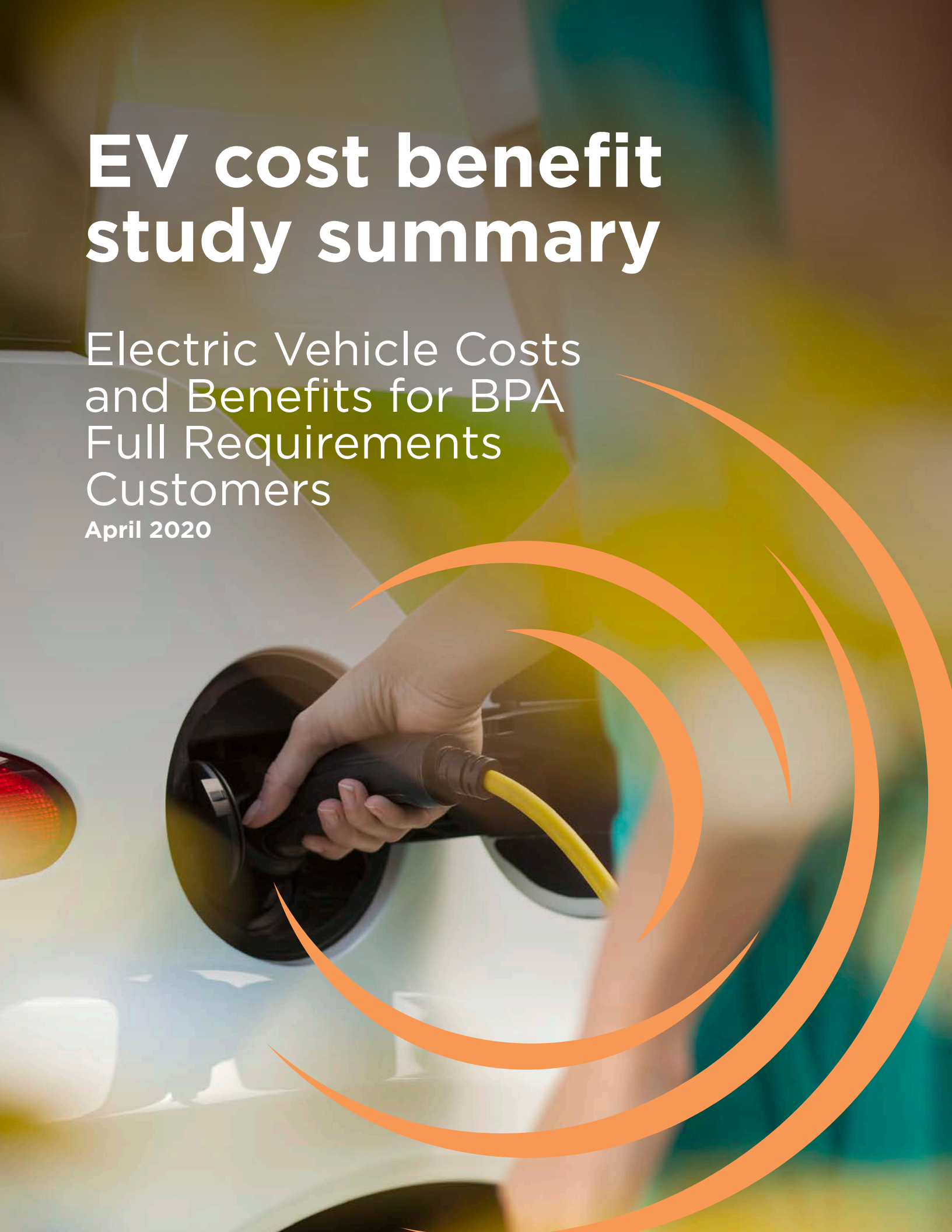
EV cost benefit study summary

Electric Vehicle Costs and Benefits for BPA Full Requirements Customers

April 2020



acknowledgements

This summary report was funded by the **Bonneville Environmental Foundation (BEF)** to showcase the findings of their commissioned cost-benefit analysis of EV adoption in the Pacific Northwest. The calculations and findings of this report were completed by the energy consulting firm, **Energy and Environmental Economics, Inc.** Major contributors to this analysis include Megan Stratman, Blake Weathers, and Betsy Bridge with the **Northwest Requirements Utilities;** Judith Estep, Justin Reel, and Brent Barclay with the **Bonneville Power Administration;** Kelly Yearick, Thor Hinkley, Connor Herman, and Jon Jantz with **Forth Mobility.**

executive summary

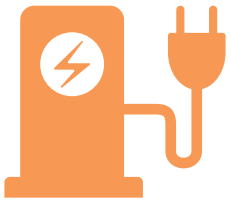
Electric vehicles (EVs) are expected to continue their proliferation across all markets. With up to a 115% to 130% increase in electricity consumption among households with EVs, this represents a significant opportunity for electricity load demand increases in a market which has stagnated over the past several decades.[1]

To best prepare the region's Consumer-Owned Utilities (COUs) for this sea change, the Bonneville Environmental Foundation commissioned Energy and Environmental Economics, Inc. (E3), to conduct a cost-benefit analysis of EVs for load-following utilities in the Pacific Northwest (PNW). This report serves as a summary of that study's findings.

Managed charging is shown to be a significant benefits multiplier. As such, the companion planning guide to this this report, *PNW Consumer-Owned Electric Utility Strategies for the Rise of Transportation Electrification,* provides recommendations for ways in which COUs can begin developing and implementing their own managed charging program.

Further, the companion planning guide provides additional details on the current state of the electric vehicle ecosystem and its relevancy to COUs of the Pacific Northwest, and the benefits these technologies have for their customers, including those that are economic, social and environmental.

Using four PNW COUs as proxies, the study concluded:



In an **unmanaged charging** scenario, on average through 2030 Electric cars adopted are expected to create

$300 to $800

in net ratepayer benefits per vehicle.

In a **managed charging** scenario, on average through 2030 Electric cars adopted are expected to create

$830 to $1,000

in net ratepayer benefits per vehicle.

EVs adopted through 2030 are estimated to add

$4,100

per vehicle to the regional economy.

1 *This upper bound for load growth/ household energy use was calculated by Jon Jantz with data and assumptions from University of Michigan study, Reference # 5 A household with one battery electric pickup truck and one battery electric SUV which are each driven 15,000mi/year consuming on average 500Watt hours/mile of electricity equates to 71kWh/day. This is a 136% increase over the typical household usage of 30kWh/ day.*

introduction

Electrification has been identified as a major focus for expanding clean energy and facilitating decarbonization. The transportation sector has the potential to shift a massive amount of energy use from liquid fuels to electricity. As detailed within E3's *Pacific Northwest Pathways to 2050* report, it's expected that battery electric and hybrid vehicles will make up most of the transportation market within the largest PNW utilities by 2030.[2] Knowing how electrification might influence the larger utilities, BEF set their sights on determining the potential impact on the smaller utilities not discussed in the previous E3 study.

In order to analyze the costs and benefits of transportation electrification for smaller full requirement BPA utilities, BEF partnered with E3, Forth, Northwest Requirements Utilities (NRU), and the Bonneville Power Administration (BPA). This guide summarizes the primary results found within E3's *Benefit-cost analysis of EVs for load following utilities in PNW* study.

For this study, E3 used four proxy utilities close in total retail load size with varied peaking seasons, including summer, winter and dual peaking, above and below high-water mark loads (RHWM). These utilities are characterized with the following nomenclature through this guide and the study:

- Dual, Below RHWN
- Dual, Above RHWM
- Summer, Above RHWM
- Winter, Below RHWM

The economic benefits EVs provide for ratepayers, utilities, and the Pacific Northwest region were found to outweigh the costs in each scenario. While EVs provide a net-benefit in an unmanaged charging case, the advantages of EVs climb dramatically when managed charging is employed.

2 *November 2018. Energy & Environmental Economics, Inc. Pacific Northwest Pathways to 2050. https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf*

economic benefits: ratepayer perspective

The table below summarizes the economic benefits for ratepayers as predicted by E3's analysis.

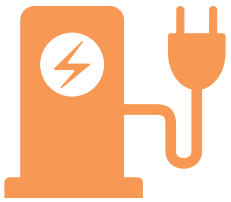
E3's study compares the grid costs of serving EV drivers (energy, generation capacity, distribution system upgrades, ancillary services) with the bill revenue they contribute to the utility and considers the impact on all utility customers.

In an **unmanaged charging** scenario, on average through 2030:

- Electric cars adopted are expected to create **$300** to **$800** in net ratepayer benefits per vehicle and correspondingly.

While the economic benefits to customers from the growth of EVs appear to be clear, benefits are increased when managed charging is implemented. For three of the four PNW proxy utilities, the EV economic benefits nearly doubled when implementing managed charging simply by shifting charging from Heavy Load Hours (HLH -6am to 10pm) to Light Load Hours (LLH -10pm to 6am).[3]

The study only used the simple metric of moving charging from HLH to LLH and didn't look at more comprehensive managed charging systems where charging can be more intensively controlled by the utility or a third-party aggregator.



In a **managed charging** scenario, on average through 2030 Electric cars adopted are expected to create

$830 to $1,000

in net ratepayer benefits per vehicle.

3 *BPA website. https://www.bpa.gov/news/pubs/Pages/Definitions---L.aspx*

Managed Charging Goals:

1. Reduce EV charging during expensive Heavy Load Hours, while maintaining enough vehicle battery state of charge to complete all vehicle trips, and
2. Prepare for a future when EV charging can be provided in ways that serve driver needs and also can provide grid services and other benefits to the serving utility.

Figure 1: Ratepayer Costs and Benefits by Utility Type (per vehicle) with EV Adoption

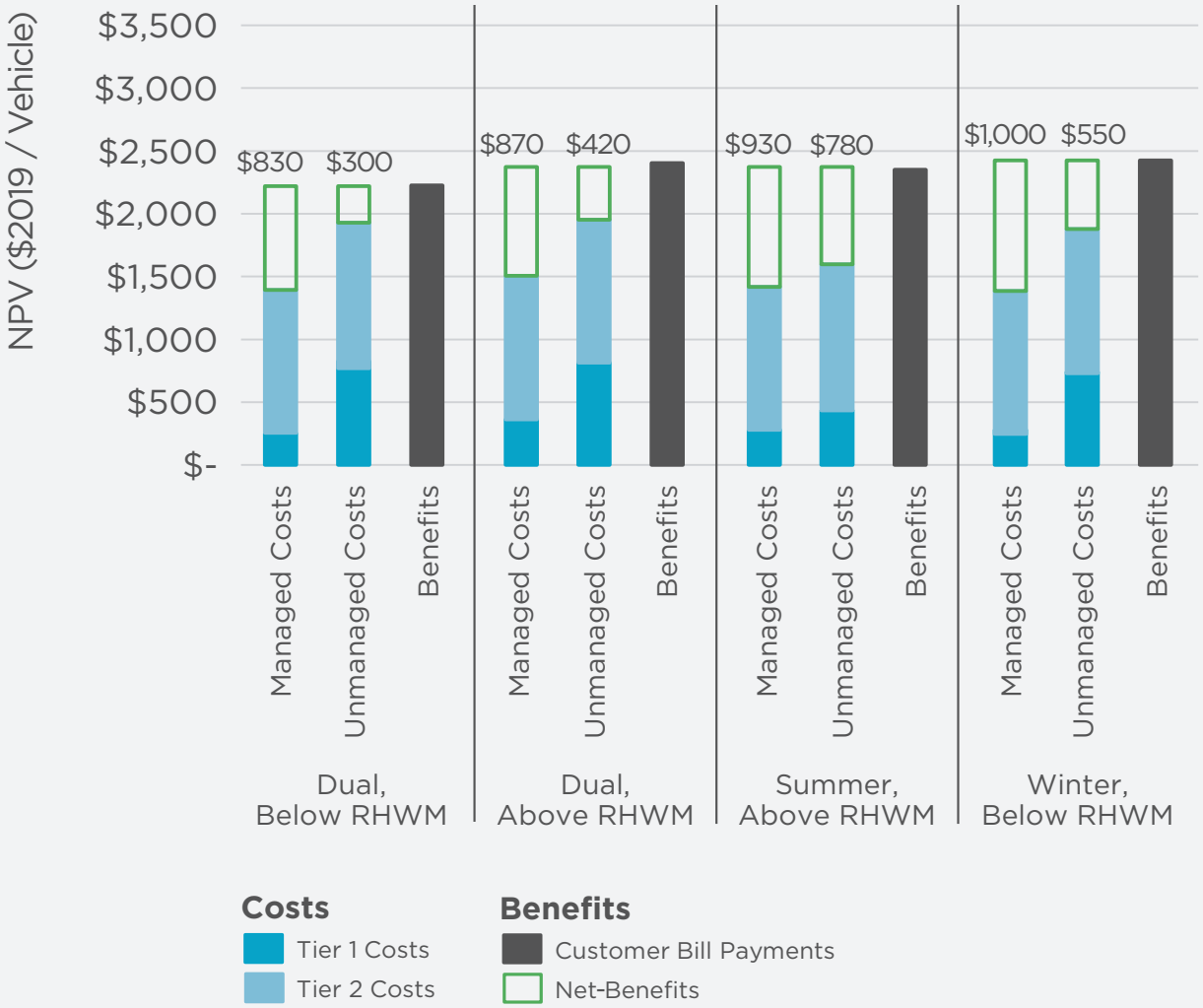
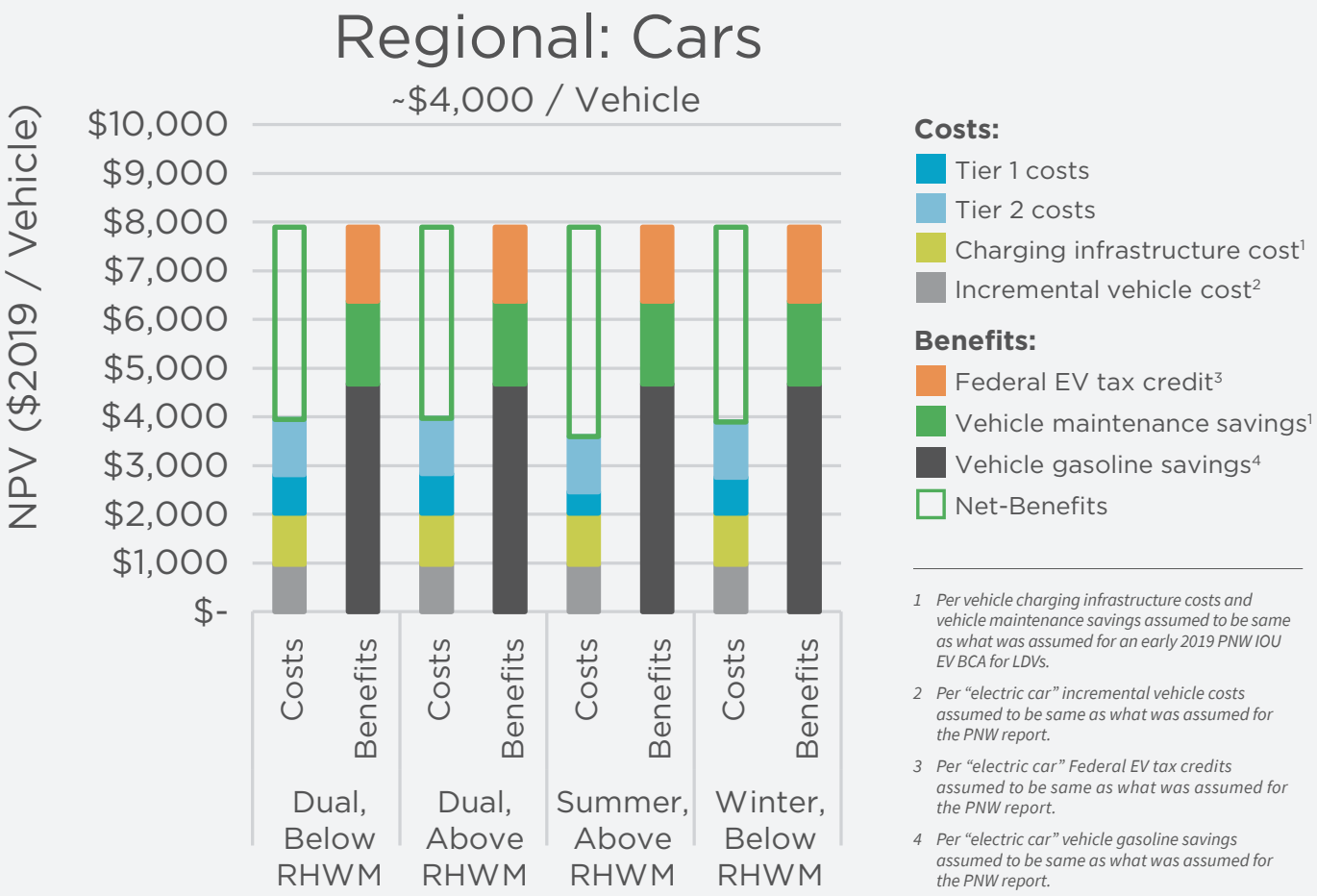


Table 1: Ratepayer Costs and Benefits by Utility Type (per vehicle) of Electric Car Adoption In Unmanaged and Managed Charging scenarios.

Utility Proxy	2030 EV Adoption		Ratepayer Net-Benefits (NPV/vehicle)				Regional* Net-Benefits (NPV/vehicle)	
			Unmanaged		Managed Charging			
	Car	Truck	Car	Truck	Car	Truck	Car	Truck
Dual, Below RHWM	600	140	$300	$530	$830	$1,100	$3,900	$4,200
Dual, Above RHWM	570	130	$420	$410	$870	$920	$3,900	$4,000
Summer, Above RHWM	330	80	$780	$900	$930	$1,050	$4,300	$4,600
Winter, Below RHWM	730	170	$550	$780	$1,000	$1,300	$4,000	$4,200

*Regional net-benefits are generalized from a 2019 benefit-cost analysis of EVs in the Pacific Northwest.

Figure 2: Regional Costs and Benefits by Utility Type (per vehicle) with EV Adoption



1 *Per vehicle charging infrastructure costs and vehicle maintenance savings assumed to be same as what was assumed for an early 2019 PNW IOU EV BCA for LDVs.*

2 *Per "electric car" incremental vehicle costs assumed to be same as what was assumed for the PNW report.*

3 *Per "electric car" Federal EV tax credits assumed to be same as what was assumed for the PNW report.*

4 *Per "electric car" vehicle gasoline savings assumed to be same as what was assumed for the PNW report.*

economic benefits: regional perspective

E3 calculated regional net-benefits by subtracting EV costs (incremental vehicle cost, charging infrastructure cost, and tier 1 and 2 electricity costs) from benefits (vehicle gasoline savings, federal EV tax credit, and vehicle maintenance savings).

E3 found that EVs are a form of economic stimulus to the region since drivers purchase locally-produced clean electric fuel.

- On average, EVs adopted through 2030 are estimated to add **$4,100** per vehicle to the local economy.

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clean fuels program amplifies the benefits in oregon

The Oregon Clean Fuels Program, implemented through the Oregon Department of Environmental Quality (DEQ), requires a 10 percent reduction in average carbon intensity of transportation fuels over the 10-year period between 2015 and 2025.

On March 10, 2020 Governor Brown issued an executive order that directed multiple state agencies to take action to further reduce greenhouse gas emissions. As part of this effort, the Governor directed DEQ and EQC to expand the Clean Fuels Program to increase the availability of low-carbon transportation fuels for Oregonians. The executive order directs the program to reduce emissions by 20% by 2030 and 25% by 2035, the most aggressive goal in the country.

Under the program, credit generators are providers of fuels whose carbon intensity is lower than the standard for the gasoline or diesel they substitute. They are not required to participate but can choose to voluntarily participate by registering with the program if they want to generate credits. An electric utility may register in the Clean Fuels Program and begin generating credits for EV chargers they own and for the number of registered EVs in their utility service area.[4]

E3 also considered the additional benefits for Oregon utilities based on the number of Clean Fuels Program credits generated for residential EV charging from increased EV adoption.

- On average, electric cars and trucks adopted are expected to create **$3,500** to **$4,600** in net Clean Fuels revenue benefits per vehicle

On average, electric cars and trucks adopted through 2025 are expected to create

$3,500 to $4,600

in net Clean Fuels revenue benefits per vehicle.

4 *Oregon DEQ website. http://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels.aspx*

conclusion

The E3 study commissioned by BEF found an overall net-benefit for load-following utilities of Bonneville Power Administration from a ratepayer, utility, and regional perspective. Further, these benefits hold for an unmanaged charging scenario but are amplified if EV charging is managed. Utilities can take actions that can impact transportation electrification and should begin to plan their efforts soon.

The E3 Study has extensive data and sensitivity analyses of various issues that are of importance to utility planners. **Benefit-Cost Analysis Study** contains much of the study information that will benefit utility EV planning and charging infrastructure work. More technical details and study assumptions will be made available upon request from BEF.

Finally, please refer to the companion document, ***PNW Consumer Owned Electric Utility Strategies for the Rise of Transportation Electrification*** for background information on the electric vehicle market and strategies for implementing transportation electrification programs.

renewables
program

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