# Who Bears the Load?

## An Equity Lens on Residential Load Management and Rate Design in British Columbia


Prepared by:

**Clare Mengebier,**
**UBC Sustainability Scholar**
**August 2026**

Prepared for:

**Dylan Heerema,**
**Senior Policy Advisor,**

**Robyn Ashwell,**
**Program Manager**

**Community Energy Program,**
**Ecotrust Canada**

ecotrust canada

Our Community Energy program is committed to a future in which energy justice is achieved in Canada — where everyone has affordable access to essential home energy services while living in comfortable, healthy homes. This transition will also catalyze a future in which communities use localized, climate safe, and resilient energy systems.

# Contents

## About the Sustainability Scholars Program

The UBC Sustainability Scholars Program is an innovative paid internship program that matches UBC graduate students with on- and off-campus organisations to undertake applied research projects that advance sustainability and climate action in the Lower Mainland and across British Columbia. The program is one of several offered by the UBC Sustainability Hub that provide students with experiential learning opportunities related to complex sustainability issues.

To learn more about the sustainability Scholars Program visit the website here:

**http://sustain.ubc.ca/scholars**

To read this and other project reports, visit the project library here:

**http://sustain.ubc.ca/scholarslibrary**

## Territory Acknowledgement

I acknowledge that this report was written and the work described herein took place on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh Úxwumixw (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations. I also acknowledge that British Columbia's modern electricity system was built largely on First Nations land taken without meaningful consultation, which has disrupted hunting and fishing areas and permanently altered ancestral lands. I respect and acknowledge the unique values and rights of these Nations as it relates to the continued development of the energy system on these lands.

# Contributor Acknowledgements


A special thank you to the following individuals for contributing their input and expertise from across the building, energy, and nonprofit space in British Columbia and North America, including:

**Robyn Ashwell, Ecotrust Canada**

**Dylan Heerema, Ecotrust Canada**

**Josephine Schrott, Ecotrust Canada**

**Michael-Anthony Lutfy, Ecotrust Canada**

**Tom Berkhout, Birch Consulting**

**Deva Veylan, CoEfficient Building Science**

**Abhilash Kantanmeni, Heating, Refrigeration and Air Conditioning Institute of Canada**

**Jeremy Overton, Technical Safety BC**

**Robert Baxter, Vancouver Renewable Energy and SolShare Energy**

**Sean Palfenier, Riverside Energy Systems**

**Stephanie Tucker, Consumers Energy**

**Dr. Werner Antweiler, University of British Columbia**

**Jason Rowley, BC Hydro**

**Melodie Bell, BC Hydro**

**Mas Babaei, EVectriX EV Solutions**

**Kerry Shaw, UBC Green Buildings & Neighbourhood Climate Action**

**Dr. Tom Mommsen, Salish Sea Renewable Co-operative**

**Ryan Coleman, Ecolighten Energy Solutions**

**Mariko Michasiw, Zero Emissions Innovation Center**

**Mike Henchmen, RMI**

**Evan Pivnick, Clean Energy Canada**

**Veena Prasad, Spark Northwest**

**Johanna Rohde, Spark Northwest**

# Executive Summary

British Columbia is in a period of rapidly rising electricity demand. Without effective action, this growth will place greater pressure on the electricity system and contribute to higher energy costs for customers.

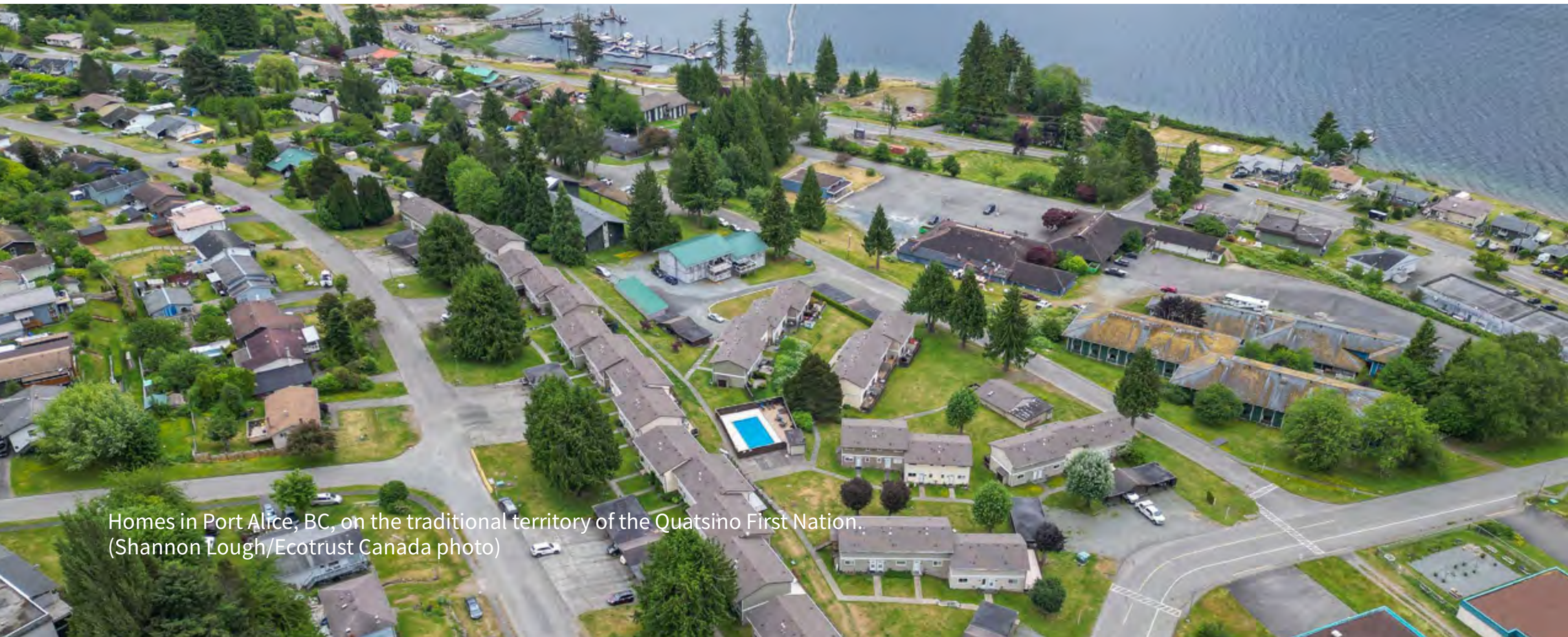
Load management technologies such as smart thermostats, batteries, and load controllers manage ***when*** and ***how*** households consume electricity, benefiting utilities through greater grid stability and lower system costs. They can also help households reduce electricity bills, avoid costly service upgrades, and unlock electrification benefits of improved health, safety, affordability, and comfort.

However, these shared benefits of load management will not be maximized or distributed equitably through technology deployment alone. The demand reduction potential of load management cannot be fully realized unless home retrofit programs and electricity rates account for the unique needs and circumstances of energy-insecure households. Achieving peak-demand reduction that also supports energy security across all households requires programs and rates that:

- Remove upfront cost and participation barriers,
- Protect households from higher bills, loss of comfort, and health or safety risks,
- Minimize the time and mental load required to participate, and
- Accommodate unique housing contexts and preferences.

The following load management solutions matrix was scored across equity and implementation considerations using evidence from stakeholder interviews, a literature review, and a household-level cost-benefit where data was available.

Three categories of actions are recommended. Solutions were prioritized where they can be implemented through existing programs and where they exhibit strong evidence of equity benefits. The recommended rate revisions complement BC Hydro's current rate structure



Homes in Port Alice, BC, on the traditional territory of the Quatsino First Nation. (Shannon Lough/Ecotrust Canada photo)

| Technology / Solution | Equitable Outcome | Cost Effectiveness | Utility and Grid Value | Feasibility and Readiness | Scalability and Program Fit | Adoption and Acceptance | Household Net Benefit | Utility Net Benefit | Recommendation |
|---|---|---|---|---|---|---|---|---|---|
| Hot Water Controllers | 3 | 4 | 3 | 3 | 4 | 3 | $405 | $1,191 | Advance |
| Smart Thermostats | 3 | 4 | 3 | 4 | 4 | 3 | $273 | $992 | Advance |
| Load Sharing Devices | 4 | 4 | 2 | 3 | 3 | 4 | $3,700 | $185 | Advance |
| Energy Communities | 3 | 3 | 3 | 2 | 2 | 2 | N/A | N/A | Advance Conditionally |
| Virtual Power Plants | 2 | 2 | 3 | 2 | 3 | 2 | N/A | N/A | Targeted Application or Pilot |
| Smart Panels | 2 | 2 | 3 | 2 | 2 | 2 | ($744) | $185 | Targeted Application or Pilot |
| Rooftop Solar PV | 3 | 1 | 2 | 2 | 2 | 2 | $1,724 | $10,712 | Low priority |
| Battery Storage | 1 | 1 | 3 | 3 | 2 | 2 | ($4,332) | $10,890 | Low priority |

***Note***. Scores were rated on a scale from 1-4, with 1 being the lowest score (*"Solution provides no noticeable benefit under this criterion or may create significant negative impacts."*) to 4 being the highest score (*"Solution performs consistently well and provides clear, significant benefits with no major limitations."*).

and adapt it to expand load management benefits to a wider population.

1. Advance the most promising load management technologies via BC Hydro's Peak Saver program and Energy Conservation Assistance Program (ECAP), and CleanBC's Energy Savings Program.

- ✓ Offer free purchase and installation of ***smart thermostats*** and ***water heater load controller***s via Peak Saver and raise rewards to reflect peak load reduction value.
- ✓ Make ***load sharing devices*** eligible for ESP retrofits where a service upgrade is unavailable, impractical, or exceeds the amount covered through the program.
- ✓ Provide training for ESP-approved contractors (through the Home Performance Stakeholder Council) and ECAP advisors and contractors on application of load management technologies in participating households.
- ✓ Incorporate Peak Saver education and enrollment support via ECAP and CleanBC's Energy Coach Service so households can make an informed enrollment decision.

2. Expand access to shared solar generation to extend the benefits of larger-scale load management beyond individual homeowners.

- ✓ Increase the Community Generation rate for income-qualified customers or provide credits so lower-income ratepayers can benefit from solar generation.
- ✓ Reserve community-generation funding carve-outs for lower-income members, Indigenous communities, and housing cooperatives.
- ✓ Fund technical assistance and capacity building for community-led solar projects.

3. Design rates to align incentives for load management while protecting affordability.

- ✓ Amend the current Time-of-Use rate

to add broader discounted shoulder periods.

- ✓ Offer bill protections for income-qualified Time-of-Use ratepayers, including first-year bill guarantees and penalty-free opt-outs.
- ✓ Provide personalized bill estimates so customers can easily compare rate options.
- ✓ Introduce a Subscription+ rate option with income-qualified supports.

Once short-term priorities are addressed, longer-term pilots and program amendments are also recommended. Actions include piloting plug-and-play batteries for renters, deploying battery storage in social and affordable housing, and restoring low-cost solar financing.

These recommendations will not be successful without the use of equity-focused program design. Applying program design best practices, including the use of trusted delivery partners and stakeholder-centered outreach, will help overcome participation barriers and reduce risk of harm. This design approach encourages broader participation, which not only enables long-term benefits to marginalized households but also creates a larger and more reliable source of peak-demand reduction for the electricity system.

**BARRIERS**

- Up-front costs
- Mental load & limited flexibility to shift energy use
- Digital access gaps
- Autonomy, trust and privacy
- Inaccessible information
- Tech designed for affluent early adopters

→

**EQUITABLE PROGRAM DESIGN**

- Energy efficiency before load management
- Accessible financing
- Communication & education
- Equity-centered pilots
- Trusted delivery partners
- Meaningful success metrics
- Regulator & installer clarity

→

**LONG-TERM BENEFITS**

- Affordability & energy security
- Emissions reduction
- At-home health & comfort
- Backup power & resilience
- Community ownership & governance

# Introduction

British Columbia is experiencing significant electricity demand growth, and demand is expected to rise by approximately 50% over the next 15 years.[1] This growth is being driven by rising industrial demand, through artificial intelligence and industrial electrification, and residential demand, via electric vehicle adoption and home electrification.

Electrification provides important economic, health, and environmental benefits, particularly for energy insecure households. Clean Energy Canada (CEC) estimates that households switching to a heat pump enjoy energy bill savings of up to $849 CAD per year and can reduce heating and cooling emissions by up to 97%.[2] Enabling home electrification can have important health and safety benefits such as in-home air quality improvements and safer indoor temperatures.[3] These issues are becoming more pressing given the risks of extreme heat. The 2021 heat dome was associated with over 600 heat-related deaths across the province.[4] On a climate scale, province-wide electrification of space and water heating could reduce emissions by as much as 3.5 megatons per year, or about 6% of B.C.'s current emissions.ii British Columbia recognizes these broad benefits, setting a target of 100% clean electricity by 2030 through its CleanBC Roadmap.[5]

However, electrification increases pressure on the grid by adding new electricity demand. Natural Resources Canada estimates that the number of heat pumps in B.C. homes nearly tripled from 2017 to 2022. While replacing fossil-fuel heating with electric heat pumps reduces emissions and lowers energy bills, widespread adoption also contributes to winter peak demand, which is projected to rise by 44% by 2050.[6]

Because the system must serve the highest-demand hours, rising energy peaks on the coldest winter day require costly infrastructure investments that place upward pressure on electricity bills, disproportionately impacting energy-insecure households. Approximately 5% of B.C. households already spend at least 10% of their after-tax income on home energy, and rising bills mean more homes may have to choose between heating their home or buying groceries.[7]

Residential demand response and load management are strategies for relieving peak electricity demand. These strategies create significant benefits for both utilities and households by shifting, limiting, or temporarily reducing flexible loads. Technologies such as water-heater controllers can pre-heat before peak periods, while batteries can charge overnight and provide electricity when demand is high. Load-sharing devices and smart panels can help households add electric appliances without exceeding their existing electrical capacity, avoiding costly service upgrades.

Electricity rates and utility-run demand-response programs can incentivize adoption of these technologies by rewarding households for shifting or reducing demand. BC Hydro is already incorporating load management into its energy planning through its Power Smart 2.0 plan. Released in May 2026, the program includes residential measures such as free smart thermostats and advancement of its Peak Saver program, a voluntary program that rewards customers for using less electricity during peak demand periods and allows the utility to make small, temporary adjustments to home devices.[8] Coordinating many small reductions during peak periods can free system capacity, support grid reliability, and reduce the need for costly infrastructure upgrades. Research has shown that these programs not only benefit program participants, but they also drive down bills for ***all*** customers by reducing the total cost of operating the electric grid.[9]

For more detailed background explanations on the topics of demand response, load management, and rate design and BC Hydro's current programs, refer to Appendix I.

**Electrification, load management, and B.C.'s energy inequity**

Load management technologies, rate designs, and associated demand response programs can support more affordable electrification, but without deliberate program design, their benefits will not be distributed equitably and, in some cases, may even worsen energy insecurity.x Up-front costs, limited digital access, lack of control over housing infrastructure decisions, inflexible schedules, and concerns about utility control can exclude households that stand to benefit most. Research from the National Laboratory of the Rockies, formerly the National Renewable Energy Laboratory (NREL), emphasizes that early engagement and consideration of energy justice principles in program design are necessary to incorporate stakeholder needs and ensure that injustices are not "locked in" to the project development process.[10]

These considerations are timely given the recent $222 million expansion of the Energy Conservation Assistance Program (ECAP), a province-wide program that provides no-cost energy efficiency improvements to income-qualified households. The expansion provides an opportunity to increase participation in residential load management while accounting for the unique contexts of energy insecure and marginalized households. xxv

To meet BC Hydro's mandate to manage a safe, reliable, and affordable electricity system while supporting the public interest of British Columbia, the utility needs to understand the unique needs, benefits, and routines of households across the province. As electrification accelerates, the value of load management will increasingly depend on where technologies are deployed and which local grid constraints they help address. As Evan Pivnick of Clean Energy Canada explained, there can be "incredibly high value at a distribution level [to defer] infrastructure upgrades, but also to build out resiliency, support affordability, and enable electrification." Analysis must also look beyond the broad category of "low-income households", since renters, rural residents, Indigenous communities, seniors, medically vulnerable households, and other groups have distinct needs, constraints, and risks. Assessing load management across these contexts will help utilities and policymakers select appropriate technologies, design effective safeguards, and maximize benefits for households and the wider electricity system.

Finally, there is evidence that social acceptance of clean energy programs is more prevalent when distributive and procedural justice factors are recognized throughout project development.[11] This suggests the critical importance of considering equity factors unique to British Columbia's context if the province wants to meet its aggressive clean energy goals it has set out.

## Research Approach

This report focuses on load management and rate design solutions relevant to energy-insecure homeowners and renters in British Columbia. Energy insecure households are those that meet Statistics Canada's classification as "energy poor", or households that spend 10% or more of after-tax income on energy bills.[12] Large, high-rise buildings governed under Part 3 of the BC Building Code are outside the report's scope.

Research was conducted in four stages. First, a comprehensive inventory of technologies and rate designs was compiled and screened for potential alignment with the equity and implementation dimensions below. Appendix II provides the full solutions inventory, including options not selected for analysis.

Second, shortlisted solutions were examined in detail using the following sources:

- **Literature Review** of peer-reviewed academic sources and trusted non-academic sources, including industry, government, and utility publications.
- **Case Studies** of demand-response programs, pilots, and rate design from comparable jurisdictions.
- **Stakeholder Interviews** with over 20 individuals from the building, energy, and non-profit sectors across Canada and the United States.

Third, each solution was assigned a score using a weighted scoring framework across the following dimensions:

### Scoring Dimensions and Weights

| Dimension | Weight | Assessment question |
|---|---|---|
| Equitable Outcomes | 25% | Will the solution meaningfully benefit energy-insecure households while mitigating or avoiding negative impacts? |
| Cost Effectiveness | 15% | Will the solution lower bills, avoid major costs, enable beneficial electrification, or provide other material net benefits? |
| Utility and Grid Value | 15% | Will the solution produce reliable peak reduction, flexible capacity, infrastructure deferral, or other grid benefits at a reasonable utility cost? |
| Feasibility and Readiness | 15% | Is the solution commercially mature, supported by current regulations and electrical codes, and compatible with existing programs and technologies? |
| Scalability and Program Fit | 15% | Can the solution be delivered at scale through existing or expanded utility, government, or retrofit programs without excessive administrative or delivery complexity? |
| Adoption and Acceptance | 15% | Is installation minimally disruptive, is operation easy to understand, and ongoing household effort low? |

Assigning scores allowed comparison of solutions across priority considerations. The equity dimension received a higher weight aligned with the report's main objective to evaluate solutions from an equity lens. Equity is clearly defined in the following section. Implementation dimensions were also used to assess whether a solution can feasibly deliver equity benefits on-the-ground and at-scale. Each technology received a score from 0 to 4 per dimension based on the strength and consistency of the available evidence. These scores were weighted and summed to produce an overall score out of 100.

### Scoring Scale

| Score | Meaning |
|---|---|
| 0 | Solution provides no noticeable benefit under this criterion or may create significant negative impacts. |
| 1 | Solution performs poorly, has no evidence, or faces substantial limitations. |
| 2 | Solution provides moderate or mixed benefits that depend on program design or household context. |
| 3 | Solution performs well, with manageable limitations or implementation conditions. |
| 4 | Solution performs consistently well and provides clear, significant benefits with no major limitations. |

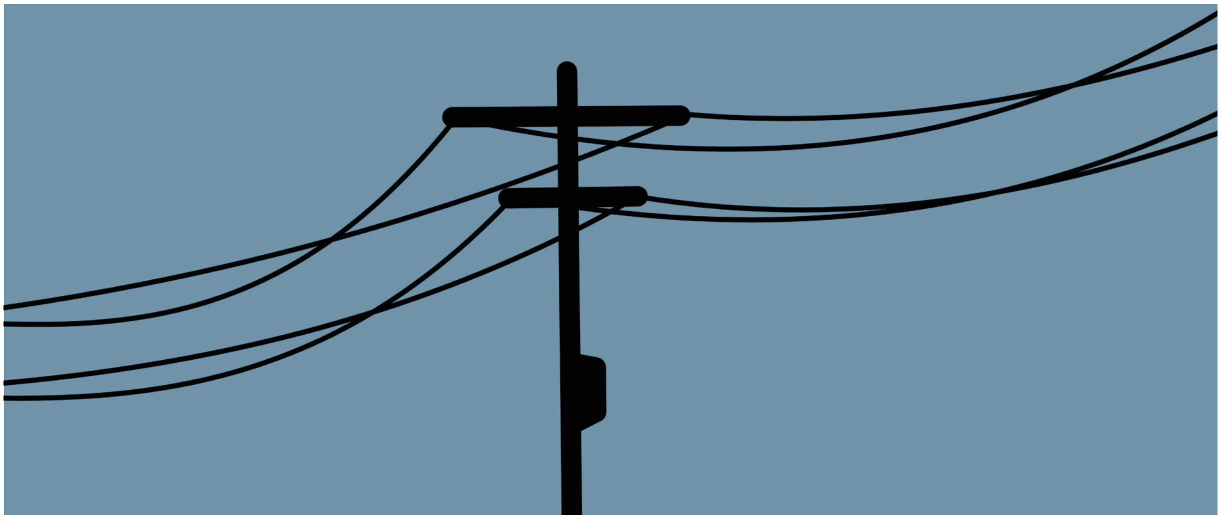
Where sufficient data were available, a cost-benefit analysis was also conducted to add a quantitative estimation of net benefits for the household and utility. Technologies were recommended for advancement if they showed positive net benefits for both groups and achieved a high aggregate score based on the following scale:

### Recommendation Scale

| Score | Recommendation |
|---|---|
| 80 - 100 | Advance |
| 60 - 80 | Advance conditionally |
| 50 - 60 | Targeted application or pilot |
| Below 50 | Do not prioritize until conditions change |

**Note**. Each criterion score was divided by the maximum score of four, multiplied by the assigned weight and summed across criteria to produce a weighted score out of 100.

Finally, electricity rates were assessed for compatibility with load management technologies. A comparable quantitative scoring approach was not applied because the household load-response data needed for a reliable comparison were not available. Instead, evidence from the literature review and stakeholder interviews was used to compare benefits, limitations, risks, and potential among rates and incentives. Rate options with the lowest risks for energy-insecure households and strongest potential to complement load management solutions informed the final rate recommendations.



### Equity Defined

Research and scoring on the equity dimension of load management was guided by the Urban Sustainability Director's Network's definitions of equity.[13]

| Equity Dimension | How It Relates to Load Management |
|---|---|
| **Procedural Equity:** Inclusive, accessible, and authentic engagement and representation in processes to develop or implement sustainability programs and policies. | • Energy support programs use trusted community partners, simple messaging, and hands-on support rather than expecting households to navigate rate, rebate, and technology choices alone.<br>• Technologies and rate designs match household contexts rather than assuming universal suitability.<br>• Diverse households are engaged during pilots, including renters, social housing tenants, manufactured home residents, Indigenous communities, and medically vulnerable households. |
| **Distributional Equity:** Programs and policies that result in fair distribution of benefits and burdens across all segments of a community, prioritizing those with the highest need. | • Utility-side savings from peak reduction can benefit all ratepayers, but direct financial incentives may still flow mainly to participants.<br>• Implement tracking mechanisms to measure benefits by income, tenure, housing type, and geography. |
| **Transgenerational Equity:** Counsels sustainability decision-making processes that consider generational impacts and do not result in unfair burdens on future generations. | • Technologies are prioritized that reduce long-term system costs for vulnerable households.[1]<br>• Solutions address future climate change impacts such as rising risks of extreme heat and power outages. |
| **Structural Equity:** Decision-makers institutionalize accountability, and decisions are made with recognition of historical, cultural, & institutional dynamics and structures that routinely advantage privileged groups. | • Address barriers embedded in housing, utility, financing, and program systems, including renter-landlord split incentives, limited access to capital, digital exclusion, and historic underinvestment.<br>• Change program rules and delivery models rather than relying only on households to overcome these barriers. |

1 For example, current EV ownership is concentrated among more affluent buyers in B.C. but as vehicle costs decrease and more used EVs become available on the market, decisionmakers should prioritize load management solutions that target this technology with low-income context in mind.

# A Pathway to Equitable Load Management

## Barriers to Equitable Load Management

Cross-cutting barriers have emerged as recurring themes across the academic literature, stakeholder interviews, and industry reports. If left unaddressed, these barriers can exclude energy-insecure households, concentrate benefits among affluent early adopters, and expose participants to higher costs and reduced comfort. Equitable program design practices provide a pathway to overcome these barriers and ensure the long-term benefits are equitably shared among all households.

This section focuses on broad barriers, program design practices and long-term benefits. Benefits and risks for specific load management technologies and rates are listed in the profiles below.

**Pathway to Equitable Load Management**

**BARRIERS**

- Up-front costs
- Mental load & limited flexibility to shift energy use
- Digital access gaps
- Autonomy, trust and privacy
- Inaccessible information
- Tech designed for affluent early adopters

→

**EQUITABLE PROGRAM DESIGN**

- Energy efficiency before load management
- Accessible financing
- Communication & education
- Equity-centered pilots
- Trusted delivery partners
- Meaningful success metrics
- Regulator & installer clarity

→

**LONG-TERM BENEFITS**

- Affordability & energy security
- Emissions reduction
- At-home health & comfort
- Backup power & resilience
- Community ownership & governance

**Up-Front Costs**

Many technologies require equipment, installation, and electrical work, so most low-income households are excluded unless up-front costs are fully subsidized, directly installed, or financed in a way that produces immediate net savings.  Although electric vehicle costs are decreasing, the high cost of EVs prevent many lower-income households from benefiting from EV charging, including lower bills from pairing charging with Time-of-Use rates. BC Hydro offers rebates for these technologies, but this form of incentive is often inaccessible to low-income households if they must pay upfront and wait for reimbursement.

**Flexibility Capital Divide**

Households differ significantly in their ability to monitor energy use or shift activities to lower-cost periods. Caregiving responsibilities, shift work, health needs, financial stress, and irregular schedules can make programs that require frequent attention or manual behavior changes difficult to sustain. This contributes to a "flexibility capital divide", where higher-income households are more likely to use automated technologies without sacrificing comfort, while lower-income households may need to delay cooking, laundry, heating, or other activities manually to receive the same benefits. Increases in domestic labor and mental load have also been shown to disproportionately affect women.xv

A 2025 research study found that older adults and persons with disabilities experienced increases in bills when enrolled in a time-of-use program due to reliance on energy for medical equipment and sensitivity to temperatures that lower their ability to shift load to off-peak hours.[14]

**Digital Access Barriers**

Smart devices, batteries, and other technologies often require Wi-Fi, which can exclude households with poor internet access, particularly in rural, remote, and First Nations communities. Approximately 76.5% of rural B.C. households and 80.3% First Nations households have access to high-speed internet, compared with 96.1% of all B.C. households. The price of high-speed internet was 21% higher for rural households than urban households.[15] B.C. has committed to connecting every household with high-speed internet by 2027.[16] This should reduce the infrastructure gap, but affordability and device access reliability barriers may remain even where broadband becomes available.

**Autonomy, Trust, & Privacy**

Utility-controllable devices may offer larger grid benefits, but households may resist utility control over home devices due to concerns about autonomy, trust, surveillance, privacy, or loss of control. Ecotrust Canada's staff working in remote communities report a higher level of distrust for their utility in areas where people experience higher rates of power outages (for example, end-of-line communities such as northern Vancouver Island). Thus, load management solutions that can mitigate the effects of outages such as batteries or solar cooperatives may increase trust and improve customer relations between communities and the utility.

**Lack of Accessible Information**

Households may be unaware of relevant technologies, rates, incentives, or subsidies, particularly when information is technical, spread across multiple programs, or requires substantial time to research. These barriers can be greater for households managing financial stress, irregular work schedules, caregiving, language barriers, or limited familiarity with utility and retrofit programs.

### Technology designed for affluent early adopters

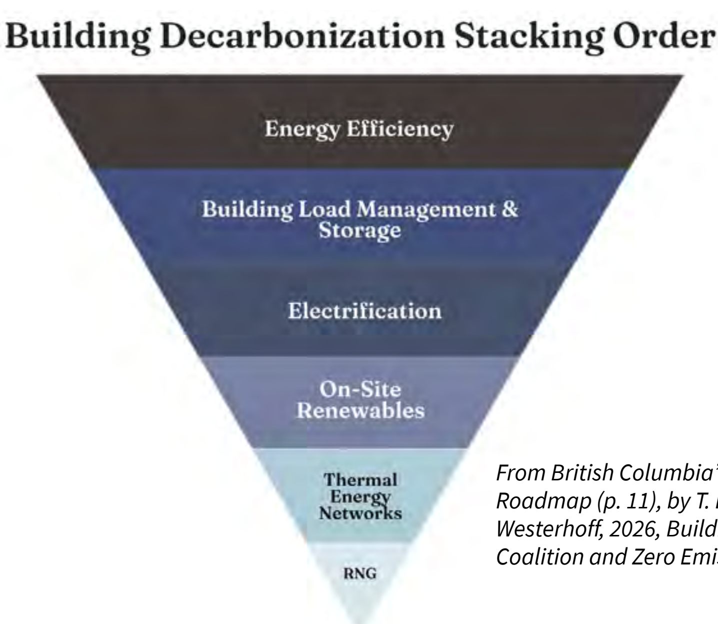
Product offers for emerging technologies tend to target affluent groups with flexible assets (for example, upside-only retail offers available to people who already own high-cost assets such as EVs).xv Research suggests late adopters of smart energy technologies and flexible tariffs are also more likely to have low incomes, experience energy poverty, or have health vulnerabilities. The study also showed that these households are only likely to adopt these technologies with policy intervention.xv As a result, low-income and vulnerable households can be routinely shut out of opportunities that could lower their bills and allow them to experience the benefits of the clean energy transition.

## Best Practices for Equitable Program Delivery

Equitable-centered program design ensures that load management initiatives lower the above barriers and distribute program benefits equally across incomes, household types, and community contexts. The following practices are grounded in B.C.-focused research and should be applied alongside the implementation of the specific technologies and rate designs assessed in subsequent sections.

### Energy Efficiency Before Load Management

Load management devices deliver the greatest benefit when they are installed after homes have removed unused loads, upgraded their building envelope, and replaced older appliances with energy-efficient models. This approach follows the B.C. Building Electrification Roadmap and Power Efficient Design principles, which prioritize reducing heat loss and instantaneous electricity demand before increasing electrical capacity or installing controls.[17] Implementing the most cost-effective improvements first lowers the household's baseline load and allows load management technologies to address remaining capacity constraints.




*From British Columbia's Building Electrification Roadmap (p. 11), by T. Berkhout and L. Westerhoff, 2026, Building to Electrification Coalition and Zero Emissions Innovation Centre.*

### Accessible Financing

Low- or no-cost purchase and installation can help households overcome the up-front cost of load management technologies. Past programs that require households to pay up-front costs and then apply for rebates have tended to be used more often by higher-income households.[18] Programs offering load management solutions should therefore consider covering the equipment and installation costs up front.

Accessible financing can also support adoption of technologies not covered by B.C. retrofit programs but still offer significant long-term household benefits, including rooftop solar. Property Assessed Clean Energy (PACE) programs, such as Alberta's Clean Energy Improvement Program, allow installation costs to be repaid through property taxes over longer terms and at lower interest rates. These options are explored further in the Solar Technology Profile below.

### Inclusive Communication, Education, and Outreach

Clear and accessible communication and education on load management and rate pairings are critical to maximizing positive impacts, avoiding negative impacts, and increasing adoption among energy-insecure households. Program administrators should communicate benefits of technologies and demand response programs using tangible impacts on household costs and benefits. Spark Northwest, a Seattle-based energy non-profit, holds community information sessions on home battery systems in partnership with PSE's Flex Batteries program team. In the session they demonstrate that a 10-kWh battery can keep a refrigerator running for 50 hours or charge an iPhone 952 times.[19]

Greater explanation about BC Hydro's status as a publicly-owned Crown corporation could help address skepticism among communities that have historically distrusted utilities or larger institutions. BC Hydro should clearly communicate how reducing peak demand through programs like Peak Saver help mitigate costs for all ratepayers, versus generating excess profits for a privately-owned company.

Evidence also shows that lower-income households are less likely to access online utility portals, highlighting the importance of offering customer education beyond digital channels. Incorporating hands-on training and support for smart technologies into programs such as ECAP will help households make informed choices and address educational, skills-based, and risk-perception barriers.

Finally, providing materials and translation services in multiple languages will help overcome linguistic barriers and support culturally responsive engagement across B.C.'s diverse communities.

### Equity-Centered Piloting

Pilot programs for newer load management technologies and rate designs should include renters, lower-income residents, Indigenous communities, and other marginalized groups so equity considerations are built in from the outset rather than added later. This is important given the limited research on the impacts of demand response programs on quality of life, cost of living, and living conditions for low-income residents.[20] Piloting only with a narrow set of households may overlook the distinct benefits, risks, and behaviors of energy-insecure groups.[21] Utility-funded programs such as ECAP provide an opportunity to test load management solutions at a smaller scale for these groups and apply "do no harm" practices before broader rollout.

### Program Metrics & Success Measurement

Program success should be measured using equity outcomes alongside enrollment rates or peak kilowatts reduced. Programs should track participation, benefits, opt-outs, and incentive distribution by income, housing type, and geography where feasible. Quantitative data should be complemented by interviews and outreach through trusted community partners to capture the on-the-ground experiences of energy-insecure households and identify impacts that program data may miss.

### Appropriate Program Delivery Partners

Partnering with trusted community-based organizations can improve participation and program effectiveness. Organizations such as Ecotrust Canada and Empower Me work directly with communities and provide targeted outreach, trusted support, and culturally appropriate services. In-person engagement is especially important for groups who may be less able to navigate program websites and utility apps, attend public meetings, or manage technology installations and setup independently.

In some cases, government-led programs may be more equipped to deliver equity-focused electrification programs because they can prioritize social outcomes, while utilities must justify investments through system-wide grid benefits.

### Regulatory and Installer Clarity

A common barrier identified in stakeholder interviews was the lack of clarity on the current Canadian Electrical code interpretation and general familiarity with residential load management technologies among electricians, HVAC contractors, and retrofit program evaluators. This creates a risk that households are directed toward costly service upgrades or rejected from heat pump retrofit programs such as ECAP.

Technical Safety BC expects the next electrical code update to provide broader and clearer guidance for these technologies, but B.C. adoption is unlikely before late 2027 or 2028. Until then, applicants must seek variances with Technical Safety BC to install technologies such as load sharing devices and smart panels not included in the current Code's scope.

Contractors strongly influence household decisions and need confidence that installations are permitted, safe, and financially viable. As Abhi Kantamneni from HRAI explains, "most contractors don't have experience with these technologies, including how to deploy them at scale." He cited industry-led hands-on training on how to use load management technologies as a key enabler. The benefit of industry-led training is that it can be led by their peers, incorporate hands-on, interactive training, and incorporate business-side benefits and considerations.

### Other Program Design Best Practices

Kambo Energy Group conducted research as part of their Power Up Communities project launched in 2025 to support B.C. municipalities to embed equity into local climate action. Their report "Power Up BC: Advancing Equity Through Municipal Climate Leadership" outlines other recommendations for equitable program design for B.C. energy programs.xxi

## Long-Term Benefits

When equitable program design removes barriers to access, enrollment, and participation, more households can benefit from load management technologies without taking on added financial, health, or economic risks. Broader and more sustained participation can also provide utilities with a reliable source of flexible demand, helping defer infrastructure upgrades, improve system resilience, and lower long-term costs for all ratepayers.

There are benefits specific to each load management technology but there are also cross-cutting benefits, including:

### Affordability and Energy Security

Load management lowers household energy costs by shifting use away from peak periods under time-of-use rates and by making it possible to install more efficient technologies, such as electric heat pumps, without costly panel or service upgrades. Automated controls reduce household energy use without requiring households to ration essential services or sacrifice comfort. In the long term, reducing peak demand benefits *all* ratepayers by reducing the risk of power outages and helping to limit long-term rate increases.[22]

### Backup Power and Resilience Benefits

The rising risk of climate change-induced extreme heat, cold snaps, and wildfire smoke increases the equity relevance of energy technologies for communities residing in poor-quality housing or located in areas with a higher risk of power outages. Resilience investments should prioritize communities with high outage exposure, limited infrastructure, or essential-service vulnerabilities. Distributed resources, batteries, solar, microgrids, and Virtual Power Plants have additional equity value in these contexts.

### Community Ownership and Governance

Energy communities and cooperatives can improve equity by sharing capital costs, creating community revenue, increasing local control, and enabling participation for renters or households without suitable rooftops. However, cooperatives can reproduce inequity if membership requires disposable income, time, technical knowledge, property ownership, or high minimum investment. Long-term benefits will depend on who holds decision-making power, how revenues are distributed, and whether lower-income households can participate meaningfully.

### Emissions Reduction

According to the Regulatory Assistance Project, over 50% of system flexibility worldwide will need to come from demand-side flexibility by 2050 to achieve net-zero carbon emissions.[23] Load management can support emissions reduction by making it easier and less costly for households to replace fossil-fuel heating and water heating with electric technologies. In regions like British Columbia where the electricity grid is clean, these electrification measures result in significant greenhouse gas emissions reductions.[24] When paired with well-designed rate incentives, these technologies can help B.C. meet its 2050 net-zero emission reduction target under the Climate Change Accountability Act.[25]

# Technology Solutions

This section profiles the most promising load management technologies for B.C., assessing where each solution can deliver the greatest value and what program safeguards are needed to support equitable participation. It considers both individual technologies, such as load sharing devices and smart panels, and aggregated models such as virtual power plants and energy communities.

**Load Management Technologies: Summary Results**

| Technology / Solution | Equitable Outcome | Cost Effectiveness | Utility and Grid Value | Feasibility and Readiness | Scalability and Program Fit | Adoption and Acceptance | Household Net Benefit | Utility Net Benefit | Recommendation |
|---|---|---|---|---|---|---|---|---|---|
| Hot Water Controllers | 3 | 4 | 3 | 3 | 4 | 3 | $405 | $1,191 | Advance |
| Smart Thermostats | 3 | 4 | 3 | 4 | 4 | 3 | $273 | $992 | Advance |
| Load Sharing Devices | 4 | 4 | 2 | 3 | 3 | 4 | $3,700 | $185 | Advance |
| Energy Communities | 3 | 3 | 3 | 2 | 2 | 2 | N/A | N/A | Advance Conditionally |
| Virtual Power Plants | 2 | 2 | 3 | 2 | 3 | 2 | N/A | N/A | Targeted Application or Pilot |
| Smart Panels | 2 | 2 | 3 | 2 | 2 | 2 | ($744) | $185 | Targeted Application or Pilot |
| Rooftop Solar PV | 3 | 1 | 2 | 2 | 2 | 2 | $1,724 | $10,712 | Low priority |
| Battery Storage | 1 | 1 | 3 | 3 | 2 | 2 | ($4,332) | $10,890 | Low priority |

## Load Sharing Devices

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 4 | 4 | 2 | 3 | 3 | 4 | 85% | Advance |

### Description

Electrical load management devices distribute electrical power across multiple devices. They usually control two high-demand loads, an intermittently used load and a prolonged-use load, to reduce overall demand and avoid an expensive electrical service upgrade.

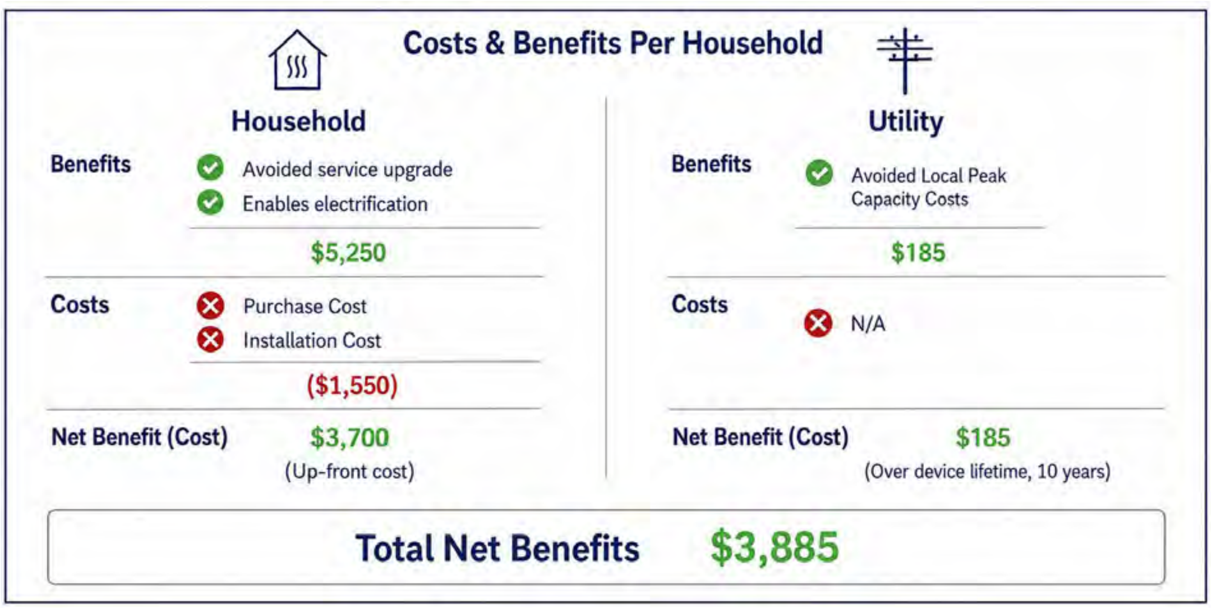
Common devices include:

**Branch Circuit Switching Devices:** installed inside or alongside the panel to allow two large loads to be connected to a single circuit by providing power to secondary load only when primary load is off. Primarily loads run infrequently but must run when needed, including electric cooktops, dryers, or heat pumps, and secondary loads can be shut down temporarily, such as an EV charger or tanked electric water heater.

**Load Pausing Devices:** monitors the electrical load on the entire electrical panel and pauses connected devices when total household demand exceeds a set threshold.

### Housing Contexts

- ✓ Single-family homes, duplexes, and row homes with dedicated electrical panels.
- ✓ Manufactured homes, strata's, and rural homes where electrical upgrades are difficult or expensive.
- ✓ Heat pump installations for propane or oil-powered homes with 60amp service
- × Older homes that have fuses instead of breakers likely require at least a panel upgrade[26]




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III. Avoided costs based on the assumption that devices contribute to lower peak demand by preventing multiple high-power loads from operating simultaneously. However, these may not lower coincident peak demand unless device operation aligns with system peak periods.

**Considerations by Scoring Dimension**

- **Equitable Outcomes:** Load sharing devices can help lower-income, rural, and manufactured-home households avoid service upgrades that would otherwise block participation in electrification retrofit programs such as ECAP.

- **Cost Effectiveness:** Devices are relatively low-cost, with prices ranging from $850 and $1,300.[27]

- **Utility & Grid Value:** Load sharing devices may reduce local coincident peak demand, but they are not utility-dispatchable and do not provide enough certainty that the reduction will occur during BC Hydro's system peak to justify claiming avoided generation capacity benefits.

- **Feasibility & Readiness:** Load management devices have traditionally been used for discretionary loads disproportionately used by higher-income households, such as EV chargers, hot tubs, and workshop equipment.[28] The current Canadian Electrical Code does not provide clear guidance on deploying these devices for other loads such as heat pumps or dryers and requires electricians to apply for a variance with Technical Safety BC before installing.2 Although some ECAP contractors have installed load sharing devices in eligible households, including dryer-hot water tank, range-hot water tank, and range-heat pump pairings, more consistent program guidance is needed to reduce uncertainty for contractors and enable the devices in more households.

- **Scalability & Program Fit**: By avoiding or delaying costly electrical panel and service upgrades, these devices can help stretch limited retrofit funding further for CleanBC's Energy Savings Program and BC Hydro's Energy Conservation Assistance Program (ECAP).

- **Adoption and Acceptance:** After installation, these devices operate automatically and require little attention. Pairing loads that can be paused briefly, such as a dryer and water heater, can keep disruption low. However, contractors should carefully assess household usage patterns to ensure load sharing configurations do not disrupt daily needs.

**Program Pairings**

**ECAP >** ECAP should standardize training and guidance for *all* contractors and evaluators to offer installation of load sharing devices where a service upgrade is unavailable, impractical, or exceeds the amount covered through the program. Increasing clarity will support appropriate installations, reduce unnecessary disqualifications, and improve program consistency and administrative efficiency.

**CleanBC ESP >** Integrate load management devices into Heat Pump or Water Heater rebates as an eligible and fully funded alternative if a service upgrade is unavailable (e.g. remote areas) or exceeds the $5,000 offer currently covered for electrical service upgrades when switching. Provide training for ESP-approved contractors through the Home Performance Stakeholder Council on appropriate application of these technologies.

2 The next electrical code is expected to provide broader acceptance of load management technologies, but BC adoption is unlikely before late 2027 or 2028.

## Smart Panels

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 2 | 2 | 3 | 2 | 2 | 2 | 54% | Targeted Application or Pilot |

### Description

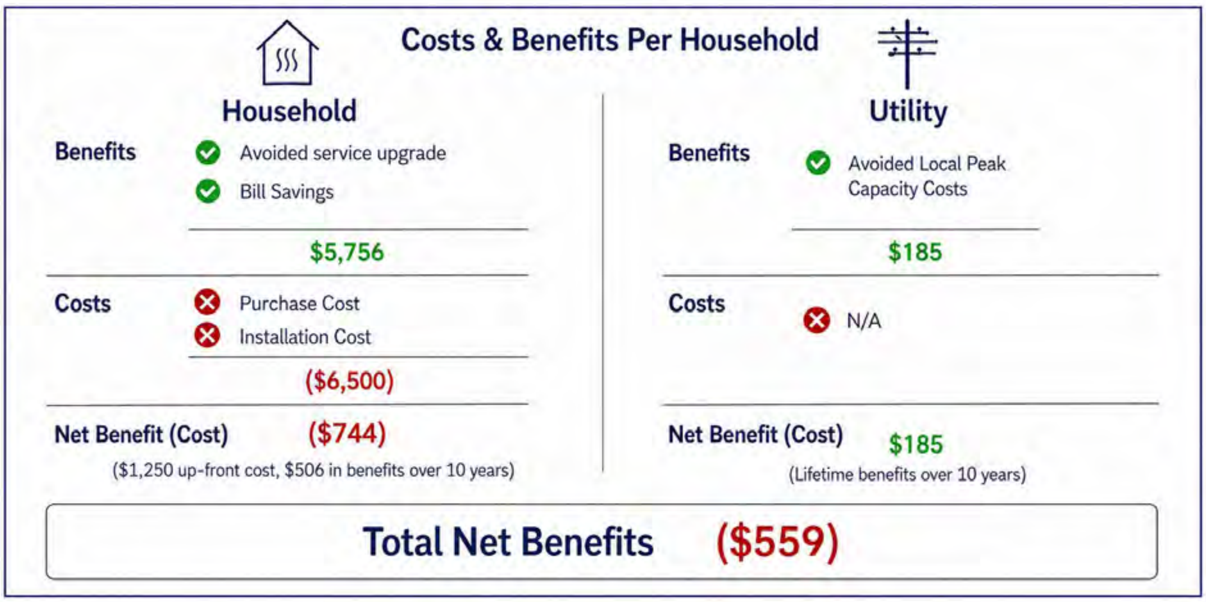
Software-based electrical distribution panels that combine conventional circuit protection with built-in sensors to monitor, manage, and control home electricity at the circuit level in real-time. Unlike a load-sharing device that controls one or two loads, a smart panel can prioritize several loads, including heat pumps, electric water heaters, EV chargers, cooking appliances, and batteries.

Smart electrical panels can either completely replace a home's traditional breaker box or be installed next to it as a supplementary subpanel. Some systems turn selected circuits off temporarily, while more advanced systems can modulate power supplied to selected equipment. During an internet outage or software interruption, the panel can continue distributing electricity and protecting circuits, but remote monitoring and automated control may be unavailable.

Smart panels can keep total household demand within a set service limit by automatically delaying, reducing, or temporarily disconnecting lower-priority loads. This can help households add multiple electric technologies without a service upgrade.

### Housing Contexts

- ✓ Older multi-unit buildings, particularly low-income housing, where electrical upgrades may trigger costly remediation such as asbestos removal and push project costs into the millions.
- ✓ New construction and single-family homes transitioning to multi-unit homes
- ✓ Heat pump installations for propane or oil-powered homes with 60amp service
- × Older homes with fuses instead of breakersxxii
- × Detached homes adding only one flexible load where a low-cost load sharing device may provide the same benefit.
- × Homes without reliable internet access, which can inhibit remote monitoring and automation features[29]




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III. Devices may lower peak demand contribution by preventing multiple high-power loads from operating simultaneously. However, these may not lower coincident peak demand unless device operation aligns with system peak periods.

**Considerations by Scoring Dimension**

- **Equitable Outcomes:** Installing smart panels in multi-unit buildings can enable electrification in affordable housing, secondary-suite conversions, and multi-unit buildings. However, tenant-landlord benefits sharing should be accounted for.[30]
- **Cost Effectiveness:** Smart panels are a more expensive load sharing solution than other load sharing devices, ranging from $4,000-$5,000.xxiii Specialized installation and application for variances may increase installation costs.
- **Utility and Grid Value:** Where utility control is enabled, smart panels can support demand response by safely and automatically modulating and reducing load during system peak periods. Smart panels are increasingly being integrated into virtual power plants (VPPs) in other jurisdictions such as Pacific Gas & Electric's Seasonal Aggregation of Versatile Energy (SAVE) program.[31]
- **Feasibility & Readiness:** Similar to load sharing devices, there is a lack of clarity in the B.C. Electrical Code on guidance for installation, and until updates occur in late 2027 or 2028, variances are required to be submitted to Technical Safety BC.
- **Scalability & Program Fit:** Given their high upfront costs and relatively low benefits, smart panels are not currently a viable solution for most low-income homeowners and are better suited to new construction and multi-unit buildings facing extensive upgrade costs.
- **Adoption & Acceptance:** California Lighting Technology Center (CLTC) evaluated smart panel technologies through occupied-home demonstrations and found they caused minimal disruption to normal household

operations.[xxvi] However, some sophisticated smart panels collect data to learn from occupants' daily routines and optimize power use, introducing possible trust and privacy concerns, especially if installed by a utility or government. Programs involving these technologies should provide clear customer consent, privacy protections, and opt-out options for any utility-controlled functions.

**Program Pairings**

**Multi-Unit Residential Building Retrofit Program / Social Housing Energy Savings Program >** Within-program pilots are recommended given the early stage of smart panel technologies and their strong potential in multi-unit residential buildings. The pilot could prepare affordable housing providers for growing low-cost electrification options, including used electric vehicles and declining solar and battery costs, while also avoiding electrical upgrades, which can become even more prohibitively expensive than detached dwellings. Delivering the pilot through direct installation, paired with service support, will enable participation among housing providers with limited time and resources.

## Smart Thermostats

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 3 | 4 | 3 | 4 | 4 | 3 | 85% | Advance |

### Description

Remotely-controllable thermostats can help manage household heating and cooling loads via built-in sensors connected to home Wi-Fi. This technology has become more sophisticated, with many products now able to provide real-time energy use data, customized temperature adjustments based on learned household behavioral patterns, and motion sensors or geofencing to detect whether people are home.

Different models are designed for different heating systems because electric baseboards and in-floor heating generally use line-voltage controls, while furnaces and many heat pumps use low-voltage controls and different wiring. Heat pumps may require additional compatible controls that coordinate the compressor and backup heating.[32]

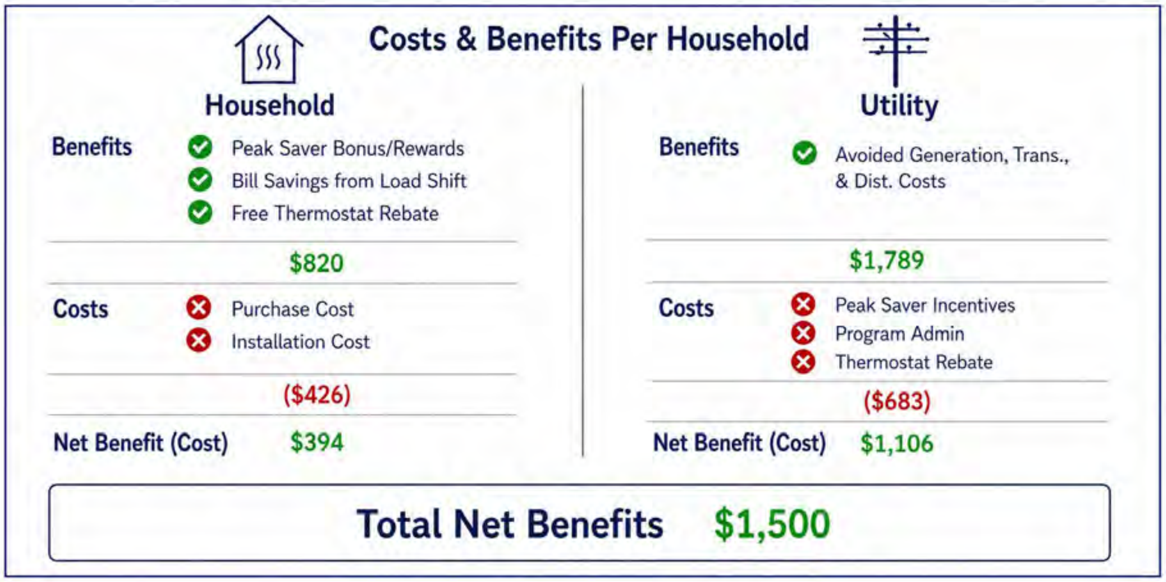

As a load management technology, smart thermostats can automatically reduce or shift heating and cooling demand by adjusting temperatures during peak periods. When enrolled in a utility demand response program, many thermostats can be coordinated to reduce system-wide peak demand. Smart thermostats can also reduce household energy use by up to 16%, according to a study by Lockheed Martin Energy.[33]

**Housing Contexts**

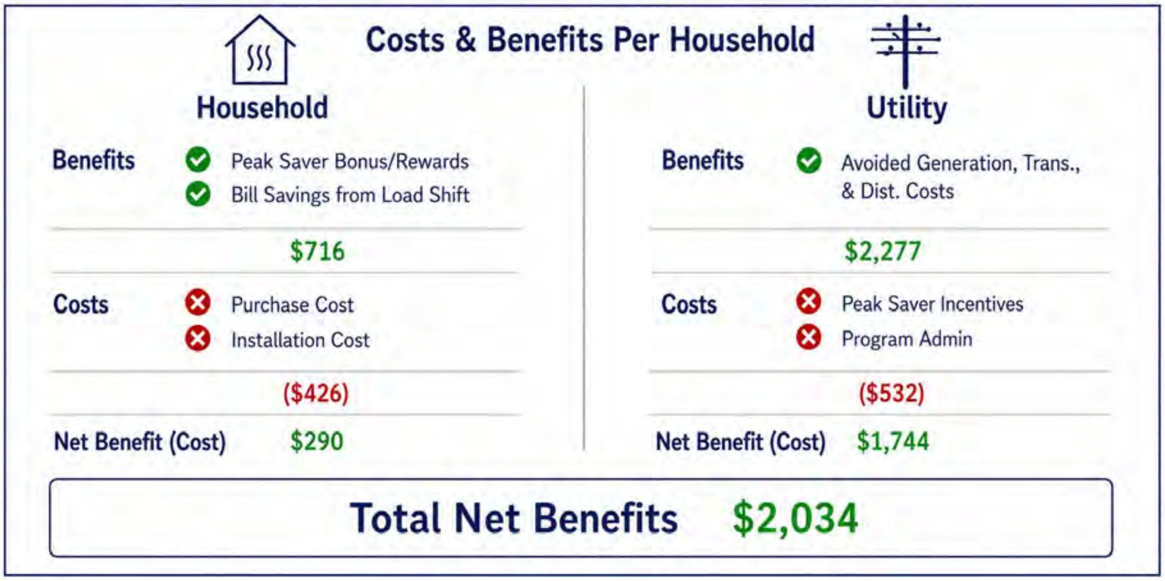
- ✓ Homes with electric resistance heating, where smart thermostats can reduce unnecessary heating without requiring major equipment changes.
- ✓ Rental units, given the smart thermostat is available for free and can be installed without an electrician. These devices may be more amenable for landlords to consent to installation and provide more tangible benefits to renters.
- × Poorly insulated homes, which may experience energy bill increases with constant cycling to maintain a target temperature.x
- × Older homes that don't have a dedicated C-wire in the thermostat cable.

**Costs & Benefits Per Household**

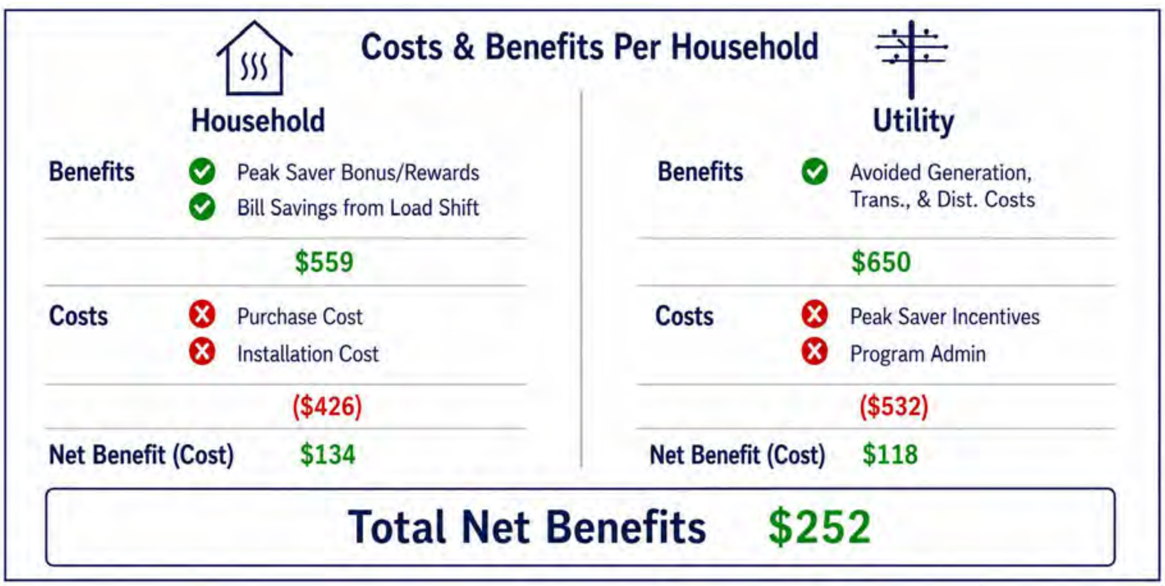
Scenario 1: Electric Baseboard



Scenario 2: Electric Furnace




Scenario 3: Heat Pump




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III.

**Considerations by Scoring Dimension**

- **Equity Outcomes:** Free or fully installed thermostats can provide bill and comfort benefits to electrically heated homes, including renters and households unable to undertake major retrofits. However, when a landlord holds the utility account, Peak Saver enrollment incentives or bill savings may accrue to the property owner while tenants experience the temperature adjustments. Tenants may also have limited input into whether a thermostat affecting their unit is enrolled in the program.

- **Cost Effectiveness:** Low equipment costs, bill savings and peak load reduction benefits make this technology cost-effective. In the analysis above, electric baseboard homes show the highest net benefit because thermostats can reduce or shift a relatively large heating load while maintaining comfortable temperatures. Heat pumps are already efficient and thus offer less flexible load to reduce temperature without affecting comfort, limiting savings from thermostat control.

- **Utility & Grid Value:** Dunsky's study on distributed energy resources estimates average peak savings are 0.55 kW/unit for baseboard heating, 0.70 kW/unit for electric furnaces, and 0.20 kW/unit for heat pump when each heating type is paired with smart thermostats.[34] However, there is some evidence that use of smart thermostats paired with certain rates can create unintended rebound peaks, reducing the benefits of peak demand reduction.[35]

- **Feasibility and Readiness:** Smart thermostats are commercially mature, widely available, and already used in utility demand response programs across Canada and the U.S. Compared with smart panels, batteries, or load-sharing devices, smart thermostats are lower cost, easier to install, and better suited to mass deployment.

- **Scalability & Program Fit:** BC Hydro is offering free smart thermostats to eligible households starting Fall 2026 through its Power Smart 2.0 program so  a delivery channel for mass deployment already exists.viii

- **Adoption & Acceptance:** Utility-controlled programs such as Peak Saver may raise concerns about the utility controlling household temperatures. Furthermore, research on residential smart temperature controls found that energy savings can decline over time when occupants perceive reduced comfort and subsequently override energy-saving settings. Programs should therefore keep temperature adjustments within minimally noticeable ranges and preserve easy customer override options.

- Protecting comfort is important for all participants, but especially for energy-vulnerable households that may already be limiting heating or cooling to reduce bills.[36] However, if appropriate precautions are taken, automated schedules can reduce the need for daily behavior changes or constant engagement.

- Finally, while smart thermostats do not require professional installation, residents need to be comfortable with basic wiring and use of power tools to install. Residents also need to be comfortable adjusting settings to be aligned with the time of use rate if they're enrolled.

**Program Pairings**

**Peak Saver >** Installation is not explicitly covered in BC Hydro's free thermostat offer.viii Installation support should be offered for ***all*** households. Given the high net benefits to the utility, BC Hydro should increase the enrollment bonus to increase incentives for higher participation rates.

**ECAP >** Offer free smart thermostat installation, particularly where a home is not a good candidate for heat pump installation and where building envelope upgrades are completed first to maximize benefits. Incorporate education that includes guidance on efficient thermostat settings that reduces the need for manual adjustments and explanation of the risks and benefits of enrolling the device in BC Hydro's Peak Saver program.

## Water Heater Load Controllers

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 3 | 4 | 3 | 3 | 4 | 3 | 83% | Advance |

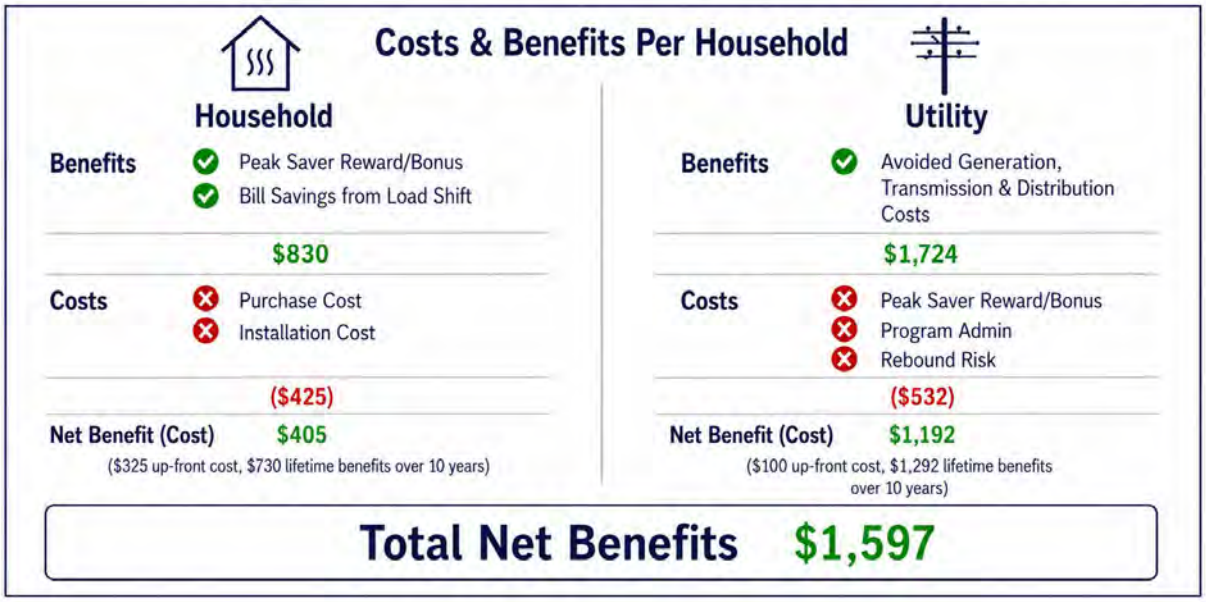
**Description:** Smart devices installed directly onto existing electric storage water heater tanks. They reduce energy consumption by limiting when the water heater runs, delaying heating during peak periods or shifting to off-peak, overnight hours.  There are other technologies available on the market that manage water heaters as flexible loads including:

1. Smart water heaters: Native, all-in-one appliances with built-in Wi-Fi, sensors, and app-connected thermostats. These units do not require an additional load controller but are currently too expensive for the scope of this report.

2. Direct load control (DLC) switches: Devices installed on electric water heaters to temporarily interrupt heating during peak or emergency events. DLC switches do not provide two-way communication and do not provide the grid operator with feedback on load performance. Thus, utilities are trending away from deploying switches and toward installing technologies that can be enabled as grid assets.

### Housing Contexts

- ✓ Households (single-family homes, duplexes, townhomes, manufactured homes, and some apartments and condos) with individual electric water heaters.
- ✗ Homes without electric storage water heaters, including natural gas, propane, oil, tankless electric, or instantaneous gas water heaters.




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III. Regarding rebound risk, smart water heating technologies exhibit pre-charging or heating delays but will still heat the same amount pre- or post-event, creating risks of new peak periods similar to smart thermostats.

### Considerations by Scoring Dimension

- **Equitable Outcomes:** Controllers can extend demand response benefits to many households with individual electric storage water heaters while requiring little change in daily routines. However, BC Hydro reports that 57% of Energy Savings Kit and ECAP Basic participants do not have electric water heating and thus would not be able to benefit from this technology.[37]

- **Cost Effectiveness:** Load controllers represent one of the lowest-cost load management solutions, with prices around $150.[38]

- **Adoption & Acceptance:** The ability to maintain water temperature while still being able to participate in demand response programs lowers risk of opt outs while lowering risk of comfort sacrifice. Enabled water heaters automatically turn off or cycle as needed, requiring no effort from the customer.[39]

- **Scalability & Program Fit:** Scalability is high because the target load is widespread given ~1/3 of water heating in B.C. is electric[40] and controllers can be easily attached to electric resistance or heat pump water heaters.

- **Utility & Grid Value:** Water heating accounts for roughly 20% of average household electricity use, so controllable water heaters represent a meaningful flexible load for BC Hydro.xl However, given smart water heating technologies still need to heat the same amount pre- or post-peak load events, there are risks of creating new peak periods similar to smart thermostats.[xxxiv]

- **Feasibility & Readiness:** Electrical code requirements may need to be updated to provide clear guidance for controllable water heaters. Specifically, Dunsky's publication on DER reports that building code should require new water heaters to be compatible with load-control technologies.[xxxiv]

### Program Pairings

**Peak Saver >** Given the net benefit for both households and the utility, BC Hydro should cover purchase and installation cost of load controllers of water heater load controllers for eligible households. BC Hydro should increase the Peak Saver reward to better reflect the benefits of water heater controller technology and incentivize higher enrollment.

**ECAP >** BC Hydro has reportedly piloted these technologies, but they're currently not incorporated into ECAP. The program should add these as a fully funded option to install for households with electric hot water heating, enabling access to Peak Saver benefits if they choose to enroll. Incorporate enrollment support and education on the risks and benefits of enrolling the device in BC Hydro's Peak Saver program.

### Case Study: Smart Water Controls with EnergyCloud + Clúid Social Housing, Ireland[41]

EnergyCloud is a charity in Ireland that redirects surplus renewable electricity that would otherwise be curtailed into social housing homes by using smart controls on electric hot water tanks. In partnership with Clúid Housing and Microsoft AWS, EnergyCloud installed smart devices on existing immersion hot water tanks so tenants could receive free tanks of hot water when surplus renewable generation was available. The pilot in 2023 was completed for 1,000 homes and expanded in 2026 to an additional 200 households in partnership with Kildare County Council and South Dublin County Council.[42]

The program demonstrates a housing provider-led direct installation model rather than a customer rebate program. It also shows how surplus renewable energy can be used to reduce energy poverty, positioning low-income households as active beneficiaries of grid flexibility. Given this program was based in a jurisdiction with a dominant wind energy mix, it could become more relevant since BC Hydro recently awarded over 1,100 MW of wind power capacity in the 2025 Call for Power.[43]

## Battery Storage

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | 3 | 2 | 2 | 48% | Low Priority |

### Description

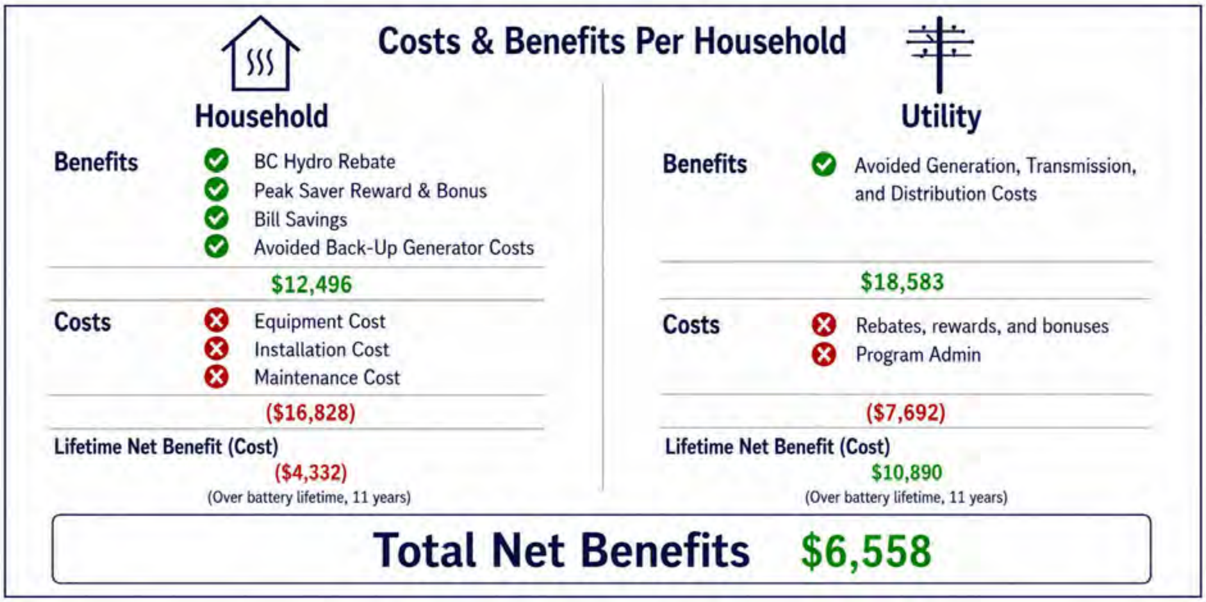
A residential battery energy storage system is a rechargeable device that stores electricity and discharges during peak periods, outages, or utility demand response events. Systems range from small plug-and-play batteries that connect to a standard wall outlet and power individual appliances, to larger 5-15 kWh units typically installed in a garage or on an exterior wall to serve multiple household loads.

When integrated with solar panels, the battery charges using excess energy generated during the day for use at night. Without solar, the system uses a smart charging approach to draw electricity directly from the grid during off-peak hours when rates are lowest and discharges the stored energy during peak hours or power outages.

Energy storage is also a pillar of the Consortium for Power Efficiency's Power Efficient Design principles, which identify strategies for reducing buildings' contribution to system-wide peak demand.[44]

### Housing Contexts

- ✓ Multi-unit residential buildings with shared metering, particularly where residents depend on critical medical equipment during outages.
- ✓ Rural households experiencing frequent outages, particularly as battery costs decline and rates of climate change-induced weather events increase outage risk.
- ✓ Renters, as emerging plug-and-play batteries may offer renters more easily installable backup power and demand response benefits (see case study below).
- ✗ Detached homes, townhomes, and row homes not a good fit given current costs and low net benefits.




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III. Results reported for electrically-heated homes. For non-electrically heated homes, net benefits were negative for both the household and utility. Avoided back-up generator costs include fuel costs plus unmeasured benefits such as reduction in local air pollution and noise, and potential revenue from carbon credits or federal carbon pricing rebates.

**Considerations by Scoring Dimension**

- **Equity Outcomes:** Increasing climate change-induced frequency of heat domes, cold snaps, and wildfires increases the risk of power outages.[45] This increases the value of a reliable backup power source, particularly in areas of B.C. that are affected by higher rates of outages (for example, end-of-line communities such as northern Vancouver Island). Batteries or solar-plus-storage can provide backup power during outages, allowing essential loads to continue operating for a period.

- **Cost Effectiveness:** Currently, high up-front costs (estimated between $12,000 to $22,000 including installation)[46] may often be greater than the lifetime value of the equipment. However, battery technology is exhibiting rapidly declining market costs and may offer higher net benefits in the future.

- **Utility & Grid Value:** Battery storage can provide dispatchable flexibility by shifting demand, reducing peak loads, and supporting distribution networks and frequency control. However, there is evidence that standalone home batteries may not provide sufficient net benefits for peak load reduction value. In an Ontario modeling study, a 5 kW/13.5 kWh home battery reduced average peak draw by 97%, but its annualized cost of $601/kW-year was nearly equal to $604/kW-year cost of new peak supply.

- **Scalability & Program Fit:** Deployment of lithium-ion batteries requires careful safety precautions, particularly for lithium-ion batteries in multi-unit buildings. Improper placement and installation can create fire risk and release of harmful gases that pose health risks.[47] However, newer, smaller plug-and-play batteries can provide renters and lower-income households access to backup power and demand response benefits without costly installation risks or landlord approval.

**Feasibility and Readiness:** Residential battery systems are already used in utility programs across North America, though they are still gaining maturity compared to solar panels and other load management technologies. However, safe installation can be difficult especially for multi-unit buildings due to fire-code requirements, space limitations, building ownership structures, and complex electrical distribution. Rural households may face greater installation barriers because eligible battery contractors can be limited.

**Adoption and Acceptance:** Once installed, batteries require little household effort, but installation is more complex than smaller load management devices. For most B.C. households that do not experience power outages, the main benefit is bill savings through B.C.'s demand response program, but uptake may be limited for households unaware or unwilling to enroll due to concerns about utility control.

**Program Pairings**

**ECAP / Peak Saver**> In conjunction with efforts to expand ECAP to benefit multi-unit buildings[48], explore procurement and piloting of smaller plug-and-play batteries similar to New York's model (see case study). Given all new buildings require air conditioning installed in all new residential buildings[49], batteries could be paired with A/C units to power them aligned with the Peak Saver demand response program.

**Social Housing Energy Savings Program >** Target batteries where they provide the greatest combined household and system value, such as social housing or multi-unit buildings with medically vulnerable households. Consider utility ownership, leasing, or third-party financing models to eliminate the substantial upfront cost barrier for low-income households.

**Partners in Indigenous Energy Efficiency & Resilience (PIEER)Program >** Prioritize battery incentives for First Nations, particularly on-reserve and remote communities that experience higher rates of power outages and grid disruptions. BC Hydro's PIEER program could provide rebates high enough to cover most or all of the cost of eligible battery storage systems, reducing upfront cost barriers while improving energy resilience. Pairing batteries with heat pumps or air conditioning systems would help maintain safe indoor temperatures during outages and reduce reliance on diesel generators.

**Case Study 1: New York Plug-and-Play Battery Program for Renters[50]**

A program run by New York City utility Con Edison and battery company Every Electric provides renters with free, plug-and-play batteries that can power window air conditioners without requiring an electrician or landlord approval. The microwave-sized battery plugs into a standard 120-volt outlet, and the air conditioner plugs directly into the battery, avoiding common installation and ownership barriers in rental housing.

The battery charges automatically during lower-demand, off-peak periods, when electricity is generally less expensive. During peak afternoon hours, it powers the air conditioner using stored electricity, reducing demand on the grid. Because the system is installed and operated by the renter, program benefits flow directly to the household rather than the property owner. Participants can receive cash rebates or bill credits of up to $200 per air conditioner each year for helping reduce peak demand.

**Case Study 2: Washington Flex Batteries Program[51]**

Puget Sound Energy's Flex Batteries Program rewards customers for allowing grid-connected home batteries to support the local electricity system during high-demand periods. Alongside standard rebates and annual participation credits, the program offers enhanced incentives for customers facing financial, disability-related, or other socioeconomic barriers.

Eligible households can receive up to $10,000, or up to 100% of eligible equipment and installation costs. Customers living in areas with frequent outages may qualify for up to $5,000, or full coverage of eligible costs. PSE verifies outage frequency at the household level and can enroll qualifying customers directly. The utility also uses outage data to send targeted mailers to households that may be eligible. This approach directs battery support toward customers who may benefit most from both resilience and grid participation.

## Solar Photovoltaic (PV)

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 2 | 2 | 2 | 2 | 53% | Low Priority |

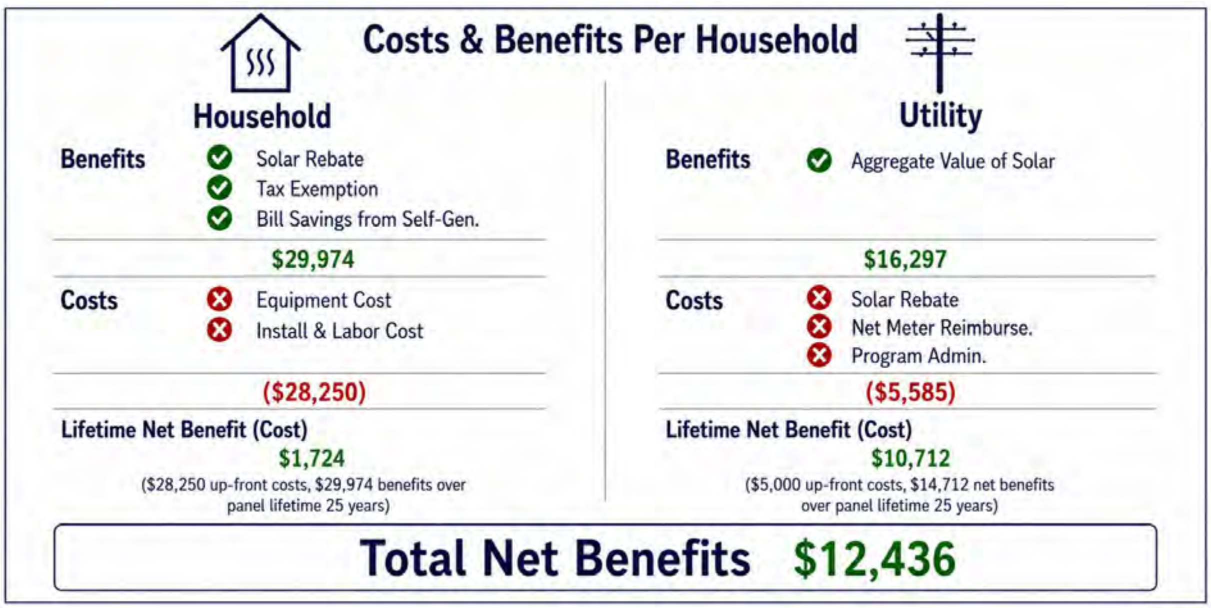
**Description**

Residential solar photovoltaic (PV) systems generate on-site electricity from sunlight. While traditionally mounted on building roofs or racks on the ground, solar PV technology has advanced so panels can now be wall-mounted or can be used as actual roofing material. Most systems are grid-tied, allowing homes to power household appliances during the day, draw from the local utility grid at night, and earn energy bill credits or compensation when the system generates a surplus and discharges it back to the grid.

This section focuses on solar PV installed for individual buildings, while shared-generation models are discussed in the community energy section below.

**Housing Contexts**

- ✓ Nonprofit housing, housing coops, or social
  housing may be promising due to the potential for long-term operational cost savings.
- × Renters who pay their own BC Hydro bills but do not own the roof or electrical infrastructure
- × Low-income single-family homes without access to low-cost financing or high upfront subsidies.
- × Manufactured home parks may face higher upfront barriers because many sites were not designed for distributed generation or additional electrical capacity.[3]




***Note.*** Net present value of costs and benefits for an archetype single-family household over the lifetime of technology. All monetary values reported in CAD. Detailed calculations, assumptions, and sources reported in Appendix III. Aggregate value of solar based on Dunsky's value-of-solar analysis, which estimates utility benefits of behind-the-meter solar to be 9.84-10.04 cents per kWh.lxxxv Costs include panels, inverter, racking, and permitting.

3 Individual rooftop solar installations may require upgrades beyond the PV system itself, such as service-panel upgrades, roof or structural work, metering changes, or park-level electrical infrastructure improvements. These added costs reduce household payback and increase project complexity. For these housing types, shared

**Considerations by Scoring Dimension**

- **Cost-Effectiveness:** Solar generation can significantly lower monthly electricity bills, but the high upfront installation cost prevents many households from accessing these benefits.  A $5,000 rebate does not make solar meaningfully accessible to most low-income households if the remaining cost is still $15,000–$20,000. Thus, solar is more equitable when delivered through social or co-op housing, Indigenous housing, or community/shared models. In addition, if an electrical panel is undersized or outdated, the home may need an upgrade to install solar. A 60- or 100-amp panel, which is more likely in lower-income households, is likely to lack space and not meet current code.[52]

- **Equity Outcomes:** Rooftop solar can advance energy justice by increasing household energy autonomy, resilience, and participation in the energy system. It helps correct historical inequities by ensuring marginalized households share in the economic and environmental benefits of the clean energy transition.

- **Feasibility & Readiness:** Rooftop solar adoption can be constrained by the local distribution grid's available hosting capacity. A California study found that communities with higher shares of disadvantaged populations tend to have lower grid capacity for new distributed solar, meaning that even well-designed incentive programs may fail to produce equitable adoption unless grid upgrades are prioritized in historically underserved communities. A B.C. rooftop solar equity strategy should require utilities to identify constrained feeders serving low-income households and include those areas in proactive grid-upgrade planning.[53]

- **Scalability & Program Fit:** Solar is commercially available and technically mature, but not yet scalable for low-income households without major financing reform or direct-install models. Social housing providers can access dedicated solar and clean energy funding through multiple utility and government programs, but uptake is limited because of the complexity and variation of application requirements and timelines across programs, making it difficult for providers to assemble funding.

- **Utility & Grid Value:** Solar primarily offsets daytime household electricity demand and does not directly reduce space-heating loads or evening winter peak demand unless paired with battery storage or other load management controls. However, because the province's hydroelectric reservoirs effectively serve as large-scale batteries, increased solar generation can conserve water for later use during periods of higher demand. This value may become increasingly important as climate change reduces snowpack and alters seasonal precipitation patterns.

- **Adoption & Acceptance:** Uptake will be low among low-income homeowners without full subsidies, accessible financing, and installation support.

**Program Pairings**

**Social Housing Energy Savings Program + social housing solar rebates >** Nonprofit housing, housing coops, or social housing may be promising if solar rebate/funding programs can be streamlined and made easier to access due to the potential for long-term operational cost savings.

**Zero-interest or PACE financing >** The federal Canada Greener Homes Loan offered up to $40,000 in interest-free financing over 10 years and reportedly broadened solar adoption across income groups in B.C. Since the program closed in 2025, the lack of an affordable replacement shifted adoption back toward higher-income households with access to low-cost credit. Reintroducing zero-interest financing could expand equitable solar access and provide an estimated $10,712 net benefit to the utility (per the above analysis).

Clean Energy Canada proposes alternative service-based models, such as installation of solar by the utility for a monthly charge, or enabling local governments to provide financing through PACE programs.ii Property Assessed Clean Energy (PACE) allows property owners to fund clean energy upgrades with little or no upfront payment and repay the cost through their municipal property tax bill. Because the obligation is attached to the property, it can transfer to a new owner when the property is sold. Alberta's Clean Energy Improvement Program (CEIP) uses this model, offering repayment terms of up to 20 years, helping align financing with the long lifespan of technologies such as solar PV and lowering annual repayment costs compared with shorter-term consumer loans.[54] In B.C., implementation could involve the government, utilities, financing partners, and solar installers.

**Case Study: Connecticut's Residential Solar Investment Program (RSIP)[55]**

Connecticut launched the Residential Solar Investment Program (RSIP) in 2012 through the Connecticut Green Bank, with a goal of supporting 30 MW of residential solar by 2022. The program was deliberately designed to broaden rooftop solar access, particularly in low- and moderate-income communities.

A 2024 study compared solar adoption across Connecticut before and after RSIP, while accounting for declining solar installation costs. Following implementation, the median solar adoption growth rate doubled statewide, and the policy was associated with an 11% increase in pre-program growth trajectories. Low- and moderate-income communities experienced adoption growth rates 1.54 times those of higher-income communities. Growth rates were also higher in majority non-white communities and communities with larger renter populations. The case shows that deliberately inclusive incentives can accelerate overall solar adoption while helping previously underserved communities close participation gaps.

# Community-Scale Solutions

Aggregation of load management technologies can extend these benefits beyond individual homeowners. Energy communities can share generation and storage across households, including renters and residents without suitable roofs or upfront capital. Virtual power plants can coordinate many household technologies as a single grid resource, creating utility value that can support higher incentives, direct installation, or shared-ownership models for lower-income participants.

## Energy Communities

| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 3 | 3 | 3 | 2 | 2 | 2 | 64% | Advance Conditionally |

**Description**

Energy communities is a broad term for local households or groups collaborating to produce, share, or manage renewable energy for shared economic, environmental, and social benefit. The most common source is solar, but some community-owned wind projects also exist. They can take many legal forms, including cooperatives, non-profit organizations, partnerships, municipalities, or corporations

Energy cooperatives are a type of energy community in which members collectively own and democratically govern energy assets. Members may include individuals, local governments, businesses, and community organizations. Cooperatives commonly finance projects through two distinct models: virtual net metering for utility bill credits and direct Power Purchase Agreements for cash dividends. Some communities may offer additional services for members such as negotiating bulk discounts for members with solar-friendly rooftops or offering consulting to members who want to install their own solar systems. These services can reduce costs, build local capacity, and expand access to distributed energy resources, particularly for households that may not otherwise participate.

### Housing Contexts

- ✓ Renters, condo residents, and households unable to install or afford rooftop solar.
- ✓ Indigenous communities: Strong fit where a trusted community organization can host the project, direct savings to members, and support local ownership.
- ✓ Strata's, where the strata corporation can operate shared generation, with savings benefiting unit owners or reducing strata fees.
- ✓ Housing cooperatives, particularly those with low- and middle-income residents
- ✗ Dispersed rural households without a shared project site
- ✗ Communities without a trusted anchor organization, such as a cooperative, nonprofit, municipality, First Nation, or housing provider, to coordinate the project.
- ✗ Renters without direct bill credits or benefit protections.

### Costs & Benefits Per Household

| | Community Member | Utility |
|---|---|---|
| **Benefits** | **Lower and more predictable energy costs**: Members can receive compensation for excess generation, and economies of scale and bulk purchasing can reduce project and time investment costs compared with individual installations.<br><br>**Community ownership and investment:** Members can collectively finance energy assets, and support local economic development through transparent, locally tailored decision-making that can strengthen social cohesion and keep dollars in the community.<br><br>**Equitable decarbonization:** Expanded access to clean energy, reduce diesel reliance, and increase decision-making power in remote and Indigenous communities that have historically borne the largest burden of carbonized and centralized energy systems.[56] | **Transmission & distribution cost savings:** Solar cooperatives can defer local distribution upgrades by supplying electricity locally, particularly in neighborhoods experiencing growing demand from electrification.<br><br>**Increased support for new generation:** Evidence that community support for renewable energy generation is significantly higher when the projects are locally owned, designed, or community-led.[57]<br><br>**Lower project transaction costs:** Working with one community organization can simplify outreach, enrollment, and coordination compared with managing many individual systems. |

| | | |
|---|---|---|
| **Costs/ Risks** | **Upfront costs:** Membership fees, shares, or project contributions can exclude lower-income households unless subsidized.<br><br>**Delayed and uncertain returns:** Community energy projects can take years to develop, and financial returns are sensitive to project performance, utility credit rates, operating costs, and member allocation rules.<br><br>**Administrative burden:** Members may need to understand contracts, bill credit allocation, tax implications, and exit terms. Benefits may be unevenly distributed if decision-making is dominated by more affluent or technically knowledgeable members.<br><br>**Volunteer capacity:** Community-led projects often rely on sustained volunteer effort for governance, outreach, fundraising, and administration, which can lead to burnout. | **Program administration:** Utilities may incur costs to review projects, manage hosting-capacity studies, and other related costs.<br><br>**Variable generation:** Standalone solar does not reliably reduce B.C.'s winter evening peak and may require complementary storage, flexible loads, or other balancing resources. |

**Considerations by Scoring Dimension**

- **Equity Outcomes:** There is a high equity potential if communities are designed to share capital costs and return benefits to low-income residents. However, careful governance is needed to avoid benefits being captured by higher-income members. In a survey-based report of energy cooperatives in Europe, cooperatives tend to be composed of more affluent members. There is evidence of similar trends in Ontariolv and British Columbia. Community energy projects in multi-unit buildings extend benefits of solar generation to renters, but benefits can be limited if bill credits do not flow to tenants or if landlords retain most building-level savings. Cooperative participants may also face low or negative returns on their investment without receiving the direct benefits associated with on-site solar generation.
- **Cost Effectiveness:** Given high up-front capital costs, energy communities that serve lower-income participants likely will need to seek a diverse set of funding, including tax credits, grants, membership share purchases, and loans.
- **Scalability & Program Fit:** Housing cooperatives in B.C. are typically composed of low- and moderate-income residents and hence may be a better fit for these

energy models.[58] An analysis of a housing cooperative in BC showed a 6-year payback period for solar and a reduction in rent for their tenants when current rebates and subsidies are included.[59] However, housing cooperatives have been slow or hesitant to commit to a solar project, likely due to the relatively new and less proven models of success in the province.

- **Utility & Grid Value:** Solar cooperatives may not contribute to peak demand reduction alone since the sun doesn't shine during winter evening peak hours, but they can defer local distribution upgrades by supplying electricity locally, particularly in neighborhoods experiencing growing demand from electrification.
- **Feasibility & Readiness:** While solar technology and cooperative business models are mature, community energy remains niche in Canada and depends on supportive regulation, financing, and community generation frameworks. A 2022 census identified fewer than one hundred renewable energy cooperatives in Canada, including fewer than eight in British Columbia.[60] Stakeholders in B.C. reported that financial and regulatory frameworks are not well adapted to RECs (see discussion in Community Generation Rates Section below).
- **Adoption & Acceptance:** Evidence also shows that community support for renewable energy generation is higher when the projects are locally owned, designed, or community-led. In British Columbia, 75.5% of B.C. respondents to a nationally representative online survey supported a shift toward "more local control of energy systems.[lvi]

**Program Pairings**

**Green Municipal Fund Community Energy Systems / BC Indigenous Clean Energy Initiative >** Invest in capacity building by providing grants for technical assistance, legal services, financial planning, cooperative development, governance training, and early staff capacity. Community organizations may have viable project ideas but lack the paid expertise and administrative capacity needed to navigate financing, agreements, interconnection, and governance. Relying on volunteer labor will favor communities with greater income, professional networks, and available time.

**BC Hydro Solar Rebates + Community Generation Rate >** Pair community generation funding with equity set-asides**.** Reserve a portion of program funding or project capacity for low- and moderate-income participants, Indigenous communities, non-profit housing providers, and projects serving marginalized communities.

**Future BCUC rate proceedings >** Create long-term compensation certainty. Expand virtual net metering and shared-generation eligibility while establishing transparent and predictable compensation structures. Long-term certainty will enable community organizations to finance projects and plan for assets with operating lives of 20 years or more. Illinois Solar for All provides a relevant model by requiring one-quarter of approved community solar gardens to serve environmental justice communities and allocating funding for diversity-focused training programs.[61]

**Case Study: SolShare / Haida Gwaii Community Solar Partnership**[62]

SolShare, a subsidiary co-operative of the Vancouver Renewable Energy Co-operative

(VREC), is developing a community-owned solar project in Masset on Haida Gwaii. The proposed 100 kW solar array will be hosted on the rooftop of the Grocery Co-op. The project is expected to generate approximately 90,000 kWh of electricity per year and reduce greenhouse gas emissions by more than 89,000 kg annually[63] from reduced reliance on imported diesel.[64]

The project builds on lessons from the Xaadáa Gwaay Renewable Energy Co-operative efforts, which faced barriers similar to other groups attempting to start an energy co-operative in B.C.:

1. **Organizational Capacity:** Lack of funding to hire a full-time staff member prior to revenue generation, reducing effective community support with only volunteers.
2. **Utility and regulatory constraints:** Haida Gwaii is classified as a non-integrated area and thus faced a cap on installed solar energy. Because solar could not exceed 10% of generation, the co-operative was limited in its ability to grow.
3. **Rebate eligibility:** The project sought to use rebates available for commercial buildings but was reportedly denied because it was structured as a community-based shared ownership project. This design can unintentionally create higher incentives for non-community qualifiers, including large commercial corporations, to qualify for these rebates.

SolShare offers a modified approach that still enables local partnership while reducing burdens on the local co-operative. SolShare draws on VREC staff capacity for project development, administration, and technical support. The project would initially be developed as a SolShare-owned project with the option for future transfer of ownership to local community owners. Participating members still benefit by earning an annual dividend. The model includes several equity-oriented features to reduce barriers for low-income members to join:

Lowering the membership share price from $1,000+ to $500.

Allowing membership applicant to self-identify as low-income. Shares for qualifying members could then be offered at a reduced cost or for free, depending on the decisions of the project's community leaders.

Using grant funding and a revolving loan structure to reduce financial barriers.

The SolShare / Xaadáa Gwaay project provides a model for a more equitable community energy co-operative design. It combines local ownership, a trusted community rooftop host, lower-cost participation, and diversified funding support.

## Virtual Power Plants

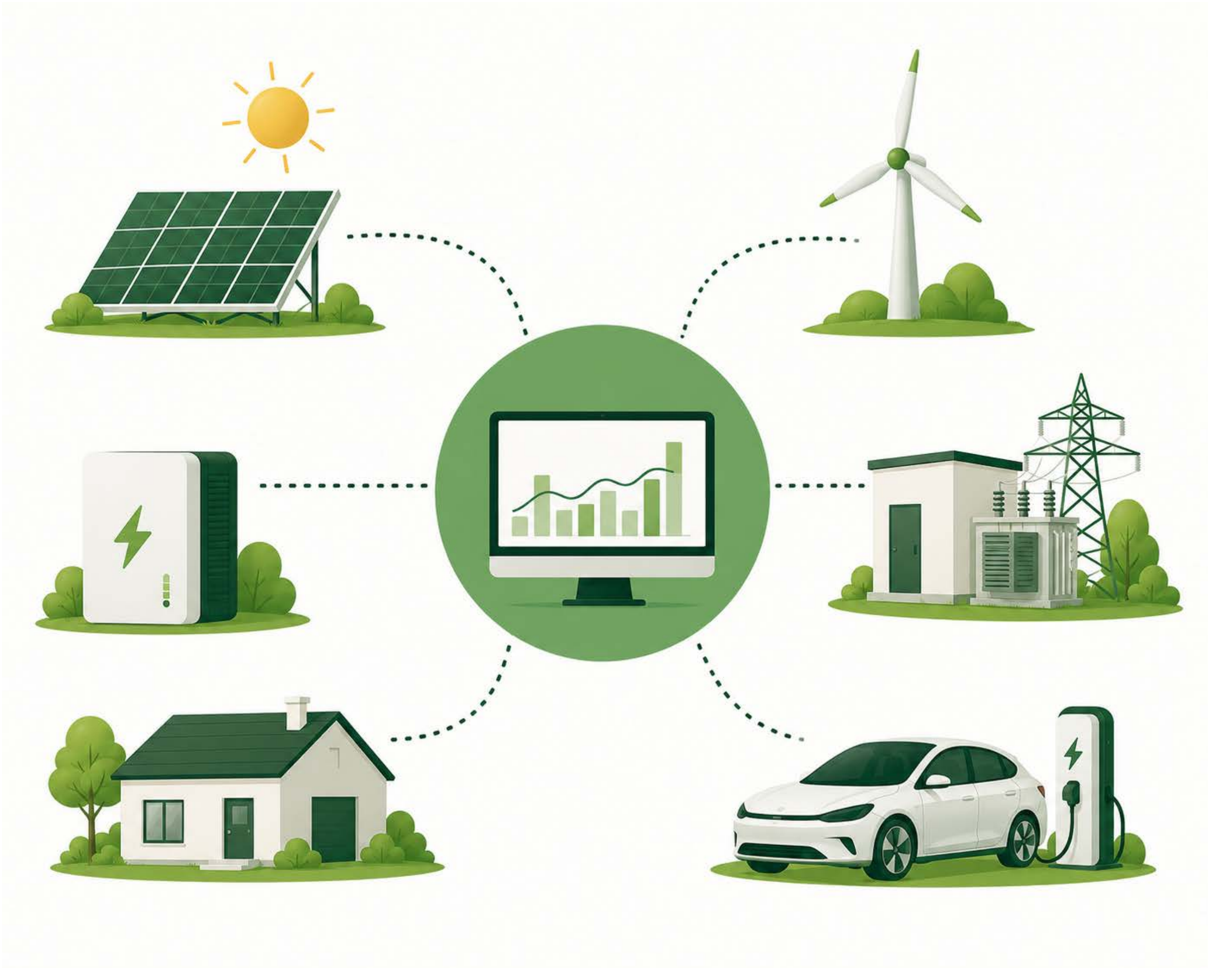
| Equitable Outcome | Cost Effective | Utility & Grid Value | Feasibility & Readiness | Scalability & Program Fit | Adoption & Acceptance | Weighted Score | Recommendation |
|---|---|---|---|---|---|---|---|
| 2 | 2 | 3 | 2 | 3 | 2 | 58% | Targeted Application or Pilot |

**Description**

Virtual Power Plants (VPPs) are a collection of distributed energy resources (DERs) aggregated and coordinated by the utility to provide services similar to power plants. Residential DERs can include either controllable loads or deployable power sources, such as EVs and chargers, electric water heaters and heat pumps, smart devices, and solar and battery systems. They can be made up of a single resource type (e.g., batteries) or a portfolio of diverse resources. Enrollment and management of VPPs can be managed by the utility alone or in partnership with a DER manufacturer or independent VPP platforms.

Components of a VPP include[68]:

- Enrollment of sufficient participant households and organizations with eligible DERs to provide meaningful grid capacity.
- Hardware and controls to connect, monitor, and control DERs as a unified system.
- Aggregation software that forecasts resource availability, coordinates devices, and communicates with utilities or electricity markets.
- Participant compensation through bill credits, payments, or other incentives in exchange for participation.



### Housing Contexts

- ✓ Single-family homes, duplexes, and town homes
- ✓ Indigenous housing contexts, with equitable revenue and governance models
- ✗ Apartments and condos: Evidence for VPPs in a multi-unit building context is not as mature and these building types may not be as good a fit from an equity perspective, since the main value comes from owners installing building-level assets as an investment into their property.

### Costs & Benefits Per Household

| | Community Member | Utility |
|---|---|---|
| Benefits | **Compensation for VPP Participation:** Households can be compensated by the utility via up-front bonuses/incentives, payments, or bill credits based on energy discharged or curtailed during peak demand events. A Massachusetts battery demand-response program delivered $2.14 in customer benefits per dollar spent, with participating battery owners earning up to $1,500 annually.[65]<br><br>**Avoided electrical upgrades.** VPP-ready load management can help avoid panel/service upgrades while still adding heat pumps, EV charging, or electric water heating.<br><br>**Community-wide benefits from system restructure:** By reducing peak demand, VPPs also drive down bills for non-participating customers through long-term deferral of new generation capacity and infrastructure investments.<br><br>**Access for renters and multifamily residents:** Community storage models allow households that cannot install a battery at home to participate through "shares" in a larger battery located at a substation, municipal building, or community facility. Participants can receive bill credits while the host site provides broader community resilience benefits.[66] | **Peak capacity and avoided generation costs:** VPPs coordinate flexible loads and storage to reduce peak demand, support resource adequacy, and limit reliance on natural gas peaker plants or new utility-scale generation. One study estimated that 60 GW of VPP capacity could meet resource adequacy needs for US$15–35 billion less than conventional resources over ten years. Another found that VPP peak capacity could cost utilities 40% less than utility-scale batteries and 60% less than gas peaker plants.[67]<br><br>**Deferred grid upgrades and ratepayer savings:** Targeting VPPs in constrained areas can reduce local feeder and distribution-system peaks, delaying costly upgrades. National Grid identified two feeder projects that VPP programs could defer for five years.[68] These savings can reduce upward pressure on customer rates.<br><br>**Scalable, near-term capacity:** VPPs can be expanded incrementally by enrolling additional devices as electricity demand grows. This can provide flexible capacity faster than building new generation, transmission, or distribution infrastructure and help BC Hydro manage near-term load growth while larger projects are planned and constructed. |

| | | |
|---|---|---|
| **Costs/ Risks** | **Up-front costs:** VPP devices, including solar and battery systems, can be unaffordable for underserved households. Additional compatibility upgrades may be needed in rural or older homes, further increasing costs.[69]<br><br>**Digital Access Barriers:** Areas with unreliable Wi-Fi or limited cellular coverage may have issues with remote DER aggregation, which are commonly controlled via app-based software. Green Mountain Power, a Vermont utility, equipped an affordable housing development with a solar and battery VPP and cited issues with internet connections when dispatching batteries to respond to peak demand.[70]<br><br>**Customer control, privacy, and mistrust:** Households may be reluctant to participate in VPPs due to utility remote device control, collection of detailed energy-use data, and involvement from corporate third parties. | **Integration and interoperability costs:** VPPs may require investment in aggregation software, DER controls, and DERMS integration. A 2018 NREL review found standardized communication gaps, inverter design issues, and software incompatibility costs across five case studies.[71]<br><br>**Program operation costs:** Including forecasting available capacity, dispatching devices, customer support, metering and telemetry, verifying performance, and processing payments.<br><br>**Cybersecurity and data management:** VPPs increase the number of connected grid devices, requiring secure communications, data protection, system monitoring, and cybersecurity upgrades. |

**Considerations by Scoring Dimension**

**Equity Outcomes:** VPPs are increasingly of interest to First Nations as a pathway to energy sovereignty, grid resilience, decarbonization, and reduced energy expenses. An energy system that aggregates local energy sources into a shared resource is more familiar to cultures with deep traditions of collective land management and shared governance. For example, Nimiipuu Energy, an energy company owned by the Nez Perce Tribe in western U.S., is planning to install solar and battery systems in tribal homes. Tribal nations have reported experiencing outages over six times more frequently than the national average so building a community-owned VPP aims to lower or eliminate power bills, decrease dependency on grid supplied power, and build energy independence.[72]

However, Indigenous communities have often experienced resource projects where outside companies captured most benefits while communities carried the impacts. VPP arrangements may reproduce these harms if communities lack ownership, decision-making authority, revenue sharing, local employment benefits, or control over participation in grid services.

**Feasibility & Readiness:** Research in California's two largest utility territories found hosting-capacity disparities associated with demographic and socioeconomic conditions.[1]lii Underserved communities may require additional grid upgrades before DERs can connect, increasing participation costs and potentially discouraging VPP developers from serving these areas.

**Utility & Grid Value:** VPPs can reduce the need for large generation projects that create significant environmental and social impacts. These risks are illustrated by the Site C project, where a Joint Review Panel identified significant adverse effects on species, vegetation, wildlife, land, and cultural heritage.[73]

**Cost Effectiveness:** VPPs that rely mainly on households already owning EVs, rooftop solar, batteries, or smart thermostats will favor higher-income participants. NREL identifies upfront costs, financing barriers, split incentives, and limited program awareness as major constraints on DER adoption.[104] Rebates may still exclude lower-income households when participants must pay first and wait for reimbursement. More accessible resources may include water-heater controls, smart thermostats, electric-heating load controls, shared multifamily assets, and utility-provided devices.

**Scalability & Program Fit:** BC Hydro would need controllable DERs, sufficient participant enrollment, reliable device communications, and a utility-level DERMS or aggregation platform to dispatch and measure performance. Existing programs such as Peak Saver, connected-device incentives, and planned smart thermostat offerings provide useful building blocks. VPPs can scale as more EV chargers, batteries, thermostats, water heaters, and solar-plus-storage systems are added.

### Program Pairings

**Peak Saver** > Pairing VPP development with Peak Saver would allow BC Hydro to build on existing customer enrollment, communications, incentives, and dispatch systems rather than create a separate program. The utility should allow low-cost devices to participate in VPPs such as thermostats, water heater controllers, and energy solar and battery assets. For example, Shifted Energy's 2.5 MW VPP in Hawaii installs smart, programmable water heaters for VPP participation.[74]

Device cost coverage or direct installation could be offered for eligible households. Enrollment and participation rewards could also be increased to incentivize participation and reflect the significant potential benefits to the utility.

**BC Indigenous Clean Energy Initiative** > BCICEI could fund Indigenous-owned VPP pilots that combine community solar, batteries, and controllable loads. Funding could cover VPP feasibility studies, aggregation software, technical assistance, and governance capacity to support communities to move projects from planning to community-owned implementation while building long-term local expertise.

### Case Study: Roanoke Cooperative Upgrade to $ave Program[lxxi]

Roanoke Cooperative launched Upgrade to $ave in 2016 in the fourth-lowest-income congressional district in the U.S. The program energy efficiency upgrades with demand response offerings such as smart thermostats and water-heater control switches.[1] Through Pay As You Save® (PAYS®), the cooperative paid upfront for cost-effective upgrades and recovered costs through a fixed tariff charge tied to the meter and set below estimated annual savings. Eligibility depended on the building's savings potential, not household income or credit. Smart thermostats and water-heater controls were free, and participants received a $4 monthly performance credit.

By November 2024, 750 members formed a 1.75 MW VPP. Participants cut electricity use by about 20%, while the utility achieved roughly 20% peak reductions in summer and winter and projected more than US$2 million in lifetime net present value.[2] Key success factors included inclusive financing, delivery through trusted administrator EEtility, and consumer protections covering installation quality, bill savings, and adjustment or suspension of charges when savings were not achieved. The model removed upfront cost, credit, and debt barriers while delivering measurable household and utility benefits.

# Rate Design for Equitable Load Management

Load management technologies help households reduce or shift electricity demand, but rate design determines how they are rewarded for doing so. Well-designed rates can strengthen the value of load management while limiting bill risk for low-income and energy-insecure households. The following rate profiles examine the rate and incentive models with the strongest potential to support equitable load management, with key considerations to maximize benefit and reduce harm to energy insecure households. A number of other rate designs were considered but ruled out for equity and low-value reasons. See Appendix II for the full list of rates considered.

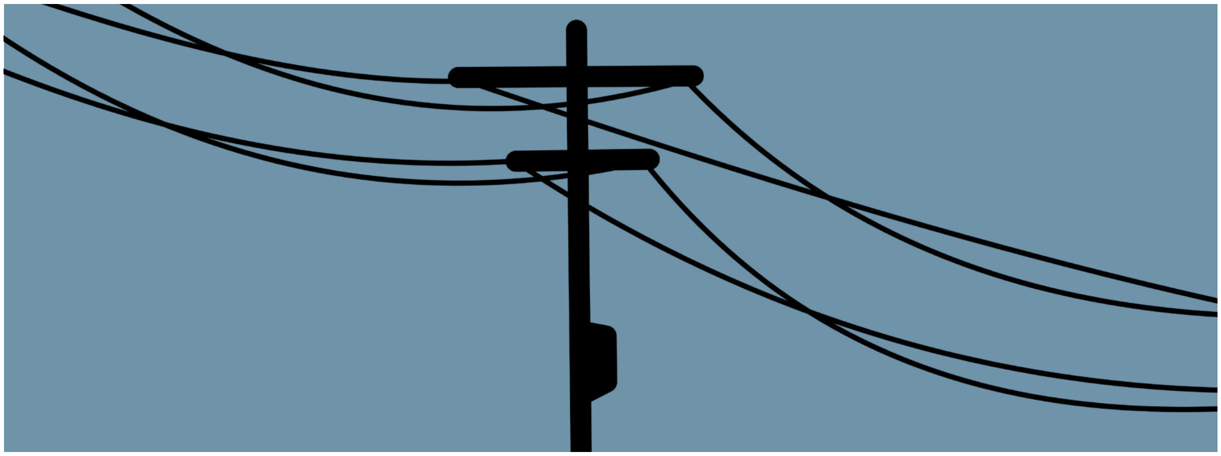
## Time-of-Use Rates

**Description:** Time-of-use (TOU) rates charge different rates for electricity based on when it is consumed. These rates typically charge a discounted per-kwH rate during off-peak hours (usually overnight) and premium kWh rate during peak demand periods (usually in the evening).

There are increasing numbers of customers with TOU rates as their default in North America (for example, Ontario), but the most common approach for utilities is to offer TOU as opt-in rates.[75]

BC Hydro's optional time-of-day rate applies a 5¢/kWh surcharge from 4 to 9 p.m., a 5¢/kWh discount from 11 p.m. to 7 a.m., and no adjustment during other hours. It can be added to either the tiered or flat rate.

Critical Peak Pricing (CPP) is another common form of time-varying pricing that charges much higher electricity prices during a small number of high-demand event hours and a deeper discount during off-peak hours, usually with advance notice. This design carries a higher risk for energy vulnerable ratepayers because it risks higher bill-volatility and increases financial penalties for households with limited ability to shift essential electricity use. Thus, this design is not advised from an equity perspective.



| Advantages | Disadvantages |
|---|---|
| **Strong fit with load management** because it can provide a cost-based signal for flexible loads such as EV charging, water heating, and smart devices to automatically shift use. | **Benefits limited if unable to shift loads.** Rate may exacerbate financial impacts for energy vulnerable households with less flexibility, irregular schedules, medical electricity needs, or inefficient housing. For example, apartment buildings may have noise restrictions that limit residents from doing laundry late at night. |
| **Lowers system-wide peak demand** if enough customers shift usage.[4] | |
| **Helps utility recover peak-related costs** through higher peak-period prices without requiring complex residential demand charges.[lxxiv] | **People living in poverty are more likely to judge their comfort as tradeable** for reduced cost and are thus more likely to underheat, overheat, or ration energy to avoid peak prices, sacrificing comfort and potentially health.[xv] |
| | **TOU rates suit EV charging** better than loads more commonly available in low-income households, since it rewards households with a large, non-essential load that can be moved completely overnight. For example, heating demand often coincides with winter peaks, and shifting smart thermostat heating can be difficult without affecting comfort. |

4 BC Hydro projects 270 MW in demand response capacity savings supported by the current voluntary time-varying rate.

**Load Management Pairing Considerations**

Generally, devices that can automate load shifting from peak periods without disrupting household comfort or activities are best fit with TOU rates.

**Level 2 Networked EV Chargers:** The strongest fit for TOU because EV charging is a large, flexible, and schedulable household load that can usually be shifted overnight with little impact on comfort or daily routines.

**Smart Panels:** A strong fit, particularly those with modulation features that can adjust load management technologies in ways that maintain safety and comfort for households (for example, EVectriX Smart Panel). Modulation can lower power to a load, delay part of a cycle, or prioritize essential circuits rather than fully interrupting service like load sharing devices.

**Water Heater Load Controllers & Smart Thermostats:** There's a risk of rebound effects as the number of households using these devices pair with the same TOU rate. Devices may optimize by curtailing during the peak-price window and either pre-heat or ramp up when off-peak prices begin, creating a synchronized "rebound peak" that shifts peak demand rather than reducing it.

**Batteries:** The current time-of-use rate provides insufficient savings to justify charging batteries at lower overnight rates and discharging them during higher-priced on-peak hours, once efficiency and degradation losses are considered.[xxxiv]

**Recommendations for Equitable Design**

**Add discounted shoulder periods beside the peak window.** Offer the lowest or a reduced rate immediately before 4 p.m. and after 9 p.m., while retaining an overnight EV discount. This would support pre-heating and post-event recovery. Dunsky specifically recommends locating lower-priced periods closer to the peak window for time-constrained thermal loads.[xxxiv] Rebound risk, if many automated devices restart when the discounted period begins and create a second peak, can be partially mitigated using Peak Saver controls to coordinate restart times for a subset of enrolled devices.[76]

**Pair TOU rate with automation, customer education, and protections** rather than relying on vulnerable households to manually shift essential activities. In 2018, California regulators ruled on two customers protections to include in their system-wide rollout of TOU tariffs[xv]:

Include a 'shadow bill' that shows customers whether they are better off with the time-of-use rate or their old rate.

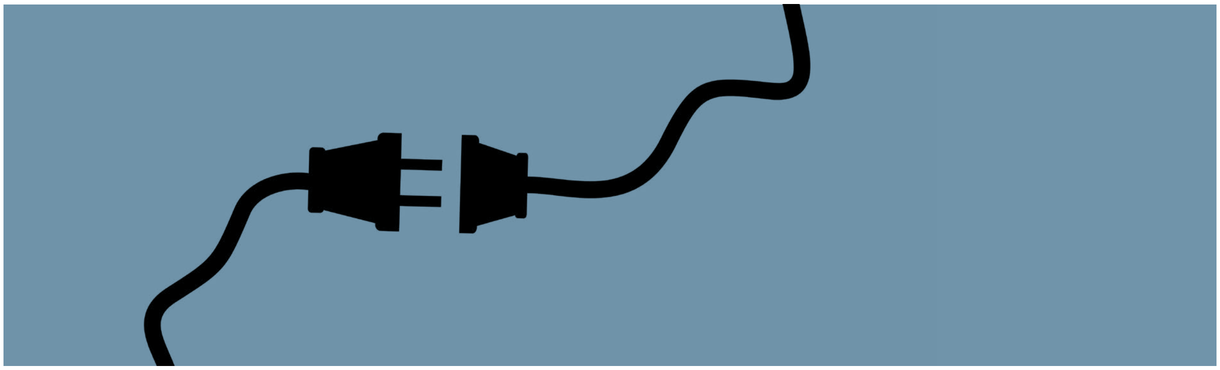
Guarantee that, for the first year of the transition, customers who would have saved more on the old rate will be credited the difference.

The utility could also include penalty-free return to the previous rate, because these households have less ability to absorb bill increases or shift essential electricity use.

## Subscription+ Rates

**Description**: A fixed monthly charge for electricity based on a customer's historical, weather-normalized usage. The "plus" component means the fixed-bill offer is coupled with energy efficiency or demand flexibility measures to address the risk that fixed bills reduce incentives for efficient consumption. For example, a customer is required to enroll in a demand response program that allows the utility to control certain end-uses. Some Subscription+ rates may include an end use-targeted incentive. For example, Xcel Energy provides free off-peak EV charging as part of their subscription rate.[77]

BC Hydro is considering offering an optional FixedBill+ rate that requires enrollment in the Peak Saver program and charges a fixed monthly rate with 5-10% premium. The rate would be readjusted annually based on the previous year's consumption.[78]



| Advantages | Disadvantages |
|---|---|
| Increases bill predictability for households and may reduce customer service costs and improve customer experience.[79] | Requires customers to have smart, networked devices and willingness to let utility control devices as part of demand response enrollment |
| Payments aligned with other product payments customers are used to, such as cell phone plans and streaming subscriptions, making it easier to understand. | Fixed bills can remove incentives for efficient consumption if the "plus" component is weak or if customers are not readjusted appropriately.[lxxiv] |
| The "plus" component of the rate incentivizes efficient energy consumption. | Rates have not been as commonly implemented by utilities in North America so impacts are not as predictable.[lxxiv] |
| May encourage demand response participation from customers who would otherwise be unwilling to adopt those measures. | |

**Load Management Pairing Considerations**

- Strongest fit with devices that can deliver automated and low-impact demand flexibility and can be enrolled in demand response programs. Therefore, this rate pairs best with utility-controllable devices such as smart thermostats, water heater controls, batteries, and EV chargers.

**Recommendations for Equitable Design**

- **Add Subscription+ as a rate option and pair with enhanced support for income-qualified customers** such as:
    - Free device and free installation.
    - Targeted communications for customers who may need additional support with enrollment.
    - Bill guarantees for the first year of enrollment that the fixed bill will not worsen affordability, with no-penalty opt-outs if it does.
- **Allow enrollment with a single eligible device** to lower participation barriers and make Subscription+ accessible to households with limited resources. Eligibility should extend beyond EV chargers to lower-cost devices such as smart thermostats and water-heater controls.

## Demand Charges

**Description:** A demand charge bills customers based on their maximum electricity demand in kW for a billing period, rather than only their total electricity consumption in kWh. Demand charges are more common for commercial rates but some utilities offer these, such as Georgia Power's Smart Usage Rate[80].

- Demand charges can be designed in several ways:
- Non-coincident demand charges: based on customer's highest demand at any time in the month
- Coincident demand charges: based on customer's demand during system peak
- Demand subscription / capacity threshold rates: where the customer subscribes to a kW level and must stay below it or face penalties/ service limits.

| Advantages | Disadvantages |
|---|---|
| **Reflects grid capacity costs:** Demand charges recover costs based on a household's highest demand, not only total electricity use. This can reduce cross-subsidies from customers with steady usage to those creating short, high-demand peaks. | **May not reflect system costs:** A household's monthly peak may occur outside of the grid's peak, weakening alignment between the charge and utility costs. |
| **Supports load management:** Charges create an incentive to avoid simultaneous high-power use, pairing well with smart panels, load-sharing devices, batteries, and managed EV charging. | **Creates distorted incentives:** Once a monthly peak is reached, customers may have little reason to reduce demand below that level for the rest of the billing period. This can also weaken incentives to reduce total electricity use. |
| **May pair well with heat pumps:** Heat pumps tend to use energy steadily rather than in short bursts. Shifting some cost recovery from per-kWh rates to demand charges could improve the economics of fuel switching for households with relatively stable demand. | **Difficult to understand and manage:** Customers may not know when their monthly peak will occur, and a single short demand spike can impact the entire bill. |
| | **May penalize electrification:** Households adding EVs, heat pumps, induction stoves, or electric water heaters could face higher bills without automated load controls, making poorly designed charges regressive or financially punitive. |

### Load Management Pairing Considerations

Demand charges should not rely on manual customer behavior. They are more viable when paired with automation that prevents accidental peaks.

Solar plus battery: Evergy's Even Use Plan pairs a lower energy rate with a demand charge, which can suit rooftop solar customers who reduce grid purchases but must manage peak demand carefully. Adding a battery can store midday solar for evening peaks, but high up-front capital costs and housing constraints limit access for many low-income households.[81]

### Recommendations for Equitable Design

Demand charges are not recommended as an equitable rate option until solar-plus-battery systems become accessible to a wider range of households. Research suggests low-usage customers may pay more while high-usage customers save, and low-income households may have limited ability to avoid overlapping essential loads.

If introduced later, the following should be considered:

1. On-peak or coincident demand charges will be more effective than all-hours non-coincident charges because they better align the customer signal with periods when the utility system is stressed and can send appropriate price signals.[82]

2. The rate should be opt-in and paired with free or subsidized devices, strong bill protection, and targeted analysis of impacts on low-income and electrically heated households.

## Solar Tariffs for Individual Rooftop PV

**Description:** Compensation mechanisms that provide end users with credit or payment for excess energy produced by behind-the-meter generation, often solar photovoltaic (PV). These most commonly include:

**Net Metering:** credits excess solar power to a customer's electricity bill at the full retail rate, which the customer can draw down at night or when solar power isn't available.

**Net Billing:** pays a lower wholesale rate for excess solar power than the retail rate.

**Feed-In Tariff:** policies offering a fixed, often long-term contract price for all power generated, independent of personal consumption, typically above retail price to incentivize renewable energy adoption.

Effective July 2026, BC Hydro moved from Net Metering Service Rate (Schedule 1289) to Self-Generation Service Rate (Schedule 2289), which is a net billing structure decoupled from customer's retail electricity rate.[83] Under the new Self-Generation Service Rate, customers can build systems large enough to meet their own energy needs and can send up to 100 kW per phase back to the grid at 10 cents/kWh. RS 2289 is designed for customers who primarily offset their own electricity use, with exports occurring only when onsite generation exceeds consumption.[84]

This section analyzes equity trade-offs between BC Hydro's net metering rate and the BC Hydro's Self-Generation Rate, which uses net billing.

| Net Metering Rate (Previous Rate) | Net Billing (New Self Generation Rate) |
|---|---|
| Higher export credits shorten payback periods and allow summer credits to offset winter bills. | Lower export compensation reduces savings and may extend payback periods, though this may be only 1-2 years.[5] Reduces the ability to carry the full value of summer exports into the winter heating season. |
| Creates greater potential for grid costs to shift to customers without solar. | Better aligns export compensation with avoided utility costs and reduces cost-shifting concerns. |
| Provides less financial incentive to store electricity because exports receive the retail rate. | Makes batteries more valuable by encouraging self-consumption, but increases the upfront investment needed to maximize savings. |

5 Single-home example from Kamloops: Resident installed 10kw solar panels 6 years ago. When comparing net metering with the new self generation rate, the annual difference was only $160/year less projected income from excess solar sold to grid. For new solar installers on single homes, the payback period increased from 10 to 11 years under new self generation rate, which is minor.

**Equity Takeaways**

- Net billing may help reduce risk that distributed generation customers shift grid costs onto lower-income customers without distributed generation. BCUC's modelling estimated lower cost shifting under net billing than net metering. Estimates projected approximately $24 million in annual cost shifting under net billing compared with $33 million under net metering in 2030, increasing to $54 million and $98 million respectively by 2050.[85]
- BC Hydro states that its solar rebate should offset the average residential impact of the rate change. However, rebates don't cover more than 50% of eligible costs and therefore do not sufficiently remove the upfront affordability barrier for lower-income households.[86]
- Lower export compensation increases the value of using solar electricity on-site or storing it in a battery. This can reward flexible consumption but may concentrate benefits among households able to afford storage.
- Existing net-metering customers may remain on the previous rate for up to ten years from their original enrollment date, while new customers enter the Self-Generation Rate.xiii Households able to adopt solar earlier retain higher-value credits, while later adopters, including lower-income households that faced upfront cost barriers, receive less favorable compensation.
- Rooftop solar systems last 20 years or more, while BC Hydro reviews rates every five years, creating uncertainty about future export value and payback periods. This can disproportionately

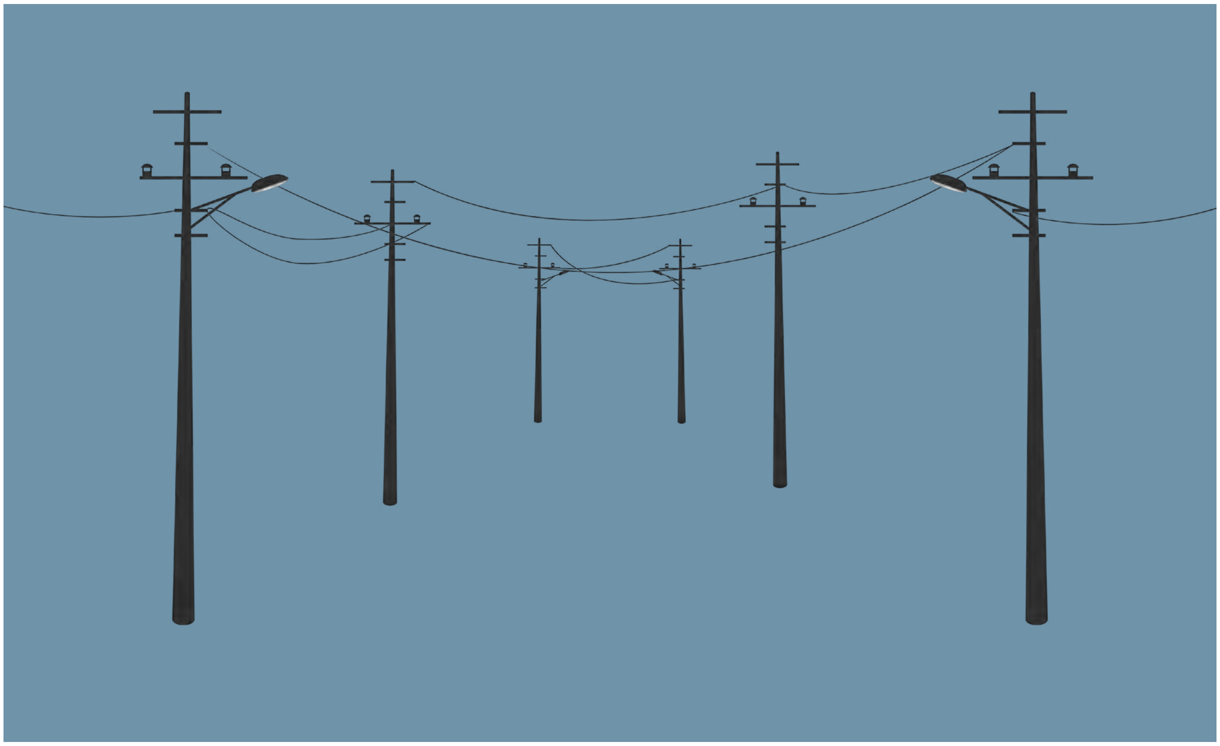
deter lower-income households, which have less capacity to absorb investment risk or delayed returns.

Overall, net metering provides stronger participant savings but may shift more grid costs to customers without solar, rewarding those with the resources to install solar at the expense of those without. Net billing improves cost alignment, but lower export compensation may further restrict access unless paired with targeted rebates, shared-generation options, and accessible financing.

## Community Generation Rates

**Description:** BC Hydro's Community Generation Service Rate (RS 2290), effective July 1, 2026, allows multiple customers to share the benefits of a single shared generating facility. Community generators earn a fixed 10 cents per kWh for surplus electricity supplied to the grid. Under a 2 MW injection limit, projects to generate substantially more electricity than typical household solar systems, subject to local grid capacity. Benefitting customers are defined as any BC Hydro customer (including facilities owned by First Nations) receiving financial compensation based on their allocated share of the Net Generation value. xiii For example, a strata corporation is the community generator that operates the shared generating facility, while benefitting customers are the strata unit owners.

The specifics of the arrangement would be up to the parties themselves, including investment minimums, credit-sharing agreements, and number of members. Benefiting customers typically pay a subscription fee to the community generator. In return, they receive an allocated share of the project's generation credits, either on their BC Hydro bill or directly from the generator.



| Advantages | Disadvantages |
|---|---|
| May allow projects to take advantage of economies of scale, larger injection limits, BC Hydro solar rebates, capital cost credits/ incentives, and public or community sites.[87] | The economics are uncertain because the rate is unproven, interconnection costs may be material, and the 2030 review creates uncertainty for long-term project planning.[lxxxvi] |
| Could support local control and community benefit models if paired with cooperatives, First Nations, public buildings, social housing, or community organizations. | The 10¢/kWh credit may be too low for subscription-based shared solar models if participants need to pay more in subscription costs (which are estimated be 15¢/kWh to cover costs).[88] |
| | The community generation rate may unintentionally create unequal benefits between households that can host solar and those that can only participate through shared generation. Rooftop solar customers benefit by offsetting their electricity consumption, while community generation participants may receive only the export credit value. This can reduce the financial attractiveness of shared solar. |

**Recommendations for Equitable Design**

**Enable low-cost subscription models.** A subscriber bill credit model could reduce up-front cost barriers by allowing participants to pay a monthly subscription fee rather than paying a large up-front cost for membership shares. However, this model depends heavily on the value of the community generation credit. It is estimated that participants may need to pay effectively 15¢/kWh through monthly membership shares but would only receive around 10¢/kWh back via the Community Generation Rate. For a subscription-based shared solar model to work well, the utility needs to raise the community generation rate and pair it with income-qualified incentives.

## Income-Qualified Rates

**Description:** Rates available to customers who meet a specified income criteria. Common income-qualified rate designs include:

- **Percentage of Income Payment Plan (PIPP):** a cap of household utility payments at a pre-determined share of income (usually 3-10% of household income).[89] Instead of paying for the amount of electricity, customers pay a consistent monthly amount based on their total household income. For example, in Virginia a cap of electric bills is applied at 6% of income without electric heating or 10% with electric heating. PIPPs directly target energy burdens by capping bills at a share of income and can protect low-income households from rate increases. However, they are administratively burdensome because they require income verification, usage data, and coordination with utilities and public agencies.

- **Flat Discount:** a set a percentage or dollar amount discount on bill. Can also be in the form of credits and can be based on electricity usage as well as income. Flat discounts are simple, have low administrative burden, and do not distort price signals as much as rate discounts. However, these are not adjusted to a household's specific income level.
- **Lifeline Rates:** apply a lower rate up to a certain reasonable consumption threshold to cover essential energy use such as heating and cooking. The lifeline rate also may reduce or completely eliminate the fixed charge portion of the customer's bill. Since these rates are calculated based on a defined "essential consumption" amount, an under-estimated amount results in high-need households being under-supported while an over-estimated amount results in high program costs paying for non-essential use.
- **Tiered Discount Programs:** applies a percent or dollar discount to different income tiers. Since this is a hybrid of flat discount and PIPP rates, tiered discounts can better account for income differences than flat discounts while remaining less complex than PIPPs.

| Advantages | Disadvantages |
|---|---|
| Eases customer financial pressures, protects against rising bills, and provides predictability for low-income customers who disproportionately are burdened by energy cost pressures.<br><br>Lifeline rates reduce need for lower-income customers to make a tradeoff between essential energy uses.<br><br>BC Hydro customer engagement found strong support for helping customers in need: 88% of customers rated ensuring options effectively support those in need as a top first or second consideration for rate options.[90] | BCUC has explicitly blocked BC Hydro past rate applications on income-based rates on the ruling of the rates being "unduly discriminatory" under the Utilities Commission Act and due to lack of legal jurisdiction to approve reduced rates for identical services based on an individual's income.[xciv] |

#### Recommendations for Equitable Design

Given the BCUC barrier for income-based rates, near-term recommendations may be more feasible through bill credits, rebates, or government-directed affordability supports rather than a new income-based rate class. For income-qualified rates to be pursued, they require legislative or regulatory changes, clear funding sources, privacy protections, and automatic or simplified enrollment.

For future consideration for income-qualified rates:

- **Keep affordability support unconditional:** Pair income-qualified rates or bill discounts with load management as an added benefit, not as a requirement that could expose vulnerable households to discomfort, higher bills, or penalties.
- **Bundle bill support with no-cost upgrades:** Prioritize income-qualified households for free energy audits, insulation, smart thermostats, water-heater controls, and other measures that reduce both bills and peak demand.
- **Use automatic enrollment where possible:** Connect eligibility to existing income-tested programs to reduce administrative burden and increase participation. Some U.S. programs automatically enroll households that qualify for other supports via LIHEAP or SNAP[lxxviii]. The CleanBC Energy Savings Program or ECAP could serve as proof of income eligibility and automatic enrollment at the income-qualified rate.

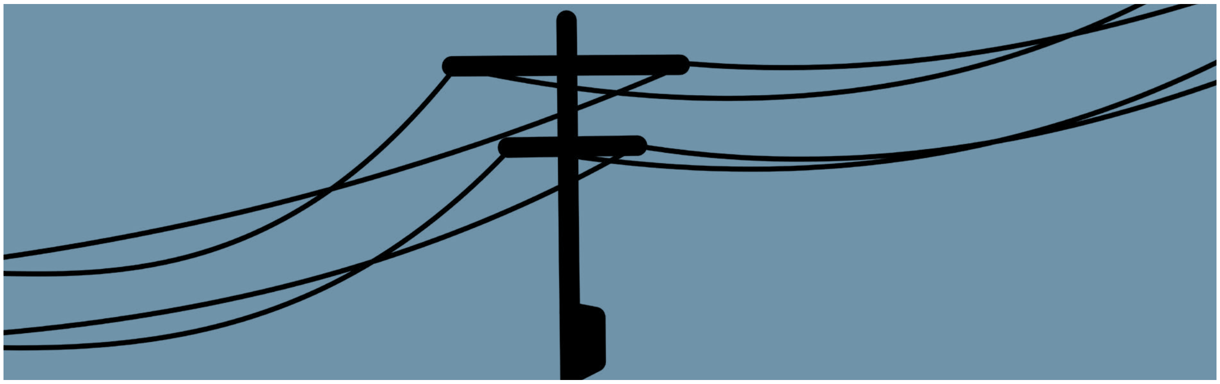
## Rate Subsidies/Credits

**Description**: Bill credits or rebates sit on top of rates and may be designed in the form of:

- **Fixed Credits:** flat, sliding-scale amount credited to bill or refunded based on income-level and household size, usually designed to offset the estimated portion of essential energy use such as heating and cooking. Fixed credits are easy to understand, more manageable to administer, and preserve conservation incentives because households keep the savings from reducing use. However, fixed credits may be less equitable for households with structurally higher energy needs, including those with electric heating or essential medical electricity needs.
- **Variable Credits:** a percentage of consumption is refunded based on the household's previous energy consumption pattern. Variable Credits are responsive to this energy burden but may be more difficult to understand than fixed credits and may remove conservation incentives.
- **Rate Freezes:** usually in the form of regulatory policy that prevents utility companies from raising rates for a specific period. Rate freezes are not considered within the scope of this report.

BC Hydro has offered ad-hoc income-qualified credits in the past, most recently the 2024 electricity affordability credit[91], but doesn't offer these rates currently. A significant amount of low-income ratepayer support funds bill payment assistant programs, such as bill forgiveness, arrears management plans, and budget billing. These programs, while important to support energy vulnerable customers, is not within the scope of this report.

| Advantages | Disadvantages |
|---|---|
| Credits can provide direct affordability support without changing the underlying rate design or removing cost-reflective price signals. | Bill credits would likely need to be funded by the government and may be more vulnerable to cancellation. |
| Credits may face fewer BCUC barriers than low-income rates because the Province can require BC Hydro to provide them without a separate BCUC approval process. | It is a challenge defining “essential” consumption to calculate the appropriate credit amount. |



**Load Management Pairing Considerations**

- Credits can be paired with free or subsidized load management devices so that vulnerable households receive immediate affordability support while also gaining tools to reduce bills and peak demand.
- Targeted credits for electric heating, medical needs, or high winter bills could be paired with smart thermostats, insulation, and heat pump support to reduce both energy burden and future peak demand.

**Recommendations for Equitable Design**

**Pair credits with free or subsidized load management devices** so that vulnerable households receive immediate affordability support while also gaining tools to reduce bills and peak demand. Programs with simple application processes or automatic crediting generally provide the strongest customer experience because they reduce participation barriers.

**Use the Low-Income Measure (LIM) to set sliding-scale credits:** The utility should base income eligibility and credit levels on LIM rather than the Low-Income Cut-Off (LICO), because LIM updates with median income and better reflects current affordability conditions, while LICO relies on older spending patterns.

**Suitable for use as a short-term cost relief measure,** but to address underlying causes of energy insecurity, initiatives must be pursued in parallel with other strategies, such as electrification retrofits and affordable housing.

**Case Study: Consumers Energy's Targeted Credits[92]**

Consumers Energy, a Michigan utility, offers three credits to target different customer needs: Home Heating Credits, Senior Citizen Bill Credits, and Green Giving Credits. The Home Heating Credit is a one-time, state-funded bill credit accessed through tax filing, while the Senior Citizen and Green Giving credits are recurring.

To maximize the effectiveness of credit programs, the utility evaluates the effectiveness of these programs using the following metrics:

- Total financial support provided through credits
- Number of customers receiving bill credits
- Average bill savings achieved through those credits

They've designed their program with a simple application processes, automatic application of credits to customer accounts, and provide customer support to reduce barriers to participation. However, credit programs by themselves do not build customer ownership or provide the sustained support needed to address energy affordability over the long term.

# Final Recommendations

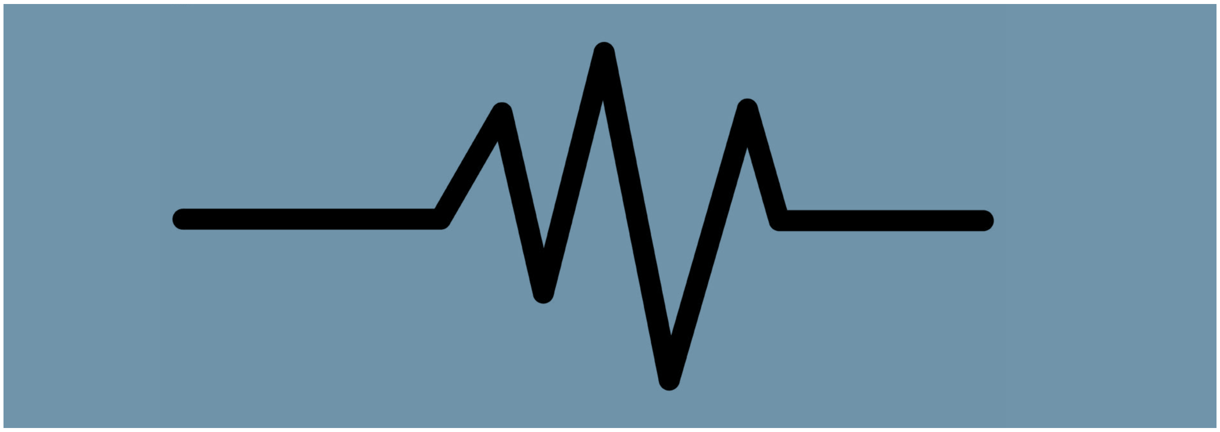
Recommendations are structured as a staged solutions pathway to equitable load management implementation. In the short-term, existing B.C. programs can immediately deploy mature, lower-cost technologies. In the medium term (3-6 years), more expensive or institutionally complex solutions should first be tested through targeted pilots. Longer-term solutions (6+ years) require maturing regulatory, financial, and market conditions and in-field demonstrations before they can scale.

## Short-Term Implementation (1-2 Years)

These actions use mature technologies and existing programs and primarily require additions or changes to existing program design.

| Recommendation | Actions |
|---|---|
| Design rates to increase demand response participation while protecting affordability | 1. **Add discounted shoulder periods to the peak Time-of-Use (TOU) window.** Offer a discounted rate immediately before 4 p.m. and after 9 p.m., while retaining the overnight discount. This would extend TOU financial benefits beyond EV owners and include load management activities more accessible to low-income households, such as pre-heating water tanks through load controllers.<br>2. **Pair TOU rates with automation, education, and bill protections.** Provide all customers with a "shadow bill" comparing what they would pay under the TOU rate with their selected rate. For income-qualified customers enrolled in TOU, guarantee that any first-year increase compared with their previous rate will be credited back, and allow penalty-free opt-outs. These protections reduce financial risk and support informed participation.<br>3. **Introduce opt-in Subscription+ with enhanced income-qualified supports.** Pair with free devices and installation, as well as targeted enrollment assistance delivered in partnership with ECAP installers. Consider a first-year bill guarantee, penalty-free opt-outs, and bill credits to improve bill predictability while helping the utility enroll more devices in demand response programs and scale peak-demand impacts. |

| | |
|---|---|
| Advance the most promising load management technologies via BC Hydro's Peak Saver, Energy Conservation Assistance Program (ECAP), and CleanBC's Energy Savings Program (ESP) | 1. **Offer free purchase and installation and raise incentives via Peak Saver** for smart thermostats and water heater controllers to better reflect their peak-demand value. Stronger rewards improve households' benefit of participating and encourage higher enrollment.<br>2. **Integrate demand response support into ECAP & CleanBC's Energy Coach Service.** Offer optional Peak Saver enrollment during home visits and train ECAP and CleanBC Energy advisers to explain device control, privacy, efficient use, risks, benefits, and opt-out options. In-person support improves informed participation and helps responsibly enroll more reliable demand response participants.<br>3. **Make load sharing devices eligible under CleanBC retrofit rebates.** Include load pausing and switching devices as alternatives when an electrical service upgrade is unavailable, impractical in remote areas, or exceeds the maximum amount covered through ESP. These devices can prevent large electrical loads from operating simultaneously, reducing upgrade costs while easing pressure on local distribution infrastructure.<br>4. **Provide consistent contractor guidance on load sharing through ECAP and HPCN.** Provide training for CleanBC Better Homes Energy Coaches and ECAP evaluators, electricians, and installers to identify suitable load sharing opportunities instead of unnecessarily recommending service upgrades or disqualifying homes. Clear guidance would improve administrative consistency, lower program and household costs, and enable more homes to complete electrification upgrades. |



| | |
|---|---|
| Expand equitable access to shared solar generation | 1. **Enable affordable subscription-based energy communities.** Increase the Community Generation Rate and pair it with a higher or kWh-based credits or incentives for income-qualified customers, with a per-customer capacity cap, rather than the flat 10¢/kWh credit. Explore alternative payment approaches such as monthly subscription instead of purchasing membership shares up front. Estimates suggest participants would need to pay about 15¢/kWh in subscription fees while receiving only about 10¢/kWh in bill credits. Closing this gap would improve household affordability and help BC Hydro expand participation in shared generation.<br>2. **Set aside a portion of BC Hydro solar rebates and community generation funding for low- and moderate-income households, Indigenous communities, and projects serving marginalized communities.** This would broaden access to local energy benefits while supporting more inclusive distributed generation.<br>3. **Fund community project development and administration.** Use programs such as the Green Municipal Fund's Community Energy Systems initiative and the BC Indigenous Clean Energy Initiative to fund technical assistance, legal services, financial planning, cooperative development, governance training, and early staffing. This would reduce reliance on unpaid volunteer labor and help communities develop viable, well-managed projects that are easier for utilities to assess and connect. |

## Medium-Term Implementation (3-6 Years)

| Recommendation Category | Actions |
|---|---|
| Pilot plug-and-play batteries in MURBs | To support ECAP's new expansion to apartments and condos[xlvii], explore procurement and pilot of small batteries modeled on Con Edison and Every Electric's renter-focused demand response program (see New York case study). The units can power window air conditioners without costly installation or landlord approval. Pair them with Peak Saver incentives so renters have opportunities to equitably benefit from load management tech. |

| | |
|---|---|
| Target batteries through social housing programs | Social Housing Energy Savings Program should consider deploying batteries in social housing, rural outage-prone communities, and homes with medically vulnerable residents, where battery storage benefits have the highest benefit potential. Utility ownership, leasing, or third-party financing could remove up-front costs. Although outages are uncommon, batteries could provide increasing value as climate-related outage risks rise. |
| Restore low-cost, accessible financing for rooftop solar | Reintroduce a zero-interest financing similar to the closed Greener Homes Loan or offer service-based models that allow households to repay utility-installed solar through monthly charges. B.C. could also enable local Property Assessed Clean Energy (PACE) financing. Coordinating provincial and local governments, utilities, lenders, and installers would expand access and equity. |
| Launch an equity-focused VPP pilot through Peak Saver | Build on Peak Saver's existing enrollment, incentives, communications, and dispatch systems. Allow accessible devices, including thermostats, water heater controls, managed EV charging, and shared building assets, to participate. Provide low- or no-cost enrollment, bill protection, clear consent and opt-outs, trusted community partnerships, and compensation that reflects the value households provide to the grid. |

## Future Pathways (6+ years)

| Recommendation Category | Actions |
|---|---|
| Explore income-qualified EV charging subsidies | Dunsky projects that EV charging will contribute significantly to peak-load growth through 2040.[xxxiv] As used EVs and lower-cost imports expand access, provide income-qualified subsidies for managed home charging and installation. Pair these supports with Peak Saver enrollment and TOU rate guidance. This would help lower-income households reduce transportation costs while enabling BC Hydro to manage charging demand. |
| Fund Indigenous-owned VPP pilots | After initial VPP pilots establish technical and operational best practices, BC Indigenous Clean Energy Initiative (BCICEI) should fund projects combining community solar, batteries, and controllable loads, including feasibility studies, aggregation software, technical assistance, and capacity building. Indigenous ownership maintains local economic benefits while improving local resilience and energy sovereignty. |
| Develop equitable V2X participation pathways | Vehicle-to-Everything (V2X) technology allows EV batteries to supply electricity to homes, buildings, or the grid. As the technology matures, BC Hydro can explore equitable applications such as creating shared or fleet-based options for renters and households without EVs, guaranteed minimum battery charge levels, clear compensation, privacy protections. |

# Conclusion

Opportunities for further research include strengthening quantitative scenario analysis across household contexts, exploring localized load management applications with Indigenous communities, and adding a qualitative evaluation of impacts on marginalized households.

First, a deeper quantitative analysis should evaluate how household and utility net benefits change with different rate designs, housing types, energy-use profiles, and retrofit pairings. This exercise can help identify which combinations deliver the strongest shared benefits and ensure solutions are appropriate for the unique needs of different energy insecure households. This report also identifies several promising load managements benefits in First Nations and Indigenous communities, but a separate research effort should be conducted to capture the values, governance structures, and energy needs of individual Nations and communities. Solutions should be formulated in direct partnership with Indigenous leaders with attention to ownership, local capacity, and long-term community benefits. Finally, advances in metering and analysis make it easier to assess demand response impacts by customer segment, but marginalized households require more contextual data and targeted methods. Future studies should combine quantitative data with surveys, interviews, and direct community engagement to understand impacts on bills, comfort, autonomy, and quality of life.

In conclusion, British Columbia can manage growing electricity demand while maintaining affordability by treating equity as a core element of load management and rate design. Integrating load management into retrofit programs such as ECAP enables more households to electrify, lowers bills, and improves comfort, while increasing participation in demand response programs such as Peak Saver. Community energy initiatives build upon these benefits by incentivizing new renewable generation, improving grid resilience, and providing community ownership opportunities. Rate design and financial incentives are an important tool to improve the household economics of load management and encourage broader adoption of peak load-reducing technologies. As economies of scale reduce costs and market dynamics and climate change increase benefits of more expensive load management technologies such as networked EV chargers, programs should be re-evaluated to incorporate these technologies using the equity framework outlined in the Future Pathways section.

With coordinated action from BC Hydro, governments, regulators, contractors, and community organizations, an equity-centered approach to load management can deliver direct benefits to more households and reduce system-wide costs for all ratepayers. By applying the approaches outlined in this report, British Columbia can build a stronger, cleaner, and more resilient energy system whose benefits are shared by all.

# Appendices

## Appendix I: Load Management and Rate Design Explainer

This section provides a primer on load management and rate design for those unfamiliar with these topics.  It also includes a review of BC Hydro's related programs and rates.

### What is load management?

Residential load management is the process of controlling when and how much electricity devices use to balance household electricity consumption with electrical capacity and grid supply. Every electrical device creates a load, meaning the amount of power it draws at a particular moment. A home's total load rises when appliances, such as an induction stove, dryer, or heating appliance operate at the same time. The home's electrical service and panel can only support a certain amount of load at once, and when many households use high-power devices simultaneously, their combined demand contributes to system-wide peaks that can strain the entire grid.

As home electrification adds new loads, overall demand on the grid increases. Because the electricity system must be built to meet the highest-demand periods, utilities invest in additional grid infrastructure to meet the rising capacity, placing upward pressure on electricity rates. Energy efficiency measures, such as insulation, LED lighting, and high-efficiency heat pumps, can reduce overall electricity use, while load management prevents several appliances from operating at the same time by spreading out or temporarily reducing electricity use during high-demand periods.

The main benefits of load management include:

1. **Reducing pressure on the electricity system.** By lowering system-wide peak demand, utilities can avoid or reduce the amount of expensive grid infrastructure upgrades needed, reducing utility costs that may cause rising electricity rates.
2. **Enabling integration of renewable energy sources.** By optimizing use of power assets and reducing grid congestion, curtailment, and outages, load management ensures continued grid reliability as intermittent wind and solar resources are added to the grid, thus future-proofing the grid for increasing electrification of end uses.
3. **Making electrification more affordable.** Adding a heat pump, electric water heater, induction range, or EV charger can exceed the capacity of an older electrical service. A load management device may allow the new equipment to be installed without a panel or service upgrade, which can help avoid thousands of dollars in household costs.
4. **Lower household energy bills.** When households are enrolled in time-of-use electricity rates that charge a lower rate for off-peak hours, load management technologies can automatically shift electricity use to off-peak, lower price hours, lowering the household's

monthly electricity bill.

There are a number of different load management solutions available, and new technologies are emerging. Examples include:

| | |
|---|---|
| **Load Sharing Devices** | Devices installed within or alongside a home's electrical panel that allow large electrical loads to use limited household capacity without operating at the same time. For example, when a resident turns on their clothes dryer, the EV charging will automatically be paused until the dryer is complete. |
| **Smart Thermostats** | Remotely controllable home thermostats that can help manage household heating and cooling loads via built-in sensors connected to home Wi-Fi. |
| **Home Battery Storage Systems** | Behind-the-meter battery stores electricity and can discharge during peak periods, outages, or utility demand response events. When integrated with solar panels, the battery charges using excess energy generated during the day for use at night. Without solar, the system uses a smart charging approach to draw electricity directly from the grid during off-peak hours when demand and rates are lowest and discharges the stored energy during peak hours or power outages. |

There are shared and aggregated load management models that build upon these load management technologies and are also included as solutions, including:

| | |
|---|---|
| **Energy Communities** | A broad term for local households or groups collaborating to produce, share, or manage renewable energy for shared economic, environmental, and social benefits. The most common source is solar, but some community-owned wind projects also exist in North America[6]. They can take many legal forms, including cooperatives, non-profit organizations, partnerships, municipalities, or corporations. |
| **Virtual Power Plants (VPPs)** | A collection of distributed energy resources (DERs) that, aggregated together and coordinated by the utility, provide reliability, economic value, and utility-grade grid services similar to power plants. Virtual Power Plants need many homes and other energy consumers with controllable loads that can be adjusted automatically for short periods. |

6 Wind projects require larger capital investments and experience with large infrastructure projects than solar. One example is Bear Mountain Wind Park, started by Peace Energy Cooperative and transferred ownership to an energy company largely due to high operating & maintenance costs.

Like many other utilities in North America, BC Hydro has started investing in load management to manage peak demand, including:

**Power Smart 2.0:** Released in May 2026, this program commits more than $1 billion to energy efficiency and demand response. Unlike BC Hydro's first Power Smart program, which focused heavily on voluntary behavior and passive education, version 2.0 more intentionally prioritizes load management.viii The program includes free smart thermostats for eligible customers with baseboard heating and seasonal rewards for participation in" Team Power Smart" challenges, which reward customers for reducing electrical usage during peak events.

**Peak Saver:** BC Hydro's main residential demand-response program encompassed within the larger Power Smart plan. Similar to Team Power Smart challenges, customers can enroll load management technologies such as load controllers, batteries, or smart thermostats that are briefly and temporarily adjusted by the utility during peak demand events, with options for customer override.

**Pilot Programs:** BC Hydro is testing newer technologies to support local grid reliability and defer infrastructure upgrades. The utility is installing 200 residential batteries in two B.C. neighborhoods to pilot a virtual power plant model, where the utility will manage battery operation remotely to lower peak demand.[93] Another pilot in Vancouver is installing smart-panels into buildings that are transitioning from single-family to multi-unit residences to evaluate load management as a solution for increasing densification of buildings.[94]

## What is rate design and how does it relate to load management?

Electricity rates determine how customers are charged for electricity consumption and grid connection. Rate design is the process of deciding how costs are recovered from customers, how they're divided among customer groups, and how they appear on a bill.

Compared to commercial and industrial electricity rates, residential rates are designed to be relatively simple and offer flexible, short-term agreements typically charged monthly and readjusted annually. BCHydro evaluates residential rate design using 4 main objectives[lxxxix]:

1. **Affordability: i**mpacts on household energy bills.
2. **Economic Efficiency:** how closely the price of electricity reflects the utility's cost of supplying it.
3. **Decarbonization:** aligned incentives to switch from fossil fuels to clean electricity.
4. **Flexibility:** ability to respond to economic and policy changes and anticipate needs for differentiated rate designs.

Residential rates combine 3 main categories of charges:

- **Customer (i.e. Basic) Charge:** A fixed daily or monthly amount that does not change with electricity use. BC Hydro's basic charge recovers ~60% of customer-related costs and includes meters, billing, and a portion of service lines and transformer costs.lxxiv
- **Volumetric Charge:** A charge for each kilowatt-hour of electricity used. It varies with total consumption and may also vary by time, season, or consumption tier. It covers

energy-related costs such as generating or purchasing electricity and in practice often also recovers some customer- and demand-related costs.lxxiv

- **Demand Charge:** A charge based on the customer's highest electricity demand, measured in kilowatts, during a billing period or defined peak window. Demand charges are more common for commercial and industrial customers but are being explored as a residential charge by some utilities (see Rate Design section).

The portion of utility costs recovered through each component varies by rate and almost never coincides exactly with the underlying cost category.

Rate design plays an important role in load management because prices and incentives can influence when a household uses electricity. A well-designed rate can:

- Help households save money when using load management technologies.
- Reduce system costs by encouraging electricity use when capacity is available.
- Support affordable electrification by lowering the cost of operating heat pumps and other efficient electric equipment.

For example, a rate can improve heat-pump economics by lowering the marginal cost of the additional electricity used for heating, particularly when the heat pump operates during lower-cost hours. However, a rate that places high prices on hours when heating is essential could increase bills and discourage electrification. Rate design and load management therefore need to be assessed together.[95]

The following are examples of rates that can be paired with demand response programs. Each uses a different mix of fixed, volumetric, and demand-based charges:

| | |
|---|---|
| **Time-of-Use Rate** | A volumetric charge that varies based on when electricity is consumed, with higher prices during peak hours and lower prices during periods of lower demand. |
| **Subscription+ Rate** | The customer pays a fixed monthly amount based on their historical, weather-normalized electricity use. The "plus" requires participation in demand response programs, such as enrolling smart devices in BC Hydro's Peak Saver Program. |
| **Demand Charge** | Charges based on a customer's maximum electricity demand for a billing period, rather than only on total consumption. They can be designed based on the customer's highest demand at any time of the month or customer's demand during system-wide peaks. |
| **Solar Generation Rates** | These rates determine how customers are compensated when they generate electricity, typically through rooftop solar. The utility provides solar producing households with a bill credit or payment for excess energy they discharge the grid surplus of what they consume. |

Incentives can be added onto rates to reward households for reducing or shifting electricity use. They can provide an opportunity for customers to save on their energy bills without being exposed to peak prices or penalties. Example incentives include:

- **Enrollment incentive:** A one-time payment or bill credit for registering an eligible device or joining a demand-response program such as the Peak Saver program.
- **Event-based reward:** A payment for reducing electricity use during a specific peak-demand event such as a particularly cold or hot day.
- **Seasonal participation payment:** A fixed reward for keeping a device enrolled and available for the utility to make small adjustments to home appliances during a high-demand winter or summer season.

## Appendix II: Solutions Inventory

### Full List of Load Management Technologies and Solutions Considered

| Solution | Description | Main Benefits | Main Drawbacks | Advance for Assessment? |
|---|---|---|---|---|
| **NON-UTILITY CONTROLLED DEVICES** | | | | |
| **Branch circuit switching devices** | Split an existing circuit between two appliances, supplying the secondary load only when the priority load is off. | Allows addition of one electric appliance, avoiding or deferring service upgrade; relatively low cost; fits existing retrofit programs. | Requires professional installation and compatible loads; landlord approval may be needed; manages limited number of loads. | **Yes** |
| **Load pausing devices** | Monitor whole-home demand and temporarily pause connected loads when electricity use approaches preset limit. | Can support multiple electrified loads on a 100-amp service; avoids or defers service upgrades; relatively low cost | Requires professional installation and compatible loads; commonly designed for EV charging; evaluate load pausing impacts on daily life | **Yes** |
| **Standalone smart energy monitors** | Installed onto an existing electrical panel to provide real-time household or appliance-level electricity-use data. | Lower-cost alternative to a smart panel; may help identify standby loads and schedule flexible equipment. | Savings depend on sustained app engagement; requires strong Wi-Fi; may be less suitable for MURBs. | **No -** High engagement requirements weaken equity and energy-saving case. |
| **UTILITY-CONTROLLABLE, UNIDIRECTIONAL DEVICES** | | | | |
| **Smart panels** | Internet-connected breaker panels monitor, prioritize, and control household circuits in real time. | Coordinates several electric loads; helps avoid service upgrade; supports demand response and future electrification | High equipment and installation cost; newer tech; in MURBs benefits may accrue to owners rather than tenants. | **Yes** |

| | | | | |
|---|---|---|---|---|
| **Water heater load controllers** | Automatically delay electric water heating during peaks or shift it to lower-cost hours. | Targets a large, flexible household load with little comfort impact; low cost; automation reduces effort. | Requires a compatible electric water heater; not relevant for buildings with centralized water heating. | **Yes** |
| **Smart thermostats** | Use connected controls and sensors to automatically adjust household heating or cooling. | Can automate peak reduction and bill savings; included in existing BC Hydro programs; low cost; easy install. | Performance depends on heating system, insulation, Wi-Fi, and correct setup; risks of unequal renter/ landlord cost-benefit | **Yes** |
| **Networked EV chargers and EV energy management systems** | Connect EV charging to software that can schedule, limit, or remotely manage charging demand. | Shifts a large flexible load away from peaks; central systems can manage charging across multi-unit buildings. | Costly equipment & install; grid needs to support connection; near-term benefits skew toward vehicle & property owners. | **No -** Lower priority for an equity-focused household technology assessment. |
| **Plug- and device-level controls** | Use smart plugs, switches, outlets, or bulbs to automate individual small loads. | Low cost; broadly compatible with housing types; can reduce standby use and automate lower energy use. | Small grid impact; unexpected shutoffs in demand-response can be disruptive | **No -** Low net benefits and greater disruption risk for households. |
| **BIDIRECTIONAL AND DISTRIBUTED ENERGY RESOURCES** | | | | |
| **Vehicle-to-grid (V2G)** | Allows a compatible EV battery and bidirectional charger to send electricity to a building or the grid. | Could provide backup power and flexible capacity while using an existing battery asset. | Emergent technology and standards; limited compatible vehicles; requires specialized equipment and interconnection. | **No -** Not yet mature for broad residential application; retain as a future option. |
| **Home battery storage** | Stores grid or solar electricity for discharge during peak periods, outages, or demand-response events. | High peak reduction potential, bill-reduction potential; clean backup power source; can increase the value of solar. | High upfront cost; current multi-unit rebate eligibility is limited. | **Yes** |
| **Rooftop solar PV** | Generates on-site electricity and credits excess production through a self-generation rate. | Lowers energy costs; support resilience and energy independence; value maximized when paired with batteries and controls | High upfront cost and site constraints; output has limited alignment with B.C. winter evening peaks; renters ownership barriers. | **Yes** |
| **AGGREGATION AND COMMUNITY MODELS** | | | | |
| **Virtual power plants (VPPs)** | Aggregate connected distributed resources so they can be coordinated as a single flexible grid resource. | High peak load reduction and provides grid services; participant compensation; Builds on BC Hydro demand response program | Requires connected devices, aggregation software, sufficient enrollment, clear control rules, and strong equity-centered design. | **Yes** |

| | | | | |
|---|---|---|---|---|
| **Energy community models** | Legal entities with households, municipalities or small businesses that provide energy services so members can benefit from shared generation. | Shares capital costs; can distribute bill savings and grid-service revenues; strong potential for renters, Indigenous communities, and social housing. | Requires skilled capacity and up-front financing; benefits may be captured by higher-income members without explicit safeguards. | **Yes** |
| **Advanced metering infrastructure (AMI)** | Combines smart meters, communications, and data systems for two-way utility-customer information exchange. | Enables interval billing, demand response, and automated load-management programs. | Data governance and privacy considerations; does not itself deliver household savings or load flexibility. | No **-** BC Hydro already implemented AMI; it is an enabler rather than a new solution. |

## Full List of Rates and Incentives Considered

| Rate / Incentive | Description | Main Benefits | Main Drawbacks | Advance for Assessment? |
|---|---|---|---|---|
| **USAGE-BASED RATES** | | | | |
| **Flat rate** | Charges one price per kilowatt-hour regardless of total use or time of consumption. | Simple and predictable; may lower bills for electrically heated, colder-climate, or larger households. | Provides no peak-reduction signal and may shift system costs from high-demand households to others. | **No -** Existing option with limited value for load-management. |
| **Tiered inclining block rate** | Charges a lower price up to a consumption threshold and a higher price for additional electricity use. | Protects some lower-use customers and provides a conservation signal. | Can penalize households with electric heating, inefficient housing, medical loads, or other structurally high needs; conservation effects have weakened. | **No -** BC Hydro expects to phase out the rate by 2030. |
| **Tiered declining block rate** | Reduces the price per kilowatt-hour as household electricity consumption increases. | Could lower the marginal cost of electrification for high-use households. | Encourages higher consumption and poorly targets households that need electrification support. | **No -** BC Hydro considered and rejected this design. |
| **Prepaid metering rate** | Requires customers to purchase electricity in advance and top up their balance as needed. | May provide immediate feedback on spending and eliminate payment arrears. | Creates high disconnection and under-consumption risks for households unable to top up; adds monitoring burden. | **No -** High equity risk and previously considered but not adopted by BC Hydro. |
| **Straight fixed-variable rate** | Combines a higher fixed monthly charge with a lower charge for each kilowatt-hour consumed. | May benefit electric-heating customers by reducing volumetric charges and can better reflect fixed system costs. | Can raise bills for low-use households and create cost shifts if participation is optional. | **No -** BC Hydro has not advanced it and other designs better target peak costs. |
| **Demand charge** | Adds a charge based on a household's highest kilowatt demand during the billing period. | Reflects capacity costs and encourages households to avoid simultaneous high-power use; pairs well with automated load controls. | Difficult to understand; one short spike can raise the bill; may penalize electrification without automation and bill protections. | **Yes** |

| | | | | |
|---|---|---|---|---|
| **TIME-VARYING RATES** | | | | |
| **Time-of-use (TOU) rate** | Charges different prices by time of day, generally with higher evening and lower overnight prices. | Can reduce system peaks and reward flexible loads; pairs directly with automated controls, batteries, and overnight charging. | Households with limited flexibility may pay more, ration essential energy, or face added mental burden. | **Yes** |
| **Critical peak pricing (CPP)** | Applies a much higher price during a small number of critical system-peak events. | Targets the hours that drive capacity needs and can produce a stronger response than routine TOU pricing. | Sharp price spikes create high bill and comfort risks and may be difficult to understand or accept. | **No -** Equity risks are high and BC Hydro has not advanced the design. |
| **Seasonal rate** | Varies electricity prices by season or incorporates seasonal adjustments within another rate. | Could support households with high winter heating needs and respond to changing winter or summer peaks. | May not align with hydro-system conditions and could add complexity without directly targeting peak hours. | **Yes** |
| **Real-time dynamic rate** | Changes prices frequently, usually hourly, with wholesale costs or real-time system conditions. | Provides a granular cost signal that automated devices could use efficiently. | Creates severe complexity and bill-volatility risks and requires digital access, automation, and price caps. | **No -** High equity risk and unnecessary complexity for most residential customers. |
| **BILL-STABILITY RATES** | | | | |
| **Subscription (fixed) rate** | Sets a fixed monthly payment from weather-normalized historical use, often with a risk premium or later true-up. | Improves bill predictability and makes budgeting easier. | May include a premium or year-end adjustment and weakens conservation and peak-reduction incentives. | **No -** Limited peak value without required efficiency or demand flexibility. |
| **Subscription+ (fixed+) rate** | Pairs a fixed monthly bill with required energy-efficiency or utility-controllable demand-flexibility measures. | Combines bill predictability with utility access to flexible loads and may reduce customer effort. | Requires compatible connected devices and willingness to allow utility control; premiums and annual resets may lower savings. | **Yes** |

## Appendix III: Cost-Benefit Analysis Details

Below is a summary the cost-benefit analysis conducted separately in more detail.

**Assumptions:**

- Net present value calculated using benefits and costs over lifetime of technology and evaluated on a per household basis
- Household Archetype: Single-family home in British Columbia with 100A/240V electrical
- Discount Rate: 4.45% (Canadian Prime Rate as of July 2026)
- Excluded:
    - Environmental costs & benefits, including emissions reduction
    - End-of-Life discard and replacement costs
- Rate: B.C. Hydro Residential Flat Rate + Time-of-Use Rates[96]
- Electricity consumption averages based on B.C. Hydro report from 2022[97]

### Load Sharing Devices

| Cash Flow Item | Year 0 | Year 1... | ...Year 10 | 10-Year NPV |
|---|---|---|---|---|
| **HOUSEHOLD** | | | | |
| Benefit: Avoided service upgrade[xxii] | $5,250 | $0 | $0 | |
| Cost: Device purchase[xxiii] | ($1,000) | $0 | $0 | |
| Cost: Installation[xxiii] | ($550) | $0 | $0 | |
| **Net household cash flow** | **$3,700** | **$0** | **$0** | |
| **Present value** | **$3,700** | **$0** | **$0** | **$3,700** |
| **UTILITY** | | | | |
| Benefit: Avoided peak-capacity costs[xxxiv] | $0 | $23 | $23 | |
| Benefit: Reduces local transformer and feeder pressure as electrification scales. | Non-measurable | | | |
| Costs | $0 | $0 | $0 | |
| **Net utility cash flow** | **$0** | **$23** | **$23** | |
| **Present value** | **$0** | **$22** | **$15** | **$185** |
| **Total net present value** | | | | **$3,885** |

***Note.*** This case is for a family getting a heat pump or other electrical appliance installed that would need an electrical upgrade without a load sharing device.

### Smart Panel

| Cash Flow Item | Year 0 | Year 1.. | ..Year 10 | 10-Year NPV |
|---|---|---|---|---|
| **HOUSEHOLD** | | | | |
| Benefit: Avoided service upgrade[xxii] | $5,250 | $0 | $0 | |
| Benefit: Bill savings | $0 | $85 | $85 | |
| Cost: Device purchase[xxiii] | ($5,000) | $0 | $0 | |

| | | | | |
|---|---|---|---|---|
| Cost: Installation | ($1,500) | $0 | $0 | |
| Cost: Maintenance and vendor lock-in risks | Non-measurable | | | |
| Cost: Variance costs for current B.C. electric code | Non-measurable | | | |
| **Net household cash flow** | **($1,250)** | **$85** | **$85** | |
| **Present value** | **($1,250)** | **$82** | **$55** | **($572)** |
| **UTILITY** | | | | |
| Benefit: Avoided peak-capacity costs[98] | $0 | $23 | $23 | |
| Benefits: enables fuel switching for more homes without increasing service size | Non-measurable | | | |
| Costs (N/A) | $0 | $0 | $0 | |
| **Net utility cash flow** | **$0** | **$23** | **$23** | |
| **Present value** | **$0** | **$22** | **$15** | **$185** |
| **Total net present value** | | | | **($387)** |

***Note***. Bill savings estimates based on combined calculations of bill savings from the smart thermostat and water heater load controller analysis, given the smart panel can modulate both of these devices in the same way. Bill savings will likely increase with the number of appliances managed by the smart panel.

### Battery Storage

| Cash Flow Item | Year 0 | Year 1.. | Year 7 | ..Year 11 | 11-Year NPV |
|---|---|---|---|---|---|
| **HOUSEHOLD** | | | | | |
| Benefit: Rebate[lxxxv] | $5,000 | $0 | $0 | $0 | |
| Cost: Peak Saver bonuses & rewards[99] | $500 | $50 | $50 | $50 | |
| Benefit: Bill savings | $0 | $250 | $250 | $250 | |
| Benefit: Avoided generator purchase | $1,500 | $0 | $0 | $0 | |
| Benefit: Avoided generator fuel cost | $0 | $69 | $69 | $69 | |
| Benefit: Lower air and noise pollution from fuel generator | Non-measurable | | | | |
| Benefit: Potential revenue from carbon credits, clean energy certificates, or federal carbon pricing rebates | Non-measurable | | | | |
| Cost: Device purchase | ($12,000) | $0 | $0 | $0 | |
| Cost: Installation[100] | ($3,750) | $0 | $0 | $0 | |
| Cost: Maintenance[101] | $0 | $0 | ($1,400) | $0 | |
| **Net household cash flow** | **($8,750)** | **$643** | **($757)** | **$643** | |
| **Present value** | | | | | **($4,332)** |
| **UTILITY** | | | | | |
| Benefit: Avoided generation & trans. costs[xxxiv] | $0 | $2,173 | $2,173 | $2,173 | |
| Benefit: Residential batteries help utility collect data how distributed energy resources perform in real homes for future VPP or DERMS | Non-measurable | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Cost: Peak Saver bonuses & rewards | $500 | $250 | $250 | $250 | |
| Cost: Rebate | $5,000 | $0 | $0 | $0 | |
| Cost: Program admin & operations costs[xxxiv] | $0 | $6 | $6 | $6 | |
| **Net utility cash flow** | **($5,500)** | **$1,917** | **$1,917** | **$1,917** | |
| **Present value** | **($5,500)** | **$1,835** | **$1,476** | **$1,187** | **$10,890** |
| **Total net present value** | | | | | **$6,558** |

***Note***. Assumes battery shifts 100% of on-peak electricity use to overnight, which was viable under the consumption behaviors of an average B.C. household. Battery product based on Eguana Technologies Evolve LFP 14kWh/5kW battery, which is the battery used for BC Hydro's pilot program.

### Water Heater Load Controller

| Cash Flow Item | Year 0 | Year 1.. | ..Year 10 | 10-Year NPV |
|---|---|---|---|---|
| **HOUSEHOLD** | | | | |
| Benefit: Peak Saver enrollment bonus | $100 | $0 | $0 | |
| Benefit: Peak Saver seasonal reward | $0 | $50 | $50 | |
| Benefit: Bill savings | $0 | $42 | $42 | |
| Cost: Device purchase[xxxviii] | ($150) | $0 | $0 | |
| Cost: Installation | ($275) | $0 | $0 | |
| **Net household cash flow** | **($325)** | **$92** | **$92** | |
| **Present value** | **($325)** | **$88** | **$60** | **$405** |
| **UTILITY** | | | | |
| Benefit: Avoided generation costs[xxxiv] | $0 | $159 | $159 | |
| Benefit: Avoided transmission and distribution costs[xxxiv] | $0 | $58 | $58 | |
| Cost: Peak Saver enrollment bonus | ($100) | $0 | $0 | |
| Cost: Peak Saver seasonal reward | $0 | ($50) | ($50) | |
| Cost: Program administration and operations[xxxiv] | $0 | ($4.50) | ($4.50) | |
| **Net utility cash flow** | **($100)** | **$163** | **$163** | |
| **Present value** | **($100)** | **$156** | **$105** | **$1,191** |
| **Total net present value** | | | | **$1,596** |

***Note***. Bill savings estimates based on NREL modelling. NREL estimates an electric resistance water heater can shift about 0.5-1.8 kWh of electricity per control event.

### Smart Thermostat

| Cash Flow Item | Period | Electric Baseboard | Electric Furnace | Heat Pump |
|---|---|---|---|---|
| **HOUSEHOLD** | | | | |
| Benefit: Peak Saver enrollment bonus[xcviii] | Year 0 | $100 | $100 | $100 |
| Benefit: Peak Saver seasonal reward | Years 1-10 | $50 | $50 | $50 |
| Benefit: Bill savings | Years 1-10 | $22 | $28 | $8 |
| Benefit: Free thermostat rebate[102] | Year 0 | $151 | $0 | $0 |

| | | | | |
|---|---|---|---|---|
| Benefit: Improved comfort control and convenience through room-by-room scheduling and automation | Non-Measurable | | | |
| Benefit: Increased energy awareness from app-based visibility can further reduce unneeded cooling and heating | Non-Measurable | | | |
| Cost: Device purchase[103] | Year 0 | ($151) | ($151) | ($151) |
| Cost: Installation (for some households) | Year 0 | ($275) | ($275) | ($275) |
| **Net household cash flow** | **Year 0** | **($175)** | **($326)** | **($326)** |
| **Net household cash flow** | **Years 1-10** | **$72** | **$78** | **$58** |
| **Present value** | **Year 1** | **$69** | **$74** | **$55** |
| **Present value** | **Year 10** | **$46** | **$50** | **$37** |
| **Household net present value** | **10-year** | **$394** | **$290** | **$134** |
| **UTILITY** | | | | |
| Benefit: Avoided generation costs[xxxiv] | Years 1-10 | $165 | $210 | $60 |
| Benefit: Avoided transm. and dist. cost[sxxxiv] | Years 1-10 | $61 | $77 | $22 |
| Cost: Peak Saver enrollment bonus | Year 0 | ($100) | ($100) | ($100) |
| Cost: Peak Saver seasonal reward | Years 1-10 | ($50) | ($50) | ($50) |
| Cost: Program admin and operations[xxxiv] | Years 1-10 | ($4.50) | ($4.50) | ($4.50) |
| Cost: Free thermostat rebate | Year 0 | ($151) | $0 | $0 |
| Cost: Reduced avoided costs from rebound risk, where heating demand rises after the setback period. | Non-Measurable | | | |
| **Net utility cash flow** | **Year 0** | **($251)** | **($100)** | **($100)** |
| **Net utility cash flow** | **Years 1-10** | **$171** | **$233** | **$28** |
| **Present value** | **Year 1** | **$164** | **$223** | **$26** |
| **Present value** | **Year 10** | **$111** | **$150** | **$18** |
| **Utility net present value** | **10-year** | **$1,106** | **$1,744** | **$118** |
| **Combined net present value** | **10-year** | **$1,500** | **$2,034** | **$252** |

***Note.*** Nominal annual cash flows are unchanged from Years 1–10 for all heating types. Bill savings based on assumption that smart thermostat pre-heats home during standard hours and reduces kWh during on-peak hours and that heating load is only available to adjust during cold months when heat is turned on.

### Rooftop Solar*

| Cash Flow Item | Year 0 | Year 1.. | ..Year 25 | 25-Year NPV |
|---|---|---|---|---|
| **HOUSEHOLD** | | | | |
| Benefit: Rebate[xcviii] | $5,000 | $0 | $0 | |
| Benefit: Tax exemption[104] | $1,750 | $0 | $0 | |
| Benefit: Bill savings | $0 | $1,558 | $1,558 | |
| Benefit: Solar panels can add up to 3-4% to a home's sale price above those without[105] | Non-measurable | | | |
| Benefit: Increased energy autonomy, resilience, and alternative source of revenue. | Non-measurable | | | |

| | | | | |
|---|---|---|---|---|
| Cost: Purchase and installation[106] | ($25,000) | $0 | $0 | |
| Cost: Panel Upgrade[107], [108] | ($3,250) | $0 | $0 | |
| Cost: Long-term investment uncertainty if rates change the payback period and compensation | Non-measurable | | | |
| **Net household cash flow** | **($21,500)** | **$1,558** | **$1,558** | |
| **Present value** | **($21,500)** | **$1,492** | **$525** | **$1,724** |
| **UTILITY** | | | | |
| Benefit: Aggregate value of solar[lxxxiv] | $0 | $1,093 | $1,093 | |
| Cost: Rebate | ($5,000) | $0 | $0 | |
| Cost: Net metering reimbursement | $0 | ($37) | ($37) | |
| Cost: Program administration and operations | $0 | ($1.80) | ($1.80) | |
| Benefit: Future protection from rising summer peaks as climate warms | Non-measurable | | | |
| Cost: Net billing doesn't fully eliminate cost shifting to non-solar prosumers | Non-measurable | | | |
| **Net utility cash flow** | **($5,000)** | **$1,054** | **$1,054** | |
| **Present value** | **($5,000)** | **$1,009** | **$355** | **$10,712** |
| **Total net present value** | | | | **$12,436** |

***Note.*** Bill savings based on BC Hydro's self generation rate and flat rate effective July 1, 2026. Assumes 10 kw solar panel based on small house estimate and electrically-heated home.

## Appendix IV: Generative AI Use Statement

Generative AI tools, primarily ChatGPT (GPT-5.6 Model) and Gemini (3.5 Model), were used to support the development of this report and presentation in accordance with UBC and Ecotrust Canada guidelines. ChatGPT assisted with organizing research notes and improving grammar, flow, and length. It was also used to create some of the images included in the report, though the ideation of these images were the author's own.

Generative AI was used as a supplementary research and writing aid, not as a substitute for analysis or decision-making. The report's research approach, equity framework, assessment of technologies and rate designs, recommendations, and conclusions were developed by the author. All AI-generated wording was reviewed, revised, and checked against the underlying sources. No factual claim, citation, interpretation, or recommendation was included solely based on AI-generated content. Analysis, judgments, and recommendations are the author's own.

## Appendix V: Citations


1 BC Hydro, “Projects,” accessed August 3, 2026, https://www.bchydro.com/energy-in-bc/projects.html

2 Jana Elbrecht and Evan Pivnick, ***More for Less*** (Clean Energy Canada, December 2025), https://cleanenergycanada.org/wp-content/uploads/2025/12/Report_2025_HeatPumpsBC-V6.pdf

3 “The 2026 BC Building Electrification Roadmap Launch Webinar,” hosted by Mariko Michasiw, May 12, 2026, YouTube video, posted by Zero Emissions Innovation Centre (ZEIC), https://www.youtube.com/watch?v=cG1LbNGISpc&t=2340s

4 Statistics Canada, “Surviving the Heat: The Impacts of the 2021 Western Heat Dome in Canada,” June 27, 2022, https://science.gc.ca/site/science/en/blogs/science-health/surviving-heat-impacts-2021-western-heat-dome-canada

5 Government of British Columbia, ***CleanBC Roadmap to 2030*** (2022), https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_brochure.pdf

6 “Powering B.C.’s Future: New Plan Drives Clean Energy, Growth, Jobs,” news release, Government of British Columbia, June 15, 2026, https://news.gov.bc.ca/releases/2026ECS0030-000705

7 Salomé Dionne-Laforest, David Heisel, and Jerry Situ, “Estimation of Energy Poverty Rates Using the 2021 Census of Population,” Statistics Canada, February 20, 2024, https://www150.statcan.gc.ca/n1/pub/46-28-0001/2024001/article/00001-eng.htm

8 BC Hydro, ***Power Smart 2.0: Putting Conservation First*** (May 2026), https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/residential/programs/power-smart-plan.pdf

9 Kevin Brehm, Mark Dyson, Connor Usry, and Avery McEvoy, ***Virtual Power Plants, Real Benefits: How Aggregating Distributed Energy Resources Can Benefit Communities, Society, and the Grid*** (RMI, January 2023), https://rmi.org/resources/virtual-power-plants-real-benefits/.

10 BC Hydro, “Customer Generation Service Rates Updates,” accessed August 3, 2026, https://www.bchydro.com/toolbar/about/strategies-plans-regulatory/rate-design/self-generation-rate-updates.html

11 Luis Mundaca, Henner Busch, and Sophie Schwer, “‘Successful’ Low-Carbon Energy Transitions at the Community Level? An Energy Justice Perspective,” ***Applied Energy*** 218 (2018): 292–303, https://doi.org/10.1016/j.apenergy.2018.02.146

12 Statistics Canada, “Estimation of Energy Poverty Rates Using the 2021 Census of Population”, released February 20, 2024, https://www150.statcan.gc.ca/n1/pub/46-28-0001/2024001/article/00001-eng.htm

13 Angela Park, ***Equity in Sustainability: An Equity Scan of Local Government Sustainability Programs*** (Urban Sustainability Directors Network, March 2015), https://www.usdn.org/uploads/cms/documents/USDN_

Innovation_Report_Tools_Equity_Scan-3-2015.pdf

14 Lee V. White and Nicole D. Sintov, "Health and Financial Impacts of Demand-Side Response Measures Differ across Sociodemographic Groups," ***Nature Energy*** 5, no. 1 (2020): 50–60, https://doi.org/10.1038/s41560-019-0507-y

15 First Nations Technology Council, ***BC First Nations Community Internet Connectivity*** (August 2024), https://technologycouncil.ca/wp-content/uploads/2024/09/FNTC-IDES1.pdf

16 Government of British Columbia, "Connectivity in B.C.," accessed August 3, 2026, https://www2.gov.bc.ca/gov/content/governments/connectivity-in-bc

17 Tom Berkhout and Lisa Westerhoff, ***British Columbia's Building Electrification Roadmap*** (Building to Electrification Coalition and Zero Emissions Innovation Centre, 2026), https://b2electrification.org/sites/b2electrification.org/files/posts/2026%20BC%20Building%20Electrification%20Roadmap.pdf

18 Runa R. Das et al., "Energy Poverty in British Columbia: Policy Gaps in Canada's Clean Energy Leader," Environmental Research: Energy 3, no. 2 (2026): 025014, https://doi.org/10.1088/2753-3751/ae6599

19 Spark Northwest, "Residential Batteries—Education & PSE FLEX Battery Program," Vimeo video, 1:05:00, November 19, 2025, https://vimeo.com/1138732891

20 Ximena Aristizabal and Erin Baker, ***A Systematic Literature Review on Residential Demand Response, with a Focus on Equity*** (University of Massachusetts Amherst, 2024), https://doi.org/10.7275/55088

21 Kambo Energy Group, Power Up BC: Advancing Equity through Municipal Climate Leadership (July 28, 2025), https://cdn.prod.website-filescom/6566696df54477b2faa61145/69792e4eb8cfcd7be467d7fa_Power%20Up%20Report_2025-07-28.pdf

22 U.S. Department of Energy. (2006). Benefits of demand response in electricity markets and recommendations for achieving them: A report to the United States Congress pursuant to Section 1252 of the Energy Policy Act of 2005 (pp. vii, 27, 77). U.S. Department of Energy.

23 Yule-Bennett, S., & Sunderland, L. (2024, January). Flex-ability for all: Pursuing socially inclusive demand-side flexibility in Europe. Regulatory Assistance Project.

24 Building to Electrification Coalition. (2023, March). Home electrification: Service upgrade not required! https://b2electrification.org/home-electrification-service-upgrade-not-required

25 Government of British Columbia. "Climate Action and Accountability." Province of British Columbia. Last modified April 1, 2026. https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action

26 BC Housing, ***The Homeowner's Guide to Electrical Load Management*** (2024), https://www.bchousing.org/sites/default/files/media/documents/Homeowners-Guide-to-Electrical-Load-Management-2024.pdf

27 Frank Crawford, "Home Electrification: Service Upgrade Not Required!," Building to Electrification Coalition, March 2023, https://b2electrification.org/home-electrification-service-upgrade-not-required

28 Peter Slowik and Michael Nicholas, ***Expanding Access to Electric Mobility in the United States*** (International Council on Clean Transportation, December 6, 2017), https://theicct.org/wp-content/uploads/2021/06/Expanding-access-electric-mobility_ICCT-Briefing_06122017_vF.pdf

29 CEDIA, "Offline Smart Homes: Are They Possible & How?," last updated February 12, 2026, https://cedia.org/homeowners/knowledge/offline-smart-homes-are-they-possible-how/

30 Cori Jackson, "Managed Loads, Maximum Flexibility," Lighting Design + Application 56, no. 3 (March 2026): 36–38, https://doi.org/10.1177/03606325261429658

31 Utility Consumers' Action Network, Comments on the Electrification Impact Study Part 2 Draft Reports Filed by San Diego Gas & Electric, Southern California Edison, and Pacific Gas & Electric on October 31, 2025, proceeding R.21-06-017 (California Public Utilities Commission, December 15, 2025), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M590/K904/590904791.PDF

32 Consortium for Advanced Residential Buildings and Steven Winter Associates, ***Designing Forced-Air HVAC Systems***, last updated August 31, 2010, https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/forced_air_hvac_guide.pdf

33 Lockheed Martin Energy, Home Energy Management System Savings Validation Pilot: Final Report, NYSERDA Report 17-16 (November 2017), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/Home-Energy-Management-System-Savings-Validation-Pilot.pdf

34 Clean Energy Canada, "BC Distributed Energy Resource Potential Study: Final Report" (PowerPoint presentation, Dunsky Energy + Climate, February 2026), https://cleanenergycanada.org/wp-content/uploads/2026/03/Dunsky_CEC_DER-Potential-Study_FINAL.pdf.

35 Kiesling, L. L., Levine, D. I., & Price, M. K. (2017). The effectiveness of thermostat programs for reducing peak electricity demand. Energy Economics, 64, 548–557. https://doi.org/10.1016/j.eneco.2017.04.013

36 Scheepens, A. E., & Vogtländer, J. G. (2018). Insulation or smart temperature control for domestic heating: A combined analysis of the costs, the eco-costs, the customer perceived value, and the rebound effect of energy saving. Sustainability, 10(9), 3231. https://doi.org/10.3390/su10093231

37 British Columbia Hydro and Power Authority. Demand Side Management Milestone Evaluation Summary Report F2024. Vancouver: BC Hydro, 2025. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/2025-01-15-bch-f05-f06-rra-f2024-report.pdf

38 Sinopé Technologies. "Calypso - Smart Water Heater Controller V2." Accessed August 6, 2026. https://www.sinopetech.com/en/products/calypso-water-heater-controller-wifi-v2

39 Mehrhoff, J., & Feldman, B. (2020). Capturing value from electric water heaters as a non-invasive demand response resource: Market trends, applications for grid services, and recommendations for utility program design [White paper]. Guidehouse Insights. Commissioned by Armada Power.

40 BC Hydro. "Water Heaters." Accessed August 6, 2026. https://www.bchydro.com/powersmart/residential/tips-technologies/water-heaters.html

41 Clúid Housing. "EnergyCloud Launches New Initiative to Provide Free Hot Water to 1,000 Irish Homes Using Surplus Renewable Energy." February 23, 2023. https://www.cluid.ie/news-stories/energycloud-launches-new-initiative-to-provide-free-hot-water-to-1000-irish-homes-using-surplus-renewable-energy/

42 Microsoft Source Ireland. "Turning Surplus Renewable Energy into Free Hot Water for Homes in Kildare and Dublin." Source EMEA. June 16, 2026. https://news.microsoft.com/source/emea/features/turning-surplus-renewable-energy-into-free-hot-water-for-homes-in-kildare-and-dublin/

43 BC Hydro. "2025 Call for Power Participants." Last modified May 13, 2026. https://www.bchydro.com/work-with-us/selling-clean-energy/2025-call-for-power/participants.html

44 Consortium for Power Efficiency. Overview of Power Efficient Design Strategies. Dunsky Energy + Climate, March 2025. https://powerefficiency.ca/wp-content/uploads/2025/03/report_overview-of-power-efficient-design.pdf.

45 Swiss Re Institute. "Avoiding Gridlock: The Impact of Climate on Electric Grids." June 27, 2024. https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/impact-of-climate-on-electric-grids.html

46 Based on interviews with solar businesses in BC in June 2026 and the following source: Solar Guide Canada. "Battery Energy Storage in Canada: Everything You Need to Know." Last modified March 27, 2026. https://solarguide.ca/solar-battery-energy-storage/.

47 U.S. Environmental Protection Agency, "Battery Energy Storage Systems: Main Considerations for Safe Installation and Incident Response," last updated July 31, 2026, https://www.epa.gov/electronics-batteries-management/battery-energy-storage-systems-main-considerations-safe

48 BC Hydro. "Free Product Installation and Energy Coaching." Last modified June 29, 2026. https://www.bchydro.com/powersmart/residential/rebates-programs/savings-based-on-income/free-product-install-and-advice.html

49 Government of British Columbia, Residential Tenancy Branch, Air Conditioning (AC) Units (May 2024), https://www2.gov.bc.ca/assets/gov/housing-and-tenancy/residential-tenancies/information-sheets/rtb-acunits.pdf

50 Every Electric, "Get Paid to Plug In," accessed August 6, 2026, https://everyelectric.com/

51 Puget Sound Energy, "Flex Batteries Enhanced Incentives," accessed August 6, 2026, https://www.pse.

com/en/rebates/PSE-flex/flex-batteries/enhanced-incentives

52 Jon Franke, "Does Your Solar System Need a Main Panel Upgrade?," Aurora Solar, January 21, 2026, https://aurorasolar.com/home-solar/blog/energy-101/solar-panel-upgrade

53 Anna M. Brockway, Jennifer Conde, and Duncan Callaway, "Inequitable Access to Distributed Energy Resources Due to Grid Infrastructure Limits in California," Nature Energy 6 (2021): 892–903, https://doi.org/10.1038/s41560-021-00887-6

54 Alberta Municipalities, "Clean Energy Improvement Program," accessed August 6, 2026, https://www.abmunis.ca/products-services/clean-energy-improvement-program

55 Emily G. Holt and Deborah A. Sunter, "Growth in Energy Justice: Exploring Impacts of Residential Solar Incentive Program on Rooftop Solar Adoption Growth Rates in Connecticut," Energy Research & Social Science 109 (2024): 103410, https://doi.org/10.1016/j.erss.2024.103410

56 University of Saskatchewan Centre for the Study of Co-operatives. (2023, February 17). Equity, diversity and inclusion in Canada's renewable energy co-operatives [Video]. YouTube. https://www.youtube.com/watch?v=otkr0o6xNUk

57 Joseph Fiander et al., "Energy Democracy, Public Participation, and Support for Local Energy System Change in Canada," Energy Research & Social Science 113 (2024): 103526, https://doi.org/10.1016/j.erss.2024.103526

58 Co-operative Housing Federation of British Columbia, "FAQ," accessed August 6, 2026, https://www.chf.bc.ca/faq/

59 Robert Baxter, SolShare and Vancouver Renewable Energy Co-operative, interview by author, Google Meet, July 3, 2026.

60 Marc-André Pigeon, Josie Ward, and Martin Boucher, Community Energy Co-operative Policy Index (Canadian Centre for the Study of Co-operatives and NorQuest College, June 19, 2025), https://usaskstudies.coop/documents/research-reports/community-energy-co-operative-policy-index_-oct-corrected.pdf

61 Commonwealth Edison Company, Workforce Development Implementation Plan Report on Calendar Year 2018 Activities (July 1, 2019), https://www.icc.illinois.gov/docket/P2017-0332/documents/288221/files/502616.pdf

62 Robert Baxter, SolShare and Vancouver Renewable Energy Co-operative, interview by author, Google Meet, July 3, 2026.

63 SolShare Energy, "Haida Gwaii Grocery Co-op," accessed August 6, 2026, https://www.solshare.ca/haidagwaii/.

64 B.C.'s First Indigenous-Owned and Operated Solar Plant in a Non-Integrated Area Powers up in Haida Gwaii. 8 Dec. 2025, https://www.bchydro.com/news/press_centre/news_releases/2025/nia-haida-gwaii.html

65 Todd Olinsky-Paul, ConnectedSolutions: A New State Funding Mechanism to Make Battery Storage Accessible to All (Clean Energy Group, February 2021), https://www.cleanegroup.org/wp-content/uploads/connected-solutions-policy.pdf

66 Bryndis Woods et al., ConnectedSolutions: A Program Assessment for Massachusetts (Applied Economics Clinic for Clean Energy Group, September 2021), https://www.cesa.org/wp-content/uploads/ConnectedSolutions-An-Assessment-for-Massachusetts.pdf

67 Mark Wolfe, End of Winter Energy Update (National Energy Assistance Directors Association, April 2023), https://neada.org/wp-content/uploads/2023/04/eowapril2023.pdf

68 Ashtin Massie, Samuel Huestis, and Lauren Shwisberg, "Grid-Scale Virtual Power Plants Are Here. Have Utilities Noticed?," RMI, May 14, 2026, https://rmi.org/resources/grid-scale-virtual-power-plants-are-here-have-utilities-noticed/.

69 Brittany Speetles, Eric Lockhart, and Adam Warren, Virtual Power Plants and Energy Justice, NREL/TP-7A40-86607 (Golden, CO: National Renewable Energy Laboratory, October 2023), https://doi.org/10.2172/2008456

70 Bo Shen, Fredrich Kahrl, and Andrew J. Satchwell, "Facilitating Power Grid Decarbonization with Distributed Energy Resources: Lessons from the United States," Annual Review of Environment and Resources 46 (2021): 349–375, https://doi.org/10.1146/annurev-environ-111320-071618

71 Jeffrey J. Cook et al., Expanding PV Value: Lessons Learned from Utility-Led Distributed Energy Resource Aggregation in the United States, NREL/TP-6A20-71984 (Golden, CO: National Renewable Energy Laboratory, November 2018), https://doi.org/10.2172/1483067

72 Sonali Razdan, Jennifer Downing, and Louise White, Pathways to Commercial Liftoff: Virtual Power Plants, 2025 Update (U.S. Department of Energy, January 2025), https://www.smartenergydecisions.com/wp-content/uploads/2025/04/liftoff_doe_virtualpowerplants2025update.pdf

73 Karen Bakker, Gordon Christie, and Richard Hendriks, Assessing Alternatives to Site C (Environmental Effects Comparison), report no. 2 (University of British Columbia, Program on Water Governance, May 2016), https://watergovernance.sites.olt.ubc.ca/files/2017/11/Briefing-Note-2-Site-C-Environmental-Effects.pdf.

74 Jeff St. John, "This Startup Turns Electric Water Heaters into Grid Batteries," Canary Media, March 6, 2023, https://www.canarymedia.com/articles/grid-edge/this-startup-turns-electric-water-heaters-into-grid-batteries

75 Ryan Hledik and Sanem Sergici, Residential Rate Design in British Columbia: Key Issues for Consideration (The Brattle Group, prepared for BC Hydro, February 27, 2024), https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/the-brattle-group-discussion-paper-2024feb27.pdf

76 Fabian L. Müller and Bernhard Jansen, "Large-Scale Demonstration of Precise Demand Response

Provided by Residential Heat Pumps," Applied Energy 239 (2019): 836–845, https://doi.org/10.1016/j.apenergy.2019.01.202

77 Xcel Energy, Energy Efficiency and Electric Vehicles: Sustainability Report 2020 (2021), https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Sustainability%20Report/2020%20SR/2020-Energy-Efficiency-and-EVs-SR.pdf

78 BC Hydro, "Residential Rate Design Engagement Session," PowerPoint presentation, November 18, 2021, https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/residential-rate-design-engagement-session.pdf

79 BC Hydro, "Optional Residential and Small General Service Rates: Workshop 1," PowerPoint presentation, October 20, 2025, https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/optional-residential-small-general-service-rates-workshop-presentation-2025-10-20.pdf

80 Georgia Power, "Smart Usage Rate Plan," accessed August 6, 2026, https://www.georgiapower.com/residential/rate-plans/smart-usage.html

81 Evergy, "Private Generation Rate Plan Options," accessed August 6, 2026, https://www.evergy.com/manage-account/rate-information-link/plan-options/private-generation-plan-options

82 NARUC Staff Subcommittee on Rate Design, NARUC Manual on Distributed Energy Resources: Rate Design and Compensation (National Association of Regulatory Utility Commissioners, November 2016), https://media.ark.org/psc/NARUC_Distributed_Energy_Resources_Manual.pdf

83 BC Hydro, "Self-Generation," accessed August 6, 2026, https://app.bchydro.com/accounts-billing/electrical-connections/customer-generation/self-generation.html.

84 Sarb Verma and Erin Monaghan, "Rates + Rebate Webinar," webinar presentation, June 3, 2026, https://homeperformance.ca/wp-content/uploads/2026/06/Solar_Webinar_June3.pdf

85 British Columbia Utilities Commission, British Columbia Hydro and Power Authority: Net Metering Service Rates, Order G-64-26 (March 24, 2026), https://www.ordersdecisions.bcuc.com/bcuc/orders/en/523115/1/document.do

86 BC Hydro, "Rebates for Solar Panels and Battery Storage," accessed August 6, 2026, https://app.bchydro.com/accounts-billing/electrical-connections/customer-generation/solar-battery-rebates.html

87 BC Sustainable Energy, "BCSEA Webinar—'Understanding BC's Community Generation Potential,'" YouTube video, streamed June 17, 2026, https://www.youtube.com/watch?v=6pH914EMXe8.

88 Robert Baxter, "Comments on Community Generation and the RS 2290 Rate" (unpublished report, SolShare Energy and Vancouver Renewable Energy Co-operative, n.d.), provided to author July 4, 2026.

89 RMI, "Percentage of Income Payment Plans," Electricity Affordability Toolkit, last updated September

22, 2025, https://affordability-toolkit.rmi.org/policies/percentage-of-income-payment-plans.

90 BC Hydro, "BC Hydro 2024 Rate Design Applications: Workshop 1—Session 1, Residential Service Rates and Non-Integrated Areas Rates," PowerPoint presentation, November 27 and 29, 2023, https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/Residential-and-Non-Integrated-Area-Rates-Presentation-20231201.pdf

91 BC Hydro, "B.C. Electricity Affordability Credit," accessed August 6, 2026, https://app.bchydro.com/accounts-billing/bill-payment/bill-credit.html

92 Stephanie Tucker, Strategist/Consultant at Consumers Energy Company, interview with the author via Google Meet, June 3, 2026

93 BC Hydro, "BC Hydro Debuts Advanced Virtual Power Plant Project in B.C. Homes," news release, May 15, 2025, https://www.bchydro.com/news/press_centre/news_releases/2025/virutal-power-plant.html

94 "Province, BC Hydro Launch Pilot Program to Cut Energy Costs, Support Housing Density," news release, Government of British Columbia, June 19, 2025, https://news.gov.bc.ca/releases/2025ECS0025-000596

95 Edward Yim and Sagarika Subramanian, Equity and Electrification-Driven Rate Policy Options (American Council for an Energy-Efficient Economy, September 14, 2023), https://www.aceee.org/white-paper/2023/09/equity-and-electrification-driven-rate-policy-options.

96 BC Hydro, "Residential Rates," accessed August 6, 2026, https://app.bchydro.com/accounts-billing/rates-energy-use/electricity-rates/residential-rates.html

97 BC Hydro, Optional Residential Time-of-Use Rate (information booklet, November 2022), https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-matters/Optional-Residential-TOU-Workshop-November-2022-Info-Booklet.pdf

98 Yanqing Weng, Andrew Musgrave, Bo Chen, and Yu Christine Chen, "Estimating Probabilistic Load Coincidence Factors for Distribution System Operation," in 2025 57th North American Power Symposium (NAPS) (IEEE, 2025), 1–5, https://doi.org/10.1109/NAPS66256.2025.11272255.

99 BC Hydro, "Enroll Your Smart Home Devices in Peak Saver," accessed August 6, 2026, https://www.bchydro.com/powersmart/residential/rebates-programs/peak-saver/enroll-smart-home-devices.m.m.html

100 Cansoft, "Tesla Powerwall Cost in Canada: What You Need to Know," Kelowna Solar Panels, March 2, 2025, https://kelownasolarpanels.ca/tesla-powerwall-cost-in-canada/.

101 Solar United Neighbors, Battery Storage Guide for Homeowners, accessed August 6, 2026, https://solarunitedneighbors.org/wp-content/uploads/2023/01/Solar-United-Neighbors-Battery-Storage-Guide-1.pdf

102 BC Hydro, "Deals on Energy-Efficient Products," accessed August 6, 2026, https://www.bchydro.com/powersmart/residential/rebates-programs/product-rebates.html#thermostat

103 Mysa Smart Thermostats, "Mysa for Electric Baseboard Heaters V2," accessed August 6, 2026, https://getmysa.com/products/mysa-baseboard

104 British Columbia Ministry of Finance, Energy, Energy Conservation and the ICE Fund Tax, Bulletin PST 203, revised September 2022, https://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/pst-203-energy-conservation-ice-fund-tax.pdf

105 Heather McDiarmid, Canada's Home Electrification Toolkit: Solar Power, version 1.2 (Building Decarbonization Alliance, June 2025), https://buildingdecarbonization.ca/wp-content/uploads/2025/06/BDA_CanadasHomeElectrificationToolkit_SolarPower.pdf

106 BC Hydro, "Solar Panels," accessed August 6, 2026, https://www.bchydro.com/powersmart/residential/tips-technologies/solar-panels.html

107 Line In Electric Ltd., "Panel Upgrades," accessed August 6, 2026, https://lineinelectric.com/services/panel-upgrades/

108 Influx Electric, "Electrical Panel & Service Upgrades in Vancouver," accessed August 6, 2026, https://influxelectric.ca/electrical-panel-service-upgrade/

ecotrust canada


## Vancouver Office

225 West 8th Avenue, Suite #300
Vancouver, BC V5Y 1N3

## Prince Rupert Office

425-309 Second Avenue West
Prince Rupert, BC V8J 3T1

**ecotrust.ca**