propane, or natural-gas) fires only during the coldest hours of the year, when HP efficiency declines and demand on the electricity system approaches periods of highest capacity utilization across generation, transmission, and distribution. Early studies examining the impacts of electrification on electricity system load undertaken by Energy and Environmental Economics Inc. (E3) for Nova Scotia Power suggested that province-wide adoption of hybrid heating systems could reduce winter peak electricity demand while still achieving emissions reductions under the assumptions in place at the time[6]. This project builds on that earlier analysis by considering updated assumptions, data, and system conditions within the current provincial context.

This project brings together several project components focused on hybrid heating programs and their relevance to the Nova Scotia context. The sections that follow include: (1) a jurisdictional scan of hybrid heating programs in other regions, (2) customer research to understand awareness, interest, and decision drivers, (3) electricity system modelling to assess potential system-level impacts, and (4) program development considerations.

The jurisdictional scan reviews how other jurisdictions have designed, incentivized, and administered hybrid heating programs. The customer research and modelling build on this context to explore how hybrid heating could interact with customer behaviour and provincial energy system conditions. Program development considerations draw on findings from across the project, as well as Nova Scotia's evolving DSM, regulatory, and electricity planning environment.

The findings of this project are not intended to promote hybrid heating as a predetermined or preferred solution. Rather, they are intended to support a balanced, evidence-based assessment of

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5 Government of Canada, C. E. R. (2024, September 10). Provincial and Territorial Energy Profiles - Nova Scotia. https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nova-scotia.html#:~:text=GHG%20Emissions,-Nova%20Scotia%27s%20GHG&text=Nova%20Scotia%20emissions%20per%20capita,14%25%20(Figure%206)

6Mettetal, L., Levine, M., Spencer, S., & Olson, A. (2023, October). The Economics of Electrification in Nova Scotia. Energy and Environmental Economics. https://www.ethree.com/wp-content/uploads/2023/12/E3_NS-Power_Electrification-Report.pdf hybrid heating as one of several potential tools that could be considered within the broader context of DSM, DR, emissions reduction, and energy system planning in the province.

## 1.1 Background

Nova Scotia's electrical grid is winter peaking, meaning hourly demand for electricity reaches its annual maximum on the coldest mornings and evenings when lighting, appliance use, and existing electric heating coincide. Since available generation and transmission lines and distribution infrastructure must all be sized to meet the coincident peak, even a modest increase in electrical demand during those hours can drive disproportionate infrastructure costs. Recent system data highlights the scale of anticipated peak demand growth. Nova Scotia Power's 2026 Load Forecast reports a recent high actual system peak of 2,455 MW in 2023 and forecasts peak demand to increase to 2,730 MW by 2035[7].

A previous study examining the impacts of electrification on electricity system load, undertaken by E3, provides important context for this project. In a scenario where all fossil-fuel and electric resistance-heated buildings are converted to all-electric air-source heat pumps (ASHPs), E3 found that current-performance heat pumps could increase coincident peak demand by more than 1,000 MW by 2050.

Hybrid heating can help mitigate that risk by shifting energy demand back to the home's non-electric system during the coldest hours. In the same analysis by E3, modelling with a hybrid heating system using mini-split heat pumps, configured to switch over to the fossil-fuel system at −1 °C while continuing to operate the heat pump, showed the buildings sector's incremental non-coincident winter peak in 2050 dropped from an increase of 1,160 MW to an increase of 436 MW under the same 1-in-2 weather year. The economic signals pointed in the same direction in the E3 study. E3 noted that the adoption of dual-fuel systems presented positive net benefits for homeowners, ratepayers, and the province[8.]

More recently, Nova Scotia Power has completed piloting of a CPP residential rate. Under this pilot, customers receive a lower electricity rate outside of the winter period, while higher electricity prices are applied during forecast "critical peak" hours, limited to the winter period between November 1 and March 31, to encourage load reductions during peak periods. Critical peak events may be called on multiple days per week during the winter (up to eighteen weekday events and up to three weekend events per year), with advance notice provided to enable voluntary load adjustments. CPP is intended to provide customers with a price-based signal to shift or reduce consumption when the system is most constrained, thereby contributing to peak reduction without direct control of customer

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7 Nova Scotia Power Inc. (2025, June 27). 2025 Load Forecast Report. Nova Scotia Energy Board.

8 Mettetal, L., Levine, M., Spencer, S., & Olson, A. (2023, October). The Economics of Electrification in Nova Scotia. Energy and Environmental Economics. https://www.ethree.com/wp-content/uploads/2023/12/E3_NS-Power_Electrification-Report.pdf

equipment[9]. Customers with existing hybrid heating configurations would be well positioned to respond to such price signals.

In parallel, E1 has launched Eco Shift, a residential DR program designed to test the impact of automated load adjustment on grid stability and peak demand. Eco Shift enables customers to enroll eligible connected devices that can automatically adjust their energy use during peak demand periods. Eligible devices for enrollment included smart thermostats, electric water heaters, electric vehicle (EV) telematics and chargers, and home battery storage systems that can be dispatched to reduce load or supply local load during DR events[10]. An automated hybrid heating control program could conceptually complement this existing offering.

## 1.2 Objective and Approach

The objective of this study is to develop an evidence-based understanding of the potential role of hybrid heating in managing winter peak electricity demand in Nova Scotia. The study is intended to support informed decision-making by improving the understanding of system impacts, customer behavior, and program considerations, rather than to prescribe or recommend a specific program design. To support this objective, the study focuses on four project areas.

First, the study seeks to understand how hybrid heating has been implemented in other jurisdictions. This includes reviewing program frameworks, control methods, customer segmentation approaches, incentive and rebate structures, regulatory and policy contexts, and measures of success. The purpose of this work is to identify lessons learned, implementation challenges, and design considerations that can inform subsequent analysis and discussion in the Nova Scotia context, rather than to directly replicate external programs.

Second, the study aims to improve understanding of customer perspectives in Nova Scotia through targeted data collection. This includes assessing customer awareness of hybrid heating concepts, willingness to participate in a potential program, sensitivity to financial incentives, tolerance for peak-event operation, preferences related to control and communication, and levels of opposition. The survey results are used to identify potential early participant segments, key drivers and barriers to participation, and areas where additional engagement or program clarity would be required.

Third, the study includes electricity system modelling to assess the potential impacts of a hybrid peak approach on the province's electrical system. The modelling examines how different levels of customer participation and control strategies could affect winter peak demand and related system outcomes. This analysis is intended to provide directional insight into the magnitude and shape of

9 Nova Scotia Power. (n.d.). Critical Peak Pricing pilot. https://www.nspower.ca/your-home/residential-rates/critical-peak#about-the-pilot

10 Efficiency Nova Scotia. (n.d.). Eco Shift. https://www.efficiencyns.ca/programs-rebates/eco-shift

potential system benefits and to help identify which assumptions and variables are most important for future modelling efforts.

Finally, the study explores future program development considerations related to residential hybrid heating within Nova Scotia's evolving electricity system and regulatory context. The section reviews potential institutional roles, evolving DSM and regulatory developments, and considerations that may influence future assessment of hybrid heating alongside other DSM strategies.

The scope of this study is therefore intentionally bounded. It does not seek to finalize program rules, incentive levels, eligibility criteria, program costs, or governance arrangements, nor does it evaluate hybrid heating as a substitute for other peak mitigation strategies. In line with the project proposal, the study is designed to inform a potential decision gate, after which stakeholders could determine whether further work or expanded stakeholder engagement is warranted.

# 2. Lessons from Other Jurisdictions

Completed in June 2025, the jurisdictional scan reviewed hybrid heating programs in a range of cold-climate jurisdictions across Canada, the United States, and Europe. These included pilots, nascent and mature programs, as well as evolving regulatory and market-based models. Despite differences in energy systems, housing stock, and policy landscapes, several consistent patterns emerged across programs and are discussed herein. A full copy of the jurisdictional scan is provided in Appendix A.

## 2.1. Jurisdictional Scan Objective and Approach

The primary objective of the jurisdictional scan was to develop an understanding of hybrid heating programs and to identify possible best practices, incentive and administrative models that can inform a potential solution tailored to Nova Scotia.

To build a clear picture of how hybrid heating programs work elsewhere, the jurisdictional scan was organized around seven thematic pillars.

1. Motivators
2. Program Design, Target Customers and Adoption
3. Control and Dispatch Methods
4. Incentive Structures
5. Administrative Models
6. Regulatory Frameworks
7. Key Performance Indicators and Success Metrics

The scan included a desk review of publicly available filings, evaluations, and technical guides for hybrid heating programs in comparable jurisdictions. Close to one hundred literature sources were identified for possible inclusion in this study. For each source, a preliminary review was conducted to ensure that it had adequate relevance to the topic of hybrid heating and provided relatively unbiased, high-quality information. In addition to the desk-based review, six semi-structured interviews were conducted with utility representatives, including staff from BCHydro, FortisBC, Énergir, Hydro Quebec, Manitoba Hydro, and London Hydro, to capture nuanced insights into their respective jurisdictions.

Although this methodology was fairly robust, the nature of this work still presents several limitations that should be taken into consideration. (1) Hybrid-heating programs are evolving rapidly, with many still at the pilot scale, so today's lessons may shift as initiatives mature and larger datasets emerge.

(2) Comparative findings are also highly context-dependent - fuel prices, rate structures, and regulatory frameworks differ across jurisdictions, meaning any "best practice" identified elsewhere will need careful adaptation to Nova Scotia's conditions. (3) The analysis relies on publicly available documents and interviews; internal utility data and proprietary evaluations, particularly related to program costs and operational performance, were largely inaccessible.

## 2.2. Overview of Jurisdictions Reviewed

The jurisdictions reviewed are summarized in Table 1. Jurisdictions in the In-Depth Review column were examined across most thematic pillars, whereas those in the Preliminary Review column were assessed only for select insights drawn from a subset of those pillars. Canadian jurisdictions with limited or emerging hybrid-specific programs were included in the preliminary review to capture contextual insights.

TABLE 1 - JURISDICTIONS REVIEWED

| In-Depth Review Jurisdictions | Preliminary Review Jurisdictions |
|---|---|
| Québec | Ontario |
| British Columbia | Manitoba |
| Minnesota | France |
| Wisconsin | Germany |
| Utah | Netherlands |
| | United Kingdom |

To enable a more targeted comparison, select jurisdictions were reviewed in greater detail. These jurisdictions were chosen for their relevance to Nova Scotia's climate, electricity system characteristics, and/or availability of information. Table 2 summarizes key information of the jurisdictions reviewed fully.

TABLE 2 - JURISDICTION SUMMARY

| Jurisdiction | Climate Objective | Program Maturity | Primary Objective | Control Approach | Incentive Approach | Key Relevance for Nova Scotia |
|---|---|---|---|---|---|---|
| Québec  | 37.5% GHG reduction by 2030 (vs. 1990); Net-zero by 2050; | Established | Winter peak management and emissions reduction | Automated temperature-based switching | Capital rebates and discounted dual-fuel electricity rate | Demonstrates scalable delivery, automation, and performance tracking at scale |

| | | | | | | |
|---|---|---|---|---|---|---|
| **British Columbia**  | 40% GHG reduction by 2030; 80% GHG reduction by 2050 (vs. 2007) | Pilot / early rollout | Emissions reduction with emerging peak benefits | Customer-based smart thermostat control | Capital rebates | Highlights contractor-driven delivery and commissioning challenges |
| **Minnesota**  | 50% GHG reduction by 2030 (vs. 2005); Net-zero by 2050; | Mature | Peak demand management | Utility-controlled switchover | Discounted dual-fuel electricity rates | Shows dispatchable load control and system-level value |
| **Utah**  | No legislated GHG target; emissions reduction pursued through planning frameworks | Established | Peak management and customer cost savings | Automated temperature-based switching | Capital rebates | Example of coordinated electric and gas utility program design and incentive alignment |
| **Wisconsin**  | No legislated GHG target; Paris Agreement–aligned emissions reduction ambition | Mature | Peak demand management | Utility-controlled switchover | Discounted dual-fuel electricity rates | Technology-agnostic design |

## 2.3. Key Patterns Identified

### 1. Motivators

Across jurisdictions, hybrid heating programs are motivated by a common challenge: reducing GHG emissions from residential heating while managing constraints on electrical grids during peak periods. In many cases, hybrid systems are viewed as a first step in fuel switching, serving as a transitional strategy that supports near-term emission reductions and lays the groundwork for longer-term electrification. While the objective is shared, the design of each program reflects local conditions, such as regulatory frameworks, energy pricing, utility roles, the existing mix of heating fuels, and the need to manage legacy fossil-based infrastructure during a period of declining demand.

## 2. Program Design, Target Customers, and Adoption

Hybrid heating programs primarily target retrofits in single-family homes and small multi-unit buildings, rather than new construction. Eligibility often hinges on the presence of a compatible backup fuel system (e.g., a gas furnace) or the technical feasibility of integrating a dual-fuel configuration. Programs generally focus on central ASHPs that can share existing ductwork with a backup furnace; ductless mini-split HPs are often excluded, and air-to-water HPs remain an emerging technology in North America. Furthermore, programs generally focus on owner-occupied homes, with renters and low-income households served by parallel support mechanisms or left out altogether.

## 3. Control Methods

Three primary control approaches are used across jurisdictions:

- Manual switching by the user
- Automated switchover based on outdoor temperature thresholds
- Automated utility-controlled load interruption

Some jurisdictions are also exploring predictive or AI-based control approaches to further enhance system efficiency, though these remain at an early stage of development.

While these categories describe the control logic used to switch between electric and non-electric heating, their practical implementation is strongly influenced by the underlying heating system configuration. Hybrid heating automated control is most straightforward in homes with central, ducted forced-air systems, where a single thermostat or control interface can coordinate the HP and backup furnace.

More complex configurations, such as homes combining ductless HPs with forced-air or hydronic backup systems, require additional control integration, custom logic, or relay-based coordination to ensure reliable and safe operation. These systems are technically feasible but typically involve higher commissioning effort, higher cost, and greater reliance on installer expertise. As a result, many large-scale automated control programs prioritize ducted forced-air systems to reduce delivery risk and ensure consistent performance.

## 4. Incentives Mix

Programs typically rely on a mix of upfront and ongoing incentives, including:

- Capital (Rebate) incentives to support equipment installation (e.g., up to $20,000 in Québec, $10,000 in BC)
- Rate based structures to incentivize switching (e.g., dual-energy rates in Québec, Minnesota and Wisconsin)

Programs with well-aligned incentives and simple application processes tend to see higher adoption rates.

### 5. Administrative Structures

Administrative and delivery models vary across jurisdictions and include joint programs delivered through partnerships between electric and gas utilities (e.g., Hydro-Québec and Énergir), vertically integrated utility programs (e.g., FortisBC), and cooperative-led models (e.g., Riverland and Vernon Electric Cooperatives in Wisconsin), where local electric cooperatives administer programs under centralized regulatory oversight. Across models, program success often depends on a streamlined customer journey, strong contractor networks, and the ability to track performance in real time.

### 6. Regulatory Framework

Hybrid heating programs are enabled by regulatory frameworks that define delivery authority, rate design, cost recovery, and load management capabilities. Across jurisdictions, successful programs are supported by regulatory approval for dual-fuel or interruptible rates and clear authority for delivery organizations to manage or influence residential heating load through automated controls. In North America, these programs are typically implemented through DSM and conservation frameworks that allow the delivery organization to recover program costs and pursue fuel switching or peak management without financial penalty. In Europe, hybrid heating is more often embedded within building codes and appliance standards, providing prescriptive performance requirements and clearer operational rules. Equity considerations are generally addressed outside hybrid-specific programs, with access for renters and low-income households typically supported through parallel energy assistance or housing programs rather than within hybrid program rules themselves.

### 7. Success Metrics

Common performance metrics used to assess hybrid heating programs include program uptake, peak demand and energy reduction, GHG emissions reductions, and participant satisfaction. Some jurisdictions apply more comprehensive evaluation frameworks that assess societal, utility, and participant-level benefits.

## 2.4. Key Design Considerations from Jurisdictional Scan

Drawing on lessons from other jurisdictions, the following considerations may be relevant when designing a hybrid heating program in Nova Scotia.

### 1. Design with System-Level and Climate Objectives in Mind

Hybrid heating programs should aim to reduce winter peak load while also contributing to provincial GHG reduction targets. Program parameters, such as switchover trigger and equipment specifications, should be calibrated to Nova Scotia's climate, load profile, and fuel mix to ensure that the emissions benefits are not offset by unnecessary fuel use.

As electrification increases over time, program design should also consider the risk of creating or prolonging stranded fossil fuel heating assets. Hybrid heating programs are most effective as transitional tools when they align with anticipated equipment replacement cycles and avoid incentivizing long-lived fossil systems that may become underutilized as the electricity system decarbonizes.

## 2. Implement Fit-for-Purpose Control Systems

As outlined previously, hybrid control approaches vary in complexity and are closely tied to underlying heating system configurations. While hybrid operation is technically feasible across a wide range of systems, the level of integration effort, commissioning risk, and scalability differs materially by configuration. This is one of the main conclusions from the jurisdictional scan: the practicality of hybrid heating depends not only on the heating technology, but also on how easily the system can be controlled, verified, and operated during peak periods.

In Nova Scotia, the residential heating stock is highly heterogeneous, reflecting a mix of ducted and non-ducted homes, legacy oil and hydronic systems, and widespread ductless heat pump retrofits. This diversity limits the suitability of a single standardized control pathway across the housing stock. Different configurations present trade-offs in terms of ease of deployment, integration complexity, achievable peak reduction, and total program and participant cost.

## 3. Layer Incentives Strategically to Drive Participation

Consideration could be given to tiered incentive structures that combine upfront capital rebates to support equipment requirements with performance-based incentives or time-based electricity rates. The jurisdictional scan indicates that financial incentives are mostly paired with clear operating requirements and customer value propositions, rather than treated only as equipment rebates. Potential design elements may include early-adopter bonuses or bundling with other efficiency upgrades (e.g., smart thermostats). Such approaches could help address upfront cost barriers, particularly for middle- and low-income households, while recognizing the potential system benefits associated with peak demand mitigation.

## 4. Integrate the Program into Existing DSM Frameworks

Embedding the hybrid program into the province’s broader electricity DSM efforts promotes consistency, facilitates resource coordination, and enables tracking of cumulative impacts. Alignment with existing DSM structures can help streamline program delivery, monitoring, and evaluation.

## 5. Promote Equity through Inclusive Design

Consider program designs that are accessible to a diverse range of customers, including low-income households, renters, rural residents, and Indigenous communities. Use targeted outreach and engagement strategies in underserved areas. Consider alternative participation pathways, such as landlord incentives, financing tools (e.g., on-bill repayment), or community-based deployment models.

## 6. Establish Strong Administrative and Delivery Infrastructure

Identify a clear program administrator or coordinating body that can lead implementation, oversee partnerships, and manage data collection and reporting. Consider multi-party delivery models that leverage the strengths of utilities, third-party contractors and administrators, and community organizations to enhance efficiency and effectiveness. Build on existing contractor networks to streamline the customer journey and broaden delivery capacity. A key lesson from other jurisdictions is that program delivery depends heavily on contractor readiness, customer education, equipment compatibility, and clear roles among delivery organizations.

## 7. Define Clear KPIs and Build Evaluation into Program Design

Adopt a consistent set of key performance indicators (KPIs) from the outset, such as:

- Peak demand reduction
- Energy savings
- Total GHG reduction
- Cost-effectiveness (e.g., net benefit per dollar spent)
- Program uptake across demographics
- Customer satisfaction and persistence of participation
- Additionally, consider incorporating monitoring, reporting, and verification (MRV) systems that allow for continuous learning and improvement. The jurisdictional scan shows that established programs benefit from performance tracking that can demonstrate whether hybrid heating is delivering the intended peak, emissions, customer, and cost-effectiveness outcomes.

In the Nova Scotia context, evaluation approaches would need to align with the applicable legislative and regulatory frameworks governing DSM planning. Taken together, the scan suggests that hybrid heating program design for Nova Scotia would need to be locally tailored, with careful attention to system objectives, housing stock diversity, customer economics, control feasibility, delivery capacity, and regulatory fit.

# 3. Customer Research

The customer research was conducted using an online survey administered by Narrative Research to customers of Nova Scotia Power through its Customer Advisory Panel. Data collection took place between October 21 and October 28, 2025. A total of 2,453 survey invitations were distributed, resulting in 608 completed responses and an overall response rate of 25%. The average survey completion time was 14 minutes. A copy of the survey questions is provided in Appendix B.

As the survey was administered to an opt-in customer panel, results are not associated with a statistically defined margin of error and may reflect a higher level of engagement or interest in energy-related topics than the general customer population.

Respondents were screened to include only those who indicated they are responsible for decisions related to maintaining or replacing the primary heating system in their household. For analytical purposes, respondents who reported already having both a fossil fuel–based heating system and an electric heating system were classified as "eligible." This classification reflects existing system configurations that could more readily support hybrid heating options, rather than formal eligibility for any specific program. Regardless of existing heating configuration or classification, all screened respondents were asked to complete the remainder of the survey.

## 3.1. Survey Objective and Approach

The findings from this research are intended to inform future considerations related to potential program design and customer communication preferences. To support this, the primary objectives of the survey are to:

- Understand customer motivations, perceived benefits, and barriers to participating in a hybrid heating program;
- Assess overall willingness to participate and identify levels of opposition within the customer base;
- Estimate the financial incentive levels required to encourage adoption of hybrid heating systems;
- Explore customer preferences related to control methods and communication strategies during peak events;
- Gauge future heating system upgrade intentions, particularly among customers currently using fossil fuels; and

- Collect basic demographic and household data to support customer segmentation and analysis.

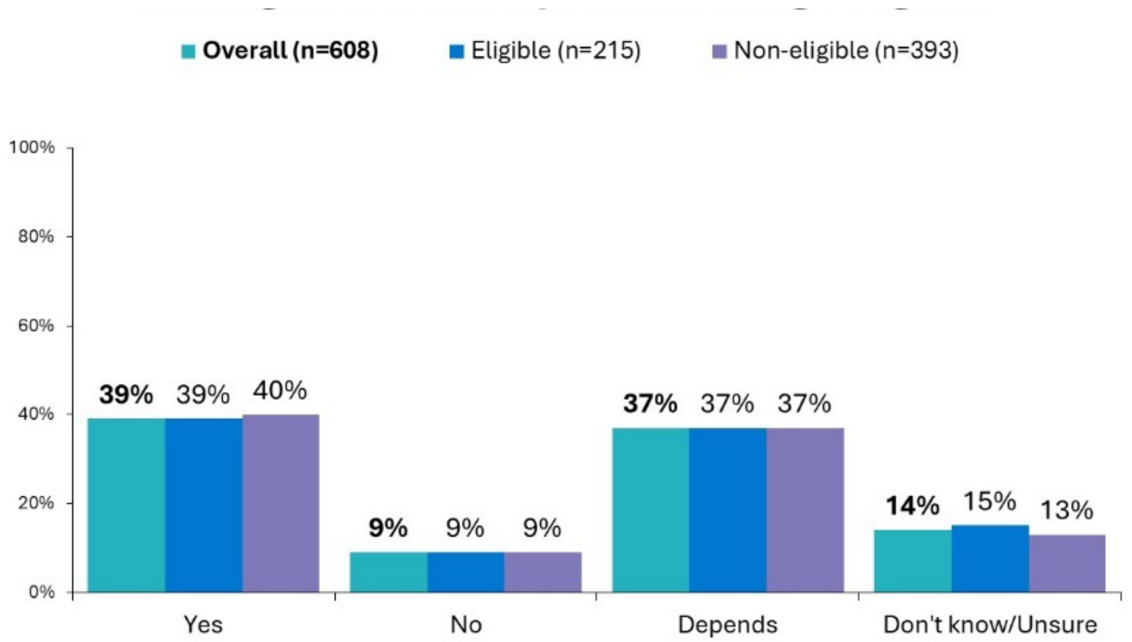
## 3.2. Customer Interest and Participation in Hybrid Heating

### 3.2.1. Willingness to Enrol in a Hybrid Heating Program

Survey results indicate that a strong majority of customers are either interested in enrolling in a Hybrid Heating Program or open to learning more (Figure 1). After receiving a brief explanation of how the program could operate, only 9% of respondents indicated that they would be unwilling to enrol in such a program. 39% reported a willingness to enrol, while the remainder indicated that their participation would depend on additional information or that they were unsure. Overall, these findings suggest broad openness to the concept of hybrid heating and limited outright resistance.

Willingness to enrol varies by age group. Customers aged 25–34 are more likely to express interest in enrolling compared to older customers, particularly those aged 55 and over. This suggests younger households may represent an early-adopter segment, while older customers may require additional information or reassurance to support participation.

FIGURE 1 - WILLINGNESS TO ENROLL IN A HYBRID HEATING PROGRAM

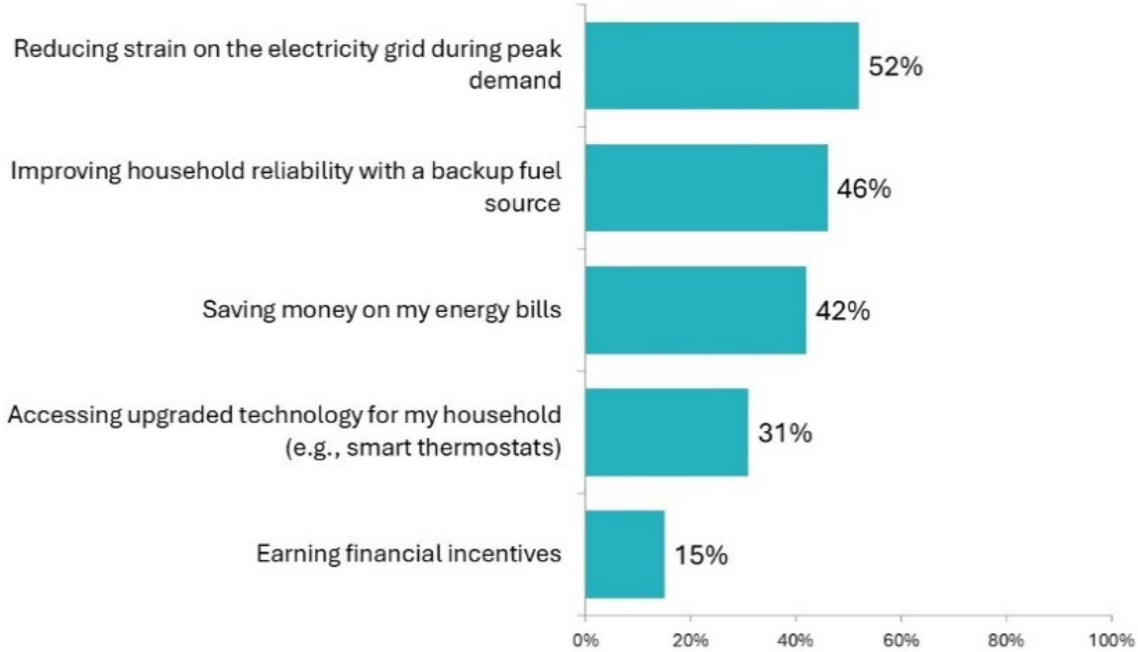



*Q.B1a-b: **[IF CURRENTLY HEAT HOME WITH [Q.B1A: ELECTRICTY/Q.B1B: NON-ELECTRIC] AND AT LEAST ONE FOSSIL FUEL HEAT SOURCE (OIL, NATURAL GAS, PROPANE) IN Q.A2]** During winter peak events (when more homes are using electricity), some utilities around the world offer programs with a financial incentive to switch from an electric heating system to a non-electric heating system for several hours (typically 2-4) during the coldest days of the year. This is called a* *hybrid heating program. [QB1B: imagine a hypothetical situation where your home is equipped with both an electric and non-electric heating system, and you would be eligible to sign up for a hybrid heating program.] Would you be willing to enroll in such a program?*

### 3.2.2. Awareness of Potential Program Benefits

Customer awareness of the potential benefits of participating in a Hybrid Heating Program is generally low, indicating a need for education and targeted outreach (Figure 2). 52% of respondents were previously aware that hybrid heating could potentially reduce strain on the electricity grid during peak demand periods. Awareness levels are slightly lower for other potential benefits related to improving household reliability through a backup fuel source and saving money on energy bills. Fewer respondents were aware of potential benefits related to accessing upgraded household technology, such as smart thermostats, or earning financial incentives.

FIGURE 2- AWARENESS OF POTENTIAL BENEFITS OF HYBRID HEATING (%)

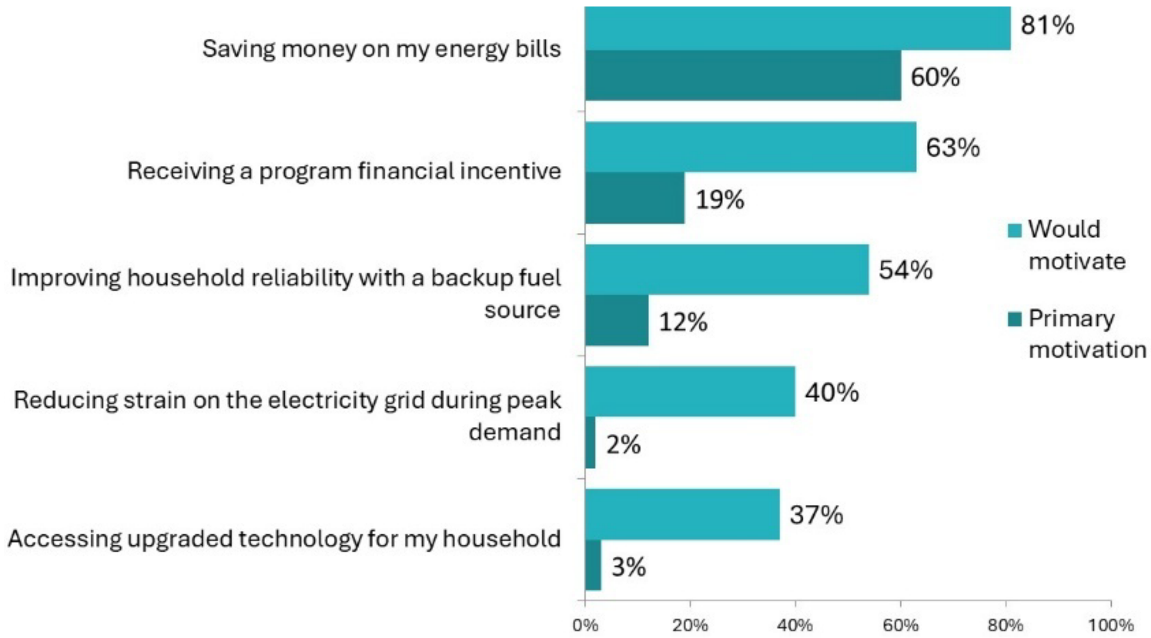



*Q.B2a-e: The following are some potential benefits of participating in a hybrid heating program. For each, please indicate whether or not you were aware of it before today. (n=608)*

### 3.2.3. Motivating Factors for Program Participation

Financial considerations are the primary drivers of interest for a Hybrid Heating Program (Figure 3). Saving money on energy bills is the most cited motivator, selected by 81% of respondents, with 60% identifying it as their primary motivation. Most respondents also indicate that receiving a financial incentive and improving household reliability through a backup fuel source would motivate them to participate. In contrast, fewer than half of customers report being motivated by system-level benefits, such as reducing strain on the electricity grid during peak demand, or by access to upgraded household technologies. Motivations vary by age, with customers aged 55 and older more likely to prioritize improved reliability, while younger customers aged 25–34 are more likely to identify access to new technology as a primary motivator.

FIGURE 3 – MOTIVATING FACTORS FOR PARTICIPATION IN A HYBRID HEATING PROGRAM (%)




*Q.B4a: Which of the following would motivate you to participate in a hybrid heating program? Select all that apply. (n=608)*
*Q.B4b: **[IF SELECTED AT LEAST ONE MOTIVATION FOR PARTICIPATING HYBRID HEATING PROGRAM IN Q.B4A]** And which would offer you the greatest motivation to participate in a hybrid heating program?*

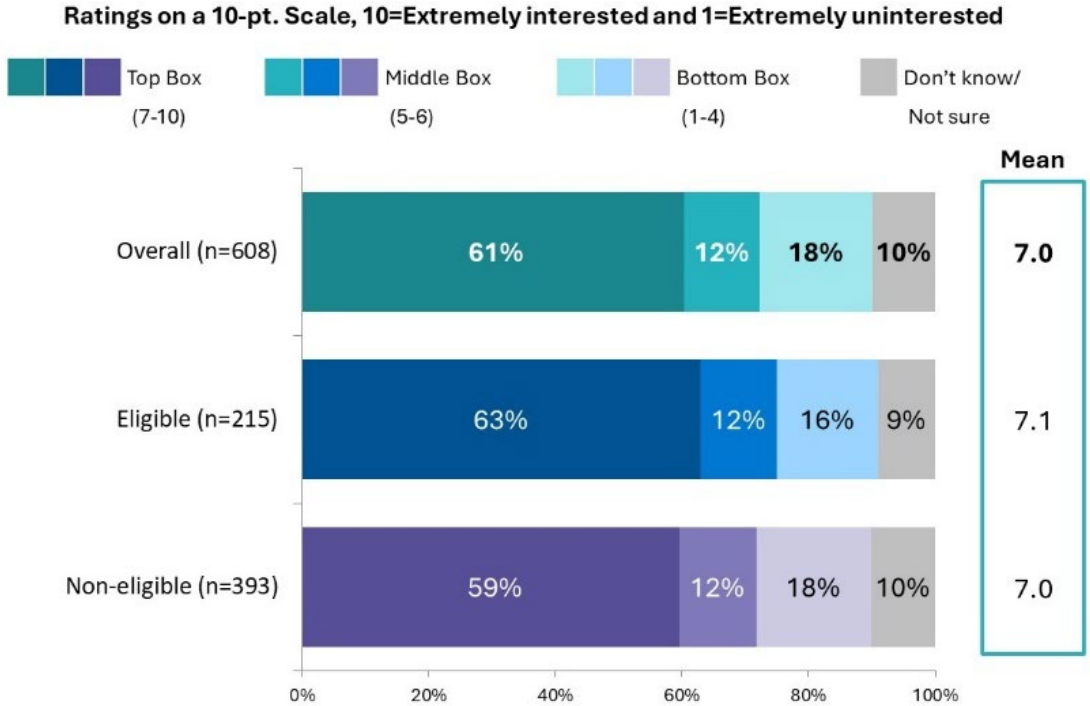
### 3.2.4 Interest in Participating in a Hybrid Heating Program

After learning about the potential benefits of participation, customers express moderate to strong interest in a Hybrid Heating Program (Figure 4). Overall, 61% of respondents rate their interest in participating in the program in the top range of the 10-point scale, indicating a generally favourable response once program benefits are better understood.

18% of respondents report low levels of interest, while a smaller share remains unsure, indicating that outright disengagement is limited and that most customers are at least open to considering participation. Mean interest scores are consistent across groups, reinforcing the overall pattern of moderate interest following exposure to program information.

However, Interest varies by customer characteristics. Customers with smart thermostats are more likely to report being extremely interested in participating compared to those without smart thermostats, suggesting that familiarity with energy management technologies may increase receptiveness to a hybrid heating program.

FIGURE 4 – INTEREST IN PARTICIPATING IN A HYBRID HEATING PROGRAM




*Note: Responses are grouped into High Interest (ratings 7–10), Moderate Interest (ratings 5–6), and Low Interest (ratings 1–4) based on a 10-point interest scale where 10 = Extremely Interested and 1 = Extremely Uninterested.*

*Q.B5: After learning about hybrid heating programs and some of the potential benefits, how interested would you be in participating in a hybrid heating program, if you became eligible?*

### 3.2.5. Concerns or Barriers Preventing Participation

While many customers express interest in a Hybrid Heating Program, survey results identify several concerns and/or barriers that could limit participation if not addressed through program design and communication. The most cited concern relates to the potential for increased costs or insufficient savings. Closely related, some customers note the need for clearer information about the program, including how it would operate in practice and what would be required of participants. Upfront installation costs and the inconvenience associated with setting up a new system are also cited as barriers by a smaller but notable share of respondents.

A subset of customers indicate barriers related to personal circumstances or preferences, including satisfaction with their current heating system, uncertainty about whether the program would apply to their home, or lack of access to a secondary heating system. A small minority express concern about continued reliance on fossil fuels or increased emissions. However, nearly half of respondents report no concerns, suggesting that barriers are concentrated within specific segments rather than widespread across the customer base.

The open-ended responses provides additional context to these findings. Several customers emphasize the importance of cost-effectiveness and return on investment, noting concerns such as the need to "realize a return on investment within three years." Others highlight complexity and control as barriers, with comments such as "if it's too complicated, I'm not interested," and "I don't believe in handing over complete control to an outside party." Concerns about fossil fuel reliance are also evident, including perceptions that hybrid heating runs counter to the goal of moving away from fossil fuels "I thought the idea of a heat pump was to get away from fossil fuels". Finally, some respondents note household-specific factors, such as already having multiple heating systems in place or uncertainty about remaining in their current home long term, which influence their willingness to participate.

## 3.3. Hybrid Heating Program Preferences

### 3.3.1. Peak Event Duration and Frequency Preferences

To understand customer tolerance for how a Hybrid Heating Program might operate, respondents who expressed interest in participating (or who were unsure) were asked to consider winter peak events assuming they were already enrolled in the program. Results indicate a preference for shorter and more limited peak events (Figure 5). Most respondents indicate comfort with peak events lasting up to four hours. A smaller share indicate tolerance for longer events, and 26% remain unsure, suggesting that clearer expectations and program details could influence customer comfort levels.

With respect to how often peak events could occur over a winter season, customers generally prefer a moderate number of events. Most respondents indicate that between 1 and 14 events per winter would be reasonable.

FIGURE 5A - ACCEPTABLE DURATION OF WINTER PEAK EVENTS

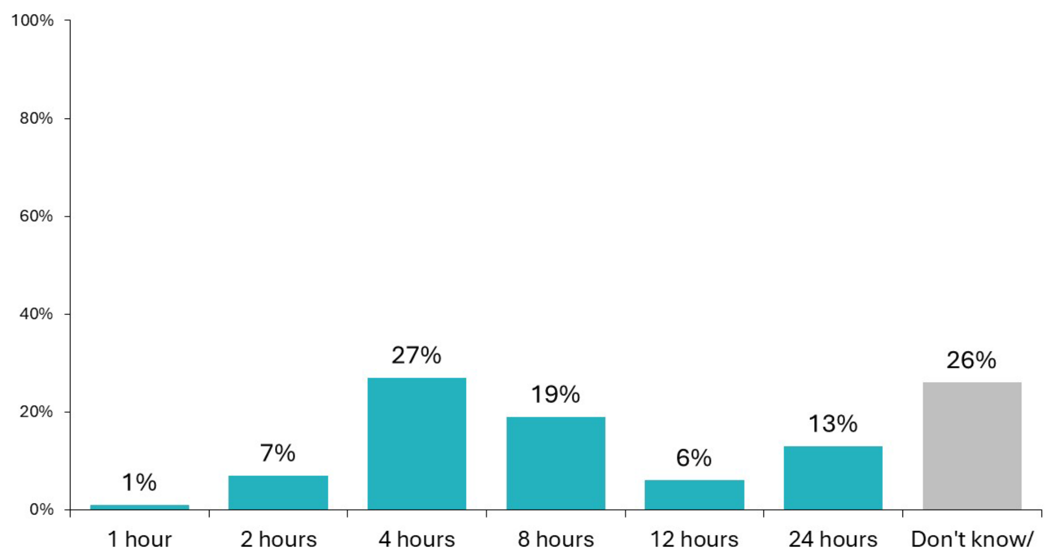
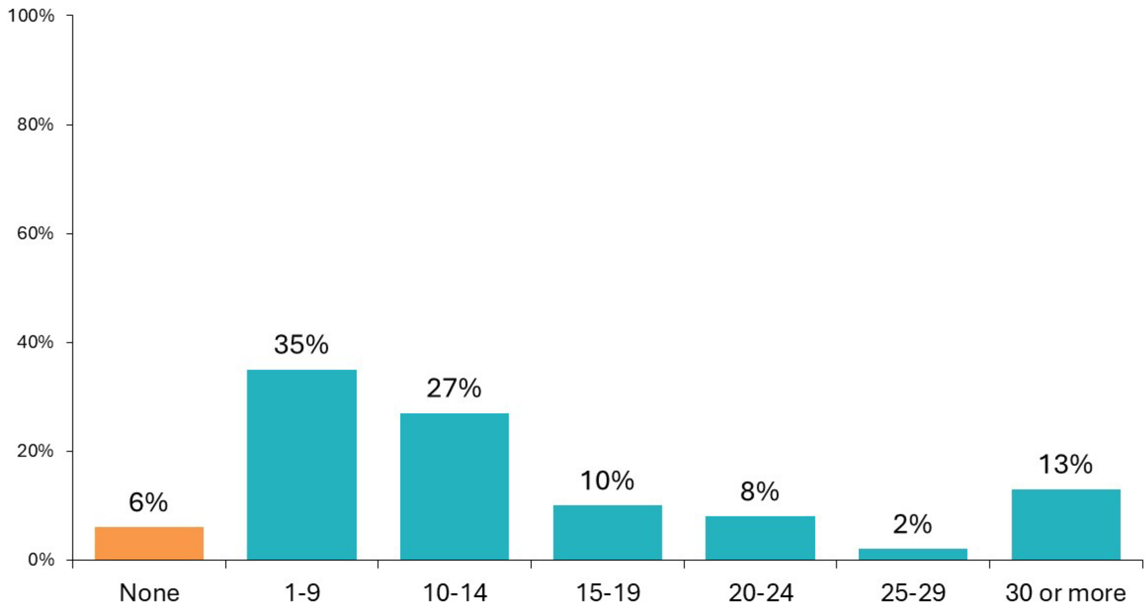


FIGURE 5B - ACCEPTABLE FREQUENCY OF WINTER PEAK EVENTS




***[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]*** *For these next questions, imagine you have enrolled in the Hybrid Heating program. Q.B6: In your opinion, what is the maximum length of time that would be reasonable or acceptable for a winter peak event (i.e., you have been asked to switch from your electric heat to an alternate system)? Q.B7: How many 4-hour peak events per winter would you consider acceptable?*

### 3.3.2 Comfort with Third-Party Involvement and Automated Controls

Survey results indicate that customers are generally more comfortable with automated system switching enabled by in-home technology than with third-party control of their heating systems (Figure 6). Among customers interested in participating in a Hybrid Heating Program, 84% of respondents indicate comfort with having a sensor added to their heating controls that would automatically switch systems when outdoor temperatures reach a predefined threshold. However, a majority of those who express comfort with this approach note that the ability to override the controls would be important.

When it comes to allowing a third party to control system switching during peak events, 61% of respondents indicate willingness to provide third-party control, while 34% indicated they would not be comfortable with this arrangement. Attitudes toward third-party control also vary by program design preference: customers who favour mandatory participation are more likely to express comfort with third-party control compared to those who prefer participation to remain optional.

FIGURE 1A - COMFORT WITH AUTOMATED AND THIRD-PARTY CONTROL DURING PEAK EVENTS

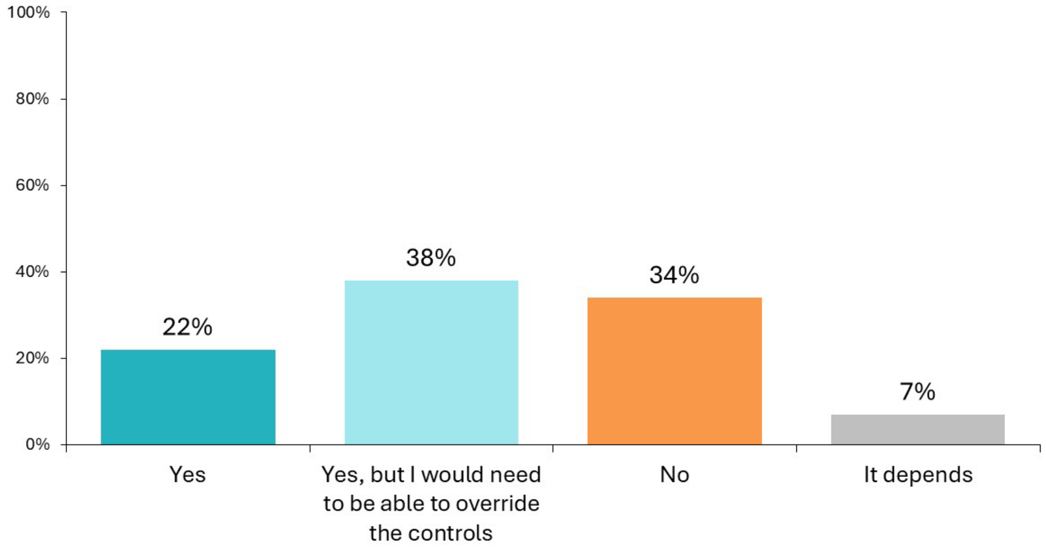
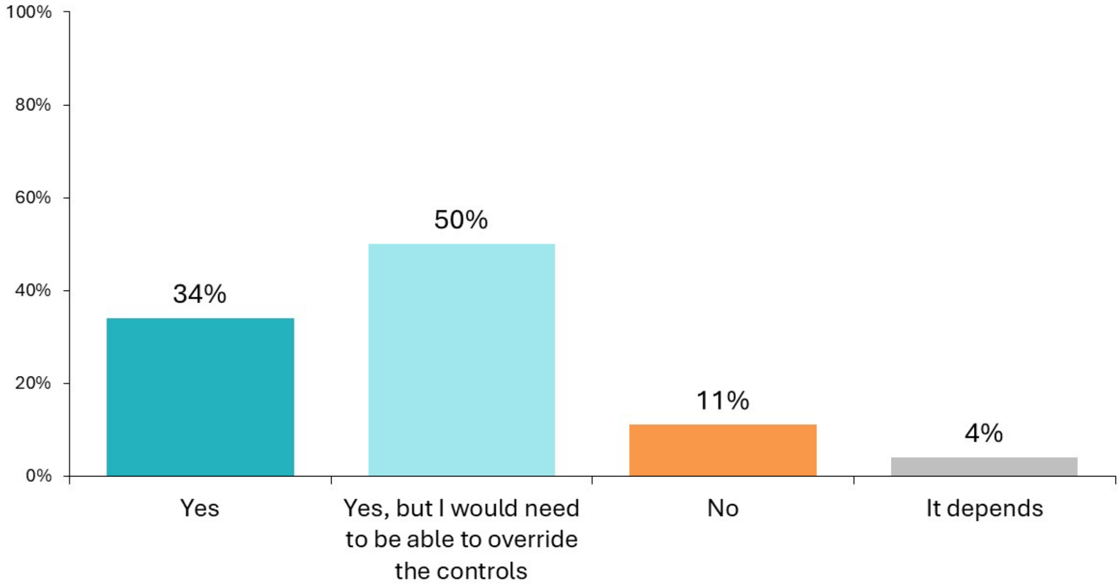



FIGURE 2B - COMFORT WITH A SENSOR ADDED TO HEAT CONTROL TO AUTOMATICALLY SWITCH WHEN OUTSIDE REACHES A PRE-DEFINED TEMPERATURE




***[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]*** *Assume you are happy with the incentives being offered and are participating in the hybrid heating program. Q.B8a: Would you be comfortable providing a third partner with control to switch over your system, during peak events so that you do not have to (e.g. switching from heat pump to natural gas heat during peak periods)? Q.B8b: Would you be comfortable with a sensor being added to the heat control in you home so that your heating system automatically switched when the outside temperature reaches a pre-defined temperature (e.g. switching from heat pump to natural gas heat when the temperature drops below –30 degrees)? (n=501)*

### 3.3.3. Communication Preferences for Peak Events

Survey results show a clear preference for direct, digital communication methods when notifying customers about upcoming peak events or providing updates (Figure 7). Text messages and email are the most preferred channels, with text messages selected by the majority of respondents (61%) and email close behind (54%). Other communication methods, such as mobile app notifications and phone calls, receive more limited support overall. Mobile app notifications are more popular among customers aged 35–54 compared to older customers, suggesting some variation in channel preference by age. Very few customers indicate no preference for how they receive communications.

With respect to timing, survey results indicate that most customers prefer some level of advance notice before a peak event that requires switching heating sources. 17% of respondents reported being comfortable with fully automated switching with no prior notice. By contrast, 46% indicated a preference for receiving four hours' notice or less, while 14% preferred notice periods of 12 hours or longer and 15% indicated a preference for 24 hours' notice or longer.

FIGURE 3A - PREFERRED COMMUNICATION METHODS FOR PEAK EVENTS

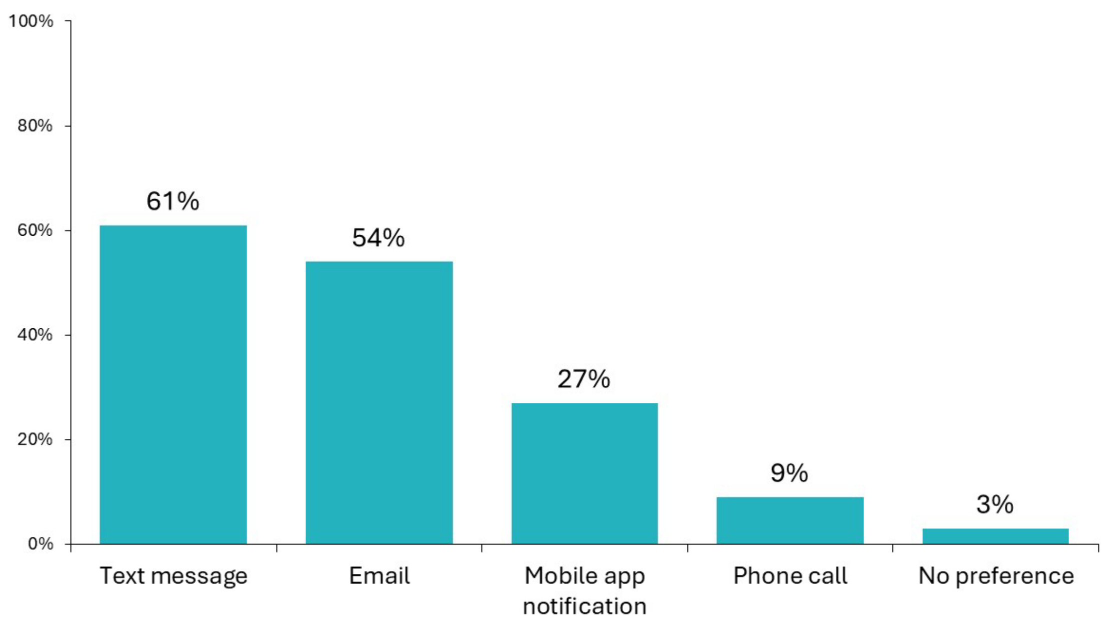
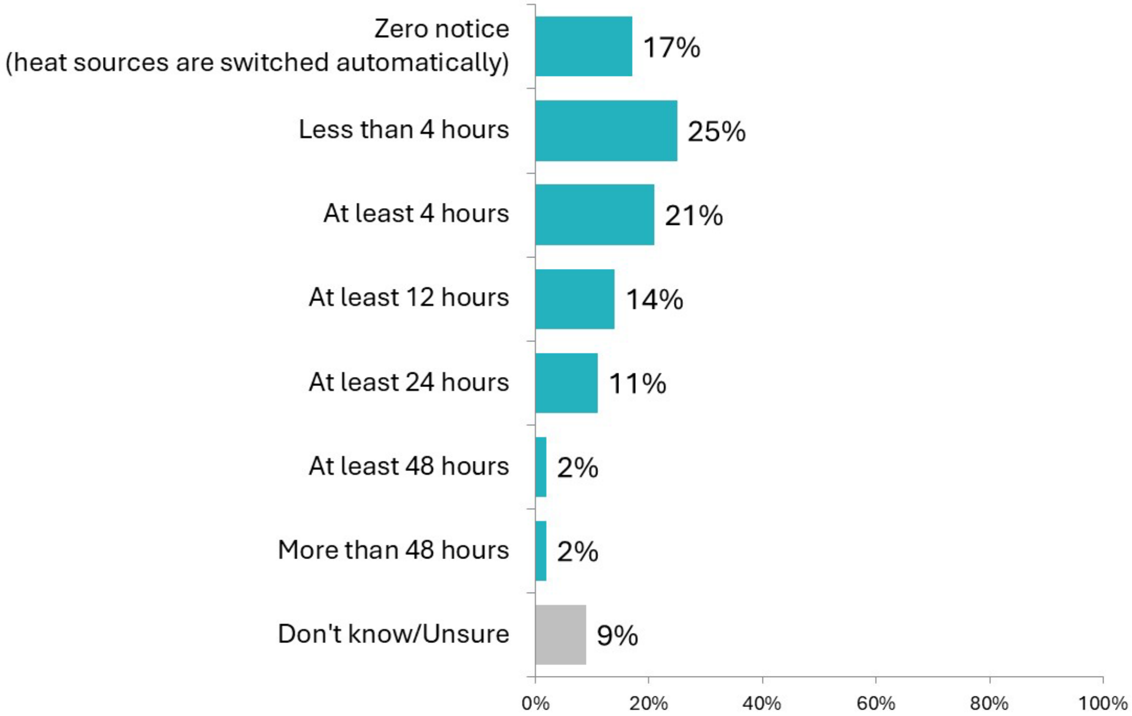


FIGURE 4B - ADVANCE NOTICE EXPECTATIONS FOR PEAK EVENTS



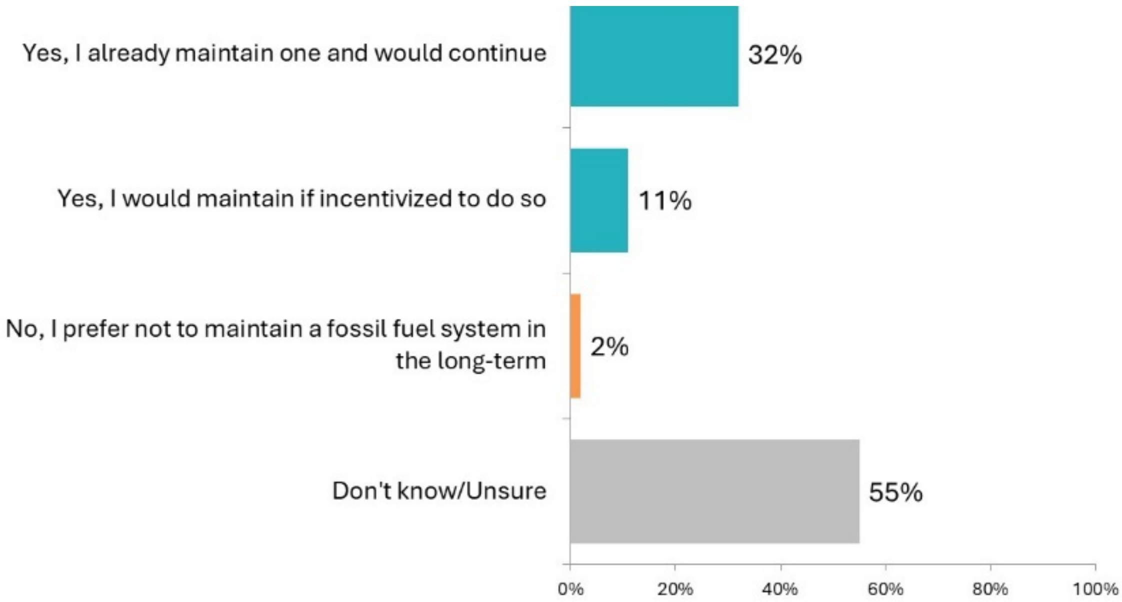

***[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]*** *Q.B9: Still imagining you are enrolled in the hybrid heating program, how would you prefer for us to communicate for advance notice or updates about peak events? Select all that apply. Q.B10: How much advance notice would be reasonable before a peak event requiring you to switch heat sources? (n=501)*

## 3.3.4. Maintaining a Non-Electric Heating System as Backup

Survey results indicate that a meaningful share of customers are open to maintaining a non-electric heat system as a backup to participate in a Hybrid Heating Program, although uncertainty remains high (Figure 8). 32% indicate that they already maintain a non-electric heating system and would continue to do so as part of program participation. 11% indicated that they would be willing to maintain a non-electric system if financial incentives were provided. In contrast, very few customers indicate a preference not to maintain a fossil fuel–based system in the long term. More than half of respondents (55%) report that they are unsure whether they would be willing to maintain a non-electric heat system as a backup.

Differences are observed across customer segments. Customers who currently use oil as their primary heating source are more likely to indicate that they willing to maintain a non-electric system. In contrast, customers who operate electric only systems as their primary heating source are unsure about maintaining a non-electric heating system. This may indicate that electric customers are unaware of long-term maintenance requirements or are unsure about adding a non-electric backup.

FIGURE 8 – WILLINGNESS TO MAINTAIN A NON-ELECTRIC HEATING SYSTEM BACKUP




***[IF CURRENTLY HEATING HOME WITH ELECTRICTY AND AT LEAST ONE FOSSIL FUEL HEAT SOURCE IN Q.A2 AND INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]*** *Q.B11: Would you be willing to maintain your non-electric heating system (e.g. oil, propane, or natural gas as a backup to participate in a hybrid heating program? (n=346)*

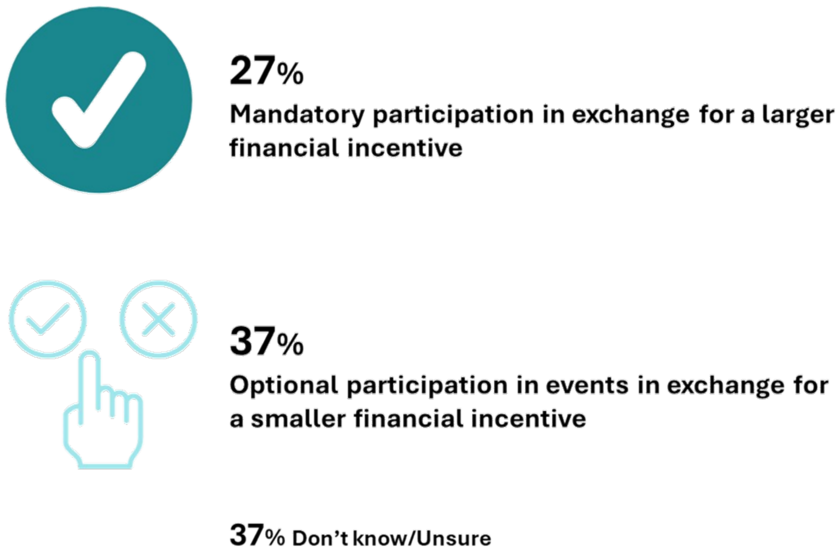
# 3.4. Customer Enrollment & Incentive Preferences

## 3.4.1. Program Enrollment Preferences

Survey results indicate mixed customer preferences regarding program enrollment structure, with a slight preference for optional participation paired with smaller financial incentives (Figure 9). When asked to choose between optional participation in peak events with a lower incentive or mandatory participation with a higher incentive, 37% indicated a preference for optional participation. 27% prefer mandatory participation in exchange for a larger incentive, while the remaining 37% are unsure.

Given that preferences are split across optional participation, mandatory participation, and uncertainty, the results suggest that a single, uniform enrollment approach may not be effective for all customers. Differences are also observed across age groups, with customers aged 35–54 more likely to prefer mandatory participation compared to other age groups.

FIGURE 9 – PREFERRED OPTION FOR HOW PARTICIPATION IN A HYBRID HEATING PROGRAM IS SET-UP

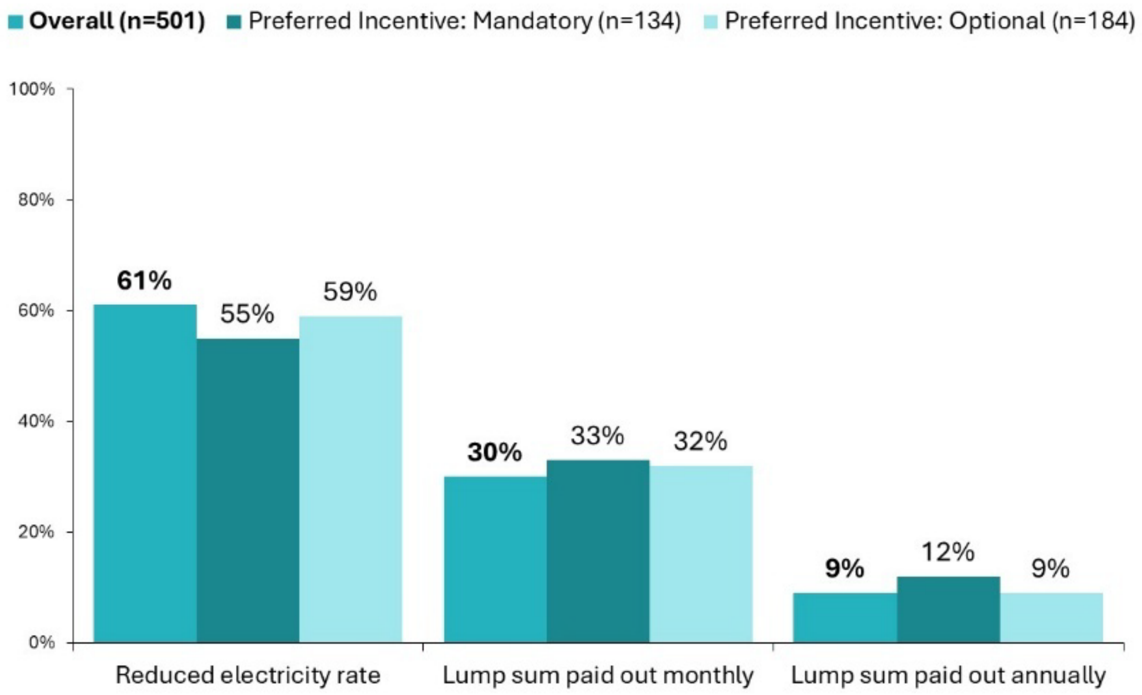



*[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5] Q.C1: Assuming you are open to considering enrolling in a hybrid heating program, these next questions will ask you about what incentives might be appealing. To begin, which of the following options would you prefer when it comes to how participation in the hybrid heating program is set up? (n=501)*

### 3.4.2. Incentive Type Preference

Survey results indicate a preference for incentives delivered through ongoing electricity bill reductions rather than lump-sum payments (Figure 9). 61% of respondents indicate that they would prefer to receive an incentive in the form of a reduced electricity rate. In comparison, 30% would prefer a monthly lump-sum payment, while only 9% favour an annual lump-sum payment.

FIGURE 10 – PREFERRED INCENTIVE DELIVERY METHOD




***[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]*** *Q.C2: How would you prefer to receive your incentive for participating in a hybrid heating program?*

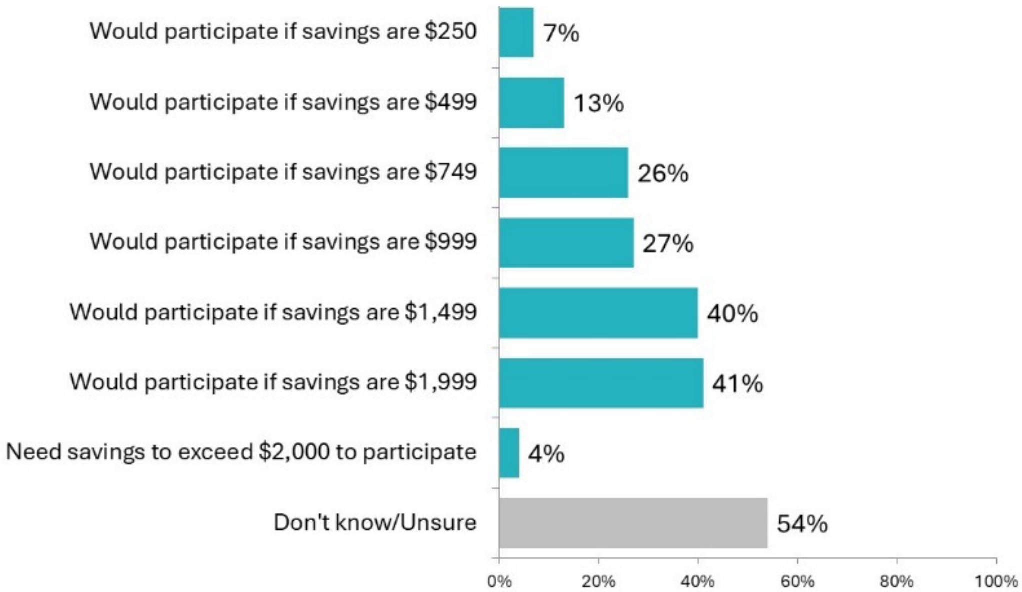
### 3.4.3. Annual Financial Savings to Motivate Participation

Survey results indicate that customer expectations for annual financial savings vary widely, with many respondents expressing uncertainty about the level of savings required to motivate participation in a Hybrid Heating Program (Figure 11). To assess savings thresholds, customers who were interested in participating (or unsure) were asked to enter a dollar amount that would motivate them to participate. Results are presented cumulatively, meaning that each threshold reflects all respondents who indicated a value at or below that amount. For example, the share of customers willing to participate at $749 in annual savings includes all those who entered values below $750.

Among respondents who provided a specific value, 27% indicated that annual savings of around $999 would motivate their participation. Willingness increases as savings rise, with 40% and 41% indicating an annual savings of $1,499 and $1,999, respectively, would be sufficient to motivate participation. A small share (4%) indicate that savings would need to exceed $2,000 per year.

More than half of respondents are unable to specify a savings threshold, suggesting that many customers require clearer information about program structure and expected impacts before they can assess the financial value of participation.

FIGURE 11 – ANNUAL FINANCIAL SAVINGS TO MOTIVATE PARTICIPATION




***Note:** Values are rounded to the nearest whole percentage point; therefore, totals may not equal 100%*

***[IF INTERESTED (RATINGS OF 5-10) IN PARTICIPATING IN HYBRID HEATING PROGRAM OR DON'T KNOW/UNSURE IN Q.B5]** Q.C3: Assuming you already have a compatible heating system, what amount of annual financial savings would motivate you to participate in a hybrid heating program? Please enter the dollar amount below. (n=501)*

# 3.5 Respondent & Household Characteristics

## 3.5.1 Housing Characteristics

Survey respondents are primarily homeowners living in single-detached dwellings (87%). Most respondents (64%) reside in urban areas, although a substantial minority live in rural communities. Homes are generally mid-sized, with the majority (77%) between 1,000 and 2,999 square feet.

The respondent base skews older, with a majority (70%) aged 55 and over. While younger age cohorts are represented, this distribution aligns with the higher likelihood of homeownership and primary heating decision-making among older households.

## 3.5.2 Primary Heating Systems and Technologies

Electricity is the dominant primary heating energy source among respondents (71%), followed by oil (19%), with smaller shares using wood (5%), natural gas (2%), or propane (2%). Many homes rely on relatively mature heating systems, with 22% of primary heating systems over 10 years old and 18% exceeding 20 years in age.

HP adoption is already present in a significant share of homes, with 51% of respondents reporting one or more ductless mini-split systems and 14% indicating the presence of a central ducted HP.

Thermostat configurations vary, with most homes using standard manual (52%) or programmable thermostats (37%), and a smaller but notable share using smart or learning thermostats (18%). Among customers with programmable or smart thermostats, levels of engagement with automated control differ: 47% report always using programmed settings, 25% occasionally use programmed settings, and 25% operate their thermostat like a standard manual control.

Domestic hot water systems are predominantly electric (77%) or fuel oil–based (17%), with very small shares using propane (3%), natural gas (3%), or solar hot water systems (<1%). Most homes rely on conventional storage-tank water heaters (79%), while smaller proportions use combination boilers (12%), tankless systems (5%), heat-pump water heaters (4%), or solar thermal systems (1%).

### 3.5.3 Planned Heating System Replacement or Upgrade

A limited number of customers anticipate replacing or upgrading their primary heating system in the near term. 16% expect to replace or upgrade within the next five years, while a larger share anticipate doing so more than five years from now (38%) or remain unsure (46%). Customers currently using oil as their primary heating source are more likely to anticipate near-term replacement.

Respondents who expect to replace or upgrade their system within the next five years were asked to select all reasons that apply for considering a replacement. Among this group, the most cited reason is that the system is approaching the end of its useful life (55%). Reducing energy costs is also a major driver (44%), followed by improving winter comfort (27%) and accessing rebates or incentives (21%). Environmental considerations (20%) and interest in adding cooling capacity (16%) are cited less frequently.

## 3.6 Key Findings from Customer Research

### 1. Overall openness to hybrid heating

Customers demonstrate broad openness to the concept of hybrid heating. After receiving a brief overview of how a Hybrid Heating Program could operate, a strong majority of respondents indicate they are either willing to enrol or open to learning more. Only a small minority express outright unwillingness to participate. This openness is evident even among customers with differing existing heating system configurations, suggesting that interest in hybrid heating extends beyond households already operating multiple systems.

### 2. Financial considerations are central

Financial factors are the dominant drivers of participation. Saving money on energy bills is the most important motivator, followed closely by financial incentives. Customers indicate a clear preference for incentives delivered through ongoing electricity bill reductions rather than lump-sum payments. However, many customers struggle to quantify the level of savings required to motivate participation, highlighting the importance of clear, credible communication around program costs, savings, and requirements.

### 3. Awareness gaps present an opportunity

Customer awareness of the broader system benefits of hybrid heating, such as reducing strain on the electricity grid during peak demand, is relatively low. Awareness is higher for household-level benefits like reliability and cost savings but remains uneven across customer segments. These findings suggest a strong opportunity for targeted education and messaging to improve understanding of both customer and system-level benefits.

### 4. Concerns are present but not widespread

While many customers report no major concerns, those who do raise issues tend to focus on uncertainty around cost savings, lack of information, and concerns about continued reliance on fossil fuels. A smaller share cites concerns related to system complexity, loss of control, or installation inconvenience. These concerns underscore the importance of transparent program design, customer control options, and clear explanations of how hybrid heating aligns with long-term decarbonization goals.

### 5. Preferences for program design and operation

Customers generally prefer program designs that preserve household control. Most are comfortable with automated system switching based on temperature thresholds, particularly when an override option is available. Comfort levels are lower for direct third-party control, although a segment remains open to it depending on program structure and incentives. Customers also express a preference for limited peak event duration and frequency, with shorter events and advance notification via text message or email strongly favoured.

### 6. Future system upgrades and backup heating

Only a small share of customers anticipate replacing or upgrading their primary heating system in the near term, suggesting that program uptake may initially rely on existing system configurations or incremental upgrades rather than full system replacement. Many customers are uncertain about maintaining a non-electric backup system, indicating a need for clearer communication around long-term maintenance expectations and cost.

# 4. Modelling

For the project, quantitative modelling was undertaken to assess the potential system-level impacts of hybrid heating adoption in Nova Scotia. This work was conducted in two stages.

The first stage focused on constructing hybrid heating load reduction profiles outside PLEXOS, building on Nova Scota Power's 2025 load forecast assumptions and incorporating residential electric heating data, trigger assumptions, customer segments, and adoption assumptions. The second stage used those profiles in IESO NS's resource planning software PLEXOS[11] to assess actual system peak reduction, resource build impacts, generation dispatch costs, and GHG implications.

The modelling is not intended to predict a specific program design or participation outcome. Rather, it provides an analysis to illustrate a range of potential peak and energy impacts, and to evaluate how those impacts translate into system-level benefits under different uptake and trigger assumptions.

## 4.1. Hybrid Heating Load Scenario Construction

This section describes how the hybrid heating load reduction profiles were developed. The analysis begins with a baseline residential electric heating load shape developed by Nova Scotia Power using 2022 advanced metering infrastructure (AMI) data. Hybrid heating scenarios were then created by modifying this baseline to reflect different trigger mechanisms, including temperature-based operation and critical peak event-based operation.

The resulting per-customer load reductions were then scaled under different adoption assumptions to represent a range of possible program sizes and eligible customer segments. This produced program-level hourly load reduction profiles for each hybrid heating scenario.

### 4.1.1. Residential Electric Heating Load Shape

The analysis performed by Nova Scotia Power uses a baseline residential electric heating load shape that describes the hourly distribution of electricity consumption attributable to space heating in residential buildings. The load shape represents the relative pattern of residential heating demand over time and serves as the reference case for all subsequent modelling scenarios (Figure 12).

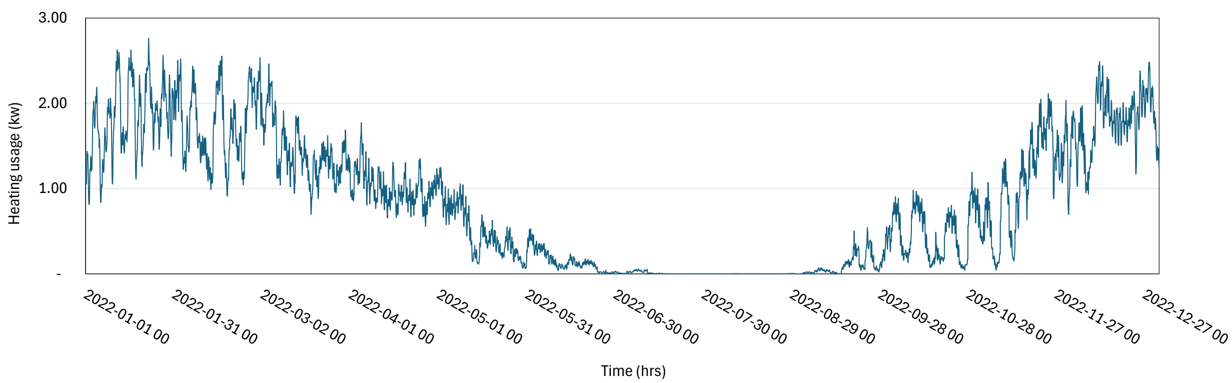
The baseline load shape was developed by Nova Scotia Power using 2022 AMI data from residential customers. A disaggregation methodology was applied to separate total household electricity consumption into end uses, with the residential space-heating portion isolated for analysis. The

11 In this report, "PLEXOS system modelling" refers to the IESO-NS electricity system model implemented in PLEXOS. The ISO-NS forecasted system load was used as the baseline and was not reconstructed in this analysis. Hybrid heating impacts were represented separately by adding the load reduction profiles as fixed-output resources during event hours.

resulting load shape reflects heating-only electricity demand and excludes non-heating residential loads.

The baseline represents an average residential heating load profile across customers identified as having electric heat pumps with a high level of confidence (p > 90%), comprising 22,130 residential customers. It includes electricity consumption associated with heat pump operation as well as secondary electric heating used within these households. This baseline residential load shape provides a consistent reference case against which Nova Scotia Power can model alternative residential heating configurations and operating assumptions.

FIGURE 512 - BASELINE RESIDENTIAL ELECTRIC HEATING LOAD SHAPE




## 4.1.2. Hybrid Heating Trigger Scenarios

To explore the potential impact of hybrid heating on the residential electric heating load shape, an initial set of operating approaches were modelled, using 2022 system and weather data as the reference year. These approaches illustrate how different methods of triggering hybrid heating operation may affect the timing and magnitude of residential electric heating demand.

Under each approach, electric space-heating load is set to zero during defined “hybrid heating event” hours, representing periods when heating demand would be met by a non-electric backup system rather than electric heat. Outside of these event hours, the baseline residential heating load shape remains unchanged.

The operating approaches differ in how hybrid heating event hours are defined:

1. **Temperature-Based Threshold (T < −10°C) -** Hybrid heating events are triggered when outdoor air temperature falls below −10°C, resulting in approximately 225 event hours over the year. The −10°C threshold represents an initial temperature breakpoint selected to broadly align with periods of high system load while accounting for geographic variation in temperatures across the province (Figure 13).

2. **Critical Peak Events –** Hybrid heating events are triggered when critical peak events were called as part of Nova Scotia Power's Critical Peak Pricing Rate Pilot, using the 2022 schedule as the reference year. Events were called when demand for electricity was expected to be highest during the winter months, typically due to cold temperatures or periods of low renewable energy generation. A list of Critical Peak event times can be found on the Nova Scotia Power website[12]. Note that for the purposes of this study, hybrid events were also triggered for two critical peak events which were planned but ultimately not called due to technical difficulties (on January 11th 2022 and February 16th 2022). This is to ensure that peak impact can be accurately reflected in the study (Figure 14).

For each trigger definition, the modified residential heating load shapes are compared against the baseline load shape to assess changes in hourly demand profiles under the differing assumptions about hybrid heating operation.

FIGURE 613– TEMPERATURE-BASED HYBRID HEATING OPERATION (T < −10 °C)

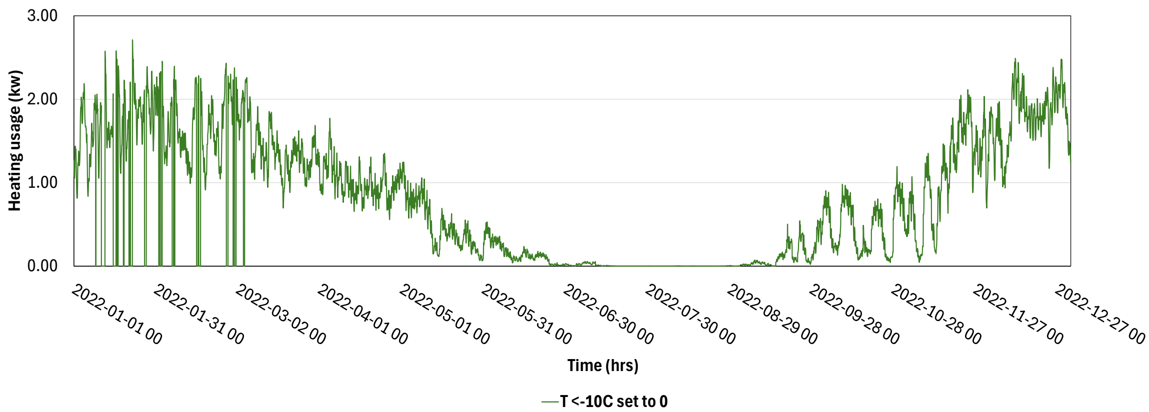
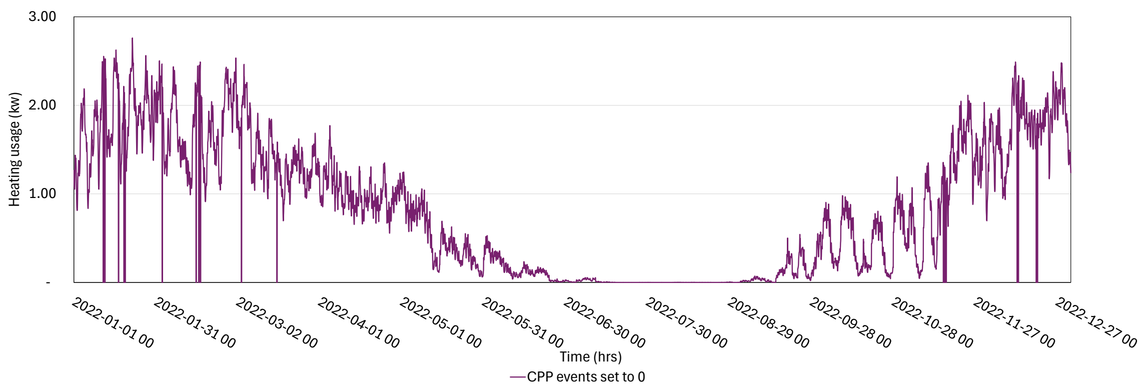



FIGURE 14 – CRITICAL PEAK EVENT-BASED HYBRID HEATING OPERATION

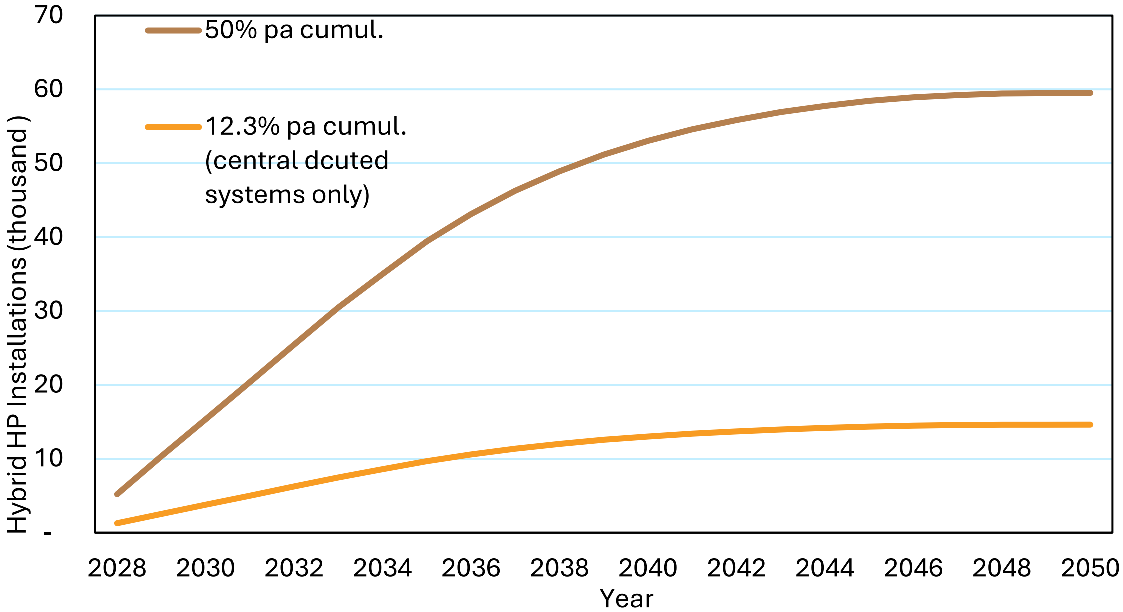



12 Nova Scotia Power. (n.d.). Critical Peak Pricing pilot. https://www.nspower.ca/your-home/residential-rates/critical-peak-pricing/critical-peak-events

### 4.1.3. Adoption and Customer Segment Assumptions

To estimate the potential system-level impact of hybrid heating over the long term, the per-household load shape impacts derived under each scenario are scaled based on Nova Scotia Power's projected residential HP installations between 2028 and 2050, from the 2025 Load Forecast. The cumulative hybrid heat pump installations under each uptake assumption are shown in Figure 15. Only those installations projected to take place in homes that do not already have electric heating systems were considered. This scaling converts the per-customer impact into an aggregate hybrid heating impact at the program level.

FIGURE 15 – CUMULATIVE HYBRID RESIDENTIAL HEAT PUMP INSTALLATION (2028-2050)




A set of adoption assumptions was developed to reflect uncertainty around customer uptake of a hypothetical hybrid heating program in Nova Scotia. Cumulative hybrid heating installations were estimated by assuming that different shares of new HP installations in homes that do not already have electric heating are deployed as hybrid systems. These assumptions are not intended to predict actual program participation, but to provide reference cases for assessing potential program scale and system impacts.

Two participation cases were advanced for the load impact analysis: a 50% participation case and a lower 12.3% effective participation case. The 50% case was applied broadly to new heat pump installations in non-electric heating homes. The 12.3% case represents a more targeted "central systems only" scenario, where participation is limited to homes with forced-air central heating systems. Based on E1's energy audit data from 2020 to 2026, approximately 61.4% of audited non-electric homes fell into this category. Applying a 20% participation assumption to this subset results in an effective participation rate of approximately 12.3% across the broader non-electric heating customer segment.

For context, survey results indicate customer openness toward hybrid heating participation, but also uncertainty around final uptake. After receiving an initial explanation of how a hybrid heating program could operate, 39% of respondents indicated a willingness to enrol, while an additional 37% indicated that their participation would depend on program details. After learning more about potential program benefits, 61% of respondents expressed moderate to strong interest in participating. The survey also found that 32% of respondents already maintain a non-electric backup heating system and would continue to do so as part of a hybrid heating program, while an additional 11% indicated they would be willing to maintain such a system if financial incentives were provided. These findings provide useful context for the adoption assumptions but were not used directly to parameterize adoption in the modelling. The scenarios advanced for load impact analysis are summarized in Table 3.

TABLE 3 – PROGRAM SCENARIOS EVALUATED

| Trigger Mechanism | Uptake Assumptions Evaluated |
|---|---|
| T < -10°C | 50% |
| Critical Peak Events | 50%; 12.3% (Central Systems Only) |

### 4.1.4. Hybrid Heating Event Scenarios

*Program Scenario 1: Temperature triggered, high adoption*

A hybrid heating event occurs during hours when the temperature is less than -10 °C. This program assumes 50% participation of all non-electric conversions, meaning that 50% of all customers with fossil fuel heating systems who convert to heat pumps will maintain those fossil systems as backup and participate in the hybrid heating program.

*Program Scenario 2: Event based, high adoption*

Hybrid heating events correspond to the hours when critical peak events are called. These are a limited number of 4-hour windows in the colder months when customers are incentivized to shift their energy use. Like the first program, this program assumes 50% participation of all non-electric conversions, meaning that 50% of customers with fossil fuel heating systems who convert to heat pumps will maintain those fossil fuel systems as backup and participate in the hybrid heating program.

*Program Scenario 3: Event based, low adoption*

Hybrid heating events correspond to the hours in which critical peak events are called. This program assumes a 12.3% participation rate, representing 20% participation among households with existing ducted (central) fossil fuel heating systems that convert to heat pumps and retain their fossil fuel system as backup. The scenario focuses on customers with existing central heating infrastructure, where participation in a hybrid heating program may be more readily implemented due to the ability to switch between heating sources with limited additional equipment or system modifications.

## 4.2. Program Capacity from Residential Heating Load Reduction

This section presents the direct outputs from the hybrid heating load scenario construction. These results represent customer-side residential heating load impacts before assessing broader electricity system outcomes in PLEXOS.

The results of Nova Scotia Power's modelling indicate that hybrid heating can deliver program-level reductions in residential electric heating load at the winter system peak of 25 MW and 103 MW by 2035 and 38 MW and 156 MW by 2050, depending on trigger and uptake assumption (Table 4). This corresponds to an estimated reduction of ~4 % of net system requirement (NSR) at peak in 2035 based on Nova Scotia Power's 2025 Load Forecast Report[13]. These values represent the estimated program capacity available from the residential heating load reduction. Values are the same for a given uptake assumption, irrespective of the hybrid event trigger, because the system peak value is taken from a single hour. Consequently, the estimated program capacity is sensitive only to the number of customers participating in the program, assuming that a hybrid event is triggered at that time.

TABLE 4 – PROGRAM CAPACITY (MW)

| Trigger: | T < -10C | Critical peak events | |
|---|---|---|---|
| **Uptake Assumption:** | **50%** | **50%** | **12.3% (central systems only)** |
| **2028** | -14 | -14 | -3 |
| **2029** | -27 | -27 | -7 |
| **2030** | -40 | -40 | -10 |
| **2031** | -53 | -53 | -13 |
| **2032** | -67 | -67 | -16 |
| **2033** | -80 | -80 | -20 |
| **2034** | -92 | -92 | -23 |
| **2035** | -103 | -103 | -25 |
| **2036** | -113 | -113 | -28 |
| **2037** | -121 | -121 | -30 |
| **2038** | -128 | -128 | -31 |
| **2039** | -134 | -134 | -33 |
| **2040** | -139 | -139 | -34 |
| **2041** | -143 | -143 | -35 |

13 Nova Scotia Power Inc. (2025, June 27). 2025 Load Forecast Report. Nova Scotia Energy Board.

| | | | |
|---|---|---|---|
| **2042** | -146 | -146 | -36 |
| **2043** | -149 | -149 | -37 |
| **2044** | -151 | -151 | -37 |
| **2045** | -153 | -153 | -38 |
| **2046** | -154 | -154 | -38 |
| **2047** | -155 | -155 | -38 |
| **2048** | -155 | -155 | -38 |
| **2049** | -156 | -156 | -38 |
| **2050** | -156 | -156 | -38 |

## 4.3. System-Level Modelling (PLEXOS)

This section describes how the program-level hourly load reduction profiles were used in PLEXOS to assess electricity system impacts.

### 4.3.1. Methodology

First, the hourly system load shape was adjusted outside PLEXOS to account for the hourly effects of the hybrid heating program, creating a modified load profile. The new system peak of this modified load shape is then compared with the original system peak to quantify the reduction in firm capacity provided by each hybrid heating program scenario.

Next, the modelling was completed using Energy Exemplar's resource planning (capacity expansion and economic dispatch) software, PLEXOS. A Base Case with no hybrid heating was modelled, along with a separate scenario for each of the three hybrid heating program scenarios.

The hourly load reduction profiles developed for the three hybrid heating program scenarios were input into PLEXOS and represented as fixed-output generators. This allowed the model to reflect the hybrid heating load reductions as equivalent reductions in system demand during event hours.

Separate capacity expansion runs were conducted for each program scenario to determine changes in resource build requirements relative to the Base Case. This was followed by hourly production cost simulations to evaluate operational impacts on the electricity system. Finally, the avoided cost of DSM methodology was used to estimate the capacity value and avoided energy costs associated with each hybrid heating program scenario.

### 4.3.2. Modelling Assumptions

Key assumptions used in the PLEXOS modeling are based on those used in the analysis that supported the Wasoqonatl Transmission Line (NS-NB Reliability Intertie Project)[14] with the following updates:

- The planning horizon covers the period from 2028 through 2050.
- System load assumptions are aligned with the 2025 Load Forecast filed by Nova Scotia Power with the Nova Scotia Energy Board on June 27, 2025 (M12349) and extended from 2036 to 2050.
- The following resource additions are fixed into the expansion plan for all scenarios:
    - 250 MW of wind generation procured through the Green Choice program, supported by 165 MVA of distributed synchronous condensers;
    - 350 MW of new wind generation is assumed to be procured by 2030;
    - 600 MW procurement of new aeroderivative combustion turbines by 2030.
- Frame combustion turbines, sized at 150 MW, were added as a supply-side option.

### 4.3.3. Actual System Peak Reduction

The PLEXOS scenarios were used to compare the program capacity estimated from the residential heating load analysis with the actual system peak reduction achieved after the full system load profile was considered. This distinction is important because a hybrid heating program may provide a targeted amount of load reduction during event hours, but the actual system peak reduction may be lower if the system peak shifts to another hour.

Figure 16 shows an example for the year 2035 from the temperature-triggered program scenario. This program has a program capacity of 103 MW. However, the new system peak shifts to a different day, so the actual system peak reduction is 92 MW.

[14] Wasoqonatl Transmission Incorporated. (2025, April 10). NS-NB Reliability Intertie Project Application. Appendix C. Nova Scotia Energy Board.

FIGURE 16 - CHANGE IN FIRM PEAK - TEMPERATURE TRIGGERED HYBRID HEATING PROGRAM (2035)

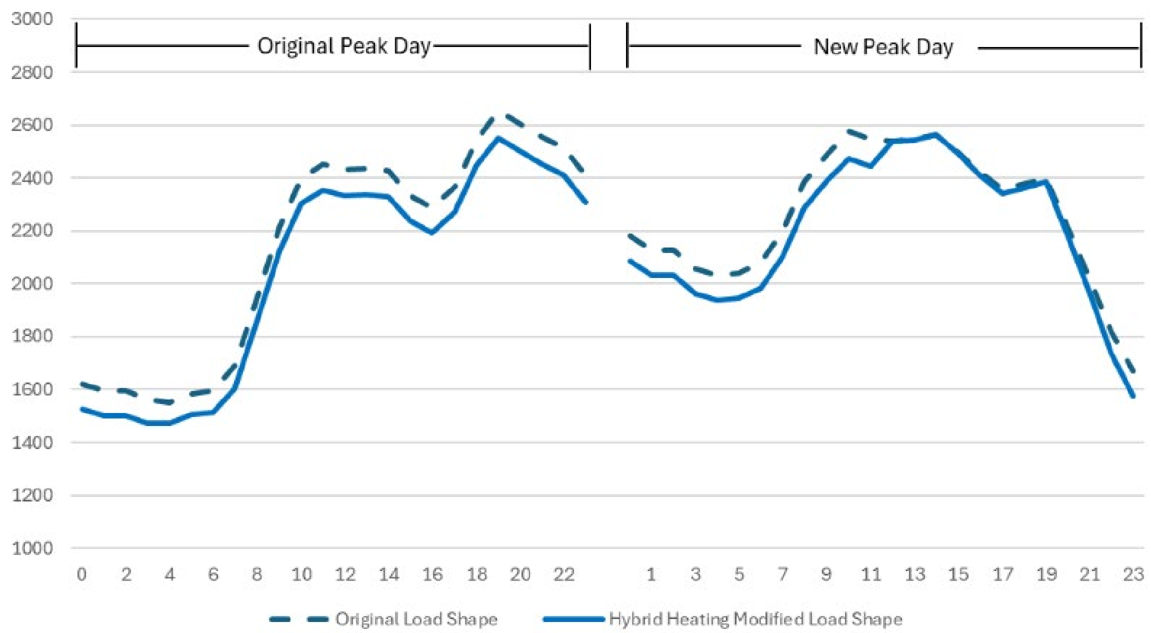



Table 5 shows the program capacity compared to the actual peak reduction for each hybrid heating program scenario.

TABLE 5 – PROGRAM CAPACITY AND PEAK REDUCTION

| Hybrid Heating Program Design | Program Capacity (MW) | | | Actual Peak Reduction (MW) | | |
|---|---|---|---|---|---|---|
| | 2030 | 2035 | 2040 | 2030 | 2035 | 2040 |
| Program Scenario 1 - Temperature Triggered Program<br>• Triggered in hours when temperature < -10 deg C<br>• 50% adoption of all non-electric conversions | 40 | 103 | 139 | 40 | 92 | 77 |
| Program Scenario 2 - Event Based Program<br>• Critical Peak Events<br>• 50% adoption of all non-electric conversions | 40 | 103 | 139 | 40 | 92 | 77 |
| Program Scenario 3 - Event Based Program<br>• Critical Peak Events<br>• 12.3% adoption of central system conversions | 10 | 25 | 34 | 10 | 25 | 34 |

For Program scenarios 1 and 2, the actual peak reduction is less than the program capacity in the outer years due to the shifting of the peak to a different day. This is due to changes in the forecast system load shape from space heating and transportation electrification. While the hybrid heating programs reduce demand during the original peak periods, the new peak may occur during hours when the hybrid heating event criteria are no longer met. Program scenario 1 and program scenario 2 are similar because the criteria for a hybrid heating event are both met during the same peak hours. By the year 2040, the actual peak reduction is about half the program capacity demonstrating the need for program design to evolve over time to maintain alignment with the needs of the power system. Program scenario 3 is a smaller program than the other two. As a result, the actual peak reduction is the same as the program capacity in all years; it does not have a shift in peak day as in program scenarios 1 and 2.

### 4.3.4. Capacity and Resource Build Impacts

The PLEXOS modeling produces a capacity expansion plan and the hourly energy dispatch and associated production cost for each hybrid heating program scenario. This is compared to the Base Case with no hybrid heating. Figures 17, 18 and 19 show difference in planned resource capacity between each hybrid heating scenario and the Base Case (Hybrid Heating Case – Base Case) for each model year. Negative values indicate years where less resource capacity is required in the hybrid heating case relative to the Base Case due to lower peak electricity demand. Zeros indicate that both cases require similar capacity levels in that year. The figures show changes in planned resource capacity by resource type and should be interpreted as capacity expansion differences, not as a direct measure of firm capacity reduction. Because different resources provide different levels of firm capacity contribution, the total height of the bars in the figures is not directly comparable to the firm capacity values reported in Table 6.

FIGURE 17 - COMPARISON OF EXPANSION PLANS - PROGRAM 1 TEMPERATURE TRIGGERED

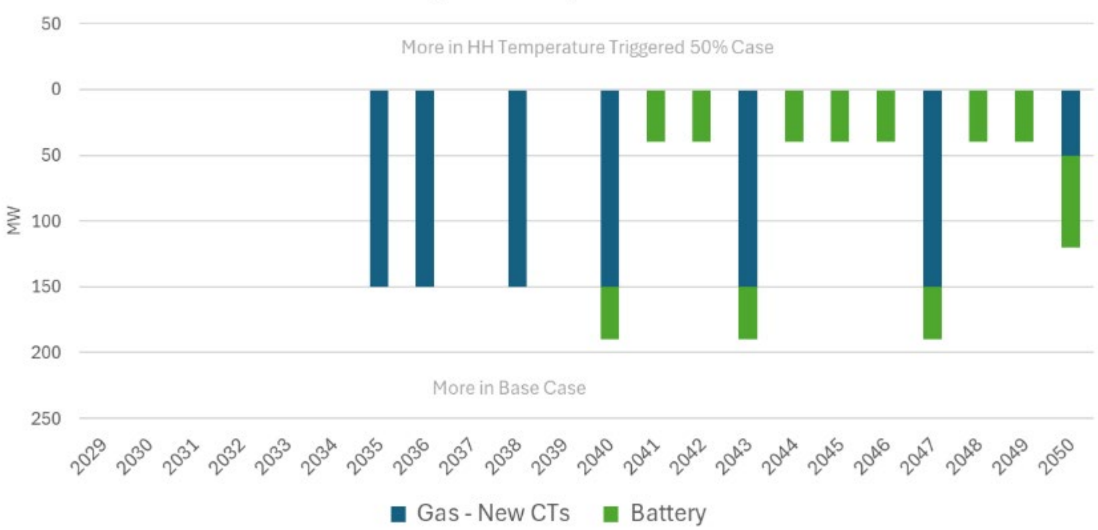


FIGURE 18 - COMPARISON OF EXPANSION PLANS - PROGRAM 2 CRITICAL PEAK EVENTS (50% ADOPTION)

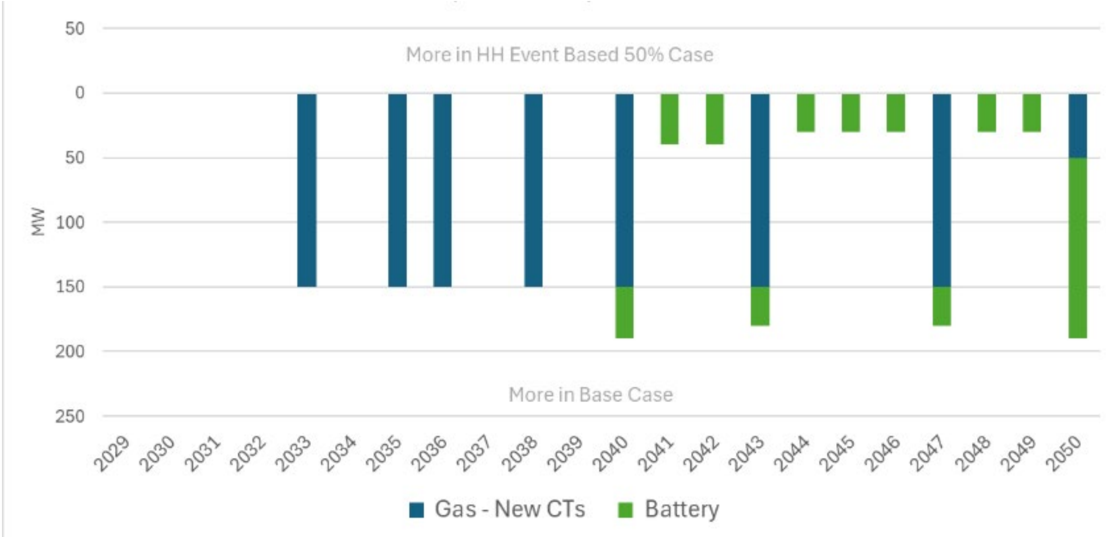
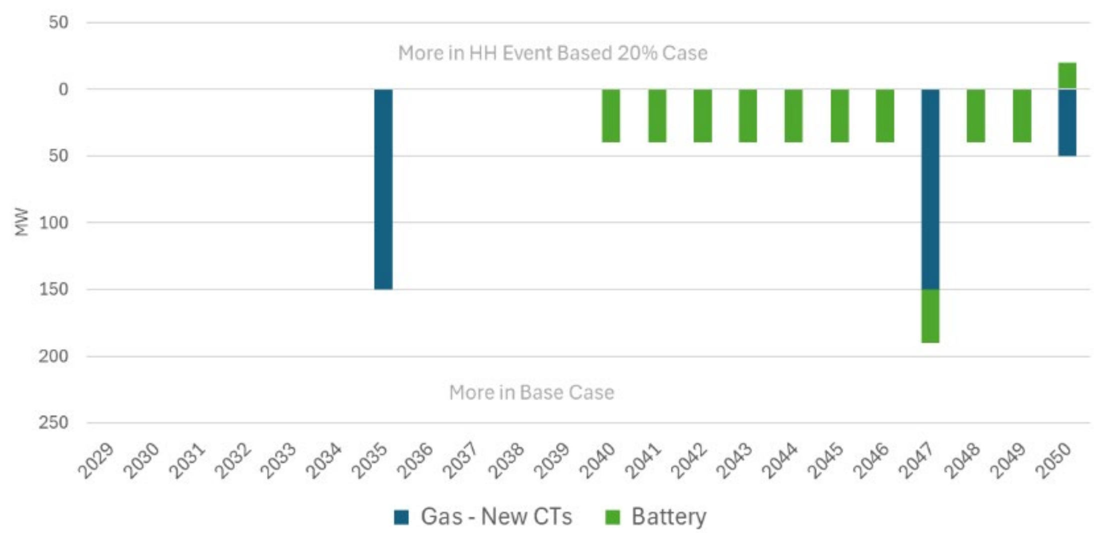



FIGURE 19 - COMPARISON OF EXPANSION PLANS - PROGRAM 3 CPP EVENTS (12.3% ADOPTION)




Program scenarios 1 and 2 have similar impacts on planned resource capacity. Both avoid battery and combustion turbine capacity additions relative to the Base Case (Figures 17 and 18), particularly in the later years as cumulative hybrid heating adoption increases. This occurs because both programs reduce electricity demand during many of the same winter peak hours, resulting in similar reductions in firm capacity requirements. Program scenario 3 is a smaller critical peak event program and primarily avoids battery capacity additions (Figure 19) due to its lower participation level and smaller overall impact on peak demand.

Based on the expansion plans produced in PLEXOS, the reduction in firm capacity built relative to the Base Case can be observed. Table 6 compares the program capacity, actual peak reduction, and avoided firm capacity across the three scenarios. It is important to note that the avoided capacity shown in the figures includes a mix of resource types, batteries and combustion turbines, which do not contribute to firm capacity on a one-for-one basis and are built in discretely sized blocks. As a result, reductions in firm capacity requirements do not directly correspond to reductions in peak demand. The larger program scenarios 1 and 2 achieve greater reductions in firm capacity requirements than program scenario 3 due to their larger program capacities and associated peak demand reductions.

TABLE 6 – PROGRAM COMPARISON – REDUCTION IN FIRM CAPACITY BUILT

| Hybrid Heating Program Design | Program Capacity (MW) | | | Peak Reduction (MW) | | | Reduction in Firm Capacity Built (MW) |
|---|---|---|---|---|---|---|---|
| | 2030 | 2035 | 2040 | 2030 | 2035 | 2040 | Avg 2028 - 2050 |
| Program Scenario 1 - Temperature Triggered Program<br>• Triggered in hours when temperature < -10 deg C<br>• 50% adoption of all non-electric conversions | 40 | 103 | 139 | 40 | 92 | 77 | 54 |
| Program Scenario 2 - Event Based Program<br>• Critical Peak Events<br>• 50% adoption of all non-electric conversions | 40 | 103 | 139 | 40 | 92 | 77 | 60 |
| Program Scenario 3 - Event Based Program<br>• Critical Peak Events<br>• 12.3% adoption of central system conversions | 10 | 25 | 34 | 10 | 25 | 34 | 23 |

### 4.3.5. Dispatch and Energy System Impacts

Figures 20, 21 and 22 below summarize the annual difference in energy production by resource type between the Base Case and each hybrid heating program scenario. Negative values indicate lower electricity generation or imports in the hybrid heating case relative to the Base Case, while positive values indicate higher generation levels in the hybrid heating case.

FIGURE 20 - ANNUAL ENERGY DIFFERENCE - PROGRAM SCENARIO 1 TEMPERATURE TRIGGERED (50% ADOPTION)

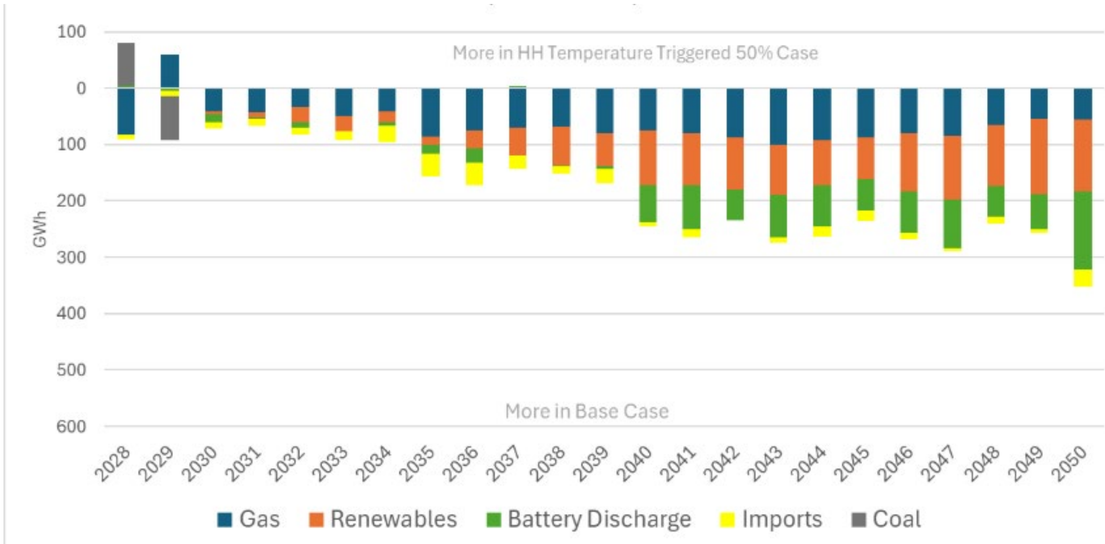



FIGURE 21 - ANNUAL ENERGY DIFFERENCE – PROGRAM SCENARIO 2 CRITICAL PEAK EVENTS (50% ADOPTION)

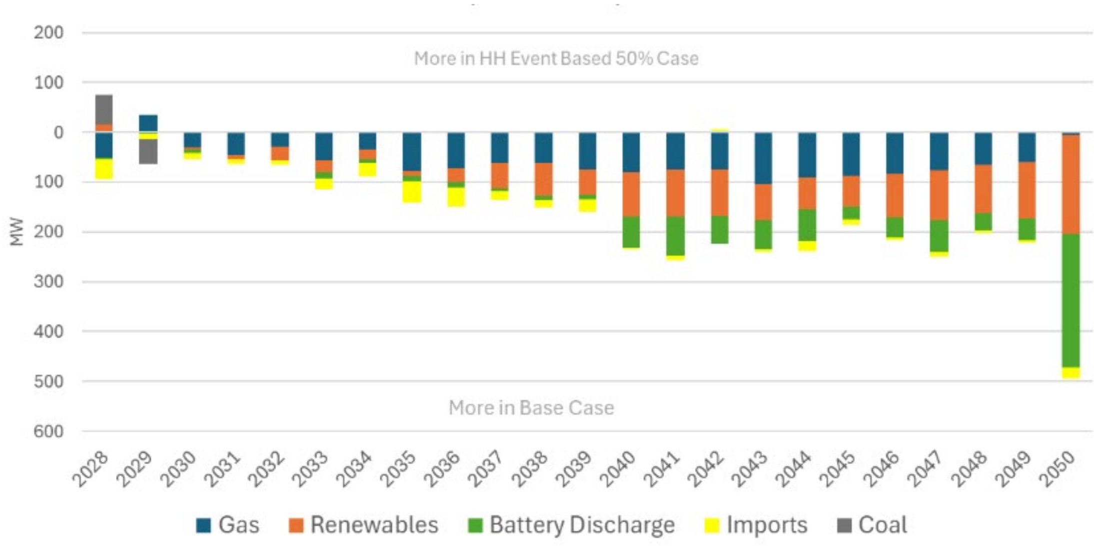
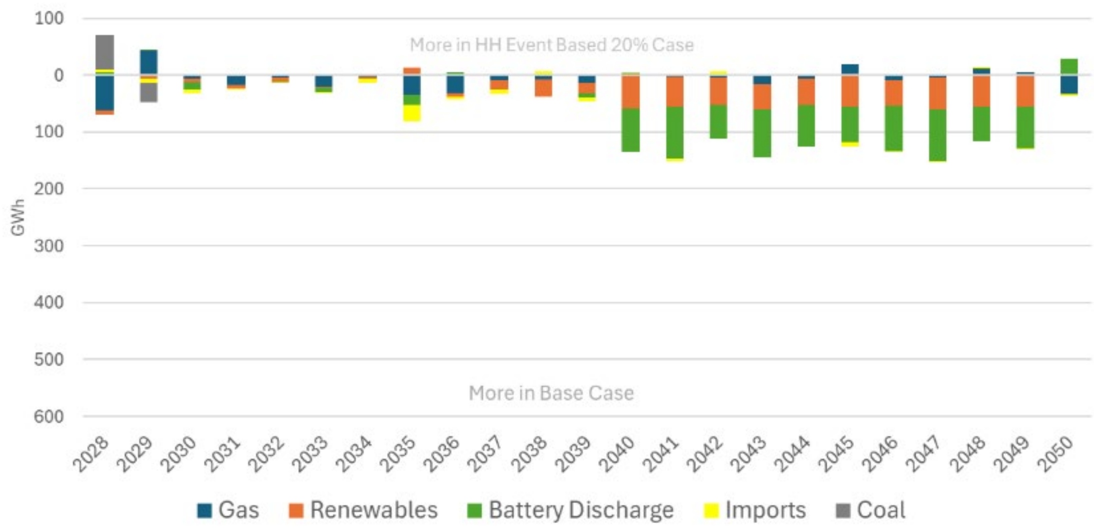


FIGURE 22 - ANNUAL ENERGY DIFFERENCE - PROGRAM SCENARIO 3 CRITICAL PEAK EVENTS (12.3% ADOPTION)




Program scenarios 1 and 2 displace fossil fuel generation (mostly gas-powered) and imports as shown in Figures 20 and 21. Program scenario 1, the temperature triggered program, displaces more renewable generation compared to the other programs. This is because the program operates during all hours when the temperature is below -10 degrees Celsius, including those that coincide with periods of high wind generation, reducing the need for renewable generation during those periods. Program scenario 3 is the smaller critical peak events program and displaces less natural gas generation and imports (Figure 22) due to its lower participation level and smaller overall impact on system demand.

## 4.4. Program Value, GHG Implications, and Design Insights

This section interprets the modelling results by considering program value, GHG implications, and program design trade-offs.

### 4.4.1 GHG Implications of Hybrid Heating Operation

The hybrid heating scenarios also have greenhouse gas implications because hybrid operation shifts a portion of residential heating demand from electricity to a non-electric backup fuel during event hours, while also reducing electricity system generation and associated emissions. To provide a high-level estimate of this trade-off, an additional GHG screening calculation was completed for each program scenario.

The calculation includes two components:

1. Emissions from backup fuel use, estimated by assuming that participating hybrid heating systems use oil furnaces during hybrid heating event hours.

2. Avoided electricity system emissions, estimated from the PLEXOS modelling results by comparing total annual electricity system emissions in each hybrid heating program against the Base Case.

Table 7 summarizes the key assumptions used to estimate emissions from the backup fuel operation.

TABLE 7 – BACKUP FUEL EMISSIONS CALCULATION ASSUMPTIONS[15]

| Assumption | Value Used | Explanation |
|---|---|---|
| Backup heating fuel | Oil | The calculation assumes the non-electric backup system is an oil furnace, which is a common fossil backup heating system in Nova Scotia. |
| Representative oil furnace capacity | 45 MBH | A typical residential oil furnace size was assumed. This is equivalent to 45,000 BTU/hour. |
| Furnace efficiency | 85% | This reflects the assumed useful heat output relative to fuel input. |
| Fuel input rate | ~0.056 GJ/hour | This is the estimated fuel energy consumed by one oil furnace for each hour of hybrid operation, after accounting for efficiency. |
| Oil combustion emissions factor | 0.075 $tCO_2e/GJ$ | This factor was used to convert oil fuel consumption into GHG emissions. |
| Program 1 event hours | 225 hours/year | Program scenario 1 is temperature-triggered and operates when temperature is below -10°C. |
| Program 2 event hours | 60 hours/year | Program scenario 2 is event-based and operates during critical peak event hours. |
| Program 3 event hours | 60 hours/year | Program 3 is also event-based but applies to a smaller customer group. |

The backup fuel emissions were calculated as follows:

$$\begin{aligned}&\boldsymbol{Backup\ fuel\ emissions\ (tCO_2e/year)}\\ &\qquad = \boldsymbol{Number\ of\ participating\ systems} \times \boldsymbol{Event\ hours}\\ &\qquad \times \boldsymbol{Fuel\ input\ per\ hour} \times \boldsymbol{Fuel\ emissions\ factor}\end{aligned}$$

On a per-home basis, this gives approximately 0.95 $tCO_2e$/year for Program scenario 1 and 0.25 $tCO_2e$/year for Program scenarios 2 and 3. Program 1 has higher per-home emissions because it operates for 225 hours per year, compared with 60 hours per year for the event-based programs. Table 8 summarizes the cumulative GHG impacts of each hybrid heating program over the 2028–2050

15 Note: The oil consumption assumption and oil combustion emissions factor used in this calculation are based on the NRCan electrification study assumptions and the ACES database.

modelling period, including emissions associated with backup oil operation, avoided electricity system emissions, and the resulting net GHG impact.

TABLE 8 – CUMULATIVE GHG RESULTS OVER THE 2028–2050 MODELLING PERIOD

| GHG Component | Program Scenario 1: Temperature Triggered, 50% Adoption | Program Scenario 2: Critical Peak Events, 50% Adoption | Program Scenario 3: Critical Peak Events, 12.3% Central Systems |
|---|---|---|---|
| Cumulative emissions from oil backup operation | 950 $ktCO_2e$ | 253 $ktCO_2e$ | 62 $ktCO_2e$ |
| Cumulative avoided emissions from electricity system | -779 $ktCO_2e$ | -687 $ktCO_2e$ | -45 $ktCO_2e$ |
| Net GHG impact | +170 $ktCO_2e$ | -434 $ktCO_2e$ | +17 $ktCO_2e$ |

As a sensitivity case, the GHG screening calculation was repeated assuming natural gas, rather than oil, as the backup heating fuel. Under this assumption, cumulative backup fuel emissions are lower due to the lower emissions intensity of natural gas and the higher assumed furnace efficiency (95%). The natural gas sensitivity results in net GHG impacts of approximately -168 $ktCO_2e$ for program scenario 1, -524 $ktCO_2e$ for program scenario 2, and -5 $ktCO_2e$ for program scenario 3 over the 2028–2050 modelling period. These results demonstrate that the net GHG outcome of hybrid heating is sensitive to the backup fuel used and that programs relying on lower-emission backup fuels can achieve more favourable emissions outcomes.

Positive values indicate an increase in emissions relative to the Base Case, while negative values indicate an emissions reduction. As shown in Table 8, program scenario 2 provides the most favourable GHG outcome, with an estimated net reduction of approximately 434 $ktCO_2e$ over the modelling period. This is because the program is event-based and limits backup oil operation to fewer, higher-value system hours while still avoiding electricity system emissions. Program scenario 1 avoids more electricity system emissions than program scenario 3, but it also operates for many more backup fuel hours. As a result, the emissions from oil backup operation exceed the avoided electricity system emissions, leading to a net increase of approximately 170 $ktCO_2e$. Program scenario 3 has a relatively small net GHG impact because its lower participation level results in fewer backup fuel emissions, but also fewer avoided electricity system emissions.

Overall, the results show that the net GHG impact of hybrid heating is driven by two main factors: the number of hours that customers switch to backup fuel, and the amount of electricity system emissions avoided during those same hours. The calculation assumes that future hybrid heating operation follows the modelled 2022 event definitions: 225 hours based on the 2022 temperature profile for the temperature-triggered program, and 60 hours based on the 2022 CPP event schedule for the event-based programs. These 2022-based event definitions are used as reference cases for comparing program designs and are not intended to predict the exact number or timing of future hybrid heating events. It also assumes oil backup operation, a representative furnace size and efficiency, and full operation during event hours. In practice, the actual number, timing, and duration of switching events would depend on future weather, system conditions, customer participation, and program control rules. This highlights the importance of careful program design so that hybrid heating events are targeted to hours where system benefits are highest, while avoiding unnecessary backup fuel operation. The calculation is therefore best interpreted as a screening-level estimate that helps compare program designs, rather than as a precise forecast of future emissions.

### 4.4.2. Program Benefits and Avoided Costs

The avoided capacity build and displaced generation result in system cost savings with each of the hybrid heating program scenarios. Using the avoided cost of DSM methodology, these cost savings are allocated to the capacity benefit and avoided cost of energy. Table 9 shows these benefits levelized from 2028 to 2050.

TABLE 9 – COMPARISON OF PROGRAM BENEFITS

| Hybrid Heating Program Design | Levelized Capacity Benefit with PRM ($/kW-Yr) | Levelized Avoided Cost of Energy ($/MWh) | Average household peak reduction (kw) | Average annual electric energy reduction during event hours per home KWh/Yr | Avoided T&D Costs (avg 2028 to 2050) ($/kW-Yr) | Approx. gross system value per participating home ($/Yr) |
|---|---|---|---|---|---|---|
| **Program Scenario 1 - Temperature Triggered Program**<br><br>Triggered in hours when temperature < -10 deg C 50% adoption of all non-electric conversions | $188 | $141 | 2.6 | 414.0 | $81.4 | $764 |
| **Program Scenario 2 - Event Based Program**<br><br>Critical Peak Events 50% adoption of all non-electric conversions | $184 | $139 | 2.6 | 149.4 | $81.4 | $716 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Program Scenario 3 - Event Based Program**<br><br>Critical Peak Events 12.3% adoption of central system conversions | $207 | $77 | 2.6 | 149.4 | $81.4 | $765 |

The levelized capacity benefit is within the same range for all hybrid heating programs. This metric represents the annualized avoided capacity value associated with reducing system peak demand, expressed on a $/kW-year basis. The values in Table 9 include an adjustment for the planning reserve margin (PRM)[16], meaning the peak reduction is adjusted to reflect the additional reserve capacity required for system reliability. The levelized avoided cost of energy for program scenarios 1 and 2 is almost double that of program scenario 3. This reflects the dispatch for program scenario 3 which displaces significantly less gas generation compared to the other two programs. As a result, program scenario 3 provides lower overall operational energy cost savings despite achieving comparable capacity value on a per-unit basis.

The modelling results estimate a total system value of approximately $716 to $776 per participating household per year, depending on the program design. This range is broadly comparable to the $749 annual savings threshold shown in Figure 11, where 26% of respondents indicated they would participate. However, Figure 11 also shows a high degree of uncertainty, with 54% of respondents indicating that they did not know or were unsure what level of savings would motivate participation. While the modelled value per home is meaningful, not all of this value would be available to participating customers, as program administration, delivery, equipment, and other implementation costs would also need to be considered.

### 4.4.3 Discussion of Program Design Implications

Recent ELCC analysis prepared for IESO NS and Nova Scotia Power provides useful context for interpreting the hybrid heating modelling results[17]. ELCC measures the contribution that a resource provides toward meeting system reliability needs, relative to a perfect capacity resource. The ELCC study found that call duration is a key driver of capacity value for DR resources. In the generic DR analysis, a four-hour program achieved an ELCC of 61%, while longer-duration programs achieved higher ELCC values, reaching 86% for eight-hour calls and 95% for 24-hour calls.

These findings are relevant to hybrid heating because the resource may be capable of supporting load reductions over extended periods during extreme winter conditions. Unlike conventional short-

16 The planning reserve margin (PRM) reflects the additional capacity required above forecast peak demand to maintain reliability. The capacity benefit is expressed on a $/kW-year basis after adjusting the peak reduction for the PRM. This means the avoided capacity value is normalized over the peak reduction plus the associated reserve requirement.
17 Energy and Environmental Economics (E3). 2026 Nova Scotia Electric System ELCC Study. Prepared for IESO Nova Scotia and Nova Scotia Power.

duration DR programs, hybrid heating can potentially remain active for the duration of a prolonged cold-weather event, provided participating homes are able to maintain comfort using backup heating systems. This capability may provide additional reliability benefits during periods when system risks extend beyond a conventional four-hour event window. However, these benefits must be balanced against increased backup fuel use and associated GHG emissions.

The temperature-triggered and event-based program designs evaluated in this study each have advantages and limitations. The temperature-triggered approach may align with periods of elevated winter demand but may also operate during lower-value hours when system demand is lower or renewable generation is readily available, potentially resulting in unnecessary backup fuel use. As illustrated in Figure 23, however, the load reduction can persist across prolonged periods of elevated system demand rather than being confined to a limited event window, providing sustained demand reduction during extended cold-weather events.

By comparison, the event-based approach provides greater dispatch flexibility and can be targeted to periods of greatest system need. As illustrated in Figure 24, load reductions are concentrated during selected peak periods, reducing backup fuel operation outside those hours. This approach may better align with electricity system conditions and renewable generation availability but may provide less value during prolonged winter reliability events if limited to short-duration calls.

Future program designs may benefit from incorporating elements of both approaches to balance reliability benefits, emissions outcomes, customer comfort, and efficient utilization of renewable electricity generation.

FIGURE 23 - HYPOTHETICAL TEMPERATURE-TRIGGERED EVENT - EXTREME PEAK

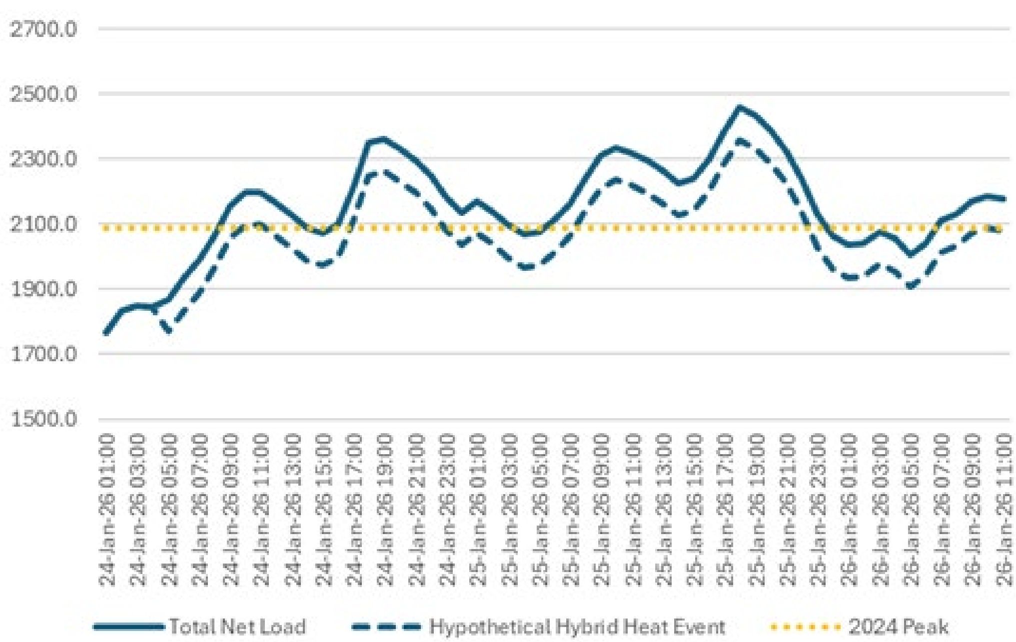
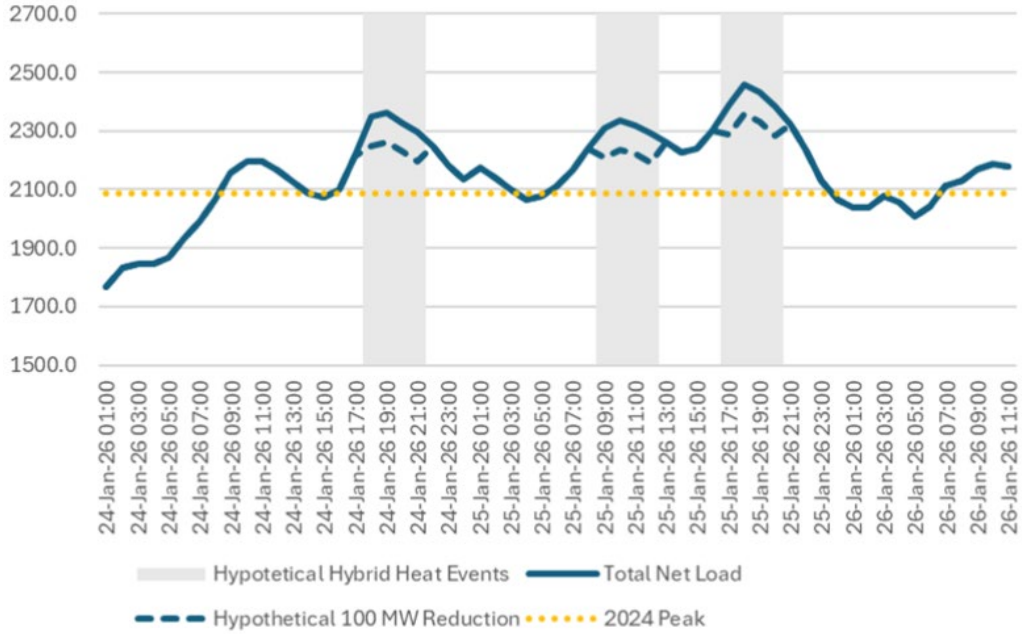


FIGURE 24 - HYPOTHETICAL EVENT-BASED PROGRAM - EXTREME PEAK




## 4.4.4. Conclusion on Modelling Results

Three hybrid heating program scenarios were modelled in this analysis. One scenario was temperature-triggered (Program Scenario 1), while the other two were event-based programs (Program Scenarios 2 and 3) modelled after NSP's CPP program pilot. The scenarios differed in both participation rates and control strategies, resulting in varying levels of peak demand reduction and system benefit.

The results indicate that hybrid heating can provide measurable capacity and energy benefits under a range of program designs. Across all scenarios, levelized capacity benefits were estimated at $184–$207/kW-year. Levelized avoided energy costs were estimated at $141/MWh for program scenario 1, $139/MWh for program scenario 2, and $77/MWh for program scenario 3. The lower value observed for program scenario 3 reflects its smaller scale and different dispatch characteristics relative to the larger program scenarios.

Program Scenarios 1 and 2 produced similar system planning outcomes despite their differing control strategies. Both scenarios reduced the need for future battery and combustion turbine capacity additions relative to the Base Case and achieved comparable reductions in firm capacity requirements. Program Scenario 3 produced smaller impacts due to its lower participation level and correspondingly smaller reduction in peak demand.

The modelling results also suggest that larger programs may experience diminishing returns as system peaks shift to different hours or days. While program scenarios 1 and 2 achieved substantial reductions in firm capacity requirements, the actual peak demand reduction was significantly lower than total program capacity. By comparison, program scenario 3 achieved a peak demand reduction equal to its targeted program capacity. Collectively, these results suggest that a program size between the scenarios evaluated may provide a more efficient balance between peak demand reduction and avoided capacity requirements. While smaller hybrid heating programs can provide meaningful system benefits, avoiding or deferring new generation capacity investments would likely require hybrid heating to either scale to a capacity comparable to a new generation resource (approximately 50 MW) or contribute alongside other DR programs.

Overall, the analysis suggests that hybrid heating could serve as a viable peak demand management tool capable of supporting SE while reducing future capacity requirements. Program design, scale, and control strategy were found to be important determinants of both system value and operational performance. Consistent with recent ELCC findings, the results also suggest that hybrid heating approaches capable of supporting longer-duration operation during extreme winter conditions may provide additional reliability value relative to conventional four-hour DR events. Future assessments should therefore consider both dispatch flexibility and event duration when evaluating hybrid heating program designs.

# 5. Future Program Development Considerations

## 5.1. Institutional Delivery Context

Electricity DSM in Nova Scotia is delivered by Efficiency Nova Scotia through E1 under a provincially granted franchise, with program funding recovered through Nova Scotia Power rates and regulatory oversight provided by the Nova Scotia Energy Board. Nova Scotia's electricity planning environment is also evolving through the transition toward the IESO NS, which is assuming responsibility for IRP and broader electricity system coordination. Within this framework:

- E1 is responsible for designing, delivering, and evaluating DSM and DR programs.
- Nova Scotia Power provides customer billing and rate recovery, and electricity system data relevant to DSM implementation and evaluation.
- IESO NS is responsible for IRP and broader electricity system coordination, including development of future planning assumptions related to DSM resources, electrification, and system reliability.
- The Province of Nova Scotia establishes the legislative and policy context for DSM.
- The Energy Board approves DSM plans, budgets, and cost-effectiveness.

Any future hybrid heating programs would need to be considered within this existing governance and regulatory structure.

## 5.2. Evolving DSM and Regulatory Context

At the time of writing, E1 filed its 2027–2031 DSM Plan with the Nova Scotia Energy Board. The filing includes a proposed portfolio of energy efficiency, DR and solar photovoltaic resources. As part of its planning process, E1 explored several SE pathways and technologies, including heat pump water heaters, cold-climate heat pumps for space heating, hybrid heating concepts, and custom electrification measures (i.e., incentives to support the installation of new systems to replace fossil fuel use with electricity). However, a dedicated SE program was ultimately not included in the filed DSM Plan. According to the filing, the proposed measures were assessed within the context of the Public Utilities Act definition of SE, which requires activities to reduce both GHG emissions and overall electricity costs. The filing notes that the proposed SE pathways did not satisfy the statutory requirements that DSM reduce electricity costs for customers. For hybrid heating concepts targeting in-market hybrid-heating systems, funding is currently not in place for detailed program design and deployment, but is listed as a key activity in E1's SE Focus Area in its proposed Innovation Framework for the filed DSM Plan.

The DSM Plan filing outlines a different approach to residential DR than the hybrid heating concepts explored in this study. The filing primarily focuses on broader DR mechanisms, including smart thermostat-enabled load management, and direct load control concepts, rather than a dedicated hybrid-heating DR program.

The filing also notes limitations on expansion of residential DR programming within the Preferred Plan due to cost-effectiveness considerations, while continuing to support further research, development, and evaluation activities related to future DR opportunities[18].

In parallel, Nova Scotia's electricity system planning environment continues to evolve. The IESO NS is advancing the province's 2026 IRP, while utilities and regulators continue evaluating approaches related to electrification, peak demand management, distributed energy resources, and system flexibility. Within this context, hybrid heating remains one of several potential approaches that may warrant continued assessment alongside other demand-side and supply-side strategies.

These developments reinforce that hybrid heating should be considered within a broader planning and regulatory context rather than as a standalone initiative. Future decisions related to program implementation would likely depend on evolving regulatory direction, system planning outcomes, funding availability, and demonstrated cost-effectiveness under approved DSM evaluation frameworks.

## 5.3. DSM Potential Study

In 2026, E1 and a third-party consultant are undertaking a DSM Potential Study intended to support the IESO NS's 2026 IRP. The study is expected to evaluate future DSM potential and assess additional DR pathways beyond those included in the filed 2027-2031 DSM Plan.

Areas identified for assessment include:

- Potential projections of all existing energy efficiency and DR measures included in the filed 2027–2031 DSM Plan;
- Potential projections for expanded DR measures beyond the filed plan, including direct load control measures applied to mini-split heat pumps installed in homes with central fossil-fuel space-heating systems; and

18 EfficiencyOne. (2026, March 31). Application of EfficiencyOne as Holder of the Efficiency Nova Scotia Franchise. Nova Scotia Energy Board.

- Outputs aligned with the latest IRP forecast assumptions and broader electricity system planning activities underway in Nova Scotia.

This study will in part be informed by past participation of E1 programs as well as insights available on natural adoption.

# 6. Conclusion and Recommendations

Nova Scotia faces a complex energy transition challenge: reducing greenhouse gas emissions from the building sector while managing increasing winter electricity demand associated with electrification. As adoption of electric heating technologies continues to grow, there is increasing interest in approaches that can support emissions reductions while limiting pressure on electricity infrastructure during peak winter conditions.

This study explored residential hybrid heating as one potential tool that may contribute to these broader objectives. Through a jurisdictional scan, customer research, and electricity system modelling, the project examined how hybrid heating programs operate in other regions, how Nova Scotia customers may respond to different program concepts, and how hybrid heating could influence winter peak electricity demand under a range of assumptions.

The jurisdictional scan demonstrated that hybrid heating programs are already being deployed in several jurisdictions using a variety of administrative models, incentive structures, and control approaches. Common themes emerged related to winter peak management, automation, integration with DSM frameworks, and the importance of aligning program design with local regulatory and energy system conditions. The review also found that no single program design is universally applicable, with successful programs typically reflecting local housing stock, heating fuel mix, customer preferences, and electricity system needs. Automated controls were most commonly deployed in homes with central heating systems, while other configurations often required alternative participation approaches.

Customer research findings suggest that Nova Scotia customers are generally open to the concept of hybrid heating, particularly when potential cost savings and reliability benefits are clearly communicated. Financial considerations were identified as the strongest motivator for participation, while concerns related to complexity, control, and cost-effectiveness may represent barriers for some customer segments. Survey results also indicate greater comfort with automated temperature-based switching than with direct third-party control of household heating systems.

The electricity system modelling undertaken as part of this project suggests that hybrid heating could reduce winter peak electricity demand relative to fully electrified heating pathways under certain assumptions. The results indicate that hybrid heating may provide meaningful system value through both avoided capacity requirements and reduced electricity supply costs, while also highlighting the importance of program scale, control strategy, and event duration in determining overall performance. The analysis further suggests that larger programs may experience diminishing returns as system peaks shift to different hours or days, and that approaches capable of supporting longer-duration operation during extreme winter conditions may provide additional reliability benefits relative to conventional short-duration DR programs. However, results remain sensitive to several factors, including participation rates, control strategies, housing stock characteristics, fuel prices, and broader electricity system conditions.

Importantly, this study does not conclude that hybrid heating should be pursued as a predetermined or preferred pathway for Nova Scotia. Rather, the findings suggest that hybrid heating warrants continued consideration alongside other approaches related to SE, DR, rate design, and broader electricity system planning. At the same time, several important uncertainties remain regarding long-term program design, program costs to ratepayers, regulatory treatment, funding mechanisms, customer adoption, and overall cost-effectiveness within Nova Scotia's evolving electricity system. Additional work would likely be required before any large-scale implementation decisions could be considered.

Based on the findings of this work, the following actions are recommended:

1. Continue evaluating hybrid heating within E1's DSM activities and IESO Nova Scotia's IRP processes. Future work should focus on program designs capable of supporting extended-duration deployment, as the ability to sustain load reductions beyond conventional four-hour DR events may represent a key advantage of hybrid heating relative to other residential DR options.

2. Project partners should continue monitoring developments in other jurisdictions and working collaboratively to build a shared understanding of the opportunities, limitations, and potential role of hybrid heating in Nova Scotia. Particular attention should be given to program cost-effectiveness, program funding pathways, program delivery, and alignment with Nova Scotia's electricity system and decarbonization objectives.

3. Consider a pilot-scale demonstration to assess operational performance, customer participation, and program delivery considerations under Nova Scotia conditions prior to broader deployment. A pilot could help determine whether hybrid heating events, including longer-duration events, can be delivered reliably without unacceptable customer comfort impacts, while also providing evidence on program cost-effectiveness, customer response, contractor requirements, backup fuel use, and monitoring and verification needs. Implementation of such a pilot would require the identification of appropriate funding sources.

If a Hybrid Heating program is pursued the following items should be considered:

4. Consider hybrid heating control strategies that balance reliability benefits, emissions outcomes, and efficient utilization of available renewable electricity generation.

5. Consider how Nova Scotia's housing stock, heating fuel mix, customer preferences, and electricity system needs may influence future hybrid heating program design. Given the diversity of residential heating configurations, a single program design is unlikely to be

suitable for all customers. Automated control approaches may be best suited to homes with existing central heating systems, while manual or customer-confirmed approaches may be more appropriate for homes with ductless heat pumps or other non-central heating configurations.

6. Consider developing a customer education and engagement strategy as part of any future program design. Clear communication will be needed to explain program requirements, expected savings, backup fuel use, customer responsibilities, available incentives, and the role of hybrid heating within broader electrification and emissions reduction efforts.

Overall, the findings of this study are intended to support informed, evidence-based discussion regarding the potential role of hybrid heating within Nova Scotia's evolving energy transition and electricity system planning landscape

# Abbreviations

| Abbreviations | Meaning |
|---|---|
| ASHP | Air-source heat pump |
| CPP | Critical Peak Pricing |
| DR | Demand Response |
| DSM | Demand-side management |
| E1 | Efficiency One |
| E3 | Energy and Environmental Economics Inc. |
| GHG | Green House Gases |
| HP | Heat Pump |
| IESO NS | Independent Electricity System Operator Nova Scotia |
| IRP | Integrated Resource Plan |
| KPI | Key Performance Indicator |
| M&V | Measurement and Verification |
| NSR | Net System Requirement |
| SE | Strategic Electrification |

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