Policy Brief on Designing and Evaluating Electric-Bicycle Incentive Programs

for the

Active Transportation Division
Washington State Department of Transportation

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Executive Summary

During the 2023 legislative session, the Washington state legislature allocated $5 million to the Washington State Department of Transportation (WSDOT) from the state's sale of carbon emission permits to fund a pilot program for e-bike rebates. The budget proviso required a policy brief from the University of Washington to inform decisions about structuring the rebates.

Policy Goals for E-bike Rebate Program

The policy objectives for the e-bike rebate program are established in law and state transportation plans. Washington's Climate Commitment Act of 2021 (CCA) created the cap-and-invest program requiring large carbon emitters to purchase allowances from the state at auction and directs some of the auction proceeds to programs that will reduce carbon emissions in transportation. A budget proviso in 2023 directed $5 million of CCA funding to establish the e-bike rebate program and set key program design features. WSDOT adopted an Active Transportation Plan in 2021 and a Strategic Highway Safety Plan in 2019 (refer to the full report for footnotes to all relevant documents). Together, these foundational documents set the policy framework for the e-bike rebate program. Key policy goals include:

- Reduce transportation carbon emissions cost-effectively
- Reduce non-carbon pollutants associated with automobiles
- Direct 60% of e-bike rebate funds to lower income households and 40% of funds and benefits to overburdened communities as defined in the CCA
- Improve access, mobility, and public health through adoption of e-bikes
- Reduce deaths and serious injuries on roadways

Some of the people who take advantage of e-bike rebates would have bought an e-bike even without a rebate. These "baseline buyers" enjoy a lower price for their e-bike purchase but the emissions reductions and other public benefits from their e-bike use do not count as effects of the rebate program since those benefits would have occurred even without the rebate. Baseline buyers may constitute well over half of the rebate purchases depending on the rebate amount and e-bike prices. It is the behavior of the "induced buyers" – those buyers who would not have purchased an e-bike but for the rebate – that drives the carbon reductions and other benefits for purposes of CCA reporting. The relative shares of baseline and induced buyers will vary with the program design and target market.

Options on Program Delivery

WSDOT can choose among three models for implementing the e-bike rebate program that differ in the share of the rebate program activities performed by state employees. California has chosen to contract for nearly all of the program services, Colorado has contracted out some but not all program functions, and many cities have adopted a public employee model where city staff perform almost all program services.

Many factors influence an enterprise's decision to contract or self-perform a set of activities. For WSDOT, the relevant criteria include assessment of the agency's core competencies, cost, quality, and time-to-market as well as the agency's standard practices for this type of activity. One core competency of particular importance for a program that will be gathering personal

financial information to qualify low-income households for rebates is experience and competence with the systems and security for data management of confidential information.

Any of the three implementation approaches used by other jurisdictions could work for WSDOT. However, contractor's ability to shorten the time-to-market and manage confidential personal information criteria favor adopting the California model. If time-to-market is especially important to stakeholders in Washington, then WSDOT will want to take practical steps to shorten the procurement and contract negotiation process with a potential contractor.

Options on Program Design

The UW team reviewed other e-bike rebate programs and developed recommendations on program design for consideration by WSDOT program staff that are relevant whether the program is delivered by public employees or contractors.

Table ES-1 Program Design Recommendations

Design Element	Recommendation
Incentive Amount	Consider offering rebates below the statutory maximum to lower the program cost per induced e-bike sale and allow greater flexibility.
Outreach to Overburdened Communities	Select a small set of bike shops in identified overburdened communities and leverage the use of social media.
Allocation in Oversubscribed Programs	Adopt Colorado's model and randomly select applicants to receive rebates from within the pool of people who submitted online applications.
Income Eligibility	Use area-based income measures developed by HUD; work with a third party to verify income and Washington residency.
E-Bike Eligibility	Exclude mountain e-bikes (required under the funding proviso); require UL listing; allow rebates for e-bikes from all three classes.
Purchase Availability	Require a physical store in Washington state per funding proviso; encourage participation by local retailers in overburdened communities.
Data Collection for Program Assessment	Survey sample of e-bike rebate recipients and applicants who did not get rebates. Add GPS and trip logging as the project research budget allows.
Program Start Up Approach	Use a phased start-up approach; begin in a few communities, then expand to the rest of the state

Introduction and Background

Electric bicycles (e-bikes) have become increasingly popular in North America. In 2021, e-bike sales outpaced electric car sales.[1] According to the National Bicycle Dealers Association, e-bike sales in the US surpassed $1.3 billion in 2022, marking a 33% increase from the previous year.[2] Trade publications project that e-bike sales in the United States will continue to grow and reach $1.6 billion in 2023.[3]

Compared to traditional bicycles, e-bikes allow users to ride farther and faster, and more easily climb hills and carry loads.[4] Compared to cars, e-bikes offer users a lower cost, motorized option for some trips, increasing mobility for those unable to afford a car.

E-bikes generate public benefits in addition to their advantages for users. E-bike owners substitute using e-bikes for trips that they would otherwise make with a car, reducing greenhouse gas emissions and other pollutants generated by automobiles.[5] Substituting e-bike trips for auto trips also has the potential to reduce demand for the physical space that cars occupy on roadways and in parking areas. In addition to reducing the environmental costs associated with cars, e-bikes tend to increase their riders' physical activity, which can lower the economic costs associated with poor physical and mental health.[6]

These public benefits from e-bikes, together with goals for aiding low-income households and communities with high exposure to motor vehicle pollutants, have prompted public policymakers to fund incentives for e-bike purchases. As of 2023, over 160 e-bike incentive initiatives have emerged from state and local governments across the US and Canada, including Washington state.[7]

During the 2023 legislative session, the Washington state legislature allocated $5 million to the Washington State Department of Transportation (WSDOT) from the state's sale of carbon emission permits to fund a program for e-bike incentives.[8] The budget proviso specifies the following program design elements:

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[1] https://electrek.co/2022/01/26/electric-bicycles-are-now-outselling-electric-cars-and-plug-in-hybrids-combined-in-the-us/

[2] For comparison, U.S. car and truck sales in 2023 were $635 billion. National Automobile Dealers Association, "NADA Issues Analysis of 2022 Auto Sales and 2023 Sales Forecast | NADA."

[3] Wang, "E-Bike Market Report 2022 - 2023."

[4] MacArthur, J., C. R. Cherry, M. Harpool and D. Scheppke (2018). A North American survey of electric bicycle owners, National Institute for Transportation and Communities (NITC).

[5] Philips, Anable et al. 2022

[6] Riiser et al., "E-Cycling and Health Benefits."

[7] Bennett, C., J. MacArthur, C.R. Cherry, L.R. Jones (2022) "Using E-bike purchase incentive programs to expand the market." National Institute for Transportation and Communities (NITC). https://trec.pdx.edu/research/project/1507

[8]Section (16)(a)(i) https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bills/House%20Passed%20Legislature/1125-S.PL.pdf

- $2 million for rebates up to $300 to Washington residents 16 years of age and older
- $3 million for rebates up to $1,200 for residents 16 years of age and older who reside in households with income below 80% of the county median
- Buyers must be able to apply the rebate at the time of purchase
- Rebates for e-bikes (including e-trikes), bicycle helmets, safety vests, bicycle lights, bicycle locks, and any maintenance agreement sold at the time of the e-bike purchase
- WSDOT must establish application procedures to qualify e-bike retailers for participation
- Qualifying retailers must have one or more physical retail locations in Washington that provides on-site e-bike sales, service, and repair and must be registered with WSDOT to participate in the incentive program
- Applicants must provide contact information (including a physical address, email address, and phone number) and demographic information (including the applicant's age, gender, race, and ethnicity) at the time of applying for the rebate
- No more than one rebate may be awarded per household

The budget proviso also directed WSDOT "to contract with the University of Washington's sustainable transportation lab to publish a general policy brief that provides innovative e-bike rebate and lending library or ownership grant program models and recommendations, a report on survey results based on data and demographic information collected under the e-bike rebate program … and a report on program information and data collected under the e-bike lending library and ownership grant program …"

This policy brief meets the legislative requirement to provide a discussion of e-bike rebate program models and recommendations. It also provides a foundation for developing the report on survey results called for in the budget proviso by identifying the key policy objectives for the program. A discussion of e-bike lending libraries will be delivered in a later policy brief to match the availability of funding for that program.

This brief begins with a discussion of the potential policy goals and objective measures of program performance. The brief then turns to the program design decisions that WSDOT must make including the incentive amount, how to qualify buyers, retailers, and bicycle models, and how to promote the program. We then discuss options for contracting out some or all of the program management for the rebate program before summarizing our findings.

Policy Objectives for E-Bike Rebate Programs

Clarity about policy objectives will help inform program design decisions for e-bike rebates as well as measures of program effectiveness. Washington's Climate Commitment Act of 2021 (CCA) is a cap-and-invest program that requires entities covered by the law to obtain emissions allowances equal to the greenhouse gases they generate. These allowances are obtained through quarterly auctions or bought and sold on a secondary market. The revenue raised from the auction of emissions allowances is re-invested into projects and grants that help to achieve state climate change mitigation and resilience goals. The number of allowances being auctioned will be reduced every year to help ensure Washington achieves its 2030, 2040, and 2050

greenhouse gas limits set in state law. The Washington Department of Ecology in November 2023 published a report on the use of $76.15 million in CCA funds appropriated for fiscal year 2023 (July 1, 2022, through June 30, 2023).[9]

The net proceeds from the auction of emission allowances are directed to several state accounts, including a carbon emissions reduction account which includes legislative guidance on expenditures:

> Expenditures from the account are intended to affect reductions in transportation sector carbon emissions through a variety of carbon reducing investments. These can include, but are not limited to: Transportation alternatives to single occupancy passenger vehicles; … It is the legislature's intent that expenditures from the account used to reduce carbon emissions be made with the goal of achieving equity for communities that historically have been omitted or adversely impacted by past transportation policies and practices.[10]

The CCA doesn't define "equity for communities" but it does define "environmental justice" as:

> ... the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, rules, and policies. Environmental justice includes addressing disproportionate environmental and health impacts in all laws, rules, and policies with environmental impacts by prioritizing vulnerable populations and overburdened communities, the equitable distribution of resources and benefits, and eliminating harm…"Overburdened community" means a geographic area where vulnerable populations face combined, multiple environmental harms and health impacts or risks due to exposure to environmental pollutants or contaminants through multiple pathways, which may result in significant disparate adverse health outcomes or effects.[11]

The CCA states that "not less than 35 percent and a goal of 40 percent of total investments …(should) provide direct and meaningful benefits to vulnerable populations within the boundaries of overburdened communities."[12]

The CCA requires that the Department of Ecology prepare an annual report on use of funds and the amount and cost of greenhouse gas reductions:

> The report must identify, at a minimum, the recipient of the funding, the amount of the funding, the purpose of the funding, the actual end result or use of the funding, whether the project that received the funding produced any verifiable reduction in greenhouse gas emissions or other long-term impact to emissions, and if so, the quantity of reduced greenhouse gas emissions, the cost per carbon dioxide equivalent metric ton of reduced greenhouse gas emissions, and a comparison to other greenhouse gas emissions

[9] WA Department of Ecology, "REPORT TO THE LEGISLATURE Distribution of Funds from Climate Commitment Act Accounts Fiscal Year 2023."
[10] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.65.240
[11] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.02.010
[12] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.65.230

reduction projects in order to facilitate the development of cost-benefit ratios for greenhouse gas emissions reduction projects.

By requiring reporting on the cost per ton of reduced carbon and a comparison of relative costs among projects and the use of cost-benefit ratios, the CCA supports evaluation of the cost effectiveness of carbon reduction measures. By directing funds to measures with a lower cost per ton of greenhouse gas reduction, policymakers can reduce the economic cost of transitioning to an economy with zero carbon emissions.

Given these requirements, the primary policy objectives required by the legislation funding and creating the e-bike rebate program can be summarized as:

- Reduce transportation carbon emissions cost-effectively
- Reduce non-carbon pollutants associated with motor vehicles, especially as they affect local communities
- Direct 35-40% of funds and benefits to overburdened communities as defined in the CCA.
- Direct 60% of e-bike rebate funds to lower income households

In addition to CCA and the e-bike budget proviso, state planning documents developed by WSDOT also shape the policy goals for the e-bike program. Those planning documents include the 2021 Active Transportation Plan and the 2019 Strategic Highway Safety Plan[13]. From these documents, we identified other relevant state policy objectives that could guide decisions about the design of the rebate program:

- Improve access, mobility, and public health through adoption of active transportation modes, including e-bikes
- Reduce deaths and serious injuries on roadways
- Reduce vehicle miles traveled

For each of these potential policy objectives, we next review the available evidence on the potential impact of e-bike rebates and potential quantitative measures that program managers might use to evaluate them. We focus particularly on measures that could be derived from the planned survey of people who apply for e-bike rebates but also include other potential measures that are beyond the scope of the survey required by the e-bike rebate budget proviso.

Reduce Carbon Emissions Cost-Effectively

The mechanism by which e-bike rebates reduce carbon emissions involves a chain of decisions by individuals about vehicle purchases and trip-making:

1. The rebate induces people who would otherwise not purchase an e-bike to buy one.
2. Some of these rebate-induced e-bike purchases are used for trips that would otherwise be made with automobiles.

[13] Washington State Department of Transportation, “Washington State Active Transportation Plan 2020 and Beyond”; Washington State Department of Transportation, “Washington State Strategic Highway Safety Plan 2019.”

3. The displacement of auto trips reduces the carbon emissions and other pollution associated with the miles that the automobiles would have traveled.

Some of the people who take advantage of e-bike rebates would have bought an e-bike even without the incentive. These "baseline buyers" benefit from paying a lower price for their e-bike but the emissions reductions from their e-bike use does not count as an effect of the rebate program, since the reductions would have occurred even without the rebate. Baseline buyers may constitute well over half of the rebate purchases depending on the rebate amount and e-bike prices[14]. It is the behavior of the "induced buyers" – those buyers who would not have purchased an e-bike but for the rebate – that produces the carbon reductions that count toward the program's impacts. The relative shares of baseline and induced buyers will vary with the program design and target market.

Likewise, not all of the trips made by rebate-induced e-bike buyers may count towards CCA reported emissions reductions. Some of the trips those users make would have been made on foot, on a conventional bicycle, or by public transit. Some of the trips are new, occurring only because the owner has newfound access to an e-bike. However, it is only trips by induced buyers that displace automobile trips that are counted in the CCA reported reduction of carbon emissions.

A survey of users of the City of Denver's e-bike rebate program found that they replaced 3.4 round-trip automobile trips per week and the average trip length was 3.3 miles.[15] The city's report estimates that the e-bike rebate program reduced 2,040 metric tons of carbon dioxide per year. However, it is not clear from the report if this estimate is based on trip making of only the induced buyers or induced plus baseline e-bike purchasers.

It is important to note that motor fuels are among the GHG emissions sources subject to a firm limit in Washington under the CCA's emission allowance limits. If total emissions are capped, any reductions in emissions due to avoided driving will free up emissions allowances to be used by others. If the statewide cap on GHG emissions is binding on fuel sales, then the net reduction in carbon emissions from any marginal change that reduces driving is zero. Nevertheless, policymakers want to know the cost per ton of different carbon reduction measures so they can direct auction proceeds to those that are more cost-effective and thereby accelerate the transition to a clean energy economy. From a program evaluation perspective, it is reasonable to evaluate individual measures as if there was not an emissions cap to develop plausible estimates of the cost per metric ton of carbon reduction.

[14] Analysts recently estimated that the $7,500 federal electric vehicle subsidy induced between 15% and 31% of Tesla buyers meaning over 69% of the purchasers were baseline buyers who would have purchased a Tesla without the incentive. See Rapson and Muehlegger, "The Economics of Electric Vehicles."

[15] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."

The CCA does not establish cost-effectiveness targets for the measures funded from the carbon emissions reduction account but it does require agencies to track and report the cost per metric ton of carbon reduction. Economists and policymakers have expended considerable effort to estimate the social cost of carbon to serve as a guide to identify cost-effective carbon reduction and sequestration measures. Recently, the Biden Administration increased their estimate of the social cost of carbon from $51 to $190 a ton.[16] In Washington state, the carbon emission permits sold at auction in August 2023 were priced at $66.68 per ton[17], a cost of carbon well below the new national standard. From a state policy perspective, any measure that reduces carbon at a cost below $67 per ton could be viewed as cost-effective. From a national perspective in the view of the current administration, any measure that reduces carbon at a cost below $190 is viewed as cost-effective. Selecting carbon reduction measures with lower prices per ton of carbon will accelerate the decarbonization of Washington's economy compared to funding high-cost measures.

Evidence from e-bike rebate programs and research studies indicate that the cost of carbon reduction from e-bike rebates is considerably more than $190 per metric ton. The City of Denver's report on their e-bike rebate estimated that the program saved 0.94 pounds of CO_2 per dollar spent or a cost of $2,341 per metric ton. The actual cost of carbon reduction may be higher if their calculations failed to differentiate between induced and total e-bike sales.[18]

Separately, researchers at Portland State University estimated that a single e-bike could save 225 kg of CO_2 per year in the Portland metro area.[19] If an e-bike lasts for 7.5 years, that would result in 1.7 metric tons of reduced carbon over the life of an e-bike. If we make the optimistic assumption that 90% of program funds go to rebates and 100% of the sales with rebates are induced, then the cost per metric ton of reduced carbon is $706 per MT for e-bikes purchased with a $1,200 rebate. Refer to Appendix A for calculations and sensitivity analysis for the potential cost of carbon from e-bike rebates over a range of plausible assumptions.

Even if e-bike rebates are not cost-effective solely as a carbon reduction measure, consideration of the other benefits associated with induced e-bike sales may justify ongoing policy support. Rather than focus exclusively on the cost of reducing carbon emissions, policymakers may choose to measure the program cost per induced e-bike purchase and compare that cost to the value of all the associated benefits, including carbon reductions, of an induced e-bike sale.

One key factor in the rebate program's overall cost-effectiveness is the ratio of total rebates paid to the total program costs. The budget proviso for Washington's e-bike rebate program limits WSDOT's administrative costs for the program to 5% of the program total. WSDOT will need to determine what costs count as administration as distinct from program operations. Operations

[16] https://www.nytimes.com/2023/12/02/climate/biden-social-cost-carbon-climate-change.html
[17] https://apps.ecology.wa.gov/publications/documents/2302072.pdf
[18] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[19] McQueen, MacArthur, and Cherry, "The E-Bike Potential."

include a wide range of activities including program design and evaluation; validating eligibility of retailers, buyers, and e-bike models; and marketing, advertising, communications, and community outreach. California has contracted for all of these functions with a non-profit agency at a cost of 25% of the total program budget in the early years, falling to 10% after the program is established.[20] Connecticut and Vermont have outsourced a smaller set of their e-bike rebate functions to contractors and expect those costs to run at about 6% of the total program costs.[21] Regardless of whether the program functions are performed by contractors or state employees, the level of non-rebate costs as a percentage of the total program costs will fall over time as the initial start-up costs are spread over a larger total of rebates to consumers.

Another key factor in the program's cost-effectiveness is the amount of the incentive. Washington's budget proviso establishes rebates up to $1,200 per bike for low-income households and $300 per bike for all other households. This program design implicitly acknowledges that it costs more per e-bike to induce lower income households to make a purchase than it does for moderate- and upper-income households. A rebate program focused exclusively on cost-effectiveness as measured by induced e-bike sales per total program costs might not include higher rebates for low-income households.

One way to interpret the legislative requirements to send funds to overburdened communities and to people in households at or below 80% of median income, along with the absence of any targets for the cost of carbon reduction, is that the distributional impacts of the funding from the carbon emissions reduction account are at least as important cost-effectiveness. Nonetheless, measures of cost-effectiveness will be of keen interest to policymakers and the public.

Potential Measures:

- Dollar amount of rebates distributed as percentage of total program costs
- Total program costs per induced e-bike purchased
- Estimated number and average mileage of auto trips replaced with e-bike trips per week among rebate-induced e-bike owners
- Annual reduction of carbon emissions from avoided car trips by induced e-bike purchasers, measured in metric tons in the absence of a state carbon cap
- Estimated carbon emission reductions in metric tons/total program costs

Reduce Non-Carbon Pollutants

In addition to reducing greenhouse gasses, e-bikes that replace automobile travel also reduce non-carbon pollutants emitted from tail pipes. These include ozone, particulate matter, carbon monoxide, lead, sulfur dioxide, and oxides of nitrogen known as criteria pollutants because of standards set by the federal Environmental Protection Agency.[22] Automobiles also emit non-criteria pollutants including volatile organic compounds, hydrocarbons, benzene and other

[20] Conversation with Shaun Ransom of the California Air Resources Board on November 28, 2023.
[21] *Find citations from those states. I heard this from Shaun. Daniel*
[22] https://www.epa.gov/criteria-air-pollutants

pollutants.[23] In addition, cars and trucks generate microparticles from tires and brake linings that create air and water pollution.[24] The Washington Department of Ecology used measured levels of criteria pollutants to determine the location of overburdened communities under the CCA, reinforcing the ties between greenhouse gas reductions and efforts to reduce harms from other pollutants associated with motor vehicles.

Several studies of global efforts to reduce greenhouse gas emissions have shown that the simultaneous reductions in non-carbon pollutants generate greater decreases in mortality and morbidity than those associated solely with reducing greenhouse gases.[25] The EPA has developed a methodology for states and local governments to use to evaluate the emissions reductions from policies that reduce vehicle miles traveled using the Motor Vehicle Emission Simulator (MOVES) software.[26] This tool could be applied to analyze the impacts of e-bike rebates on criteria pollutants in Washington.

Potential Measures:

- Total reductions in criteria pollutants from induced e-bikes
- Reduction in criteria pollutants per induced e-bike sold
- Reductions in mortality and morbidity from reduced criteria pollutants

Direct Benefits to Overburdened Communities & Low-Income Households

The CCA sets a goal of delivering 40% of the "investments that provide direct and meaningful benefits to vulnerable populations within the boundaries of overburdened communities," with a requirement that 35% of investments provide such benefits. "Overburdened community" definitions in statute direct WSDOT to utilize the Environmental Health Disparities map developed by the Department of Health.[27] As described in RCW.405.140, this is "a cumulative impact analysis to designate the communities highly impacted by fossil fuel pollution and climate change in Washington", and "may integrate with and build upon other concurrent cross-agency efforts in developing a cumulative impact analysis". As an example of a use of this information, Washington's Department of Ecology has identified 16 places as overburdened based on their exposure to criteria air pollutants as shown below in Figure 1. In addition to requirements under the CCA another state environmental justice law, the Healthy Environment for All (HEAL) Act, applies to WSDOT's work. Under legislative direction from the HEAL Act,[28] WSDOT is collaborating with Ecology, the Department of Health, and other agencies to work with the affected constituencies in all communities recognized as overburdened. As definitions evolve, program criteria will need to be updated to comply with requirements.

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[23] https://afdc.energy.gov/vehicles/emissions_pollutants.html
[24] Lopez et al., "Metal Contents and Size Distributions of Brake and Tire Wear Particles Dispersed in the Near-Road Environment."
[25] West et al., "Co-Benefits of Mitigating Global Greenhouse Gas Emissions for Future Air Quality and Human Health"; Silva et al., "Future Global Mortality from Changes in Air Pollution Attributable to Climate Change."
[26] https://www.epa.gov/moves
[27] https://fortress.wa.gov/doh/wtnibl/WTNIBL/.
[28] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.02&full=true#70A.02.100

Reducing carbon emissions affects the global stock of greenhouse gases in the atmosphere and potentially benefits people across the planet while reducing criteria air pollutants generate local and regional air quality benefits. Reducing mobile source pollutants in areas with high levels of human exposure to criteria pollutants will generate more public health benefits than in areas with low exposure.

The legislation creating the e-bike incentive program added a requirement to target low-income households in addition to the geographic targets established by the CCA for use of funds from the carbon emissions reduction account. The legislative design of the e-bike rebate program targets 60% of the funding to incentives of up to $1,200 for buyers from households with incomes at or below 80% of county household median income. The other 40% of the funds go to rebates of up to $300 for households above 80% of county median household income. Given this legislative direction, the e-bike rebate program should set a goal that a minimum of 35% and up to 40% of the rebates flow to households in the designated overburdened communities and ensure that 60% of the rebates flow to households at or below 80% of county household median income.

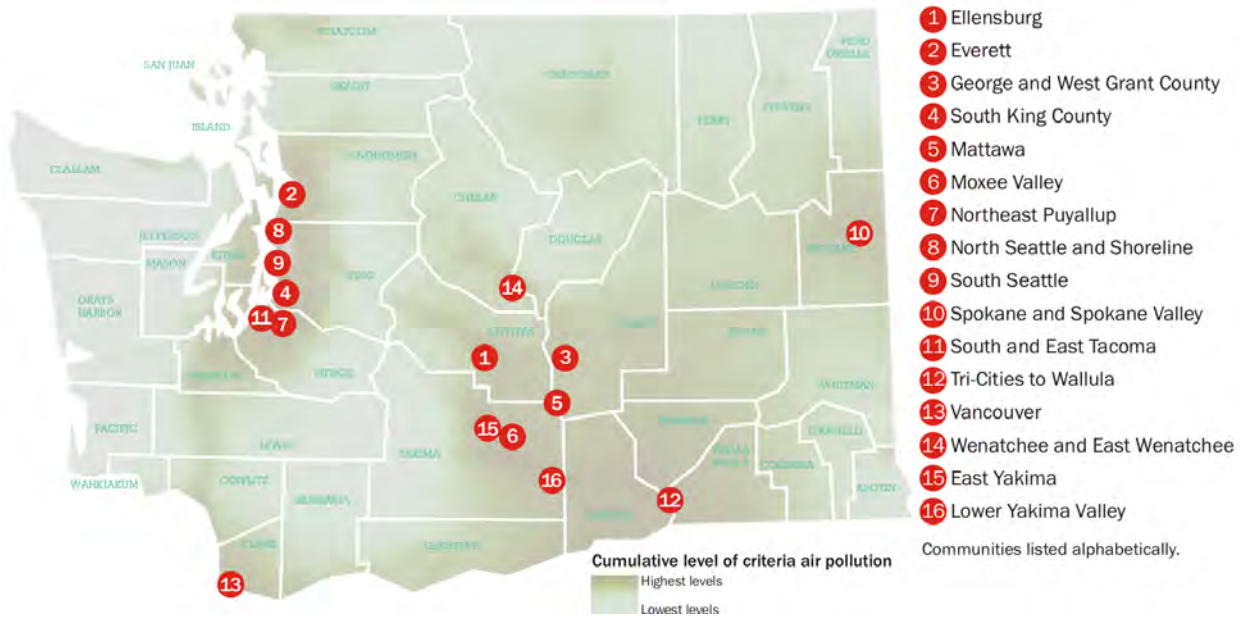

Figure 1. Washington communities identified as overburdened by WA Department of Ecology[29]

Potential Measures:

- Reduction in criteria pollutant emissions created by e-bike use within overburdened communities
- Dollar value of rebates to households in overburdened communities/total dollar value of rebates

[29] For more information see https://ecology.wa.gov/air-climate/climate-commitment-act/overburdened-communities

- E-bike unit sales with rebates to households in overburdened communities/total e-bike unit sales with rebates
- Dollar value of rebates to households at or below 80% of county median income/total dollar value of rebates
- E-bike unit sales with rebates to households at or below 80% of county median income/total e-bike unit sales with rebates

Improve Access, Mobility, and Health

E-bike rebates benefit e-bike users and others in the form of cost savings and improvements in access, mobility, and health.

For the baseline buyers who would have purchased an e-bike without the incentive, the rebates lower their cost of transportation, which is a benefit to them. Baseline buyers are made better off by the amount of the rebate. We categorize this as an improvement to access and mobility because the e-bike rebates lower the costs of mobility for these users.

Induced buyers benefit from all the trips they make on e-bikes, since they would not have made these trips but for the rebate program. This includes trips that would have been made in cars, trips that replace walking and transit, as well as trips that would not have been made at all without an e-bike. E-bikes effectively lower the cost of trip making by reducing the time and effort, and increasing the enjoyment compared to the alternatives. Providing this new access and mobility is a benefit from the rebate program to the induced buyers of e-bikes.

The induced e-bike trips that displace auto travel may also create benefits for auto users by reducing road congestion and demand for parking. In principle, a meaningful reduction in congestion might induce new auto trips which would offset some of the modeled reductions in emissions from e-bikes. Travel demand and road network simulations models that include active transportation modes can reveal some of these offsetting effects.

In addition to having improved mobility options, users of e-bikes experience improvements in cardiovascular health, increased muscle strength, improved balance and enhanced mental health.[30] Riders who switch from conventional bikes to e-bikes extend their trip lengths and so don't experience significant decreases in their total amount of exercise in spite of power assist from the e-bike motor.[31] Studies that examine the health effects of exposure to air pollutants while biking concluded that the health benefits of exercise in almost all cases outweigh the risks of breathing polluted air.[32] Moreover, auto travelers also are exposed to air pollution in car

[30] Bourne et al., "Health Benefits of Electrically-Assisted Cycling." and Castro et al., "Physical Activity of Electric Bicycle Users Compared to Conventional Bicycle Users and Non-Cyclists."
[31] Castro et al., "Physical Activity of Electric Bicycle Users Compared to Conventional Bicycle Users and Non-Cyclists."
[32] Tainio et al., "Can Air Pollution Negate the Health Benefits of Cycling and Walking?"

interiors, especially at congested intersections.[33] Cycling routes can potentially reduce the exposure to air pollution that would occur if the trip were made by car.

Benefit-cost analysis provides a framework for measuring the user benefits from all these different forms of improved mobility and health. The basic economic frameworks developed for evaluating transit benefits[34] and road user benefits[35] can also apply to active transportation modes.[36] Estimating these benefits would require information on the number and length of trips made, and the value of travel time on e-bikes compared to other modes in order to estimate the changes in the user benefits associated with the trips made on e-bikes purchased with rebates.

Potential Measures:

- Number, length, and purpose of trips on baseline and induced e-bikes with rebates
- Changes in measures of user benefits from trip-making on e-bikes using benefit-cost analysis
- Average increase in hours of physical activity among induced e-bike riders
- Dollar value of estimated reductions in mortality and morbidity from increased physical activity
- Dollar value of reductions in mortality and morbidity from reduced criteria pollutants
- Total program benefits measured in dollars/total program costs (benefit/cost ratio)

Improve Safety on Roadways

WSDOT's Active Transportation Plan[37] incorporates the state's Target Zero goal for eliminating deaths and serious injury by 2030, and is grounded in the Safe System Approach Strategies for achieving the goal include redesigning roadways, bike lanes, and sidewalks to reduce vehicle speeds, improve signage and warnings, and increase physical separation between cars and cyclists. Making these changes will require a long-term commitment to investing in active transportation infrastructure. To the extent that e-bike rebates increase e-bike adoption and use, the program will also build a constituency for continued public investments that will reduce the number and severity of crashes.

A 2013 study on cycling, health, and safety[38] by the Organization for Economic Cooperation and Development found that increasing the number of cyclists on roads decreases the rate of crashes per mile cycled. While the raw number of cycling fatalities increases with the number of cyclists on the road, the chance that any one of those cyclists is killed tends to fall. This

[33] https://news.ucr.edu/articles/2020/01/13/clearing-air-inside-your-car
[34] ECONorthwest and Parsons Brinkerhoff, "Estimating the Benefits and Costs of Public Transit Projects: A Guidebook for Practitioners | Blurbs New | Blurbs | Publications."
[35] FHWA, "Transportation Systems Management and Operations Benefit-Cost Analysis Compendium: Fundamentals of Benefit-Cost Analysis - FHWA Office of Operations."
[36] *Guidelines for Analysis of Investments in Bicycle Facilities*.
[37] Washington State Department of Transportation, "Washington State Active Transportation Plan 2020 and Beyond."
[38] OECD, "Cycling, Health and Safety."

negative correlation between the crash rate and the number of cyclists on the road is called the safety in numbers effect.

The report identifies several mechanisms that contributed to safety in numbers:

- Awareness: The more cyclists there are on the road, the more drivers expect to see cyclists and avoid them.
- Collective vigilance: The more cyclists there are on the road, the more likely that some will notice potential threats and communicate this information to the other cyclists who then have a greater chance to avoid the threat.
- Knowledgeable leaders: The more cyclists there are on the road, the greater the chance that at least one of them will be knowledgeable about route and traffic conditions. The knowledgeable cyclist may lead the others along safer routes.

The rapid adoption of e-bikes corresponds with an increase in crashes on e-bikes. The US Consumer Product Safety Commission (CPSC) reports that e-bike fatalities increased from 18 in 2020, to 32 in 2021, and to 42 in 2022,[39] although we don't have a good understanding of the crash rate of e-bike riders versus riders of regular bicycles. Automotive crashes also increased over the same period with on-road fatalities increasing from 38,824 in 2020 to 42,795 in 2022[40]. By contrast, U.S. air carriers had just two fatalities between 2010 and 2021[41]. Much work remains if cyclists and auto users traveling on U.S. roadways are to enjoy the same level of safety of airline passengers flying through the skies.

To the extent that e-bike rebates increase the number of people riding bicycles, it will tend to increase popular support for measures to reduce speeds and increase the physical separation of drivers, cyclists, and pedestrians. More cyclists on the road also tends to decrease the number of crashes per mile cycled but may still result in an increase in the total number of bicycle crashes, if only in the short term, assuming WSDOT and local jurisdictions are successful in achieving Target Zero.

Potential Measures:

- Measured support for Target Zero improvements in a survey of applicants who do and don't receive e-bike rebates
- Long-term changes in cycling mode share and the crash rate per mile of cycling

Summary of Program Policy Goals and Measures

Table 1 summarizes the potential policy goals that WSDOT could consider in designing the program and evaluating its success. The first three goals of carbon reduction, targeting benefits,

[39] U.S. Consumer Product Safety Commission. "Micromobility Products-Related Deaths, Injuries, and Hazard Patterns: 2017–2022." Accessed December 6, 2023. https://www.cpsc.gov/content/Micromobility-Products-Related-Deaths-Injuries-and-Hazard-Patterns-2017%E2%80%932022.
[40] https://www.nhtsa.gov/press-releases/2023-Q2-traffic-fatality-estimates
[41] https://www.airlines.org/dataset/safety-record-of-u-s-air-carriers/

and cost-effectiveness are called out specifically in the legislation that funds and creates Washington's e-bike rebate program. The other policy goals are consistent with the CCA and WSDOT's planning documents. There are potentially other benefits associated with shifting a significant share of trips to e-bikes related to more efficient use of the public right of way and land devoted to parking. These potential effects are more attenuated than the first order effects on users and emissions reductions listed in Table 1.

The project team from the University of Washington and Portland State University will work with the representatives of WSDOT to determine which measures in Table 1 to assess with the funding available for surveys and analysis. Program design decisions will influence how surveys can best be structured to develop reliable measures of the program's performance.

Table 1. Policy Goals for E-bike Rebates & Potential Measures of Program Performance

Policy Goals	Potential Measures
Reduce carbon emission cost-effectively	● Dollar amount of rebates distributed as share of total program costs ● Total program costs per induced e-bike purchase ● Estimated number and average mileage of auto trips replaced with e-bike trips per week among rebate-induced e-bike owners ● Annual reduction of carbon emissions from avoided car trips by induced e-bike purchasers, measured in metric tons in the absence of a state carbon cap ● Estimated carbon emission reductions in metric tons/total program costs
Reduce non-carbon pollutants	● Total reductions in criteria pollutants from induced e-bikes ● Reduction in criteria pollutants per induced e-bike sold ● Reductions in mortality and morbidity from reduced criteria pollutants
Deliver benefits to overburdened communities and low-income households	● Reduction in criteria pollutant emissions created by e-bike use within overburdened communities ● Dollar value of rebates to households in overburdened communities/total dollar value of rebates ● E-bike unit sales with rebates to households in overburdened communities/total e-bike unit sales with rebates ● Dollar value of rebates to households at or below 80% of county median income/total dollar value of rebates ● E-bike unit sales with rebates to households at or below 80% of county median income/total e-bike unit sales with rebates
Improve access, mobility and health	● Number, length, and purpose of trips on baseline and induced e-bikes with rebates ● Changes in measures of user benefits from trip-making on e-bikes using benefit-cost analysis ● Average increase in hours of physical activity among induced riders ● Dollar value of estimated reductions in mortality and morbidity from increased physical activity

Policy Goals	Potential Measures
	● Dollar value of reductions in mortality and morbidity from reduced criteria pollutants ● Total program benefits measured in dollars/total program costs (benefit/cost ratio)
Improve safety on roadways	● Measured support for Target Zero improvements in a survey of applicants who do and don't receive e-bike rebates ● Long-term changes in cycling mode share and the crash rate per mile of cycling

Key Design Elements for Washington's E-Bike Incentive Program

This section of the policy brief provides a structured review of the key design elements relevant to Washington's e-bike incentive programs. Where available, we present key findings from our assessment of other incentive programs for each design element.

We gained insights on program design from four sources: 1) Washington's budget proviso language for the e-bike rebate program, 2) other e-bike programs, 3) energy efficiency programs, and 4) transit subsidy programs. Washington's e-bike budget proviso and other existing e-bike incentive programs provide the most relevant information for program design. The e-bike incentive program in Denver, Colorado[42] is well-documented and has served as an example for other states looking to implement their own e-bike incentive program. Other states, such as California[43], have begun to develop their own e-bike incentive programs with some design elements that differ from the program in Colorado. These different features help inform the design options in the following discussion. Other resources, such as Ride Review's e-bike incentive exploration tool[44] and People for Bikes' e-bike incentive toolkit[45], provided key information about a range of existing and proposed e-bike incentive programs.

Due to the recent emergence of e-bike incentive programs, the UW team also explored how incentive programs in other domains have been designed. A study conducted by Houde and Aldy[46] evaluated the effectiveness of the 2009 Recovery Act's energy efficient appliance rebate program. Transit subsidies in western Washington are provided to those enrolled in one of six other state benefit programs[47] such as Temporary Assistance for Needy Families. Sources such

[42] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[43] Carpenter, Susan. "California Will Offer E-Bike Rebates with New Electric Bicycle Incentive Project." *Spectrum News*, September 1, 2021.
[44] "Incentives | Ride Review." Accessed December 9, 2023. https://ridereview.com/incentives.
[45] Noa Banayan, Ashley Seaward, and Kyler Blodgett. "Electric Bicycle Incentive Toolkit." People for Bikes.
[46] Houde & Aldy (2017) https://doi.org/10.1257/pol.20140383
[47] "Subsidized Annual Pass - King County, Washington." Accessed December 9, 2023. https://kingcounty.gov/en/dept/metro/fares-and-payment/discounted-fares/subsidized-annual-pass.

as these provided supplemental insight into design elements that may not currently exist in e-bike incentive programs but are relevant to the design of Washington's program.

While the Washington legislature's requirements for the state's e-bike incentive program already prescribes some key design features, such as Washington residency, the incentive eligibility, and the maximum rebate amounts, we also discuss what's been learned in other areas to help explain and justify the basis for the budget proviso's design direction.[48]

Timing of Incentive Payment

There are three main structures for the timing of incentive programs: point-of-sale, post-purchase, and mileage-/use-based incentives. These different program constructs affect people's ability and willingness to participate in the program.

Point-of-Sale rebates allow participants in the program to apply discounts to their new e-bike at the time of purchase. With rebates at the time of sale, customers do not pay the full price of the e-bike. For example, Denver and Colchester, Vermont provide point-of-sale incentives[49,50]. The Washington statute requires a point-of-sale incentive: "the department must provide the qualifying individual the rebate amount in a format that can be redeemed at the time of purchase at a qualifying retailer".[51]

Offering a price reduction at the time of purchase is viewed as the most effective way to stimulate immediate adoption and encourage prospective buyers to choose e-bikes over traditional bicycles or conventional vehicles. A recent national stated preference survey[52] showed that point-of-sale discounts were the most influential at shifting e-bike adoption behavior, followed by tax credits, then mail-in rebates. More specifically, point-of-sale discounts were found to be 30% more effective than mail-in rebates.

Post-Purchase rebates require participants to first purchase their e-bike at full price, then apply to receive their incentive payment. This approach involves reimbursing a percentage of the e-bike's cost to the owner after they have made the purchase. It may appeal to those who are deterred by the upfront expense of e-bikes but still have the cash flow to enable a purchase with the expectation of receiving a reimbursement later. These post-purchase rebates are generally in two forms: mail-in rebates or tax credits. Mail-in rebates provide participants with a check at a later date after they have completed the program's required paperwork. Tax credits refund the participant when they file their taxes. The DRIVE EV/Erika Niedowski Memorial Electric Bicycle

[48] Section (16)(a)(iv)(A) https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bills/House%20Passed%20Legislature/1125-S.PL.pdf
[49] "Incentives | Ride Review." Accessed December 9, 2023. https://ridereview.com/incentives.
[50] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[51] Section (16)(a)(iv)(A) https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bills/House%20Passed%20Legislature/1125-S.PL.pdf
[52] Jones, Bennett, and MacArthur, "Consumer Purchase Response to E-Bike Incentives: Results from Nationwide Stated Preference Study." *Unpublished manuscript*

Rebate Program in Rhode Island offers post-purchase rebates of up to $1,000 or 75% of the value of the e-bike.[53]

Mileage-Based incentives are linked to the number of miles the participant travels using the e-bike. These incentives are designed to encourage sustained adoption of e-bikes by rewarding individuals for the distance they cover or the frequency of usage. Such programs often utilize smart technologies (e.g., GPS tracking) to monitor and validate users' e-bike activities. For example, Portland, Oregon's Ride2Own program[54] allows participants to get their e-bike for free if they ride the e-bike regularly for a year, track their rides in an app, complete progress interviews, and attend educational workshops. This approach can help promote the long-term integration of e-bikes into peoples' lifestyles while incentivizing reduced reliance on traditional modes of transportation.

Recommendation: Use point-of-purchase rebates required under Washington's legislative language, which have been shown to be the most effective at inducing new e-bike purchases.

Incentive Amounts

The size of the rebate provided by the incentive program plays a key role in uptake and program effectiveness. Some incentive programs opt for a fixed incentive amount that is uniform for all eligible participants, providing a straightforward and easily understandable benefit. Alternative structures tie the incentive amount to income qualifications, acknowledging that ability to pay varies with income. Other factors can play a role in the total incentive amount, such as the relative cost of the e-bike, the type of e-bike being purchased, and how often or far the e-bike is used.

Equal Incentives: These incentives are uniform subsidies or rebates provided to all eligible participants in an e-bike incentive program. Equal incentives achieve one definition of fairness in that all buyers receive the same benefit. Ashland, Oregon's program is one example of equal incentives as the city offers $300 rebates to any resident of the city.[55]

Income-Based Incentives: Income-based incentives tailor the subsidy amount to the financial circumstances of the participant. This approach recognizes that individuals or households with lower incomes may face greater barriers to e-bike adoption due to the higher upfront costs. By providing a higher incentive to those with lower incomes, e-bikes become more accessible to a broader range of socio-economic groups. Denver's e-bike incentive program offers $300 for any resident and up to $1,200 for income-qualified residents[56], the same structure that was adopted in Washington's budget proviso.

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[53] "Incentives | Ride Review." Accessed December 9, 2023. https://ridereview.com/incentives.
[54] ride2own.org. "How to Apply." Accessed December 9, 2023. https://www.ride2own.org/how-to-apply.
[55] "Transportation Electrification - Climate and Energy Programs - Find Resources - City of Ashland." Accessed December 9, 2023. https://ashlandor.org/climate-energy/find-resources/transportation/.
[56] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."

Percentage of E-Bike Value: This strategy focuses on how much the incentive amount covers the e-bike cost. As mentioned previously, the DRIVE EV/Erika Niedowski Memorial e-bike rebate program in Rhode Island allows participants to save up to 75% of the e-bike price.[57] A percentage-based approach scales the incentive in proportion to the e-bike price, meaning that participants receive a higher incentive for more expensive models. Incentives that scale with e-bike prices will tend to increase program costs by allowing some consumers to purchase more expensive e-bikes, with the benefit that these e-bikes may have higher utilization as they tend to have more power or provide more carrying capacity.[58]

E-Bike Type: Programs may offer higher incentives for e-bikes with features that align with broader environmental goals, fostering a shift towards more eco-friendly transportation alternatives. For example, cargo e-bikes allow riders to carry larger loads during their trips than standard e-bikes. Programs like Denver's have provided additional incentives for cargo e-bikes[59] such as the one shown in Figure 2 below. Higher rebates for cargo bikes require clear definitions about what models do and don't qualify, as nearly all e-bikes can be fitted with racks and carry some loads. Another type of e-bike to consider for higher incentives are adaptive e-bikes and/or e-trikes. These types of e-bikes are designed specifically for people with disabilities, allowing them to take advantage of the benefits provided by electrified bicycles.[60] However, adaptive e-bike prices vary significantly and are more expensive than standard e-bikes due to the tailored modifications. Providing greater incentives for adaptive e-bikes creates a more inclusive environment and allows those with disabilities to participate in the program but will increase program costs.

Figure 2: XPedition Dual-Battery Cargo eBike[61]

[57] "Incentives | Ride Review." Accessed December 9, 2023. https://ridereview.com/incentives.
[58] Fan & Harper (2022) https://www.sciencedirect.com/science/article/pii/S1361920922000050
[59] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[60] Balfour, Vicky. "Buyer's Guide to Adaptive Bikes," June 23, 2022. https://www.bikeradar.com/advice/buyers-guides/adaptive-bikes.
[61] "XPedition Dual-Battery Electric Cargo Bike | Lectric eBikes." Accessed December 9, 2023. https://lectricebikes.com/products/xpedition-dual-battery.

Mileage-Based: This rebate strategy varies the incentive dollar amount based on the participants' activity with their e-bike. It often involves monitoring and validating users' e-bike activities over time. As mentioned previously, the Ride2Own program in Portland uses this method to provide free e-bikes to participants.

Recommendation: To increase availability of the incentives, WSDOT staff should consider lowering the fixed e-bike rebate amounts to between $800 to $1,000 instead of $1,200 for households at or below 80% of county median income and to between $200 to $250 for households above 80% of county median income. Washington budget proviso requires fixed rebates "up to" $1,200 and $300 so WSDOT has the option to offer lower rebates to stretch program dollars. About 40% of Washington's population lives in households at or below 80% of median income so the $1,200 rebate is potentially available to a large number of people. Reducing the rebate to $800 would increase the number of participants in that part of the program from 2,000 to 3,000, assuming fixed program administration and operating costs of $600,000 (20% of $3 million). Some program operating costs will vary with the number of rebates so the actual number of rebates the program can afford at different rebate amounts will depend on the relative share of fixed and variable costs. Although reducing individual incentive amounts will cover a smaller portion of each e-bike purchase, lowering the rebate amount would allow a greater number of people to participate in the program and receive incentives.

By starting the rebate amounts below the program maximums, WSDOT would preserve the option to increase them later. As the program evolves and program managers learn about consumer behavior from survey results, there will be more information to evaluate the case for increasing the rebate amounts. If program managers put a high weight on the policy goal of cost-effective carbon reduction, they may want to preserve flexibility to adjust the incentive amount up or down to decrease the cost per induced e-bike sale.

If e-bike rebate program managers offer rebates below the statutory maximum for standard e-bikes, that also provides flexibility to provide could also explore the potential effectiveness of higher incentives for cargo bikes, family bikes, and adaptive bikes. These categories of e-bikes may generate more emission reductions or serve other social goods and therefore warrant higher rebates. However, in the current market it may be difficult to develop clear definitions between "standard e-bikes" and these other categories. Another advantage of lowering rebates below the statutory maximum is it would allow the program to target higher rebates to residents living in overburdened communities.

Outreach to Overburdened Communities

Targeted outreach for e-bike incentive programs in overburdened communities is crucial for ensuring equitable access and participation. Overburdened communities "means a geographic area where vulnerable populations face combined, multiple environmental harms and health impacts, and includes, but is not limited to, highly impacted communities as defined in RCW

19.405.020".[62] That statute reads: "Highly impacted community" means a community designated by the (Washington state) department of health based on cumulative impact analyses ... or a community located in census tracts that are fully or partially on "Indian country" …" The cumulative impact analysis by the Washington Department of Health "designate(s) the communities highly impacted by fossil fuel pollution and climate change in Washington.[63]". Individuals from these communities often face barriers that may impede their awareness and engagement. By tailoring outreach efforts to these specific communities, programs can bridge the gap and provide e-bike incentives to those who need it most. A targeted approach recognizes the unique challenges faced by overburdened communities and aims to create more equitable opportunities to participate in e-bike incentive programs.

Outreach in E-Bike Programs: Although most e-bike incentive programs target communities in need with higher incentive amounts, the outreach strategies are not clearly laid out in publicly available sources. For example, California's statewide incentive program[64] will use a needs-based methodology that prioritizes applicants who live in either a disadvantaged or low-income community, applicants who have an income at or below 225% of the federal poverty level, and applicants who participate in at least one of the public assistance programs on the Clean Vehicle Rebate Project's Categorical Eligibility List.[65] However, the program does not describe their specific outreach strategy nor whether overburdened communities, in particular, are of interest. Denver's Office of Climate Action, Sustainability, and Resiliency (CASR) recommended early outreach in lower income neighborhoods for other e-bike incentive programs, but their own outreach relies primarily on email notifications.[66]

Outreach in Other Program Types: In 2017, California's High-Speed Rail Authority published an environmental impact report with best practices for environmental justice outreach.[67] Relevant best practices include:

- Proactivity – involve overburdened populations early and often to identify and address concerns in advance
- Inclusivity – offer opportunities for input and alternatives to be considered
- Sensitivity – consider overburdened population sensitivities and historical experiences in information sharing approaches and techniques
- Consistency – provide all presentations and messaging with the same information, regardless of language

[62] https://app.leg.wa.gov/RCW/default.aspx?cite=70A.02.010
[63] https://app.leg.wa.gov/RCW/default.aspx?cite=19.405.140
[64] "FAQ's - Pedal Ahead | Electric Bike Incentive Programs," February 21, 2023. https://www.pedalaheadsd.org/faq/.
[65] Clean Vehicle Rebate Project. "CVRP Info: Eligibility & Requirements." cleanvehiclerebate.org. Accessed January 13, 2024. https://cleanvehiclerebate.org/en/eligibility-guidelines#categorical.
[66] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[67] California High-Speed Rail Authority. "Bakersfield to Palmdale Project Section: Final Environmental Impact Report," May 2021.

- Accessibility – make meeting times and locations accessible by prioritizing locations where overburdened populations feel comfortable and times that are convenient. Tailor outreach to maximize reach and offer translation services
- Follow-through – follow up with constituent comments and concerns promptly and comprehensively

According to the Pew Research Center[68], low-income and specific minority populations are more likely to be dependent on smartphones than landlines. Low-income populations are also more likely to rely on smartphones rather than computers for internet connectivity. This means that social media and similar smartphone-based communications can be effective tools for outreach in overburdened communities.

Recommendation: Washington's Department of Ecology has identified 16 communities across the state as overburdened due to health, social, and environmental inequities.[69] These 16 communities are Ellensburg, Everett, George and West Grant County, South King County, Mattawa, Moxee Valley, Northeast Puyallup, North Seattle and Shoreline, South Seattle, Spokane and Spokane Valley, South and East Tacoma, Tri-Cities to Wallula, Vancouver, Wenatchee and East Wenatchee, East Yakima, and Lower Yakima Valley. Per the governing legislation, WSDOT should also consider targeting other "highly impacted communities" identified by the Department of Health's Environmental Health Disparities Map[70]. The e-bike program operators should also follow the guidance in WSDOT's 2024 Community Engagement Plan[71] The first program specific steps in outreach could involve selecting a geographically diverse set of overburdened communities for program piloting. WSDOT could then invite all the bike shops in those communities to apply to serve as authorized retailers for the rebate program. Working with the qualified e-bike retailers, WSDOT or its program contractor could test social media-based outreach campaigns in these communities.

Allocation in Oversubscribed Programs

One challenge that emerged in the implementation of the first e-bike incentive programs is excess public demand. For instance, when Denver initially introduced an e-bike incentive program for their residents, demand exceeded expectations, resulting in more requests for rebates than the available funding could accommodate.[72] Oversubscribed rebate programs disappoint and frustrate interested buyers. It is important for public credibility to ensure that the mechanisms for allocating constrained supply are perceived as fair.

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[68] Smith, Aaron. "U.S. Smartphone Use in 2015." *Pew Research Center: Internet, Science & Tech*, April 1, 2015. https://www.pewresearch.org/internet/2015/04/01/us-smartphone-use-in-2015/.
[69] Washington State Department of Ecology. "Overburdened Communities." Accessed January 13, 2024. https://ecology.wa.gov/air-climate/climate-commitment-act/overburdened-communities.
[70] https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/washington-environmental-health-disparities-map
[71] https://wsdot.wa.gov/construction-planning/statewide-plans/community-engagement-plan
[72] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."

First-Come-First-Served: In a first-come-first-served strategy, the allocation of incentives is straightforward since the incentives are provided to those who signed up for the program first. While this is logistically simple and efficient, potential participants are disadvantaged if they are late to sign up for the program, creating accessibility issues. This strategy was used by Denver's first e-bike incentive program and was adjusted to promote more fairness in people's chances to sign up in time. With each round of vouchers, Denver released hundreds of rebates through its website, where residents filled out a short form to sign up. Due to demand, the program moved the release time-of-day from 8:00 am to 11:00 am to give people with less internet access time to sign up at places that provide free Wi-Fi and access to computers, such as libraries.[73] Even with accessibility considerations, a first-come-first-served method still creates barriers for those with a lack of access to sign-up resources. For example, rural residents and those without stable internet, computers, or smart devices have a significant disadvantage when it comes to participating in the program. At the same time, these communities may have a greater need for e-bike incentives given a lack of public transportation and/or high costs associated with owning a car.

Income Prioritization: For programs that already provide further incentives for low-income communities, priority can be given to them during the selection process. This helps maintain a program's goal of providing incentives to those who need it most. California's e-bike incentive program gives special priority to those under 225% Federal Poverty Level or living in a disadvantaged community.[74]

Random Selection: To promote fairness, states like Colorado have adopted a randomized selection process among applicants for the e-bike rebate. This approach involves randomly choosing participants from the pool of eligible applicants, eliminating biases and providing an equal chance for everyone to receive incentives.[75]

Lower the Rebate Below that Statutory Maximum: As discussed in the earlier section on the rebate amount, lowering the rebates below the statutory maximum will reduce demand for the program and allow more people to participate, reducing the level of over subscription.

Recommendation: We recommend random selection for distributing rebates as it avoids favoring households with higher social capital, more flexibility, and stronger internet access, who would otherwise disproportionately benefit from a first-come-first-served system. Distributing rebates randomly among qualified applicants will also assist in surveying those who do and don't get rebates, and in developing valid measures of effects of the rebates on purchase behavior.

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[73] Peters, Adele. "What Denver Learned from Its Wildly Popular E-Bike Rebate Program." *Fast Company*, March 13, 2023. https://www.fastcompany.com/90863781/ebike-rebate-program-denver-lessons-learned.
[74] "E-Bike Purchase Incentives - CalBike." Accessed December 9, 2023. https://www.calbike.org/bike_purchase_incentives/.
[75] "Frequently Asked Questions." Accessed December 9, 2023. https://coloradoenergyoffice.aptim.com/faq/.

Methods to Establish Income Eligibility

Washington's legislation provides higher rebates for households at or below 80% of the county area median income (AMI) and so requires a reliable and trustworthy mechanism to determine the income level of potential participants. The U.S. Department of Housing and Urban Development (HUD) annually calculates estimates of median family income that are used by public agencies across the country.[76] HUD uses data from the Census Bureau's American Community Survey to estimate median incomes at the county level. Using the data made available by HUD, the 80% AMI limits in King County are $70,650 for individuals, $80,750 for families of two, $90,850 for families of three, and $100,900 for families of four. In Spokane County, the 80% AMI limits are lower: $49,850 for individuals, $57,000 for families of two, $64,100 for families of three, and $71,200 for families of four.

Utilizing reported income from wage statements or the most recent tax returns is a practical and verifiable method for categorizing income levels. In this case, participants can be required to provide proof of income such as a copy of their tax returns. This approach reduces the potential for misrepresentation of income levels that may occur with pay stubs; however, tax returns contain personal and sensitive information that require safeguards to protect the privacy of participants. Vermont's e-bike incentive program uses tax returns to establish eligibility for incentives that are available to those who make less than $100,000.[77] The program provides additional incentives if the resident's income is under $50,000.

Recommendation: We recommend adopting the HUD's county-level household income limits for 80% of median income by family size. Using 80% of Area Median Income as calculated by HUD would meet the program's legislative requirement without undertaking new estimates of median income. Since WSDOT's active transportation division does not typically handle confidential financial information, it may be prudent to engage a third party with experience in verifying the income of participants and to confirm that they are Washington residents.

E-Bike Eligibility

Determining which e-bike models and types are eligible for incentives can help shape the outcomes of the program. Certain types of e-bikes serve as better substitutes for car travel and may warrant additional subsidies.

Approved or Prioritized Features: Most standard e-bikes are eligible for incentives, such as cruiser, commuter, and road e-bikes. California's e-bike incentive program will provide a list of approved e-bike models to choose from and all three classes of e-bikes will be eligible for the

[76] US Department of Housing and Urban Development. "Statement on FY 2023 Median Family Income Estimates and Income Limits," 2023. https://www.huduser.gov/portal/datasets/il/il23/Statement-on-FY-2023-Income-Limits.pdf.
[77] Noa Banayan, Ashley Seaward, and Kyler Blodgett. "Electric Bicycle Incentive Toolkit." People for Bikes.

program.[78] These three classes of e-bikes/e-trikes, defined under Washington state law in RCW 46.04.169[79], include:

- Class 1: pedal assist only; no motor assistance at speeds above 20 mph
- Class 2: pedal assist and/or throttle; no motor assistance at speeds above 20 mph
- Class 3: pedal assist only, no motor assistance at speeds above 28 mph

Cargo e-bikes have been prioritized by some rebate programs due to their utility for riders and increased cost compared to standard e-bikes. Denver's e-bike incentive program provided an extra $500 for the purchase of cargo e-bikes.[80] Colorado's statewide program uses the following criteria to define eligible cargo e-bikes:

- "Designed to carry one or more passengers in addition to the rider OR designed to carry heavier or bulkier loads than a traditional bicycle can carry (short john, cycle truck, utility bike)
- Has an extended frame (long tail, long john, Bakfiet, or box bike)
- Extended frame has a published cargo load carrying capacity of at least 100 lbs.[81]

Excluded Features: Some e-bike incentive programs have excluded mountain e-bikes. Denver's e-bike incentive program declared that full-suspension mountain e-bikes were not eligible for incentives because they are used primarily for recreation.[82] Recreational e-bikes are less likely to substitute for auto travel; therefore, providing an incentive for these types of e-bikes does not align with the goals of most e-bike incentive programs. Washington's budget proviso language explicitly excludes electric mountain bikes.[83] Although there is no official definition for what classifies a mountain bike, these types of bikes generally feature wider tires with a rugged tread for off-roading and suspension systems that absorb the shock from bumpy trails.[84] Mountain bikes can feature full suspension to the front and rear of the bike, only the front, or not have any suspension at all. Full suspension bikes are typically the most expensive and require more maintenance, but allow riders to travel off-road with more comfort Retailers that sell e-bikes will need to be trained on distinguishing which models and types are eligible for incentives within Washington's program.

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[78] "E-Bike Purchase Incentives - CalBike." Accessed December 9, 2023. https://www.calbike.org/bike_purchase_incentives/.
[79] Washington State Legislature. "RCW 46.04.169," September 1, 2023. https://app.leg.wa.gov/rcw/default.aspx?cite=46.04.169.
[80] Duncan, Ian. "How Denver Used E-Bike Vouchers to Get Thousands out of Their Cars." *The Washington Post*, December 19, 2022. https://www.washingtonpost.com/transportation/2022/12/19/denver-ebike-program/.
[81] "Frequently Asked Questions." Accessed December 9, 2023. https://coloradoenergyoffice.aptim.com/faq/.
[82] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[83] Section (16)(a)(vii) https://lawfilesext.leg.wa.gov/biennium/2023-24/Pdf/Bills/House%20Passed%20Legislature/1125-S.PL.pdf
[84] "Mountain Biking for Beginners: Getting Started | REI Expert Advice." Accessed December 9, 2023. https://www.rei.com/learn/expert-advice/mountain-biking-beginners.html.

Safety Standards such as the UL 2849 certification can serve as a benchmark for an incentive program's eligible e-bikes. In particular, the UL2849 (Standard for Electrical Systems for eBikes) provides a fire safety certification and examines the e-bike's drivetrain, battery, and charger system.[85] Protecting against potential safety hazards is crucial, as there have been several incidents of fires due to issues in e-bike batteries[86] resulting in bans on e-bikes that don't meet industry safety standards.[87] UL 2849 is a standard that looks at the whole of an e-bike's electronics—battery, motor, controller, charger, display and wiring harness, as well as the throttle if it includes one. UL 2271 (Standard for Batteries for Use in Light Electric Vehicle Applications) looks at the battery alone.[88] UL certification for e-bikes is a requirement under proposed federal legislation that would offer a federal e-bike tax credit[89].

Recommendation: Require eligible e-bikes to be UL 2849 and UL 2271 listed and exclude mountain bikes per Washington's legislation. Offer e-bikes across all three e-bike classes and adaptive e-bikes to ensure that participants can purchase an e-bike that suits their specific needs.

Qualifying Retailers

The types of e-bike retailers that offer rebates will influence the program's reach and ease of access. Three categories are especially relevant for program design: online, large retailers, and local/small businesses. Washington's law defines "qualifying retailer" as "a retail business establishment with one or more physical retail locations in this state that provides on-site e-bike sales…".

Online: Online retailers often offer lower prices and access to anyone with a computer and internet connection including households in rural communities without local bike shops. Participants can make their purchase on the retailer's website without having to physically shop around at a store but typically must do some assembly when the boxed e-bike arrives at their home. Online sales may impede long-term use of an e-bike if customers cannot easily reach a shop for maintenance and repairs. California plans to address these concerns by allowing online retailers as long as there is a mechanism for them to have the e-bikes assembled locally.[90] The local assembly of e-bikes with an online retailer allows for a hybrid approach that combines the accessibility of online retail with the availability of a physical store for additional needs. One of the country's largest online retailers of e-bikes, Rad Power Bikes, is headquartered in Seattle

[85] UL Solutions. "E-Bikes Certification:Evaluating and Testing to UL 2849." Accessed December 9, 2023. https://www.ul.com/services/e-bikes-certificationevaluating-and-testing-ul-2849.
[86] Cat Ellis. "E-Bike Fires: Why They Happen, and How You Can Prevent Them | TechRadar," February 12, 2022. https://www.techradar.com/news/e-bike-fires-why-they-happen-and-how-you-can-prevent-them.
[87] Winnie Hu. "E-Bikes in NYC: What to Know About Fires, Safety and a New Law - The New York Times." *The New York Times*, September 15, 2023. https://www.nytimes.com/article/ebike-laws-nyc.html.
[88] UL Solutions. "Personal E-Mobility Evaluation, Testing and Certification." Accessed January 13, 2024. https://www.ul.com/services/personal-e-mobility-evaluation-testing-and-certification.
[89] https://www.theverge.com/2023/3/22/23651557/ebike-act-bill-congress-rebate-tax-credit-amount
[90] "E-Bike Purchase Incentives - CalBike." Accessed December 9, 2023. https://www.calbike.org/bike_purchase_incentives/.

and offers on-site sales at a store in Seattle. The language in the budget proviso funding e-bike rebates appears to allow rebates on online sales from Rad by virtue of their one retail store with a service shop.

Large Retailers: Large retailers including REI, Costco, Walmart, as well as large direct-to-consumer on-line sellers such as Rad Power Bikes that also have physical stores. Rad Power Bikes chose to open a retail store in Denver and out-sold local shops using the city's rebates to the consternation of those small businesses.[91] Due to the size of these retailers, they can order in bulk and pass further discounts to participants in the program. Their smaller competitors fault them for lacking personalized service and tailored guidance on the most suitable e-bike for an individual.

Local/Small Businesses: Using a local or small/business-based strategy allows the e-bike incentive program to utilize local community connections and support smaller business enterprises. Eligible bike shops in Denver's e-bike incentive program were any brick and mortar stores located within five miles of Denver that sold qualifying e-bikes. These Independent Bike Dealers (IBDs) were required to offer on site service and repair in case there was an issue with their e-bike after purchase.[92] Local/small businesses can help offer personalized advice and services for the local area and tend to be made up of workers who are knowledgeable in the products they sell. These shops can ensure that a selected e-bikes fits the user properly and are available to provide maintenance and repair to allow for long-term utilization. However, compared to online or large retailers, local and small businesses may lack the same variety of e-bike options and may not be able to offer the same low prices. Limiting e-bike rebates to sales from brick-and-mortar stores may also present barriers in underserved communities that lack local shops to meet demand.

Under the terms of the budget proviso, retailers that provide e-bikes to participants must first be qualified by the incentive program administrators, be able to provide maintenance and other services agreed upon at the time of purchase and verify the identity of the qualifying individual at the time of purchase. Program managers may decide to add additional requirements for qualified retailers such as ensuring that the e-bike is properly assembled, the bicycle is the right size, the seat and handlebars are adjusted for the rider, and that warranties of reasonable length (e.g., at least one year) are guaranteed.

There are important equity dimensions to the decisions about which retailers to include in the program. Collaborating with IBDs in areas identified as overburdened could help achieve goals in the Climate Commitment Act. In addition, IBDs may provide better sales support to ensure a good fit and support regular service and maintenance.

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[91] Maia Luem. "One Retailer Dominates Denver's e-Bike Rebate Program, Prompting Mixed Feelings." BusinessDen, November 13, 2023. https://businessden.com/2023/11/13/one-retailer-dominates-denvers-e-bike-rebate-program-prompting-mixed-feelings/.

[92] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."

Table 2. Decision to allow on-line sales depends on how program managers score and weight the relevant criteria for qualifying retailers

Example of two approaches to weighting criteria to qualify retailers

Should e-bike incentives be available through on-line retailers with at least one physical store in the state that sell directly to customers who don't visit the store?

	Even weights on criteria				Higher weights on low price & rural access		
	Criteria Weight	Yes	No		Criteria Weight	Yes	No
Ensure proper assembly	11.1%	1	3		5.0%	1	3
Ensure correct sizing	11.1%	1	3		5.0%	1	3
Adjust saddle/ handlebar fit	11.1%	1	3		5.0%	1	3
Offer service close to point of sale	11.1%	1	3		10.0%	1	3
Serve areas without e-bike shops	11.1%	3	1		30.0%	3	1
Offer lower prices	11.1%	3	1		30.0%	3	1
Confirm identity of purchaser	11.1%	2	3		5.0%	2	3
Provide convenient warranty service	11.1%	2	3		5.0%	2	3
Conduct local outreach with community partners	11.1%	1	3		5.0%	1	3
	100%				100%		
Weighted Score		1.44	**2.22**			**2.20**	1.65

The decision of whether to allow on-line retailers with one physical store to sell directly to customers depends on the evaluative criteria that WSDOT program managers choose for qualifying retailers and how they score and weight those criteria. Table 2 shows an example of two different approaches to weighting nine relevant decision criteria that would yield different answers as to whether to allow direct to consumer sales online. The table uses a three point scale but program operators might choose five or ten points instead. On the first criteria of

ensuring proper assembly, a “Yes” to allowing on-line sales scores a 1 while a “No” scores a 3 because online sales require some assembly by the purchaser that the seller cannot inspect in person. The scores presented in the table are only an example of potential scores rather than a definitive evaluation. The key point of the table is to note that with identical scoring on each of the nine criteria, the final score depends on the criteria weights. Even weights on the criteria results in a higher score for “No”, higher weights on low prices and rural access results in a higher score for “Yes.”

Recommendation: Require e-bike sellers to meet all the legislative requirements for being a “qualifying retailer” in the e-bike rebate program including having one or more physical retail locations in the state that provide on-site e-bike sales, service and repair. Qualified retailers should also offer maintenance service and provide warranties for the e-bikes that they sell. The program should encourage e-bike retailers in overburdened communities to participate in the program. Regardless of the retailer type, any exchanges of e-bikes purchased with incentives should go to the same person who received the rebate to avoid reselling. WSDOT program operators may want to consider a scoring and weighting scheme as presented in Table 2 to help make decisions about which categories of retailers to include or exclude in the rebate program.

Data Collection for Program Assessment

Systematically gathering and analyzing relevant e-bike use and program data will enable evaluation of the program's outcomes, participant demographics, and overall success. The data can show the number of participants, patterns of e-bike adoption, the overall distribution of incentives, and the program's influence on transportation behaviors. Collecting data can also help identify areas for improvement, allowing for enhancements to future program iterations. Three main data collection instruments are used to evaluate e-bike programs: surveys, GPS trackers, and trip logging apps.

Surveys: Conducting surveys on participants and stakeholders in the e-bike incentive program can help provide qualitative and quantitative data to assess the performance of the program. Surveys can be employed to collect feedback directly, allowing participants to share their experiences, preferences, and challenges faced while participating in the incentive program. Questions can be tailored to assess the impact on commuting habits, satisfaction with and use of their e-bike, and overall experience with the program. Denver’s Office of Climate Action, Sustainability, and Resiliency administered surveys to explore how participants are using their e-bikes and help quantify the impacts of the program.[93] However, surveys rely on respondents self-reporting behaviors, which can be subject to imperfect recall and in some cases to participants responding with what they think the survey takers want them to say.[94] While surveys can be an effective tool, they are most useful when paired with other more objective methods of data collection.

[93] City and County of Denver et al., “Denver’s 2022 E-bike Incentive Program: Results and Recommendations.”
[94] Wen et al. (2021) https://doi.org/10.1016/j.tranpol.2021.02.001

GPS Trackers: GPS trackers integrated into e-bikes or participants' smartphones can capture real-time data on usage patterns, travel routes, and distances covered. This information helps assess how frequently and where participants are utilizing their e-bikes, providing insights into the integration of e-bikes into daily commuting routines. California's e-bike incentive program administrator, Pedal Ahead, is working with a university-based research team to use GPS tracking to monitor participants' trip distances and patterns[95].

Trip Logging Apps: Building mobile apps tailored to the requirements of a particular incentive program has become a popular option. While there is some upfront time and resources required to develop apps, they allow the program to have flexibility and control in the data collected and how it is collected. This can be crucial for ensuring that the program assessment data has high quality and can be used to make assessments for different areas of the program. For Denver's e-bike incentive program, Ride Report worked with the city of Denver to promote their smartphone application, Ride App. Ride App was a custom app built for automatic e-bike ride detection and logging. Participation was optional for those in the rebate program, but additional $30 gift cards at the local bike shops were offered if they used Ride App. A total of 70 riders logged over 3,500 e-bike rides with 15,000+ miles traveled during the pilot.[96] The National Renewable Energy Lab's (NREL) OpenPath provides another app-based solution for tracking travel modes and patterns.[97] NREL is also working with Denver and the state of Colorado to provide evaluations using OpenPath.

Recommendation: At a minimum conduct a survey of program participants as well as people who applied to get a rebate but didn't get one because the program was oversubscribed. In addition to a survey for these two groups, explore the feasibility of using GPS trackers and mobile trip logging apps if sufficient research funds are available.

Program Start-Up Approaches

When launching an e-bike incentive program, policymakers face a crucial decision regarding the program's initial scope: whether to start small, focusing on specific cities or communities, or to start the program at a statewide level. Each approach presents distinct advantages and considerations.

Statewide Approach: Launching an e-bike incentive program statewide offers the potential for broader impact and visibility, reaching a larger and more diverse population. There is a level of fairness to this approach, where all communities across the state have an equal opportunity to participate in the incentive program. For example, Colorado's program will include low-cost

[95] "FAQ's - Pedal Ahead | Electric Bike Incentive Programs," February 21, 2023. https://www.pedalaheadsd.org/faq/.
[96] City and County of Denver et al., "Denver's 2022 E-bike Incentive Program: Results and Recommendations."
[97] "NREL OpenPATH: Open Platform for Agile Trip Heuristics." Accessed December 9, 2023. https://www.nrel.gov/transportation/openpath.html.

online e-bike brands to ensure access in smaller communities and rural areas.[98] Connecticut also has a statewide program that is open to all Connecticut residents who are 18 years or older.[99]

Phased Approach: A phased approach can be used as a compromise, where success at the local level informs the expansion to a statewide initiative. This allows for iterative improvements while gradually scaling the program's reach. In Colorado, the statewide e-bike incentive program was first informed by the lessons learned by Denver's pilot program. Several recommendations made by Denver were adopted by the greater Colorado program, including point-of-sale incentives, income-qualified incentives, and additional incentives for e-cargo and adaptive bikes.[100] A statewide program in Washington could build on both the lessons learned from other states as well as local pilot initiatives within the state. Similar to the points mentioned above in the *Outreach to Overburdened Communities* section, local pilots could be conducted in areas with overburdened communities to target those with limited access and greater need.

Recommendation: Adopt a phased approach to gain insights into local needs based on feedback, then fine-tune the program design leading up to the statewide rollout. The statewide program should recognize the differences in community access across the region and design the program accordingly.

[98] Sam Brasch. "Colorado's Statewide e-Bike Rebates Launch Aug. 16. Here's How to Qualify | Colorado Public Radio," August 10, 2023. https://www.cpr.org/2023/08/10/colorado-ebike-rebates-how-to-qualify/.
[99] Connecticut and Department of Energy & Environmental Protection. "Electric Bicycle (eBike) Incentive Program." Accessed December 9, 2023. https://portal.ct.gov/DEEP/Air/Mobile-Sources/CHEAPR/Electric-Bicycles.
[100] "Frequently Asked Questions." Accessed December 9, 2023. https://coloradoenergyoffice.aptim.com/faq/.

Summary Recommendations on Program Design

Table 3. Recommendations and Justifications for Program Design Elements

Design Element	Recommendation	Justification
Incentive Type	Point-of-sale	Point-of-sale incentives are more effective and accessible than post-purchase incentives[101] and are required by Washington statute.
Incentive Amount	Consider establishing rebates below the statutory maximum to allow greater flexibility in program design.	Reducing some incentives below the upper limit set by Washington statute will increase program access, reduce oversubscription, and provide future program flexibility. Some e-bike types require more incentives to accommodate the needs of all types of participants.
Outreach to Overburdened Communities	Select a small set of bike shops in overburdened communities for piloting and use social media-based outreach campaigns.	Targeting overburdened communities promotes equity within the program. Smartphone dependency is higher in low-income and minority communities.
Allocation in Oversubscribed Programs	Hold random drawings for rebates among the different categories of applicants.	Random drawings don't allow for gaming, are perceived as fair, avoid giving advantages to those who have more online access, and support more rigorous program evaluation methods.
Income Eligibility	Use HUD's area-based income measures. Work with a third party to verify income and Washington residency.	Providing a relative measure of income (80% AMI) and Washington residency is required by the Washington statute.

[101] Noa Banayan, Ashley Seaward, and Kyler Blodgett. "Electric Bicycle Incentive Toolkit." People for Bikes.

Design Element	Recommendation	Justification
E-Bike Eligibility	Exclude mountain e-bikes; require UL 2849 and UL 2271; allow rebates for e-bikes/e-trikes from all three classes.	Recreational mountain e-bikes are excluded in the Washington statute. UL listing can address recent safety concerns over e-bike fires during charging. Available e-bike models should accommodate the needs of a diverse participant pool.
Purchase Availability	Require e-bike sellers to have a physical store with repair service; encourage local retailers in overburdened communities, make program broadly available to all qualified e-bike retailers.	The Washington statute requires retailers to have at least one physical store and CCA calls for targeting funds to overburdened communities.
Data Collection for Program Assessment	Survey e-bike rebate recipients and applicants who did not get rebates. Add GPS and trip logging as the project research budget allows.	WA budget proviso calls for a survey of rebate recipients. Applicants who fail to get rebates provide an essential control group. GPS and trip logging apps can mitigate some survey weaknesses.
Program Start Up Approach	Use a phased start-up approach; begin in selected communities then expand to the rest of the state.	Starting small can help to fine-tune the program's design and administration before launching statewide.

Models for Program Implementation

WSDOT can choose among three models for implementing the e-bike rebate program that vary the share of the rebate program activities performed by state employees. California has chosen to contract for nearly all of the program services, Colorado has contracted out some but not all program functions, and many cities have adopted a public employee model where city staff perform most program services.

California Model

The California Air Resources Board (CARB) has allocated $13 million to fund e-bike incentives. The agency issued a solicitation for a program contractor in April 2022 and selected Pedal Ahead, a not-for-profit organization based in San Diego, to deliver a comprehensive rebate program across the state. The contractor's responsibilities include:

- Program planning and development
- Education and outreach
- Incentive distribution and processing

- Record keeping and reporting

CARB has negotiated a contract with Pedal Ahead but the program has not yet begun distributing rebates. CARB's contract with Pedal Ahead budgets 21.7% for all non-rebate costs with a maximum of 25%. This amount will drop to 10% in future years after the program is up and running[102].

Colorado Model

The Colorado Energy Office is implementing a statewide rebate program with $12 million in funding from the state legislature. Colorado contracts with APTIM, a private company, to manage the application process and qualify applicants for income-based rebates but most other program functions are implemented by public employees. Colorado pays 6%-8% of the total program costs for these services.

Public Employee Model

Many cities with e-bike rebate programs conduct all of the program functions with city employees and make minimal use of contractors.

Choosing An Implementation Model

Many factors influence an enterprise's decision to contract or self-perform a set of activities. For WSDOT, the following criteria may be relevant:

- **Time to market** - Often contractors can deliver a service more quickly than state agencies. This is especially true if a contractor has specialized knowledge about program delivery that public employees lack.
- **Cost and quality** - Policy arguments about contracting out existing public services often revolve around differences in cost and quality between services provided by contractors and public employees. This remains an open debate.
- **Temporary versus long-term programs** - Contracting makes sense for temporary programs because a state agency can avoid hiring and then laying off public employees. To the extent that the e-bike rebate program is viewed as a pilot that may not be continued, contracting out more services may be sensible.
- **Core competencies** - Public agencies often contract for services that are outside their core competencies including specialized legal, engineering, or other services. For WSDOT, the development and implementation of systems to manage personal financial information are not among the agency's core competencies.
- **Strategy and partnerships** - Public agencies will also contract for goods and services when doing so serves strategic or partnership objectives.

Any of the three implementation approaches used by other jurisdictions could work for WSDOT. However, most of the criteria above tend to favor adopting the California model for Washington. If time to market is especially important to constituencies in Washington, then WSDOT will want to take practical steps to shorten the procurement and contract negotiation process with a potential contractor. That may include launching the program in a few pilot markets before rolling out the program statewide.

[102] Email exchange with Shaun Ransom of CARB on December 7, 2023.

Conclusion

The principal policy goals of the budget proviso that created Washington's e-bike rebate program are carbon reduction, targeting benefits to communities affected by current and past pollution from transportation, and serving low-income households. E-bike rebates can also help reduce other forms of pollution, increase access and mobility, and improve public health. The evidence from other e-bike rebate programs suggests that e-bike incentives are not especially cost-effective as a carbon reduction measure, but the other associated benefits may warrant continued public policy support. Evaluation of program measures of all the potential benefits from e-bike rebates can help quantify total program benefits relative to costs.

The legislative language creating the Washington e-bike rebate program adopted program design elements that are well supported by evidence from other jurisdictions that have implemented e-bike incentives. Our review of the published literature and conversations with program staff in other states validate the core program design in legislation and point to other recommended program elements summarized in Table 2. Other states have contracted out for some or all of their e-bike rebate programs. California may offer a promising model, but WSDOT should try to set a faster pace for completing a contract with a qualified service provider.

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Appendix A. Modeled Cost of Carbon Reduction

		Green shaded cells are model parameters,
$1,600,000,000	U.S. E-bike Sales in 2023	https://www.revibikes.com/blogs/news/e-bike-market-report-2022-2023
2.30%	WA as % of U.S. Population	U.S. Census for 2021
$36,800,000	WA 2023 E-Bike Sales Estimate	
$2,500	Average Price per E-bike	Average e-bike price $2000-$3000
14,720	WA 2023 E-bike Unit Sales Estimate	
$2,000,000	Funding for rebates to households above 80% of median	
$3,000,000	Funding for rebates to households below 80% of median	
$300	Rebate amount to all households	
$1,200	Rebate amount to households below 80% of median	
80%	Share of funds to rebates	Balance of funds to go to administer, train, advertise and promote for program.
5,333	Unit sales to all hshlds if all funds used	
2,000	Unit sales to hshlds < 80%if all funds used	
7,333	Total unit sales with rebates	
21.82%	Share of rebate sales induced by rebates	Derived from price elasticity calculation below
1,600	Induced e-bike sales from rebate	
$3,125	Program cost per induced e-bike sale	
3.4	Gas vehicle trips replaced per week	Denver report on e-bike rebate program
3.3	Average vehicle trip length in miles replaced by e-bikes	Denver report on e-bike rebate program
933,504	Total annual reduction in VMT from induced e-bike sales	
400	Averge carbon emissions per auto VMT (grams)	https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle
373	Estimated annual carbon emissions from e-bike rebate (MT)	
7.5	E-bike useful life in years	
$1,785	**Carbon Reduction Cost per MT**	

Price Elasticity to Induced Sales Share		
12%	% Price reduction of rebate to all households	Rebate amount divided by average e-bike price
48%	% Price reduction of rebate to hshld below 80% of median	
-1.00	Estimated price elasticity	Inelastic demand: -0.5, Unit elastic demand: -1.0, Elastic demand 2.5%
	Induced sales at that price elasticity	
640	All households	Applies price elasticity times % change in price to number of bikes sold with incentives
960	Households below 80% of median	
1,600	Total	
21.82%	Share of rebate sales induced by rebates	
Carbon Reduction Cost per MT With Change in One Model Parameter		
$3,571	Price elasticity of demand = -0.5	
$714	Price elasticity of demand = -2.5	
$1,428	Average e-bike price = $2,000	
$2,142	Average e-bike price = $3,000	
$2,678	Bike useful life = 5 years	
$1,339	Bike useful life = 10 years	