Fleet Electrification
Rate Design Workshop

REVISON - Slides 8, 19, 24 and 36 Updated

May 28, 2019

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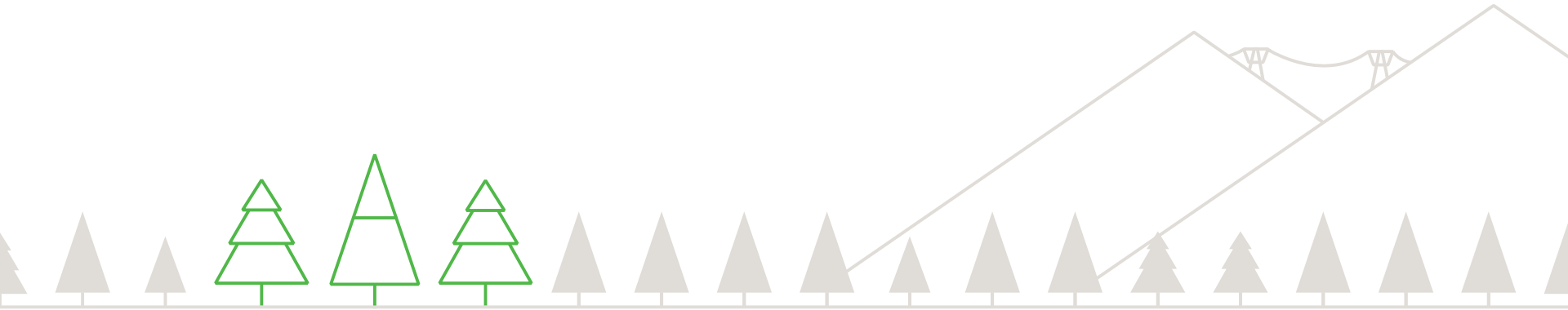
Workshop Agenda

Approximate Time	Topic	Presenter
9:00 – 9:05	Welcome	Fred James Regulatory and Rates
9:05 – 9:30	Objective and Key Rate Drivers	Gord Doyle Customer Service
9:30 – 10:00	Jurisdictional Review	Allan Chung Regulatory and Rates
10:00 – 10:20	Break	
10:20 - 10:45	Rate Design Criteria and Economic Assessment	Anthea Jubb Regulatory and Rates
10:45 – 11:30	Rate Options and Discussion	Allan Chung Anthea Jubb Regulatory and Rates
11:30 – 11:45	Closing	Anthea Jubb Regulatory and Rates

Objective and Key Rate Drivers



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Objective

Develop optional rates to support fleet electrification while benefiting all ratepayers

Photo Source: TransLink

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Key Drivers

- Support fleet electrification in achieving greenhouse gas (GHG) emission reduction targets
- Shift charging loads to off-peak where possible
- Customers have indicated that Large General Service (LGS) demand charges are a barrier to converting to electric fleets

The Province set new targets for GHG emissions:

- 40% by 2030
- 60% by 2040
- 80% by 2050

Charging Scenarios

Two charging scenarios with distinct characteristics have been identified:

- **In Route Charging**
- **Depot Charging**

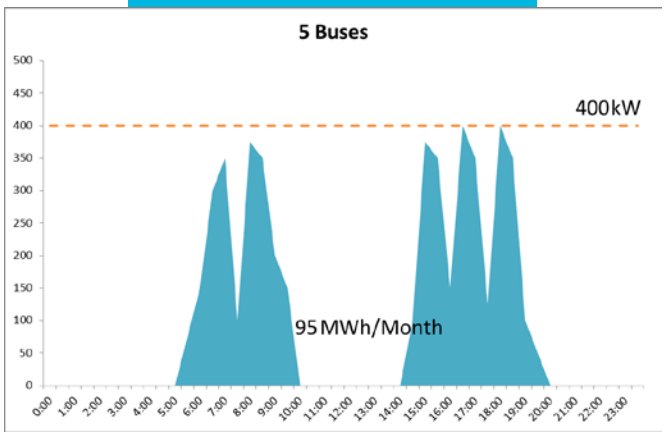
Charging Scenarios | In Route Charging

In Route Charging Characteristics

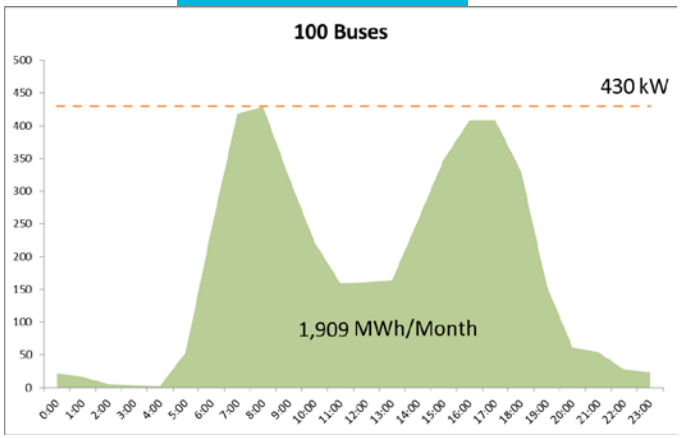
- Buses will charge at bus stops located along their route
- Most charging will occur during the daytime
- Chargers will be approximately 450 kilowatts (kW) each

Illustrative In Route Charging Load Shape Scenarios

Early Deployment Stage



Full Deployment



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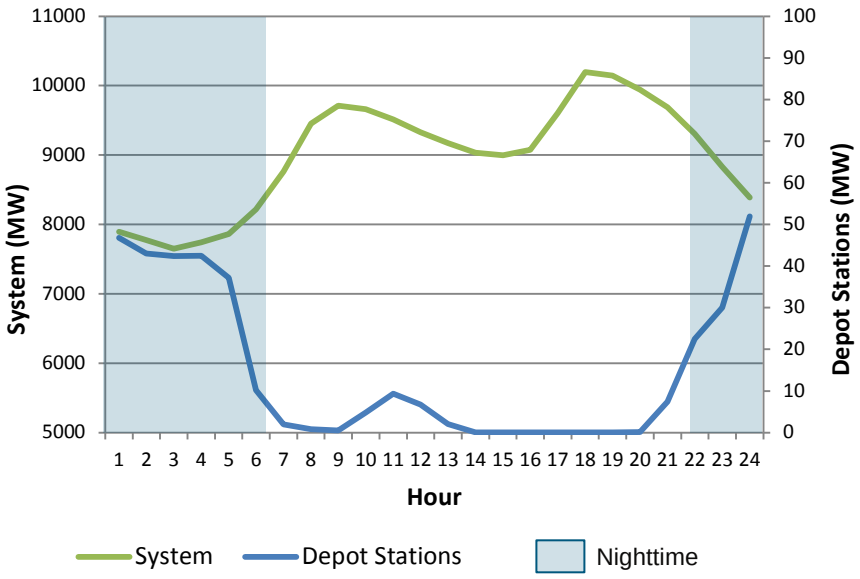
Charging Scenarios | Depot Charging

Depot Charging Characteristics

- Majority of charging will occur overnight between 10pm and 6am
- Some daytime charging may be needed to meet operational / battery range requirements
- Chargers will be in the 100 kW-150 kW range each

Illustrative Depot Charging and BC Hydro System Load Shape



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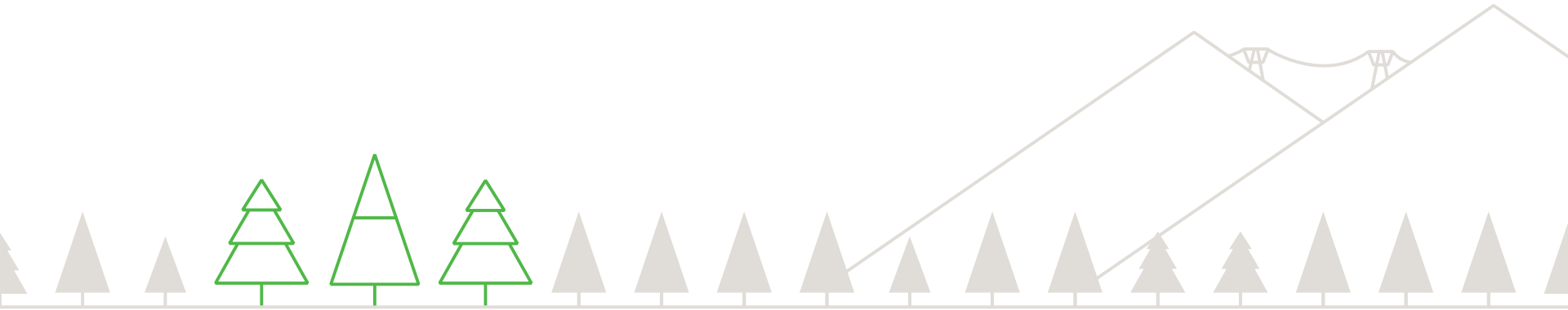
Proposed Rate Availability:

- Separately metered new charging load over 150 kW
- Fleet charging (e.g. public transportation, commercial fleets)

Question: Are there other availability criteria that should be considered?

Jurisdictional Review

- The following section includes rates for commercial EV charging in other jurisdictions.



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Jurisdictional Review

Electric Vehicle (EV) rates seek to encourage EV adoption and other objectives e.g., encouraging load to shift to periods that are less costly to serve

1. Time of use (TOU) energy charges and in some cases TOU demand charges.
2. Lower energy charges and no demand charges during overnight period.
3. In some cases, no demand charge or phase-in no demand charge back over transition period (e.g., over 10 years).
4. EV rate may provide significant bill saving over standard rate.

Commercial EV Rate Jurisdictional Review

Utility	Rate	Season	Peak Price	Mid-Peak Price	Off-Peak Price	Customer Charge	Availability
Hawaiian Electric Company	E-Bus-P TOU Energy TOU Demand	All year	Energy 27.0655 c/kWh (5pm-10pm) Demand $26.50 $/kW/ month	Energy 14.3541 c/kWh (9am-5pm) Demand $0 $/kW/ month	Energy 15.6688 c/kWh (10pm-9am) Demand $0 $/kW/month	$5 ($/month)	For electric on-road bus charging facilities with existing host commercial account on LGS rate
Liberty Utilities (serves communities in California Including Lake Tahoe)	A-3 TOU Energy TOU Demand TOU Energy TOU Demand	Summer Winter	Energy 7.306 c/kWh (10am-10pm) Demand $13.12 $/kW/month Energy 6.907 c/kWh (5pm-10pm) Demand $7.95 $/kW/month	 Energy 6.813 c/kWh (7am-5pm) Demand $2.99 $/kW/month	Energy 5.523 c/kWh (10pm-10am) Energy 5.445 c/kWh (10pm-7am) Demand $0 $/kW/month	$455.59 ($/month)	Customers with demand greater than 200 kW. Includes Buses/Stations, Bus Fleet Charging Stations

Commercial EV Rate Jurisdictional Review

Utility	Rate	Season	Peak Price	Mid-Peak Price	Off-Peak Price	Customer Charge	Availability
Pacific Gas and Electric	Proposed CEV-L-S TOU Energy No Demand Charge	All year	Energy 30.267 c/kWh (4pm-10pm)		Energy 11.079 c/kWh (2pm-4pm, 10pm-9am) Super Off-Peak 8.882 c/kWh (9am-2pm)	Monthly subscription charge $183.86 per 50 kW of connected load	For fleet and public charging with charging capacities >100 kW
Southern California Edison (SCE)	TOU EV-8 TOU Energy No demand charge first 5 years Year 6 – Year 10 Phase-in Demand Charges Year 11+ Return to energy and demand charges	Summer Winter	Energy 46.20 c/kWh (4pm-9pm weekdays)	Energy 25.58 c/kWh (4pm-9pm weekends) Energy 29.11 c/kWh (4pm-9pm all days)	Energy 11.77 c/kWh (All except 4pm-9pm all days) Energy 12.58 c/kWh (9pm-8am) Energy Super-off Peak 6.73 c/kWh (8am-4pm)	$125.25 ($/month)	For customers with demand between 21-500 kW solely for fleet and public charging

Jurisdictional Review Summary

1. TOU energy rates provide an opportunity for EV charging loads to be shifted to periods with cheaper prices.
2. TOU demand rates apply during peak periods or during the day, which allow for demand charge free EV charging overnight.
3. Demand transition rates allow a period of demand charge relief to help during the initial years when EV charging has low utilization and poor load factor.

Break

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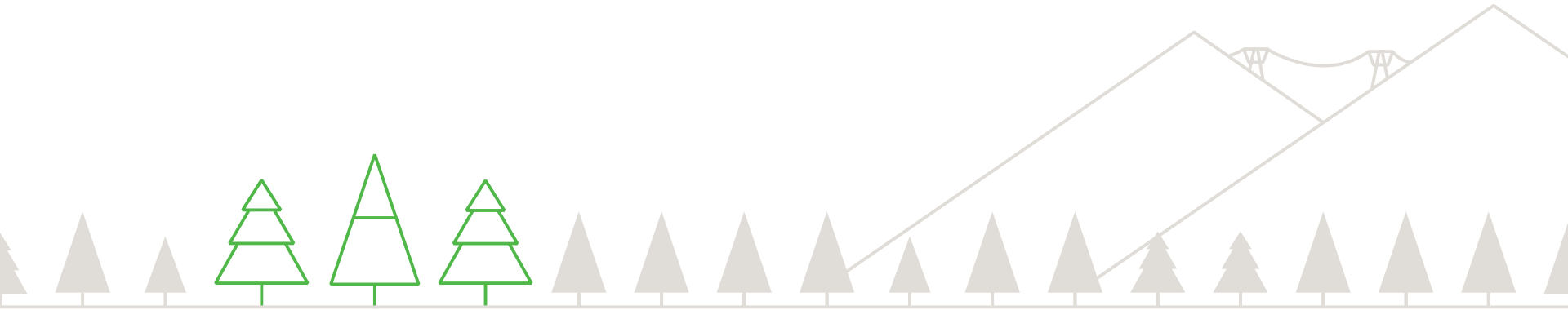
Rate Design Criteria and Economic Assessment



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Otherwise Applicable Rate - LGS

Rate Schedule 1600, 1601, 1610, 1611 (LGS 150 kW and over)

Basic Charge:

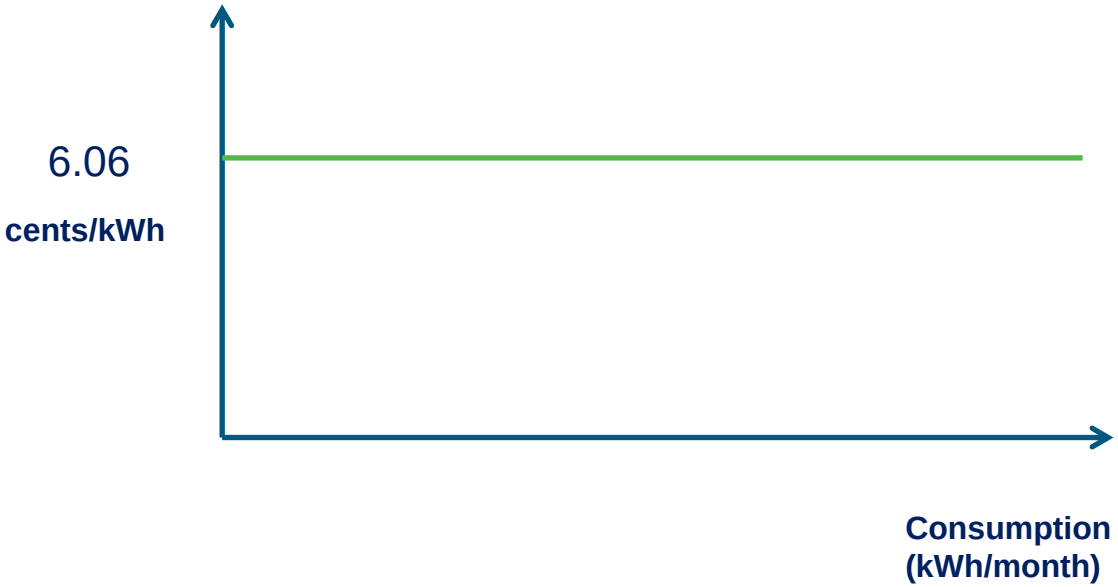
26.73 cents/day

Demand Charge:

$12.34 per kW of Billing Demand

Billing Demand is defined as the highest kW demand in the billing period

Energy Charge:



Key Rate Design Criteria

- **Economic Efficiency** – price signals that encourage efficient use and discourage inefficient use
- **Fairness** – fair apportionment of costs among customers, no undue discrimination
- **Practicality** - customer understanding and acceptance, practical and cost effective to implement
- **Stability** – revenue and rate stability

Economic Assessment Framework

Estimates the impact on electricity rates for all ratepayers due to marginal changes in utility revenues and costs

Benefit	Cost
Increase in utility revenue	Marginal cost of energy
	Marginal cost of generation capacity
	Marginal cost of transmission and distribution
	Incremental BC Hydro administrative cost

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Monitoring and Evaluation

Annual Monitoring

- New load (energy, demand, load shape and load factor)
- Revenues
- Incremental costs (e.g., metering, billing)

Three Year Evaluation

- Impact on electricity rates for all ratepayers
- Pricing principles, fair allocation of costs
- GHG reduction
- Availability and eligibility
- Customer feedback

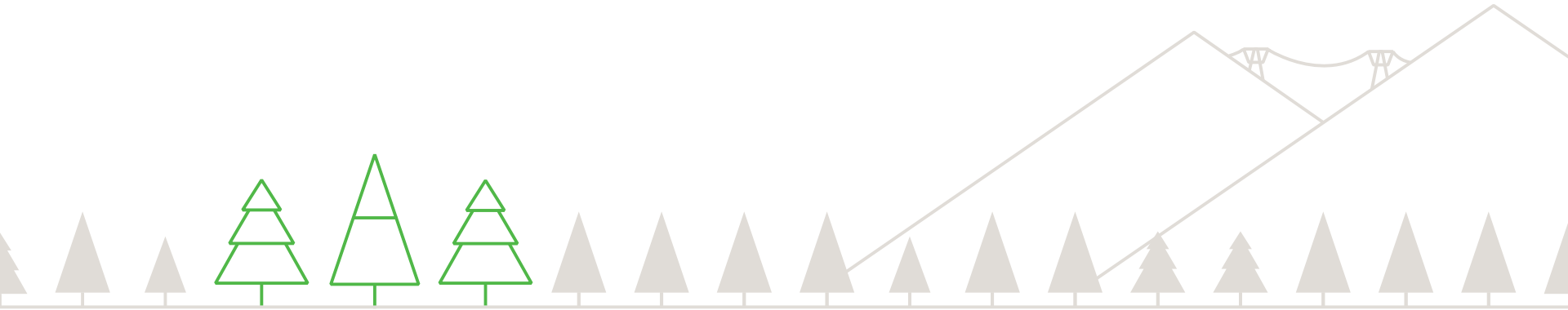
Question: Are there additional metrics and outcomes we should monitor and evaluate?

Rate Design Context

BC Hydro developed rate options to address specific customer charging needs

1. Overnight Rate with Demand Time of Use (TOU) was developed for overnight depot charging load.
2. Overnight Rate with Energy and Demand TOU was developed for overnight depot charging load.
3. Demand Transition Rate was developed for in route charging load.

Overnight Rate with Demand Time of Use



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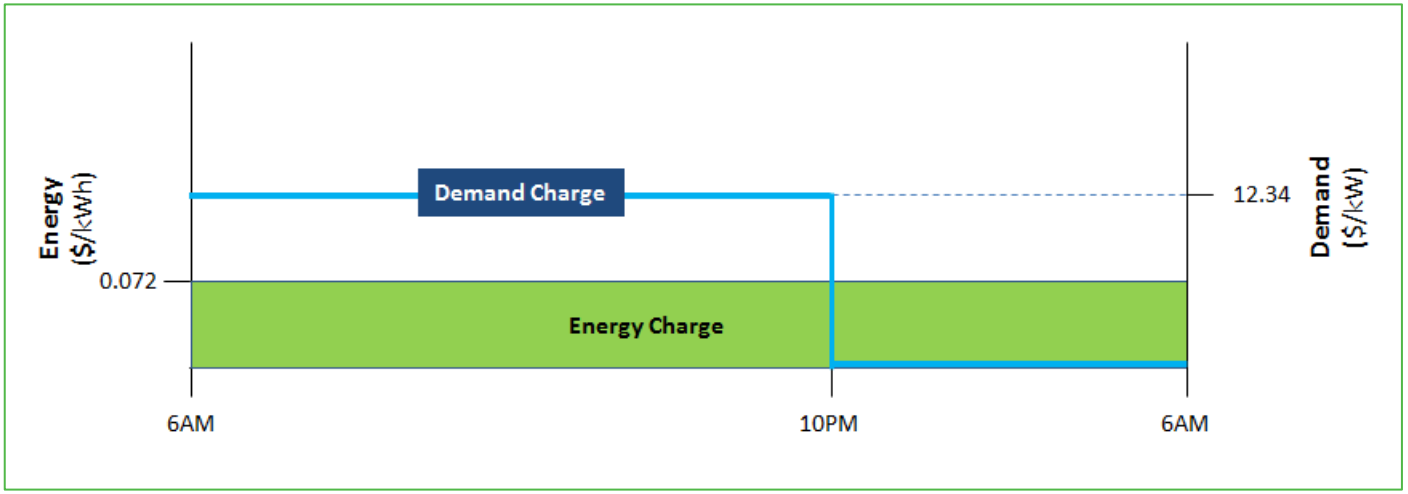
Option 1 Overnight Rate with Demand Time of Use



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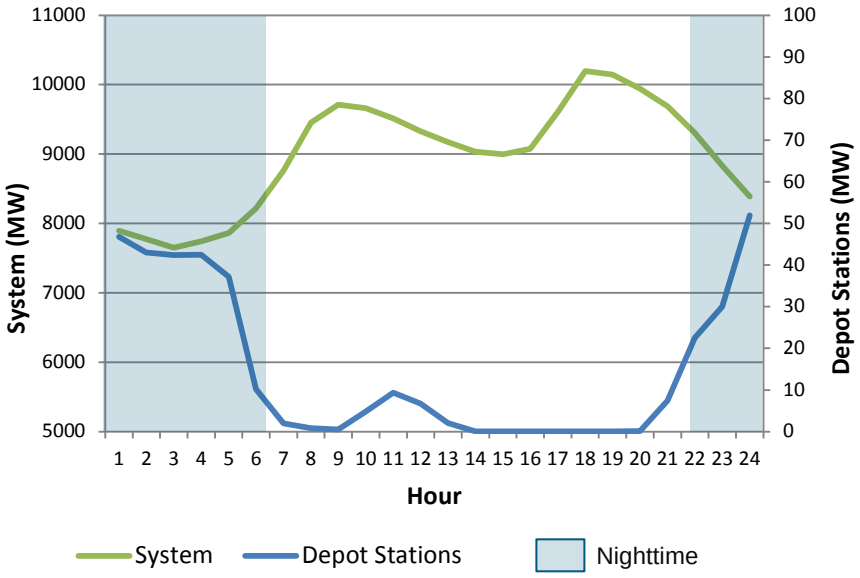
Charging Scenarios | Depot Charging

Depot Charging Characteristics

- Majority of charging will occur overnight between 10pm and 6am
- Some daytime charging may be needed to meet operational / battery range requirements
- Chargers will be in the 100 kW-150 kW range each

Illustrative Depot Charging and BC Hydro System Load Shape



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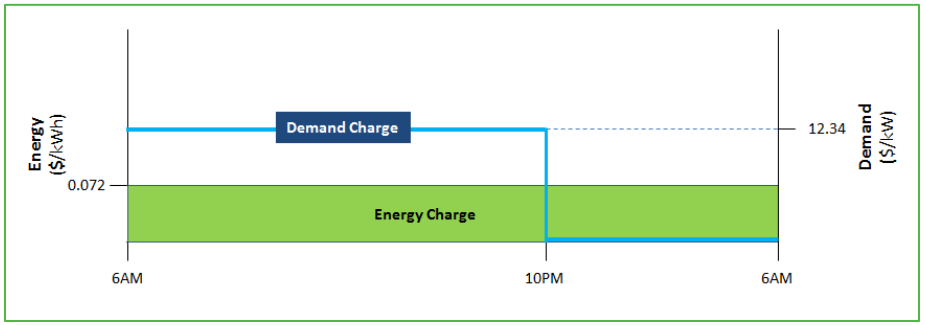
Fleet Electrification Rate Options

Option 1: Overnight Rate with Demand TOU (Depot Charging)

Description:

- Energy Charge: calculated to capture costs not recovered through the demand charge, assumes depot charging load profile
- Demand Charge:
  - **Daytime**: standard LGS Demand Charge
  - **Nighttime**: no Demand Charge



Objective:

- To encourage fleet electrification while prioritizing: economic efficiency, fairness, stability, customer understanding

Pros:

- Economic Efficiency – price signal encourages usage overnight when BC Hydro's system has spare capacity
- Fairness – fair apportionment of costs with revenues sufficient to recover both fixed and variable costs
- Fairness – incremental revenues exceed marginal costs resulting in benefits to all ratepayers
- Stability – optional rate can be offered on an ongoing basis
- Practicality – simple, easy to understand pricing

Cons:

- Practicality – time of use demand charges requires more complex metering and billing solutions

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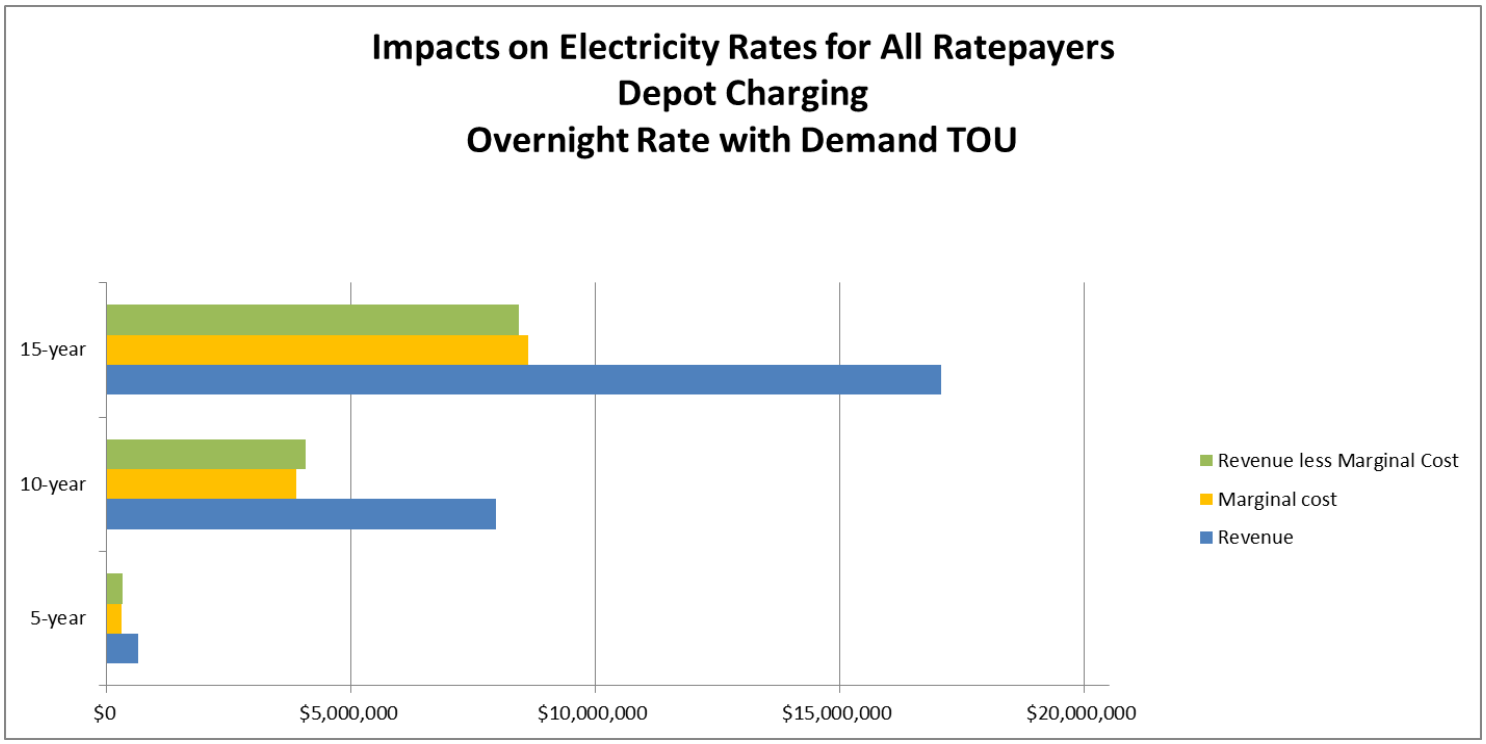
Preliminary Economic Assessment Results

Option 1 Overnight Rate with Demand TOU



✓ Customer

✓ Ratepayer

Period	Bill Saving (Percent)	Ratepayer Benefit Cost Ratio
5-year	66.9%	2.14
10-year	62.1%	2.04
15-year	61.5%	1.98

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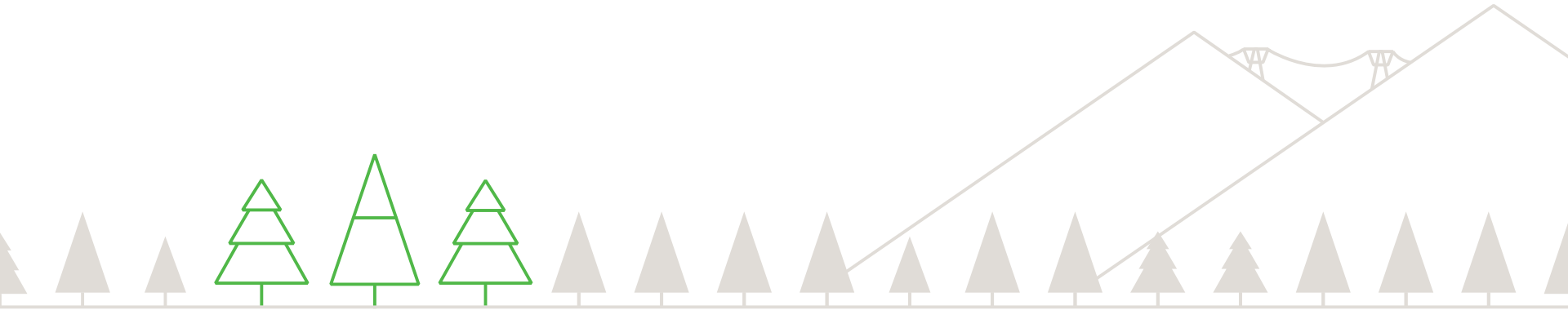
Overnight Rate with Energy and Demand Time of Use



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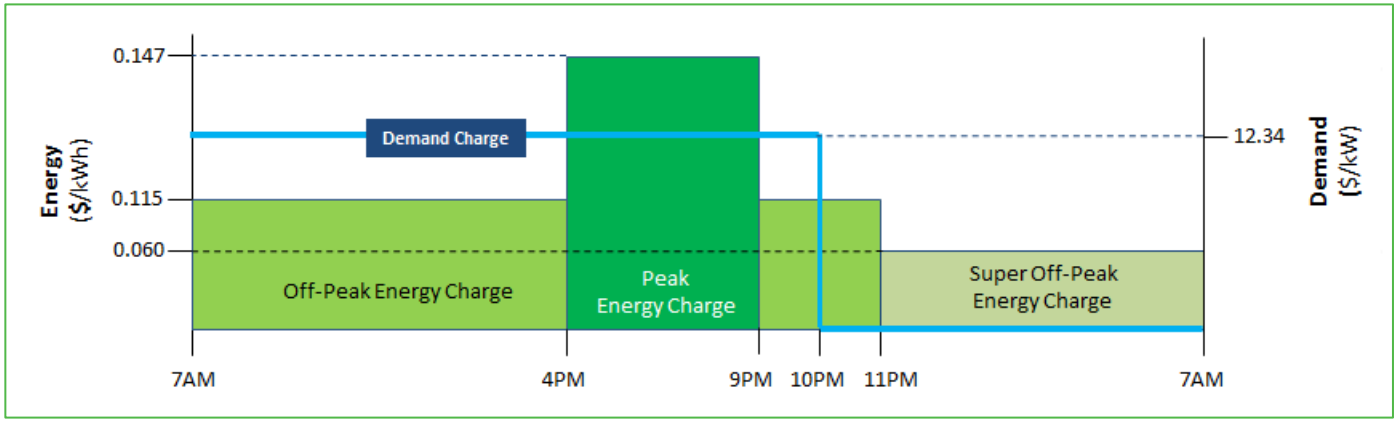
Option 2 Overnight Rate

with Energy and Demand Time of Use



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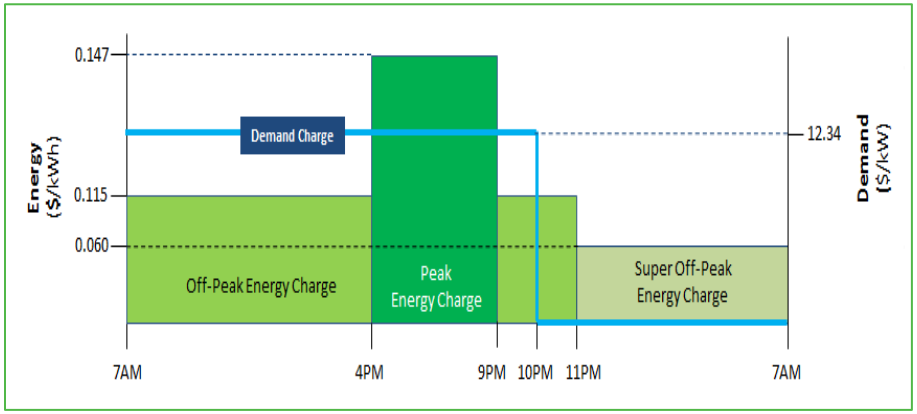
Fleet Electrification Rate Options

Option 2: Overnight Rate with Energy and Demand TOU (Depot Charging)

Description:

- Revenue neutral to Overnight Rate based on depot charging load shape
- Energy Charge:
  - **Peak** price based on a portion of marginal capacity costs
  - **Off-Peak** price based on revenue neutrality
  - **Super Off-Peak** price based on default LGS energy rate
- Demand Charge:
  - **Daytime** standard LGS Demand Charge
  - **Nighttime** No demand charge



Objective:

To encourage fleet electrification while prioritizing: economic efficiency, fairness, and rate stability

Pros:

- Economically efficient – price signal encourages usage away from daytime, particularly from peak periods, and to overnight when BC Hydro's system has spare capacity
- Fairness – fair apportionment of costs with revenues sufficient to recover both fixed and variable costs
- Fairness – incremental revenues exceed marginal costs resulting in benefits to all ratepayers
- Stability – optional rate can be offered on an ongoing basis

Cons:

- Practicality – time of use energy and demand charges requires more complex metering and billing solutions
- Practicality – more complex for customer to understand
- Fairness – provides greater bill savings to participants, and less benefits to all ratepayers than Option 1 Overnight Rate with Demand TOU

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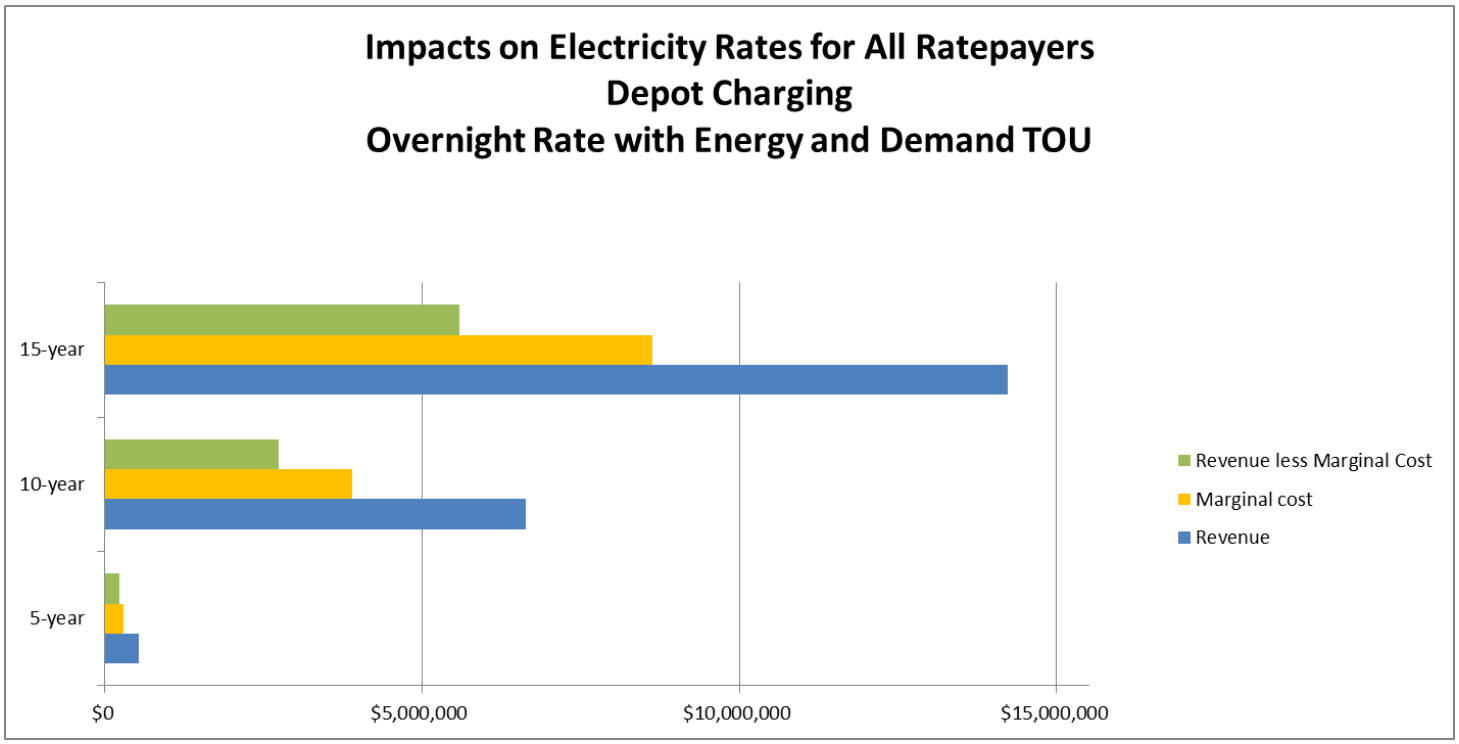
Preliminary Economic Assessment Results

Option 2 Overnight Rate with Energy and Demand TOU



✓ Customer

✓ Ratepayer

Period	Bill Saving (Percent)	Ratepayer Benefit Cost Ratio
5-year	72.4%	1.78
10-year	68.4%	1.70
15-year	67.9%	1.65

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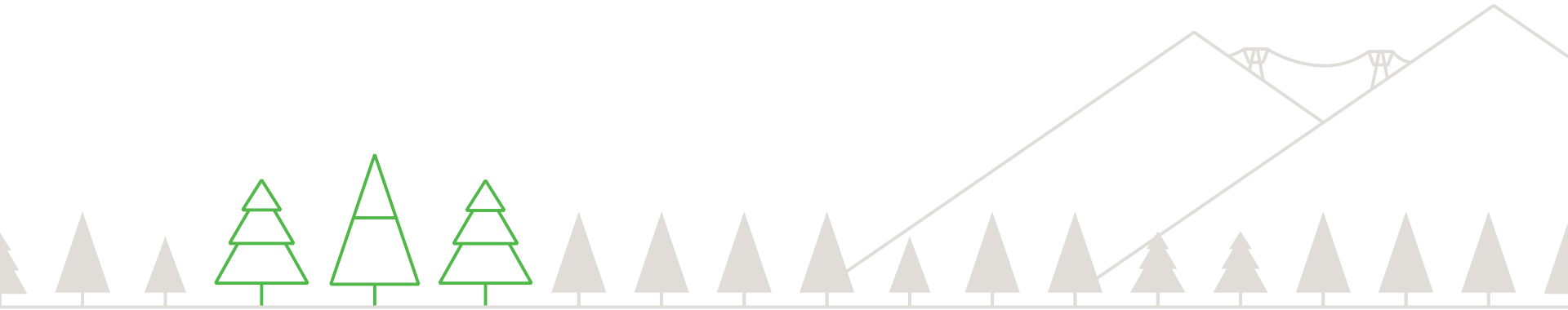
Demand Transition Rate



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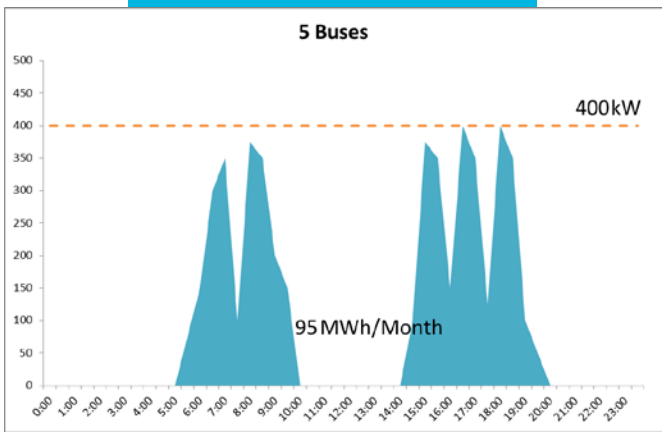
Charging Scenarios | In Route Charging

In Route Charging Characteristics

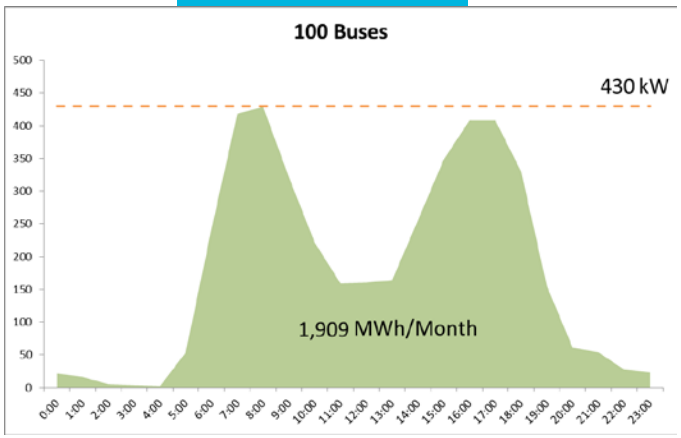
- Buses will charge at bus stops located along their route
- Most charging will occur during the daytime
- Chargers will be approximately 450 kW each

Illustrative In Route Charging Load Shape Scenarios

Early Deployment Stage



Full Deployment



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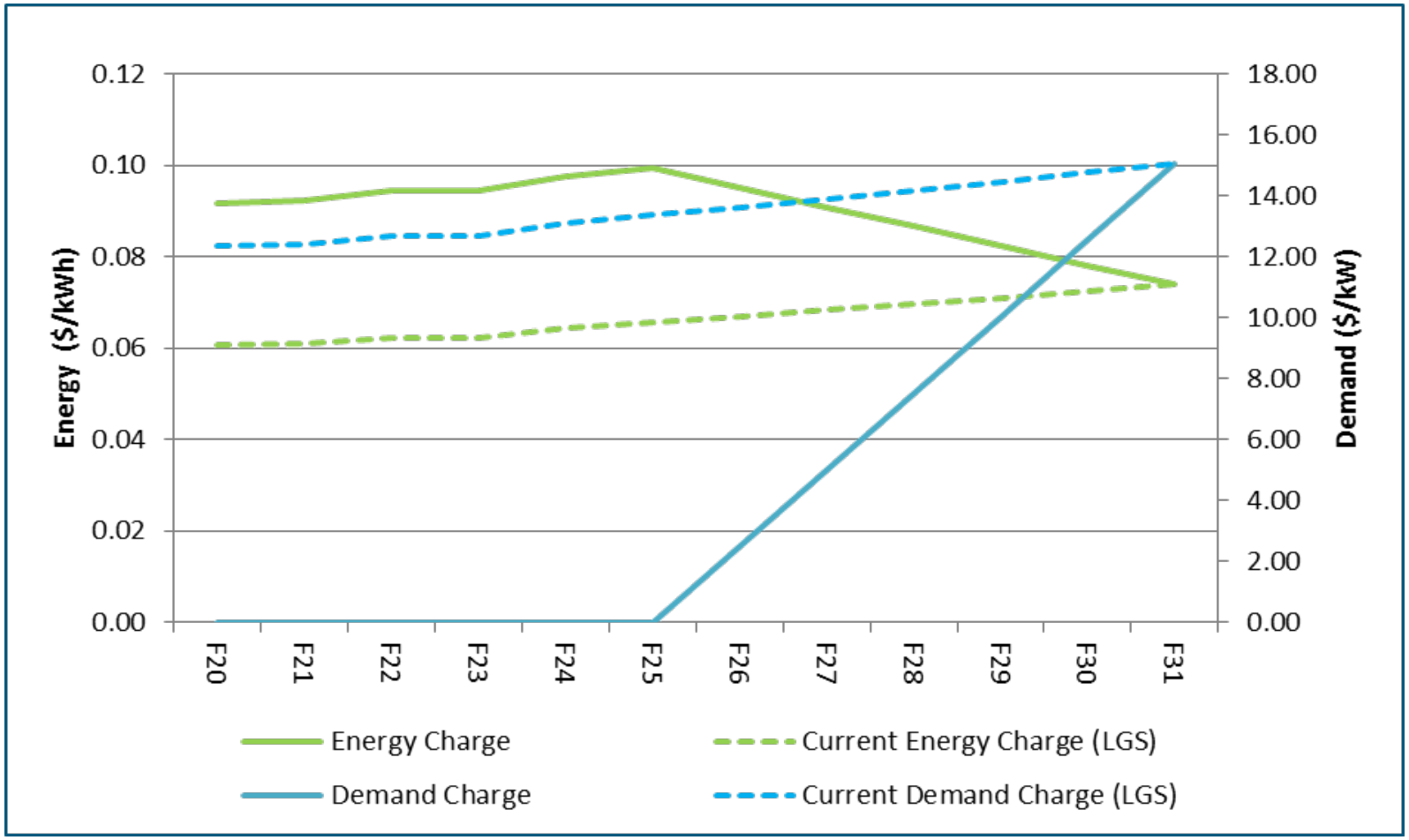
Option 3 Demand Transition Rate



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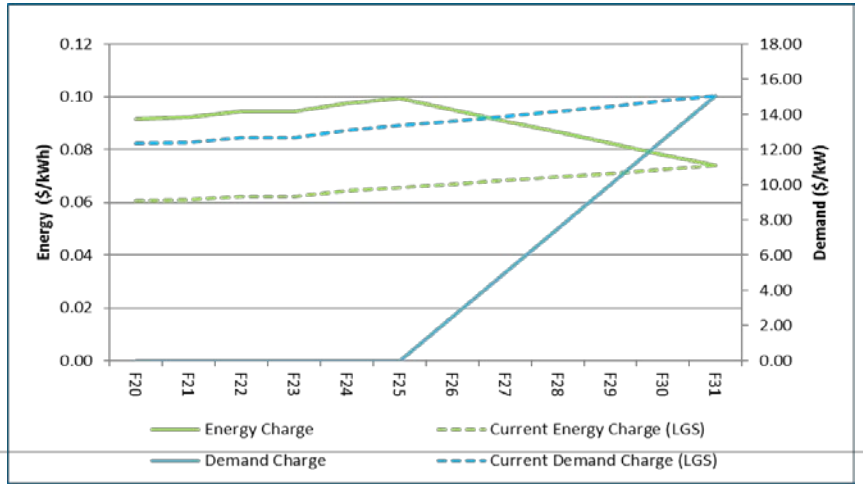
Fleet Electrification Rate Options

Option 3: LGS Demand Transition Rate

Description:

- Energy Charge:
  - Flat Energy Charge during F20-F25 based on class average load factor (55%)
  - Decreasing during F26-F30 to phase in to the standard LGS Energy charge
- Demand Charge:
  - No Demand Charge during F20-F25
  - Increasing during F26-F30 to phase in to the standard LGS Demand Charge
- Following the 11 year Transition Period, customers will be moved back to the standard LGS rate



Objective:

To encourage fleet electrification while prioritizing: customer understanding and acceptance, ease of implementation

Pros:

- Practical – practical and cost effective to implement with existing billing and metering systems
- Practical – customer understanding should be high as rate design is based on existing LGS rate
- Fairness – recovers marginal costs and therefore provides benefits to all ratepayers
- Fairness – customers transitioned to LGS after 11 years

Cons:

- Economic efficiency - price signal does not encourage shifting usage to times with lower costs to serve
- Fairness – revenues may not be sufficient to recover fixed costs, may not result in fair apportionment of costs
- Customer Acceptance – customer bill savings highly dependent on the timing and load factor of their new load
- Stability – the rate changes year to year

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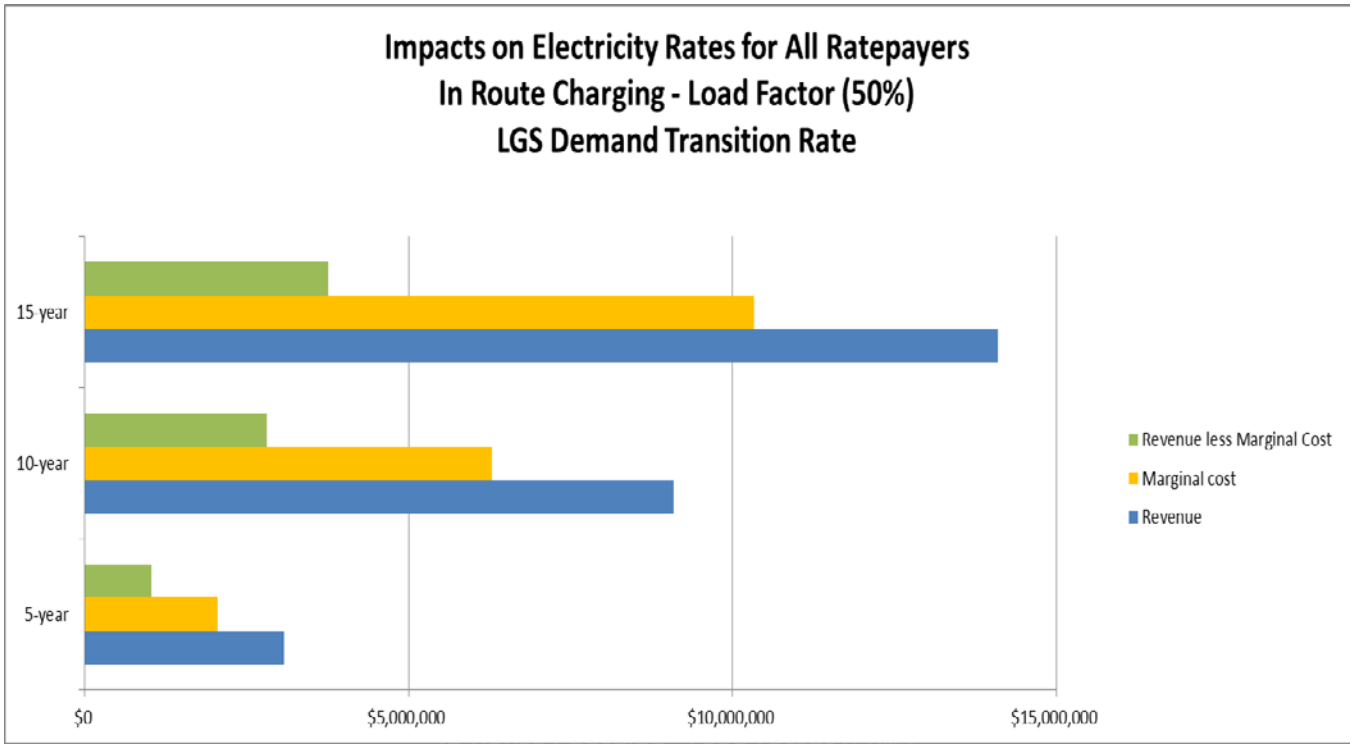
Preliminary economic assessment results

Option 3 LGS Demand Transition Rate



X Customer

✓ Ratepayer

Period	Bill Saving (Percent)	Ratepayer Benefit Cost Ratio
5-year	1.6%	1.50
10-year	0.9%	1.45
15-year	0.6%	1.36

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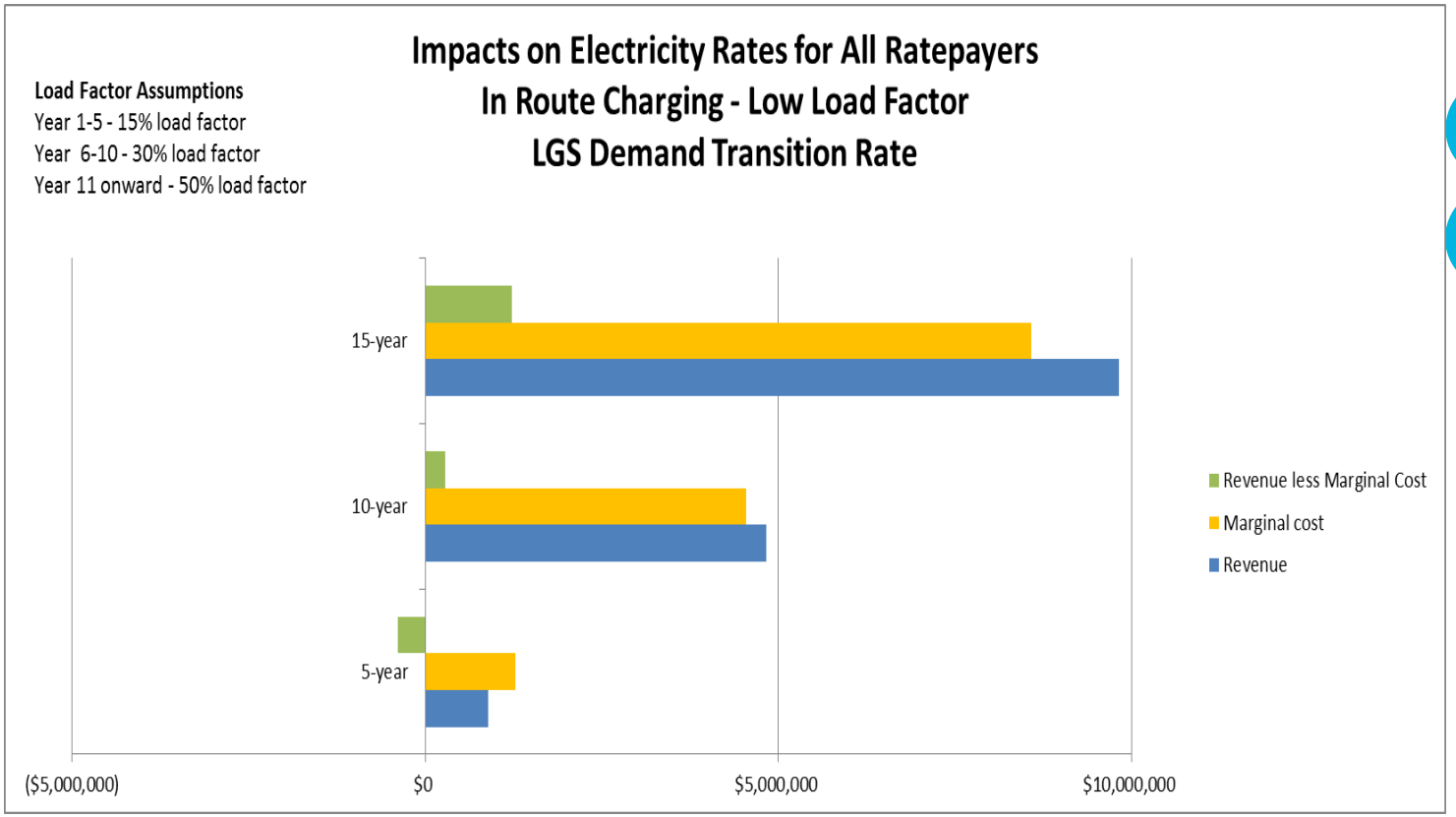
Preliminary economic assessment results

Option 3 LGS Demand Transition Rate



✓ Customer

? Ratepayer

Period	Bill Saving (Percent)	Ratepayer Benefit Cost Ratio
5-year	47.0%	0.70
10-year	20.6%	1.06
15-year	11.3%	1.14

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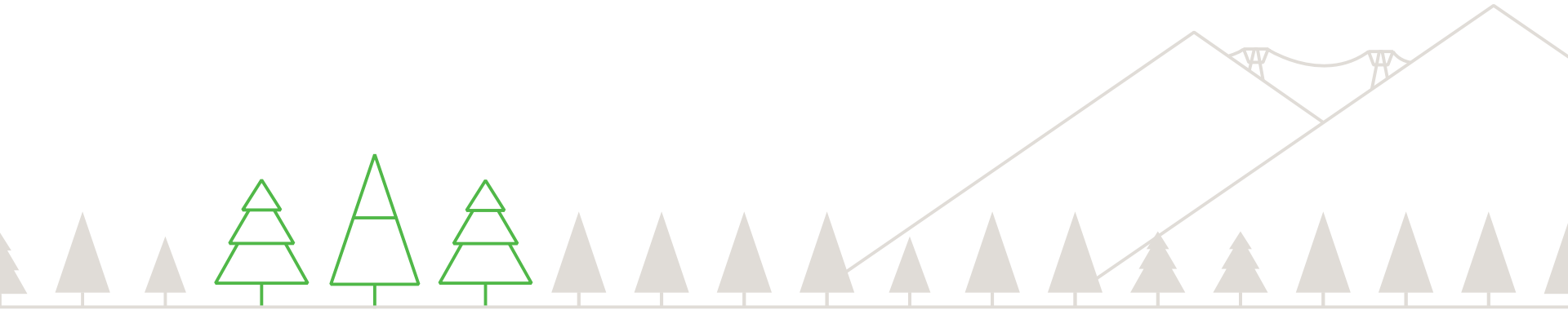
Discussion



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Discussion

Based on current forecast public transit battery electric bus charging load

1. Option 1 Overnight Rate with Demand TOU - Best supports overnight depot charging; stable rate design could be available on an ongoing basis, provides both participant and all ratepayer benefits.
2. Option 2 Overnight Rate with Energy and Demand TOU – Similar to Option 1 but with greater complexity, greater participant bill savings and lower all ratepayer benefits
3. Option 3 Demand Transition Rate – May support in route charging, participant bill savings are highly dependent on customer load factor and timing of fleet roll-out.

Closing and Next Steps

Please send your feedback forms to bchydroregulatorygroup@bchydro.com or leave them at your table.

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