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Using E-Bike Purchase Incentive Programs to Expand the Market – North American Trends and Recommended Practices

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The Light Electric Vehicle Education and Research (LEVER) Institute is a consortium of powered micromobility researchers and educators that currently includes faculty and staff from University of Tennessee, Portland State University, University of North Carolina, Queensland University of Technology and Monash University. LEVER started in 2014 to bring together some of the leading researchers in the field to collectively answer some of the biggest questions related to emerging micromobility vehicle systems. The mission of LEVER is to bring a collective focus through interdisciplinary research directed at micromobility adoption, system integration, societal impacts, and related policy. The LEVER Institute on micromobility vehicles aims to bridge academia, industry, government, and non-government organizations to solve pressing challenges related to successful integration of micromobility systems.

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Executive Summary

Background

The electric bicycle (e-bike) is a low-emission mode of transportation that offers communities benefits in the areas of health, planning, time, cost, street safety, congestion, air pollution, noise pollution, and energy security, among others. Due to pedal assistance, e-bikes are more accessible for a wider range of demographics and use cases than conventional “acoustic” bicycles because range, cargo capacity, and accessible terrain are all increased. They offer an attractive alternative to vehicle travel for many road users, and thus may play a crucial role in achieving mode share, emissions, and vehicle miles traveled (VMT) reduction goals that have been established by many municipalities in North America.

E-bikes have become increasingly popular in the last few years. Between 2018 and 2021, units sold in the U.S. annually increased from less than 300,000 to over 1 million. Notably, the large increase in sales volume corresponding with the COVID-19 pandemic – the “bike boom” – was sustained through 2021 for the e-bike market, while sales of conventional bicycles returned to historic rates.

Despite the establishment of a stable and growing market, e-bike ownership remains prohibitively expensive for many people. The purchase price of a commuter or leisure-style e-bike ranges from $1,000 to $5,500, averaging around $2,600, while cargo style e-bikes range from $2,000 to $9,000, averaging around $5,000. Ownership, maintenance, and charging costs for e-bike users range around $400/year, including battery replacements. This is in contrast to average ownership costs of over $8,000 for a private vehicle and average purchase prices around $28,000. These values vary significantly with miles driven, and vehicle type, age, and resale value, but are an order of magnitude larger than the comparable costs for e-bike ownership in the majority of cases. Because of this stark difference in cost, encouraging the transition to e-bikes is a potential tool for pursuing transportation equity. However, the upfront cost of an e-bike purchase is a hard pill to swallow for many potential adopters of the technology, particularly low-income individuals.

Existing Incentive Programs

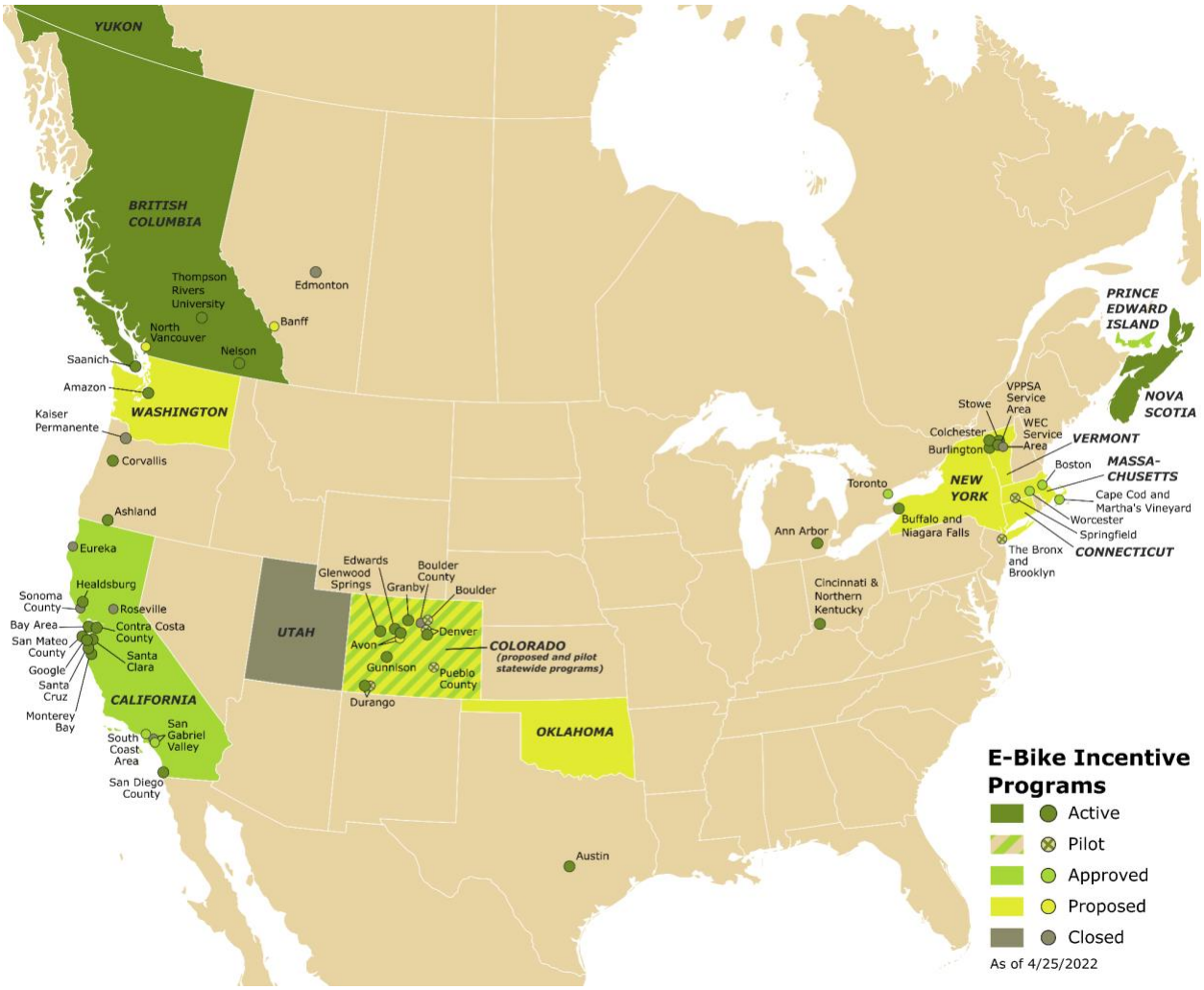
Across the world, incentive programs have emerged as a popular technique in the effort to bridge the chasm of e-bikes’ technology adoption curve. For this white paper, a review of existing programs in the U.S. and Canada was conducted, finding 53 active, pilot, or closed programs, in addition to a further 7 which were approved and awaiting implementation, and 13 which have been proposed in the federal, state, or local legislature.

A review of active, pilot, and closed programs found that the overwhelming majority were cash incentives in the form of post-purchase rebates (23) or point-of-sale discounts (12). Cash incentive amounts range from $100 to $1,365 for the general public, with a maximum incentive amount of $1,700 for income-qualified applicants receiving the additional cargo-bike incentive in the recently passed Denver, CO incentive. The majority of incentive programs (58%) fall in the range of $200-600, with six programs providing incentives of less than $200, and six programs providing incentives greater than $1,200.

One quarter (25%) of the programs were fully income-qualified, meaning that all participants needed to report less than a given income threshold. More than 10% (11%) of the programs provided additional benefits for people reporting incomes below a given threshold.

Program administration duties were carried primarily by power districts (22), and local governments (13), with nonprofits and advocacy groups (7), state and provincial governments (5), private entities (5), and air quality management authorities (2) managing the rest.

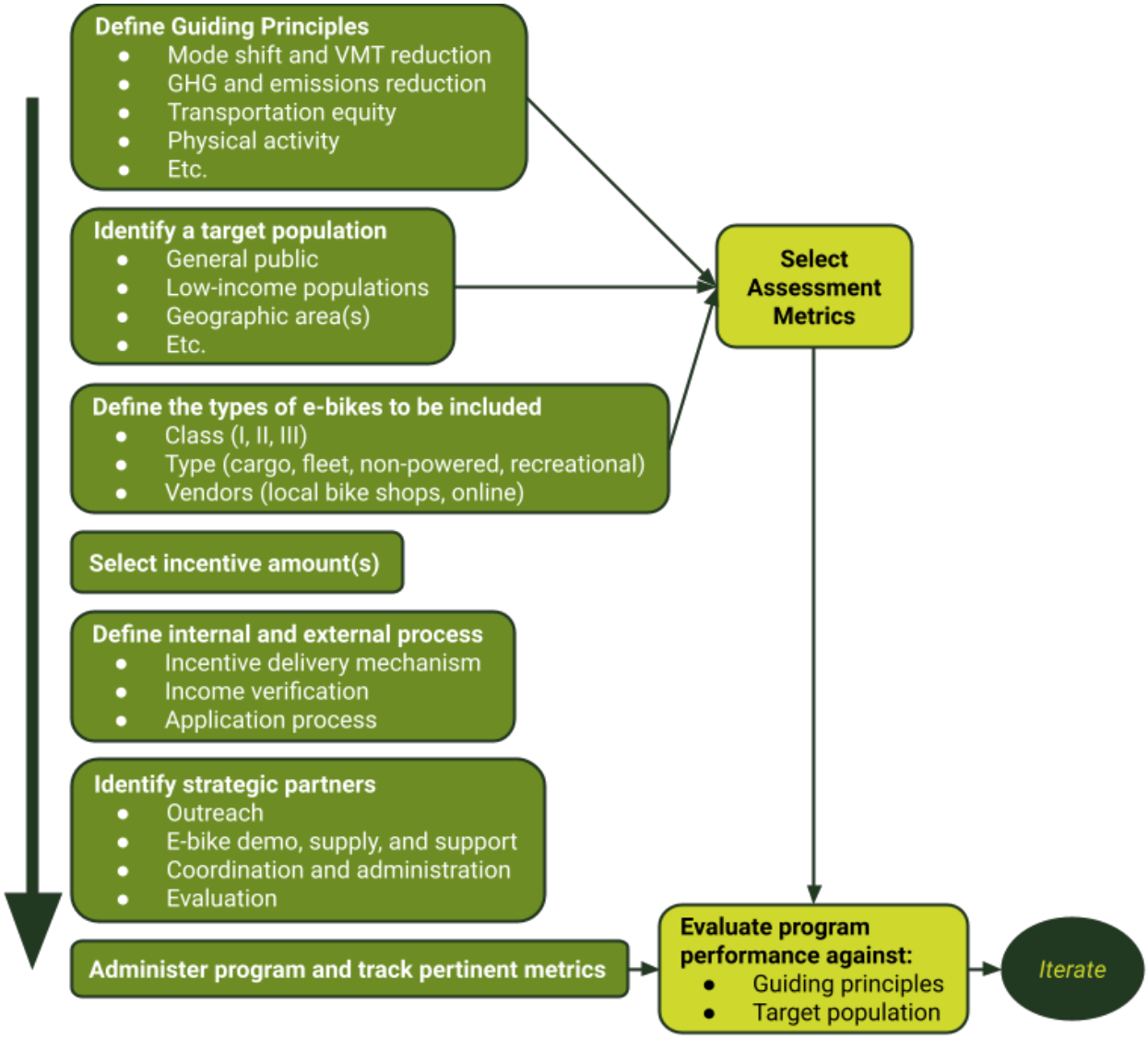
Half of existing purchase subsidy programs are restricted to purchases from local bicycle dealers and do not allow purchase from online retailers.



Map of Identified E-Bike Incentive Programs, U.S. and Canada *(as of 4/25/22)*

Recommended Practice for Incentive Program Design

A series of interviews with program managers and conversations with industry leaders and academics was conducted to generate a collection of recommended practices for e-bike incentive program development and implementation. The following flowchart outlines the proposed model for program development, including key considerations. Each bubble is elaborated upon in the white paper, and a general overview of recommended practice is provided here.



Program Development Flowchart

The recommended program structure for an e-bike purchase subsidy is as follows:

- **Define Guiding Principles and Select Assessment Metrics**
    - Program goals are defined appropriately for the provider's priorities in an area impacted by e-bike ownership and use.
    - Assessment metrics are developed that can be easily tracked and used as evaluation tools after the program.
    - Minimizing the proportion of inframarginal participation is considered as a guiding principle in program design; inducing new purchases that would not have otherwise taken place is the goal.
- **Identify a Target Population**
    - Programs available to the general population are acceptable.
    - Income-qualification for the program or additional subsidy value is considered as a method to induce further new purchases.
    - Equity goals are addressed through an analysis of the needs of the community and benefits provided by e-bike ownership.
- **Define the Types of E-Bikes to be Included**
    - All classes (I, II, III) of e-bike are qualified to participate in the program to provide for a wide variety of use cases, unless local regulations or program goals preclude doing so.
    - Consideration is taken not to exclude cargo e-bikes from the program. Additional incentives for cargo models may be warranted.
    - Consideration may be taken to exclude e-bikes designed and used primarily for recreation, sensitive to local needs, values and demand.
    - Both local retailers and online vendors are included in program eligibility requirements. Local bike shops can provide assistance in outreach, test rides, and access to service. However, the inclusion of online retailers will maximize choice for program participants and minimize pipeline challenges for in-demand models. A vendor application process open to all vendors may be considered as an avenue to participation in a program.
- **Select Purchase Incentive Amounts**
    - Graded or preferential incentive levels are used to support low-income groups.
    - An appropriate subsidy level is determined through a local price sensitivity survey or econometric analysis, with focus on outcomes for the defined target group(s).
    - A flat-rate subsidy is provided, rather than subsidy amounts proportional to the purchase price of the e-bike in order to minimize a disproportionate amount of program funding being distributed to people able to purchase more expensive models.
        - Cargo e-bikes or applicants meeting income thresholds may be provided separate subsidy values.
    - Consideration is given to including monetized externalities when setting incentive values, such as: greenhouse gas (GHG) equivalents, air quality benefits, public health benefits. Bike shop revenue increases, consumer spending effects, and quality of life benefits may provide reasons for private-sector support of an incentive.
- **Define Internal and External Process**
    - Incentive Delivery Mechanism
        - A point-of-purchase subsidy or voucher method is selected in order to minimize the burden on participants who may be unwilling or unable to carry additional cost while awaiting a post-purchase rebate.

        - Sales tax waivers are considered as an alternative point-of-purchase benefit. However, this approach offers less flexibility in total subsidy value and may be best used as a complement to additional cash incentives.
    - Income verification is conducted through a third party to minimize administrative overhead. Participation in existing low-income programs may minimize potential paperwork requirements for participants. An honor system may be appropriate in some cases to minimize administration needs and embarrassment for participants.
    - The application process is made to be as simple as possible, and is conducted entirely digitally with paper options available upon request.
- **Identify Strategic Partners**
    - Local community organizations are leveraged for outreach, education, communication, and identification of community needs and challenges.
    - Local bike shops are included in decisions surrounding product pipeline, local e-bike legislation, and existing customer base. Existing inventory can be leveraged for test rides, outreach, and education events.
        - Online and local vendors alike may be able to assist in program administration by recognizing point-of-purchase subsidies.
    - Financial institutions may be included to assist in financial asset management, and the extension of low-interest loans to participants as an additional measure to lower barriers to e-bike ownership.
    - Academic institutions, community organizations, and bicycle advocacy groups are included as partners in program design and evaluation.
- **Administer Program and Track Relevant Metrics**
    - Communication is maintained with participants, strategic partners, and program administrators in order to gather feedback throughout the program's operation.
    - An incentive program may be branded as a "pilot" in an effort to make it easier to implement and gain provisional political and social support. However, this designation may impede a program's longevity, ability to scale, and potential of renewal.
    - Worries of fraud, recreational use of subsidized e-bikes, and receipt by unintended groups is not a primary focus in program design. However, these concerns can be explored in program evaluation.
- **Evaluate Program Performance**
    - Evaluation criteria is based on initial program goals and assessment metrics, as well as feedback received and lessons learned in the process of program design.
    - An intake survey collecting demographics and motivations for purchasing is conducted. Ideally, a follow-up survey should be administered six months to a year after purchase to understand how the individual is using the e-bike.
    - Consideration is given to program renewal, based on performance in accordance with established program goals, as well as the state of the local e-bike market and mode share.

While this paper focuses primarily on cash incentives, a menu of other methods to encourage e-bike adoption is provided. Many of these strategies have precedent in North America and Europe which can be looked to for further guidance and inspiration. A number of credit unions and municipalities are offering low-Interest loans for e-bike purchase. Bikes may be distributed through lending libraries, loans with purchase options, ride-to-own schemes, or provided free of cost to target populations. E-bike riders may also be reimbursed as they ride, for example through commute mode shift programs. Any program model may be administered through an employer, either directly or utilizing an outside contractor or other partner.

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Introduction

The electric bicycle (e-bike) is a low-emission mode of transportation that offers communities benefits in the areas of health, planning, time, cost, street safety, congestion, air pollution, noise pollution, and energy security (Benoît et al., 2011). E-bikes enable more people to ride a bicycle for longer distances despite physical limitations, difficult terrain, and the presence of cargo (MacArthur et al., 2018). In the most recent U.S. National Household Travel Survey (NHTS), completed in 2017, 35% of trips made in single-occupancy vehicles (SOVs) were two miles or shorter, while 60% of trips were five miles or shorter (Federal Highway Administration, 2022). These trip distances are within 8- and 20-minute travel ranges for an e-bike, assuming an average speed of 15 miles per hour (mph). Initial studies on mode substitution by e-bikes indicate that they have a strong potential to replace vehicle trips (Bigazzi & Wong, 2020). Additionally, e-bikes provide a more accessible and cost-effective option than other alternative modes. Due to pedal assistance, e-bikes are more accessible for a wider range of demographics and use cases than conventional "acoustic" bicycles because range, cargo capacity, and accessible terrain are all increased. The purchase price for e-bikes is typically less than 10% than that of an electric vehicle, and operation and infrastructure costs are minimal compared to SOVs or transit. Therefore, e-bikes provide a promising pathway for legislators to address their transportation-sector emissions, mode share, and vehicle-miles-traveled (VMT) reduction goals.

Major U.S. metropolitan areas of all sizes, including Kansas City, Las Vegas, Milwaukee, Nashville, and Washington, D.C., have established climate or transportation plans that set objectives for cycling mode shares far above current levels, typically in excess of 5% of trips (ACEEE, 2021). Because these goals require mode replacement – rather than fuel replacement as in the case of electric vehicles – cycling must be seen as an attractive alternative to driving for many trips. In order to accomplish this, a high rate of e-bike adoption is likely necessary due to their increased ability to travel longer distances under various use cases. In the context of mode share and VMT reduction goals, policymakers across the country would likely consider the market for e-bikes to have considerable room for growth. To meet environmental and operational objectives and increase the number of people cycling, how can e-bikes be shifted out of the early adopter phase? A core group of early users has been established in North America; bridging the chasm of e-bike's technological adoption curve is the next major challenge in the market, as shown in the technology adoption curve in Figure 1. Supply chain challenges due to the COVID-19 pandemic, as well as knowledge and acceptance of e-bikes as a form of transportation, provide hurdles to adoption. However, for many consumers, price provides the most significant barrier to entering the market for a relatively unfamiliar product.

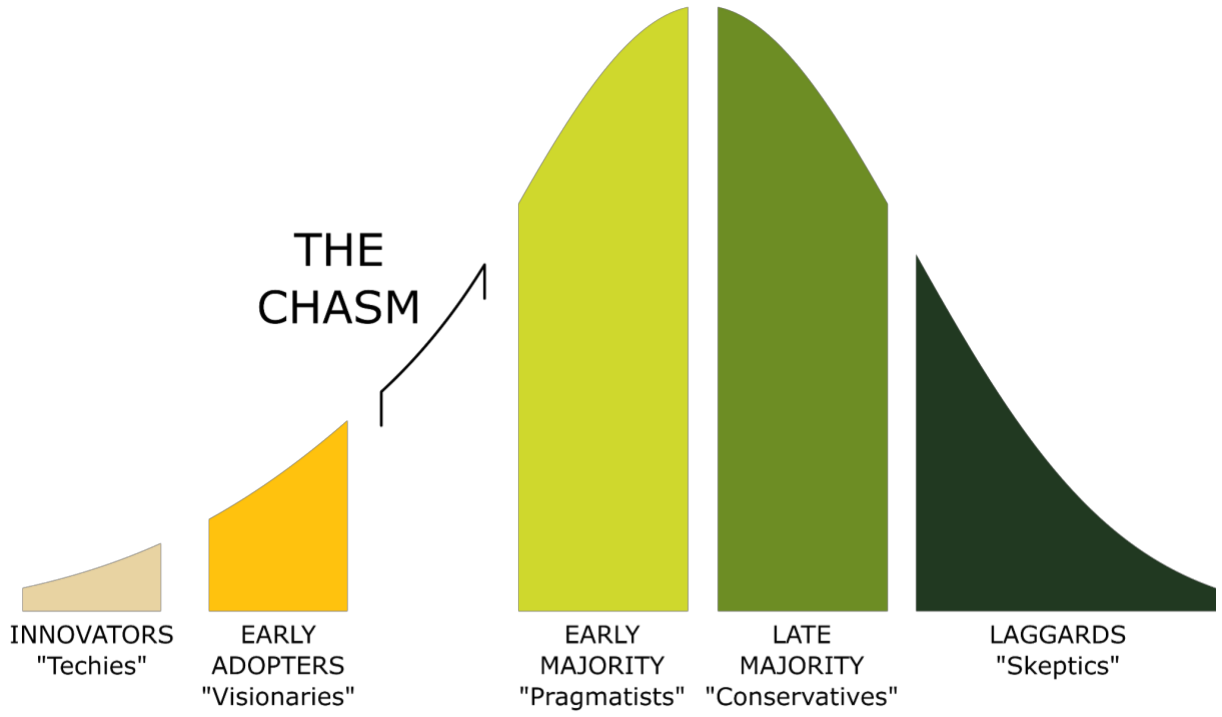

Figure 1. Technology Adoption Lifecycle Curve (Moore, 1991)

Overall, e-bike adoption in the United States remains limited due, in part, to high purchase cost (Dill & Rose, 2012; Popovich et al., 2014). A March 2022 survey of major e-bike brands and models by the author of this paper found an average price of around $2,600 (N = 50, median = $2,400) for commuter and leisure e-bike models, and $5,000 (N = 10, median = $4,500) for cargo e-bike models. A plot of the prices found in this survey is provided in Figure 2. A survey of self-selected e-bike owners in North America found that, on average, an e-bike costs $2,600 to purchase (MacArthur et al., 2018). For comparison, a mountain bike has an average wholesale cost in the U.S. of $620 (Bicycle Retailer and Industry News, 2018). A conventional bicycle purchased at a specialty store costs $753, on average, in the U.S., and a conventional bicycle purchased at a department, discount, or chain toy store costs $89, on average (National Bicycle Dealers Association, 2015). Clearly, a price disparity exists.

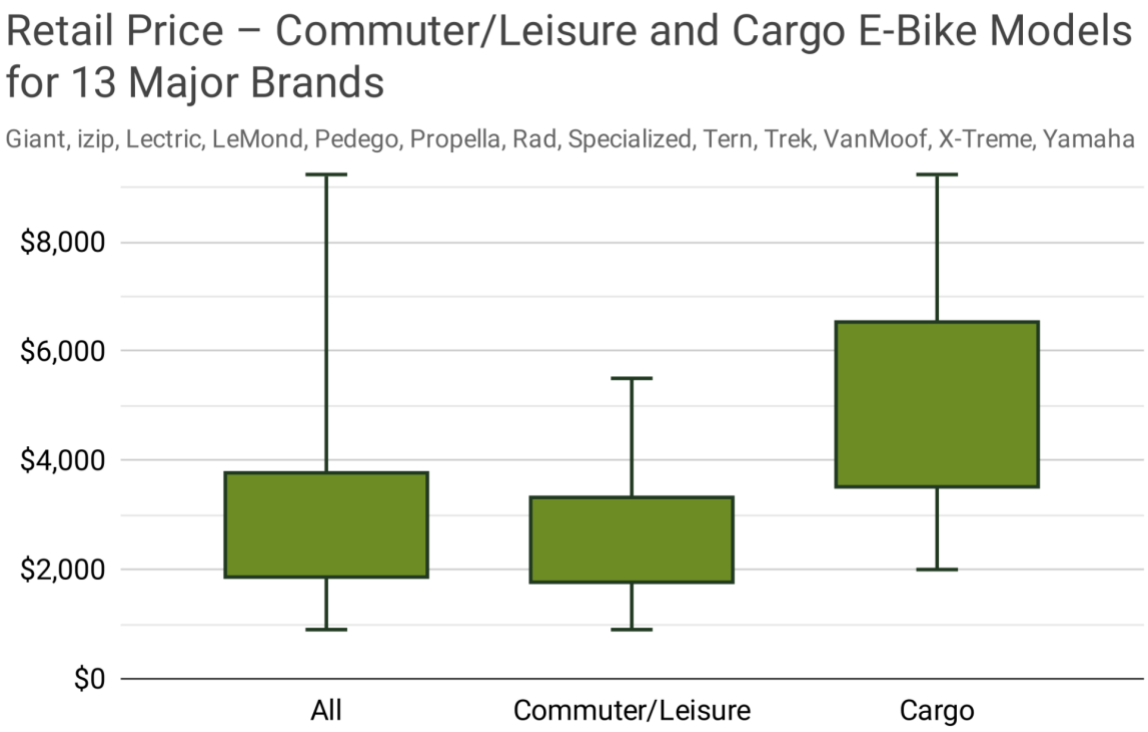

Figure 2. Retail Price for Commuter/Leisure and Cargo E-Bike Models, March 2022

The European Cycling Federation suggests that e-bike incentive programs are an effective part of the solution to overcoming the price barrier to e-bike ownership (Haubold, 2017). Recent polling in Britain indicates that a rebate of 25% of the purchase price may be enough to convince half of people to strongly consider purchasing an e-bike (BikeIsBest, 2022). In the U.S. and Canada, these financial incentives have emerged as a popular technique; more than 75 active, lapsed, or proposed e-bike incentive programs have been identified to date. This white paper summarizes the trends and recommended practices in these existing e-bike purchase incentive programs. Web searches and news alerts using Google and the Transport Research International Documentation (TRID) database were used to obtain studies and program information pertaining to incentive strategies. In addition, recommended practices and lessons learned from select programs within the United States were obtained through phone and email correspondence with program administrators. The goal of this white paper is to provide policymakers, agency leads, and local community leaders with a range of techniques to develop and structure e-bike incentive programs to help meet emissions, SOV travel, and VMT reduction objectives.

Incentive vs. Rebate vs. Subsidy

A variety of terms are used to describe financial assistance provided for e-bike purchases. A high-level overview of these terms is provided here to describe how they will be used throughout this white paper.

Incentive – An incentive is any mechanism used to encourage a behavior. When encouraging e-bike adoption, many forms of incentives may be used. Lending libraries, pay-to-ride schemes, low-interest loans, and others were found in a review of existing programs, and are explained later in this white paper. However, this paper will focus primarily on purchase incentives, which provide direct support for the purchase of an e-bike by an individual or business.

Rebate – A rebate is a form of purchase incentive in which a partial repayment of a purchase price is provided, often after the purchase takes place. However, rebates may be paid at the point-of-purchase through vouchers or discounted purchase prices. This is the most typical form of e-bike incentive program today.

Subsidy – A subsidy is a targeted investment from a governing body to an individual or business with the intent of fueling growth, development, or accessibility for a particular market or product. These can be direct, as in the case of cash distribution, or indirect in the form of tax breaks. Rebate programs, sales tax waivers, or tax liability credits may be described as subsidies.

Background

Definition of an E-Bike

Electric bicycles, or e-bikes, are bicycles with pedals and an electric motor. Typically, the electric motor is limited to 750 watts (1 horsepower), although regulations differ by location. An e-bike must have pedals, meaning that it can be ridden with human power – without the motor engaged. The e-bike may or may not have a throttle, allowing it to be ridden without pedaling. In the U.S., e-bike speed and throttle characteristics are typically described and regulated using a 3-class system, as shown in Table 1. Thirty-seven states currently have legislation in effect that adopt all or part of the 3-class system definition (PeopleForBikes, 2022). Most states stipulate that Class 3 e-bikes (speed pedelecs) are required to have a speedometer visible while riding. Some states also require helmets for riders of Class 3 e-bikes.

Table 1. E-Bike Classification

Class	Max. Speed (mph)	Throttle
1	20	×
2	20	✓
3	28	×

History of E-Bike Incentive Programs

An e-bike incentive program is a scalable plan established to encourage the uptake of using an e-bike as a primary mode of utilitarian transportation with the goal of simultaneously reducing single-occupancy vehicle use. It effectively encourages users to make changes in travel behavior by reducing barriers to entry for using this new mode of travel, often by offering financial incentives and/or revealing the latent benefits of using an e-bike. The goal of such incentive programs can be to shift the transportation mode split of a region or local jurisdiction such that its transportation system's carbon footprint can be reduced.

The previous version of this white paper, *How E-Bike Incentive Programs are Used to Expand the Market*, was published in May 2019 by the Transportation Research and Education Center (TREC) at Portland State University, and includes a thorough history of incentive programs that have been used to encourage e-bike adoption. The review summarized incentive programs that have been studied in academia including a car-bike swap, an annual bike-to-work event, an e-bike mileage reimbursement program, and an e-bike loan program. Some of these, in addition to other more recent programs, are reviewed in less detail here.

A variety of e-bike loan programs have proven to be an effective way to raise awareness and encourage the use of the technology. Starting in 2015, Switzerland implemented a nationwide intervention, dubbed "Bike4Car," through which over 1,800 participants gave up their car keys in exchange for a free e-bike for use during a two-week trial period. Participants reported in the post-trial survey that they had a high intention to buy an e-bike and drive less in the future. Immediately after the trial, 15% of participants (271) purchased an e-bike (Moser et al., 2016). In Brighton, United Kingdom, 80 participants were loaned an e-bike for six to eight weeks without any financial compensation. About three-quarters of the participants used the e-bike about once per week, with an average mileage across all participants between 15 and 20 miles per week. Commuting was the dominant purpose for these e-bike trips, and 43% of participants reported that they traveled less as a car driver (Cairns et al., 2017). A sample of employees of the Kaiser Permanente hospital system at three campuses in Portland, OR were provided an e-bike to use for six weeks at a time, again without financial compensation. Compared to before

the trial, the amount of people commuting to work by bicycle in the study group doubled from 28% to 59% (MacArthur et al., 2017). Google has provided six-month e-bike loans to employees since 2015. During a study of program participants, single-occupancy vehicle commuting dropped by 2.4 days per week, on average. More than half (62%) of loan program participants bought a bike at the end of their loan period (Fitch et al., 2022). Combined, these programs indicate that effectively demonstrating the inherent attractiveness of an e-bike could be a cost-effective way to stimulate uptake for utilitarian purposes. Such programs should shrink barriers preventing potential users from having a positive first experience, the hook that induces a travel behavior change.

A typical intent of emerging e-bike incentives is lowering the cost of purchasing an e-bike and bringing e-bikes into price parity with conventional bicycles. In Europe, e-bike purchase incentives have become commonplace. More than 300 tax-incentive or purchase-premium incentives are available across the continent, provided on all levels of national, regional, and local authorities (Haubold, 2022). This includes large-scale national programs, such as the one administered in Sweden between 2018 and 2019. Under this program, the Swedish federal government provided $48 million in subsidies at a rate of 25% of the purchase price of the e-bike, up to $1,000. E-bike sales doubled during the program's lifetime, with over 100,000 bikes being sold, 63% of which were subsidized (Anderson & Hong, 2022). As a result, the European e-bike market has seen significant growth in the past decade, with annual unit sales now over 3 million (Haubold, 2020).

In the last half-decade, there has been a proliferation of e-bike incentive programs in North America. Over 75 such programs have emerged, with the vast majority being purchase incentives in the form of cash rebates or point-of-sale discounts. These programs are primarily concentrated in California, Colorado, and Vermont, but are beginning to see a greater geographic spread. The following sections of this white paper will provide summary statistics on these programs and explore various philosophies, delivery mechanisms, and recommended practices uncovered through a policy scan and program manager interviews.

Current E-Bike Market Trends

The U.S. e-bike market is currently booming. The 2020 "bike boom" saw increases in unit sales for non-electric bicycles of around 37% to around 64,800,000 units, while e-bike unit sales more than doubled to around 820,000 units (NPD Group, 2022). Tellingly, while the conventional bicycle market returned to historical trends in 2021, the U.S. e-bike market increased a further 50+%, likely breaking the million-unit mark for yearly sales, nationally (NPD Group, 2022). These trends are visible in NPD Group data shown in Figure 3 and Figure 4. On unit sales alone, e-bikes outsold electric cars in 2021 (Boudway, 2022; IEA, 2022). Another analysis found that the North American and European markets combined are estimated to have reached 6.4 million annual unit sales in 2021, while 30 million units are sold annually in China (Stewart & Ramachandran, 2022). These trends are likely indicators of the establishment of a large market for e-bikes as they shift from a novelty or recreational vehicle to a viable mode enriching the transportation network.

Statistics for current U.S. e-bike market trends shown in Figure 3 and Figure 4 were obtained from NPD Group market data provided by PeopleForBikes. This data is generated from insights to Independent Bicycle Dealers (IBDs) and Rest of Market sales (ROM; sporting goods specialty, mass market, and online), and is thought to represent roughly a third of all units sold in the United States. The remainder of sales not represented in this data are through online independent bicycle dealers (eIBDs), third-party online sales, or direct-to-consumer sales.

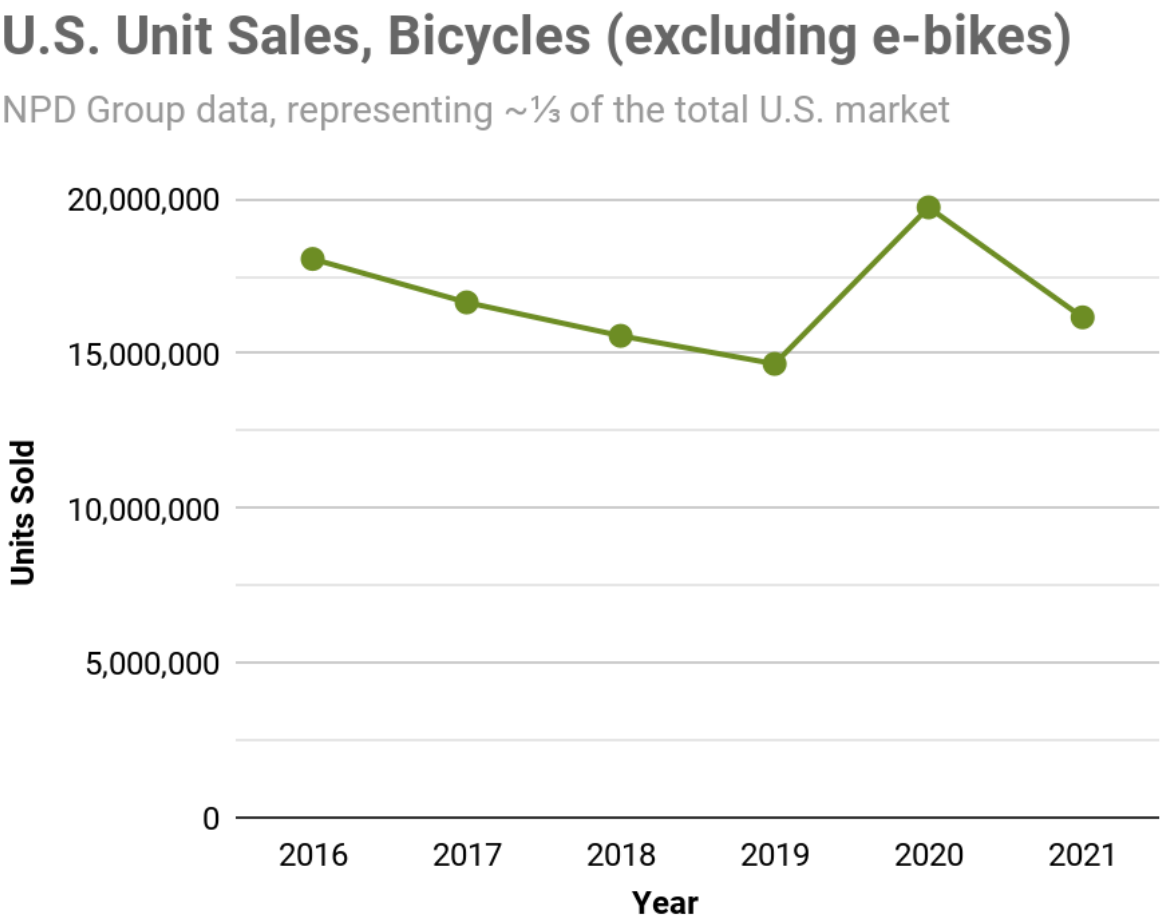

Figure 3. Unit Sales of Non-Electric Bicycles, 2016-2021 (NPD Group, 2022)

Based on these numbers, it is likely that there are more than 3 million e-bikes in U.S. households today. Of those e-bikes, approximately 30% are transit or fitness styles, while mountain and leisure/lifestyle styles account for around 15% each. Road-specific e-bikes make up a small (<5%) portion of the market. The remaining ~40% of the market is not captured by these categories, and may include cargo bikes, or bikes for which a type was not recorded. These shares are shown as the number of units sold for each category in Figure 4.

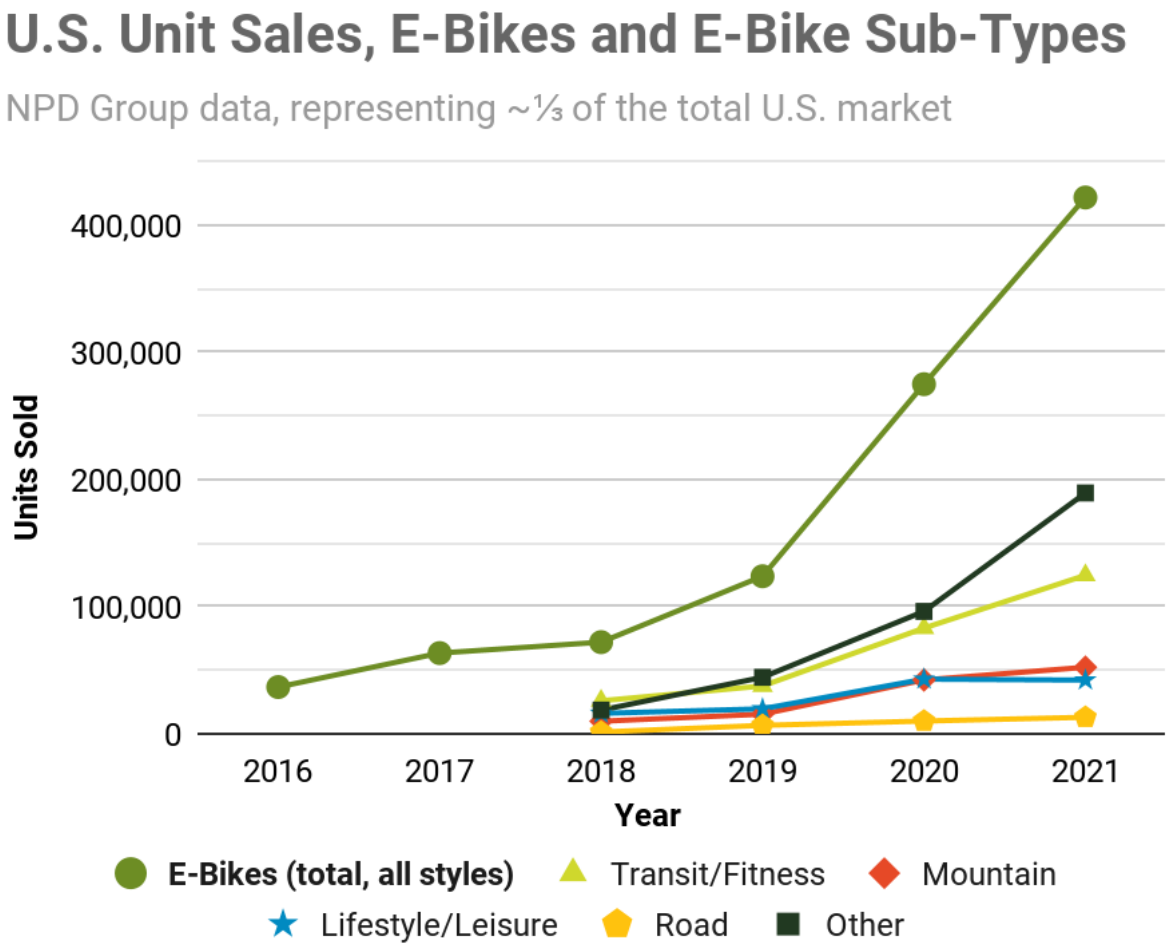

Figure 4. Unit Sales of E-Bikes and E-Bike Sub-Types, 2016-2021 (NPD Group, 2022)

Cost of Ownership

E-bikes have the potential to offset VMT due to the relatively low costs associated with their purchase, maintenance, and operation. Average prices are around $2,600 for commuter and leisure e-bike models, and $5,000 for cargo e-bike models, as shown in Figure 2. Power and maintenance costs for e-bikes are typically very small. The average battery capacity from the market survey was around 500 watt-hours (Wh) with an average range of over 50 miles. The average cost of electricity in the U.S. as of March 2022 is around $0.10 per kilowatt-hour (kWh) (EnergyBot, 2022). Based on this, power for an e-bike can be estimated to cost less than one cent per mile. For typical use, this equates to less than $30/year for power alone. Maintenance costs are also typically twice that of a standard bicycle due to battery replacement ($500 every 5-10 years), higher wear and tear on tires and brakes due to the bike being heavier, and maintenance to the motor and electronics ($100 annually for parts and $150 annually for service). This results in an average ownership cost for an e-bike of around $400 per year when used heavily on a day-by-day basis.

As a comparison, the average used car price in the U.S. was over $28,000 as of January 2022 (Tucker, 2022). The IRS standard mileage rate for 2022 is 58.5 cents per mile driven for business use, which takes into account all ownership, maintenance, and operations costs, including depreciation, insurance costs, and interest accrued on an auto loan (Internal Revenue Service, 2021). The average U.S. vehicle travels over 14,000 miles per year (Hardesty, 2021), resulting in an average cost to the owner of over $8,000 (American Automobile Association, 2022), although this figure varies considerably with vehicle type, vehicle age, miles driven, and vehicle resale value.

These figures suggest that the purchase price of an e-bike, when used primarily to replace vehicle travel, could pay for itself after just a few months.

The comparatively low ownership and operation cost of an e-bike is a potent argument for the potential for e-bikes to work as an equity-driving tool. For people with lower incomes, transportation costs can make up a significant portion of household expenditures. If destinations are safe and accessible by bicycles, e-bikes offer a low-cost alternative to vehicle travel. This benefit may be especially meaningful as global oil supplies and cost fluctuates due to impacts from the pandemic and other crises. Initial reports seem to point to an increased demand for e-bikes as people consider ways to offset their transportation costs. Together, these trends and figures suggest that now may be a critical time to encourage and support the adoption of e-bikes as a travel mode on economic grounds.

Status of a U.S. Federal E-Bike Incentive

The Electric Bicycle Incentive Kickstart for the Environment (E-BIKE) Act, introduced to the House of Representatives in February 2021, proposed a tax liability credit for the purchase of e-bikes at 30% of the purchase price of the bicycle, up to a maximum credit of $1,500 (Congress.gov, 2022). The maximum pre-incentive purchase price for e-bikes to qualify for the program was set at $8,000.

The bill has subsequently been rolled into H.R. 5376, or the Build Back Better Act, in SEC. 136407 – Credit for Certain New Electric Bicycles. In this new iteration, the e-bike credit was lowered to 15% of the purchase price for a time, but has subsequently been returned to the initial 30% figure, with a maximum rebate of $900. The maximum aggregate purchase price of a

bicycle applicable to the rebate would be $4,000 (House Committee on the Budget, 2022). Maximum allowable credit amounts are reduced by $200 for each $1,000 (or fraction thereof) by which the taxpayer's modified adjusted gross income exceeds $75,000 for individuals, $112,500 for heads of household, or $150,000 for joint filers. Class 1, 2, and 3 e-bikes would be allowed to be applied to the credit.

The maximum purchase price of $4,000 would exclude most cargo bike models and some higher-end standard e-bike models. This is a shortcoming of the bill; parents with young children are a large and growing segment of the e-bike market. Crucially, they are key supporters of e-bike regulations and incentive programs and have been instrumental to successful bicycle movements in the past, so their exclusion from this bill's structure potentially excludes an important market segment, especially considering the goal of replacing shorter car trips. It is unclear why this distinction was made for e-bikes, other than the potential of not wanting the credit to be applied to high-priced recreational models. Based on a scan of cargo bike model pricing from popular brands, raising the maximum allowable purchase price to $6,000 should capture most cargo bike purchases. Separate criteria could also be developed to define approved cargo e-bike models, which would be subject to a higher price cap, as was done for electric vehicles. H.R. 5376 includes a similar tax credit for electric vehicles but provides varying price limits for sedans ($55,000), vans ($64,000), SUVs ($69,000), and pickup trucks ($74,000). A recent program in Denver, CO, provides a model for this type of stratification in the context of e-bikes.

Additionally, the credit in the Build Back Better Act does not provide any additional benefits for low-income Americans. This is likely based on precedent set by previous federal mobility incentives, like the Plug-In Electric Drive Vehicle Credit (IRC 30D), and the desire to minimize administrative overhead. However, because the credits will be self-reported through tax filing, administrative needs for income verification would be minimal. Additionally, the income thresholds at which credit amounts are diminished are set lower for the e-bike credit than those set for the credit for electric vehicles ($150,000/$112,500/$75,000 vs. $800,000/$600,000/$400,000 for joint returns or surviving spouse/head of household/any other case). Because e-bikes provide an accessible long-range mobility option for low-income Americans, an equity-focused incentive has the potential to induce more new purchases than a smaller but universally available incentive. Further discussion on this topic can be found in the *Addressing Equity Goals* section of this white paper.

The e-bike incentive in the Build Back Better Act would allow for power purchase agreement (PPA), meaning that the retailers would be able to claim the tax benefit on behalf of the consumer. This mechanism could effectively turn the incentive from a tax credit to a point-of-purchase benefit for the consumer, likely improving its uptake prospects, especially among low-income populations for whom a distant credit would be less attractive. It is currently not clear whether or not benefits from the e-bike credit would be refundable if they were in excess of tax liability for the year in which they were claimed. The PPA arrangement has the added benefit of enabling retailers to assist consumers in avoiding this potential pitfall.

The credit of 30% of the purchase price provided in the Build Back Better Act would not establish price parity between e-bikes and conventional bicycles, and likely would not fully remove e-bikes from the early adopter phase in many areas. As with electric vehicle incentives, it is likely that state and local incentives programs would supplement, rather than be replaced by, this federal incentive. This model for marginal incentivization is well-established in electric vehicles. State and local incentives also have the opportunity to complement a federal incentive with an equity-driven approach by providing additional incentives to people with lower incomes, in targeted areas, or with particular use cases.

Electric Vehicle Incentives

It's important to recognize that incentives for the adoption of new mobility technology are not a novel concept. A federal tax credit of up to $7,500 has been available for the purchase of electric vehicles (EVs) for over a decade. Forty-five states and the District of Columbia offer some form of incentive for EVs or plug-in hybrid electric vehicles (PHEVs), either through statewide legislation or through local utility providers.

The federal Plug-In Electric Drive Vehicle Credit (IRC 30D) was adopted as part of the Energy Improvement and Extension Act of 2008. Since January 1, 2010, consumers have been able to claim a credit of $2,500 plus $417 "for a vehicle which draws propulsion energy from a battery with at least 5 kilowatt hours kWh of capacity," plus an additional $417 for each kWh of battery capacity in excess of 5kWh, up to a total of $7,500. Claimable credit begins to phase out when a manufacturer has sold at least 200,000 qualifying vehicles in the United States on a cumulative basis since the start of the program. To date, full phase out has only been initiated for vehicles manufactured by General Motors and Tesla, while tax credits remain available for purchase of qualified EVs from any other manufacturer (Internal Revenue Service, 2022).

A number of states provide purchase incentives for EVs that can be claimed in addition to the federal credit. For example, California offers a $2,000 incentive through the Clean Vehicle Rebate Project, while Colorado offers $4,000, and Connecticut offers $5,000, among a number of other states. Oregon provides $2,500, or up to $5,000 for income-qualified applicants. Many states also offer incentives in the form of waived registration fees, support for the installation of charging infrastructure, or high-occupancy-vehicle (HOV) lane exceptions (Hartman & Shields, 2021).

With the addition of these state incentives, the purchase of a new EV may be subsidized at rates upwards of 20%, providing price parity with comparable gas-powered vehicles. This has proven to be an effective technique to spur the further adoption and development of EV technology, with EVs becoming an ever-growing portion of the U.S. vehicle fleet in the past decade despite their relatively high purchase price. Importantly, the authors of IRC 30D anticipated the establishment of a large-scale market for EVs, and designed the incentive program to phase out following the bridging of the chasm of Moore's technology adoption curve, which shown in Figure 1. This model may be useful for the development of longer-term federal or state-level incentive programs for e-bikes, as their adoption is likely to follow a similar trajectory.

Policy Scan

This section describes the current state of U.S. and Canadian e-bike incentive programs. A scan of past, presently ongoing, and proposed future e-bike incentive programs was completed in the spring of 2022. As part of this scan, program details such as program administrator, incentive model, discount mechanism, and income-qualification were collected. This section provides a quantitative review of this survey, while the remainder of the white paper provides qualitative findings and recommendations uncovered.

The complete list of programs identified by the researchers as of April 16, 2022 is included with this white paper in Appendix A. Summary statistics are provided for those programs here. As of May 2022, an actively updated version of the incentive program tracker with key program details and links to program websites can be accessed at the TREC website (trec.pdx.edu/e-bike-research). The date of the most recent update to the inventory is listed at the header of the table. Figure 5 shows a map of all the programs included in the inventory and subsequent analysis.

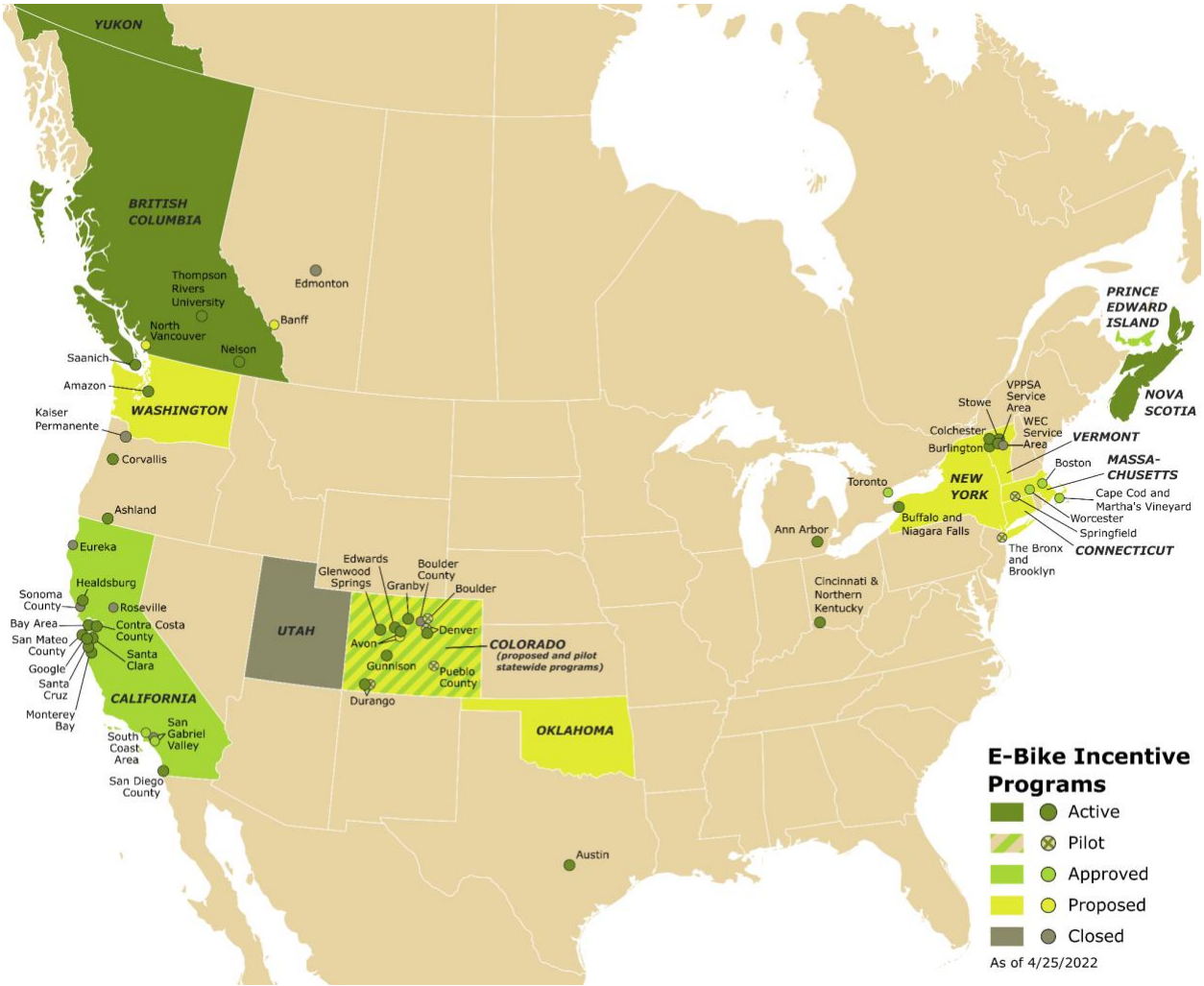

Figure 5. Map of Identified E-Bike Incentive Programs, U.S. and Canada *(as of 4/25/22)*

Seventy-five e-bike incentive programs were identified in the U.S. and Canada. Of these, 38 are active, 7 are considered “pilot” programs due to their small size or limited timeframe, 2 are statewide parent programs administered through local programs, 7 programs are approved and do not yet have full details available, 8 have been closed, and 13 have been proposed but not yet enacted.

Of proposed programs, three are from local governments, eight are from state or provincial governments, one is from a power district, and one – H.R. 5376 – is from the U.S. government. Administrators of approved programs awaiting activation are as follows:

- Toronto, ON: City of Toronto
- Prince Edward Island: Province Government
- California: California Air Resources Board (CARB) (statewide air quality management authority)
- San Gabriel Valley, CA: ActiveSGV (advocacy group)
- South Coast Area (including LA), CA: South Coast Air Quality Management District (air quality management authority)
- Boston, MA: Metro Mobility (private entity)
- Cape Cod and Martha’s Vineyard, MA: Cape Light Compact (Power district)

Two parent programs are included in the survey data set:

- The California Air Resources Board “Clean Cars 4 All” program is administered at a local level. Some local administrators include e-bike incentives or vouchers in their vehicle trade-in benefits, and were analyzed as independent programs.
- The Massachusetts Clean Energy Center’s MassCEC and the Department of Energy Resources (DOER) have made funding available to a number of local programs, some of which provide e-bike-related benefits.

The remaining 53 programs identified were classified as either Active, Pilot, or Closed. Summary statistics for these programs are shown here. A full list of the identified programs is available in Appendix A.

The overwhelming majority of the programs identified were cash incentives in the form of post-purchase rebates (23) or point-of-sale discounts (12). Free e-bikes (4), lending libraries (4), ride-to-own e-bikes (3), vehicle trade-in vouchers (2), low-interest loans (1), and programs with multiple options available (3) making up the rest. This breakdown is shown in Figure 6. This was due to the way in which programs were searched for. The primary mechanism for finding program information was Google News alerts for “e-bike”, “e-bike incentive”, and “e-bike bill.” There are undoubtedly further examples of incentives that were not cash subsidies that were not captured in the data collection process. However, for the purposes of this white paper, cash incentive programs were of the most interest, and more focus was given to developing a complete list of these.

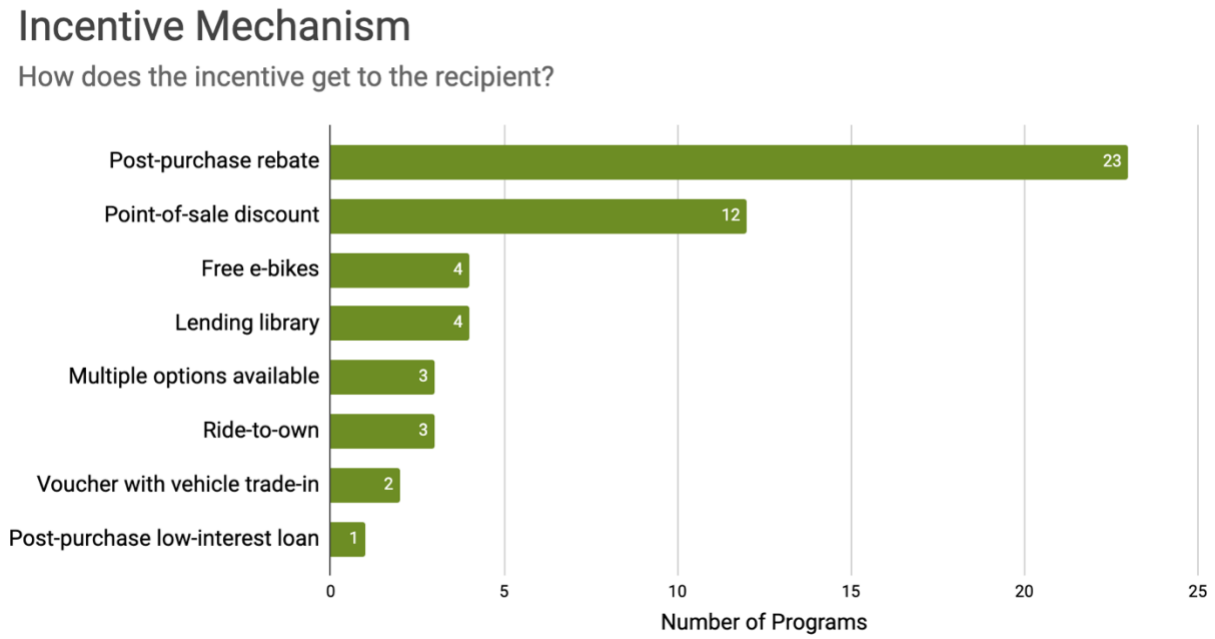

Figure 6. Incentive Mechanisms

As shown in Figure 7, of the 37 cash incentive programs, a dollar value was established through a flat rate (24) in the majority of cases. Eleven programs provided a percentage of the purchase price with a cap, while one – from the Equitable Commute Project in New York City, NY – did not provide a cap in the online descriptions of the program. One program – in British Columbia – provided a cash incentive in the form of a sales tax waiver. While no current programs do so, a number of approved and proposed programs provide a cash incentive through a tax liability credit.

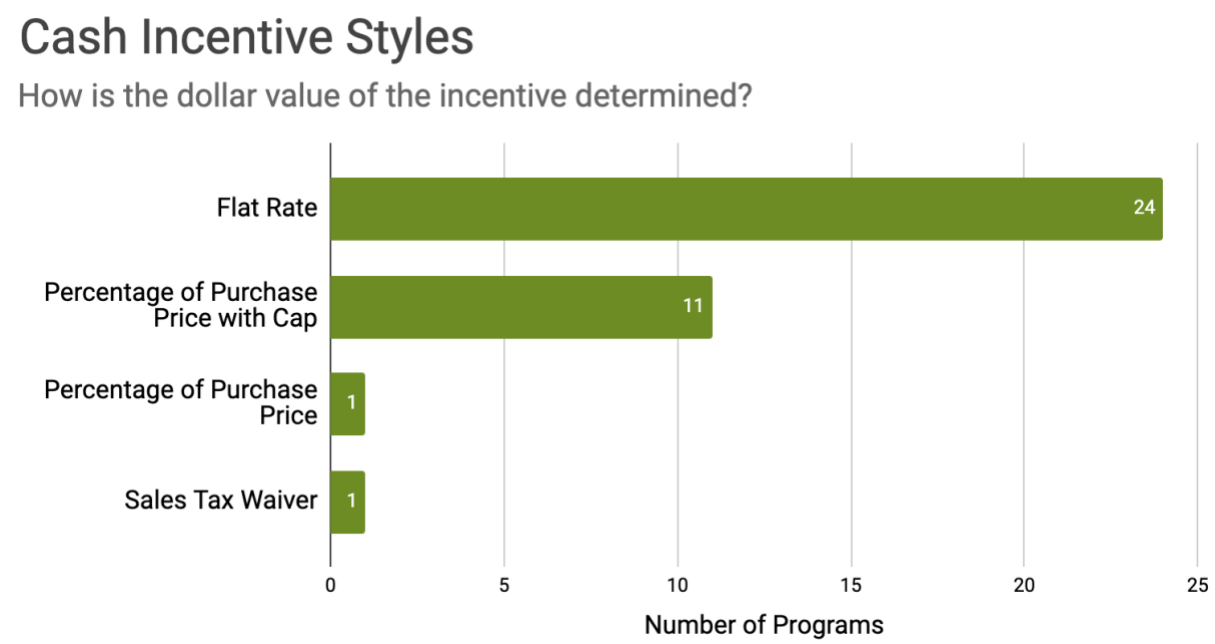

Figure 7. Cash Incentive Styles

Cash incentive amounts shown in Figure 8 range from $100 to $1,365 ($1,700 CAD) for the general public, with a maximum incentive amount of $1,700 for income-qualified applicants receiving the additional cargo-bike incentive in the recently passed Denver, CO, incentive. The majority of incentive programs (58%) fall in the range of $200-600, with six programs providing incentives of less than $200, and six programs providing incentives greater than $1,200.

For Figure 8, maximum incentive amounts are shown. The highest allowable incentive amount is used for programs which establish amounts proportional to purchase price. The aforementioned Equitable Commute Project in New York City, NY, was omitted from the figure due to it not providing a cap on incentive value.

Four programs – Saanich, BC; Yukon, Canada; Denver, CO; and Austin, TX – provided specific rebates for cargo or commercial fleet cargo e-bikes at $1,330, $1,175, $900, and $400, respectively. The Denver cargo bike incentive also includes a low-income option at $1,700. These options are included as separate programs in Figure 8 only.

Of the programs, one quarter were fully income-qualified, meaning that all participants needed to report less than a given income threshold. Another 11% of the programs provided additional benefits for people reporting incomes below a given threshold. These income-qualified programs and low-income options are shown as independent programs in a lighter color in Figure 8.

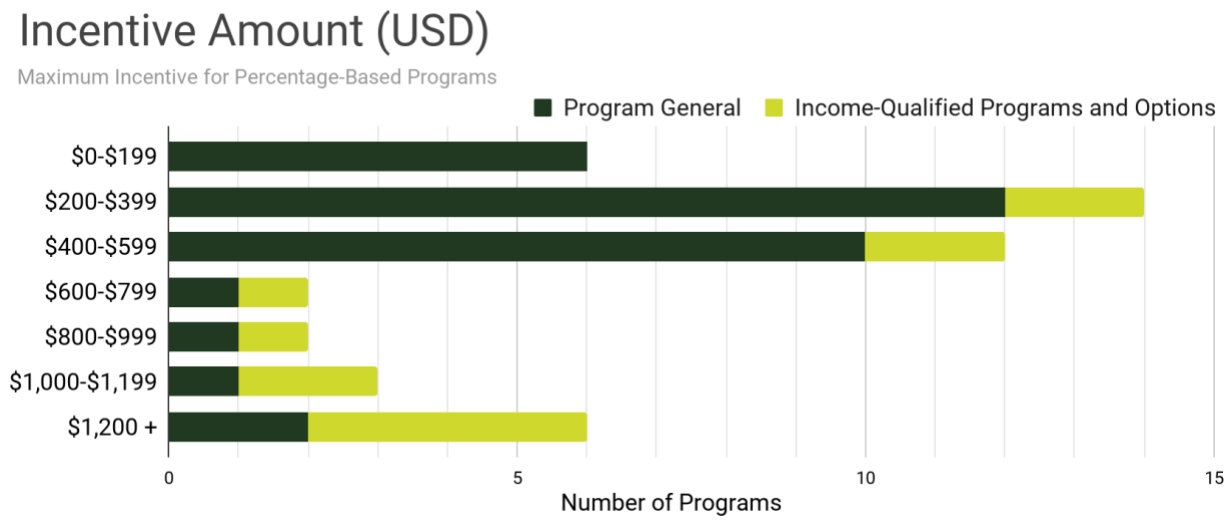

Figure 8. Incentive Cash Amounts (USD)

Low-income thresholds used by programs were as follows, and were often based on Federal Poverty Guidelines (FPG) developed by the U.S. Department of Health and Human Services.

- Participation in an income-qualified program (4)
- Equal to or approximately 400% FPG (4)
- Equal to or approximately 200% FPG (3)
- 80% of median family income for the area (2)
- Multiple levels at approximately 300%, 400% FPG (1)
- 60% of the statewide median family income (1)
- 50% of median family income for the area (1)
- $35,000 annual income (1)

Program administration duties were carried primarily by power districts (22), and local governments (13), with nonprofits and advocacy groups (7), state and provincial governments (5), private entities (5), and air quality management authorities (2) managing the rest.

Among the cash rebate programs for which it could be discerned, half (50%) restricted eligible purchases to local bike shops, while half allowed online or out-of-area purchases.

There are likely additional e-bike incentive programs of various structures administered by private entities that were not identified in this survey. Privately managed programs tend to be reserved for employees of the administrator and, thus, are not widely publicized. One well-known contractor providing program design and administration for corporate clients is Bikes Make Life Better, which administered the program at Google captured in this survey. The Google program has been the subject of prior research which may provide valuable inspiration for prospective corporate program administrators (Fitch et al., 2022).

Program Development Overview

The following sections will provide guidance for the development of an e-bike purchase incentive program. Principles discussed were generated through a review of existing programs, discussion with industry leaders, and interviews with program managers. Considerations and recommended practices will be provided in accordance with the process presented in Figure 9.

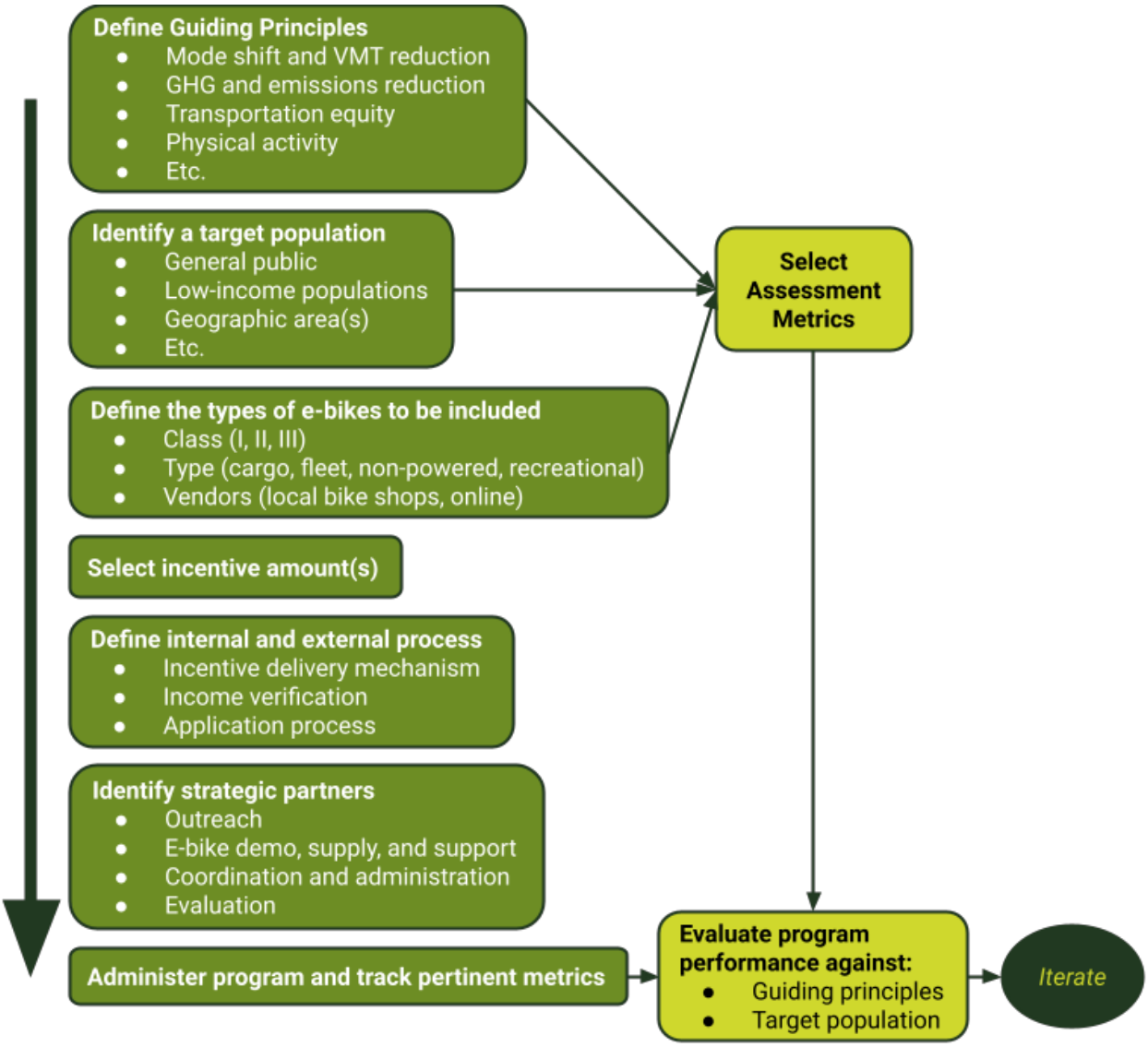

Figure 9. Program Development Flowchart

Define Guiding Principles and Select Assessment Metrics

At the outset of a program's design, it is important for program managers to define what success means to them and how it may be tracked. Program goals may include, but are not limited to:

- Vehicle miles traveled (VMT) reduction, resulting in:
    - Increased bicycle mode share and a reduction in single-occupancy vehicle (SOV) demand
    - Greenhouse gas (GHG) and tailpipe emissions reduction
    - Safety co-benefits through "safety in numbers" Elvik Bjørnskau, 2017; Jacobsen, 2003)
    - Increased community support for further cycling interventions, such as infrastructure or public bikeshare
    - Quality-of-life improvements
    - Consumer spending increases (Clifton et al., 2013)
- Transportation equity:
    - Access to opportunity by providing a longer-range transportation option to communities in transportation deserts, or for people for whom driving is difficult or inaccessible
    - Access to a lower-cost alternative to vehicle ownership and use for people for whom transportation costs may be a burden
- Physical activity increase through e-cycling
- Diversification of a cycling community, including social equity-focused goals

For each of these goals, a variety of metrics may be developed to establish baselines and performance measures. Trip diaries, follow-up surveys, GPS tracking, participant interviews, solicitation of participant and community feedback, and community group engagement are all ways to generate quantitative and qualitative data for analysis. The methods and metrics selected will depend on the specifics of the program, the desires of participants and managers, and the requirements of the funding sources. Partnership with local academic institutions, non-profit organizations, and advocacy groups is recommended, due to researchers' familiarity with these techniques and readiness to take on this type of work.

An appropriate tracking timeline is also important to establish. Research suggests that habit formation may take six months or more (Lally et al., 2010); behavioral changes resulting from e-bike introduction should be evaluated on this timeframe or longer. An evaluation program might find it useful to gather data at the time of purchase and, subsequently, at time periods that are appropriate to track the behavior change goals of the program.

These goals and relevant tracking metrics will also be heavily influenced by the next steps of identifying target populations and defining e-bike models to which the program applies, and should be revisited and refined throughout the program visioning and design process.

Inframarginal Participation

A potential concern for program managers is the receipt of subsidies by “inframarginal”, or “non-additional”, consumers who would have purchased an e-bike regardless of whether or not a purchase incentive was available. Because most program goals will be reliant on inducing new purchases, particularly for people who currently drive a car for transportation, estimating inframarginal participation will be important when assessing program efficacy. To do so, program managers will need an understanding of background sales, use, and ownership rates, and ways to track these metrics changing during the administration of the incentive program. The analysis performed by Anders Anderson and Harrison Hong (2022) may provide a model to do so. Their examination of a high-subsidy (~$1,000 USD), nationwide Swedish e-bike purchase incentive program open to the general public found that 41% of rebates were distributed to new purchases in households that drove a car. While this may seem like a 59% reduction in efficacy for program funds, many additional subsidies supported auto trip reduction or transportation access for households already considering an e-bike purchase, or at the very least stimulated the local economy through an effective tax break.

Identify a Target Population

Once general program goals have been defined, incentive recipients appropriate to these goals should be identified. At the bare minimum, the vast majority of programs require proof of residency or status as a utility customer in order to restrict the program to constituents of the administrator's service area. The majority of programs are available to the general public, encouraging uptake for as many people as possible. This is an appropriate approach, especially if the primary goal of the program is to encourage mode shift and VMT reduction. However, programs may be further restricted or targeted in an effort to more tactically distribute funds or address equity goals through economic, geographic, or demographic measures. The decision to do so is heavily dependent on program goals. Some considerations in narrowing program scope are included in this section.

Income-Qualification

Many programs restrict the receipt of cash incentives to income-qualified individuals, or reserve extra funds to provide additional purchase incentive value to those who qualify. Because of the high retail price of e-bikes, many consumers with low incomes may be priced out of the market despite the presence of financial incentives. Traditionally marginalized groups also suffer from a lack of access to low-interest credit, and may not have tax liability in excess of a potential tax liability credit. On the other hand, non-cash incentives or outreach efforts may be just as effective in stimulating uptake of the technology for higher-income groups. Therefore, requiring income-qualification as part of a program application can be an effective tool in focusing subsidies on people who may see more direct benefit, and thus inducing more new purchases.

Defining "low income" is a potential concern for program administrators. One tool that many programs use is the poverty guidelines published annually by the Department of Health and Human Services (HHS). These values are intended for administrative use, as opposed to the poverty thresholds published by the Census Bureau, which are intended for statistical use. Many programs define "low" income as a factor of these guidelines, which are stratified by household size, typically at 200% or 400%. Another typical approach to low-income classification is verifying income through participation in a low-income program, such as a local food support program (like a supplemental nutrition assistance program (SNAP)), or rental assistance program. More simply, program managers could choose a percentage of the local median income by which to classify, such as the 80% threshold selected for the Corvallis, OR, program. Proportional benefits can be provided to people at multiple income levels, such as in the Saanich, BC, program, which stratified benefits into three levels by household income.

Program managers should consider the income stratification of their service area when defining thresholds. A subsidy may be very influential in the purchase decision for households in the middle class, for whom large purchases may provide a source of stress. However, the income levels at which this is true will differ by location.

An additional consideration is whether applicants should be required to prove their low-income status, or whether self-reporting is sufficient. The program in Corvallis only requires self-reporting, due to the fact that being repeatedly asked to prove income status may be embarrassing or sensitive for applicants (Houston, 2022). This approach may not be appropriate for all programs and may provide an additional mechanism for abuse, but should be considered by program administrators as a way to reduce the burden of the application process.

Addressing Equity Goals

Many existing programs seek to assist marginalized and underserved communities through income-qualification or tiered benefits for lower income levels. However, there are additional ways in which programs can address social justice needs, including geographic or demographic targeting and context-sensitive program design.

Women and people of color, in particular, are underrepresented in the U.S. cycling population (McLeod et al., 2018). Thus, these groups would make appropriate target groups under an equity-driven program designed to broaden the cycling community. Due to their underrepresentation in the current cycling landscape, women and people of color may benefit from additional incentivization to realize the benefits of e-bike adoption, as many may not have previously considered it a viable option.

Women, in particular, may realize great benefits from e-bike adoption. Caregivers' and homemakers' daily travel patterns tend to involve more and shorter trips than their commuting counterparts. E-bikes, especially cargo e-bikes, allow people to complete these trips without using a car, which can provide a sense of joy, power, and freedom (Maus, 2022). Because women in North America continue to bear disproportionate amounts of the errand-running and childrearing household tasks, they may prove to be ready adopters of e-bikes for daily travel.

There are significant geographic and built environment barriers to wanting an e-bike, including difficulties in purchasing, maintaining, and using the e-bike. Many low-income areas suffer from a lack of accessible bike shops, without which potential riders will experience difficulty trying and purchasing an e-bike, and will have added challenges in obtaining service and parts when the need arises. A lack of safe cycling infrastructure may also mean that the benefits of e-bike ownership may be less visible and harder to obtain for many people living in these areas. The inclusion of direct-to-consumer brands may help to address some of these challenges by making home delivery and at-home service available to people in bike shop deserts. Training and licensing of local home- or community-based shops for e-bike service may also establish easier paths to service for people in these areas.

For groups with communication barriers, whether linguistic, cultural, geographic, or technological, outreach events and access to local shops may be especially important. Only 76% of adults with incomes less than $30,000 own a smartphone, and thus may have limited internet access (Pew Research Center, 2021), and many urban areas have neighborhoods with a high concentration of immigrants or people for whom English may be a second language. Outreach events facilitate communication through tactile interaction with e-bike technologies, and may be supported by community group leaders or language interpreters.

The existence of a state or federal incentive should not dissuade the creation of a more local incentive; instead, an opportunity should be recognized to target a program more narrowly to establish equity goals. If a wider-area incentive is available to a broad swath of the general public, a local incentive program may complement it by providing additional benefits to more price-sensitive or hesitant populations.

For these reasons, outreach to – and continued coordination with – target groups is crucial for a program's success in achieving equitable outcomes. Communication regarding the economic benefits of replacing vehicle trips with an e-bike, cycling safety, and route selection can help to make the case for e-bikes as an emerging mode of transportation in communities where their use is not already widespread. Recommended practice includes coordination with local bike

shops for these communication and outreach efforts when working with marginalized communities, as doing so can lower barriers to try, purchase, and maintain an e-bike.

Receipt of Incentive by Unintended Groups

Program managers may be concerned about subsidies going to unintended groups of people who may not have a strong impact on the ultimate goals of the program. These groups may be college students or other temporary residents, recreation-only riders, or riders younger than driving age. Typically, controlling the receipt of incentives by a particular group is unlikely to be worth the high administrative effort required to do so. It is not recommended that programs take any extraordinary effort to do so.

As an illustrative example, in Saanich, BC, concern with the student population taking advantage of the incentive program was expressed during the program design. However, recipients were mostly older residents, who seem to be more ready adopters of the technology; multiple participants expressed to the program managers that their new e-bikes helped them to get back to cycling after they had stopped doing so. This dynamic played out similarly in Corvallis, OR.

Evaluation is important to address any goals or concerns related to impact on target groups, or receipt by unintended parties. Data to do so can be generated in the form of follow-up surveys, usage tracking, or demographics collection from participants.

Define the Types of E-Bikes to be Included

Once project goals and target populations have been defined, program administrators must consider which models of e-bikes will be available for incentivization, and through which retailers. The most important consideration likely to vary by program are the ways in which electric cargo bikes are treated. It is recommended that cargo e-bikes are provided additional incentives due to their higher purchase prices and ability to replace car trips for a larger variety of uses.

Further considerations for e-bike model qualification are described in this section. In general, it is strongly recommended to incentivize all e-bikes to provide for the widest possible range of use cases, interest groups, and choice to consumers.

Class

A number of existing programs restrict qualified e-bikes by class along the 3-class system described in the *Background* section. Program administrators should consider local regulations pertaining to e-bikes; some states and local areas may have restrictions in place for the use or sale of e-bikes of certain classes by rider age, facility type, or other criteria. The PeopleForBikes website (peopleforbikes.org) provides a variety of resources for surveying this legislative landscape. Dealers, lawmakers, the local cycling community, and local bike shop owners may have additional insight to consider, and should be consulted regarding e-bike type restrictions.

Some programs have specifically restricted certain classes. Typically, Class 2 e-bikes may be considered for exclusion due to the throttle. There are perceived concerns raised regarding the safety of this feature – the bike can be accelerated without a rider on it, or may accelerate in excess of what the rider is able to control. Class 3 e-bikes are often considered for exclusion due to their higher maximum assisted speed, 28 mph, and associated safety and facility access concerns. There is limited research exploring the use and safety concerns of these classes, especially in the U.S. Since all these classes are typically considered bicycles and motor vehicles, and provide functionality that could help increase cycling, it is recommended that all classes are included in an incentive program, depending on the goals of the program, to provide the largest possible range of models for participants to choose from to meet their needs.

One case where restrictions by e-bike class are recommended is for programs for which a primary goal is increased physical activity. While Class 2 e-bikes provide more physical activity than driving, due to the addition of a throttle they do not provide comparable benefits to pedal assist only Class 1 and 3 e-bikes. To date, the vast majority of the research supporting the physical activity benefits of e-bikes has addressed Class 1 e-bikes only.

Type

E-bikes come in all shapes and sizes. Consequently, this means that there are e-bikes available for a large variety of use cases, including hauling children and/or cargo, commercial-grade cargo operations, and various forms of recreation. These specialty bikes each come at higher-than-normal price points and warrant particular consideration in program design.

Cargo E-Bikes

Electric cargo bikes are typically much more expensive than standard e-bikes. However, these

models provide unique value for people who regularly travel with children or significant amounts of cargo and should not be excluded from incentive programs. If necessary, program managers should create a separate price cap for this category of bike or provide an approved model list and opportunity for petition. Based on the review of popular cargo bike models completed for this white paper, an appropriate price cap would be $6,000 or higher.

Additional consideration should be given to providing higher subsidies for electric cargo bikes, due not only to their higher purchase price, but also their ability to offset vehicle trips. These bikes are extremely unlikely to be used recreationally due to their size, weight, and form factor, and thus will consistently replace vehicle miles traveled when in use. Only the programs in Denver, CO, and Yukon, Canada, provide additional rebates for cargo bikes specifically to date, at $500 and $585 ($750 CAD), respectively. However, an additional subsidy closer to $2,500 is needed in order to bring electric cargo bikes into price parity with standard e-bikes.

One concern in including cargo e-bikes is that it may be hard to determine a typology for a "cargo" bike given the many different designs. Providing an approved model list for models stocked at local bike shops or popular online retailers is one possible work-around, as was done by the Eureka, CA, program (redwoodenergy.org/e-bikes). Alternatively, applications could be reviewed on an individual basis, but this approach may quickly overwhelm project administrators and provides space for reviewers' discretion to seed conflict with program applicants.

The program administered by the City of Denver, CO, may provide a model for how to objectively qualify an e-bike as a "cargo" model. The following criteria are from the program webpage (denvergov.org):

> *Cargo e-bikes must have an extended frame designed to carry additional people or cargo. A cargo e-bike must meet the following criteria:*
>
> - *Designed to carry one or more passengers in addition to the rider.*
> - *Designed for carrying heavy or bulky loads.*
>
> *OR cargo e-bikes are determined by having three of the four following:*
>
> - *A published total weight capacity (rider+bike+cargo) rating of at least 400 lbs.*
> - *An extended frame designed to carry additional containers, bags, passengers or has included as a standard component a cargo rack.*
> - *Additional attachment points (front/back) to support the addition of racks/baskets/seats.*
> - *Marketed or advertised as a "cargo" or "utility bike" beyond what would be typical for an e-bike used for commuting.*

Recreational E-Bikes

Most program goals (i.e., greenhouse gas emission reductions, congestion mitigation, transportation affordability and access) are reliant upon the replacement of vehicle miles by the incentivized e-bike. These goals will be less successful if e-bikes are used primarily for recreation rather than for transportation. In general, it seems that it will be cost-prohibitive to manually restrict the purchase of recreational bikes and doing so won't significantly influence the outcomes of the program. Additionally, recreational style e-bikes may provide dual-purpose for recreation and transportation, especially in rural areas. Evaluation will be key in assessing this dynamic, as results will likely vary by location.

Some programs require tracking of use for a period following the purchase of the bicycle, which may exert some social pressure to follow program guidelines on the purpose the e-bike was purchased for, but this is a cumbersome approach for participants and program managers alike. Most programs address the usage concern by issuing incentives on an "honor system," with the mutual understanding that the e-bikes should be used primarily for transport. This approach is likely to be sufficient for local incentives; the most recent large-scale survey of U.S. e-bike owners found that about twice as many trips were reported using an e-bike for utilitarian purposes than for recreation or exercise alone (MacArthur et al., 2018). However, larger-scale programs will provide less social pressure for participants to adhere to program guidelines, making an honor system potentially less effective.

If program managers want to attempt to address this problem, excluding full-suspension bikes from receiving an incentive – as the recent Denver, CO, program has done – may be an effective way to restrict some recreation-only purchases, as few transportation-focused e-bike models feature full suspension. Special consideration should be taken when implementing this type of restriction in places where a trail system could be used for utilitarian trips, such as Boise, ID; Boulder, CO; or Bend, OR. Additionally, this approach does not exclude road-style recreational e-bikes and may see pushback from the mountain biking community for that reason.

Another possible approach is implicit restriction through setting a price cap. Most recreational-specific, high-performance mountain- or road-specific e-bikes tend to be much more expensive than the utilitarian or leisure models, with models from well-known brands typically running over $4,000. If an incentive program has a cap on retail price set to an appropriate level, participants will not be able to claim an incentive for many of these models. When setting price caps, however, the higher price range of cargo bikes must be considered. In this case, providing a separate subsidy tier for cargo e-bikes will likely be appropriate.

Conversion Kits

E-bike conversion kits allow users to install a battery and electric motor on a conventional bicycle, converting it to a functional e-bike. These kits tend to be lower in cost than most e-bike models. A small handful of programs, including in Nelson, BC; Healdsburg, CA; Contra Costa, CA; and Glenwood Springs, CO allow for subsidies to be applied towards these kits, while a number of others explicitly restrict them from participation in the program. These kits should be considered for inclusion in the program in order to increase accessibility to e-bike technology at a lower price point. However, local bicycle retailers should be consulted, as installation and service may provide barriers to use and introduce liability concerns.

Non-Powered Bicycles

Some cycling advocates may accuse e-bike incentive programs of falling short of their climate, equity, and mode shift goals by omitting non-powered bicycles. The question of whether or not to do so is an important consideration in program design. If an argument can be made that the ultimate goals of a program are being addressed by their inclusion, it makes sense that conventional bicycles should receive incentivization as well. In many cases, however, this is likely not the case if the incentive program desires to induce new purchases. Roughly half of U.S. households have a bicycle available to them in working order (Poushter, 2015). Among e-bike owners, this figure rises to 97% (MacArthur et al., 2018). Because of this, it is unlikely that an incentive for conventional bicycles would provide much additional benefit in inducing purchases, as the share of households who do not already have a bike but are interested in

trying one is likely small. These dynamics will be investigated in the near future by the authors of this paper.

Commercial Fleet Cargo E-Bikes

There has been an emergence of e-bike usage for local parcel delivery and other commercial services. UPS has piloted e-bike deliveries in 30 cities. B-Line, a Portland, OR, company, has a fleet of powered trikes available for commercial and promotional use. A variety of commercial cargo e-bike services have emerged in Europe in the past two decades as well. Such services offer benefits by offsetting heavy vehicle miles on in-demand urban street networks. Because of this, special consideration for commercial-style cargo bikes is warranted, both in value and in allowed specification.

E-bikes built for commercial purposes tend to have higher wattage and torque specifications than standard e-bikes, and often have more than two wheels. In fact, four-wheelers are currently the fastest-growing e-bike sector in Europe. These models of e-bike also tend to demand a higher price.

Fleet-style electric cargo bikes provide a different mode substitution dynamic entirely and may be considered separately from a general incentive program, depending on program goals and the local environment. The incentive program administered by Austin Energy in Texas may provide a model. The program includes a separate rebate option for commercial fleets worth an additional $100 over the one available for standard e-bikes. Applicants are required to purchase between 5 and 25 bikes, display Austin Energy branding on the bikes, and provide a report on usage and lessons learned to Austin Energy at the end of the in-service duration of the fleet, which must be at least one year.

Retailer

There are a variety of retailer types that program managers may consider allowing subsidized e-bikes to be purchased from. In order to keep money in the local community, around half of existing programs restrict purchases to local bike shops, which are typically independent bicycle dealers (IBDs), but may include sporting goods specialty stores, mass market stores, and online sales from any of these dealers. Online independent bicycle dealers (eIBDs), third-party online sales, or direct-to-consumer sales offer additional options to consumers and warrant consideration for inclusion from program managers. All possible purchase locations have value, but vendors providing service support, whether through a local brick-and-mortar operation or on-call at-home service support, could provide the best experience for participants and longevity of the purchased e-bikes as viable transportation options.

Explicit partnership with local bike shops provides many benefits. Program recipients will have a great ability to test ride multiple bikes before purchase, and shops may be able to host outreach and demonstration events to garner public interest. Additionally, bikes purchased from local shops are ensured accessible service, whereas bikes purchased online may not have authorized or trained mechanics available in the immediate area. An implicit benefit is that the cash incentive circulates within the local economy after it is redeemed.

Like many industries, though, bicycle manufacturers and dealers have not been immune to the supply chain shortages spurred by the COVID-19 pandemic. These challenges have been compounded by an unexpected surge in demand for bicycles – the 2020 “bike boom.” While sales of conventional bicycles have since returned to normal levels, demand for e-bikes remains

exceptionally high and has again been compounded by rising fuel prices in early 2022. The increase in demand for e-bikes and global supply chain challenges continue to make it difficult for many local bike shops to keep in-demand models in stock, especially when further demand is induced by an incentive program. Allowing participants to shop through online retailers offers a pathway to purchase if local bike shops continue to experience pipeline issues going forward. This purchase mechanism may become more common with the further proliferation of online commerce.

Limiting a program to local bike shops may also have the effect of limiting consumers to a more expensive market. Local bike shops rarely offer in-demand models at sale prices that may be available online, and generally carry higher-end models than may be available from brands online.

Around two-thirds of e-bikes sold in the U.S. today are sold online, and a number of in-demand e-bike brands – such as Rad and VanMoof – are only available through direct-to-consumer online sales. These brands, much like Tesla in the automotive industry, only sell their bikes online. Strong customer service, on-call technician assistance, and mail-in maintenance support are typically provided to make up for the lack of serviceability at local bike shops. This model may be particularly appealing to many people living in car-free households or in areas without bike shops. Additionally, many online bicycle retailers offer generous return policies; Rad and VanMoof allow returns for up to 14 days, and Lemond up to 30. This leniency allows consumers the chance to try the e-bike for an extended period in a setting that will reflect their actual use of the bike.

Rad is widely considered the largest seller of e-bikes in the U.S. by unit volume, having accrued a total of over $329 million in investment to date (Frothingham, 2022). However, insight to the market dynamics of Rad and other companies selling primarily through a direct-to-consumer model are limited. Regardless, it can be confirmed anecdotally that this model represents a large share of the total e-bike market, and used by a number of in-demand brands. Because of this, limiting e-bike purchases to local bike shops will likely have the effect of detrimentally constraining the purchase choices of program participants.

The ability to include online retailers will depend, in part, on the incentive delivery mechanism selected in the subsequent steps, as it may be difficult to coordinate point-of-sale discounts with third-party online distributors. However, it is recommended that an effort is made to include online retailers for program participation, perhaps through direct outreach or a vendor application process.

As with many program design considerations, post-implementation evaluation is key. If participants report difficulty finding in-demand models available for purchase from approved vendors, it may become appropriate to relax restrictions on this front.

Select Purchase Incentive Amounts

At the moment, there is no consensus on the most effective subsidy amount for inducing new, non-inframarginal purchases of e-bikes. However, anecdotal evidence suggests that in order to support low-income groups and incentivize additional purchases, fixed program budgets should distribute fewer, larger subsidies reserved for income-qualified participants. For programs looking to provide subsidies to the general public, targeted universalism, an approach which provides additional incentivization for lower-income groups, could be effective. Of existing programs, 11% provide some additional benefit for income-qualified applicants.

There are a variety of methods that program administrators can use to determine a subsidy amount, acquire funding, or rationalize a program to constituents or policymakers. Some of these philosophies are described in detail in this section, starting with economic methods, and followed by monetized externalities of the sale and use of e-bikes.

Targeted Universalism to Support Low-Income Groups

"Targeted Universalism" is an approach that, as the name implies, combines targeted and universal strategies in an attempt to provide appropriate means for all groups to meet a universal goal (powell et al., 2019). The term was coined by john a. powell, Stephen Menendian, and Wende Ake at the Haas Institute at UC Berkeley, and is used widely in equity circles. This approach was adopted for use in e-bike purchase incentives by program managers in Saanich, BC who based their incentive levels and corresponding income thresholds on research from the University of British Columbia (Bigazzi & Berjisian, 2021).

When incentives for high-value, in-demand items such as e-bikes or electric vehicles are not restricted by income, a large portion of incentive funding tends to be claimed by high-income households, likely without incentivizing any new purchases (MilNeil, 2021). This is because, rather than inducing new purchases, these subsidies go to people who were already planning on buying the incentivized product. Generally, these people will fall in higher income brackets because they were previously considering a high-price product. This effect will be more pronounced with low-value subsidies, as more of them tend to go to less price-sensitive consumers.

High-subsidy programs see higher rates of participation, especially among low-income groups, because they induce new purchases. Setting aside higher-value subsidies for low-income groups allows for a more targeted use of incentive program funding, directly supporting people otherwise priced out of the market.

Economic Subsidy Level Setting

The following methods for determining a subsidy amount rely on funding available and the price sensitivity of the target population with no included monetization of the benefits of e-bike use.

Function of Funding and Desired Number of Recipients

The simplest – and seemingly the most popular – method for determining a subsidy amount is a simple function of program funding and total number of rebates. For example, a program with $50,000 in funding looking to provide purchase incentives for 100 applicants would select a subsidy value of $500 under this model. Consideration for additional subsidies for target groups

(low-income, essential workers, etc.) can also be included under this model. In the above example, if 25% of incentives were to be reserved for low-income residents at double the value of the standard incentive, 25 low-income applicants would receive $800 subsidies, while 75 general public applicants would receive $400.

Price Sensitivity Survey

Determining a subsidy value that would be meaningful to the target population for a program can be done directly through a price sensitivity survey. Such a survey aims to define the price a target population would be willing to pay by asking participants at which price point they would make a purchase for a given product. In this case, the subsidy would then provide the difference to the retail price for the e-bike.

This model was used by the Corvallis/Benton County, OR, incentive program. In their price sensitivity survey, program managers listed a variety of e-bike models with retail prices, photos and features, and asked prospective participants what they would be comfortable with paying for each model. Participants also ranked their top choices from the models provided. Additional questions asked whether a loan would help with the purchase of the e-bike, and what an affordable loan payment would be. Other recommended survey questions not included in the Corvallis survey include household income, number of children in the household, age, and race. These sociodemographic measures will allow program managers to tune incentive program parameters to a target group if desired, or to weight results to represent the general population.

There is a lack of a national-scale survey for understanding e-bike price elasticity. A generalized understanding of price sensitivity along socio-demographic, geographic, and bike-cultural markers would allow for the selection of an appropriate subsidy value for the target population for a given program. This gap will be addressed in forthcoming work by the authors of this white paper – see the *Recommendations for Future Research* section for further information.

Econometric Analysis

Performing econometric modeling of incentive dynamics based on price sensitivity across groups can inform an appropriate subsidy value for the number of desired purchases for target groups based on income or other input variables. University of British Columbia (UBC) researchers Alexander Bigazzi and Elmira Berjisian provided a model for this type of analysis in their 2021 paper *Modeling the impacts of electric bicycle purchase incentive program designs.* This paper provided the foundation for the incentive program run by the local government in Saanich, BC. The program managers continue to work with UBC researchers to perform longitudinal tracking of participants, completing three waves of behavioral surveys to provide insight to the program's efficacy. Results are expected in late 2023.

Flat vs. Proportional Rebate Amounts

Because many e-bike models fall into similar price ranges, a purchase-price-limited incentive program is likely to yield similar subsidy values with either a flat or proportional structure (i.e., when the rebate value is a predetermined dollar amount (flat) or a function of the purchase price of the e-bike (proportional)). Largely, these two styles of determining the incentive value will yield similar market results (Bigazzi & Berjisian, 2021). However, flat rebate structures provide better income equity because the rebate amount is not tied to the purchase price, and therefore not tied to the spending ability of the rebate recipient. Because of this, flat rebate structures are recommended for the development of new programs.

Incentive Value Setting with Monetized Externalities

There are myriad personal and societal benefits to e-bike use, many of which can be parameterized and used to establish an economic value for e-bike purchase incentivization. A few of these benefits are included here, some of which are not yet represented in existing programs.

There seems to be reluctance to pursue incentive value setting through these means explicitly, likely due to the uncertainty of the degree to which e-bikes accomplish any of these goals. For example, while electric vehicles offer a direct substitute to combustion engine vehicles and, thus, have a readily available greenhouse gas emission reduction factor, the rate at which e-bikes replace car trips is less certain. The ability of e-bikes to replace cars is dependent on many factors, including the local transportation infrastructure, land use patterns, and climate. Because of this, it may be more difficult to explicitly base an incentive program's value on the benefits gathered in e-bike uptake. However, this should not dissuade program designers from incorporating some of the externalities explained in this section.

E-bikes provide a broad range of benefits not offered in combination by other transportation modes. Prospective program administrators are encouraged to develop a value statement using a combination of the methods described here. Besides administrative hurdles, there is no reason why the many benefits of e-bikes cannot be explicitly combined in support of an incentive program. Such an approach may allow program administrators to accrue more total funding and provide larger incentives to recipients. This approach is likely taken indirectly by many programs which may not explicitly state their development philosophies. At the very least, a consideration of the variety of potential avenues to funding presented here strengthen a proposed program through more entry points for stakeholders with a variety of community interests.

Greenhouse Gas (GHG) Equivalents

The Burlington Electric Department offers an e-bike rebate that is calculated based on Vermont state Statute V.S.A § 8005, an effort to monetize environmental impact. Per the statute, utility companies must offset a growing amount of fossil fuel use, up to the equivalent of 12% of annual electricity sales by 2032. An alternative compliance penalty charge of $0.06/kWh will otherwise be assessed by the state. A consensus process estimated that an e-bike in Vermont replaces approximately 10,000 automobile vehicle miles traveled over an eight-year life span. The resulting fuel savings is converted to equivalent heat units (BTUs). This avoided energy expenditure from fossil fuels is multiplied by the average electricity generation efficiency of fossil fuel power plants in the United State to obtain an equivalent produced kWh avoided. The

resulting total is then multiplied by the legislated penalty rate, resulting in about $300 of avoided penalty charges per e-bike lifetime. The savings created from the use of an e-bike is mostly passed on to the customer through a $200 e-bike purchase incentive. During the first year of the program in 2018, BED set aside $40,000 for 200 rebates.

Because the Burlington, VT, program was one the earliest highly publicized incentive programs in North America, this $200 rebate value seems to have set a precedent for many other programs nationally.

Air Quality Management

There is considerable academic literature linking nitrogen oxides, carbon monoxide, and small particulate matter emitted from vehicles to increased rates of asthma (Friedman et al., 2001), lung cancer (Chen et al., 2015), cardiovascular disease, and development of new allergies (California Air Resources Board, 2022). Due to the ability of e-bikes to offset vehicle miles traveled, many of the California-based programs acquired funding through air quality mitigation programs. This method uses the assumption that e-bikes will replace miles traveled in a private vehicle, thus reducing the air quality effects of travel. Some air quality management districts provide low-carbon fuel vehicle credits, which can be expanded to include e-bikes. Cap and trade benefits may also be leveraged to establish funding and decide on incentive values.

Vehicle Miles Traveled Offset

Incentivizing a reduction in vehicle miles traveled is in the financial best interest of local governments. Bike infrastructure is cheaper to construct than vehicle infrastructure – a Portland, OR, study found that the cost to rebuild the city's entire bicycle network was approximately equal to the construction cost of one mile of urban freeway (Geller, 2011). The removal of vehicle traffic from a network also provides economic benefits through time cost savings from congestion reduction, and maintenance savings through reduced vehicle loading to roadway surfaces. A study completed in support of the e-bike purchase incentive program in Burlington, VT, estimated that 10,000 vehicle miles are replaced over the lifetime of an e-bike. Leveraging potential savings from such a shift across the entire transportation system may provide ample funding to support an e-bike subsidy program.

Pairing an e-bike incentive program with a congestion pricing scheme is a potentially potent way to encourage mode shift. In particular, this model could be used to address a common concern of congestion pricing schemes – that low-income drivers will be impacted disproportionately. By preferentially providing incentive funding to low-income groups, some of this damage may be mitigated by providing access to the transportation system with a lower-cost mode that is exempt from congestion pricing.

Public Health

In recent years, active transportation has emerged as a popular public health intervention to

approach has been well-documented (Dill, 2009; Pucher & Buehler, 2010; Shephard, 2008). E-bikes provide an additional active mode of transportation that is well-positioned to replace

a wider range of use cases and terrains. The benefits of e-bikes on human health are well-documented. E-bikes are uniquely capable of shifting trips out of private vehicles and onto bikes (Bigazzi & Wong, 2020; Cairns et al., 2015; MacArthur et al., 2018), a change which has associated benefits in the reduction of airborne toxins from vehicle traffic (California Air

Resources Board, 2022; Chen et al., 2015; Friedman et al., 2001), lost time and stress due to congestion, and "safety in numbers" for existing vulnerable road users Elvik Bjørnskau, 2017; Jacobsen, 2003). E-bikes are also able to provide sufficient exercise to meet physical activity requirements (Gojanovic et al., 2011; Haskell et al., 2007; Langford et al., 2017; Peterman et al., 2016; Simons et al., 2009), and tend to result in more frequent ridership, especially among older adults (Fyhri & Fearnley, 2015; MacArthur et al., 2014; Van Cauwenberg et al., 2022). The inclusion of e-bikes in public health interventions is recommended. Such programs may provide additional avenues to funding an e-bike purchase incentive program, especially if targeted to groups who experience higher rates of obesity or lower access to active transportation options.

Benefits to the Local Economy

E-bike incentive programs have the potential to benefit the local economy by inducing new sales at local bike shops while maintaining profitability, stimulating increased spending, and providing knockback effects on livability. Combined, these economic benefits provide a potent argument for support of e-bike incentive programs by private entities for whom business performance is a primary concern.

Incentive programs in Ann Arbor, MI (active) and Boulder, CO (closed) were funded directly by local bike shops. In both of these cases, store owners expected additional revenues from marginal sales to outweigh the revenue lost from the relatively small incentives. Econometric modeling suggests that revenues are expected to outweigh incentive costs even for subsidy values up to 30% of purchase price, or $1,250, due to a higher percentage of marginal new purchases being induced at higher incentive values (Bigazzi & Berjisian, 2021). An additional benefit is provided to the local bike shops as marginal purchases install more e-bikes into the community. This, in effect, grows the market for their product, generating awareness and desire and providing more opportunities for acquaintances of e-bike owners to test ride the bikes informally. The reason cited for the closure of the vendor-funder incentive in Boulder, CO, was that the market was now established enough to be self-supporting. For this reason, this model may be more relevant in locations with a less-developed e-bike market, or a lower share of cyclists in the population.

This model may also be less relevant following the COVID-19 pandemic. Through early 2022, many bike shops have seen demand for both electric and conventional bicycles far outweigh supply due to the dueling effects of the COVID-induced "bike boom" and supply chain challenges during the pandemic.

One common concern with replacing vehicle travel with bicycling is that cyclists are less generous patrons of local businesses. However, research has shown that, while cyclists spend less per trip, they tend to spend the same or more on average than people arriving by other modes (Clifton et al., 2013; Dunne, 2019). One reason for this may be an increased amount of disposable income afforded to cyclists through transportation cost savings, although some of this effect may be due to the characteristics of people who choose to cycle rather than the mode choice itself.

Additionally, bicycle- and pedestrian-oriented streets are routinely recognized as attractive urban spaces, and typically feature thriving street life and adjacent business. A key component for making such spaces possible is a high level of access for cyclists and pedestrians, and a supportive high mode share of people arriving by bike or on foot. E-bikes provide an opportunity to grow this base of active users of urban space, which will provide knockback effects on the economic output and desirability of a commercial area. Leveraging the anticipated sales,

property value, and quality of life benefits from an increased cycling mode share could provide further motivation to fund an e-bike purchase incentive.

Additionally, bicycles and e-bikes of any size or type require only a fraction of the parking space required by single-occupancy vehicles. By encouraging the replacement of auto trips with e-bikes, on-street parking space can be freed up for parklets, bicycle and pedestrian infrastructure, and living street initiatives. A reduced pressure on local parking also provides benefits for local traffic conditions, as a significant portion of traffic in congested areas may be attributed to drivers cruising for parking (Shoup, 2005).

Define Internal and External Process

There are a number of programmatic considerations that will maximize program benefits and rates of satisfaction for participants, including the selection of an appropriate incentive delivery mechanism and income verification process. These details will be discussed below, as well as some specific considerations regarding equitable access to program benefits.

Incentive Delivery Mechanism

Delivery method may be a strong determining factor in program participation, especially among people with lower incomes. Due to the high upfront cost of many e-bike models, many potential participants may find it difficult to carry the incentive value as they wait for a post-purchase rebate, tax credit, or likewise delayed delivery of the subsidy cash. Additionally, tax credit program structures provide institutional barriers to participation for people whose tax liability does not exceed the credit value, or people with no income altogether. Therefore, incentive delivery mechanisms that do not require participants to carry the cost of the subsidy – such as point-of-purchase rebate vouchers or discounts, sales tax waivers, low-interest loans, or ride-to-own schemes – are recommended to maximize program accessibility. This section outlines some of the methods revealed in the review of existing programs.

Point-of-Purchase Rebate

A point-of-purchase rebate model allows participants to receive the subsidy at the time of purchase. Under this setup, participants are not required to put any money down while they await a rebate, and thus do not need to take on any additional financial burden beyond the final purchase price. This mechanism provides the highest level of accessibility to cash-insecure participants, and is the recommended method for most programs.

Point-of-purchase rebates often require applications to be submitted for approval prior to the time of purchase in order to qualify participants and bikes based on the program's criteria, manage program quotas, and ensure participant buy-in. Partnership with local vendors is essential for this model, as they must be familiar with processing approved applications and applying discounts at the point of sale.

Post-Purchase Rebate

Post-purchase rebates are the most prominent style of rebate among existing programs due to their administrative simplicity. Under this model, participants share purchase information with program administrators after they have purchased the e-bike, and expect a payment at a later date. This model provides a barrier to participation for lower-income applicants, who will be required to pay full retail value upfront prior to receiving a rebate.

Many administrative and public relations hurdles can be overcome in this model by requiring approved applications prior to the purchase of an e-bike. An application process can ensure that the participant and the e-bike to be purchased both meet program criteria – such as residential address, retail price, or e-bike class – and can be a chance to communicate program details to participants.

Tax Liability Credit

Tax liability credits allow participants to claim the value of the subsidy against their end-of-year tax liability. This method has the potential to ease some administrative burden by placing the onus for processing the incentive properly on the participant, but opens more avenues to potential fraud than other delivery mechanisms.

Potential barriers to participation exist for participants under this model; participants will be required to complete paperwork on their own, and will carry the liability until they claim the credit on their taxes. Some low-income participants may not have tax liability in excess of the subsidy value, which presents another administrative hurdle for this model. Potential pairings with financing options, or allowing bicycle dealers to claim the credit value against their own tax liability, may provide potential work-arounds for these concerns and help to streamline the process for the consumer.

To date, only the proposed federal incentive (H.R. 5376 SEC. 136407 – Credit for Certain New Electric Bicycles), a proposed incentive in Connecticut, and the recently approved incentive in Toronto, ON, follow this model. No further details have been released regarding the program in development in Toronto.

Sales Tax Waiver

A sales tax waiver provides a cleaner participant experience with similar administrative simplicity to a tax liability credit. Importantly, a sales tax waiver can be offered as a point-of-purchase incentive by retailers, and may help to keep business local in areas with higher sales tax. This approach has been implemented in British Columbia, where sales tax on e-bikes has been waived province-wide. In Washington state, where electric vehicles are already exempt from sales tax on the first $25,000, the House of Representatives has also passed a bill to exempt e-bikes from state sales tax, which is now awaiting Senate approval. This model may warrant additional consideration from program managers in areas adjacent to Alaska, Delaware, Montana, New Hampshire, and Oregon, where sales tax is low or zero in many cases, and a sales tax waiver may encourage business which may have otherwise been drawn away from the local area.

A major drawback to this approach is a lack of flexibility in incentive value, especially if the desired subsidy is in excess of the sales tax.

Income Verification

Income verification provides a potential administrative hurdle, as this process may be time consuming or may require obtaining, reviewing, and storing confidential information about participants. Most programs overcome this obstacle by verifying income through participation in a low-income program, such as a local food support program, rental assistance program, or other community organization. Alternatively, some programs request a copy of an IRS Form 1040. As discussed previously, it may be appropriate to verify income with a simple survey question completed on an honor system in order to minimize difficulty and embarrassment on the part of the participant.

Make the Application Process as Simple as Possible

More complex qualification for participants generally leads to higher administrative costs and lower rates of program satisfaction from both the participants and administrators. Whenever possible, keeping paperwork as simple and minimal as possible is preferred.

Multiple program managers shared that completing paperwork primarily online is best for tracking and simplicity. Having an offline option available is important, however, as only 76% of adults with incomes less than $30,000 own a smartphone, and thus may have limited internet access (Pew Research Center, 2021).

Identify Strategic Partners

Partnerships are key to minimizing administrative burden and ensuring a program's success. Program managers are encouraged to pursue partnerships with the groups listed in this section, but should also consider additional groups that will be able to address program- or area-specific needs.

Local Community Organizations

Many local community organizations are well-positioned to identify and connect program managers with potential participants. Some potential partners include rent assistance programs, food assistance programs, employers, neighborhood associations, churches, and school-based groups.

Potential benefits of building community partnerships may include stronger relationships with participants for longitudinal study of e-bike use, stronger support from program management for recipients, a stronger sense of community as participants buy e-bikes as a cohort, and support for communication. Additionally, community organizations may be able to identify particular needs for target communities that can be addressed in program design and prioritization. Target groups may have limited experience with cycling, limited English proficiency, or a limited capacity to navigate an incentive program's requirements, all of which may be alleviated by partnership with a trusted source.

Community organizations may also be able to alleviate some of the headaches associated with income verification, as they may have already gathered this information for potential participants for participation criteria in their program.

Local Bike Shops

Independent bicycle dealers and retail stores selling e-bikes may be effective partners as well. These local bike shops will be able to assist in outreach to the existing cycling community, and can provide a clear access to service if connected with participants. Additionally, bike shops with in-stock e-bikes can offer prospective program participants the opportunity to test ride bikes prior to purchase, and may be able to host publicized demo events in easily accessible locations or for particular groups targeted by program managers.

Due to the relative novelty of the technology, and the added complexity of electric motor systems, many bike shops may be unprepared to assist with mechanical needs on certain models. If a program is providing or incentivizing specific e-bike models, it will be important that a local bike shop will be able to service them. As stated above, in developing equity-focused incentives programs it is extremely important to ensure communities have access to long-term maintenance, either through a local shop or an online vendor.

Financial Institutions

Local credit unions may be able to provide preferential loan terms for e-bike purchases, helping to make purchases more accessible to a wider range of consumers. A variety of local credit unions have done so to date. Vehicle loans are well-established for purchases of cars and trucks, and many lenders may readily take on partnerships with e-bike incentive program managers. Financial institutions may offer additional assistance in developing processes for

tracking and distribution of subsidies, especially if cash is to be distributed at the point of sale by e-bike vendors.

Academic Institutions and Other Researchers

Transportation, economics, and social sciences researchers at local colleges and universities are generally very capable and willing to provide support for program design, administration, and assessment. The form of this may differ based on program specifics, but may include components in survey design, e-bike use tracking, econometric analysis, or socio-economic data collection and processing for program design. Other research-focused groups, such as non-profit organizations, advocacy groups, and consulting firms, may also readily provide support in program design and evaluation.

E-Bike Demos and Educational Outreach

Various qualitative perception studies suggest and observe that the experience of riding an e-bike in and of itself is rewarding and fun, is freeing for users with limited ability and mobility, and could even lead to a car-free household (Jones et al., 2016; MacArthur et al., 2017, 2018; Popovich et al., 2014). Anecdotally, trying an e-bike is one of the most effective arguments for their adoption and use – they are extremely fun to ride!

Lending libraries have shown to be an effective method for trying out bikes as well. These programs allow participants to take an e-bike home and use it for a defined period of time as they might use an e-bike they owned. Among existing lending library programs, participants purchase their own e-bikes after their trial periods at high rates, typically in excess of 15%.

Additionally, the myriad benefits of e-bike ownership and use, such as physical activity, lowered household transportation costs, and a reduced carbon footprint may be important persuading factors for some prospective program participants. Some programs include educational outreach as a condition for incentives to communicate these benefits in an effort to maximize usage rates, as well as to provide clarity for any pertinent local legislation.

Because of this, educational outreach and demonstration events may be a vital part of a program's success. Leveraging community partners, such as universities, churches, markets, fairs, and other gathering locations and events can allow for a high volume of interactions with the technology. Local bike shops will likely be willing to contribute bikes to test ride in these events due to an expected increase in sales volume.

Other Program Considerations

Throughout administration, the previously defined assessment metrics should be tracked to the extent possible. This process will differ for each program. Some additional considerations for final program administration are discussed here.

Communication

An active and receptive point of communication through both email and phone will be essential in providing clarity to program participants and receiving feedback. Throughout program administration, soliciting feedback on the process and outcomes is essential. This information will inform future program iteration, and will provide quantitative and qualitative value assessment.

Based on interviews with program managers, feedback from program participants tends to be overwhelmingly positive. Many participants report getting back to cycling after a long time, enjoying the ability to transport children by bicycle, and using their e-bikes to access jobs. However, in the event of negative or constructive feedback on the program process, it is important to be nimble in administration tactics throughout the period the program is active.

Branding an Incentive Program as a "Pilot"

Considerations in the branding of the program will be largely reliant on the administering organization's existing standards and practices. However, branding a program as a "pilot" may impact its perception by participants and legislators down the line.

Calling a program a pilot may make it easier for elected leaders and taxpayers to support, but will likely make it more difficult to acquire regular funding and continue the program through future iterations. Whether or not to describe a program as a pilot is an important consideration and is best left to the program managers, who should make the decision based on their knowledge of local funding sources and political climate.

Fraud

Among program managers, elected officials, and the public, there is likely to be some concern regarding the potential for fraud in a program that provides a cash rebate. Primarily, this concern is centered around incentive recipients reselling the incentivized e-bike for a profit. Some other examples of fraudulent behavior may include claiming a rebate for something that is not an e-bike, claiming a rebate when a purchase was not actually made, falsifying receipts or e-bike model codes to claim a higher incentive value, claiming more than an allowed number of incentives in a household, or claiming a rebate for an e-bike that does not meet program criteria. Many of these concerns can be alleviated through adequate oversight, administrative controls, and strategic partnerships. Partnered vendors, whether local bike shops or online retailers, can help to verify purchases, while community organizations can verify program eligibility requirements.

In our interview with program managers, some concerns were raised regarding fraud. However, none of the programs experienced any significant issues on this front.

Evaluate Program Performance

Program performance should be evaluated against the initial goals using the assessment metrics provided. Again, this process will differ by each program's respective goals, but reflection, evaluation, and iteration is essential to a program's continued success. Feedback received from administrators and participants alike should be incorporated into program renewals. Participant stories may be collected for reporting, which can help develop an understanding of the personal connection driving a buyer's behavior and can be used in additional marketing of the program. Data may be shared with research partners and processed to develop quantified models for success and to contribute to scientific literature on the topic.

Some particular topics for post-program evaluation identified in this white paper include:

- The demographics of program recipients, particularly as they align to the defined target group, any unintended recipients, or any underrepresented groups.
- The use of e-bikes, particularly the balance of recreational and utilitarian use.
- Customers' experiences with approved vendors, particularly whether selection and supply were sufficient to satisfy demand.

It is suggested that, at a minimum, program managers conduct an intake survey to collect demographics and motivations for purchasing. Ideally, a follow-up survey should be administered six months to a year after purchase to understand how the individual is using the e-bike. To encourage survey response, nominal incentives or benefits at local bike shops could be used and should be included in the program budget. For a more comprehensive and data-rich evaluation, program managers can have people opt-in to tracking trips for a period of time. This type of data collection may need additional funding and partnerships with universities or local agencies.

An important consideration from the outset of a program's development is its longevity. As e-bikes see higher levels of adoption, incentive programs may become less necessary to induce marginal purchases. However, it is likely that the market will continue to grow significantly for a number of years to come. Therefore, a recurring program structure is appropriate at the moment in many cases, and programs can be designed to be supported by a periodic funding source.

Other Methods to Encourage E-Bike Uptake

There are a variety of ways in which prospective program managers could use their funding to encourage e-bike uptake and use that fall outside of a traditional purchase incentive program. Some may be subject to the preceding discussion regarding the development of a purchase incentive program, while others may require different considerations entirely. A number of programs using these methods are included in the program inventory accompanying this white paper, and may provide additional information for program managers interested in pursuing any of these options.

Low-Interest Loans

There are a variety of programs and vendors offering low-interest loans specifically for e-bike purchases. Thompson Rivers University in Kamloops, BC, and the municipal government in Nelson, BC, offer low-interest loans as part of their e-bike incentive programs, and a variety of local credit unions have extended preferential offers for e-bike purchases. This model is well-established in the vehicle market. Many lenders may readily take on partnerships with incentive program managers to ease some administrative burden and provide access through the further lowering of the cost barrier to entry in the e-bike market.

Ride-To-Own

Small-scale programs in San Diego County, CA, and Boulder and Pueblo County, CO, have piloted ride-to-own programs in which e-bikes were given to a targeted group of recipients, whose eventual full ownership of the e-bikes was contingent on their use and tracking thereof. This model provides an effective way to ensure use, quality data collection, and direct benefit to target groups. However, it is an expensive model to run, as program participants are typically required at most to pay a small administrative fee for their participation. Thus, fewer total incentives are distributed and less benefit can be gained in line with project goals.

Free E-Bikes

Arguably the most direct way to drive adoption of e-bikes in a target community, a number of programs have decided to buy e-bikes for direct distribution. Recipients are typically low-income, classified as essential workers, or both. Two free e-bike pilot programs in Colorado included usage tracking and follow-up survey requirements with the goal of generating a stronger understanding of the e-bikes' impact on recipients' travel habits. Two further free e-bike pilots are being developed in Massachusetts under the Accelerating Clean Transportation for All (ACT4All) Program.

Shared E-Bikes and Lending Libraries

When e-bikes are made available for low- or no-cost, short-term use, potential owners and the general public will have the ability to try using e-bikes for their particular use cases beyond a quick test ride at a specified location. Many publicly available docked bikeshare programs now offer e-bikes as part or all of their fleet, including in Portland, OR; Washington, D.C.; and New York City, NY. Many of these programs address equity targets by providing lower-cost options for low-income people or people living in certain geographic areas.

While these programs provide visible, easily accessible e-bikes for use, they do not offer many benefits of private ownership, like door-to-door connectivity, customizability, and model choice, and often cost the riders on a per-minute basis. Lending libraries, where a fleet of e-bikes is made available for long-term use, provide this ownership experience. Participants can take the e-bike home with them for a specified period of time – often for days to weeks – and use it as they would use a privately owned bike. Lending libraries may be a powerful facilitator of new purchases; a 2019 survey of 52 participants of the Vermont-based Local Motion lending library program found that 17% of participants purchased their own e-bike within 12 months. Of lending library participants in Canberra, Australia, 39% did the same (Bliss, 2021).

Employer-based leasing models have become popular in Europe, with third-party providers partnering with employers to make e-bikes available at low or no cost to employees.

It is worth noting that the generous return policies of many online-only e-bike companies provide a version of this ownership trial, giving customers two weeks or more to try an e-bike before making a final purchase decision.

Temporary E-Bike Loan with Purchase Option

This model provides a slight modification to a lending library, with participants having the option to purchase the loaned bike or a new bike of their own at the end of their loan period. The purchase at the end of the loan period may be financially incentivized by the program manager to provide a reduced cost to participants and promote uptake.

Google has piloted this model since 2015. Six months was determined as the loan period due to evidence that this is a sufficient period to allow habits to form (Lally et al., 2010). Results suggest that SOV commuting dropped by 2.4 days per week, on average, due to the program. More than half (62%) of loan program participants bought a bike at the end of their loan period (Fitch et al., 2022). The after-loan purchase subsidy of $300 saw a lower uptake rate than was desired by the program manager, and was raised to $500 in 2019.

Pay-to-Ride

The Dutch province of North Brabant started a program in 2013, B-Rider, to incentivize e-bike users with monetary compensation based on the distance traveled on their e-bike. A study following the program found it to be highly effective in stimulating new utilitarian e-bike use. However, due to the existing bicycle and transit ridership found in the Netherlands, only about half of trips taken by e-bikes replaced car trips (de Kruijf et al., 2018). Similar programs exist in Belgium, Luxembourg, and the U.K.

Such an approach may be effective in encouraging the use of e-bikes for easily tracked trip types, such as commuting. However, this model does not lower barriers to entering the e-bike market, as purchase prices may still be prohibitively high for many people, especially those with lower incomes or less intrinsic motivation to try e-cycling.

Employer-Sponsored Program

Incentives offered to employees by private companies, universities, or other discrete employers have additional flexibility in incentive delivery mechanisms. Loans may be issued to be repaid through paycheck deductions, and existing relationships with employees offer ease of verification of program requirements and issuance of incentive cash.

Only three employer-offered incentive programs with publicly available information are noted in the inventory to date. Since 2019, Google has offered a $500 e-bike purchase incentive to employees of its Mountain View campus. Thompson Rivers University offers both a 10% incentive (capped at $300 CAD) and a two-year loan for e-bike purchases to both permanent and contract employees. Amazon offers an e-bike incentive program to its corporate employees, although details of the program have not been made publicly available.

Private entities that are interested in starting a bicycle incentive program for their employees and are looking to offload some of the administrative and operational burden can take advantage of San Francisco-based consultant *Bikes Make Life Better*. *Bikes Make Life Better* administers bicycle loan, maintenance, storage, and purchase incentive programs for a variety of private firms. However, in-depth details for these programs are generally not available, with data only being shared for the program administered on behalf of Google to date.

Recommendations for Further Research

Much of the research needs for e-bike uptake include dynamics that have been addressed in existing bodies of literature for other modes of transportation. Because e-bikes provide a unique value proposition, however, further research is needed to gain a better understanding of how to most effectively design an e-bike purchase incentive program, and otherwise promote the uptake of the new technology in North America.

The effects of subsidy method, incentive amount, and external cultural or environmental factors on participation rate in an incentive program, especially across different demographic groups, are not well understood. The authors are not aware of any formal study which has been completed to date on e-bike price elasticity as has been established for conventional bicycles and electric vehicles. These dynamics will be investigated in a national stated preference survey by the authors of this white paper, with results expected later this year.

Besides cost, the barriers to entering the e-bike market are manyfold. A variety of studies could address a number of knowledge gaps in the literature regarding ways to improve access to e-bikes for a variety of people and geographies:

- What are the effects of lending libraries and electric bikeshare programs on e-bike uptake in the service area?
    - These programs offer low-cost opportunities to try out e-bikes to a wide variety of people. Anecdotal reports support the idea that test riding the bikes provides a strong value statement for the power of pedal assistance over the riding experience. Do opportunities to ride in these shared environments change minds towards committing to a purchase of a privately owned e-bike? There are a limited number of studies investigating this relationship to date, but outcomes vary significantly between programs. Further research is needed to provide clarification of specific program parameters that promote uptake.
- Does access to service act as a barrier to purchasing an e-bike?
    - While service for a conventional bicycle can be done with readily available tools and general mechanical knowledge, electric motors may provide a challenge to would-be home mechanics as well as professionals. Many local bike shops are likely only able to service a limited range of e-bike models, if any at all. For many people, a local bike shop may not be accessible regardless of that shop's ability to provide service for their e-bike. In this case, an online vendor offering on-call, at-home, or mail-in service may be an attractive alternative. Whether these concerns are important to consumers is a potential area for further research, which may provide further insight to best practices for future facilitation of e-bike uptake in the community.
- How do cultural beliefs about bikes apply to e-bike purchase decisions?
    - Bikes are a taboo form of transportation for many North Americans. A large proportion of cyclists on the road today are "survival cyclists," who will readily purchase a vehicle for travel when funds become available due to convenience and the high cultural value placed on vehicle ownership (Lugo, 2018). On the other hand, a common trope among long-term cyclists is that e-bikes are "cheating" due to the pedal assistance. How these beliefs are limiting the potential for e-bikes to proliferate as a top-choice transportation mode may provide insight for program communication, community outreach, and e-bike marketing efforts.

Bigazzi and Berjisian's initial postulation that additional bike shop revenues exceed incentive value for any incentive level warrant further investigation (Bigazzi & Berjisian, 2021). If this finding holds true, additional point-of-sale benefits from bike shops may be able to be publicized as a way to take advantage of opportunities to sell bikes at high rates. In particular, this approach may be able to take advantage of current events, such as the steep gas price increase in early 2022, to convert potential buyers with little administrative overhead.

Conclusions

Electric bicycles (e-bikes) provide an attractive transportation alternative to single-occupancy vehicles. Electric pedal assistance has been shown to provide a positive experience for a wider variety of users and use cases than a conventional, non-powered bicycle. However, purchase price remains a significant barrier to e-bike ownership, despite potential cumulative savings through low-cost operation and maintenance.

E-bike incentive programs have emerged as a popular technique to encourage ownership in an effort to bridge the chasm of Moore's technology adoption curve. More than 300 programs have been implemented in Europe to date. Of the 75 programs identified in the U.S. and Canada, 38 are active, 7 are pilot programs, 2 are statewide parent programs administered through local programs, 7 are approved and do not yet have full details available, 8 have been closed, and 13 have been proposed but not yet enacted. 37 of the active, pilot, and closed programs provide cash subsidies for e-bike purchases, ranging from $100 to $1,365; 25% of the programs were fully income-qualified, while 11% provided additional benefits for people reporting incomes below a given threshold.

Interviews were conducted with program managers, industry leaders, and academics to develop a set of recommended practices and considerations for program design. The most important components of this include a focus on inducing additional purchases, which may be effectively accomplished through a "targeted universalism" approach providing tiered benefits for those most in need of assistance. Program managers are encouraged to include as wide of a variety of e-bike model choices as possible in order to account for e-bikes' many use cases; it is highly recommended to include cargo e-bikes, and consider additional incentives for their purchase. Including online sales as an option for purchase within the program is advised, although this decision may be made in conversation with local vendors. A strong focus on strategic partnerships with a variety of groups is a likely catalyst for success. From the onset, a focus on evaluation will ensure proper insight to the operations and effectiveness of the program along stated goals.

Prospective program managers are encouraged to explore the list of existing North American e-bike incentive programs included in Appendix A, as well as the live tracker of these programs which can be found at the TREC website (trec.pdx.edu/e-bike-research). These programs may provide inspiration, points of contact, and leverage for the implementation of future programs.

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Appendix A. Table of Existing and Proposed E-Bike Purchase Incentive Programs

Live version available at: tinyurl.com/ebikeincentivetracker

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
Canada	AB	Banff	Local Government	Local Government	Proposed	Partial purchase subsidy with cap		30%; up to 50% low-income		$590 ($750 CAD); up to $780 ($1,000 CAD) low-income	$31,000 ($40,000 CAD)	No	Yes	Sliding scale	No	Link to program page	
Canada	AB	Edmonton	Local Government	Local Government	Closed	Partial purchase subsidy with cap	Post-purchase rebate	30%		$590 ($750 CAD)	$39,000 ($50,000 CAD)	No	No		No	Link Closed news article	
Canada	BC	Kamloops	Thompson Rivers University	Private Entity	Active	Partial purchase subsidy with cap	Post-purchase rebate, low-interest loan	10%		$235 ($300 CAD)		No	No			employees that have permanent, full-time status may apply for financing with up to a two-year repayment period (minimum of $500 purchase price and maximum of $5,000), and employees on a contract term with TRU may apply for financing up to the end of their contract term	
Canada	BC	Nelson	Local Government	Local Government	Active	Low-interest loan	Post-purchase low-interest loan			$6,260 ($8000 CAD)		No	No		No	Participants will be able to choose an amortization period of two or five years, with an interest rate of 3.5%	
Canada	BC	North Vancouver	Local Government	Local Government	Proposed					$230-$1240 ($300-$1600 CAD)						Amount means tested to household size and income	
Canada	BC	Province-wide	Province Government	State / Province Government	Active	Sales tax waiver	Sales tax waiver					No	No		No	Provincial sales tax (PST) waived for class 1 and 2 e-bikes, non-motorized bicycles, and non-motorized, adult-sized tricycles	
Canada	BC	Province-wide	Clean BC Go Electric Transportation Options Program	State / Province Government	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$1,365 ($1,700 CAD)		No	No		No	Businesses can buy up to 5 bikes with the incentive	Child
Canada	BC	Province-wide	Clean BC Go Electric Transportation Options Program	State / Province Government	Active	Voucher with vehicle trade-in	Voucher with vehicle trade-in		$960 ($1,200 CAD)	$600 ($750 CAD)		No	No		Yes	Program page	Parent
Canada	BC	Saanich	City of Saanich Sustainability Office	Local Government	Active	Partial purchase subsidy flat rate	Point-of-sale discount OR Post-purchase rebate AND sales tax waiver			$280 ($350 CAD); up to $1275 ($1600 CAD) for income-qualified households; $600 ($750 CAD) Scrap a car; $1,330 ($1,700 CAD) for fleet cargo e-bikes	$160,000 ($200,000 CAD)	No	Yes	Custom scale with multiple incentive levels	No	The program offers incentives to 300 participants with 120 incentives initially reserved for income qualified applicants	
Canada	NS	Province-wide	Province Government	State / Province Government	Active	Partial purchase subsidy flat rate	Point-of-sale discount			$400 ($500 CAD)		No	No		Yes	Link	
Canada	ON	Toronto	City of Toronto	Local Government	Approved		Tax Liability Credit									The amount for the incentive has not been announced yet	

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
Canada	PE	Province-wide	Province Government	State / Province Government	Approved					$400 ($500 CAD); $80 ($100 CAD) for non-powered bicycles						News of approval	
Canada	YT	Province-wide	Province Government	State / Province Government	Active	Partial purchase subsidy with cap	Point-of-sale discount OR Post-purchase rebate	25%		$590 ($750 CAD) for e-bike, $1,175 ($1,500 CAD) for cargo bike		No	No		No	Link to program page Only dealers that have gone through the application process may offer point-of-purchase incentives	
US	CA	Bay Area	Bay Area Air Quality Management District	Air quality management authority	Active	Voucher with vehicle trade-in	Voucher with vehicle trade-in			$7,500		No	No		No	$7,500 grant to purchase an e-bike with trade-in of vehicle 2005 or older. Households of more than one person may purchase additional e-bikes with the $7,500 grant. Grantees may use a portion of the grant for e-bike accessories (e.g. helmets, lights, cargo equipment, etc.). The remaining grant amount can be converted to a public transit card.	Child
US	CA	Contra Costa County	511 Contra Costa	Local Government	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$150; $300 low-income		No	Yes	400% FPL	No	Link	
US	CA	Eureka	Redwood Energy Authority	Power district	Closed	Partial purchase subsidy with cap	Post-purchase rebate	50%		$500	$41,500	No	No		No	Link	
US	CA	Healdsburg	Healdsburg Electric	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			Variable		No	Yes	200% FPL	No	$700 for income-qualified CARE customers $400 for an e-bike purchased in Healdsburg $300 for an e-bike purchased outside of Healdsburg $50 for an e-bike conversion attachment kit Capped at 100% of purchase price for income-qualified, 75% of purchase price for others Mountain bikes excluded	
US	CA	Monterey Bay	Monterey Bay Air Resource District	Air quality management authority	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$1,000		Yes	No	Custom scale, approx 200% FPL	Yes	Purchase price $1,000 - $4,000	
US	CA	Mountain View	Google	Private Entity	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$500		No	No			Program for company employees on Mountain View, CA campus Google had an existing e-bike lending program and the cash incentive was established as a way for employees to get their own bike after the loaner period ends after six months. Webinar about the rebate program	
US	CA	Roseville	City of Roseville	Local Government	Closed	Partial purchase subsidy with cap	Post-purchase rebate	50%		$200	$3,000	No	No		Yes	Link	
US	CA	San Diego County	San Diego County	Local Government	Active	Ride-to-own	Ride-to-own					No	No			200 electric bicycles available to participants in San Diego County Supervisorial District 4.	
US	CA	San Gabriel Valley	ActiveSGV	Advocacy Group	Closed	Partial purchase subsidy flat rate	Post-purchase rebate			$700	$70,000	No	No		Yes	Link	

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
US	CA	San Gabriel Valley	ActiveSGV	Advocacy Group	Approved	Lending Library	Lending Library									Expected in 2022	
US	CA	San Mateo County	Peninsula Clean Energy	Power district	Active	Partial purchase subsidy with cap	Point-of-sale discount	80%		$800		Yes	No	400% FPL	Yes	The voucher will hold a value of up to 80% of the purchase price of an e-bike or $800, whichever is less. Participating bike shops will redeem this voucher as a point of sale discount off the purchase price of a qualifying E-bike.	
US	CA	Santa Clara	Silicon Valley Power	Power district	Active	Partial purchase subsidy with cap	Post-purchase rebate	10%		$300; $500 low-income		No	Yes	Custom scale, approx 400% FPL	No	10% of the pre-tax cost of the eligible electric bicycle less any other discounts received, up to $300 Financial Rate Assistance Program customers will receive an additional $200 for eligible electric bicycles with a pre-tax cost over $600 Link	
US	CA	Santa Cruz	City of Santa Cruz	Local Government	Active	Partial purchase subsidy flat rate	Point-of-sale discount with application			$200; $400 low-income		No	Yes	Currently enrolled in a low-income assistance program (PGE Cares, CalFresh, Medicaid, WIC, Calworks, etc)	Yes	Link	
US	CA	Sonoma County	Sonoma Clean Power	Power district	Closed	Partial purchase subsidy flat rate	Point-of-sale discount with application			$1,000		Yes	No	Income qualified state or local program (medicaid, WIC, NSL, SNAP, SSI, etc.)	Yes	Link	
US	CA	South Coast Area (Including LA)	South Coast Air Quality Management District	Air quality management authority	Approved	Voucher with vehicle trade-in	Voucher with vehicle trade-in					No	No			More information about the e-bike option "will be available soon."	Child
US	CA	Statewide	California Air Resources Board (CARB)	Air quality management authority	Approved		Point-of-sale discount with application				$10 million	Likely	Likely			Link Working Group Meeting Grant Solicitation Information Grant Solicitation Application	
US	CA	Statewide	California Air Resources Board	Air quality management authority	Parent Program	Voucher with vehicle trade-in	Voucher with vehicle trade-in			$7,500		Yes				Up to $7,500 on a prepaid card for use towards the use of bikeshare or the purchase of an electric bicycle with used-vehicle trade-in	Parent
US	CO	Avon	Town of Avon	Local Government	Active	Partial purchase subsidy flat rate	Post-purchase rebate		$1,000 / $500	$200 / $100		No	No		Yes	Link	
US	CO	Avon	Town of Avon	Local Government	Proposed	Partial purchase subsidy		10-25%								Staff asks that Council consider a rebate for e-bike purchases made at Avon brick-and-mortar retail locations in the 2022 budget. Earmarking $20,000-30,000 as a rebate incentive will allow	

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
																100-150 Avon residents to receive a $200 financial rebate.	
US	CO	Boulder	Colorado Energy Office	Power district	Pilot	Loan-to-own	Ride-to-own		$250 fee			Yes	No	50% AMI		This is a two year loaner-to-owner program requiring a fee of $250 to be paid in full before receiving your ebike. You may opt out of this program in the first 90 days and receive partial or full refund. After 90 days you may still opt out of the program but the fee will not be refunded. The value of the bike and accessories is over $1500. Bike becomes theirs after 2 years of regular ridership and data reporting	
US	CO	Boulder County	Boulder County	Local Government	Closed	Privately funded incentives	Point-of-sale discount with application	10-25%				No	No		Yes	Link	
US	CO	Denver	Colorado Energy Office	Power district	Pilot	Lending Library	Lending Library				70 e-bikes	Yes	No			A library supplying 70 electric bikes for income qualified essential workers in Denver's Sun Valley, Globeville, Elyria and Swansea neighborhoods.	
US	CO	Denver	City of Denver	Local Government	Active	Partial purchase subsidy flat rate	Point-of-sale discount with application			$400, $1,200 low-income, additional $500 for cargo bikes		No	Yes	Participation in an income-qualified program, or household income below 60% of the CO median, below 200% of the relevant federal poverty level, or below 80% of area median income	Yes	Must be purchased from a participating retailer Full-suspension mountain bikes are excluded from the program	
US	CO	Durango	Colorado Energy Office	Power district	Pilot	Free e-bikes	Free e-bikes				$50,000	Yes	No			Local restaurant workers will soon be rolling to work in sustainable style. Thanks to a grant from the Colorado Energy Office, 16 low-income workers will receive e-bikes through a pilot program	
US	CO	Durango	La Plata Electric Association	Power district	Active	Partial purchase subsidy with cap	Post-purchase rebate	25%		$150		No	No		No	Link	
US	CO	Edwards Metro District	Edwards Metro District	Local Government	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$200		No	No		No	$200 e-bike purchase rebate for full-time residents who intend to use the e-bike to offset vehicle miles.	
US	CO	Glenwood Springs	Holy Cross Energy	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$200		No	No		No	Link	
US	CO	Granby	Mountain Parks Electric	Power district	Active	Partial purchase subsidy with cap	Post-purchase rebate	25%		$150		No	No		No	Offers 25% or up to $150 for purchase of an electric mower, snow blower, or e-bikes.	
US	CO	Gunnison	Gunnison County Electric	Power district	Active	Partial purchase subsidy with cap	Post-purchase rebate	25%		$150		No	No		No	Offers 25% or up to $150 for purchase of an electric mower, snow blower, or e-bikes.	

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
US	CO	Pueblo County	Colorado Energy Office	Power district	Pilot	Loan-to-own	Ride-to-own		$150 fee			Yes	No	$35,000		Piloted with forty-two (42) e-Bikes including accessories (helmet, U-lock cable, headlamp, portable pump, and spare tubes) and to be administered by Pueblo County under two years of data gathering, monitoring & evaluation.	
US	CO	Statewide	State Government	State / Province Government	Proposed											SB 22-193 would provide $12M for: grant money to local governments and nonprofit organizations to administer a bike share program or an ownership program for the provision of electric bicycles in a community, a rebate program providing individuals in low- and moderate-income households, or bicycle shops that sell electric bicycles to program participants at discounted prices, rebates for purchases of electric bicycles used for commuting purposes.	
US	CO	Statewide	Colorado Energy Office	Power district	Pilot	Free e-bikes	Free e-bikes				13 participants	Yes	No			13 low-income essential workers in the greater Denver area received a Momentum LaFree E+ eBike (Class 1) and equipment including a helmet, pump, lock, lights and more at no cost	
US	CT	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy flat rate	Tax Liability Credit			$1,000 / $500 / $250		Yes	Yes	$50k / $100k for incentive value thresholds		Program qualification by Low- to Moderate-Income in accordance with the Department of Housing and Urban Development calculations	
US	CT	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy flat rate	Post-purchase rebate			$500		Yes	No	Various qualifications		Rebates under SB 4 would be prioritized for those making less than 300% FPL, residents of an environmental justice community, participants of SNAP, Low Income Home Energy Assistance Program, or a Head Start program; elligible e-bikes with purchase price less than $2,000	
US	KY / OH	Northern Kentucky and Cincinnati	The Devou Good Foundation	Nonprofit	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$500	$50,000 (100 rebates)	No	No		Yes	Link Applicants entered in a drawing for a $250 gift card to a local bike shop after a 90-day follow-up survey	
US	MA	Boston	Metro Mobility	Private Entity	Approved							Yes				Press release for new funding for Accelerating Clean Transportation For All (ACT4All) program "three different e-bike ownership and share models"	Child
US	MA	Cape Cod and Martha's Vineyard	Cape Light Compact	Power district	Approved		Point-of-sale discount			TBA			Yes		Yes	Press release for new funding for Accelerating Clean Transportation For All (ACT4All) program	Child
US	MA	Springfield and other Gateway Cities	Pioneer Valley Planning Commission	Local Government	Pilot	Free e-bikes	Free e-bikes				50 bikes	Yes	No			Press release for new funding for Accelerating Clean Transportation For All (ACT4All) program	Child
US	MA	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy with cap	Point-of-sale discount	40%		$500, $750 low- and moderate-income		No	Yes	Not defined		Bill H.3262	
US	MA	Statewide	Massachusetts Clean Energy Center's (MassCEC) and the Department of Energy Resources (DOER)	State / Province Government	Parent Program	Parent Program	Parent Program									Press release for new funding for Accelerating Clean Transportation For All (ACT4All) program	Parent

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
US	MA	Worcester	Massachusetts Bicycle Coalition (MassBike)	Nonprofit	Active	Free e-bikes	Free e-bikes				100 bikes	Yes	No			Link to program page	Child
US	MI	Ann Arbor	City of Ann Arbor	Local Government	Active	Partial purchase subsidy flat rate	Point-of-sale discount			$100		No	No		Yes	Link	
US	NY	Buffalo and Niagara Falls	Shared Mobility, Inc.	Nonprofit	Active	Lending Library	Lending Library					No	No			Program page	
US	NY	Statewide	New York State Energy Research and Development Authority	Power district	Proposed	Partial purchase subsidy with cap		50%		$1,100						Bill (A516) is currently in committe in the New York State Legislature	
US	NY	The Bronx and Brooklyn	Equitable Commute Project	Advocacy Group	Pilot	Partial purchase subsidy	Point-of-sale discount	50%			5,000 participants	Yes	No		No	The Equitable Commute Project is a a consortium of NYC-based NGOs, community development organizations, academics, and companies	
US	OK	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy flat rate	Tax Liability Credit			$200			No			Sitting in State House; income tax credit	
US	OR	Ashland	Ashland Electric	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$200		No	No		Yes	Link	
US	OR	Corvallis	Pacific Power / Corvallis/Benton County economic development office	Power district	Active	Partial purchase subsidy flat rate	Point-of-sale discount with application			$1,200	$60,000	Yes	No	80% of median family income for Corvallis Benton County area	Yes	The money comes from the Oregon Clean Fuels Program The instant rebate is $200 less than the purchase price; maximum of $1,200	
US	OR	Kaiser Permanente	Drive Oregon, Metro and Kaiser Permanente Northwest	Private Entity	Closed	Lending Library	Lending Library				150 employees	No	No			Research report 10 week trial	
US	TX	Austin	Austin Energy	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$300 individuals; $400 commercial fleets Varies with e-bike price		No	No		Yes	Austin Energy electric customers are eligible for qualifying rebates up to: $300 per E-Ride vehicle for individuals. $400 per E-Ride fleet vehicles.	
US	UT	Statewide	Utah Clean Energy	Nonprofit	Closed	Privately funded incentives	Point-of-sale discount	10-25%				No	No		Yes	Collaboration between: Utah Clean Energy (NGO), Utah Clean Air Partnership (NGO), Utah Governor's Office of Energy Development, Utah Department of Administrative Services, Rocky Mountain Power	
US	VT	Burlington	Burlington Electric Department	Power district	Active	Partial purchase subsidy flat rate	Point-of-sale discount			$200	$52,000	No	No		Yes	If you are a current Burlington resident (or purchasing on behalf of a Burlington business), bring your ID along with a piece of mail with your name and Burlington address to receive a $200 point-of-sale rebate on an e-bike. The rebate may be redeemed at a participating retail shop.	
US	VT	Colchester + Surrounding areas	Green Mountain Power	Power district	Active	Partial purchase subsidy flat rate	Point-of-sale discount			$200		No	No		Yes	Rebate as savings when you make your purchase. Rebate is only for commuters switching from fossil fuel, not recreational bikes.	
US	VT	Statewide	Local Motion	Nonprofit	Active	Lending Library	Lending Library					No	No			Libraries in Burlington, Upper Valley, Battleboro, and rotating statewide	

Country	State	Location	Administrator	Admin. Type	Status	Incentive Style	Discount Mechanism	Discount Rate	Minimum Purchase/Fee	Maximum Incentive	Total Earmark	Income-Qualified?	Low-Income Option?	Low-Income Threshold	Local bike shop(s) only	Details/Links	Parent/ Child Program
US	VT	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy flat rate				$200/$400 for new e-bikes, $100 for kits	$250,000	Yes	Yes	Two levels: $50k/$100k for individuals, $75k/$125k for families		Currently in committee in the House	
US	VT	Town of Stowe	Stowe Electric Department	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$200		Yes	No	Approx. 400% FPL	No	Program page	
US	VT	VPPSA-Serviced areas	Vermont Public Power Supply Authority	Power district	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$100		No	No		Yes	Link	
US	VT	Washington Electric Cooperative Service Area	Washington Electric Cooperative	Power district	Active	Partial purchase subsidy with cap	Post-purchase rebate	50%		$200		No	No		No	Program Page	
US	WA	Seattle, other corporate offices nationally	Amazon	Private Entity	Active	Partial purchase subsidy flat rate	Post-purchase rebate			$400		No	No			Values are approximate, not much information is public	
US	WA	Statewide	State Government	State / Province Government	Proposed	Partial purchase subsidy flat rate				$1,000	$100M					Combined with electric vehicle rebate program	
US	WA	Statewide	State Government	State / Province Government	Proposed	Sales tax waiver	Sales tax waiver				$500,000					For purchase of e-bike and up to $200 of related equipment in the same transaction. In committee in the house	
US		Nationwide	IRS	National Government	Proposed	Partial purchase subsidy with cap	Tax Liability Credit	30%		$900						Originally the 'E-BIKE' bill, now has been rolled into the 'Build Back Better' bill	