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COMMUNITY ENERGY

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

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Prepared for Ecotrust Canada

Executive Summary

- **B.C. electricity demand is rising** fast, which increases pressure on the grid and puts upward pressure on electricity costs
- **Load management technologies** help address this challenge, but benefits won't be equitably distributed without deliberate program design
- **Project Research Question**: Which load management technologies and financial incentives produce the highest benefit to energy-insecure households and the utility?

Best Practices for Equitable Programs

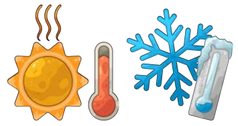
1. Remove upfront costs
2. Protect against financial, comfort, and health risks
3. Choose technologies that minimize time and mental load
4. Match technologies with appropriate housing contexts

Context

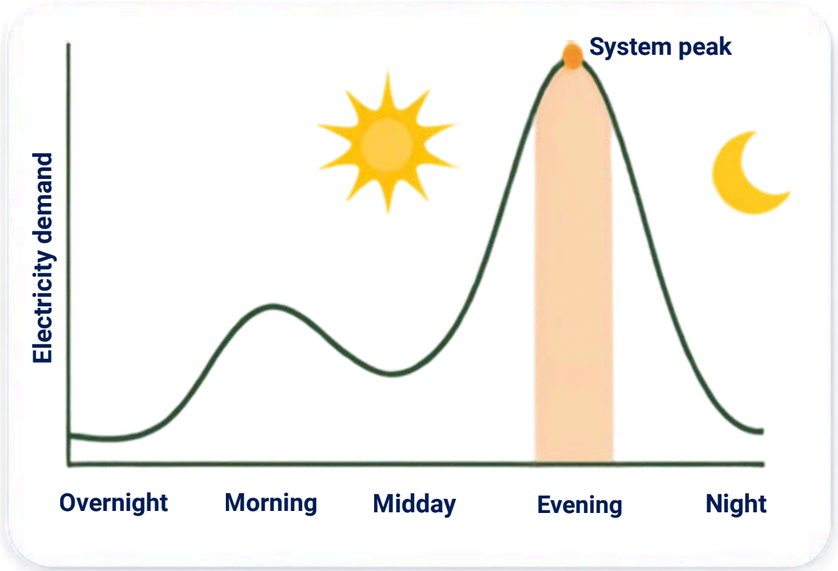
B.C. electricity demand forecasted to rise 50% and winter peak demand 44% by 2050 >>> Peak demand increases need for new generation, raising costs for B.C. households >>> 1 in 20 B.C. households already energy-poor, spending +10% of income on energy bills

Growing population

Electrification of homes & vehicles



Hotter summers & colder winters



What is Load Management?

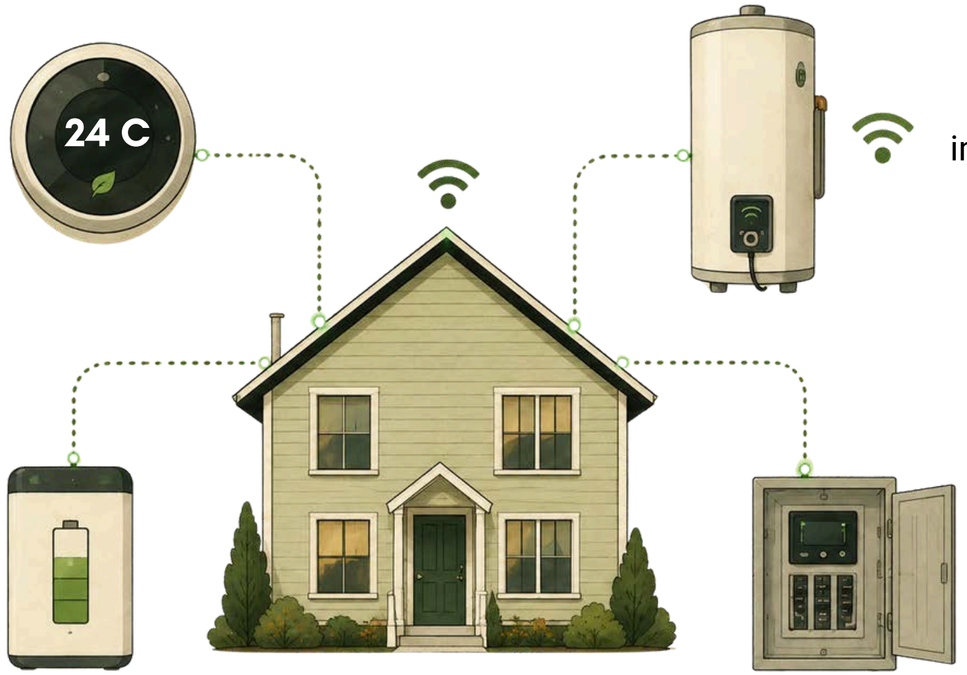
- **Definition:** Residential load management is the process of controlling **when** and **how much** electricity devices use
- **Household Benefits**: lowers household bills & helps avoid service upgrades when electrifying homes
- **Grid Benefits**: lowers peak demand, absorbs excess renewable generation, and enhances system reliability

Demand Response: A Load Management Tool

BC Hydro's Peak Saver voluntary program rewards electricity customers for temporarily reducing or shifting their power use during periods of high demand. Participants can earn financial credits on their utility bills by manually lowering their power usage during peak periods or allowing the utility to automatically adjust smart home devices like thermostats and EV chargers.

Examples of Residential Load Management

Smart thermostats use built-in sensors to manage household heating and cooling loads, connect to home Wi-Fi, and allow remote control.



Water heater load controllers reduce water heating loads by shifting heating immediately before or after peak periods.

Behind-the-meter batteries store electricity and can discharge during peak periods, outages, or utility demand response events.

Load sharing devices prevent electricity use from exceeding safe home or building circuit limits, avoiding expensive service upgrades.

Equity Barriers to Load Management

- Load management technologies principally adopted by high-income households
- Lower-income households excluded from these technology benefits due to barriers such as:
  - **High upfront costs** excluding households with limited savings
  - Renters and multi-unit building residents have **less control** over home upgrades
  - **Work schedules**, caregiving, and health needs limit when households can shift electricity use
  - Digital access, technical **knowledge, trust, privacy,** and **language** barriers

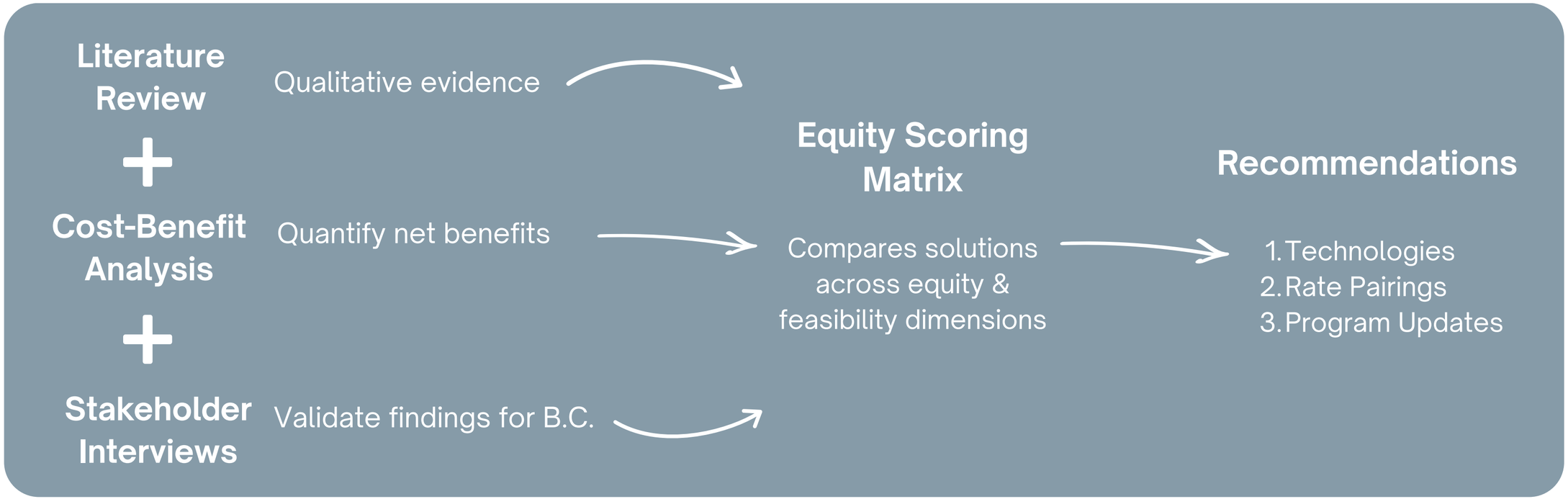
Why Equity Matters

- Without equity incorporated into energy programs, benefits flow mainly to affluent households with flexible schedules, available funds, and suitable homes
- Removing barriers expands participation, creating a larger and more reliable source of peak-demand reduction
- Equitable programs can improve affordability while lowering long-term electricity system costs for everyone

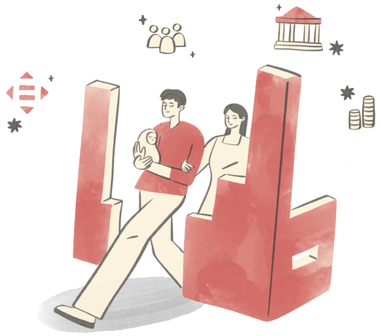
Research Approach

Research Question: Which load management technologies and financial incentives produce the highest benefit to energy-insecure households and the utility?

Target Audience: BC Hydro, B.C. government and regulators, energy program administrators



A Pathway to Equitable Load Management



BARRIERS

- Upfront 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

Best Practices for Equitable Program Design

- **Improve efficiency first**: Reduce household energy needs before adding load controls.
- **Eliminate upfront costs**: Provide free equipment, direct installation, or accessible financing instead of rebates.
- **Protect households**: Safeguard affordability, comfort, health, privacy, and customer control.
- **Simplify participation**: Use automation, clear information, and multilingual support.
- **Use trusted partners**: Deliver programs through local community-run organizations.
- **Inclusive pilots**: Include renters, lower-income households, Indigenous communities, and diverse housing types in pilots to understand unique needs.
- **Train contractors**: Provide clear and consistent guidance for energy program contractors.
- **Measure equity outcomes**: Track benefits, participation, incentives, and opt-outs across household groups.

Technology Scoring Matrix

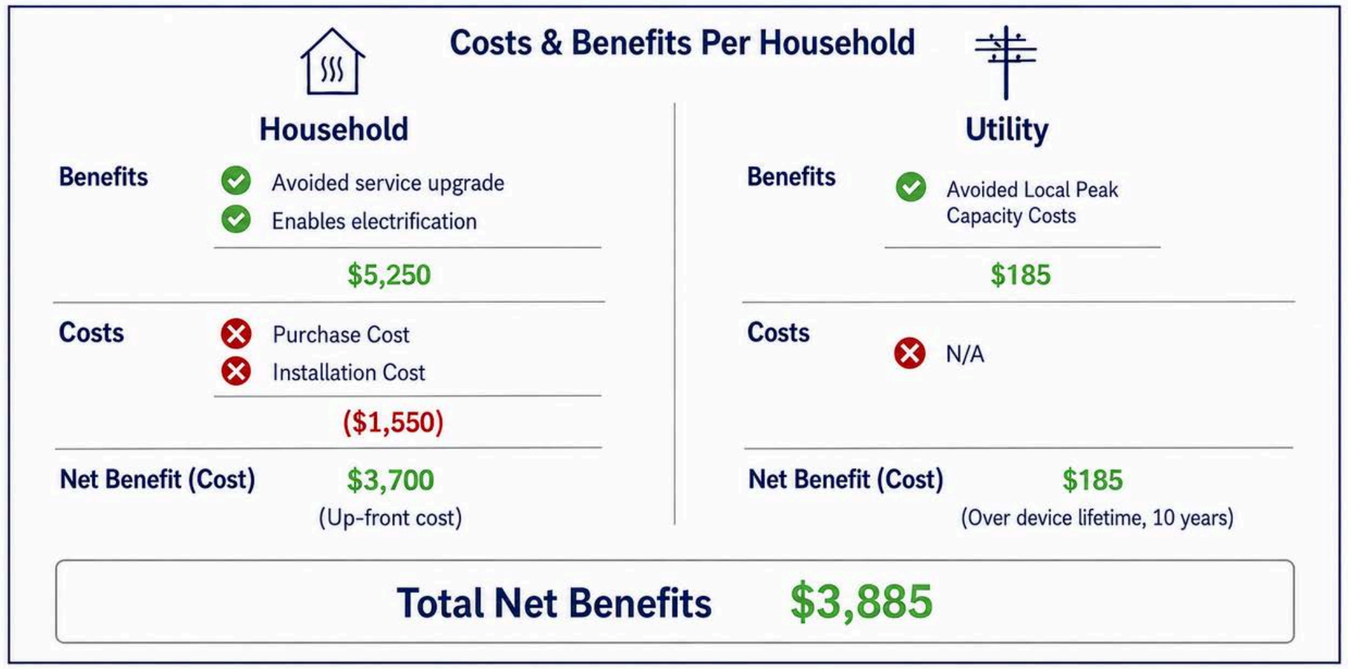
Technology / Solution Weight	Equitable Outcome 25%	Cost Effectiveness 15%	Utility and Grid Value 15%	Feasibility and Readiness 15%	Scalability and Program Fit 15%	Adoption and Acceptance 15%	Recommendation
Water Heater Controllers	3	4	3	3	4	3	Advance
Smart Thermostats	3	4	3	4	4	3	Advance
Load Sharing Devices	4	4	2	3	3	4	Advance
Energy Communities	3	3	3	2	2	2	Advance Conditionally
Virtual Power Plants	2	2	3	2	3	2	Targeted Application or Pilot
Smart Panels	2	2	3	2	2	2	Targeted Application or Pilot
Rooftop Solar PV	3	1	2	2	2	2	Low Priority
Battery Storage	1	1	3	3	2	2	Low Priority

Technology Deep-Dives

Load Sharing Devices

Devices that control two high-demand loads (e.g. EV charger and dryer) to reduce total household load and avoid expensive service upgrades.

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



Equity Advantages

Avoid costly upgrades and enable electrification in lower-income, rural, and manufactured homes.

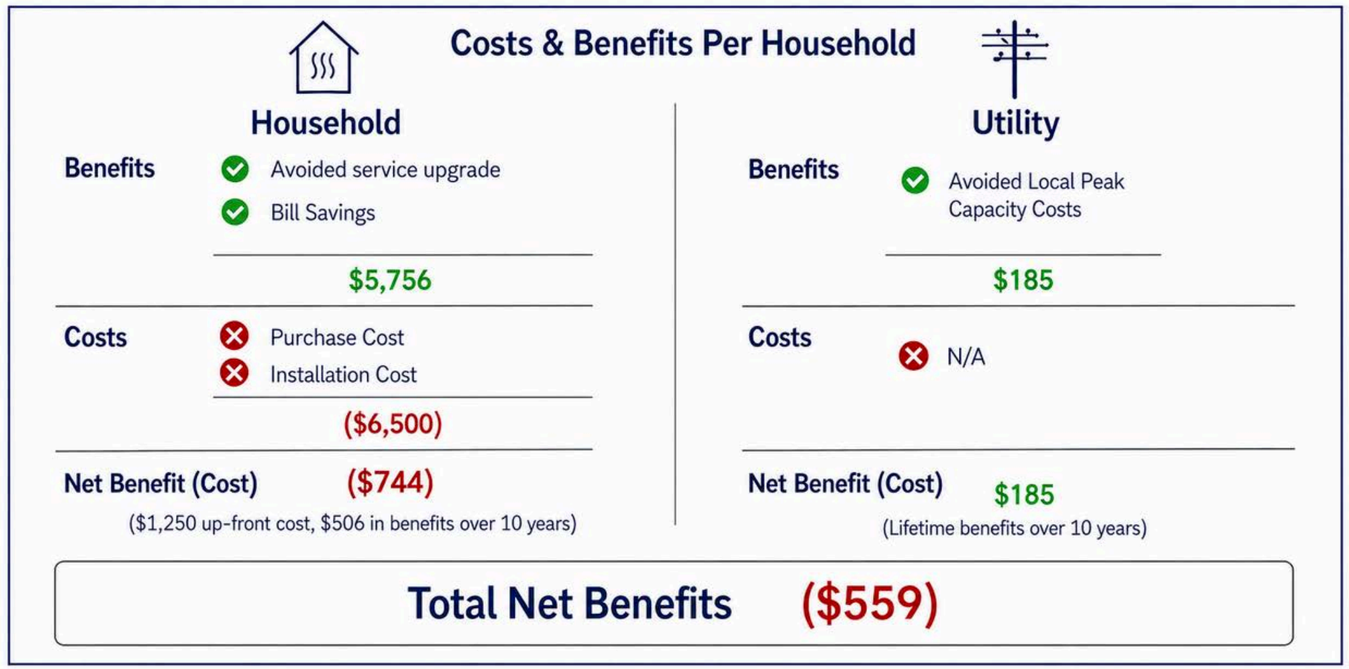
Equity Disadvantages

Older panels, unclear codes, and poor load pairings can limit suitability.

Smart Panels

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. Can prioritize several loads at once.

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



Equity Advantages

Enable affordable and multi-unit housing electrification without major service upgrades.

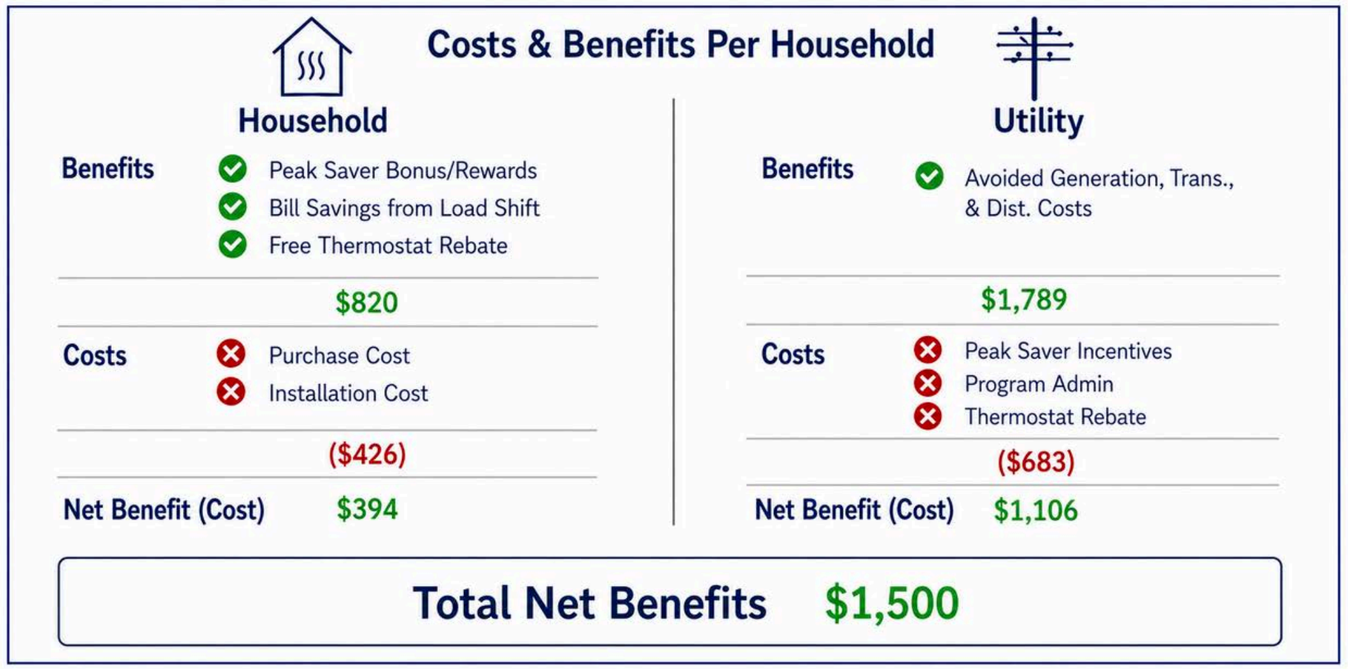
Equity Disadvantages

High costs, internet requirements, privacy concerns, and landlord-tenant benefit splits.

Smart Thermostats

Remotely controllable thermostats can help manage household heating and cooling loads via built-in sensors connected to Wi-Fi.

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



Note: For home with electric baseboard. See report for analysis for other heating types.

Equity Advantages

Low-cost automation can reduce bills and improve comfort with minimal household effort.

Equity Disadvantages

Tenants may bear temperature changes while landlords receive savings or incentives.

Water Heater Load Controllers

Reduce water heating loads by shifting water tank heating immediately before or after peak periods.

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

Costs & Benefits Per Household

	Household	Utility
Benefits	✓ Peak Saver Reward/Bonus ✓ Bill Savings from Load Shift	✓ Avoided Generation, Transmission & Distribution Costs
	$830	$1,724
Costs	✗ Purchase Cost ✗ Installation Cost	✗ Peak Saver Reward/Bonus ✗ Program Admin ✗ Rebound Risk
	($425)	($532)
Net Benefit (Cost)	$405	$1,192
	($325 up-front cost, $730 lifetime benefits over 10 years)	($100 up-front cost, $1,292 lifetime benefits over 10 years)

Total Net Benefits $1,597

Equity Advantages

Low-cost automation shifts demand with little effort or loss of comfort.

Equity Disadvantages

Only households with individual electric storage water heaters can participate.

Battery Storage

Store electricity and discharge during peak periods, outages, or utility demand response events. Systems range from small batteries that connect to a wall outlet to larger 5-15 kWh units installed in a garage or exterior wall.

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

Costs & Benefits Per Household

Household

Benefits
- BC Hydro Rebate
- Peak Saver Reward & Bonus
- Bill Savings
- Avoided Back-Up Generator Costs

$12,496

Costs
- Equipment Cost
- Installation Cost
- Maintenance Cost

($16,828)

Lifetime Net Benefit (Cost)
($4,332)
(Over battery lifetime, 11 years)

Utility

Benefits
- Avoided Generation, Transmission, and Distribution Costs

$18,583

Costs
- Rebates, rewards, and bonuses
- Program Admin

($7,692)

Lifetime Net Benefit (Cost)
$10,890
(Over battery lifetime, 11 years)

Total Net Benefits $6,558

Equity Advantages

Provides backup power and resilience for vulnerable, rural, and outage-prone households.

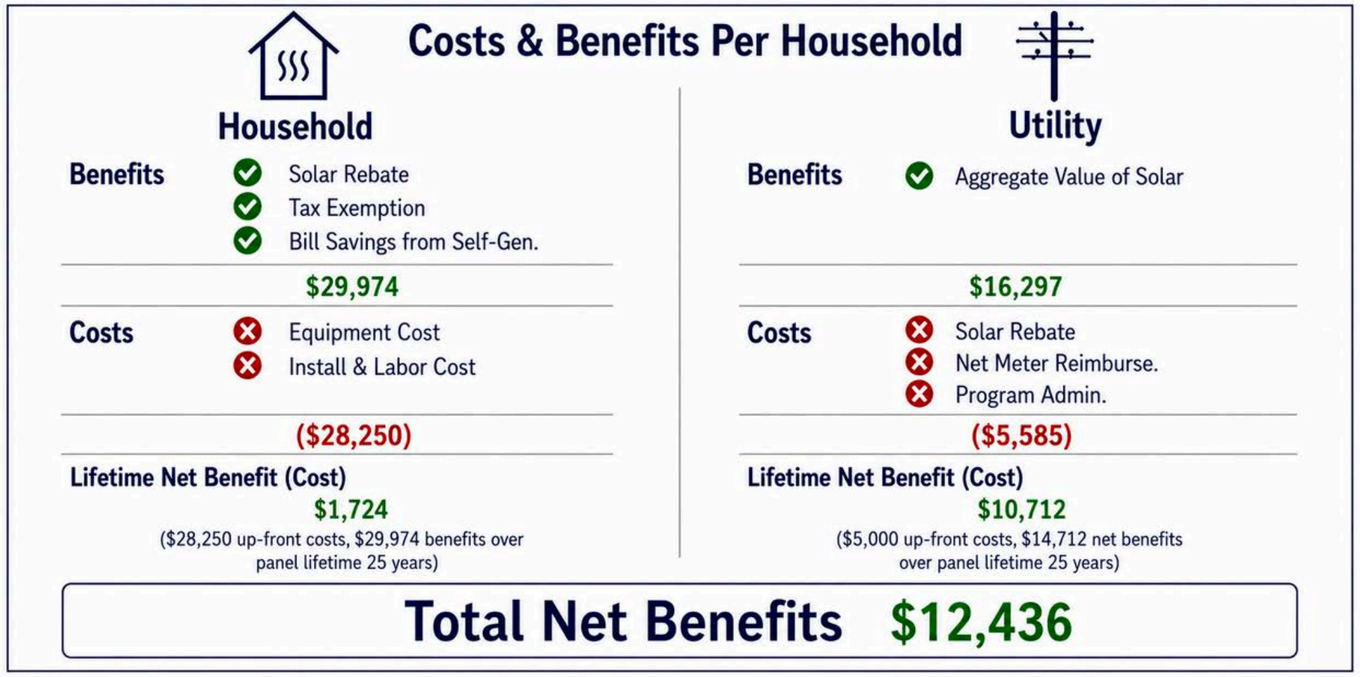
Equity Disadvantages

High costs and installation requirements exclude many renters and lower-income households.

Rooftop Solar PV

A system of solar panels placed on home's rooftop or on ground-mounted racks to generate on-site electricity from sunlight and reduce power drawn from the grid.

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



Equity Advantages

Reduces bills and improves energy autonomy, particularly through shared or social housing.

Equity Disadvantages

High upfront costs, ownership requirements, and grid constraints limit equitable access.

Energy Communities

Local households or groups collaborating to manage shared renewable energy generation for economic, environmental, & social benefit. Solar is the most common power source.

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

	Participant	Utility
Benefits	• Lower and more predictable energy costs • Shared ownership and local economic benefits • Expanded clean-energy access • Community decision-making power	• Deferred local distribution upgrades • Greater support for renewable generation • Lower outreach and coordination costs
Costs	• Upfront membership costs and delayed/uncertain financial returns • Complex contracts and credit allocation • Volunteer burden and unequal decision-making	• Project review & administration costs • Solar does not reliably reduce winter peaks in B.C. • May require storage or flexible loads

Equity Advantages

Shares costs and benefits among renters, cooperatives, and households without suitable rooftops.

Equity Disadvantages

Membership costs, complex administration, and weak governance can concentrate benefits.

Virtual Power Plants

A collection of distributed energy resources such as smart devices, solar & battery systems, and EV chargers, aggregated and coordinated to provide services similar to 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

	Participant	Utility
Benefits	• Payments or credits for participation • Avoided service upgrades • Shared assets can include renters • Lowers system costs for *all* ratepayers	• Reduced peak and generation costs • Deferred grid infrastructure upgrades • Lower upward pressure on rates • Scalable capacity added relatively quickly
Costs	• High upfront device costs • Internet and cellular access barriers • Privacy, control, and trust concerns of VPP provider control	• Software and device-integration costs • Program administration and performance verification • Cybersecurity and data-management requirements

Equity Advantages

Expands compensation, resilience, and grid savings through coordinated community resources.

Equity Disadvantages

Device costs, digital barriers, privacy concerns, and external control can exclude communities.

Equitable Rate Design

Rate Design Options for Load Management

Rate/Incentive	Description	Advantages	Disadvantages
Time-of-Use Rate	Charge different rates for electricity based on *when* it is consumed.	• Strong fit with load management • Reduces peak demand • Reflects peak-period costs	• Higher bills for those unable to shift • May encourage reduced comfort • Mainly benefits EV owners
Subscription+ Rate	Fixed monthly charge for electricity based on a customer's historical, weather-normalized usage.	• Improves bill predictability • Easier to understand • Encourages DR participation	• Requires enrolled devices & utility control consent • Lowers efficiency incentives if "Plus" weak • Impacts not well established
Demand Charge Rate	Bills customers based on their maximum electricity demand in kW for a billing period.	• Reflects grid-capacity costs • Incentives peak demand reduction • May pair well with heat pumps	• Household and grid peaks may not align • Difficult to understand and manage • One short peak can increase the bill • May penalize electrification
Income-Qualified Rate	Reduced rates based on income, including percentage-of-income, discount, lifeline, or tiered designs.	• Reduces energy burdens • Protects essential energy use • Improves bill affordability & predictability	• Faces BCUC legal and regulatory barriers • Requires income verification & admin • Essential-consumption thresholds difficult to define

BC Hydro’s Solar Generation Rate Design

Self Generation Service Rate
(RS 2289)

BC Hydro pays 10¢/kWh for excess rooftop solar exported, decoupled from retail electricity rate.

Equity Benefits

- Reduces cost-shifting from solar customers to customers without solar.

Equity Concerns

- High upfront costs still exclude many lower-income households.
- Lower export payments favor households able to invest in battery storage.

Community Generation Rate
(RS 2290)

Shared facilities receive 10¢/kWh for surplus generation. Benefits are allocated among participating customers.

Equity Benefits

- Expands access to renters & households without suitable rooftops.

Equity Concerns

- Estimated subscription costs of 15¢/kWh exceed the 10¢/kWh credit.
- Interconnection costs and the 2030 rate review create investment uncertainty.

Recommendations

Accelerate Load Management Deployment

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

- ☑ Offer free purchase and installation of **smart thermostats** and **water heater load controllers** via Peak Saver and increase 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 (via 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.

Expand Shared Solar Generation

Broaden 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 shared 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.

Update Rate Designs & Financial Incentives

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

- ☑ Amend the current **Time-of-Use rate** to add broader discounted shoulder windows to extend TOU benefits beyond EV owners.
- ☑ Offer **bill protections** for income-qualified Time-of-Use ratepayers, including first-year bill guarantees and penalty-free opt-outs.
- ☑ Provide **personalized bill estimates** (i.e., shadow billing) so all customers can easily compare rate options.
- ☑ Introduce a **Subscription+ rate option** with enhanced income-qualified supports.

Program Implementation Roadmap

Delivery Channel	Short-Term: 1–2 years	Medium-Term: 3–6 years	Long-Term: 6+ years
BC Hydro Peak Saver / Power Smart	Free purchase & install of thermostats and water heater controls; increase rewards	Launch equity-focused VPP pilot, including trusted community partners & bill protection	Offer income-qualified EV charging subsidies; develop equitable V2X applications
Energy Conservation Assistance Program	Make load sharing devices eligible where service upgrades unavailable, provide contractor training and Peak Saver enrollment support	Pilot plug-and-play batteries in multi-unit buildings	
CleanBC ESP + Home Performance Contract Network	Fund load sharing devices under retrofit rebates; train advisors and contractors on technologies		
MURB Retrofit Program + Social Housing ESP		Deploy batteries for rural, medically vulnerable, and outage-prone households	Expand battery storage access as technology costs decline
BC Indigenous Clean Energy Initiative	Fund community-energy planning and capacity building	Prepare community-owned VPP projects	Fund Indigenous-owned VPPs, transferring learnings from pilots
BC Hydro Community Generation	Increase income-qualified benefits; reserve funding for underserved communities	Monitor participation and project economics	Scale successful shared-generation models
Public-Private Financing	Design accessible solar financing options	Restore zero-interest loans, PACE financing, or subscription-based payment models	Scale financing as solar costs decline

Thank You

To View Full Report, Detailed Analysis, and Data Sources:
https://sustain.ubc.ca/about/resources/managing-electricity-demand-without-leaving-vulnerable-bc-households-behind