Residential Rate Design in British Columbia: Key Issues for Consideration

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TABLE OF CONTENTS

Executive Summary

The British Columbia Utilities Commission ("BCUC") has directed BC Hydro to file an application for changes to BC Hydro's current residential design. This application will evaluate potential changes to, or elimination of, the current rate and describe the extent to which the revised rate design(s) support government policies, provide greater flexibility to modify rates over time, and include new additional rates options for customers. In preparation for this application, BC Hydro requested that Sanem Sergici and Ryan Hledik of The Brattle Group produce a discussion paper on residential rate design considerations in British Columbia. The discussion paper addresses seven key issues identified by BC Hydro and its stakeholders.

Among several emerging trends in residential rate design, we note that utilities are increasingly including a choice of rates in their residential offerings. Given the increasingly heterogeneous character of electricity consumers, the industry's focus on decarbonization and affordability, and the rapidly changing landscape of energy technologies, many vertically integrated utilities have recognized that there is not a "one-size-fits-all" solution to rate design. For example, in our survey of 23 utilities (including BC Hydro), 16 utilities offer at least three rate options. One of the surveyed utiliites offers six different options.

Potential advantages of rate choice include improved customer satisfaction, beneficial changes in customer electricity consumption patterns, accelerated achievement of energy policy goals, and improved energy affordability. Potential challenges relate to under-recovery of costs as customers select the bill-minimizing rate option, customer confusion if the rates are not meaningfully differentiated and well communicated, and low rate uptake on an opt-in basis. Our discussion paper presents several options for addressing these challenges. In particular, we emphasize the need for a deliberate customer engagement plan.

Given the value of introducing rate choice, our discussion paper describes 13 relevant residential rate design options or features that could be considered by BC Hydro, along with our perspective regarding the attractiveness of each option inclusion in BC Hydro's upcoming rates filing. We recommend that BC Hydro offer between three and five meaningfully different rate options in its move toward rate choice, and we identify a pre-screened list of rate designs that we consider to be the highest priority options for further assessment. The paper provides further discussion of key issues when evaluating these options:

- **Inclining block rate (IBR):** BC Hydro's existing default residential rate, the Residential Inclining Block (RIB) rate, is an IBR. Our opinion is that other rate options have significant advantages over IBRs. Therefore, we do not identify IBRs as a priority for further consideration by BC Hydro this time. If BC Hydro decides to maintain an IBR option, we recommend that BC Hydro revisit the design of its IBR, and consider reducing the price differential between the tiers as well as modifying the usage threshold that defines the tiers.
- **Time-of-use (TOU) rate:** BC Hydro's proposed TOU rate recently was approved by the Commission. As such, we do not offer recommendations for modifying the offering at this time, but rather suggest monitoring experience with the rate on an ongoing basis, and refining it as more information becomes available.
- **Flat volumetric rate:** Flat rates charge customers the same cents-per-kilowatt-hour rate for all usage (though the price may change seasonally). Their advantages are simplicity and a relatively strong incentive to conserve energy. A flat rate as a voluntary option now would be a natural complement to other voluntary rate options that may have more price differentiation in response to customer or system needs.
- **Demand-based rate:** Introducing a demand charge to recover distribution costs could improve cost-reflectivity, reflecting that distribution capacity that must be reserved to ensure reliable service to the customer is primarily based on various measures of maximum demand. Effective customer education will be needed to achieve meaningful enrollment and impacts from this rate option.
- **Critical peak pricing (CPP):** CPP rates can be combined with TOU rates, with the daily TOU signal representing variability in energy and potentially distribution costs, and an event-based CPP "adder" reflecting generation capacity costs. As a result, CPP rates provide a stronger and more dynamic price signal than a simple TOU rate, and better reflect the fact that the driver of peak capacity needs is a limited number of high load hours per year.
- **Subscription pricing plus (SP+):** SP+ is an entirely fixed monthly charge for electricity. The fixed monthly charge is customer-specific, and is based on the customer's historical weather normalized usage. In a sense, it aligns the way customers pay for electricity with the way they pay for other products, such as cell phone plans and streaming services. To address the lack of incentive for efficient consumption, the fixed bill offer is coupled with energy efficiency measures or demand flexibility measures (i.e., the "plus") as a prerequisite for enrollment.

Our paper concludes with discussion of various options for mitigating adverse customer bill impacts when the default rate design is changed. Options include gradual rate design changes, temporary bill protection, and rate comparison tools, among others. We also highlight several options for addressing energy affordability for low income customers, such as bill discount programs, rate discount programs, and "percentage of income payment plans".

I. Introduction

Nature of Engagement

The British Columbia Utilities Commission ("BCUC") has directed BC Hydro, through its Order No. G-140-23, to file an application for changes to BC Hydro's current Residential Inclining Block Rate design. This application will include an evaluation of potential changes to, or elimination of, the Residential Inclining Block ("RIB") Rate and how the revised rate design supports government policy of electrification and decarbonisation. It will also address whether the revised rate design provides greater flexibility to modify rates over time and consider the addition of optional rates to reflect changes to the policy and economic environment within which BC Hydro operates.

In preparation for this application, BC Hydro has initiated an engagement with customers and stakeholders to solicit feedback on the options to be addressed in its upcoming application. With the intent to inform its stakeholders on the matters that will be addressed in its application, BC Hydro requested that Sanem Sergici and Ryan Hledik of The Brattle Group produce a discussion paper on "Residential Rate Design" via an engagement letter dated September 19, 2023.

The purpose of this discussion paper is to introduce a range of new rate designs to be considered by BC Hydro and stakeholders, and to discuss considerations when potentially moving forward with those options. Specifically, BC Hydro, after considering input from active interveners in its residential rate design regulatory proceedings, asked us to address the following issues:

1. Current trends in residential rate design and the factors and considerations which are driving these trends.
2. How and why other jurisdictions have provided residential customers with increased rate choices, including any common characteristics that have motivated certain utilities to offer increased choice to customers, and any lessons identified from those experiences.
3. The implications of providing increased rate choices to residential customers including any advantages or disadvantages and potential considerations, including potential transition options and whether there are circumstances where end-use rates should be considered.

4. How other utilities have aligned their average and marginal costs to the rates charged to customers, including:
   - How utilities have addressed discrepancies between their average and marginal costs to both send efficient price signals and allow for adequate cost recovery;
   - The extent to which the basic charge paid by residential customers in other jurisdictions recovers fixed account-related costs and the reasons why such charges may not recover all account-related costs or may over-recover account-related costs;
   - The different options for allocating remaining account-related costs as well as demand-related and energy-related costs to energy charges and under what circumstances certain options may or may not be pursued;
   - The different options for allocating demand-related costs to non-energy charges and under what circumstances certain options may or may not be pursued.
5. The different rate choices that BC Hydro may want to prioritize evaluating considering the following factors:
   - The current pricing of the Residential Inclining Block Rate;
   - BC Hydro's current average and marginal cost of service;
   - Incentives for conservation and energy efficiency;
   - Incentives for fuel-switching and energy substitution, including, but not limited to, electrification and decarbonization;
   - Harmony with, and impact on the efficacy of, BC Hydro's proposed Optional Residential Time of Use Rate and BC Hydro's current Net Metering Rate, including potential future changes to that rate;
   - How an inclining block rate structure could be priced if BC Hydro were to offer such an option to customers; and
   - Any other factors considered important.
6. How other jurisdictions have considered and mitigated situations where certain customers may experience significant bill decreases or bill increases from a rate design change.
7. How other jurisdictions have considered and addressed the ability of customers to pay for electricity from both a rate setting perspective as well as a social policy and programs perspective.

The remainder of our report is organized around these seven issues. To address the issues, we have considered ratemaking initiatives in jurisdictions in Canada, the United States and other international jurisdictions with a range of legal and regulatory frameworks. We also leveraged our own experience designing and evaluating innovative rates for utilities across North America and internationally.

Summary of Expert Qualifications

Ryan Hledik is a Brattle Principal whose consulting practice focuses on regulatory, planning, and economic matters related to emerging energy technologies and policies. His areas of expertise include retail rate design, distributed generation, load flexibility, electrification, energy efficiency, energy storage, and grid modernization. Ryan has led studies and authored papers, articles, and regulatory filings on rate design issues such as the benefits of time-varying pricing, strategies for transitioning customers to innovative rate designs, the efficient pricing of electricity for customers with distributed generation, rate design practices for public electric vehicle ("EV") charging, designing pilots to test innovative retail rate concepts, rate designs for promoting the efficient use of battery storage, and the load impacts of inclining block rates.

Ryan's clients have included electric and gas utilities, state and federal regulatory commissions, power developers, independent system operators, government agencies, industry trade associations, technology firms, research institutions, and law firms. He has published more than 30 articles on electricity industry matters, has presented at industry events in 10 countries, and has given lectures on distributed grid economics at Stanford and Yale. His research has been cited in *Forbes*, *National Geographic*, *The New York Times* and *The Washington Post*, and in trade press such as *Canary Media*, *Utility Dive*, and *Vox*.

Ryan received his M.S. in Management Science and Engineering from Stanford University, where he concentrated in Energy Economics and Policy. He received his B.S. in Applied Science from the University of Pennsylvania, with minors in Economics and Mathematics.

Sanem Sergici is a Brattle Principal and an energy economist with sixteen years of consulting and research experience. Sanem's consulting practice is focused on understanding customer adoption of and response to innovative rate designs and emerging technologies. She regularly assists her clients in matters related to rate design, electrification, grid modernization investments, emerging utility business models and alternative ratemaking mechanisms.

Sanem has been at the forefront of the design and impact analysis of innovative retail pricing, enabling technology, and behavior-based energy efficiency pilots and programs across North America over the past decade. She led numerous studies in these areas that were instrumental in regulatory approvals of grid modernization investments and smart rate offerings for electricity customers. She also regularly testifies on these topics, more recently on the design of cost-based rates for electric vehicles and commercial charging stations. Sanem regularly publishes in academic and industry journals and presents at industry events.

She received her PhD in Applied Economics from Northeastern University in the fields of applied econometrics and industrial organization. She received her MA in Economics from Northeastern University, and BS in Economics from Middle East Technical University (METU), Ankara, Turkey.

II. Commentary on the Issues

In this section, we summarize our research and provide our perspectives on each of the key issues identified in BC Hydro's engagement letter.

1. Current trends in residential rate design

Residential rate design has emerged as a top regulatory priority in many North American utility jurisdictions over the past two decades. Among the many drivers for this focus on residential rate design are the ability to cost-effectively offer new rates by leveraging advanced metering infrastructure (AMI) deployments, the need to appropriately charge and compensate customers with distributed generation, the potential role of rate design in facilitating achievement of decarbonization and electrification policy goals, and awareness of the associated implications for energy affordability. The following are key rate design trends resulting from those drivers.

Growing focus on deploying time-varying rates

Utilities are increasingly offering time-varying rates to their residential customers, with a primary focus on introducing time-of-use (TOU) rates.

Growth in residential AMI deployment across North America is a primary driver of the uptick in time-varying rate offerings. Many utility business cases for AMI investment included significant ratepayer benefits associated with customer response to new time-varying rates. As AMI deployments conclude and the technical aspects of AMI operations are resolved, regulators and utilities are now focused on ensuring that new rates-related benefits of the AMI investment can be realized for ratepayers.

Another significant driver of new time-varying rate offerings is the increased need for load flexibility to mitigate the intermittency and lack of flexibility in the output of wind and solar renewable resources. Time varying rates can be an effective mechanism to improve system reliability by encouraging customers to shift their usage to times of generation over-supply, and away from hours when renewable generation is unavailable or otherwise expensive to store.

Some utilities have begun to deploy residential TOU rate offerings as the default (i.e., opt-out) option. Studies have shown that the share of customers remaining on a TOU rate when deployed on a default basis can be multiples higher than the number of customers that sign up for a TOU rate when deployed on an opt-in basis. In the US, default TOU rates have been deployed in California, Michigan, and Missouri. Ontario also has default TOU.

While there is a clear trend toward default TOU, opt-in TOU offerings remain the most common approach in North America. We note that BC Hydro recently received approval to offer an opt-in TOU rate.

Reforms to improve equity in rate design for customers with distributed generation (DG)

As customers increasingly become not only consumers but also produces of electricity, utilities, regulators, and industry stakeholders must grapple with how to price electricity for those customers. The key driver of this trend toward rate design for customers with DG is the recent growth in adoption of rooftop solar in some jurisdictions and, to an extent, behind-the-meter batteries. In particular, the move to introduce more cost-reflectivity in existing rates and compensation mechanisms for DG customers often is driven by concerns about costs being shifted from customers with DG to lower income customers.

Utilities are gradually reforming both net energy metering (NEM) policies and the underlying rates that apply to customers with distributed generation. As noted above, one common trend is toward moving DG customers on to time-varying rates. Other considerations include potentially moving from net metering to net billing, and then determining the appropriate rate to pay customers for exports to the grid. Other options are considered as well. However, those are not addressed in detail here, given that NEM reform is the subject of a separate BC Hydro initiative and outside the scope of this discussion paper. Generally, DG rate reform focuses on mitigating the aforementioned cost shift and providing customers with economically efficient price signals for technology adoption and electricity consumption, while at the same time avoiding “penalizing” the adoption of technologies that can contribute to achieving decarbonization policy goals.

Rates to facilitate positive economics for electrification

In many jurisdictions, electrification of transportation and heating is considered a cornerstone of achieving decarbonization policy goals. As such, utilities increasingly are examining their rate offerings to determine the extent to which they may serve as an unintended barrier to

promoting electrification. Additionally, rate design is seen as a tool for mitigating grid capacity constraints that could arise from electrification.

Similar to rate design for DG customers, initiatives to modify rate design to improve the cost-effectiveness of electrification also consider whether costs would shift to other customers in a way that is not reflective of the underlying economics of the power system. Along these lines, a key tension that arises is whether to provide a temporary discount through rates, in order to jump-start key industries, or to design beneficial rates that are still fully cost-based.

The most prevalent example of a rate design to facilitate electrification is the introduction of TOU rates that specifically focus on encouraging overnight home EV charging, during times of otherwise low demand. Such rates can improve the economics of EV ownership while also reducing the risk that new EV charging will contribute to local or system-level demand-related capacity constraints.

A variety of considerations for electric space heating economics are considered in residential rate design as well. Utilities in jurisdictions with building decarbonization goals are evaluating their rates to determine whether alternatives can improve the payback on consumer investments in heat pumps in a way that is complementary to other incentives that may exist for heat pump adoption.[1] The effectiveness of electricity rate design in promoting heat pump adoption is very utility-specific, and depends on the relative costs of electricity and natural gas, climate and temperature characteristics, and other considerations.

Introducing or enhancing rate choice

Customers are becoming more engaged in their energy-consumption decisions, and are seeking options for lowering their energy bills, reducing their carbon footprint, and leveraging new technologies such as rooftop photovoltaic (PV) panels, battery storage, and electric vehicles (EVs). Some customers want bill stability and are willing to pay more for it. Others want lower bills and are willing to modify their energy lifestyle to reduce their bills through participation in time-varying rates or smart device-enabled demand response programs.

[1] Sanem Sergici, Akhilesh Ramakrishnan, Goksin Kavlak, Adam Bigelow, and Megan Diehl, "Heat Pump-Friendly Cost-Based Rate Designs," ESIG Whitepaper, January 2023.

While most residential customers in North America currently remain on a rate that is primarily a flat or tiered volumetric charge, we have observed a growing trend toward offering customers a choice of alternatives to that default rate option. Given the increasingly heterogeneous nature of electricity consumers, the industry's focus on decarbonization and affordability, and the rapidly changing landscape of energy technologies, many vertically integrated utilities have recognized that there is not a "one-size-fits-all" solution to rate design. Residential rate choice – and its advantages, challenges, and implementation considerations – are the focus of much of the remainder of this discussion paper.

2. How and why other jurisdictions have provided residential customers with increased rate choices

Several utilities provide meaningful rate choice to their customers. To contextualize this observation, we reviewed the residential rate offerings of large utilities in Canada and the United States. Specifically, we identified large utilities in Canada and the U.S. with customer counts similar to BC Hydro and then summarized the residential rate offerings of each utility.

Of the 23 utilities, including BC Hydro, in our review, 17 offer at least three rate options. Inclining block rates, flat rates, and TOU rates are the most common rate offerings. Figure 1 summarizes the results of our review.

FIGURE 1: SUMMARY OF RESIDENTIAL RATES OFFERED BY LARGE NORTH AMERICAN UTILITIES

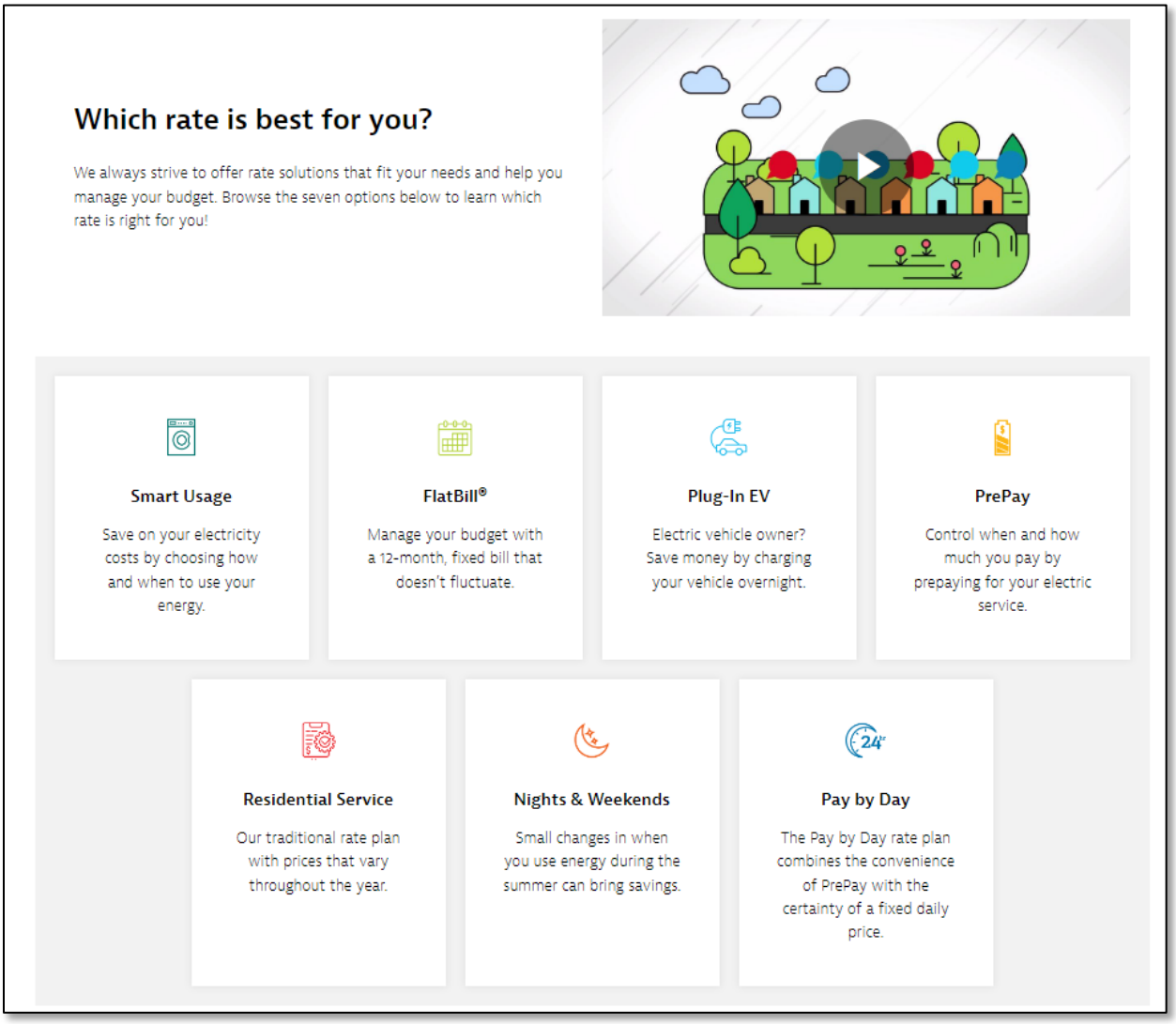
Canada	Province	# cust. (000s)	Flat	Inc. block rate	Dec. block rate	Comb. block rate	2-per TOU	3-per TOU	CPP	Demand charge	Fixed Bill	Heating rate	Other	Total
BC Hydro	BC	2,189		✓				✓						2
Hydro-Quebec	QC	4,317		✓					✓	✓		✓	✓	5
Hydro One	ON	1,334		✓				✓					✓	3
Alectra Utilities	ON	991		✓				✓					✓	3
Toronto Hydro	ON	773		✓				✓					✓	3
ENMAX	AB	675	✓											1
Manitoba Hydro	MB	587	✓											1
FortisAlberta	AB	563	✓											1
SaskPower	SK	538	✓											1
Nova Scotia Power	NS	520	✓				✓		✓			✓		4
United States	**State**	**# cust. (000s)**	**Flat**	**Inc. block rate**	**Dec. block rate**	**Comb. block rate**	**2-per TOU**	**3-per TOU**	**CPP**	**Demand charge**	**Fixed Bill**	**Heating rate**	**Other**	**Total**
Florida Power & Light	FL	5,739		✓			✓				✓			3
Southern California Edison	CA	3,881		✓				✓				✓	✓	4
Duke Energy Carolinas	NC, SC	2,765	✓				✓			✓		✓	✓	5
Dominion	VA	2,725				✓	✓			✓		✓		4
Georgia Power	GA	2,713		✓			✓	✓		✓	✓		✓	6
Pacific Gas & Electric	CA	2,269		✓			✓	✓						3
PacifiCorp	OR, CA, WA	2,003	✓	✓										2
Duke Energy Florida	FL	1,900		✓				✓				✓		3
Duke Energy Progress	NC, SC	1,689			✓		✓		✓	✓				4
Xcel Energy (MN)	MN	1,539	✓				✓	✓					✓	4
Xcel Energy (CO)	CO	1,536	✓					✓		✓				3
Alabama Power	AL	1,510				✓	✓			✓	✓		✓	5
Arizona Public Service	AZ	1,344	✓					✓		✓				3
Total (US and CA utilities)			**10**	**11**	**1**	**2**	**9**	**11**	**3**	**8**	**3**	**6**	**9**	

Notes: Dark green indicates default rate. "Other" rates include 4-period TOU rates, EV-specific rates, and clean energy rates. BC Hydro will introduce its TOU rate in 2024, so it is included in the table. The Hydro-Quebec demand rate applies only to customers with peak demand >50 kW. Manitoba Hydro's flat rate includes a customer charge that is a function of the size of the customer's panel. PacifiCorp has a default flat rate in Oregon and default inclining block rate in California and Washington. In cases where the utility offers a rate featuring both a TOU charge and a demand charge, it appears in both categories. "Combined block" indicates that the utility has an inclining block rate in the summer and a declining block rate in the winter.

In our experience, a successful rate choice offering will provide customers with options that are meaningfully different from each other, with that difference being clear through simple marketing messages. Georgia Power's rate offerings illustrate this approach. Georgia Power offers five different residential rates and multiple payment options, the differences of which can be explained with short names and concise descriptions.[2] To illustrate, Figure 2 is an excerpt from Georgia Power's website describing the rate options.

[2] Smart Usage, FlatBill, Plug-in EV, Residential Service, and Nights & Weekends are unique rate offerings. PrePay is a bill payment option, and Pay by Day effectively combines FlatBill with the PrePay payment option.

FIGURE 2: RESIDENTIAL RATE CHOICES AT GEORGIA POWER



Source: Georgia Power website.

As discussed above, our observation is that utilities believe at least a portion of their customer base is becoming more engaged and flexible in their energy use, and therefore are offering rates to match that need. Many utilities also understand that customers have diverse preferences, and want their rate offerings to cater to that diversity. Ultimately, each rate option likely will only appeal to a subset of customers. Providing the rates on an optional basis allows customers to choose the option that best meets their needs.

3. The implications of providing increased rate choices to residential customers

In general, the provision of choice should lead to better outcomes for customers, as it improves the chance that each customer will find a rate that serves his or her interest. However, from an implementation standpoint, it is still important to consider both the advantages and challenges of providing rate choice in a systematic way, in order to be able to assess the overall merits and mitigate unintended consequences.

Advantages of Increased Rate Choice

- Increased rate choice is expected to lead to improved customer satisfaction, as customers have more "products" choose from, including options that can reduce their bills.[3] When providing rate choice, it is important to offer a few options meaningfully different from the default rate, instead of a large number of options which could be overwhelming for customers to explore, understand and identify the right option for them.
- With the provision of a few additional rates, it could be possible to induce more economically efficient electricity consumption. For instance, a TOU rate with an overnight super off-peak period may be attractive for EV owners. When they shift their charging to the super off-peak period, they can take advantage of the lower prices during these overnight hours, and also consume renewable output that otherwise would have been curtailed absent the demand for charging.
- Alternative rate options may accelerate the achievement of policy goals. For instance, to the extent that an alternative rate option is more favorable (compared to the default rates) for customers who are in the market for heat pumps, this could advance the uptake of heat pumps, and would help a jurisdiction with ambitious building electrification goals to meet those goals.
- Some of the alternative rate options may lead to improved energy affordability outcomes. For instance, a low income customer with a relatively flat load profile may see a lower monthly bill under a demand-based rate - even before responding to the

[3] For example, when discussing the utility's rate modernization plan, the Chief Customer Officer of Evergy (a U.S. utility serving customers in Missouri and Kansas) recently noted: "First and foremost, customer surveys and our daily interactions with our customers indicate that higher customer satisfaction is directly related to customer choice. Customers expect to have choices as they make their purchasing decisions in most areas of the marketplace, and this is no different in their purchasing of electric services from Evergy." Direct Testimony of Charles Caisley, Case No. ER-2022-0129, January 7, 2022.

price signals - and could save further by staggering their use of energy-intensive appliances.

- Alternative rate options provide the ability to respond to shorter-term economic and policy drivers for engaged customers who are willing to change behavior accordingly. While it is important for the default rate to be uninfluenced by temporary short-term cycles, it is beneficial for customers to have options that can be more responsive to shorter-term drivers. For instance, a critical peak pricing rate may be effective in addressing a short-term peak capacity constraint, if a sufficient number of customers participate in this rate and reduce their demand on the peak days by responding to the price signals.

Challenges of Increased Rate Choice

- While improved rate choice offers many potential advantages, it has the potential to introduce revenue risk for utilities. As customers opt into rate designs that are expected to reduce their bills, utility revenues collected from these customers decline, at least in the short term.[4] There are a few options for addressing this revenue risk. Some jurisdictions allow utilities to design the optional rates by building an expected level of revenue loss into the rate design.[5] Other jurisdictions establish "decoupling mechanisms" which enable utilities to collect their allowed revenue requirements at the end of the year through rate adjustments, if their actual revenue collections fall short of the approved levels.
- It can be difficult to motivate customers to voluntarily adopt a new rate option on an opt-in basis. For example, an evaluation of several residential time-varying pricing pilots found that opt-in participation of 20% to 30% was the maximum enrollment level achieved.[6] We are aware of only two North American utilities – Arizona Public Service and Salt River Project – that have reached voluntary enrollment levels that exceed that range, and it took decades to reach that level of enrollment. A focused customer

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[4] In the long-term, however, utilities may avoid build out of future generation, distribution and transmission capacity and thereby achieve cost savings, as customers respond to some of the features of the optional rates, such as by reducing their peak usage in response to a peak price.

[5] For example, when Xcel Energy introduced an inclining block rate in its Colorado service territory in 2009, prices were set based on an expected level of energy conservation being induced by the new rate design. The utility was subsequently required to show that the expected level of conservation had materialized through measurement and verification.

[6] Peter Cappers and Richard Scheer, "Final Report on Customer Acceptance, Retention, and Response to Time-Based Rates from Consumer Behavior Studies", prepared on behalf of Lawrence Berkeley National Lab for the U.S. Department of Energy, November 2016.

engagement and communication plan is essential to reaching meaningful participatin levels.

- Increased rate choice may introduce the potential for customer confusion; especially if there are too many rate options to compare and choose from. The potential for confusion can be minimized by focusing on simplicity in rate design and offering a few alternatives that are meaningfully different from each other. Some utilities also offer online bill comparison tools which help customers to choose the right rate for them. For instance, if a customer is eligible for multiple rate schedules, customer's hourly AMI data from the previous year can be used to compute their bills on each of the rate schedules, helping to identify the most economic rate for the customer.
- Customers opt into alternative rates with the expectation that their bills will be lower under the new rates. However, some customers may see bill increases after their rate switch for a variety of reasons. They may not have a load profile ideal for the new rate design, they may have over-estimated their ability to respond to price signals to achieve bill savings, or they may not have fully understood the rate design they have opted into. Or, in the case of a change to the default rate, customers may have been benefitting from an economically inefficient design of the old rate. In order to prevent or mitigate these challenges, in addition to the aforementioned online rate comparison tools, utilities can establish well-trained customer call centers to help customers make a choice that is in their interest. In some cases, utilities calculate each customers' bill under the default rate and other available rate options, and automatically move the customers into the rate option that leads to the lowest bill. While this practice is customer-centric, there are risks of unintended consequences. A customer's bill could ultimately increase on the new rate because its recent usage patterns differed from its future usage patterns. Alternatively, some customers simply want the agency to make these decisions for themselves. For these reasons, utilities may wish to simply provide as much actionable information as possible to their customers (such as which rate option will lead to lower bills), but leave the rate choice decision to the customers.

4. Whether there are circumstances where end-use rates should be considered

As a general matter, our view is that it is preferable to offer "technology-neutral" rates. Unlike "technology-specific" rates, technology-neutral rates are designed for the class-average customer, are unsubsidized and are made available to all customers as an opt-in rate, as opposed to making only a group of customers with certain end-uses and technologies eligible

for these rates. While it is possible to design some of these optional rates with a certain technology's characteristics in mind, it is preferable for the rates to be cost-based, and unsubsidized. For instance, an optional cost-based rate with a higher fixed charge and a lower volumetric charge could be particularly favorable for electric-heating customers given their higher volumetric usage. However, since this rate is designed to collect the same amount of revenue from the average customer as the default rate, it could be made available to all residential customers (not just the electric heating customers) on a voluntary basis.[7] Customers with different appliances and use cases would opt into these rates if the structure of the rates is better aligned with their usage profiles.

If a technology subsidy is desired due to jurisdictional goals and priorities, it is typically preferable to provide these subsidies through rebates or other incentives rather than distorting price signals. Distorted price signals would lead to inefficient consumption choices and technology adoption patterns, and could contribute to other long-lasting inefficiencies in the system.

However, some conditions may merit further consideration of technology specific or end-use rates:

- If it is demonstrated that customers with a certain technology are cheaper to serve per kWh or per kW, and that customer segment is large enough (or expected to be), those customers could be designated a separate class and charged a cheaper rate that is consistent with their lower cost to serve. This implementation requires sufficient data to be available and can be demonstrated through an embedded cost study.
- If rate design is standing in the way of an important emerging technology, sometimes it makes sense to provide a temporary break in the rate design to allow the industry to develop. This is sometimes the approach used in jurisdictions with official state policies to advance a given technology (e.g., rooftop solar in California, transportation electrification in New York). For example, some jurisdictions allow utilities to temporarily limit demand charges for public charging stations, tapering that discount down over time. However, this approach has its drawbacks: it can incentivize other inefficient behaviors and outcomes, and it can be difficult to "take away" an incentive once it is introduced. If needed, rebates or other mechanisms to help the industry develop may be more desirable in this regard.

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[7] In the future, if electric heating customers reach a significant number and their cost of service is meaningfully different from other residential customers, they could be defined as a new class, with their own dedicated rates.

5. How other utilities have aligned their average and marginal costs to the rates charged to customers

Addressing discrepancies between average and marginal costs

Marginal costs are forward-looking by design and represent the cost of accommodating one incremental unit of demand. Embedded costs, in contrast, are retrospective by design and primarily track the historical costs incurred by the utility.

Economic theory predicates that pricing goods at the marginal cost maximizes economic efficiency as it mimics the pricing structure and resulting resource allocation of a competitive market. While it is possible to design rates *purely* based on marginal costs, it is practically never done. This is because marginal costs and embedded costs are almost never equal, and designing the rates based on marginal costs may lead to over or under collection of the revenue requirement.[8]

A common approach is to reflect marginal cost price elements in the rate design as much as feasible, while still ensuring the recovery of the embedded costs. For instance, various degrees of marginal pricing can be integrated into alternative rates by directly assigning some rate components the marginal costs (i.e. energy prices).

Residential costs collected by different rate design elements

There are three different rate design elements which are commonly encountered in residential rates. A basic charge (or customer charge) is a fixed charge of the same amount per customer that is collected on a monthly or daily basis for customer-related costs. Volumetric charges are assessed on a per-kWh basis and vary with the amount of energy consumed. Demand charges are assessed on a per-kW basis and vary with the level of customer's maximum demand.

Based on a perfectly cost-reflective rate design, all of the customer-related costs would be covered through a fixed basic charge; demand related costs would be covered through a demand-related charge, and energy related costs would be covered through a volumetric charge. However, historically, this has rarely been the practice in North America and elsewhere because this approach could result in up to fifty percent of the utility costs to be recovered

[8] In jurisdictions where marginal costs are used for determining class revenue allocations, marginal costs are reconciled with the embedded costs in a way to maintain the relative relationship of cost responsibility among different customer classes as implied by the marginal cost of service for each class.

through non-volumetric charges, and has been argued to provide reduced incentives and limited opportunities for residential customers to conserve energy.

Residential customer-related costs collected by basic charge

Based on a limited survey of a dozen U.S. utilities, we found that for most utilities, their basic charge (or customer charge) does not recover 100% of the customer-related costs. For these utilities, the basic charge covers 15% to 75% of the customer-related costs. The definition of the customer-related costs also vary by utility. In its broadest definition, customer-related costs could include meters, billing, service lines, transformers, overhead, and underground. Half of the utilities in our survey classified overhead, underground and transformers as customer related and the other half counted them as demand-related. We understand that BC Hydro defines customer-related costs as those related to meters, billing, and a portion of the costs associated with service lines and transformers. BC Hydro's current residential basic charge recovers approximately 60% of these customer-related costs.

Options to recover customer-related costs not collected through basic charge

Once a jurisdiction determines the maximum level of customer-related charges to be collected from customers througha basic charge (on a per customer, per month basis), the rest of these customer-related costs must be collected from other billing determinants. The best guidance on this issue is to stay as close as possible to the cost of service study, while also keeping in mind the gradualism principle. Allocating too much of the residual customer-related costs to energy charges will artificially inflate the price signals and will hurt the pace of electrification by increasing the volumetric rates. On the other hand, introducing a demand charge (if it has not been part of the rate design before) and allocating the residual fixed costs to a demand-charge may not be immediately acceptable to customers, and may need to happen over time, in a more gradual fashion.

Options to recover demand related costs

While a perfectly cost-reflective rate design would recover all of the demand-related costs through demand-based rate components, this is not a common practice for residential rate design due to concerns associated with complexity and acceptability of demand charges by smaller customers. Often, demand related costs are allocated to the basic charge and volumetric energy charge. If some of the demand related costs would be allocated to a basic charge, it may make sense to allocate demand related costs that are driven by the maximum billing demand (i.e., non-coincident peak) of the customers to the basic charge. Maximum

demand drives the need for infrastructure put in place to connect individual customers, and the cost of this infrastructure is fixed in the short-term even if a customer reduces their maximum demand in a given month. Another variation is to have a basic charge that varies as a function of the size of customers' panel (this could also be structured as a demand charge, but it will end up being a fixed charge as the size of the panel is fixed). This approach would result in higher basic charges for customers with higher demands, as the cost to connect them to the grid was higher than that of customers with smaller maximum demands.

Once a portion of the demand related costs are allocated to the basic charge, the residual can be allocated to the energy-related charges, ideally on a time varying basis. This way some of the demand charges which are driven by the coincident peak demand can be allocated to the peak period, and as customers respond to the peak price signals, it enables avoidance of future capacity costs.

6. Rate choices for BC Hydro to consider evaluating

This section describes the full menu of relevant residential rate design options or features that could be considered by BC Hydro, along with our perspective regarding the attractiveness of each option inclusion in BC Hydro's upcoming rates filing. To assist BC Hydro and stakeholders in prioritizing the options, we group them into three categories:

1. Rate offerings that exist today
2. Additional rate options that we recommend BC Hydro and stakeholders consider at this time
3. Rate options that are less likely to provide sufficient value to consumers at this time

Initially, we recommend that BC Hydro offer between three and five rate options in its move toward rate choice. Based on our review of offerings in other jurisdictions, that number of rate offerings is a productive starting point for providing customers with meaningful options without overwhelming them with the complexity of too many choices.

Existing BC Hydro rate offerings

The following are considerations regarding rates that already are or will be offered to customers by BC Hydro.

Inclining block rate (IBR)

BC Hydro's RIB rate charges customers a volumetric rate that increases as their consumption increases over the course of a billing cycle. That price signal potentially can provide an efficiency incentive, as customers may want avoid reaching the higher priced tiers. We note, however, that an IBR is not guaranteed to produce a conservation effect. The extent to which an IBR is likely to result in conservation depends in part on the share of usage that resides in the lower versus higher priced tiers.[9] The magnitude of customer response to an IBR design also will depend on the extent to which customers respond to average or marginal price.[10] A 2018 evaluation of BC Hydro's RIB rate found that the conservation effect of the rate has decreased significantly over time.[11]

Aside from the potential conservation benefit of IBRs, there are also disadvantages. In particular, it is difficult to establish a cost basis for IBRs, as the marginal cost of providing electricity does not increase with usage over a billing cycle. Due to this fundamental misalignment between costs and the rate design, IBRs can result in sub-optimal outcomes. For example, IBRs can unintentionally reduce the cost-effectiveness of heating and transportation electrification, as adoption of those end-uses will push customers into the higher priced tier of the IBR even if their new usage occurs primarily during lower cost hours of the day. For these reasons, our opinion is that other rate options have significant advantages over IBRs. Therefore, we do not identify IBRs as a priority for consideration by BC Hydro this time.

If BC Hydro decides to continue to offer an IBR in response to feedback that such an option should be maintained, it may be desirable to modify the rate to mitigate its unintended consequences. As a general matter, subject to further analysis of BC Hydro's costs, we recommend reducing the price differential between the tiers in the current rate, as this would better reflect the nature of BC Hydro's underlying costs and would reduce an artificial disincentive for electrification.

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[9] Ahmad Faruqui, Ryan Hledik, and Wade Davis, "The Paradox of Inclining Block Rates," Public Utilities Fortnightly, April 2015.

[10] Koichiro Ito, "Do Consumers Respond to Marginal or Average Price?" American Economic Review, Vol 104, Issue 2. 2014.

[11] Conservation and Energy Management Evaluation, "Evaluation of the Residential Inclining Block Rate," prepared for BC Hydro, April 2018.

Similarly, BC Hydro could consider reviewing the monthly usage threshold that defines the price tiers. One approach to consider in setting that threshold could be to use the lower priced first tier to reflect the usage associated with "essential" loads for the average household. For example, essential loads could be refrigeration, and a base amount of lighting, heating, cooling, and cooking reasonably necessary for the comfort of a customer in a modest-sized home.[12] The first tier would be priced at marginal cost, to ensure that the essential load pays only the minimum cost that it may impose on the system. The second tier would be set at a higher price to maintain revenue neutrality, thus recovering costs from "non-essential" load at a higher price.

Time Of Use (TOU) rate

BC Hydro recently proposed an opt-in residential TOU rate, which provides peak and off-peak price signals of a traditional TOU rate while still preserving the underlying structure of the default residential rate (i.e., the RIB rate or a flat energy charge rate). This innovative approach ensures that all customers will have access to the benefits of a TOU rate, without excluding smaller customers who could experience a bill increase if they otherwise needed to leave the RIB rate.

Brattle supported BC Hydro's TOU rate proposal in a separate report[13], and the Commission has approved the proposal[14]. As such, we do not offer recommendations for modifying the offering at this time.

Additional rate features that we recommend BC Hydro and stakeholders consider

The following are rate design options that we recommend BC Hydro consider for further assessment and introduction if the company moves in the direction of offering customers more rate choices.

[12] Further research and discussion is needed to determine exactly how to establish this usage amount.

[13] Ryan Hledik and Sanem Sergici, A Review of BC Hydro's Optional Residential TOU Rate, prepared for BC Hydro, February 21, 2023.

[14] British Columbia Hydro and Power Authority, Optional Residential Time-of-Use Rate Application Decision and Order G-342-23, December 12, 2023.

Flat volumetric rate

Along with block rates, flat rates are the most common default rate design for residential customers currently.[15] Flat rates charge customers the same cents-per-kilowatt-hour rate for all usage (though the price may change seasonally). One advantage is simplicity and understandability – customers do not need to be aware of price changes during certain times of day or over the course of a billing cycle, for example. Further, flat volumetric rates can play a role in promoting energy efficiency. In most existing flat rate offerings, a portion of a utility's fixed costs and all of its demand-related costs are recovered through the volumetric charge. As a result, customers face a volumetric rate that is higher than the marginal cost of energy, and have a strong incentive to conserve.

In British Columbia, introducing a flat rate as a voluntary option now would be a natural complement to other voluntary rate options that may have more price differentiation in response to customer or system needs. We understand that BC Hydro has an existing flat rate available for a small number of customers who are exempted from the default RIB rate. BC Hydro could consider amending the eligibility of this existing flat rate to expand it to a broader customer base.

Demand-based rate

As noted above, for simplicity, most existing residential rate designs recover demand-based costs through volumetric charges. Introducing a demand charge to recover distribution costs could improve cost-reflectivity, reflecting that distribution capacity that must be reserved to ensure reliable service to the customer is primarily based on various measures of maximum demand. Recovering some costs through a demand charge would mean that customers on this rate would pay a lower volumetric charge compared to a flat volumetric rate, for example. By managing their peak demand, customers could achieve financial benefits.

Demand-based rates can be combined with other rate features (e.g., with a TOU energy charge). Further, demand charges and can come in a variety of forms. For example, they can be based on maximum billing demand, demand during a peak period, or even tiered (i.e., the dollars-per-kilowatt price could increase as the customer's demand crosses higher thresholds).

[15] As noted in Figure 1 above, of the 23 surveyed utilities, 10 had a default flat rate and 10 had a default block rate.

While relatively few residential customers in North America are on demand-based rates today, there is precedent for offering these rates. Many standard rate offerings for commercial and industrial customers include a demand charge. Further, our 2019 survey of residential demand rate offerings suggest that at least 50 utilities in the U.S. have offered a demand-based rate option.[16] To our knowledge, Arizona Public Service's (APS's) residential demand rate offering is the most highly subscribed. More than 10% of APS's residential customers have enrolled in the utility's demand rate offering on an opt-in basis.[17]

A common concern with demand-based rates is that residential customers will not understand the rate, will not be aware of their peak demand, and therefore will not be able to respond. However, relatively simple messaging can effectively communicate the concept of managing demand to customers. For example, customers can be made aware of appliances with the highest electricity demand, and be encouraged to stagger the use of those appliances. This communication strategy is simple, effective, and does not require educating customers about the concept of a kilowatt or providing them with real-time information about their electricity consumption.

Critical peak pricing (CPP)

CPP rates are similar to TOU rates in the sense that they charge a higher price during peak periods and offer a lower price during other hours of the day. However, in contrast to TOU rates, those peak periods are much more limited in number (typically only 10 to 15 per year), are called on a day-ahead basis, and have a higher associated peak price. As a result, CPP rates provide a stronger and more dynamic price signal than a simple TOU rate, and better reflect the fact that the driver of peak capacity needs is a limited number of high load hours per year.

CPP rates can be combined with TOU rates, with the daily TOU signal representing variability in energy and potentially distribution costs, and the CPP "adder" reflecting generation capacity costs. In this sense, we would expect this a CPP rate design to appeal to price-responsive customers with a high degree of flexibility and an interest in pursuing bill savings through behavioral or technological changes. CPP rates are consistent with a growing trend toward adoption of more flexible end-uses such as EVs and smart thermostats.

[16] Direct Testimony of Ahmad Faruqui on behalf of Ameren Missouri, July 2019, Schedule AF-D2.

[17] According to FERC Form 1 data, roughly 130,000 of APS's 1.2 million residential customers are enrolled in the company's residential demand rate offering.

Industry experience with CPP rates is primarily limited to pilot-scale offerings at this point. However, one prominent example of a full-scale offering is Sacramento Utility District's (SMUD's) Critical Peak Pricing rate.[18] SMUD's CPP rate is layered on top of the company's TOU rate offering. Participants receive a discount of 2 cents/kWh during the off-peak and mid-peak periods of summer months and pay an incremental charge of 50 cents/kWh during CPP events. Events last one to four hours, with a maximum of 50 hours per summer. Customers receive day-ahead notification of a CPP event.

Subscription pricing "plus" (SP+)

SP+ is an entirely fixed monthly charge for electricity. The fixed monthly charge is customer-specific, and is based on the customer's historical weather normalized usage. In a sense, it aligns the way customers pay for electricity with the way they pay for other products, such as cell phone plans and streaming services.[19]

To address the lack of incentive for efficient consumption, the fixed bill offer is coupled with energy efficiency measures or demand flexibility measures (i.e., the "plus") as a prerequisite for enrollment.[20] The subscription pricing offer could include, for example, a smart thermostat that is pre-enrolled in a demand response program. Participants could receive a payment on a quarterly basis if usage decreased relative to their weather-normalized average while on the SP+ rate. An SP+ offer to encourage efficient EV charging could apply specifically to EV charging during off-peak periods. If the SP+ bundle is particularly effective at reducing costs imposed by the customer on the power system through improved efficiency and flexibility, it may even be possible to offer them a fixed bill that is lower than what they would have paid under the standard rate. Alternatively, it may be necessary to add a risk premium to compensate for the potential for increased consumption.[21]

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[18] SMUD website: https://www.smud.org/en/Rate-Information/Residential-rates/Critical-Peak-Pricing.

[19] For further detail, see Ryan Hledik, Andy Lubershane, and Peter Fox-Penner, "Fixed Bill Plus: Making Rate Design Innovation Work for Consumers, Electricity Providers, and the Environment," June 2020.

[20] Additionally, some utility fixed bill offers include a provision that would allow the utility to remove customers from the rate if their usage exceeds an extreme threshold relative to the weather normalized estimate. Also, if a customer's usage increases during the first 12-month term, that increased usage would be used to set the utility's offer price for the second 12-month term. Both serve as guardrails against usage increases.

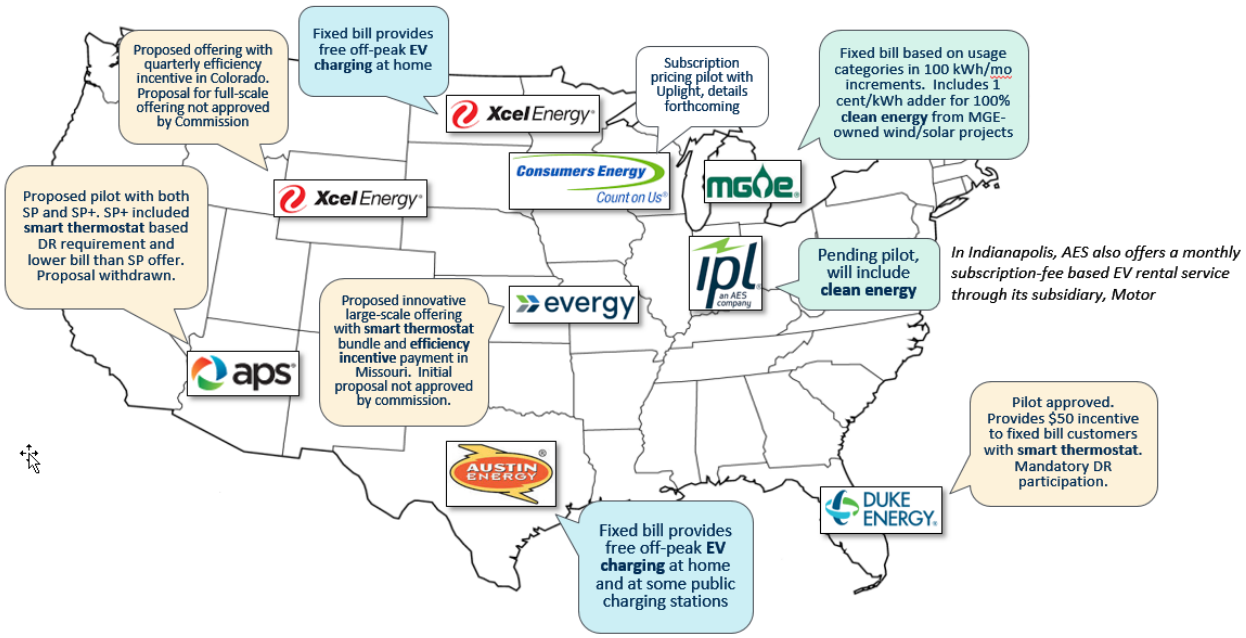
[21] Subscription pricing offers include a risk premium that accounts for the possibility of increased usage due to weather fluctuations or higher than expected costs. The bill reduction attributable to the efficiency or flexibility offers would need to offset this premium in order for the customer to experience a lower bill relative to the otherwise applicable rate.

Subscription pricing is different than pre-pay offers because, with pre-pay, customers are still subject to the underlying rate structure and face regular true-ups. In contrast, at the end of the customer's term of the SP+ plan, there are no true-ups and no surprises to the customer.

An advantage of the SP+ approach is that it provides a very high level of simplicity and predictability to participants, while also encouraging energy efficiency and demand response participation from a customer segment that may otherwise be unwilling to adopt those measures.

SP+ is a relatively new concept in residential rate design, and utilities are beginning to experiment with a variety of SP+ offers. Figure 3 summarizes SP+ offerings that are being introduced by utilities in the U.S.

FIGURE 3: SUBSCRIPTION PRICING PLUS OFFERINGS IN THE U.S.



Appealing to diverse customers

As discussed above, offering meaningfully different rate choices would allow BC Hydro to better address the preferences of a diverse customer base. In Figure 4 below, we illustrate the extent to which we would expect each of the existing and recommended rate options above to appeal to various customer segments. While no individual rate design is likely to be preferred by all customers, a menu of options could address a broad range of customer segments.

FIGURE 4: THE EXISTING AND RECOMMENDED RATE DESIGNS FOR CONSIDERATION BY BC HYDRO AND THE CUSTOMER SEGMENTS TO WHICH THEY MAY HAVE THE MOST APPEAL

Customer Segment	IBR (RIB Rate)	TOU	Flat	Demand Charge	CPP	SP+
Low usage	✓			✓		
High usage			✓			
Flexible		✓		✓	✓	✓
Prefers simplicity			✓			✓
Considering EV		✓			✓	
Considering heat pump				✓		
Considering efficiency upgrade	✓		✓			✓

Notes: Check mark indicates that the rate may have above-average appeal to a given customer segment. The figure is a broadly illustrative generalization; the appeal of the rate designs to individual customers will depend on specific rate design and implementation features. Low-income customers are a highly relevant segment, but their load characteristics and rate design preferences cannot be generalized for the purposes of this table; see the discussion later in this discussion paper regarding options to mitigate bill impacts for low income customers.

Low usage customers who currently benefit financially from having a larger share of their usage in the lower-priced tier of the RIB rate may also benefit from a tiered demand-charge rate. Conversely, higher usage customers may benefit from moving to a flat rate relative to an inclining block rate. Flexible customers of any size may be attracted to the bill savings opportunity associated with a TOU or demand based rate, and also may be more willing to accept the flexibility requirements of the SP+ rate. Customers seeking simplicity will find that in a flat rate or in the entirely predictable fixed bill of the SP+ rate. Customers considering adopting an EV may benefit from the opportunity to charge during lower-priced off-peak hours, whereas customers considering a heat pump could benefit from the lower volumetric price of a demand-based rate. Customers considering an efficiency upgrade could save more through rates with higher volumetric charges (IBR and the flat rate) and may also be attracted to SP+ offers that are bundled with efficiency measures.

Rate features that are less likely to provide sufficient value to consumers at this time

The following are rate design options which, in our view, are less relevant to achieving success in an initial move toward greater rate choice in British Columbia. We describe the rate options and our rationale for not recommending further consideration of these options at this time.

Real-time pricing (RTP)

With RTP, residential customers would pay a price for electricity that varies on an hourly or even sub-hourly basis. This approach ultimately could provide a granular and highly cost-reflective price signal to which connected devices can respond efficiently. However, that level of granularity is unnecessarily complex for the vast majority of customers at this time. Further, with limited exceptions, the concept of residential RTP is untested and the benefits are unproven for residential customers in general.

High fixed charge (i.e., straight fixed-variable pricing)

In the short run, the majority of a utility's costs are fixed. For example, while investment in the distribution grid could be reduced in the long run though more efficient and flexible electricity consumption, in the short run the embedded cost of the distribution system must be recovered from customers. Some utilities have explored the possibility of recovering a large portion of those short-run fixed costs through a fixed monthly charge that is significantly higher than existing customer charges. The volumetric charge would be reduced accordingly, such that the rate is revenue neutral.

This approach can help to facilitate the achievement of some policy goals. For example, reducing the volumetric charge will improve the economic attractiveness of electrification to consumers. However, equity concerns often arise given that increasing the fixed charge will increase the total bill for small customers. If offered on an opt-in basis, large customers could benefit from switching to this rate and shifting costs to smaller customers. Aside from equity concerns, our view is that demand-based grid costs are more appropriately recovered through demand charge or time-varying energy charge. That price signal encourages electricity consumption behavior that can reduce system costs in the long run and benefit all customers.

Fixed bill

Similar to subscription pricing plus, with a fixed bill offering customers pay the same bill each month for the term of the offer, regardless of usage. However, unlike subscription pricing plus, a standard fixed bill is not coupled with other features that encourage efficiency or flexibility. Several U.S. utilities offer standard fixed bills. Georgia Power has the most highly enrolled option, with roughly 13% of its residential customers (nearly 300,000 customers) participating on an opt-in basis.

Given that a fixed bill removes the incentive for efficient consumption, and that there is a variety of feasible options for packaging fixed bills with efficiency and flexibility offers, we recommend including the "plus" element of subscription pricing plus as described above.

Green pricing

Many utilities offer the customers the option to pay a premium in order to ensure that their usage is matched by carbon-free generation. However, given that BC Hydro's supply mix is already heavily decarbonized, there is little incremental benefit for customers to pay a premium for entirely carbon-free electricity.

Electric heating discount

As discussed above, we generally do not recommend that technologies be subsidized through rate design. Other forms of financial incentives are likely to achieve this outcome more efficiently.

Locationally differentiated prices

In some markets, that has been interest in extending the concept of locational marginal pricing (LMPs) down to the distribution system. In theory, this approach would provide incentives to adopt distributed energy resources in locations of the grid where they are most beneficial. Congested areas of the distribution system would have higher prices and therefore a higher incentive to adopt distributed resources and relieve the congestion, and vice versa.

In reality, it can be difficult politically to justify varying prices with significant geographic granularity across a service territory. There is some precedent for varying prices by climate zone in large service territories with significant microclimates. However, for both political and technical feasibility, we instead recommend achieving geographically-targeted demand reductions through locationally-varying demand response incentives.

Peak time rebates (PTR)

PTRs provide customers with a payment for measured usage reductions during PTR events. Measuring the usage reduction requires calculating a customer-specific usage baseline that would have occurred in the absence of calling the PTR event.

PTRs are essentially a no-lose proposition for participants – the participant saves money if they reduce their usage, and otherwise only continue to pay the standard applicable rate if they choose not to respond. There is no direct downside. As such, PTRs are feasible to offer on a mandatory or opt-out basis, and can be an effective tool for incentivizing peak demand reductions. In Maryland, Baltimore Gas & Electric (BGE) and Pepco have offered default PTRs to their customers for several years, and sell the demand reductions directly into the wholesale capacity market.

Given that a PTR does not specify the price that customers pay for electricity, it technically could be considered an incentive-based demand response "program" rather than a true rate design. In fact, BC Hydro's existing Peak Saver program is one form of PTR. For these reasons, we did not consider new PTR deployment as a priority for BC Hydro's initial transition to rate choice.

7. How other jurisdictions have considered and mitigated adverse bill impacts from a rate design change

If the design of the default rate is being changed, thorough consideration should be given in particular to those customers that are likely to experience significant bill increases. In this case, the first step that we recommend is to analyze the distribution of customer bill impacts using historical load data. The analysis should be conducted at a minimum for a representative load research sample. With the deployment of AMI, it is increasingly possible to conduct the analysis for a very large sample or even the full customer base. Ideally, the data will allow for evaluating the bill impacts of vulnerable customer segments and other specific customer segments that are at risk of a significant bill increase (e.g., customers with electric heat, small customers, low income customers).

Upon identifying the customers at risk of significant bill increases, the next step is to establish options for mitigating the bill increases. Options include:

- Rate design modifications: While a purely cost-based rate design is a prudent starting point, it may be necessary to deviate from this cost basis in order to limit extreme changes in bills. For example if costs support a very strong peak-to-off-peak price ratio in a TOU rate, it may be desirable initially to limit that price ratio at a level that will mitigate extreme impacts while still incentivizing load shifting.

- Gradualism: Related to the rate design modification point described immediately above, movement toward a more extreme, cost-reflective design, if desired, could be introduced gradually over a few years. This would limit year-to-year changes in customer bills to an acceptable level.
- Temporary bill protection: When transitioned to a new rate design, customers could be given a guarantee that their bill will not exceed what it otherwise would have been on the standard rate for some temporary period of time (e.g., their first six to 12 months on the rate). This approach allows customers to gain experience and learn on the new rate with limited risk. Bill protection does not necessarily need to apply to all customers; it could be limited to extreme cases (e.g., the bill will not increase by more than 10%). Further, we generally recommend bill protection only in cases where there is a significant change to the structure of the default rate design.
- Bifurcate the rate changes: If the average rate is increasing, it may be prudent to separate the rate level increase from the rate design increase by introducing the two at different times. This separation will reduce the risk that customers conflate the two effects and mistakenly attribute the bill impact of the rate level increase to the rate design.
- Rate comparison tools: Customers can be presented with tools that help them understand the rate that is most likely to reduce their bill. This information could be quantitative, based on the customer's usage history, or it could be qualitative information based on typical customer preferences and consumption behaviors.

When new rate designs are being introduced on an opt-in basis, adverse impacts on specific customer segments typically are a secondary concern. The fact that customers are not being moved to the new rates, and instead must proactively enroll in them, provides a strong safeguard against customers experiencing unexpected bill impacts, or a rate change that is not aligned with their preferences. Still, with new opt-in offerings it is prudent to provide customers with enough information about the rates that will allow them to make informed decisions.

8. How other jurisdictions have considered and addressed the ability of customers to pay for electricity

Energy assistance programs help low-income customers and other disadvantaged customers pay energy bills or reduce energy usage through energy efficiency improvements. These programs are supported by federal funding, ratepayer funds, and other sources, such as state

and local contributions and donations.[22] The primary federal funding sources in the US, for example, are the Low Income Home Energy Assistance Program ("LIHEAP") and the Weatherization Assistance Program ("WAP"). Bill payment assistance programs represent the majority of the total funding[23] and can be further broken down into two subcategories: i) bill discount programs, and ii) bill payment plans, such as bill forgiveness, arrears management plans, and budget billing. While the latter category is important to help customers manage their bill payments, our focus here will be to provide a review of the bill discount programs.

Overview of Bill Discount Programs

Bill discount programs provide credits or discounts on utility bills for eligible customers.

LIHEAP provides federally funded assistance to reduce the costs associated with home energy bills in the US. States, federally recognized tribes and tribal organizations, and territories receive grants from LIHEAP and then distribute these to households. Grant recipients (e.g., states) may set their own LIHEAP income eligibility limits but must cap them at 150% of the federal poverty level ("FPL"), except where 60% of the state median income ("SMI") is higher, and no less than 110% of FPL.

LIHEAP funds are supplemented with ratepayer-funded programs to further assist low-income customers. Eligibility for these programs typically depends on the household income not exceeding a certain percentage of the FPL or the SMI. Programs may also automatically accept customers that are already approved for LIHEAP or enrolled in public assistance programs such as Medicaid, Supplemental Nutrition Assistance Program, and Supplemental Security Income.

We recently surveyed these ratepayer funded bill discount programs offered across the U.S. and found that there were five main categories of program offerings:

1. **Flat percentage discount programs**: Provide a discount on utility bills by a certain percentage. Figure 5 presents examples that include Arizona Public Service's Energy Support Program, National Grid Massachusetts' Energy Assistance Program Rider, and Green Mountain Power's Energy Assistance Program. Given that electricity rates are higher in these jurisdictions than in British Columbia, it may be the case that the corresponding level

[22] Cluett, Amann, Ou, "Building Better Energy Efficiency Programs for Low-Income Households", American Council for an Energy-Efficient Economy (ACEEE), 2016, *available at* https://tinyurl.com/2ddmr8f7

[23] *Ibid.*

of discount required to improve affordability is higher in these jurisdictions than would be needed in British Columbia.

FIGURE 5: EXAMPLES FOR FLAT PERCENTAGE BILL DISCOUNT PROGRAMS

Program/Utility	Discount	Eligibility Criteria	Source
Arizona Public Service Company, AZ	25% on electric bills	Household income less than 150% FPL	Energy Support Program
National Grid, MA	32% on electric bills; 25% on gas bills	Household income less than 60% of state median income; or receiving benefits from any means-tested public benefit program; or eligible for LIHEAP	Electric Bill Discount; Electric Rate R-2; Gas Rate R-2;
Green Mountain Power, VT	25% on electric bills	Household income less than 185% FPL	Energy Assistance Program (EAP); EAP-Rider; EAP-Rider vs Rate 1

2. **Flat dollar amount discount programs**: Provide a discount on utility bills by a certain dollar amount. Figure 6 presents some examples to flat dollar amount discount programs.

FIGURE 6: EXAMPLES FOR FLAT PERCENTAGE BILL DISCOUNT PROGRAMS

Program/Utility	Discount	Eligibility Criteria	Source
Ontario Energy Board	Credit up to $113/month depending on income, number of people in home, and other factors	Income less than $52,000/yr, with additional assistance for indigenous customers, electric heating, or certain energy-intensive medical devices	Ontario Electricity Support Program
UniSource Energy Services, AZ	$16/month discount on electric bills	Household income less than 200% FPL	Customer Assistance Program
Minnesota Power, MN	$20/month discount on electric bills	Qualifying for Minnesota's Energy Assistance Program (EAP) by having household income less than 60% SMI. Customers of senior age or living with a disability will automatically enroll	CARE: Customer Affordability of Residential Electricity
Central Maine Power, ME	Credit of up to $900/year based on annual electricity usage and income	LIHEAP eligible (<150% FPL) or living in subsidized housing, or enrollment in oxygen pump or ventilator program	Electricity Lifeline Program

3. **Rate discount programs**: Provide discounts that apply to a portion of the rate, rather than the entire bill. Examples include UniSource Energy Services Customer Assistance Residential Energy Support Program gas discounts and Liberty Utilities Gas Rate Schedule R-4, as presented in Figure 7.

FIGURE 7: EXAMPLES FOR RATE DISCOUNT PROGRAMS

Program/Utility	Discount	Eligibility Criteria	Source
UniSource Energy Services, AZ	$3 discount on the standard Basic Service and Meter Charge as well as a 15 cent/therm discount for up to 100 therms of gas use each month from November through April	Household income less than 150% FPL (for gas discounts)	Customer Assistance Program
Liberty Utilities, NH	60% discount on gas delivery charges (not commodity)	Eligibility for LIHEAP benefits or benefits from certain other programs	Rate Schedule, R-4

4. **Tiered bill discount programs**: Provide discounts that vary based on income tiers. Different percentage of bill or dollar amount discounts are applied to each tier. Examples include Eversource New Hampshire Electric Assistance Program and Consolidated Edison Energy Affordability Program, as presented in Figure 8.

FIGURE 8: EXAMPLES FOR TIERED BILL DISCOUNT PROGRAMS

Program/Utility	Discount	Eligibility Criteria	Link
Eversource, NH	151-200% FPL: 8% discount 126-150% FPL: 22% discount 101-125% FPL: 36% discount 76-100% FPL: 52% discount 0-75% FPL: 76% discount for the first 750 kWh of monthly usage	Household income less than 200% FPL	EAP Brochure; Rate EAP
Consolidated Edison, NY	Varies by tier and service type such as gas vs electric, heating vs non-heating; $40-68/month for electric; up to $150/month for gas heating	Enrollment in LIHEAP, and receiving various other benefit programs	Financial Assistance Programs

5. **Percentage of income payment plans ("PIPPs")**: Provide payments to cap bills at a predetermined percentage of household income. Examples include Dominion Energy Virginia PIPP and Xcel Energy Colorado PIPP as presented in Figure 9.

FIGURE 9: EXAMPLES FOR PERCENTAGE OF INCOME PAYMENT PLANS

Program/Utility	Discount	Eligibility Criteria	Link
Dominion Energy, VA	Cap electric bills at 6% of income without electric heating, or 10% with electric heating	Household income less than 150% FPL	PIPP Guidelines
Xcel Energy, CO	Cap electric and gas bills each at 3% of income; or 6% with electric heating	Household income less than 185% FPL, or 60% SMI, or 80% of Area Median Income	Electric and Gas Affordability Programs
Ohio utilities	Set electric and gas bills each at 5% of income; or 6% with electric heating. Minimum monthly payment of $10	Household income less than 175% FPL	PIPP
Nevada utilities	Cap bills to reduce the energy burden of the customer statewide median household energy burden (2.29% in 2023)	Household income less than 150% FPL	Energy Assistance

Some jurisdictions have a “neighbor to neighbor” program which allows customers, particularly affluent ones, to donate funds via an app or online portal to support their neighbors' energy needs. Direct Energy in Texas and AEP in Ohio are two utilities offering these programs for their low income customers.

Advantages and disadvantages of various bill discount programs

Each bill discount program has its own pros and cons. Flat percentage and flat dollar amount discount programs are advantageous because of their simplicity, comparatively low administrative burden, and for not distorting the price signals. The fact that discounts are not tailored to the specific circumstances of the customers can be a disadvantage. Rate discount programs have a relatively low administrative burden; however, they may distort price signals. Tiered discount programs are a hybrid of flat discount programs and PIPP; therefore, the administrative complexity is moderate. The main advantage of a PIPP is offering tailored discounts to keep the energy burden below a certain threshold. However, these programs can be more complex and costly to implement and may distort price signals. Figure 10 below compares pros and cost of each of the bill discount programs.

FIGURE 10: PROS AND CONS OF BILL DISCOUNT PROGRAMS

Program	Description	Pros	Cons
1- Flat Percentage Discount Programs	Payments to reduce the bill by a certain percentage	- Low administrative burden for utility	- Not tailored to different income levels
2- Flat Dollar Amount Discount Programs	Payments to reduce the bill by a flat dollar amount	- Least administrative burden for utility - No distortions to price signals	- Not tailored to different income levels or bill amounts
3- Rate Discount Programs	Discount applies to portions of the rate rather than the total bill	- Low administrative burden	- More complex than flat bill discounts - Distorts price signals and may lead to inefficient usage
4- Tiered Discount Programs	Discounts are determined based on income tiers	- Lower complexity than PIPP, while accounting for different income levels to some extent	- High administrative burden for utility since it still requires determination of customers' tiers and discount levels
5- Percentage of Income Payment Plans (PIPP)	Payments to cap bills at a set percentage of household income	- Tailored to individual customers - Energy burden does not increase with rate hikes	- Highest administrative burden for utility - Acquisition of customer income data may be difficult

In our view, programs that modify customer bills instead of altering their rates are preferable as they do not distort the price signals. Before offering bill discount programs, it may be prudent to understand the level of energy burden in the Province, and use this information in the design of a bill assistance program.

III. Conclusion

Utilities across North America are beginning to embrace heightened customer interest in proactive management of their energy consumption. One of the ways in which utilities are responding to this interest is by offering rate choice. With the full deployment of AMI, and increased need for load flexibility, many utilities have begun offering multiple rate options to their residential customers, as we have demonstrated in this report.

With rate choice, customers can switch away from their default rate and opt into an alternative rate, if the alternative is better aligned with their financial preferences and lifestyle. Some customers will be immediately better off under these rates (without changing their consumption patterns) due to their favorable load profiles, whereas other customers will need to modify their usage patterns in order to benefit financially.

Our jurisdictional scan of rate offerings indicates that many utilities comparable to BC Hydro offer rate choice for their residential customers. While the specifics of these alternative rate options vary by utility/jurisdiction, established practices can increase the uptake of these rates and lead to lower bills for participants, thereby improving customer satisfaction. As a next step in a transition toward greater rate choice in British Columbia, it will be important to review and assess these practices for customer engagement.

First, rate options should be simple and easy to understand by customers. Customers should be able to clearly see the value proposition given their energy consumption habits, and easily formulate how they may benefit from these rates. At the same time, it can be beneficial for utilities to invest in tools and communication methods that increase awareness among customers, and help customers identify the rates best suited to their energy lifestyle. While some utilities take a more proactive approach and move customers to the rate option which results in the lowest bill for them, others help customers identify the best rate options for them and let the customer initiate the decision. Both approaches have their merits and should be decided based on a given utility jurisdiction's circumstances.

Rate choice could also be an effective tool to support affordability goals. Customers who are motivated to lower their electricity bills by responding to price signals or changing their usage patterns are more likely to achieve these outcomes through rate choice, by opting into an alternative rate design. However, rate choice is not necessarily a substitute for targeted bill assistance programs. As we discussed in this report, there are various bill discount programs that could be made available to low income customers to help lower their energy burden.

While each bill assistance program has its own pros and cons, programs that modify customer bills instead of altering their rates are preferable as they do not distort the price signals.

We recommend that BC Hydro develop a few alternative rate designs for its residential customers, which are meaningfully different from each other and from the default rate. It will be important to explore and develop customer engagement efforts to maximize the uptake of these rates by customers who would benefit from them. Further, developing a low income assistance program to accompany the rate choice offerings can help reduce low income customers' energy burden. These efforts would allow BC Hydro to leverage the capabilities of its AMI investment and empower its customers with more choice, while advancing the province's affordability and climate goals.